



# Closed Cycle Cryogenic Probe Station

The ARS PS-CC Probe Station is designed for the ultimate in flexibility for non-destructive device testing. The ability to upgrade and modify this system for further device testing has been in the forefront of this design.

This model of Probe Station accepts either our DE204 or DE210 series of cryocoolers. These cryocoolers allow for sample stage temperatures of 13K, < 10K, or 7K depending upon the model that you choose. All of the ARS Closed Cycle Cryocoolers are designed with high first stage cooling capacity which allows for fast cool downs and dissipation of high radiative heat loads. The combination of the high first stage cooling capacity and inherently lower vibrations of the pneumatically drive GM cryocooler, make it ideal for this application.

This system is designed to provide a large, clean sample environment. The vacuum chamber is made out of welded stainless steel and the radiation shield is made out of nickel plated OFHC copper. The low emissivity of the nickel plating and the high conductivity of the copper allow for a colder radiation shield and larger net refrigeration at the sample space. The high quality vacuum components are critical as it allows for deeper vacuum levels and cleaner samples with better electrical contact.

ARS' integrated approach of manufacturing for both the cryocooler and the probe station ensures consistent performance, and also facilitates diagnostics and service of the integrated system.



## Applications

- Microwave Properties
- DC, RF Properties
- MEMS
- Nanscale Electronics
- Superconductivity
- Electrical and Optical Properties of Nano Circuits
- Quantum Dots and Wires
- Non Destructive Device Testing

## Typical Configuration

- DE204 Closed Cycle Cryocooler
- Compressor (ARS-4HW)
- 2 Helium Hoses (10 foot flex lines)
- 10" Diameter Stainless Steel Vacuum Chamber with 6 Micromanipulated Probe Ports and 2 Spare NW 80 Accessory Ports Mounted on an Anodized Aluminum Table Top with Extruded Aluminum Support System.
- 8" Diameter Nickel Plated OFHC Copper Radiation Shield
- 2.25" Diameter Grounded Sample Holder made out of OFHC Copper
- 3 Stage Vibration Dampening System for < 1 micron Vibration Levels at the Sample Stage
- DC, Microwave, or Fiber Optic Probes
- 4 Sensors and 2 Heaters for temperature control and monitoring
- Lakeshore LS336 (4) Channel Temperature Controller with interconnecting cable to the cryostat.
- 7:1 Zoom Microscope with <2 micron resolution and coaxial or ring light. Includes a High Resolution 24" Wide Screen LCD Display and a light source for the microscope



# Closed Cycle Cryogenic Probe Station

## Cooling Technology

DE-204 / DE-210	Closed Cycle Cryocooler
Refrigeration Type	Pneumatically Driven GM Cycle
Liquid Cryogen Usage	None, Cryogen Free

## Vacuum Chamber

Material	Welded, Stainless Steel
Diameter	10" (254 mm)
Probe Ports	6 (standard) 7 or 8 available upon request
Spare Accessory Ports	(2) NW-80 Flanges installed with
Lid	Removable Lid with Quartz
Mounted On	29" x 36" Anodized Aluminum
Optical Access	
Window Material	High Purity Quartz
Window Diameter	2.75" (69 mm)
Window Clear View	2.5" (63 mm)

## Radiation Shield

Material	Nickel Plated OFHC Copper
Diameter	8" (203 mm)
Ports	8 (standard) Empty ports have removable
Lid	Removable Lid with Sapphire Cold Window.
Mounted On	1st stage of Cryocooler
Optical Access	
Window Material	Sapphire
Window Diameter	2.5" (63 mm)
Window Clear View	2.25" (57 mm)

