



LIQUID HELIUM MANAGEMENT PRODUCT LINE

CRYOMECH

WORLD LEADERS IN CRYOREFRIGERATION FOR MORE THAN 50 YEARS

INTRODUCTION

Although it's the second-most abundant element in the known universe, helium has become increasingly rare here on earth. It's a need that occasionally outpaces demand, threatening the valuable work of researchers worldwide.

An industry innovator for more than five decades, Cryomech now leads the helium conservation movement with the largest selection of lab-scale helium recovery and liquefier options on the market – with hundreds of successful installations to prove it.

Off-the-shelf solutions and custom configurations by Cryomech ensure your work is productive, efficient and accurate. With Cryomech, you can:

- ♦ Completely control your own helium
- ♦ Significantly lower costs
- ♦ Responsibly preserve diminishing supply

How? The world's most reliable helium products from the worldwide leader in cryorefrigeration for more than 50 years. Cryomech solutions include:

- ♦ Pulse-Tube Cryorefrigerator
- ♦ Helium Reliquefiers
- ♦ Liquid Helium Plants
- ♦ Helium Recovery Systems

Trust a name that's produced many of the world's firsts and bests. The members of the Cryomech team are the trailblazers in cryorefrigeration, unafraid of the unknown and inspired by new challenges like helium conservation.

We defy convention and push the limits of what cryorefrigeration can do. We invite you to go beyond your limits with Cryomech.



HELIUM PRODUCT SNAPSHOT

PULSE TUBE CRYOREFRIGERATOR



Single-device, it's ideal to design your wet system with a Pulse Tube in mind, ranging in scale, many recondensing options available

HELIUM RELIQUEFIERS



Single-device, point-of-use liquefaction, integrating a HeRL creates an efficient closed loop with options available to capture transfer/large boil-off spikes

LIQUID HELIUM PLANTS



Single or multiple-device, centralized liquefaction compatible with direct recovery or range of helium recovery systems

HELIUM RECOVERY SYSTEMS



Collects boil-off from multiple devices with a range of options for storage sizes, purifier type, recovery rates and pressures

ALL CRYOMECH

LIQUID HELIUM MANAGEMENT

PRODUCTS INCLUDE:

- ▶ A Cryomech Pulse Tube Cryorefrigerator designed with high reliability and long mean times between maintenance
- ▶ Warranty of three years or 12,000 hours on parts and materials*

*Some products carry different warranties. Contact Cryomech for more information.

PULSE TUBES



TWO-STAGE

- ▶ Vibration dampening options:
 - Remote motor
 - Bellows assembly
- ▶ Condensing heat exchangers
- ▶ Conflat flanges
- ▶ Both air- and water-cooled compressor models available
- ▶ Three-phase and single-phase electrical configurations
- ▶ Inverter Compressor technology available

Compare specifications to find the best fit for your application:

SPECIFICATIONS	PT403	PT405	PT407
Cooling Capacity Heat Load	0.25W @ 4.2 with 7W @ 65K	0.5W @ 4.2K with 25W @ 65K	0.7W @ 4.2K with 25W @ 55K
Base Temperature	2.8K	2.8K	2.8K
Cold Head Weight	24 lb (11 kg)	32 lb (14.5 kg)	32 lb (14.5 kg)
Compressor Package	CP103	CPA2850	CPA2870
Power Consumption 60Hz (Input Power)	208/230 VAC 1 PH / 3.0 kW	200/230 or 440/480 VAC 3 PH / 4.9 kW	200/230 or 440/480 VAC 3 PH / 7.0 kW
Power Consumption 50Hz (Input Power)	200/220 VAC 1 PH / 3.0 kW	200 or 380/415 VAC 3 PH / 5.4 kW	200 or 380/415 VAC 3 PH / 7.0 kW
Cooling Water Requirements	1.2 GPM (4.5 LPM) @ 80°F (27°C)	2.3 GPM (9 LPM) @ 80°F (27°C)	2.3 GPM (9 LPM) @ 80°F (27°C)

