

# APPLIED VACUUM TECHNOLOGY

## Vacuum Pumps and Systems

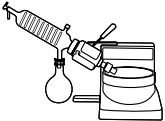

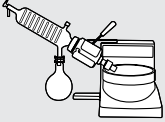



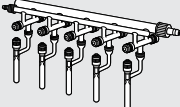
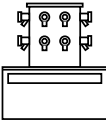





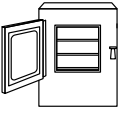




PROVIDING VACUUM INNOVATION WORLDWIDE  
**CATALOG 2016-2017**

The business of WELCH is providing you with products and expertise to address your application needs. The Welch product line offers a wide range of vacuum pumps - each expertly designed for optimum function in your application. Consult your Welch representative to make vacuum work right for you.

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# Pump Quick Selection Chart | For Common Lab Applications

APPLICATION	WELCH VACUUM PUMPS & SYSTEMS	FLOW RATE X VACUUM	UNIT PHOTO	MODEL	PAGE
<b>Rotovap</b> Volatiles, Low B.P. B.P. <100°C Samples 0-5 Liter 	Self Cleaning System with regulator, gauge, condensate jars	35 l/min. 9 torr (12mbar)		202501	2 - 5
	DRYFAST PTFE Pump	25 l/min. 9 torr (12mbar)		2034B-01	
<b>Rotovap</b> DMF, Toluene, other non-volatiles Samples 0-5 Liter 	Self Cleaning System programmable w/condensate jars	35 l/min. 2 torr (2.7mbar)		202801	2 - 5
	DRYFAST ULTRA PTFE Pump	35 l/min. 2 torr (2.7mbar)		2042B-01	
<b>Concentrator</b> DNA Pelleting  SpeedVac® & CentriVap®  Process Applications 	DRYFAST PTFE Pump	35 l/min. 9 torr (12mbar)		2044B-01	10
	DRYFAST ULTRA PTFE Pump	35 l/min. 2 torr (2.7mbar)		2042B-01	
	Welch High Capacity PTFE Pump	100 l/min. 6 torr (8.0mbar)		2054B-01	
<b>Vacuum Manifold</b> Schlenk Line 	DuoSEAL® & CHEMSTAR® Pumps	25 l/min. <1 millitorr (1.3x10 <sup>3</sup> mbar)		1400B-01 or 1400N-01	7
	GEM® System	31 l/min. 100 millitorr (0.13mbar)		8890A-70	
<b>Freeze Dryer</b> 	Welch Direct Drive pump with integral oil filtration system	173 l/min.		8917A-80	12 - 13
	CHEMSTAR Low RPM Pump	160 l/min.		1402N-01	
	Chemvac High Organic Load Pump	220 l/min.		8965C-01	
<b>Filtration</b> 	Welch Light Chemical Duty Pump	37 l/min		2019B-01	16 - 17
	DRYFAST - Chemical Duty Pump	35 l/min.		2014B-01	
	WOB-L - Standard Duty Pump	22 l/min.		2522B-01	
<b>Aspiration/Automation</b> Cell Harvester Plate Washer 	WOB-L - Standard Duty Pump	100 l/min. 27.6 in. Hg (80mbar)		2567B-50	8 - 9
	DRYFAST - Chemical Duty Pump	70 l/min. 28.5 in. Hg (47mbar)		2047B-01	
<b>Cell Culture</b> Aspiration 	Welch Aspiration Station With gauge, regulator, 1200 ml autoclavable trap with liquid blockade system	34 l/min. 27.2 in. Hg (93mbar)		2515B-75	8 - 9
<b>Vacuum Oven</b> Drying Degassing 	WOB-L - Standard Duty Pump	100 l/min.		2581B-50	15
	DRYFAST - Chemical Duty Pump	70 l/min.		2047B-01	
	Welch High Capacity PTFE Pump	100 l/min.		2054B-01	
	DuoSEAL® Belt Drive Pump	160 l/min.		1402B-01	
<b>Gel Dryer</b> 	GELMASTER™ System Complete Gel Drying Vacuum System with hose, valve	>50 l/min. of Vapor @ 28 in. (66mbar)		142601	11

## Model Selectors

Look for the Model Selector Charts in each Application Section for further pump selection guidance.

## THE WELCH SELF-CLEANING FAMILY . . . COMPLETE VACUUM SYSTEMS FOR ROTARY EVAPORATORS



- **Anti-bumping / foaming feature with controlled evaporation rate**
- **Rugged corrosion resistant PTFE construction**
- **Self-cleaning for long life and repeatable performance**
- **2 torr (2.7 mbar) models strip DMF at 35° C bath temperature  
9 torr models (12 mbar) models strip most common solvents**
- **Programmable 2028 features walk away automation**

Welch Self-Cleaning Dry Vacuum Systems™ are complete vacuum solutions for rotary evaporation. All systems feature rugged corrosion resistant PTFE diaphragm pumps for low maintenance and long life. Optimize each solvent evaporation using handy vacuum adjustment

Also included with all models:

- **Digital or analog vacuum read-out**
- **Inlet and outlet traps to protect the pump and exhaust line from liquids**
- **Prominent emergency "bump stop" switch for bumping/foaming control**
- **Automatic self-cleaning purge at shutdown**

The self-cleaning feature and vacuum control technology contribute to Self Cleaning Systems' long diaphragm life. All models are 35 l/min at 60Hz (29 l/min. at 50Hz).

**Model 2025** analog vacuum read-out, vacuum regulator, 9 torr ultimate vacuum for fast stripping of most common rotary evaporation solvents. Fast stripping of rotary evaporator solvents with boiling point < 110 °C.

**Model 2026** adjustable high vacuum. Analog vacuum read-out, vacuum regulator, 2 torr ultimate vacuum for fast stripping DMF and other solvents with boiling point < 160 °C.

**Model 2027** digital adjustable high vacuum. Digital vacuum read-out, vacuum regulator, 2 torr ultimate vacuum for fast stripping DMF and other solvents with boiling point < 160 °C.

**Model 2028** programmable high vacuum. Five user entered programs with one or two solvents and times, keyboard or electronic dial vacuum selection, digital vacuum display with menu enabled programming, 2 torr ultimate vacuum for fast stripping of DMF and other solvents with boiling point < 160 °C.

*Green*  
**By Design**

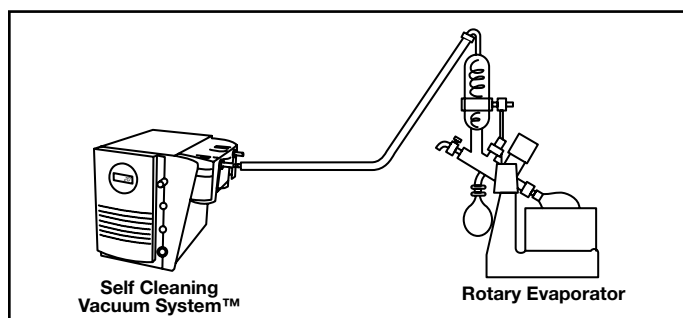


CAPTURE™ vapor emissions from rotary evaporators with an integrated solvent recovery system - see p. 40.

### Application Note | Value of Self-Cleaning

The Self-Cleaning air purge cycle at the conclusion of each run maintains consistent performance and extends service intervals. This purge feature eliminates condensates in the pump's second stage and removes volatile substances before they can solidify. This purge resets the pump diaphragms to dry startup condition, enabling consistent solvent stripping rates run after run. Solidified substances can also be abrasive to the diaphragm, impairing performance and shortening diaphragm life.

### Recommended Configuration





Model 2200



Model 2210



Model 2220



Model 2230

Specifications & Ordering - p. 27

- **Automatic Distillation**
- **Modular Design**
- **Integrated Solvent Recovery**

Use these Auto-Sensing Vacuum Systems to automate your rotary evaporations. These Systems provide efficient vacuum using proprietary EcoFlex control. EcoFlex automatically matches vacuum pumping speed with the vapor load from your evaporator, resulting in smooth evaporations with little intervention.

Vacuum Systems feature control using easy dial control from menus from the large LCD display. Use the internal solvent library or automatic boiling point sensing to control your distillation with ease.

Systems include catch-pot inlet trapping to minimize pump vapor contamination. Outlet water-cooled condenser system eliminates solvent release into room atmosphere. Safety is enhanced with plastic coated trap flasks.

Vacuum Systems are designed for chemical applications. Wetted parts are constructed from high quality chemically resistant materials, including PTFE, PEEK and PVDF.

Inlet / outlet traps connect using convenient ground glass fittings. Traps are plastic coated glass for safety.

Beveled LCD display enables convenient system control in under-counter installations. Control features include switch for cooling water solenoid valve. System data via RS232 port is available for evaporation process documentation.

**Model 2200** Compact system perfect for deep vacuum distillations (1.5 torr, 15 l/min) of typical high-boiling solvents (1 liter flask).

**Model 2210** Provides high vacuum performance (1.5 torr, 29 l/min) with sufficient flow for efficient evaporations from 2 liter flasks.

**Model 2220** High flow model provides deep vacuum (1.5 torr, 65 l/min) for larger scale evaporations (to 20 L flask).

**Model 2230** High capacity (1.5 torr, 110 l/min) model provides powerful flow for larger scale evaporations of low volatility solvents.

## Model Selector | Rotary Evaporators

Boiling Point, Atmospheric Pressure	80 °C		110 °C		160 °C		195 °C	
Example Solvents	Methylene chloride Acetone Chloroform Ethanol		Trichloroethylene n-Propyl alcohol Heptane Water Toluene Acetic Acid		1,1,2,2-Tetrachloroethane DMF Pentachloroethane		DMSO Polymers	
RotoVap Flask Volume	Pump Models	System Models	Pump Models	System Models	Pump Models	System Models	Pump Models	System Models
<b>1 L</b>	↑	↑	↑	↑	↑	2200	↑	↑
<b>2 L</b>			2034	↑	2032	2210	↑	↑
<b>10 L</b>			2044	2025	2042	2026, 2027, 2028	1400	8890A-70
<b>20 L</b>	2014	2025	2042	2026, 2027	2052, 2062	2220, 2230	1402	1402



- Powerful vacuum pumps for rotary evaporators
- Tunable vacuum to control evaporation rate
- 2 torr (2.7 mbar) models strip DMF fast at 35 °C  
9 torr (12 mbar) models strip most common solvents
- Rugged chemical duty PTFE and fluorinated plastic construction

### Tunable Vacuum For Fine Evaporation

PTFE dry vacuum pumps for rotary evaporators include essential features to ensure efficient rotary evaporation. The DRYFAST tunable vacuum adjustment allows the user to optimize the vacuum for the solvent being evaporated - see Application Note below. The tunable vacuum adjustment can also be used to stop accidental bumping/foaming.

Use 9 torr (12 mbar) DRYFAST models for common solvent evaporations. DryFast Ultra models offer 2 torr (2.7 mbar) ultimate vacuum to strip DMF fast along with other high boiling point and low boiling point solvents. The rugged low maintenance oil free pumps have PTFE heads, perfluoroelastomer valves, and fluorinated plastic wetted surfaces, making DRYFAST a durable choice for solvent, acidic and basic vapors.

**Model 2014 Collegiate** Single stage PTFE diaphragm pump with excellent flow for evaporations of solvents with atmospheric boiling points to 80 °C. Maximum vacuum is 40 torr, 35 l/min.

**Models 2034 / 2044 Research** Two stage PTFE diaphragm pumps provide tunable vacuum to 9 torr - perfect for evaporation of solvents with atmospheric boiling points to 110 °C. Select Model 2044 (35 l/min) for evaporations up to 10 L flask.

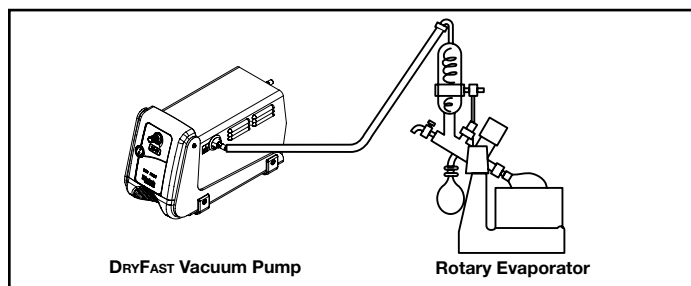
**Models 2032 / 2042 DryFast Ultra** Two stage PTFE pumps are excellent for all common evaporations, drawing a deep vacuum down to 2 torr for solvents with atmospheric boiling points to 160 °C. Distills DMF rapidly at 35 °C. Select Model 2042 (35 l/min) for evaporations up to 10 L flask.

*Green*  
**By Design**

CAPTURE™ vapor emissions from rotary evaporators with an integrated solvent recovery system - see p. 40.



Recommended Configuration

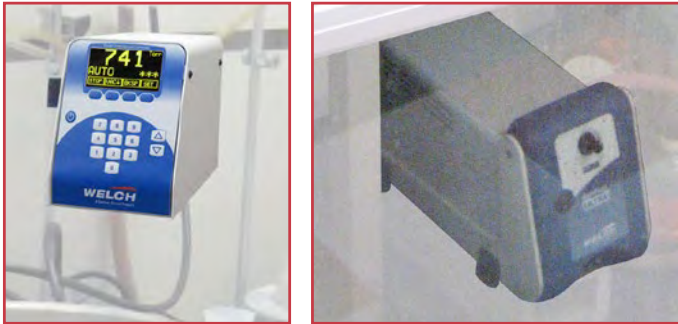


### Application Note | WELCH DRYFAST®

Use tunable vacuum adjustment to increase vacuum until bubbles form in the evaporation flask - then back off slightly. Decrease vacuum using tunable adjustment to eliminate bumping in the evaporation flask.



## PROGRAMMABLE VACUUM CONTROLLER



- Easy to set-up, program and operate
- Rack mountable to save hood space
- Corrosion resistant

The compact Model 1640 Vacuum Controller is designed to regulate the vacuum level in an apparatus. Vacuum level may be regulated from 2 torr to atmospheric pressure. Two vacuum level set points for pressure and time are available for each method set program.

The intuitive, corrosion resistant design incorporates a numeric keypad, PTFE solenoid valve, and solid state ceramic sensor for precise/reproducible vacuum control with programmable dual set-points, timer, memory and repeat functions.

The controller stores up to five method programs. The controller works with direct or belt-drive vacuum pumps up to 100 l/min, diaphragm pumps, WOB-L® piston pumps, water aspirators, or house vacuum systems.

For more information see p. 43.

## VERY HIGH BOILING POINT SOLVENT PUMP



Model  
8890A-70

Specifications &  
Ordering - p. 31

- Effective evaporation for DMSO and other very high boiling point solvents
- Adjustable vacuum to prevent bumping
- Gear pump mechanism is tolerant of vapors
- Exhaust mist eliminator prevents oil loss

The GEM® model 8890A-70 vacuum system is ideal for rotary evaporations with very high boiling point solvents. Provides vacuum to 0.1 torr with free air displacement of 31 l/min.

The rugged gear pumping mechanism has a wide range of operating pressures and passes vapors readily without the pump mechanism damage often seen in rotary vane pumps. The GEM® efficiently pumps vapors without condensing them into the pump.

The complete system comes with a gauge, vacuum regulator for easy vacuum control and an exhaust mist eliminator for recycling oil back into the pump. Ventilation to a hood is recommended.