## Sample Holders\*

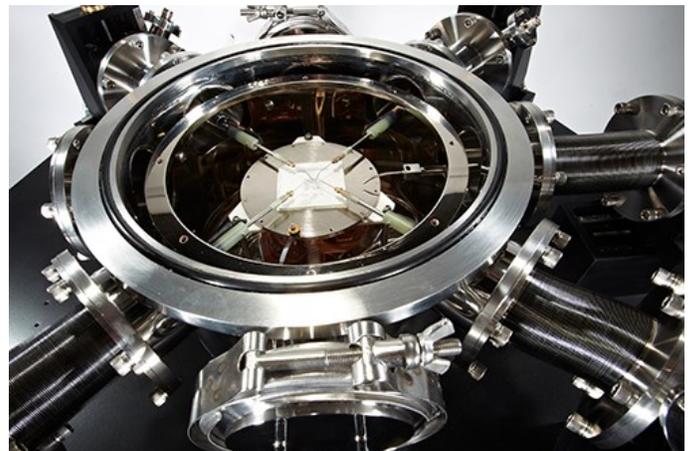
Grounded	2.25" Diameter (standard)
Electrically Isolated	2.25" Diameter (Optional)
Coaxial (Biased)	2.25" Diameter (Optional) Includes BNC Feedthrough with Coaxial Cable to sample stage
Triaxial (Biased with Guard)	2.25" Diameter (Optional) Includes Triaxial Feedthrough

\*Custom sample holders also available.

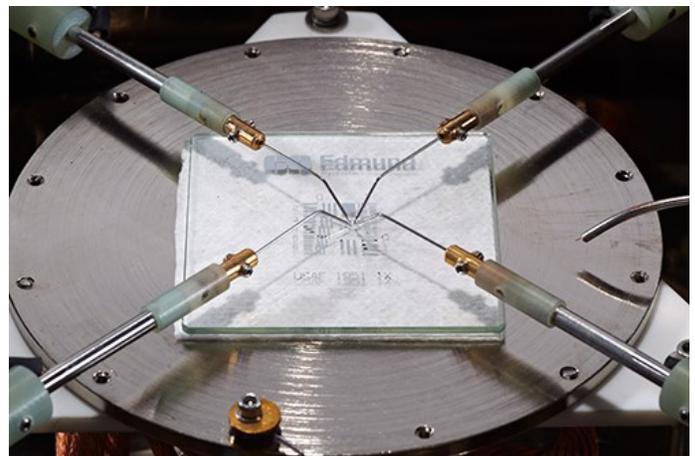
## Temperature Range\*

DE-204AF*	< 10K - 350K
Sample Stage Temp.	~13K - 400K
DE-204PF*	< 5.5K - 350K
Sample Stage Temp.	~10K - 400K
DE-210SF*	< 3K - 350K
Sample Stage Temp.	~7K - 400K
With 500K Interface	Add -3K - 500K
With 800K Interface	Add -3K - 800K
Stability	0.1K (Can tune better with PID)

\*Based on bare cold head with a closed radiation shield, and no additional sources of experimental or parasitic heat load



The above picture shows the sample space of the probe station.



The above picture shows a custom sample holder and 4 DC probes.



# Closed Cycle Cryogenic Probe Station

## Translation Stages

Drive	Direct Drive
Bellows	Stainless Steel, Edge Welded
Motion	
X-Motion (Axial)	2" (50 mm) Standard
Y-Motion (Lateral)	1" (25 mm) Standard
	2" (50 mm) Optional
Z-Motion (Vertical)	0.5" (12.5 mm) Standard
Graduations	10 micron
Sensitivity	5 micron

## Cool Down and Pump Down Time

Pump down Time\* (<5 mTorr)

Mechanical Pump (VPS-2)	~ 45 minutes
Turbo Pump (VPS-3)	~ 10 minutes
Cool down time to 10K**	-2 - 2 1/2 hours

\*The pump down time listed are approximate timelines using an ARS supplied vacuum pumping system. Actual vacuum levels of the system will be dependent of the vacuum pump itself. The system is capable of allowing for vacuum levels of  $10^{-6}$  Torr with an appropriate vacuum pumping system.

\*\*The cool down time to 10K is listed for the DE204P cryocooler under typical conditions. If customizations are made, or only a 10K cryocooler is chosen, then 10K sample stage temperatures may not be achievable.