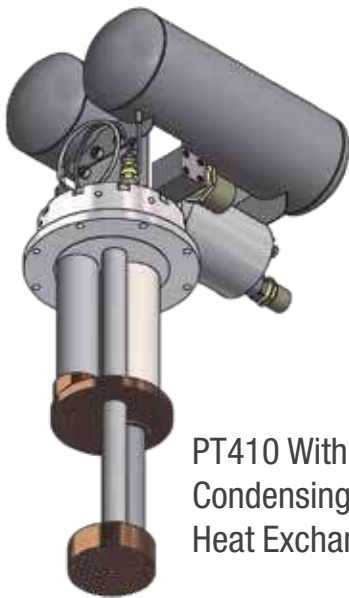


PT410 With Integrated Motor



PT410 With Bellows Assembly

PT410	PT415	PT420	PT803	PT805	PT810	PT815
1.0W @ 4.2K with 35W @ 45K	1.5W @ 4.2K with 40W @ 45K	2.0W @ 4.2K with 55W @ 45K	4W @ 20K with 8W @ 65K	8W @ 20K with 40W @ 80K	14W @ 20K with 80W @ 80K	22W @ 20K with 100W @ 80K
2.8K	2.8K	2.8K	8K	8K	8K	10K
43 lb (19.5 kg)	55 lb (25 kg)	58 lb (26.3 kg)	24 lb (11 kg)	32 lb (14.5 kg)	43 lb (19.5 kg)	55 lb (25kg)
CPA289C	CPA1110	CPA1114	CP103	CPA2850	CPA289C	CPA1110
200/230 or 460 VAC 3 PH / 8.4 kW	200/230 or 440/480 VAC 3 PH / 10.7 kW	440/480 VAC 3 PH / 12.5 kW	208/230 VAC 1 PH / 3.4 kW	200/230 or 440/480 VAC 3 PH / 4.9 kW	200/230 or 460 VAC 3 PH / 8 kW	200/230 or 440/480 VAC 3 PH / 10.7 kW
200/220 or 380/420 VAC 3 PH / 7.9 kW	200 or 380/415 VAC 3 PH / 9.2 kW	380/415 VAC 3 PH / 11.4 kW	200 VAC 1 PH / 3.4 kW	200 or 380/415 VAC 3 PH / 5.4 kW	200/220 or 380/420 VAC 3 PH / 7.2 kW	200 or 380/415 VAC 3 PH / 9.2 kW
2.3 GPM (9 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	1.2 GPM (4.5 LPM) @ 80°F (27°C)	2.3 GPM (9 LPM) @ 80°F (27°C)	2.3 GPM (9 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)



PT410 With
Condensing
Heat Exchanger



PT410 With
Remote Motor

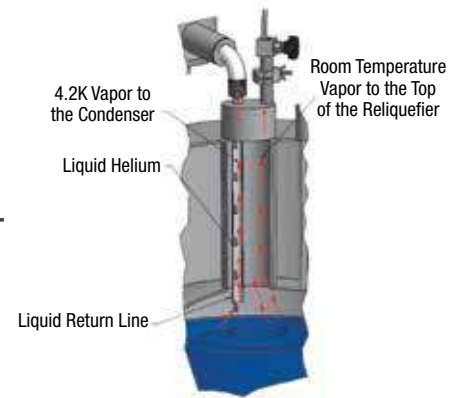
HELIUM RELIQUEFIERS (HeRL)



- ▶ Easy drop-in installation through existing fill port
- ▶ Can liquefy room-temperature helium gas from cylinders
- ▶ Powered by a Cryomech Pulse Tube Cryorefrigerator, designed with high reliability with long mean times between maintenance
- ▶ Operate 24 hours a day, seven days a week reliably, automatically and safely
- ▶ Warranty of three years or 12,000 hours on parts and materials
- ▶ Liquid Helium return line connection
 - **Standard:** 1/2" (12.7mm) or 3/8"OD 22"-30" long
 - **Custom Configuration:** Available upon request