## Model Selector | Rotary Evaporators

Boiling Point, Atmospheric Pressure	80 °C		110 °C		160 °C		195 °C	
Example Solvents	Methylene chloride Acetone Chloroform Ethanol		Trichloroethylene n-Propyl alcohol Heptane Water Toluene Acetic Acid		1,1,2,2-Tetrachloroethane DMF Pentachloroethane		DMSO Polymers	
RotoVap Flask Volume	Pump Models	System Models	Pump Models	System Models	Pump Models	System Models	Pump Models	System Models
<b>1 L</b>	↑	↑	↑	↑	↑	2200	↑	↑
<b>2 L</b>			2034	↑	2032	2210		
<b>10 L</b>			2044	2025	2042	2026, 2027, 2028	1400	8890A-70
<b>20 L</b>	2014	2025	2042	2026, 2027	2052, 2062	2220, 2230	1402	1402

## The Dry Vacuum Revolution ChemStar Dry



- Optimized high vapor flow
- Deep vacuum for fast evaporations
- Chemical resistant
- No oil mess or maintenance

### How it Works

ChemStar Dry software optimizes proprietary vacuum blower / PTFE diaphragm operation to quickly achieve high vapor flow in the key evaporative range of 0.1 to 10 torr. Maximum flow is 150 l/min at 2 torr; maximum vacuum is 50 millitorr. System automatically self-cleans to maintain top performance.

### Uses and Benefits

Perform deep vacuum operations without the risk of oil contamination and oil-seal pump mess and maintenance. ChemStar Dry provides durable, quiet vacuum for even aggressive chemical vapors. Vapor trapping recommended for select applications.

**For information, contact your Welch representative**

### Applications



Manifolds / Schlenk Lines



Vacuum Ovens



Freeze Dryers



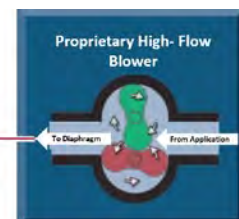
Concentrators

### Specifications

Model	2070	2080
Maximum flow @ 2 torr in LPM (m <sup>3</sup> /hr)	150(9)	300(18)
Ultimate Vacuum Pressure, torr (mbar)	0,05 (0,07)	0,05 (0,07)
Inlet/ Outlet Connection	NW25	NW25
Weight lbs (kg)	50(22,7)	88(40)
Running Amps	3	6
Overall Dimensions L x W x H, in. (cm)	18x9x18 (46x22x47)	23x11x18 (57x27x45)

### Ordering Information

Model	2070	2080
115V, 60Hz, 1 Ph with N. America cord set	2070B-01	2080B-01
Wired for 230V, 50/60 Hz, 1 Ph with Schuko and UK cord Set	2070C-02	2080C-01





## COMPACT VACUUM MANIFOLD PUMP



Model  
8890A-70

Specifications &  
Ordering - p. 31

- "Right-sized" vacuum pump for vacuum manifolds
- Compact pump takes little space
- Rugged gear pump is tolerant of vapors
- Fully accessorized

GEM® 8890A-70 high vacuum system is effective for vacuum manifold drying of large manifolds. With its 1.1 cfm (31 l/min.) flow and its ultimate vacuum of 0.1 torr (0.13 mbar), GEM dries 4 to 6 large sample vessels at once.

When operated according to Welch recommendations, the system has the optimum flow and vacuum for long-term durability on vacuum manifolds. Includes convenient vacuum regulator and gauge plus an exhaust oil recycler to capture oil mist ("smoke") from the pump exhaust and return it to the pump.

A foreline cold trap with temperature of -80 °C or lower is always recommended with vacuum manifold systems.

See Application Note for Vacuum Manifolds for pump capacity guidance.

## MOST DURABLE VACUUM MANIFOLD PUMP



Model  
1400/1400N

Specifications &  
Ordering - p. 32

- High contamination tolerance
- Best ultimate vacuum, <0.001 torr
- Low RPM for lower friction and wear
- Fewer moving parts increase pump durability

DuoSEAL® 1400 or CHEMSTAR® 1400N high vacuum pumps are effective for drying using large vacuum manifolds. The <0.001 torr ultimate pressure results in superior drying performance for the most difficult samples. Belt-drive pumps are known for their durability. Low pump RPM reduces wear and minimizes temperature to reduce oil degradation. The large oil capacity dilutes contaminants for extended service life. For pumping corrosive gases, CHEMSTAR 1400N also incorporates corrosion-resistant components for superior performance.

A foreline cold trap is always recommended when pumping on vacuum manifolds. Requires but does not include exhaust filter catalog number 1417 or 1416D.

See Application Note for Vacuum Manifolds for pump capacity guidance.

### Application Note | Vacuum Manifolds

Vacuum manifolds are commonly used for the final drying of samples removed from a rotary evaporator. Organic solvents and/or acids left behind during the distillation process are removed over several hours or more depending on the sample size. A foreline cold trap (see p. 39) is always recommended to minimize the ingestion of the solvents. An acid neutralization trap is also recommended between the cold trap and the pump when strong acids are present in the sample. When the drying is finished for the day, it is very important to either turn the pump off and remove/clean the trap or isolate the trap from pump using a valve. The reason for this is to prevent sublimation of condensed solids or vaporized liquids from the cold trap from recondensing in the pump.

The use of large capacity pumps (greater than 40 l/min.) on vacuum manifolds will actually shorten the oil change interval. This occurs because the larger pump will accelerate the sublimation process. The vapor flows through the trap too quickly to condense. When a large capacity pump is used, it is common to see at the end of a drying run that no condensables are in the trap because the chemicals have been drawn into the pump. There is a common misconception that a pump with a large pumping capacity will shorten the drying time. Due to tubing restrictions in the manifold and stopcock, this is not the case. Drying time differences between a large and a small pump occur only when the manifold system is leaky! Leaky vacuum systems should be repaired.

## COMPACT STATION FOR ASPIRATION & PRESSURE TRANSFER



Model 2511

Specifications & Ordering - p. 29

- Pumping capacity 11 l/min. @60 Hz
- Pressure transfer capability to 33 PSIG (3.3 x 10<sup>5</sup> Pascal)
- Automatic flow stop when 1.2 liter receiver full
- Lightweight, portable

Versatile model 2511 standard duty, oil-free station is an economical, portable solution for aspirating, filtering or rinsing. Added accessories include 1.2 liter autoclavable, bleach resistant collection receiver, vacuum regulator and gauge, hydrophobic inline filter, automatic shut-off when receiver is full. All wetted parts are treated for corrosion protection from moisture. Recommended for aspirating aqueous solutions including buffers, but not for acidic, basic or organic vapors or gases.

See p. 9 for hand held pipettor and other aspiration accessories.

### PARTICULATE, HYDROPHOBIC IN-LINE FILTERS

The filters are an economical solution to protect your WOB-L<sup>®</sup> piston vacuum pump from fine particulates and aerosols down to 0.2 microns in diameter.

Made of Polypropylene housing,  
CAT. No. 1475K-21 fits 1/4" to 3/8" and  
CAT. No. 1475K-23 fits 1/4" ID hose.



1475K-21



1475K-22

Made of SBS resin housing,  
CAT. No. 1475K-22  
fits 3/8" to 7/16" ID hose.



1475K-23

For Ordering Information, see p. 39

## HIGH FLOW FOR CELL CULTURE ASPIRATION



Model 2515

Specifications & Ordering - p. 29

- High pumping capacity 34 l/min. @60Hz
- Bleach resistant
- Automatic flow stop when 1.2 liter receiver full
- Lightweight, portable

High flow model 2515 standard duty, oil-free station is an economical, portable solution for aspirating or filtering. Station includes 1.2 liter collection receiver with port lid, vacuum regulator & gauge, and hydrophobic inline filter.

Receiver is autoclaveable and bleach resistant. Automatic float valve shutoff protects pump when receiver is full. For vacuum filtration, receiver port lid accepts filter funnel with stopper.

All wetted parts are treated for corrosion protection from moisture. Recommended for aspirating aqueous solutions including buffers, but not for acidic, basic or organic vapors or gases.

See p.9 for hand held pipettor and other aspiration accessories.

### REPLACEMENT JARS FOR ASPIRATION STATIONS

Spare receiver kit (1475K-20) includes a 1.2 liter autoclavable jar with auto shut-off port lid, 6ft. of tubing and two hydrophobic filters.



Pump Model

CAT. No.

2511B-75, 2511C-75, 2515B-75, 2515C-75

1475K-20

### Application Note | Aspiration Stations

The most common reason for vacuum pump failure in aspiration applications is the ingestion of liquid into the pump mechanism. Liquids ingested into the pump mechanism will lead to the valves failing or a diaphragm rupturing. Welch Aspiration Stations integrate features that protect your pump and your application:

1. The Collection Receiver captures aspirated liquid and automatically shuts down the pump when full.
2. The hydrophobic inline filter further protects the pump from aerosol ingestion. Routinely empty the Collection Receiver to assure continuous aspiration for your application.

## HAND HELD PIPETTOR FOR ASPIRATION STATIONS

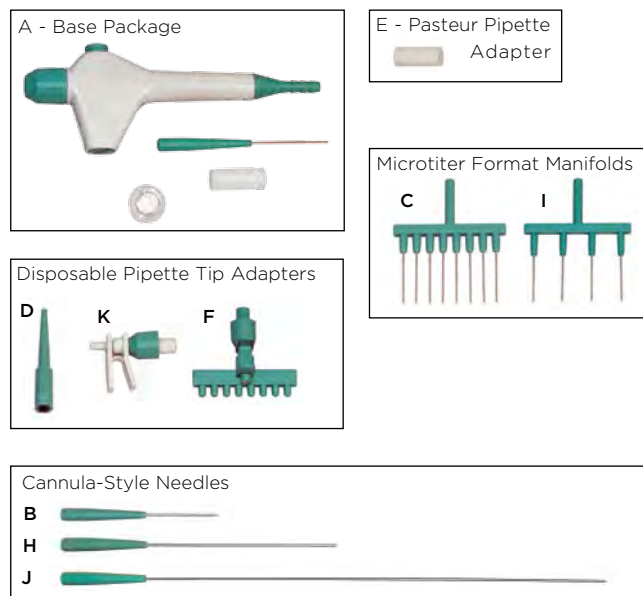


1475K-10

- Quick pipette / manifold adaptation
- Precise vacuum control button
- Ergonomic design lessens strain
- Solution contact surfaces autoclavable

Control your aspiration application with ease. The handheld pipettor system (1475K-10) provides pressure sensitive button control and enables clean transition between samples using a slight residual suction to prevent drippage; closing the adjustment screw stops all residual vacuum. Single channel and four and eight channel stainless steel manifold adapters work well with a wide range of liquid media. The single and eight channel disposable tip adapters include a convenient tip ejector. Also for use with standard volumetric pipettes. The entire unit is autoclavable and disassembles easily for cleaning.

Ordering Information		
Description	Model	Image
Handheld pipettor with 1 channel stainless steel 40 mm aspiration adapter and Pasteur pipette adapter	1475K-10	A
Adapter, stainless steel tip, 40 mm	1475K-01	B
8-channel adapter, stainless steel	1475K-02	C
1-channel adapter for disposable tips, w/o ejector	1475K-03	D
Rubber adapter for Pasteur pipettes	1475K-04	E
8-channel adapter for disposable tips, with ejector	1475K-05	F
Adapter, stainless steel tip, 150 mm	1475K-06	H
4-channel adapter, stainless steel tips, 40 mm	1475K-07	I
Adapter, stainless steel tip, 280 mm	1475K-08	J
1-channel adapter for disposable tips, with injector	1475K-09	K
Spare receiver kit-Includes: 6 ft. tubing, 1.2 liter autoclavable jar w/lid and two hydrophobic filters	1475K-20	L
Replacement hydrophobic filters (10)	1475K-21	M



## ON/OFF FOOT SWITCH

- Hands free On / Off pump operations
- No adapters or special connections needed
- Plugs directly into the power source outlet



On/Off foot switches are compatible with selected dry vacuum pump models. Switches handle up to 15 amps.

Cat. No. 1430A & 1430B come with a 3-prong U.S. Standard plug with 8 Ft. Cord, CSA, NEMA & UL Enclosure Type 1.

CAT. No. 1430C comes with a male and female IEC connections, 8 Ft. Cord, CE and plugs directly into the IEC connection on the pump.

Ordering Information			
Pump Model	Power	Switch Logic	CAT. No.
All DRYFAST <sup>®</sup> Diaphragm Pumps	115V/60Hz	Maintained On/Off	1430A
	115V/60Hz	Momentary On/Off	1430B
All WOB-L <sup>®</sup> Piston Pumps	90-230V with IEC connections	Momentary On/Off	1430C

\* Except Models 2511, 2522, 2534

## DNA PELLETING



Model  
2044

Specifications &  
Ordering - p. 24

- Recommended for SpeedVac® and CentriVap® centrifugal concentrators
- Fast evaporation for ethanol and water
- Low maintenance - no oil changes
- Reliable chemical duty PTFE pump

Replace leaking, smoking oil-seal pumps with low maintenance, low repair PTFE dry pumps. DRYFAST® pumps are effective for DNA pelleting in centrifugal condensate. DNA pelleting drying times are equivalent to oil-seal pumps without the oil changes, frequent repairs, and oil mess.

Recommended for most centrifugal concentrators including Thermo SpeedVac® and Labconco CentriVap®.

## OLIGONUCLEOTIDE PREP, BIOCHEMICAL / ORGANIC SAMPLES



Model  
2042

Specifications &  
Ordering - p. 25

- Recommended for SpeedVac® and CentriVap® centrifugal concentrators
- Fast evaporation when used with a -50 °C refrigerated trap
- Low maintenance - no oil changes
- Reliable chemical duty PTFE pump

DRYFAST® Ultra dry diaphragm pumps for vacuum concentrators are effective for oligonucleotide prep, biochemical and organic samples and large sample volumes when paired with a -50 °C refrigerated trap. With this recommended configuration drying times are equivalent to those of oil-seal pumps. The PTFE dry pump eliminates oil changes, frequent repairs, and oil mess. DRYFAST® pumps have the chemical resistance to handle aggressive chemicals such as TFA, HCl, formic acid, and acetic acid.

Recommended for most centrifugal concentrators including Thermo SpeedVac® and Labconco CentriVap®.

## Process Applications

### HIGH CAPACITY PTFE DIAPHRAGM PUMPS

- Oil-free vacuum pump
- High Flow

Process large volume or sample count evaporations with ease. High capacity PTFE pumps from WELCH are the oil-free solution to high sample volume issues.



Model  
2052/2054

Specifications &  
Ordering - p. 25

### Model Selector | Centrifugal Concentrator Pumps & Traps

Also see Chemstar Dry, p. 6

Application	Sample Load	Refrigeration	Model
DNA Pelleting	<1 ml, up to 24 tubes ≥1 ml, ≥24 tubes	Refrigerated trap optional	DRYFAST® 2044 2054
Oligonucleotide Preps	2-4 ml, up to 60 tubes ≥4 ml, ≥60 tubes	-55 °C Refrigerated trap highly recommended	DRYFAST® 2042 2052
Biochemical/Organic Samples	<5 ml, up to 60 tubes ≥5 ml, ≥60 tubes	-55 °C Refrigerated trap required	DRYFAST® 2042 2052
Biochemical or large samples	<50 ml, up to 6 tubes; ≥50 ml, ≥6 tubes	-55 °C Refrigerated trap required	DRYFAST® 2042 2052

## NO HASSLE GEL DRYING



Model  
142601

Specifications &  
Ordering - see below

- Fast results with crack-free gels
- No dry ice, no trap cleaning
- Drain condensate after 10-15 runs

The revolutionary GELMASTER™ gel dryer vacuum system (>50 l/min. of Vapor @ 28 in. Hg) dries Acrylamide DNA or protein gels as fast as a high vacuum oil sealed pump with dry ice trap. However, it needs no dry ice and it eliminates cold trap cleaning. GELMASTER's unique design uses a patented room temperature vapor trap with a built-in dry vacuum pump. Condensate is collected in liquid form so there is no messy ice buildup and the tenth drying run is as fast as the first. When the collector reaches capacity, simply drain the contents and begin again. Does not require external cold trap.