## Vibration Levels

Sample Stage Vibrations	< 1 micron
Vibration Dampening	3 Stages
Stage 1 (Low Frequency)	Soft Air Mount Feet for High
Stage 2 (High Frequency)	Elastomeric Isolators installed between the frame and the table top
Stage 3 (Sample Stage)	Supersoft Copper Braids to transmit maximum cooling power and minimal vibrations from the cold tip to the sample stage



## Instrumentation for Temperature Control\*

Temperature Sensors	Silicon Diodes
DT-670B-SD	Installed on the radiation shield
DT-670B-SD	Installed on the underside of the sample chuck for temperature control
DT-670B-SD	Installed on the cryocooler cold tip for diagnostics
DT-670-CU-4M	Calibrated Silicon Diode installed on top of the sample stage for accurate temperatures
Heaters	
50W Cartridge Heater	Installed on the under side of the sample stage for temperature control
(2) 50W Cartridge Heaters	Installed in parallel on the radiation shield to allow for 100W of heater power to assist in fast warm up of the system
Temperature Controller	LS-336 4 Channel Temperature Controller with 150W heater power

\*Interconnecting cables from the probe station to the temperature controller are supplied.



# Closed Cycle Cryogenic Probe Station

## GSG Microwave Frequency Probe Arms\*

\*All GSG Microwave Frequency Probe Arms include the Translation Stages. Probe arms are thermally anchored to the sample chuck and include +/- 5° Theta Planarization

40 GHz	Optional
Connector	K
Cable	Semirigid Coaxial
Frequency	0 to 40 GHz
Tip Material	Tungsten Beryllium Copper
Pitch	50 - 2450 micron (100 or 150 micron typical)
50 GHz	Optional
Connector	2.4
Cable	Semirigid Coaxial
Frequency	0 to 50 GHz
Tip Material	Tungsten Beryllium Copper
Pitch	50 - 1250 micron (100 or 150 micron Typical)
67 GHz	Optional
Connector	1.85
Cable	Semirigid Coaxial
Frequency	0 to 67 GHz
Tip Material	Tungsten Beryllium Copper
Pitch	50 - 1250 micron (100 or 150 micron typical)

## Fiber Optic Probe Arms\*

Range	UV/VIS or VIS/IR
Connector	Male SMA 905
Sample Termination	Bare Polished
Size (Typical)	100 micron - 400 micron
Mode	Single Mode or Multi Mode
Cable Material	Polyimide, Fused Silica

\*All Fiber Probe Arms include the Translation Stages. This does not include a light source or detector.

## DC/Low Frequency Probe Arms\*

\*All DC/Low Frequency Probe Arms include the Translation Stages. Probe arms are thermally anchored to the sample chuck.

Microminiature Coax Cable	Standard
Connector	SMA or BNC
Frequency	0 to 100 MHz
Impedance	50 Ohm
Includes Outer Ground Shield with Clip Connector	
Triaxial Cable	Optional
Connector	Triaxial - 3 Lug
Frequency	0 to 100 MHz
Impedance	50 Ohm
Kelvin Probes**	Optional
Cable	Coaxial or Triaxial
Connector	SMA, BNC, or Triaxial
Frequency	0 to 100 MHz
Probe Tips:	
Material	Tungsten (Standard) Gold Plated Tungsten (Optional)
Tip Radius	0.5 micron (standard) Other radius' also available

\*\*Kelvin Probes use 2 cables and 2 connectors, but converge down to a single tip.