AVAILABLE OPTIONS

- ▶ **The Dual LHe/LN2 Reliquifier** simultaneously recondenses helium and nitrogen in two separate closed loops
 - This product is designed for customers with LN2-jacketed liquid helium Dewars
- ▶ **Ultra-low vibration reliquifier** for operation with NMR/MEG
 - Designed with vibration-sensitive applications in mind, the HeRL can be modified to include a remote motor and flexible drainage leg
- ▶ **Operation with pumping recovery systems** to maximize the recovery from 1K sample space
- ▶ **Additional fill ports available** to allow users to top off their bath without removing the HeRL from the cryostat
- ▶ **Compatible with PPMS/MPMS systems**
- ▶ **Inverter compressors available for all models**



Compare specifications to find the best fit for your application:

SPECIFICATIONS	HeRL10	HeRL15	HeRL20	HeRL40	HeRL60
Liquefaction Rate (From room temperature helium gas)	≥10L/Day	≥15L/Day	≥20L/Day	≥40L/Day	≥60L/Day
Reliquefaction and Recondensing Rate (From helium cryostat)	≥18L/Day	≥27L/Day	≥40L/Day	TBD	TBD
Cryocooler Model	PT410/CPA289C	PT415/CPA1110	PT420/CPA1114	PT420/CPA1114 (2)	PT420/CPA1114 (3)
Power Consumption (Input Power)	8.4 kW @ 60Hz 7.9 kW @ 50Hz	10.7 kW @ 60Hz 9.2 kW @ 50Hz	12.5 kW @ 60Hz 11.4 kW @ 50Hz	12.5kW @ 60Hz 11.4W @ 50Hz	12.5kW @ 60Hz 11.4W @ 50Hz
Cooling Water Requirements	2.3 GPM (9 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)
Cool Down Time	<4 Hours	<4 Hours	<4 Hours	< 4 Hours	< 4 Hours

* The HeRL45 Helium Reliquefier consists of three (3) separate Cold Heads, each requiring its own compressor

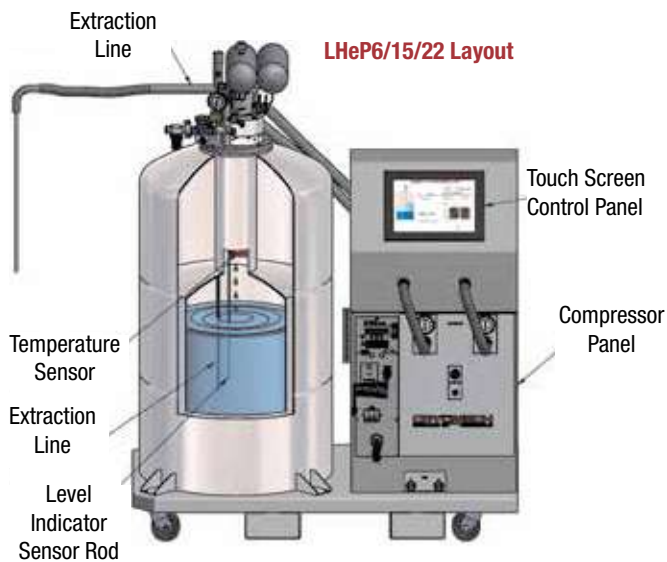


LIQUID HELIUM PLANTS (LHeP)



- ▶ Collect and liquefy boil-off helium gas directly from single device, multiple devices or recovery systems
- ▶ Modular system can be designed around your specific helium needs
- ▶ Rugged, stainless steel, liquid helium Dewar available with the following options:
 - Scalable sizes
 - Additional ports for directly accessing liquid helium bath
 - Modified Dewar necks
- ▶ Cryogenically insulated extraction line and valve for low loss liquid helium transfer
 - Custom high-efficiency extraction lines also available
- ▶ Digital touchscreen user interface includes:
 - Remote monitoring and control
 - Digital level indicator
 - System diagnostics
- ▶ Large-scale recovery available
- ▶ Warranty of three years or 12,000 hours on parts and materials
- ▶ Pressure activated intake valve
- ▶ Dewar operating pressure <10 PSIG