GELMASTER comes complete and ready to use with 5 ft. (1.5 m) of 3/8 in. (10 mm) ID PVC vacuum tubing, in-line stopcock, hose clamps, detachable line cord, and one liter of trapping fluid. An annual flushing of the collector with 8995C-70 Flushing Fluid is recommended for optimum performance.

## ONE PUMP FOR CONCENTRATOR AND GEL DRYER

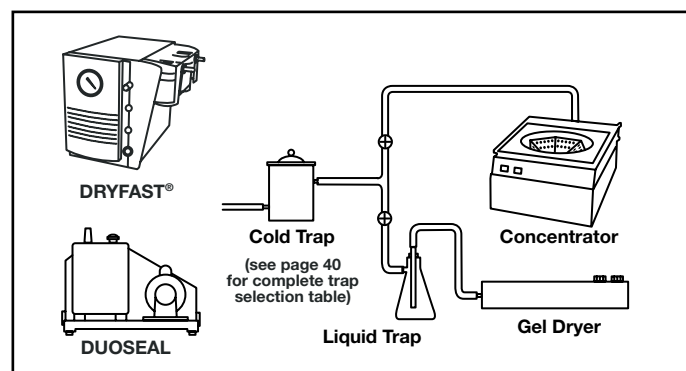


Model  
2025

Specifications &  
Ordering - p. 26

- Saves valuable lab space
- Fast, high quality results
- Reliable PTFE dry pump

The model 2025 Self-Cleaning Dry Vacuum System™ with 35 l/min. (29 l/min. @ 50Hz) of pumping capacity is effective for either a concentrator or gel dryer. Crowded laboratories find it convenient to use one vacuum pump for both devices. Simply assemble a basic manifold with tubing and two in-line valves. When the concentrator is in use, close the valve to the gel dryer, and vice versa. An in-line dry ice trap is recommended for this configuration.



Recommended Configuration

### Ordering Information

Description	Cat. No.
115V, 60Hz, 1 Ph w/ N. American plug. Dmns: 14.25"L x 15.5"W x 14"H (36.2 x 39.4 x 35.6 cm). Weight: 33.5 lbs (15.2 kg)	142601
Same as 142601 w/ 220V, 50Hz w/ Continental Europe (Schuko) plug	142602
Same as 142601 w/ 100V, 50/60Hz with US 115V plug (Japan)	142604
Same as 142601 w/ 220V, 50Hz with UK plug.	142606
Trapping fluid, 1 liter	8995C
Flushing fluid, 1 Gal (3.78 liter)	8995C-70

### Compatible with all Gel Dryers Including:

Cat. No. (115V/60Hz)	Bio-rad	Hoefler	Fisher Biotech	Labconco
142601 or 202501	583	SE 1200, GD 2000	FB-GD-45- 10	4330100, 4330150

## ECONOMY FREEZE DRY PUMP



Model  
8917

Specifications &  
Ordering - p. 30

- Light Weight and Portable
- High vacuum and vapor flow

Welch rotary vane vacuum pumps provide the deep vacuum and high flow needed to remove aqueous vapors quickly and efficiently. Use these direct drive oil-seal pumps for strong vacuum performance with the convenience of portability and a small footprint in the lab.

Pumps feature excellent water vapor tolerance, ample oil case volume to lessen contaminant effects, and light weight portability. Includes power cord and oil.

Select from a variety of free air displacement options to right-size a vacuum pump to your freeze drying system requirements. See the Model Selector and Application Note below for more information.

See p. 40 for exhaust filter and exhaust oil recycler options.

## ACIDIC/ORGANIC VAPOR FREEZE DRYING



Model  
8917A-80

Specifications &  
Ordering - p. 30

- Holds up to harsh chemicals used in proteomics and combinatorial chemistry
- System includes continuous acid neutralization and oil filtration
- Compact, quiet direct drive pump

The Welch freeze dryer vacuum system is effective for freeze drying or concentrating by freeze dryer of samples including harsh chemicals such as TFA, acetonitrile, HBr and others. These chemicals quickly attack the vacuum pump oil of unprotected vacuum pumps. The 8917A-80 system includes a powerful 173 l/min. (143 l/min. at 50Hz) vacuum pump that is protected by an integral oil filtration system.

The oil filtration system neutralizes acids and removes solid reaction products from the oil. The system also has a large oil capacity of 1.3 liters that dilutes contaminants that mix with the pump oil during freeze drying runs.

The system includes Welch Gold Vacuum Pump Oil (see p. 13) which has excellent resistance to chemical attack.

### Application Note | Freeze Dryers

Vacuum pump oil can be quickly compromised by the vapors from a freeze dryer. Once oil is chemically damaged, lubrication properties diminish and the vacuum pump quickly requires repair.

Organic solvents, acids, and other sublimated vapors often pass through the freeze dryer collector too rapidly to be effectively condensed. In general, better protection of your vacuum pump can be accomplished by

1. Using a low temperature cascade-refrigeration collectors.
2. Ensuring that your freeze dryer is operating vacuum tight. Too high a flow - augmented by system leakage - prevents the collector from operating efficiently.

Harmful vapor pass through is common in many freeze dryer systems. To maintain your lyophilizing process, select a vacuum pump designed to cope with harmful vapor ingress. See MODEL SELECTOR for the pump recommendations.

Drug discovery labs are using freeze dryers for the final drying step when samples isolated by HPLC and LC include heat sensitive proteins and peptides. These samples are typically dissolved in a water, acetonitrile, and 0.1% TFA solution. Acetonitrile and TFA and its by products will cause rapid breakdown of pump oil, changing its viscosity and leading to pump failure - sometimes after only a few runs.

- There is no way to prevent the ingestion of harsh chemicals into the pump. Three steps to minimize ingestion of harsh chemicals are:
1. Clean the freeze dryer's condenser after each freeze drying run to prevent sublimation of the frozen chemicals into the pump.
  2. Size the pump to the freeze dryer. Pumping speed that is too high will shorten residence time in the condenser, reducing its trapping efficiency.
  3. Spread the drying of multiple samples over time to evenly distribute the vapor load on the condenser.

**CAUTION:** For high acetonitrile vapor loads, add a cold trap operating at -75 °C or colder.



## HIGH ORGANIC VAPOR LOADS



Model 8960



Model 8965/8970

Specifications & Ordering - p. 31

- Degassing solvents trapped in oil case
- Freeze Dryer
- Laboratory Applications with chemical and corrosive gases/vapors

Eliminate the harmful vapors that destroy your pump in the most demanding vacuum applications. The Chemvac Combination Pump draws a deep, high-flow vacuum – suitable for freeze dry applications – with a powerful Rotary Vane Pump.

Harmful ingested fumes that would compromise the primary pump's oil are promptly degassed by Chemvac's secondary vacuum – a corrosion resistant PTFE diaphragm pump. This pumping system maintains high performance of the primary rotary vane pump, reducing maintenance and extending component life.

## RUGGED PUMP FOR CORROSIVE VAPORS



Model 1402N

Specifications & Ordering - p. 34

- Lower rotational speed for less wear and longer life
- Vital parts are corrosion resistant
- Large oil reservoir dilutes contaminants

ChemStar® belt driven vacuum pumps are the most rugged Welch vacuum pumps for freeze drying applications. The design of these pumps makes them more tolerant of chemical contamination. The large 2.1 liters oil capacity dilutes contaminants. Lower belt drive RPM lowers operating temperature, thus reducing chemical activity. Lower RPM also results in less wear and longer operating life. Vital pump parts are corrosion resistant. The pump includes Welch Gold Oil (see below) which has excellent resistance to chemical attack.

For more ChemStar information, see p. 34.

## GOLD VACUUM PUMP OIL

- Exceptionally low vapor pressure
- High stability in chemical environments
- No additives or inhibitors
- Recommended for Welch belt-drive and direct-drive pumps

A double distilled synthetic hydrocarbon oil designed for excellent chemical resistance when pumping corrosive gases or vapors. Synthetic base stock has no aromatic compounds or sulfur to accelerate varnishing, sludging and carbon build-up when pumps are used to pump corrosives. Gold oil will give a longer service life and superior protection for the internal metal components of a pump in corrosive pumping applications compared to DuoSeal® and Premium Oil. Gold Oil offers excellent vacuum pressure in both belt-driven and direct-driven vacuum pumps over time. Gold Oil is miscible with conventional hydrocarbon oils and can be used without rebuilding the pump. The oil is clear and colorless.

Recommended for Freeze Drying



### Ordering Information

Size	Liter	Gallon	5 Gallon
CAT. No.	8995G-11	8995G-15	8995G-20

### Model Selector | Freeze Dryers

Also see Chemstar Dry, p. 6

Freeze Dryer Size (volume)	Economy	Acidi/Organic Vapors	High Organic Vapors	Highly Corrosive Vapors
< 4 L	8912A	8917A-80	8960	1402N-01
4 to 12 L	8917A	8917A-80	8965	1402N-01
12 to 25 L	8925A	1376N-01	8970	1376N-01

## OIL-FREE EVACUATION OF GLOVE BOX AND TRANSFER STATION



Model 2581

Specifications & Ordering - p. 29

- High flow to shorten the purge/fill cycle
- Oil-free - no contamination, no oil changes
- Compact, lightweight, portable

WOB-L\* dry piston pumps are effective for acrylic and polycarbonate glove boxes with vacuum requirements above 5 torr (6.7 mbar). The oil-free WOB-L piston vacuum pump provides continuous, reliable, high flow vacuum for your glove box. Model 2581 is suited for transfer chamber evacuation and purge/fill cycles for a glove box of up to 30 ft<sup>3</sup> (0.84 m<sup>3</sup>). The pump is complete with vacuum adjustment, vacuum gauge to monitor vacuum level, and muffler. See application note below regarding glove box vacuum limitations.

## WELCH DIRECT DRIVE VACUUM PUMPS

- Lightweight, compact pump
- Ultimate <0.003 torr (0.004 mbar)
- Integral isolation valve

Welch direct drive vacuum pumps are high performance, but very portable with a small footprint in your lab. Ultimate vacuum to  $1 \times 10^{-4}$  torr, flow rates to 11.3 cfm for rapid box / chamber cycling.

This oil-seal pump design has an integrated isolation device to prevent oil and air contaminating your system in the event of a power failure. Pump can be ordered with an optional exhaust filter (see p. 40) to control exhaust oil mist.

## HIGH VACUUM FOR STAINLESS STEEL / GLASS GLOVE BOXES



Model 1402

Specifications & Ordering - p. 32

- High vacuum to 0.0001 torr
- High flow (5.6 cfm)
- Very rugged and reliable

DuoSEAL\* vacuum pumps are effective for use with high purity atmosphere metal glove boxes. Use DuoSEAL pumps to draw a deep vacuum when establishing glove box atmosphere and for rapid transfer chamber cycling.

The large oil capacity of the DuoSEAL pump effectively dilutes contaminants for longer maintenance intervals levels and pump life. Chemical reactions affecting the pump oil are lessened by low pump operating temperature, a result of slow pump rotation and reduced friction. Use of a cold trap to minimize harmful vapor ingress is recommended.

NOTE: Optional exhaust filter catalog number 1417A is recommended for glove box applications to control exhaust oil mist (see p. 40).



Model 8917A

Specifications & Ordering - p. 30

### Application Note | Glove Box

Standard glove boxes and transfer chambers are not normally evacuated much below 25 torr (29" Hg) due to plastic material limitations. Both acrylic and polycarbonate which are used in standard glove boxes are not suited for deep vacuum (1 torr operation).

High end glove boxes capable of deeper vacuum normally are constructed of stainless steel and heavy glass plates. Follow glove box manufacturer recommendations for vacuum pumping requirements.

### Model Selector | Glove Box

Oil-Free Vacuum for Acrylic Glove Boxes	Oil-Seal Deep Vacuum for Metal Glove Boxes	
Aqueous Vapors	Portable Direct Drive	Durable Belt-Drive
WOB-L 2581B-50	8917A	DuoSEAL 1402B-01

## AQUEOUS SAMPLES



Model 2061

Specifications & Ordering - p. 28

- Fast drying for vacuum oven samples
- Oil-free - no oil changes, no oil mess
- Attractively priced
- Compact, lightweight, portable

Standard WOB-L® dry piston pumps for vacuum ovens are effective for drying aqueous samples that are not strongly acidic or basic. These vacuum pumps were developed and tested for selected vacuum applications such as drying precipitates, food and soil samples, and glassware. Because the pumps are oil-free, there is no oil contamination of samples, no exhaust smoke, no oil leaks, and best of all, no oil changes. The pumps include a liquid trap at the inlet, vacuum adjustment, and gauge. Supplemental inlet cold traps are recommended for high water vapor loads.

## DUOSEAL PUMPS FOR HIGH VACUUM

- High vacuum to 0.0001 torr
- High flow
- Very rugged and reliable



Model 1402

Specifications & Ordering - p. 32

DuoSEAL® vacuum pumps are effective for use with large vacuum ovens. Use DuoSEAL pumps to draw a deep vacuum when removing low volatility solvents at lower temperatures.

The large oil capacity of the DuoSEAL pump effectively dilutes contaminants for longer maintenance intervals levels and pump life. Chemical reactions affecting the pump oil are lessened by low pump operating temperature, a result of slow pump rotation, reduced friction, and large oil capacity.

Use of a cold trap to minimize harmful vapor ingress is recommended.

## ACIDIC OR BASIC SAMPLES, ORGANIC SOLVENTS



Model 2042/2047

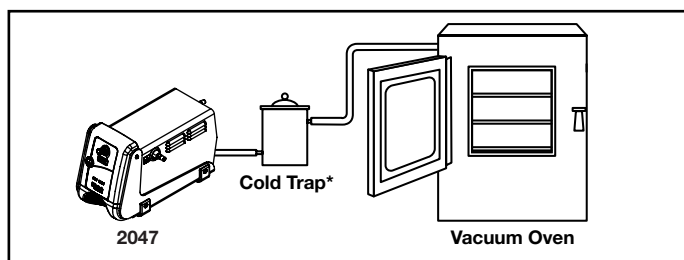
Specifications & Ordering - p. 24, 25

- Fast drying for vacuum oven samples
- Oil-free - no oil changes, no oil mess
- Rugged corrosion-resistant PTFE construction
- Compact, lightweight, portable

DRYFAST® PTFE dry pumps for vacuum ovens are effective for drying samples that are strongly acidic or basic. DRYFAST pumps are also effective for samples containing organic solvents. These vacuum pumps are recommended for work with corrosive fumes and the fluorinated contact surfaces are resistant to organic attack.

DRYFAST pumps are a dry diaphragm design that eliminates the maintenance and contamination potential issues associated with oil-seal pumps. High flow DRYFAST pumps are portable with a small footprint and handy vacuum adjustments. Cold traps are recommended for high vapor loads.

See CAPTURE™ recovery system, p. 6.