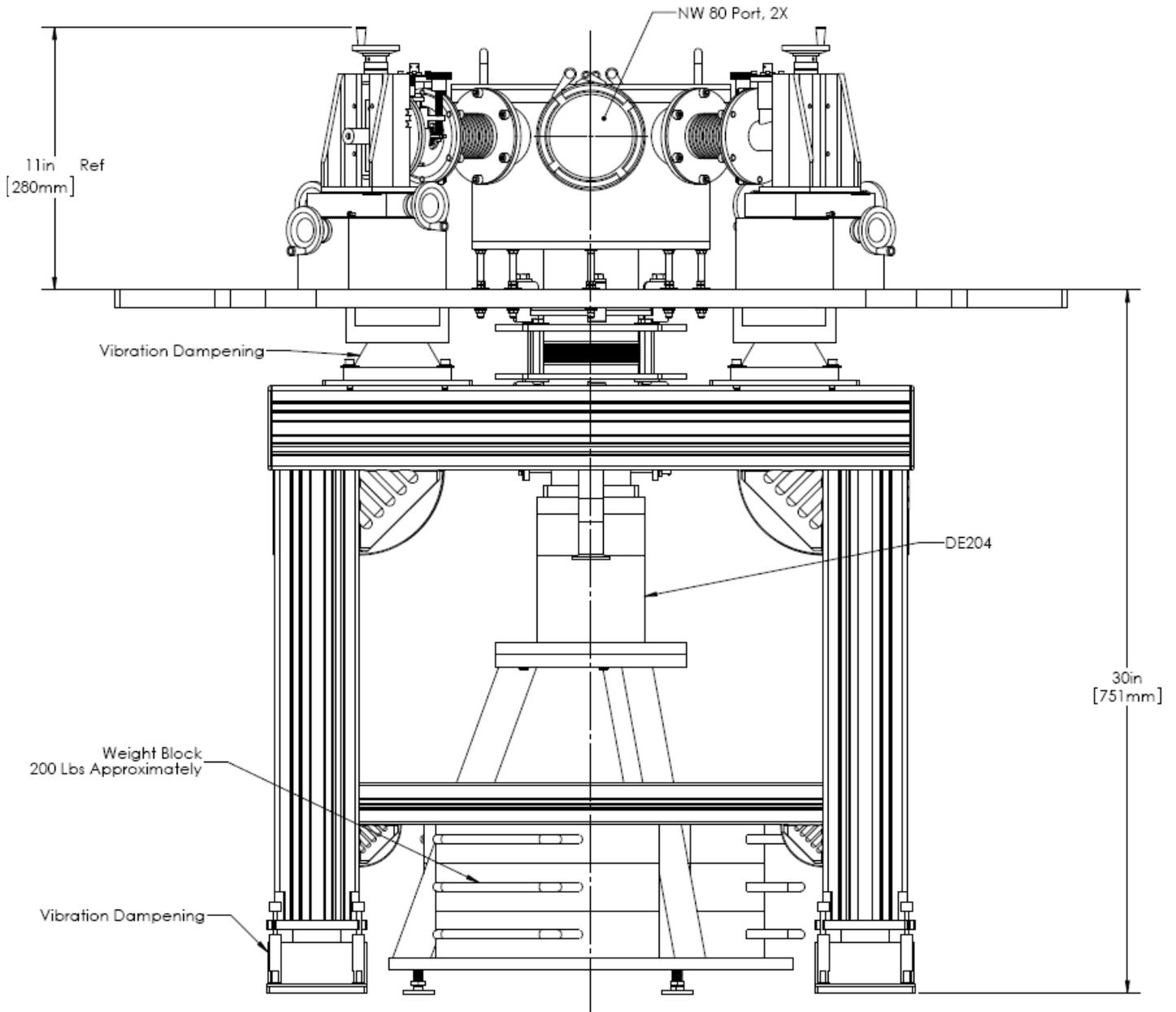
## GigE Microscope with Zoom Lens\*

Zoom	7:1 (Standard)	16:1 (Optional)
Sensor	1/2" CMOS	1/2" CMOS
Field of View	4.2 mm - 0.61 mm	12.8 mm - 0.8 mm
Working Distance	89 mm	89 mm
N.A.:	0.024 - 0.08	0.0090 - 0.15
Light (Includes Light Source)	Ring or Coaxial	Ring of Coaxial
Resolution	3 microns	2 microns
Stand	Boom Stand with XYZ manipulation	Boom Stand with XYZ manipulation
Computer Interface	Ethernet Cable	Ethernet Cable
High Resolution Monitor	24"	24"