Compare specifications to find the best fit for your application:

SPECIFICATIONS	LHeP15	LHeP22	LHeP28	LHeP55	LHeP80
Liquefaction Rate (From Room Temperature Helium)	≥15L/Day	≥22L/Day	≥28L/Day	≥55L/Day	≥80L/Day
Dewar Capacity	60L	150L	150L	350L	500L
System Dimensions	47in x 28in x 61in	56in x 30.5in x 72in	56in x 30.5in x 72in	36" OD x 85" H***	42" OD x 85" H***
System Weight	790 lb (358 kg)	1040 lb (472 kg)	1040lb (472kg)	560lb (254 kg)***	900lb (408 kg)***
Cryocooler Model (Water Cooled Only)	PT410/CPA289C	PT415/CPA1110	PT420/CPA1114	PT420 (2x)/ CPA1114 (2x)	PT420 (3x)/ CPA1114 (3x)
Power Consumption	8.4 kW @ 60Hz 7.9 kW @ 50Hz	10.7 kW @ 60Hz 9.2 kW @ 50Hz	12.5kW @ 60Hz 11.4W @ 50Hz	12.5kW @ 60Hz*(2x) 11.4W @ 50Hz*(2x)	12.5kW @ 60Hz**(3x) 11.4W @ 50Hz**(3x)
Cooling Water Requirements	2.3 GPM (9 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)
Required Gaseous Helium Flow Rates	7.3 SLPM (0.26 SCFM)	10.7 SLPM (0.38 SCFM)	13.61 SLPM (0.48 SCFM)	26.75 SLPM (0.94 SCFM)	38.89 SLPM (1.374 SCFM)
Dewar Pressure	<10 PSIG	<10 PSIG	< 10 PSIG	< 10 PSIG	< 10 PSIG

* The Liquid Helium Plant LHeP40 consists of two (2) separate cold heads; each require its own compressor

** The Liquid Helium Plant LHeP60 consists of three (3) separate cold heads; each require its own compressor

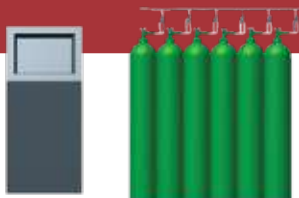
*** Cold heads and dewar only

HELIUM RECOVERY SYSTEMS



- ▶ Atmospheric Recovery Bags sized to match your boil-off rates, transfer speeds and space
 - Bag sizes ranging from <100 ft³ to >1,000 ft³
 - Custom shapes available to fit any room
- ▶ Variety of options for helium gas storage, including a medium pressure compressor with higher flow rate or high pressure compressor with condensed storage options
- ▶ Options for purification:
 - Low-cost nitrogen cold trap technology
 - Automatic cryogen-free technology
- ▶ Scaled and designed to match the liquefaction rate of the Cryomech Liquid Helium Plant
- ▶ Cryomech provides all helium connections from recovery bag to liquefier