Recommended Configuration

### Model Selector | Vacuum Ovens

Also see Chemstar Dry, p. 6

Oven Volume	Oil-Free Vacuum 1.5 to 35 torr		Oil-Seal Deep Vacuum 0.0001 to 0.002 torr	
	Aqueous Vapors	Chemical Vapors	Portable Direct Drive	Durable Belt-Drive
0.6 to 1.5 ft <sup>3</sup>	WOB-L 2561B-50	DRYFAST 2042	8905A	DuoSEAL 1400B-01
2.5 to 4.5 ft <sup>3</sup>	WOB-L 2581B-50	DRYFAST 2047	8912A	DuoSEAL 1405B-01
4.5 to 9.0 ft <sup>3</sup>	WOB-L 2581B-50	2054	8917A	DuoSEAL 1402B-01

## FOR AQUEOUS SOLUTIONS

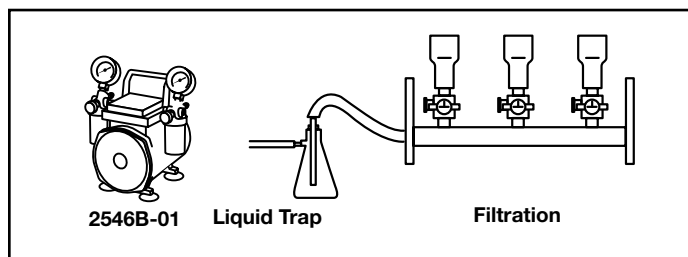


Model  
2522

Specifications &  
Ordering - p. 28

- Ideal for filtering aqueous solutions/buffers
- Vacuum or pressure filtration
- Full featured for filtration
- Attractively priced

Standard duty dry piston pumps for vacuum filtration are effective for filtering aqueous solutions that are not strongly acidic or basic. These attractively priced pumps are oil-free and loaded with powerful features for filtration; vacuum and pressure adjustments with gauges, liquid traps at inlet and outlet, liquid shutoff at inlet, and noise reduction. Two models power filtration setups of 1 to 6 funnels and larger.



Recommended Configuration

## LABORATORY FIELD USAGE



Model  
2060

Specifications &  
Ordering - p. 29

- Powerful, Portable, & Economical
- Lab or Field Usage
- Advanced Chemical Resistance

Simplify your sampling and preparative procedure with Welch's GEMINI® pump. Use the same powerful, light-weight vacuum pump in the lab, or in the field!

Quiet GEMINI pumps use DC motors, powered by an AC adapter unit in the lab or a 12V DC adapter for your vehicle. Pump fumes up to 13 l/min achieve vacuum to 190 torr.

GEMINI gives you enhanced chemical resistance - tolerant beyond aqueous fumes for use with solvents and weak acids/bases. GEMINI's high performance components will not corrode. Chemical resistance is built in with polyarylamide heads and fluoroelastomer diaphragms, tubing and valves. The oil-free dry pump design provides top performance in a portable durable package.

For convenient vacuum readout and regulation, order Model 2060. Not recommended for use with strongly acidic or basic fumes. For organic fume applications, check for chemical compatibility with fluoroelastomer. Not recommended for rotary evaporator, concentrator, or vacuum oven applications. See PTFE dry vacuum pumps and systems (p. 24 & 25) for applications requiring higher vacuum/flow with harsh or aggressive chemicals.

## PARTICULATE, HYDROPHOBIC IN-LINE FILTERS

The filters are an economical solution to protect your WOB-L\* piston vacuum pump from fine particulates and aerosols to 0.2 microns in diameter.

Made of Polypropylene housing,  
CAT. No. 1475K-21 fits 1/4" to 3/8" and  
CAT. No. 1475K-23 fits 1/4" ID hose.

Made of SBS resin housing,  
CAT. No. 1475K-22  
fits 3/8" to 7/16" ID hose.



1475K-21



1475K-23



1475K-22

### Ordering Information

Pump Model	Pore Size	Pack Qty.	CAT. No.
2511, 2515, 2522, 2534, 2546	0.8 micron	10	1475K-21
2561, 2581, 2562, 2567	0.8 micron	1	1475K-22
2562, 2567	0.2 micron	1	1475K-23

**AFFORDABLE  
CHEMICAL RESISTANT**



Model 2019

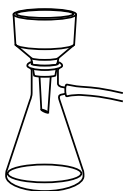
Specifications & Ordering - p. 24

- Light and portable
- PTFE contact surfaces

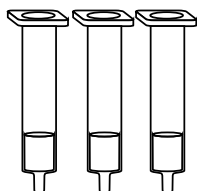
Economical Model 2019 vacuum pump is durable and chemical resistant. Use Model 2019 for vacuum filtration, desiccation, aspiration, degassing, and other mid-range vacuum applications. Free air flow 37 l/min; Maximum vacuum 24" Hg (200 mbar). Ideal for single funnel or up to 6 holder manifold filtrations - for organic and light acid/base (e.g. acetic acid) solutions.

Pump can also be used to pressurize up to 18 PSIG. Comes standard with 115V line cord, plug and convenient power switch.

**Key Applications**



Buchner Funnel Filtration



Solid Phase Extraction (SPE)

**ACIDIC OR BASIC SOLUTIONS,  
ORGANIC SOLVENTS**

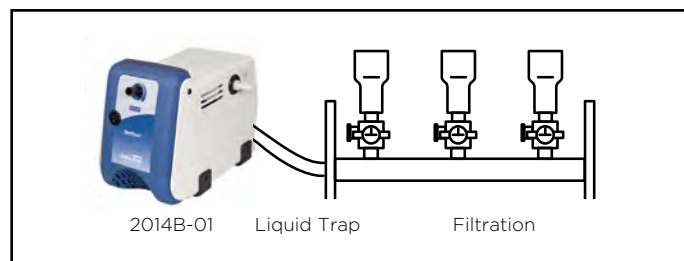


Model 2014

Specifications & Ordering - p. 24

- Recommended for filtering acidic or basic solutions and organic solvents.
- Rugged corrosion-resistant PTFE construction
- Oil-free - no oil changes, no oil mess
- Compact, lightweight, portable

Chemical duty dry pumps for vacuum filtration are effective for filtering acidic or basic solutions and organic solvents. These rugged oil-free pumps are corrosion resistant with all fluoroplastic materials at wetted surfaces. Four models power filtration setups of 1 to 6 funnels and larger.



Recommended Configuration

**Model Selector | Filtration**

Filtration Solvent / Media	Chemical Examples	Vacuum Regulation	Number of Filters	Model
Aqueous Vapors	Suspended solids samples Food slurry analysis	Yes	1-2	WOB-L 2522
		Yes	1-4	WOB-L 2534
		Yes	1-6	WOB-L 2546
		Yes	6 funnel manifold	WOB-L 2567
Mild Chemical Vapors	Weak acid /base solutions Field environmental Samples	No	1	GEMINI 2050
		Yes	1	GEMINI 2060
Low-volume Organic Vapors	Alcohol Solutions Solid Phase Extractions	No	1	2019
Strong Chemical Vapors	Chlorinated solvents Strong acid /base solutions Ketones	Yes	1-2	DryFast 2014
		Yes	1-6	DryFast 2037
		Yes	6 funnel manifold	DryFast 2047

## HIGH FLOW FOR ASPIRATING 96 OR 384 WELL SYSTEMS



Model  
2567

Specifications & Ordering - p. 29

- Effective for use in automated systems
- Oil-free for low maintenance
- Liquid separator trap protects the pump
- Compact, lightweight, portable

Standard duty dry piston pump for automated systems is effective for aspiration of aqueous or buffer samples. Designed for high throughput automated systems, Model 2567B-50 provides 100 l/min. flow at 60Hz (83 l/min. at 50Hz). This flow will provide aspiration power for 96 and 256 well systems. Because the pumps are oil-free there is no oil contamination of samples, no exhaust smoke, no oil leaks, and best of all, no oil changes. Pumps are complete with vacuum adjustment, dial vacuum gauge, and liquid separator trap.

Note: Not recommended for aspirating acidic, basic, or organic vapors or gases.

Description	Cat. No.
Standard duty vacuum pump w/filter, 115V, 60Hz, 1 Ph w/N. American plug.	2567B-50
Chemical duty PTFE vacuum pump, 115V, 60Hz, 1 Ph w/N. American plug.	2047B-01
Standard duty vacuum pump w/filter, 230V, 50Hz, 1 Ph w/Cont. European plug.	2567C-50
Chemical duty PTFE vacuum pump, 230V, 50Hz, 1 Ph w/Cont. European plug.	2047C-02

## HIGH FLOW FOR ASPIRATING HARSH CHEMICALS

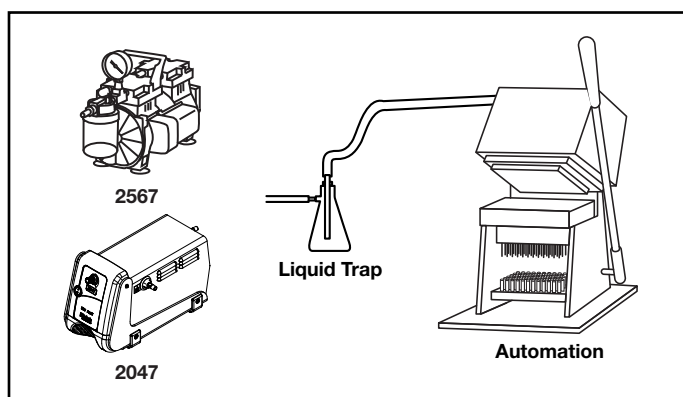


Model  
2047

Specifications & Ordering - p. 24

- Effective for use in automated systems
- PTFE dry diaphragm pump for aspirating acidic, basic, or organic liquids
- Compact, lightweight, portable

DryFast™ PTFE dry diaphragm pump for automated aspiration systems is effective for aspirating liquids that are strongly acidic, basic or organic. Designed for high throughput automated systems, Model 2047 provides 70 l/min. flow at 60Hz (58 l/min. at 50Hz). This flow will provide aspiration power for 96 and 256 well systems. Because the pumps are oil-free there is no oil contamination of samples, no exhaust smoke, no oil leaks, and best of all, no oil changes.



Recommended Configuration

### Application Note | Aspiration

The most common reason for vacuum pump failure is ingestion of liquid into the pump mechanism. Dry vacuum pumps are designed for pumping gases and vapors. Liquids ingested into the pump mechanism will either cause the valves to fail on Standard Duty Pumps or the diaphragm to rupture on Chemical Duty Pumps. Automation waste reservoirs should be sized at a minimum of 2X the daily collected volume. Welch recommends a liquid trap installation between the pump and aspiration system. At the end of each day, the automation reservoir and liquid trap need to be emptied.





Model 3100  
Analog Adjust

Model 3200  
Digital Display

### Complete system - pump head, tubing & drive

- Order with just one catalog number
- Ready out of the box

### Lok-n-Flow tubing cartridges

- Economizes the use of expensive tubing
- Tubing waste dramatically reduced
- Reduce maintenance time with fast tubing changes

### Bi-directional (reversible) flow control & max flow button

- Clean up and priming made easy

### Variable speed

- Digital and analog flow control

### Console drive

- Stackable and portable
- Power supply within housing

### Perfect for Transferring Solutions with

- Precise flow rate requirements
- Handling material sensitivity
- Moderate viscosity
- Suspended solids
- Mixed phase media



### Fast, Easy Tubing Cartridge Changes

Innovative "S" clip pivots for quick release/locking



## WELCH PERISTALTIC PUMPS

- Precise, continuous fluid delivery
- No fluid contact with pump
- Fast change tubing cartridge
- Pumps 3 to 300 ml/min.

Welch peristaltic pumps simplify your critical solution transfers. Avoid fluid cross-contamination while benefitting from precision delivery, handling material compatibility, and quick solution change-overs. Choose cartridges from four different tubing materials at one of three inner diameters for precision fluid deliveries ranging from 3 to 300 l/min. Self-priming with easy adjustment of flow rate and pumping direction.

For digital display of pump rotation speed, order Model 3200.

Specifications		
Welch Model	3100 - Analog	3200 - Digital
Flow Range	3 - 300 ml/min.	3 - 300 ml/min.
RPM	20 to 200	20 to 200
Pump Speed Display	No	Yes
Motor	Reversible	Reversible
Weight, lb.(kg)	6(2.7)	6(2.7)
Overall Dimensions LxWxH in.(cm)	7x7.5x5.5 (17.8x19.0x14)	7x7.5x5.5 (17.8x19.0x14)
Shipping Weight, lb.(kg)	10(4.5)	10(4.5)
Shipping Carton Dimensions L x W x H in.(cm)	9x12x12 (22.9x30.5x30.5)	9x12x12 (22.9x30.5x30.5)
Ordering Information		
Wired for 115V, 60Hz, with N. American 115V Plug	3100B-01	3200B-01
Wired for 230V, 50Hz, with Cont. Euro. (Schuko) Plug	3100C-02	3200C-02

Ordering Information - Tubing Cartridges (5 each)		
Tubing ID (Flow Rate Range)	Silicone (Bio-Fluids/ Food)	PVC (General/ Viscous)
1.6 mm_(3-30 ml/min)	3432K-01	3434K-01
3.2 mm (10-130 ml/min)	3432K-02	3434K-02
4.5 mm (30-300 ml/min)	3432K-04	3434K-04

### Starter Kit 3200K-01

#### Initial Tubing Cartridges

- 1.6 mm silicone (2 each)
- 3.2 mm silicone (2 each)
- 4.8 mm silicone (2 each)

4.8 mm PVC Tubing (25 feet)  
Hose Clamps (4 each)

Included with every pump.



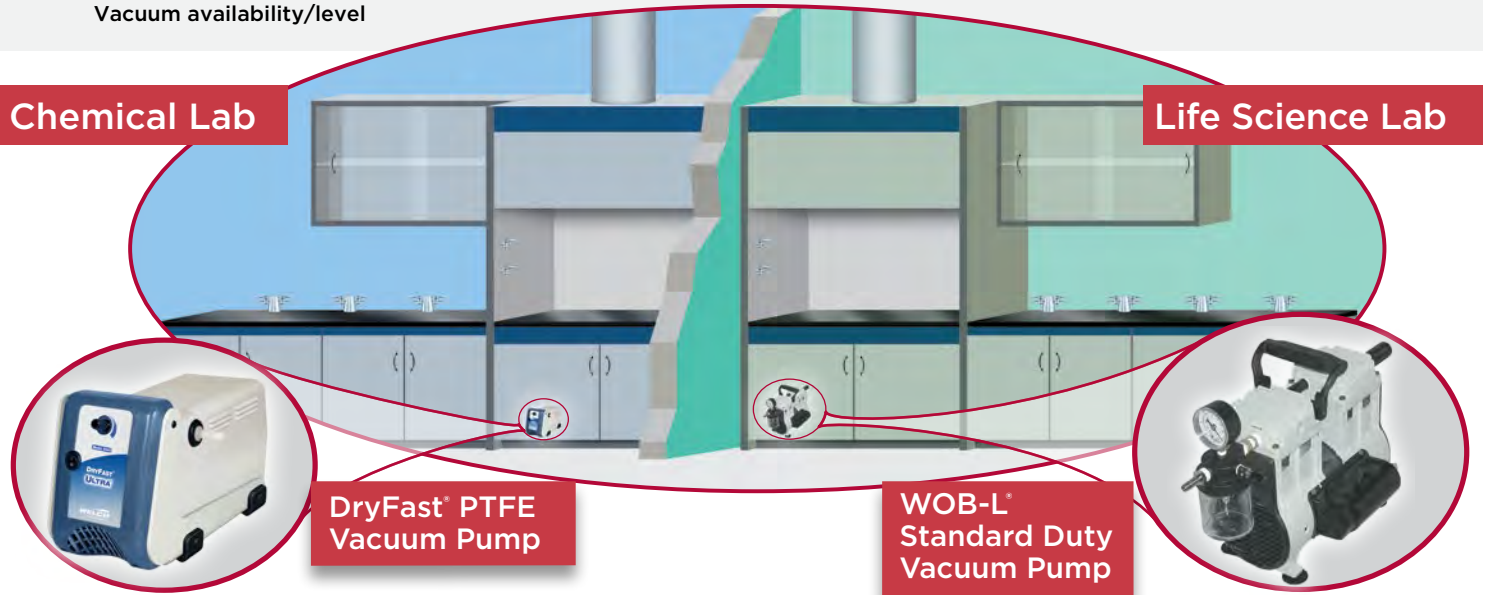
## Advantages

- Economical, Green Installation
- Modular Vacuum designed for each Lab's needs
- Superior control of:
  - Cross Contamination
  - Chemical Handling/Discharge
  - Vacuum availability/level

WelchNet™ Vacuum Systems combine installation savings with a vacuum capability tailored to your Lab's work and material flow. Using standard lab fixtures, initial WelchNet costs are typically 30-50% lower than contractor-installed central vacuum systems. Install a Welch Application-Certified dry vacuum pump in your Lab to improve control of vapor co-mingling, vacuum line contaminants and atmospheric discharge.