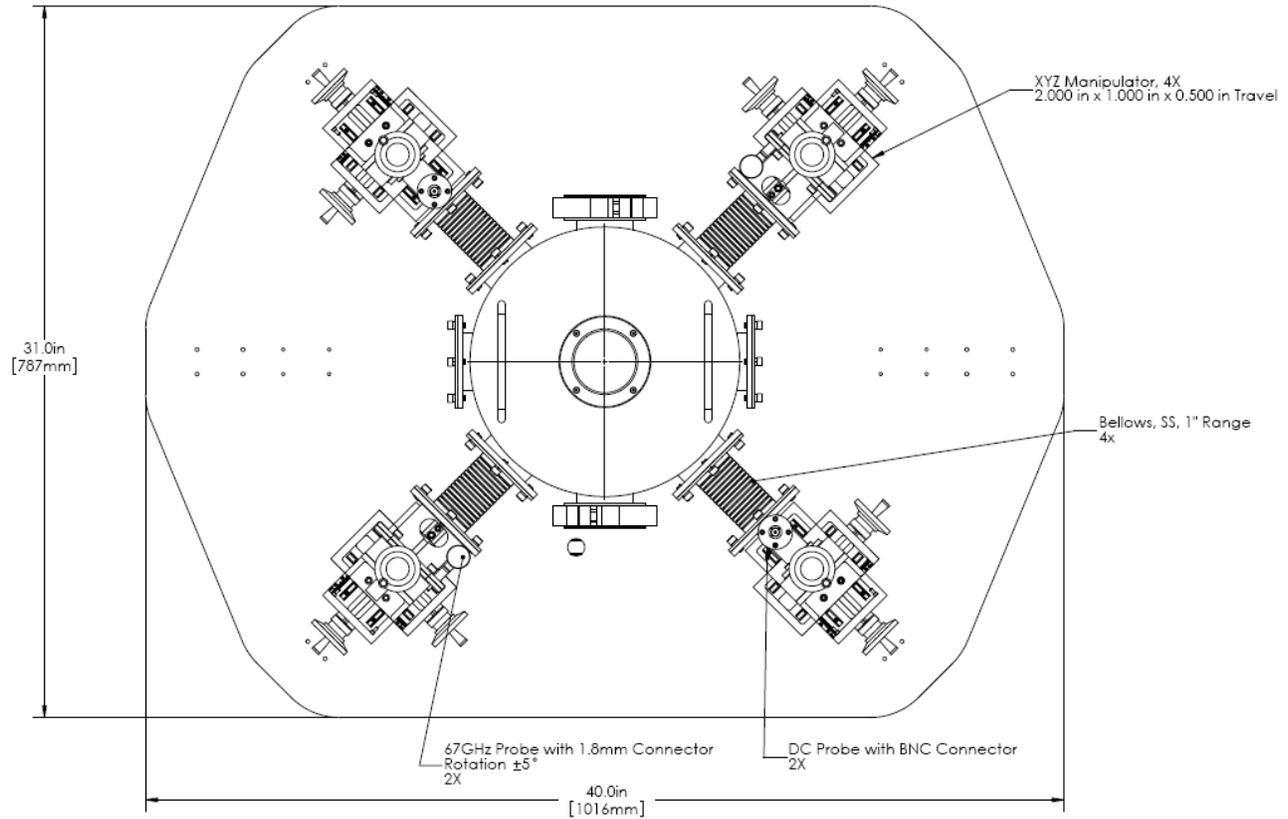
# Closed Cycle Cryogenic Probe Station

## PS-CC Probe Station Outline Drawing

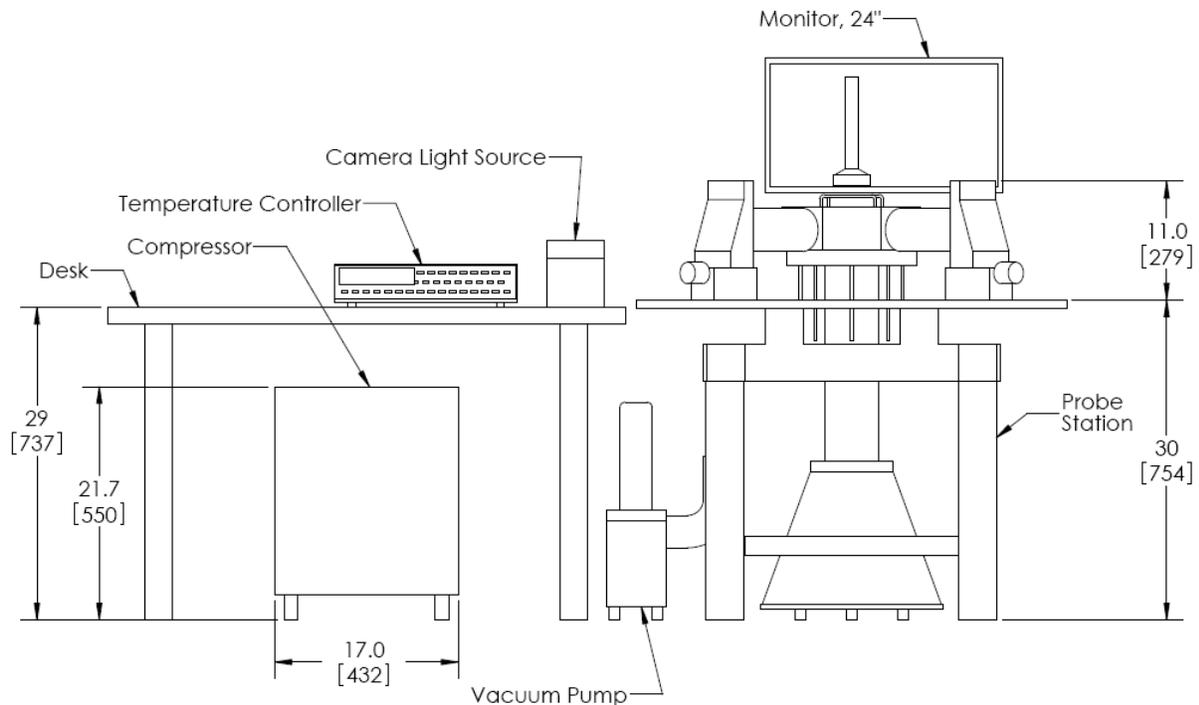


The above image shows a side profile of a probe station. The above system shows a DE204P Cryocooler, which can be substituted with a DE204A or a DE210S cryocooler.

## PS-CC Probe Station Top Down Drawing



There are (2) 67 GHz Probes and (2) DC/Low Frequency Probes. The system is setup with 1" of lateral motion but provisions are provided so that you can upgrade to 2" lateral motion in the future.



The above image shows a typical layout for the Probe Station and Ancillary equipment..



# Closed Cycle Cryogenic Probe Station

Cryocooler Model		DE-204AF		DE-204PF		DE-210SF	
	Frequency	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz
Base Temperature		<9K	<9K	<5.5K	<5.5K	<3K	<3K
Cooling Capacity	4.2K	-	-	-	-	0.8W	0.8W
	10K	2W	1.6W	3.5W	2.8W	9W	9W
	20K	9W	7.2W	8W	6.4W	16W	16W
	77K	17W	14W	14W	11W	25W	25W
Radiation Shield Cooling Capacity		18W	14W	18W	14W	60W	60W
Cooldown Time	20K	30 min	36 min	40 min	48 min	40 min	40 min
	Base Temperature	60 min	72 min	80 min	102 min	80 min	80 min
Compressor Model		ARS-4HW		ARS-4HW		ARS-10HW	
Typical Maintenance Cycle		12,000 hours		12,000 hours		12,000 hours	