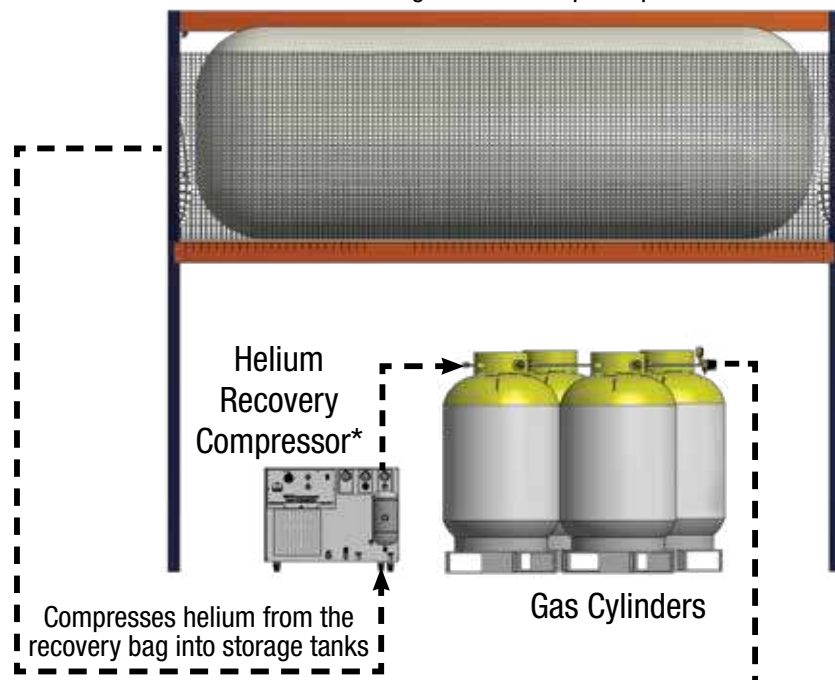
HIGH-PRESSURE RECOVERY OPTIONS AVAILABLE



**Medium pressure option shown.*

Atmospheric Recovery Bag

Stores helium gas at 1 atmosphere pressure



Atmospheric Recovery Bag Specifications

Based on standard 300 ft³ specifications:

Volume (ft ³)	Volume (m ³)	Height (ft)	Width (ft)	Length (ft)	J-22 Weight (lbs)
300	8.5	6.0	6.0	9.5	96

MEDIUM AND HIGH PRESSURE COMPARISON

MEDIUM PRESSURE RECOVERY

- ◆ Recovery rate of 8.5 SCFM or ~20 liquid liters per hour
- ◆ Medium pressure (400 PSIG) storage tanks that hold ~17 liquid liters

HIGH PRESSURE RECOVERY

- ◆ Recovery rate of 5.1 SCFM or ~10 liquid liters per hour
- ◆ High pressure (2400 PSIG) storage tanks that hold ~11 liquid liters



PURIFIER

LN2 PURIFIER

- Low running cost
- Simple operation
- Requires liquid nitrogen
- Trap regeneration interval >3.5 weeks (@0.1% impurities)
- Includes spare cold trap and regeneration kit



AUTOMATIC PURIFIER

- Air or water cooled Cryorefrigerator
- Automatic regeneration when trap is saturated
- Regeneration within eight (8) hours
- No cryogenics required
- New with Pulse Tube Cryocooler for longer mean time between maintenance