## Chemical Lab

## Life Science Lab

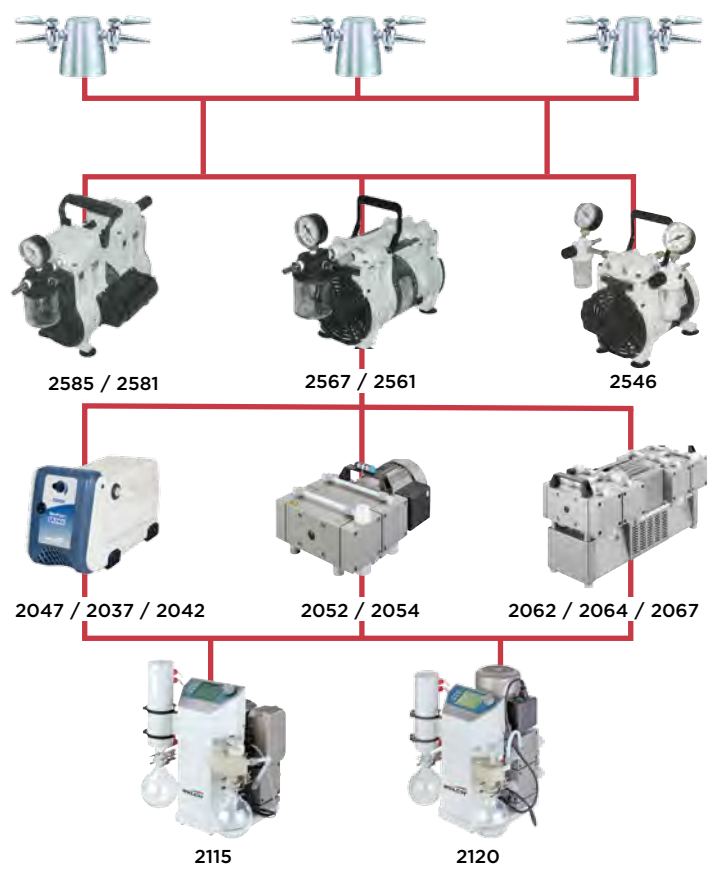


**DryFast® PTFE Vacuum Pump**

**WOB-L® Standard Duty Vacuum Pump**

## Model Selector | WelchNet™ Vacuum Systems

Application	Flow Rate	Vacuum Hg(torr)	Max. # of Outlet Fixtures	CAT. No	
<b>Filtration</b>					
Standard Duty	45 LPM	27.6"(60)	5	2546B-01	
	100 LPM	27.6"(60)	10	2567B-50	
	201 LPM	27.6"(60)	20	2585B-50	
Chemical Duty	70 LPM	28.5"(35)	8	2047B-01	
	50 LPM	28.5"(35)	5	2037B-01	
	221 LPM	27.7"(56)	15 - 20	2067B-01	
Chemical Duty On Demand System	41 LPM	29.7"(6)	5	2115B-01	
<b>Vacuum Oven</b>					
Standard Duty	Oven Volume				
	0.6 ft <sup>3</sup>	60 LPM	29.8"(5)	2 - 3	2561B-50
	1.7 ft <sup>3</sup>	100 LPM	29.8"(5)	2	2561B-50
Chemical Duty	0.6 ft <sup>3</sup>	35 LPM	29.85"(2)	2 - 3	2542B-01
	0.6 ft <sup>3</sup>	65 LPM	29.86"(1.5)	3	2052B-01
	1.7 ft <sup>3</sup>	119 LPM	29.86"(1.5)	2 - 3	2062B-01
Chemical Duty On Demand System	0.6 ft <sup>3</sup>	81 LPM	29.86"(1.5)	2 - 4	2120B-01



**Other Applications**      **Contact your Welch Representative**

## WELCHNET ON DEMAND SYSTEMS

### Pump turns on only when Vacuum is needed

- Extends system maintenance interval
- Saves Energy
- Extends Pump life



Perfect Vacuum for multiple laboratory fixtures has never been this reliable. On Demand Vacuum Systems only activate the pump when vacuum pressure is above the set point. Get the powerful vacuum you need at multiple ports - and save pump wear / tear, reduce energy costs, and capture harmful vacuum application vapors.

Systems can be adjusted to vacuum level set point with control band to trigger pump activation. Systems feature fore line catch flask for condensable vapors from applications. Outlet catch flask protects laboratory atmosphere, as a water coil condenser captures vapors expelled by pump.

On Demand System under your hood. Beveled display and hand knob enable easy vacuum adjustment. Use Model Selector to determine vacuum outlet capacity.



**Oil-Free alternative to house vacuum systems**

## WelchNet™ Titan | Intelligent Vacuum Control

- Intelligent vacuum control
- Chemical Resistant
- Green Technology
  - Oil-free
  - Energy efficient
  - Low maintenance



The WelchNet Titan is a microprocessor controlled system of high capacity PTFE diaphragm pumps. The pumps work individually or in tandem as your laboratory vacuum demand requires, holding vacuum level even if an individual pump needs maintenance.

Titan is mounted on a mobile base frame - easily positioned for adaptation to existing plumbing. Titan-4 and Titan-6 are systems utilizing 4 or 6 PTFE diaphragm pumps to provide efficient vacuum on demand for up to 30 separate users.

The individual pumps start up in tandem and are successively switched off as working vacuum pressure is attained. One or more pumps come on in response to vacuum demand, rotating usage to distribute pump wear and extend maintenance interval.

Specifications						
Model	2614	2624	2634	2616	2626	2636
	4 Pump System	4 Pump System	4 Pump System	6 Pump System	6 Pump System	6 Pump System
Pump Speed, l/min (CFM) @60Hz	300 (10.6)	480 (17)	640 (22.6)	486 (14.8)	750 (26.5)	906 (32.0)
Pump Speed, m <sup>3</sup> /hr (l/min) @50Hz	15 (250)	24 (400)	32 (533)	27.0 (450)	37.5 (625)	49.8 (828)
Ultimate pressure, torr (mbar)	<1.5 (<2)	<6 (<8)	<56 (<75)	<1.5 (<2)	<6 (<8)	<56 (<75)
Amp required @230V 60Hz 1Ph	10.4	10.4	10.4	15.6	15.6	15.6
Amp required @400V 60Hz 3Ph	8	8	8	12	12	12
Overall Dimensions LxWxH in. (cm)	15 x 37 x 26 (38x94x66)	15 x 37 x 26 (38x94x66)	15 x 37 x 26 (38x94x66)	15 x 51 x26 (38x130x66)	15 x 51 x26 (38x130x66)	15 x 51 x 26 (38x130x66)
Inlet and exhaust connection	NW25	NW25	NW25	NW25	NW25	NW25
Weight, lbs (kg)	216 (98)	216 (98)	216 (98)	308 (140)	308 (140)	308 (140)
Ordering Information						
230V 50/60Hz 1Ph	2614C-01	2624C-01	2634C-01	2616C-01	2626C-01	2636C-01

## PORTABLE HIGH VACUUM ROUGHING PUMP

- High vacuum to < 0.003 torr
- Isolation device protects samples & system
- Portable, compact pump

Direct Drive High Vacuum Pump is effective for roughing vacuum chambers to < 0.003 torr. The pump is also effective for roughing annular spaces and transfer lines to a deep vacuum. Various models have flow from 73 to 320 l/min. Pumps are compact and transportable. The optional exhaust filter is recommended for elimination of oil mist during high vacuum roughing applications. See p. 43 for the correct exhaust filter for your model.



Model 8912A

Specifications & Ordering - Page 30

### Application Note | Roughing Vacuum Chambers

Evacuation of chambers, annular spaces and transfer lines is common in material science, physics and physical chemistry labs. These vacuum tight spaces are evacuated to provide insulation, roughing out the volume prior to using a turbomolecular pump, cryopump regeneration, etc. The depth of vacuum and size of the space determines what type and size of pump is needed.

A dry pump with a pumping capacity of 100 l/min. can be used to evacuate 840 liters volume (0.84 cubic meters) in a reasonable time. High vacuum pumps based on oil sealed rotary vane technology use the rule of thumb of 1 to 1.5 times the volume of space to determine pumping capacity (300 liters volume needs a 300 to 350 l/min. pump). The reason for the differing rule on oil sealed pumps is that the evacuation needs to be below 10 torr in less than 10-15 minutes to avoid poor lubrication and overheating the internal pumping mechanism. Oil-free piston pumps don't overheat while evacuating larger chambers, however the time to maximum vacuum takes longer the smaller the pumping capacity.

## OIL-FREE INDUSTRIAL VACUUM SYSTEMS

- Instant vacuum availability
- Pump is tolerant of line moisture

Use this durable 10 gallon vacuum tank system for smooth operation of light industrial processes. Mounted WOB-L<sup>®</sup> piston pump provides powerful vacuum (to 27.6" Hg). Moisture tolerance is far superior to that of dry graphite vane vacuum pumps.

System includes ASME code receiver, vacuum gauge, exhaust muffler and manual shutoff valve. The three position switch allows for on/off continuous duty or automatic on/off at a set vacuum level. 115V, 6 ft. power cord, shipped fully assembled.



Model 8150B-30

Specifications & Ordering See Below

### Applications

- Pick and Place operations
- Small scale vacuum forming
- Vacuum chucking

### Specifications and Ordering Information

Free Air Displacement, CFM	Maximum Vacuum, in. Hg	Motor HP	Tubing, ID"	Inlet/ Outlet connections, in. FNPT	Tank volume, gal.	Weight, lbs	Dimensions, LxWxH"	Model
7.1	27.6	1/3	1/4	1/4	10	64	30 x 11 x 23	8150B-30

## VACUUM PUMP FOR ASPHALT ANALYSIS

- Powerful Vacuum for Multiple Test Stations
- Perfect for Rice Test

Use these powerful WOB-L<sup>®</sup> Piston pumps for determination of maximum theoretical gravity for bituminous paving mixtures (Rice Test). For use in ASTM D2041 and AASHTO T-209 analysis.

Oil-free vacuum pump 2562B-01 pulls down to maximum 7.5 mm Hg (7.5 torr) with flow of 2.3 CFM (65 l/min). Portable 2-stage pump is resistant to water vapor, includes muffler and hose barb for 3/8" ID Tubing. Pump should be purged with air for 10 minutes following each test.



Model 2562B-01

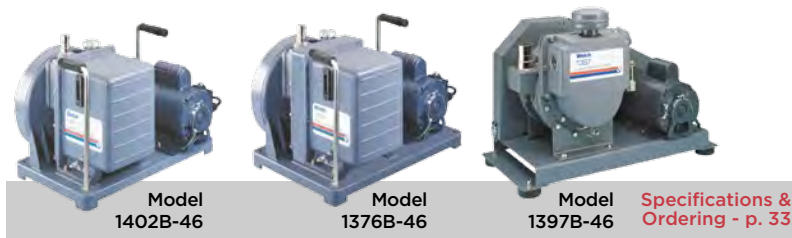
Specifications & Ordering - p. 29



## REFRIGERATION SERVICE

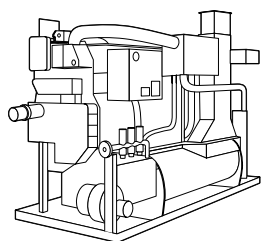
- Deep vacuum for fast evacuation and dehydration
- Precision machined from the most durable materials
- Gas ballast for high vapor loads

Select from DUOSEAL® and CHEMSTAR® models for top performance and minimum maintenance or direct drive models for portable vacuum power. The low pump RPM insures long service life and the large oil reservoir dilutes contaminants.



## LITHIUM BROMIDE ABSORPTION CHILLER

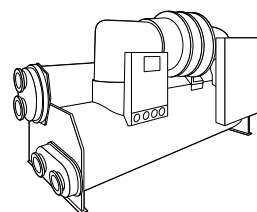
- Handles harsh salt-laden water vapor
- Withstands accidental ingestion of salt solution
- Recirculates clean fraction of vacuum oil
- Order CHEMSTAR model for maximum corrosion resistance



Tonnage	DuoSeal	ChemStar
100-500	1402B-46	1402N-01
500-	1402B-46,	1376N-01
1000	1376B-46	
1000-	1376B-46,	1376N-01
1500	1397B-46	

## HCFC, CFC OR AMMONIA CHILLER

- Seals and gaskets won't break down in the presence of R-11, R-12, R-13, R-22, R-113, R-123, R-114, R-502, R-503 or ammonia
- Draws a very deep vacuum
- Order CHEMSTAR pump for highly corrosive systems



Tonnage	DuoSeal	ChemStar
10-50	1402B-46	1402N-01
50-500	1402B-46,	1376N-01
	1376B-46	
500-	1397B-46	1376N-01
1000		

## REFRIGERANT RECOVERY / TRANSFER

- Continuous discharge pressure to 30 PSIG (3.1 x 10<sup>5</sup> Pascal)
- Pump shell rated to 100 PSIG (7.9 x 10<sup>5</sup> Pascal)
- Minimal loss of pumping efficiency below 29.9" Hg, (1,000 microns Hg, 1 torr, 1 mbar)

The CAPTURE™ pump has been specifically designed for recovery and recycling systems that evacuate refrigerant systems to greater than 29.9" Hg(1 torr, 1 mbar) and boost refrigerant vapor to a holding tank.

The recovery and recycling systems employing a CAPTURE pump transfer discharge pressure is up to 30 PSIG are built for evacuation of R-11, R-113 and R-123 chillers. The pump design has been in use in recovery and recycling systems for over 25 years.

Pump oil separation and return is accomplished by attaching a standard float actuated oil return found in refrigerators. The oil separator is a proven technology that minimizes pump oil loss even for very large refrigerant systems. DUOSEAL pump oil, cat. no. 1407K-11, is recommended lubricant to operate the CAPTURE pump.

For complete specifications and ordering information, see p. 33.



Specifications				
Vapor Pump Rate, CPM	Ultimate Vacuum Millitorr, Hg	Maximum Discharge Pressure, PSIG	Oil Capacity, Quarts	
10.6	30	30	2.5	

# PTFE Dry Vacuum Pumps | Moderate Vacuum

All Pumps are constructed with PTFE heads, perfluoroelastomer valves, and a PTFE coated, molded diaphragm. Includes intake/exhaust hose barbs. DRYFAST® and DRYFAST® ULTRA models include tunable vacuum control. General Purpose pumps include exhaust silencer.