The above chart shows the cooling capacities and base temperatures of the bare cryocoolers. These base temperatures are not of the sample stage. Please see the chart on page 2 of this data sheet for approximate sample stage temperatures.

Compressor Model		ARS-4HW		ARS-10HW	
	Frequency	60 Hz	50 Hz	60 Hz	50 Hz
Standard Voltage	Min	208 V	190 V	208 V	190 V
	Max	230 V	210 V	230 V	210 V
Transformer Options	10%	220 V, 230 V			
	15%	240 V			
High Voltage	Min			440 V	380 V
	Max			480 V	415 V
Power Usage	Phase	(1 Ph) 3.6 kW	(1 Ph) 3.0 kW	(3 Ph) 7.7 kW	
Refrigerant Gas		99.999% Helium Gas, Pre-Charged			
Noise Level		60 dBA			
Ambient Temperature		12 - 40 C (54 - 104 F)		5 - 40 C (40 - 104 F)	
Cooling Water	Consumption	2.3 L / min (0.6 Gal. / min)		5.7 L / min (1.5 Gal. / min)	
	Temperature	10 - 35 C (50-95 F)		< 20C (68F)	
	Connection	3/8 in. Swagelok Fitting		1/2 in. Swagelok Fitting	
Dimensions:	L	483 mm (19 in)		483 mm (19 in)	
	W	434 mm (17.1 in)		533 mm (21 in)	
	H	516 mm (20.3 in)		617 mm (24.3 in)	
Weight		72 kg (160 lbs)		105 kg (230 lbs)	
Typical Maintenance Cycle		12,000 hours		12,000 hours	
Water Recirculation Option		CoolPac Compatible		Not CoolPac Compatible	

The above chart shows the typical specifications for the ARS-4HW and ARS-10HW Compressor.