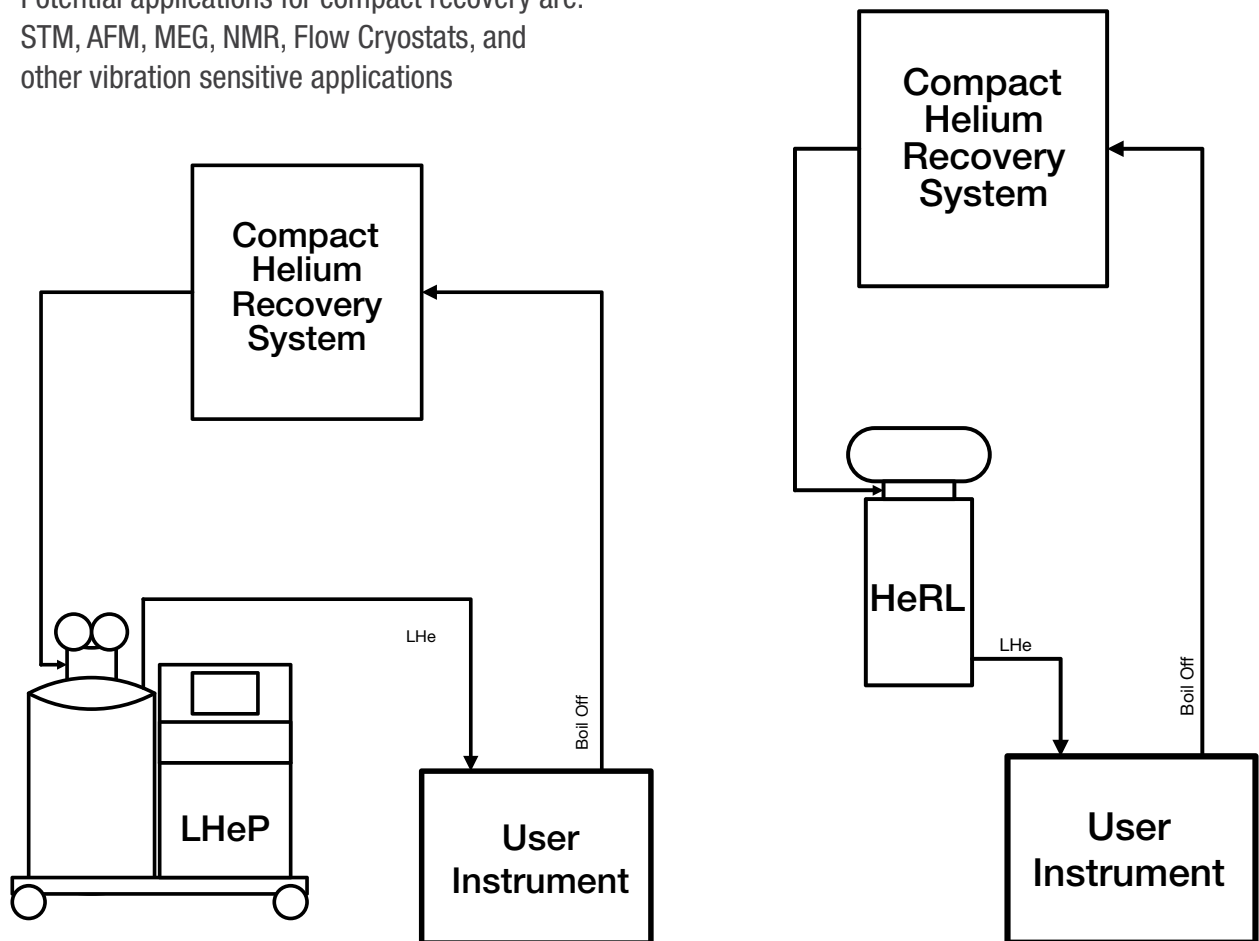
HELIUM OUTPUT PURITY $\geq 99.999\%$ PURITY

COMPACT RECOVERY

Closed-cycle helium recovery has been historically allusive for users with extremely vibration-sensitive devices and limited space.

Cryomech now offers a solution for both our Helium Reliquefiers and our Liquid Helium Plants that provides low volume gas storage only when you need it. As opposed to our full-scale recovery system, this on-demand recovery is accomplished without the space-consuming recovery bag and external purifier. Not only is this straightforward recovery a better use of your facility space, it is more efficient both in terms of your helium management and your budget.

Potential applications for compact recovery are:
STM, AFM, MEG, NMR, Flow Cryostats, and
other vibration sensitive applications



WHY CRYOMECH?

Cryomech has more than 50 years of experience working at cryogenic temperatures. Pair that with the fact that we have developed and produced numerous products that are as reliable as they are innovative. Our cryogenic knowledge comes from decades of listening to customer demands.

Cryomech's superior products operate in more than 50 countries, providing hundreds of customers with custom-built plants, recovery systems, reliquefiers and Pulse Tubes that accommodate any laboratory, anywhere in the world.

Cryomech employs the most respected, forward-thinking minds in the industry. They craft solutions that help our customers get things done. Cryomech Founder William Gifford, the inventor of the industry-standard Gifford-McMahon Cryocooler, established a reputation for pushing the limits to do great things that lives on today.



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FIND OUT
WHAT MAKES US THE BEST
CRYOREFRIGERATION
SINCE 1963



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