Model 2019

Model 2014

Models 2034 / 2044 / 2037 / 2047 DRYFAST®



## Specifications

## WELCH DryFast Pumps

Model	2019	2014	2034	2044	2037	2047
Free Air Displacement cfm(l/min.) @60Hz	1.3 (37)	1.2 (35)	0.9 (25)	1.2 (35)	1.8 (50)	2.5 (70)
m <sup>3</sup> /hr(l/min.) @50Hz	1.9 (31)	1.75 (29)	1.25 (21)	1.75 (29)	2.5 (42)	3.5 (58)
Ult. Vac. Pressure, torr(mbar)	150 (200)	40 (53)	9 (12)	9 (12)	35 (47)	35 (47)
Maximum Vacuum, in. Hg	24	28.3	29.6	29.6	28.5	28.5
Motor Horsepower - HP(watts)	1/15	1/5 (150)	1/5 (150)	1/5 (150)	1/5 (150)	1/5 (150)
Adjustable Vac./Gas Ballast		Yes	Yes	Yes	Yes	Yes
Tubing Needed, I.D. in.(mm)	1/4 (7)	1/4 (7)	1/4 (7)	1/4 (7)	1/4 (7)	1/4 (7)
Intake(Exhaust) Thread NPT		M14 (1/8)	M14 (1/8)	M14 (1/8)	M14 (1/8)	M14 (1/8)
Weight lbs.(kg)	10.2 (4.6)	15.0 (6.8)	21.25 (9.6)	21.25 (9.6)	21.25 (9.6)	21.25 (9.6)
Overall Dimensions LxWxH in.(cm)	8.8x5.0x8.8 (22.4x12.7x22.4)	12x7.0x8.3 (30.5x17.8x21.1)	13.8x6.8x8.8 (35.2x7.2x22.3)	13.8x6.8x8.8 (35.2x7.2x22.3)	13.8x6.8x8.8 (35.2x7.2x22.3)	13.8x6.8x8.8 (35.2x7.2x22.3)
Ship Weight, lbs.(kg)	10.2 (4.6)	19 (8.6)	25 (11.3)	25 (11.3)	25 (11.3)	25 (11.3)
Shipping Carton Dimensions LxWxH in.(cm)	16x12x12.8 (41x30x33)	21x14x15 (52x35x37)	21x14x15 (52x35x37)	21x14x15 (52x35x37)	21x14x15 (52x35x37)	21x14x15 (52x35x37)

## Ordering Information

Wired for 115V, 60Hz, 1 Ph with N. Amer. 115V Plug	2019B-01	2014B-01	2034B-01	2044B-01	2037B-01	2047B-01
Wired for 230V, 50/60Hz, 1Ph, w/ UK and Schuko cord sets included <sup>1</sup>	2019C-02	2014C-02	2034C-02	2044C-02	2037C-02	2047C-02
Wired for 100V, 50/60Hz for Japan	----	2014C-05	2034C-05	2044C-05	---	---

<sup>1</sup> 230V in US also requires Cord 61-8707

## Applications

	page
1. Rotary Evaporation	2 - 6
2. Vacuum Filtration	6, 17
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4. Aspiration / Automation	18
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6. Centrifugal Concentrators	10
7. Distillation	2 - 6
8. Degassing	15

### PTFE Dry Vacuum Pumps

- Chemical Resistant
- Oil Free

Use PTFE Vacuum Pumps for applications generating harsh chemical vapors. All vapor contact surfaces are PTFE/fluorinated plastic for maximum chemical resistance.

Model 2019 Filtrations of moderate solvents.

DRYFAST® Advanced diaphragm pumps provide full chemical resistance and tunable vacuum. Includes hose barb connections.

WELCH High Capacity High flow diaphragm pumps are designed for scale-up operations.

See PTFE Applications for Pump Selection.





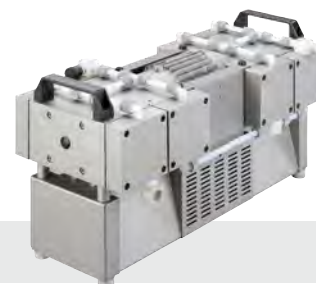
# PTFE Dry Vacuum Pumps | High Vacuum



**Models**  
2032 / 2042  
DRYFAST<sup>®</sup> Ultra



**Models**  
2052 / 2054



**Models**  
2062 / 2064 / 2067

WELCH High Capacity			WELCH DryFast Ultra Pumps - High Vacuum		WELCH High Capacity - High Vacuum	
2054	2064	2067	2032	2042	2052	2062
3.4 (100)	6.1 (173)	7.8 (221)	0.9 (25)	1.2 (35)	2.3 (65)	4.2 (119)
----	----	----	1.25 (21)	1.75 (29)	----	----
6 (8)	6 (8)	56 (75)	2 (2.7)	2 (2.7)	1.5 (2)	1.5 (2)
29.7	29.7	27.72	29.85	29.85	29.9	29.9
1/2 (370)	0.5/0.6 (370/440)	0.5/0.6 (370/440)	1/5 (150)	1/5 (150)	0.53 (390)	0.53 (370)
No	No	No	Yes	Yes	No	No
1/4 (8)	hose connector available	hose connector available	1/4 (7)	1/4 (7)	1/4 (8)	1/4 (8)
NW 16 - 1/4" NPT <sup>2</sup>	NW 16 - 1/4" NPT <sup>2</sup>	NW 16 - 1/4" NPT <sup>2</sup>	M14(1/8)	M14(1/8)	NW 16 - 1/4" NPT	NW 16 - 1/4" NPT
40.3 (18.3)	72.3 (32.8)	72.3 (32.8)	21.25 (9.6)	21.25 (9.6)	40.3 (18.3)	72.3 (32.8)
9x15x7 (22.8x38.1x17.8)	21x11x12 (53.3x27.9x30.5)	21x11x12 (53.3x27.9x30.5)	13.8x6.8x8.8 (35.2x7.2x22.3)	13.8x6.8x8.8 (35.2x7.2x22.3)	9x15x7 (22.8x38.1x17.8)	21x11x12 (53.3x27.9x30.5)
48.5 (22)	88.2 (40.1)	88.2 (40.1)	25 (11.3)	25 (11.3)	49.8 (22.6)	40.3 (18.3)
18.9x12.6x11.8 (48x32x30)	23.6x15.8x16.1 (60x40x41)	23.6x15.8x16.1 (60x40x41)	21x14x15 (52x35x37)	21x14x15 (52x35x37)	10.2x16.6x7.5 (26x42x19)	9.1x15x6.7 (23x38x16.9)
2054B-01	2064B-01	2076B-01	2032B-01	2042B-01	2052B-01	2062B-01
----	----	----	2032C-02	2042C-02	----	----
----	----	----	2032C-05	2042C-05	----	----

<sup>2</sup> For 8 mm Hose Barb, Order 710798

## For a Complete System

Component	page
• Traps	39
• CAPTURE Recovery System	6
• Inlet / Exhaust Accessories	39, 40
• Fittings / Hose	37, 38
• Gauges	41
• Regulators / Controllers	43
• Service Kits	44, 45

**Inlet/Exhaust Separator Jars**  
230 ml glass jar assembly attaches to pump intake or exhaust to capture ingested liquids.

See page 39 for replacement Jars.



**1423B**

Pump Model	CAT. No.
All DryFast models	1423B

### 1640 LabAid - Vacuum Controller

- Rack mountable
- Variable valve control
- Works with any vacuum pump

The LabAid Programmable Vacuum Controller automates Welch DryFast™ pumps or any brand dry pump with flow up to 70 l/min torr vacuum ranging from 1 torr to atmosphere. See p. 43 for more information.



# PTFE Dry Vacuum Systems | Self-Cleaning



**Model  
2025**



**Model  
2026**



**Model  
2027**



**Model  
2028**

## Specifications

## WELCH Self-Cleaning Dry Vacuum Systems

Model	w/Analog Gauge <b>2025</b>	w/Analog Gauge <b>2026</b>	w/Digital Gauge <b>2027</b>	Programmable w/Digital Gauge <b>2028</b>
Free Air Displacement cfm(l/min.) @60Hz	1.2 (35)	1.2 (35)	1.2 (35)	1.2 (35)
m <sup>3</sup> /hr(l/min.) @50Hz	1.7 (29)	1.7 (29)	1.7 (29)	1.7 (29)
Ult. Vac. Pressure, torr(mbar)	9 (12)	2 (2.7)	2 (2.7)	2 (2.7)
Maximum Vacuum, in. Hg	29.6	29.85	29.85	29.85
Tubing Needed, I.D. in.(mm)	1/4 (7)	1/4 (7)	1/4 (7)	1/4 (7)
Motor Horsepower(watts)	1/5 (150)	1/5 (150)	1/5 (150)	1/5 (150)
Adjustable Vac./Gas Ballast	Yes	Yes	Yes	Yes
Intake(Exhaust) Thread NPT	3/8	3/8	3/8	3/8
Weight lbs.(kg)	30 (13.6)	30 (13.6)	30 (13.6)	30 (13.6)
Overall Dimensions LxWxH in.(cm)	13.6x12x11.3 (34.5x30.5x28.7)	13.6x12x11.3 (34.5x30.5x28.7)	13.6x12x11.3 (34.5x30.5x28.7)	13.6x12x11.3 (34.5x30.5x28.7)
Ship Weight, lbs.(kg)	36 (16.4)	36 (16.4)	36 (16.4)	36 (16.4)
Shipping Carton Dimensions LxWxH in.(cm)	18x17x17 (46x42x43)	18x17x17 (46x42x43)	18x17x17 (46x42x43)	18x17x17 (46x42x43)

## Ordering Information

Wired for 115V, 60Hz, 1 Ph with N. Amer. 115V Plug	202501	202601	202701	202801
Wired for 230V, 50/60Hz, 1Ph, w/ UK and Schuko cord sets included	202503	---	202703	202803
Wired for 100V, 50/60Hz for Japan	202505	---	202705	202805

## Applications

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5. Distillation	2 - 6

### Self-Cleaning Dry Vacuum Systems

These chemical duty dry diaphragm pumping systems are typically used in evaporation applications, e.g. rotavaps. Self-cleaning air purge cycle at the conclusion of each run maintains consistent performance and extends service intervals. Dial up vacuum control and a handy switch for instant reaction to bumping / foaming conditions. Rugged PTFE construction of all contact surfaces.

See page 2 for description of each model.

**Green  
By Design**

CAPTURE™ vapor emissions from rotary evaporators with an integrated solvent recovery system - see p. 40



# Laboratory Vacuum Systems | Variable Speed, On-Demand



Model 2200

Model 2210

Model 2220

Model 2230

Model 2115

Model 2120



Specifications Variable Speed / Vacuum Evaporation Systems On Demand Laboratory Modular Vacuum Systems

Model	2200	2210	2220	2230	2115	2120
Number of heads/stages	4/3	4/3	4/3	8/3	4/2	4/3
Free Air Displacement <sup>1</sup> cfm(l/min.) @60Hz	0.6 (16)	1.3 (36)	2.9 (81)	5.3 (151)	1.2 (35)	2.3 (65)
Ultimate Pressure, torr(mbar)	1.5 (2)	1.5 (2)	1.5 (2)	1.5 (2)	6 (8)	1.5 (2)
Maximum Vacuum, in. Hg	29.9	29.9	29.9	29.4	29.7	29.9
Tubing Needed, I.D. in.(mm)	1/4 (8)	1/4 (8)	1/4 (8)	1/4 (8)	1/4 (8)	1/4 (8)
Motor Horsepower(watts)		1/8 (90)	1/2 (370)	1/2 (370)	1/2 (370)	1/2 (370)
Adjustable Vac./Gas Ballast	yes	yes	yes	yes	yes	yes
Intake(Exhaust) Thread NPT	1/4 (G8)	1/4 (G8)	1/4 (G8)	1/4 (G8)	1/4 (G8)	1/4 (G8)
Weight lbs.(kg)	20.9(9.5)	41.9(19.0)	59.1(26.8)	75(34)	36.8(17.5)	54.5(24.7)
Overall Dimensions LxWxH in.(cm)	10x10.2x17 (25x26x43.5)	13.8x12.6x16 (35x32x44)	13.8x12.6x16 (35x32x44)	21.2x13x18 (54x33x46)	13.8x12.6x16 (35x32x44)	13.8x12.6x16 (35x32x44)
Ship Weight, lbs.(kg)	35 (16)	55 (25)	66 (30)	81(37)	46 (21)	62 (28)
Shipping Carton Dimensions LxWxH in.(cm)	21x16x23 (60x40x58)	31x24x30 (80x60x77)	21x16x23 (60x40x58)	24x16x16 (60x40x41)	21x16x23 (60x40x58)	21x16x23 (60x40x58)

Ordering Information

115V, 50/60Hz, 1 Ph <sup>2</sup>	2200B-01	2210B-01	2220B-01	2230B-01	2115B-01	2120B-01
----------------------------------	----------	----------	----------	----------	----------	----------

For a Complete System

Component	page
• Traps	39
• CAPTURE™ Recovery System	6
• Inlet / Exhaust Separator	39, 40
• Fittings / Hose	37-39
• Gauges	41, 42
• Regulators	42
• Service Kits	44, 45

Notes:

- Free air displacement at maximum rpm.
- Every Laboratory Vacuum System is supplied with integrated Chemical Duty Diaphragm Pump and vacuum control module. Standard with 115V US plug lead and DN 8 hose connector. Comes pre-assembled and ready to use.

Contact Welch for vacuum control package and capture solvent recovery system configurations to meet your specific requirements.

Laboratory Vacuum Systems

Auto-Sensing Rotary Evaporation Systems (Variable Speed)

These chemical duty dry diaphragm vacuum pump systems provide simple access to solvent stripping control. Using either auto-sensing control of boiling points or the solvent library for reference, these electronically controlled units use variable pumping speed control to provide the correct vacuum at all times. Vapor contact surfaces are highly chemical resistant (e.g. PTFE). Solvent vapors are captured in the inlet trap vessel or the outlet water cooled condenser. See p. 3.

On-Demand Vacuum Systems

PTFE vacuum pump systems only activate in response to vacuum demand. See p. 21 for details.

# Standard Duty Dry Vacuum Pumps | WOB-L Piston



**Model  
2511**



**Models  
2522 / 2534**



**Model  
2546**



**Models  
2567 / 2561**



**Model  
2562B-01**



## Specifications

## Vacuum/Pressure Pumps

Model	2511	2522	2534	2546	2561
Free Air Displacement					
cfm (l/min.)@60Hz	0.39 (11)	0.76 (22)	1.2 (34)	1.6 (45)	2.3 (65)
m <sup>3</sup> /hr (l/min.)@50Hz	0.55 (9.2)	1.1 (18)	1.7 (28)	2.3 (38)	3.4 (57)
Ult. Vac. Pressure, torr(mbar)	219 (292)	100 (133)	70 (93)	60 (80)	5 (6.7)
Max Pressure PSIG(pascal)	33 (3.3 x 105)	100 (106)	50 (5 x 105)	100 (106)	---
Maximum Vacuum, in. Hg	21.3	26	27.2	27.6	29.8
Motor Horsepower(watts)	1/30 (25)	1/8 (93)	1/8 (93)	1/4 (190)	1/3 (250)
Tubing Needed, I.D. in.(mm)	3/16 (5)	3/16 (5)	3/16 (5)	3/16 (5)	1/4 (7)
Intake/Exhaust Thread NPT	3/16 in. Hose	1/4	1/4	1/4	1/4
Weight lbs.(kg)	5 (2.3)	11.7 (5.3)	11.7 (5.3)	13.8 (6.3)	16.5 (7.5)
Overall Dimensions L x W x H in.(cm)	7.6x4.5x7.5 (19.4x11.4x19.1)	8.1x8.8x10 (20.6x22.4x25.4)	8.1x8.8x10 (20.6x22.4x25.4)	10x7.5x9 (25.4x19.1x7.7)	17.3x6.5x10.5 (43.9x16.5x26.7)
Ship Weight, lbs.(kg)	6 (2.7)	17 (7.7)	17 (7.7)	17 (7.7)	24 (10.9)
Shipping Carton Dimensions L x W x H in.(cm)	11x7x8.3 (28x18x21)	15.3x12.3x12.7 (39x31x32)	15.3x12.3x12.7 (39x31x32)	15.3x12.3x12.7 (39x31x32)	21x12x15 (53x30x38)

## Ordering Information

Wired for 115V, 60Hz, 1 Ph with N. American 115V Plug	2511B-01 <sup>3</sup>	2522B-01 <sup>4</sup>	2534B-01 <sup>4</sup>	2546B-01 <sup>4</sup>	2561B-50
Wired for 230V, 60Hz, 1 Ph with N. American 230V Plug	---	2522C-01 <sup>4</sup>	2534C-01 <sup>4,7</sup>	2546C-01 <sup>4,7</sup>	---
Wired for 230V, 50Hz, 1 Ph2. with Cont. Euro.(Schuko) Plug	2511C-02 <sup>3</sup>	2522C-02 <sup>4,6</sup>	2534C-02 <sup>4,6,7</sup>	2546C-02 <sup>4,6,7</sup>	2561C-50 <sup>6,7</sup>
Wired for 100V, 50/60Hz, 1 Ph with a plug	2511C-05 <sup>3,5</sup>	2522C-05 <sup>4,5</sup>	---	---	2561C-56

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### Vacuum/Pressure Standard Duty Dry Vacuum Pumps

- Ultimate to <5 torr (6.7mbar)
- Lightweight, compact pump
- Inlet liquid trap with vacuum regulator

Oil-free operation for reduced maintenance. Welch Standard Duty Dry pumps are ideal for pumping water vapor. These WOB-L piston pumps have a high water vapor tolerance. Pumps come with inlet liquid trap, mounted vacuum gauge and vacuum regulator (except 2511 and 2562).

Note: Standard Duty Dry Pumps are not recommended for pumping organic, acidic and basic vapors.



**Model  
2585B-01**

# Standard Duty Dry Vacuum Pumps | WOB-L Piston, GEMINI



**Models**  
2585 / 2581



**Model**  
2511B-75



**Model**  
2515B-75



**Model**  
2050



**Model**  
2060

Standard Duty Vacuum Pumps				Aspiration/Filtration Systems		GEMINI	
2562	2567	2581	2585	2511	2515	2050	2060
2.3 (65)	3.5 (100)	3.5 (100)	7.1 (201)	0.39 (11)	1.2 (34)	0.3 (13)	0.46 (13)
3.4 (57)	4.9 (83)	4.9 (83)	10 (168)	0.55 (9.2)	1.7 (28)	---	---
7.5 (10)	60 (80)	5 (6.7)	60 (80)	219 (292)	70 (93)	190 (256)	200 (266)
---	---	---	---	33 (3.3 x 10 <sup>5</sup> )	---	---	---
29.6	27.6	29.8	27.6	21.3	27.2	22.4	22.0
1/3 (250)	1/3 (250)	1/3 (250)	1/3 (250)	1/30 (25)	1/8 (93)	---	---
3/8 (10)	1/4 (7)	1/4 (7)	1/4 (7)	3/16 (5)	3/16 (5)	3/8 (10)	3/8 (10)
3/8	1/4	1/4	1/4	3/16 in. Hose	1/4	---	---
16.5 (7.5)	16.5 (7.5)	24.5 (11.1)	24.5 (11.1)	5.7 (2.6)	13.2 (6.0)	5.3 (2.4)	11 (6)
17.0x7.5x12 (43.2x19.1x30.5)	15.0x10x10 (38.1x25.4x25.4)	17x7.5x12 (43.2x42.3x19.1)	17x7.5x12 (43.2x42.3x19.1)	11.0x8.3x10.0 (28x21x25.5)	14.8x8.3x10.0 (37.5x21x25.5)	7.6x4.5x7.5 (19.4x11.4x19.1)	9.25x7.25x8.5 (23.5x18.4x21.6)
24 (10.9)	24 (10.9)	32 (14.5)	32 (14.5)	11.0 (5)	14.8 (6.7)	7 (3.2)	13 (2.9)
21.5x12.5x16 (55x32x31)	21x12x15 (53x30x38)	21x12x15 (53x30x38)	21x12x15 (53x30x38)	15.3x12.3x12.7 (39x31x32)	21x12x15 (53x30x38)	15.3x12.3x12.7 (39x31x32)	21x12x15 (53x30x38)
2562B-01	2567B-50	2581B-50	2585B-50	2511B-75	2515B-75	2050B-01 <sup>8</sup>	2060B-01 <sup>8</sup>
---	---	---	---	---	---	---	---
---	2567C-50 <sup>6,7</sup>	2581C-50 <sup>6,7</sup>	2585C-50 <sup>6,7</sup>	2511C-75 <sup>6,7</sup>	2515C-75 <sup>6,7</sup>	2050C-02 <sup>2</sup>	2050C-02 <sup>2</sup>
---	---	---	---	2511C-76 <sup>5</sup>	2515C-76	---	---

## For a Complete System

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### Notes:

- All models are recommended for pumping vapors of aqueous solutions including buffers but not for acidic, basic or organic vapors or gases.
- Units supplied with CE marking.
- Model 2511 can deliver 33 PSIG (3.3 x 10<sup>5</sup> pascal).
- Models 2522, 2534 and 2546 come with vacuum (and pressure) regulator, vacuum (and pressure) gauge, silencer and water trap. Models 2522 and 2546 can deliver 100 PSIG (10<sup>6</sup> pascal). Model 2534 can deliver 50 PSIG (5 x 10<sup>5</sup> pascal).
- Comes with PSE mark.
- Included is UK and Schuko cord sets.
- Motor can operate at 230V, 50/60Hz, 1Ph.
- Models 2050B-01 and 2060B-01 include N. America, UK and Schuko power plug adapters for use in non-CE countries which require UK or Schuko plugs.

### Aspiration / Filtration Systems

Systems collect waste into 1.2 Liter autoclaveable reservoir. Both models enable vacuum measurement and regulation. Reservoirs are protected from overflow by float valve; inlet line hydrophobic filter further protects pump. Includes 6 ft. tubing and 2 filters. See p. 8 & 9 for more information and handy accessories.

### GEMINI Vacuum Pumps

These go-anywhere diaphragm vacuum pumps are powered by 12V DC motors. Comes with 12V adapter for auto / truck power source and 120VAC adapter for lab usage. Model 2060 has gauge / vacuum adjustment knob.

# Direct Drive Vacuum Pumps | Rotary Vane



Model  
8890

Model  
8905

Model  
8910

Models  
8907 / 8912 / 8917

Model  
8920



## Specifications

## WELCH Two Stage Pumps

Model	8890	8905	8910	8907	8912	8917
Free Air Displacement cfm (l/min.) @60 Hz	1.1 (31)	1.8 (51)	3.8 (108)	2.6 (73)	3.8(108)	6.1 (173)
m <sup>3</sup> /hr (l/min.) @50 Hz	1.6 (26)	2.6 (43)	5.4 (90)	3.7 (61)	5.4 (90)	8.6 (144)
Ult. Vac. Pressure, torr(mbar)	1 x 10 <sup>-1</sup> (0.133)	2 x 10 <sup>-3</sup> (0.0027)	3x10 <sup>-3</sup> (0.004)	1x10 <sup>-4</sup> (0.00013)	1x10 <sup>-4</sup> (0.00013)	1x10 <sup>-4</sup> (0.00013)
Sound Level, dBA	58	52	52	50	50	50
Motor/Pump Speed (60 Hz)	3450	3450	3450	1725	1725	1725
Motor Horsepower (watts)	1/4 (190)	1/4 (190)	1/4 (190)	1/2 (370)	1/2 (370)	1/2 (370)
Oil Capacity, qt.(liters)	0.48 (0.45)	0.42 (0.4)	0.48 (0.45)	1.0 (0.95)	0.9 (0.86)	0.9 (0.86)
Tubing Needed, I.D. in.(mm)	3/8 (10)	3/16, 7/16 (5, 11)	7/16	7/16, 3/4 (11, 20)	7/16, 3/4 (11, 20)	7/16, 3/4 (11, 20)
Intake Connection(thread) <sup>2</sup>	Barb (1/4 in NPT)	UNIBARB (3/4-20)	NW 16	UNIBARB (1 1/8-20)	UNIBARB (1 1/8-20)	UNIBARB (1 1/8-20)
Exhaust Connection	3/4-20	3/4-20	Threaded 3/4-20	1-20	1-20	1-20
Exhaust Filter Included	Yes <sup>6</sup>	No	No	No	No	No
Weight, lbs.(kg)	24.5 (11.1)	24.5 (11.1)	224.5 (11.1)	40 (18)	41 (18)	43 (19.5)
Overall Dimensions LxWxH in.(cm)	14.5x5.1x8.4 (36.8x13x21.3)	14.5x5.1x8.4 (36.8x13x21.3)	14.5x5.1x26 (36.8x13x11.8)	18.5x6.5x9.6 (47.1x16.5x24.3)	18.5x6.5x9.6 (47.1x16.5x24.3)	18.5x6.5x9.6 (47.1x16.5x24.3)
Ship Weight, lbs.(kg)	33 (15)	33 (15)	26 (11.8)	55 (25)	55 (25)	60 (27.3)
Shipping Carton Dimensions LxWxH in.(cm)	21.5x12.5x16 (54.6x31.8x40.6)	21.5x12.5x16 (54.6x31.8x40.6)	221x6.5x11.25 (53.3x16.5x28.6)	24x15.8x14 (61x40.1x35.6)	24x15.8x14 (61x40.1x35.6)	24x15.8x14 (61x40.1x35.6)

## Ordering Information

Wired for 115V, 60Hz, 1 Ph with N. American 115V Plug <sup>3,4</sup>	8890A	8905A	8910A	8907A	8912A	8917A
Wired for 230V, 50Hz, 1 Ph with Cont. Euro. (Schuko) Plug <sup>3,5</sup>	8890C-02	8905C-02	8910C-02	8907C-02	8912C-02	8917C-02
Wired for 230V, 60Hz with N. American 230V Plug <sup>3,4</sup>	---	---	8910C-01	---	8912C-01	8917C-01
Expl. Proof Motor 115V, 60Hz <sup>3,4</sup>	---	---	---	---	---	8917W

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Also commonly used in OEM instrumentation and high vacuum backing pump applications

### Compact for Moving From Lab to Lab

- Lightweight, compact pump
- Ultimate to <0.003 torr (0.004mbar)
- Integral isolation valve



Model  
8907A

Welch Direct-Drive Vacuum Pumps are portable high performance oil-seal pumps. These pumps come with isolation devices integral to the pump to prevent oil and air contamination of your system in the event of a power failure. Pump can be ordered with an optional exhaust filter (see p. 31) to control exhaust oil mist.

### Notes:

1. Only Model 8890 should be operated continuously at pressures above 10 torr. Ultimate Pressure measured with a trapped McCleod gauge.
2. UNIBARB™ inlet barb connections accepts two sets of tubing ID (see p. 37)
3. All single phase motors have overload protection.
4. 115V, 60Hz models are CSA approved.
5. 230V, 50 Hz models are provided w/ CE mark.
6. CAT. No. 1416B Exhaust Oil Recycler is recommended when operating GEM Model 8890 at pressures of 1 torr or higher.





**Model 8925**



**Model 890A-70**



**Model 8917A-80**



**Model 8960**



**Models 8965/8970**

WELCH Special Application Systems				WELCH Chemvac		
8920	8925	Rotovap Pump	Freeze Dryer Pump	8960	8965	8970
7.7 (218)	11.3 (320)	1.1 (31)	6.1 (173)	6.6 (110)	13.2 (220)	25.2 (420)
10.9 (182)	16 (267)	1.6 (26)	8.6 (144)	5.8 (97)	11.0 (183)	21.0 (350)
$3 \times 10^{-4}$ (0.0004)	$4 \times 10^{-4}$ (0.00053)	$1 \times 10^{-1}$ (0.133)	$1 \times 10^{-4}$ (0.00013)	$2 \times 10^{-3}$ (0.0015)	$2 \times 10^{-3}$ (0.0015)	$2 \times 10^{-3}$ (0.0015)
54	55	58	50	50	50	50
1725	1725	3450	1725	1740	1680	1680
3/4 (560)	3/4 (560)	1/4 (190)	1/2 (370)	400 (.54 HP)	900 (1.21 HP)	900 (1.21 HP)
1.3 (1.2)	1.2 (1.1)	0.48 (0.45)	1.4 (1.3)	0.58 (0.55)	1.06 (1)	0.87 (0.82)
9/16, 3/4 (14, 20)	9/16, 3/4 (14, 20)	3/8 (10)	7/16, 3/4 (11, 20)	0.75 (19)	0.75 (19)	0.75 (19)
UNIBARB (1 1/8-20)	UNIBARB (1 1/8-20)	Barb (1/4 in NPT)	UNIBARB (1 1/8-20)	NW 16	NW 25	NW 25
1-20	1-20	3/4-20	1-20	25.5 kg	42.5 kg	46.0 kg
No	No	Oil Recycler	Yes	Yes	Yes	Yes
58.5 (26.6)	69 (31.3)	27.5 (12.5)	55 (25)	56 (25.5)	94 (42.5)	101 (46)
20.5x7.1x10.7 (52.1x17.9x27.2)	21.2x7.1x10.7 (53.817.9x27.2)	14.5x5.1x14.3 (36.8x13x36.3)	18.6x11.5x9.6 (47.2x29.2x24.4)	19.7x13.0x13.4 (50x33x34)	23.2x13.6x16.5 (59x34.5x42)	23.2x13.6x16.5 (59x34.5x42)
71 (32.3)	74 (33.6)	37 (16.8)	70 (31.8)	100 (45.3)	116 (52.6)	124 (56.1)
24x15.8x14 (61x40.1x35.6)	24x15.8x14 (61x40.1x35.6)	21.5x12.5x16 (54.6x31.8x40.6)	25x18.5x14 (63.5x47x35.6)	65x41x48 (25.6x16.1x19)	65x41x48 (25.6x16.1x19)	65x41x48 (25.6x16.1x19)
8920A	8925A	8890A-70	8917A-80	8960A	---	---
8920C-02	8925C-02	8890C-72	8917C-80	---	---	---
8920C-01	8925C-01	---	---	8960C-01	8965C-01	8970C-01
---	8925W	---	---	---	---	---

## For a Complete System

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### Exhaust Filter

A replaceable filter element captures oil mist from the exhaust port of the pump and reduces pump noise.

Pump Model	CAT. No.
8890, 8905	1417
8907	1417P-7
8920, 8925, 8912, 8917	1417P-10



(See p. 40 for a complete list of filters)

### Premium Vacuum Pump Oil

Higher viscosity formula that resists breakdown at higher RPM and temperatures of direct drive vacuum pumps.

Size	CAT. No.
Quart	8995P-11
Gallon	8995P-15
5 Gallon	8995P-20



# Rugged Belt Drive Vacuum Pumps | DUOSEAL®



Model  
1400



Models  
1405 / 1402



Model  
1376



Models  
1397 / 1374



## Specifications

## Two-Stage Vacuum Pumps

Model	1400	1405	1402	1376	1397	1374
Free Air Displacement						
cfm	0.9	3.2	5.6	10.6	17.7	23
l/min.	25	90	160	300	500	650
Ult. Vac. Pressure, torr (mbar) <sup>1,2</sup>	$1 \times 10^{-4}$ (0.00013)	$1 \times 10^{-4}$ (0.00013)	$1 \times 10^{-4}$ (0.00013)	$1 \times 10^{-4}$ (0.00013)	$1 \times 10^{-4}$ (0.00013)	$1 \times 10^{-4}$ (0.00013)
Gas Ballast	Yes	Yes	Yes	Yes	Yes	Yes
Discharge Pressure (PSIG)	---	---	---	---	---	---
Pump RPM	580	525	525	525	400	510
Motor Horsepower (watts)	1/3 (250)	1/2 (370)	1/2 (370)	1 (750)	1 (750)	1-1/2 (1120)
Oil Capacity, qt.(liters)	0.62 (0.59)	2.25 (2.1)	2.25 (2.1)	2.5 (2.4)	1.25 (1.2)	1.25 (1.2)
Tubing Needed, I.D. in.	7/16 (11)	7/16 (11)	13/16 (21)	13/16 (21)	1-5/8 (41)	1-5/8 (41)
Intake, Nipple Thread	3/4-20	1-20	1-20	1-20	1.75-20	1.75-20
Exhaust, Thread Type	3/4-20	1-20	1-20	1-20	1.75-20	1.75-20
Weight, lbs. (kg)	58 (26)	112 (51)	112 (51)	156 (71)	205 (93)	220 (100)
Overall Dimensions LxWxH in.(cm)	17.8x9x12.6 (45.1x32.1x31.8)	20x12x15 (51x30.5x60)	20x12x15 (51x30.5x60)	20x14.1x15.4 (51x35.9x39)	26x13.7x18.8 (66x34.8x47.6)	26x13.7x18.8 (66x34.86x47.6)
Ship Weight, lbs. (kg)	70 (31.8)	132 (60)	132 (60)	180 (81.8)	213 (96.8)	215 (97.7)
Shipping Carton Dimensions LxWxH in.(cm)	20.5x13.8x14.5 (52.1x35.1x36.8)	22.5x15.5x19.5 (57.2x39.4x49.5)	22.5x15.5x19.5 (57.2x39.4x49.5)	22x18x19 (55.9x45.7x48.3)	27.3x18x22 (69.3x45.7x55.9)	27.3x18x22 (69.3x45.7x55.9)

## Ordering Information<sup>3,4</sup>

Wired for 115V, 60Hz, 1 Ph with N. American 115V Plug	1400B-01	1405B-01	1402B-01	1376B-01	1397B-01	1374B-01 <sup>5</sup>
Wired for 230V, 60Hz, 1 Ph with N. American 230V Plug	1400C-01	1405C-01	1402C-01	---	---	---
Wired for 220V, 50Hz, 1 Ph w/Cont. Euro. (Schuko) Plug	1400C-02	1405C-02	1402C-02	1376C-03	1397C-03	---
Explosion Proof Motor, 115V, 60 Hz	1400W-01	1405W-01	1402W-01	---	---	---
3-Phase Motor 230V, 460V, 60Hz	---	---	1402M-01	1376M-01	1397M-01	1374M-01

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### DuoSEAL Pumps

Rugged oil-seal pumps for a wide variety of vacuum needs, including Schlenk drying lines, freeze drying, degassing, concentrations, distillations, and more. Pulley drive enables low pump rpm operation - reduces friction, oil temperature, and oil degradation. Large oil reservoir minimizes contamination effects and extends maintenance intervals. Use of a cold trap is recommended to protect the pump and enhance vacuum levels.

### Refrigeration Servicing Pumps

Special Welch DuoSEAL pumps are fitted with componentry designed to withstand refrigerant contact. Models 1402B-46 and 1397B-46 include integrated handles.



### Notes:

- Two-stage pumps should not be operated continuously at pressures above 10 torr. Ultimate pressure measured with a trapped McCleod gauge.
- One-stage pumps should not be operated continuously at pressures above 50 torr.

# Rugged Belt Drive Vacuum Pumps | DuoSEAL<sup>®</sup>, CAPTURE



**Model  
1399N**



**Model  
1402B-46**



**Model  
1376B-46**



**Model  
CRR-1A**

One-Stage Vacuum Pumps w/o plate		One-Stage Vacuum Pumps w/bell jar plate	Refrigeration Servicing Pumps			CAPTURE Refrigerant Recovery
1399	1399N	1402B-46	1376B-46	1397B-46	CRR-1A	
1.2	1.2	5.6	10.6	17.7	10.6	
35	35	160	300	500	300	
$1.5 \times 10^{-2}$ (0.019)	$1.5 \times 10^{-2}$ (0.019)	$1 \times 10^{-4}$ (0.00013)	$1 \times 10^{-4}$ (0.00013)	$1 \times 10^{-4}$ (0.00013)	$3 \times 10^{-2}$ (0.04)	
No	No	Yes	Yes	Yes	---	
---	---	---	---	---	30	
750	750	525	525	400	525	
1/3 (250)	1/3 (250)	1/2 (370)	1 (750)	1 (750)	1 (750)	
0.5 (0.47)	0.5 (0.47)	2.25 (2.1)	2.5 (2.4)	1.25 (1.2)	2.5 (2.4)	
7/16 (11)	7/16 (11)	13/16 (21)	13/16 (21)	1-5/8 (41)	----	
3/4-20	3/4-20	1-20	1-20	1.75-20	1 NPT	
3/4-20	3/4-20	1-20	1-20	1.75-20	1 NPT	
51 (23)	63 (28.6)	112 (51)	156 (71)	205 (93)	122 (55.4)	
17x9x10 (43.x22.9x25.42)	17x9x10 (43.x22.9x25.42)	20x12x15 (51x30.5x60)	20x14.1x15.4 (51x35.9x39)	26x13.7x18.8 (66x34.8x47.6)	19.25x12.3x11.1 (48.9x31.3x28.1)	
62 (28.2)	74 (33.6)	132 (60)	180 (81.8)	213 (96.8)	136 (61.8)	
20.5x13.8x14.5 (52.1x35.1x36.8)	20.5x13.8x14.5 (52.1x35.1x36.8)	22.5x15.5x19.5 (57.2x39.4x49.5)	22x18x19 (55.9x45.7x48.3)	27.3x18x22 (69.3x45.7x55.9)	22x14.8x18 (55.9x37.6x45.7)	
1399B-01	1399N-01	1402B-46	1376B-46	1397B-46	CRR-1A	
---	---	---	---	---	----	
1399C-02	---	1402C-46	1376C-46	1397C-46	CRR-1B	
---	---	---	---	---	----	
---	---	---	---	---	----	

- All 115V and 230V single phase motors include thermal overload protection.
- Models 1400C-02, 1405C-02 and 1402C-02 provided with CE marking.
- Conduit wiring installation required. No cord, plug or switch provided.
- CSA approved models are 1400B-80, 1405B-80 and 1402B-80.

**DuoSeal™ Vacuum Pump Oil**  
Tested to high vacuum levels, this oil meets rigid requirements for vapor pressure, stability and viscosity.

Size	CAT. No.
Quart	1407K-11
Gallon	1407K-15
5 Gallon	1407K-20



**Exhaust Filter**  
A replaceable filter element captures oil mist from the exhaust port of the pump and reduces pump noise.



Pump	CAT. No.
1399, 1400	1417
1376, 1402, 1405	1417P-10
1397, 1374	1417P-20

## For a Complete System

Component	page
• Traps	39
• Inlet / Exhaust Accessories	39, 40
• Fittings / Hose	37, 38
• Gauges	41
• Regulators / Controllers	43, 44
• Service Kits	45
• Oil	46

Apply deep vacuum to your system in the toughest conditions. CHEMSTAR® pumps are built to withstand corrosive chemical vapor environments - durable performance over the long haul. CHEMSTAR® is designed to minimize the effects of harmful chemicals:

## Rugged Rotary Vane Design

Built to the renowned performance standards of Welch DuoSEAL® pumps, CHEMSTAR® utilizes vapor contact components that are tough and chemical resistant. The belt-drive mechanism gears the pump down, enabling slow pump operation to reduce friction and keep operating temperatures low.

## Lubrication System

The oil capacity is large for excellent dilution of contaminants. Oil is fed to the pump from the top of the reservoir, allowing sludge to settle without compromising lubrication. The recommended lubricant ("Gold Oil") is a synthetic oil designed to reduce chemically active sites. Use the nitrogen purge to drive elimination of corrosive gases.

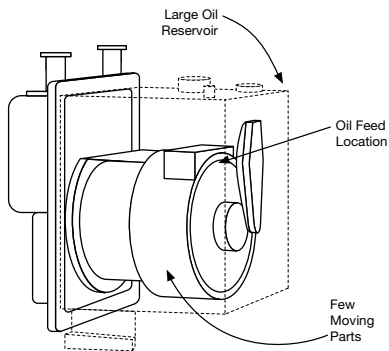
## Key Accessories

Welch also provides the system add-ons that further protect your pump and your environment. Select the equipment that augments your vacuum system needs - traps, oil mist eliminators, and system components.

## The Five Defining Features Needed For Pumping Corrosive Gases

### 1. High Contamination Tolerance

- Contaminants diluted
- Fewer moving parts
- Top oil feed for cleaner oil



### 2. Vital Parts Corrosion Resistant

- Fluoroelastomer seals and gaskets
- PTFE
- Stainless Steel
- Nickel Plated or Anodized
- Chemical Resistant Grade of Cast Iron

### 3. Reduced Frictional Wear

- Less than 580 RPM vs. typical 1750 RPM direct drive

### 4. Nitrogen Purge Standard

- Degasses and cools oil

### 5. Easy Attachment of Accessories

- Complete accessory package for corrosive gases

## For Pumping Corrosive Gases

- HCl
- O<sub>3</sub>
- H<sub>2</sub>SO<sub>4</sub>
- HBr
- HOAc
- SO<sub>x</sub>
- Br<sub>2</sub>
- F<sub>3</sub>CCO<sub>2</sub>H
- H<sub>2</sub>S
- Cl<sub>2</sub>
- CH<sub>2</sub>O
- HNO<sub>3</sub>
- SF<sub>6</sub>, CF<sub>4</sub> Fragments and other gases



Model 1402N

Specifications & Ordering - See Below

Specifications	1400N	1402N	1376N
----------------	-------	-------	-------

Free Air Displacement			
cfm (l/min.)@60 Hz	0.9	5.6	10.6
m <sup>3</sup> /hr (l/min.)@50 Hz	25	160	300
Ultimate Pressure, torr(mbar) <sup>1</sup>	1 x 10 <sup>-4</sup> (0.00013)	1 x 10 <sup>-4</sup> (0.00013)	1 x 10 <sup>-4</sup> (0.00013)
Gas Ballast	Yes	Yes	Yes
Pump RPM	580	525	525
Motor Horsepower (watts)	1/3 (250)	1/2 (370)	1 (750)
Oil Capacity, qt.(liters)	0.62 (0.59)	2.25 (2.1)	2.5 (2.37)
Tubing Needed, I.D. in.	7/16 (11)	13/16 (21)	13/16 (21)
ISO Exhaust & Intake Flange <sup>5</sup>	NW 16	NW 25	NW 25
Overall Dimensions LxWxH in.(cm)	17.8x9x12.6 (45.2x22.9x32)	19.3x14.1x15.4 (49x35.3x39.1)	19.3x12.3x15.6 (49x31.2x39.6)
Weight, lbs.(kg)	58(26)	112(51)	156(71)
Ship Weight, lbs.(kg)	71(32.3)	133(60.5)	181(82.3)
Shipping Carton Dimensions LxWxH in.(cm)	20.5x13.8x14.5 (52.1x35.1x36.8)	22.5x15.5x19.5 (57.2x39.4x49.5)	22x18x19 (59.5x45x48)

## Ordering Information<sup>2, 4</sup>

Wired for 115V, 60Hz, 1 Ph w/N. American 115V Plug	1400N-01	1402N-01	1376N-01
Explosion Proof Motor 115V, 60Hz, 1 Ph	1400N-90 <sup>3</sup>	1402N-90 <sup>3</sup>	---
Wired for 230V, 60Hz, 1 Ph w/ N. American Plug	---	1402N-60	1376N-60
Wired for 220V, 50Hz, 1 Ph w/ Cont. Euro. (Schuko) Plug	1400N-50 <sup>6</sup>	1402N-50 <sup>6</sup>	1376N-49
Wired for 100V, 50/60Hz, 1 Ph for Japan	1400N-53	1402N-53	1376N-53

## Notes:

1. CHEMSTAR pump should not be operated continuously at pressures above 10 torr. Ultimate pressure measured with a trapped McCleod gauge.
2. All single phase motors have overload protection.
3. Conduit wiring installation required. No cord, plug or switch provided.
4. Hinged clamp, centering ring assembly and hose adapter are included with all CHEMSTAR Pumps.
5. Standard filter option possible if the exhaust flange is removed, but not chemically resistant.
6. Units supplied with CE marking.

## Protective Accessories for CHEMSTAR® Pumps

- Heavy Corrosive Gas Loads
- Contaminated Exhaust Oil Mist
- Particulates In Gas Streams



- 1 Acid Neutralization Trap
- 2 Hermetically Sealed Oil Mist Eliminator

## ACID NEUTRALIZATION TRAPS



The Acid Neutralization Trap contains a large alkaline element cartridge to neutralize hydrous acids before they enter the vacuum pump. The element changes from white to bluish-transparent when spent and can be observed through the transparent trap body. Dimensions: 1420H-21, 8"Wx9"H; 1420H-20, 8"Wx13"H. (See CHEMSTAR™ application booklet for specific recommendations for use).

ISO Size	Capacity	Trap	Pump Connector Kit for Trap <sup>1</sup> CAT.No.	Replacement Element CAT.No.
NW 16	To 2 CFM	1420H-21	1420K-16	1420E-02
NW 25	To 12 CFM	1420H-20	1420K-25	1420E-01

1. Includes hinge clamp, centering ring and elbow. Use with CHEMSTAR vacuum pumps.

## HERMETICALLY SEALED OIL MIST ELIMINATORS



When attached to an effective exhaust line, the hermetically sealed oil mist eliminator prevents corrosive vacuum pump exhaust gases from escaping into the room. It also coalesces oil mist from the pump exhaust and allows it to drain back into the pump. Coalescing the oil mist prevents loss of oil and the frequent need to add expensive vacuum fluids. Stainless steel construction with borosilicate microfiber element and fluoroelastomer gaskets. Requires but does not include pump adaptor kit. Dimensions of cat no. 1416D: 5"Wx7-3/4"H; 1416F, 5"Wx13-3/8"H. 1416D exhaust port accepts 13/16" I.D. hose.

Use with Pump Model	Mist Eliminator CAT.No.	Pump Adaptor Kit CAT.No.	Replacement Element CAT.No.
1400N	1416D	1416E-01	1417Y-05
1402N, 1376N	1416D	1416E-02	1417Y-05

## GOLD VACUUM PUMP OIL



- Exceptionally low vapor pressure
- High stability in chemical environments
- No additives or inhibitors
- Recommended for Welch belt-drive and direct-drive pumps

A double distilled synthetic hydrocarbon oil designed for excellent resistance when pumping corrosive gases or vapors. A synthetic base stock that has no aromatic compounds or sulfur which accelerate varnishing, sludging and carbon build-up when pumps are used to pump corrosives. Gold oil will give a longer service life and superior protection for the internal metal components of a pump in corrosive pumping applications compared to DuoSEAL® and Premium Oil. Gold Oil offers excellent vacuum pressure in both belt-driven and direct-driven vacuum pumps over time. Gold Oil is miscible with conventional hydrocarbon oils and can be used without rebuilding the pump. The oil is clear and colorless.

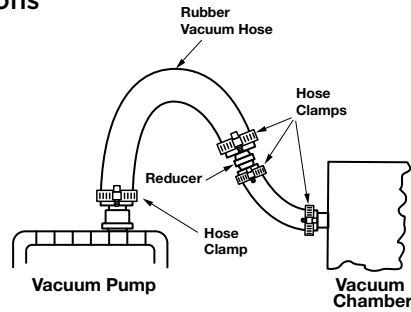
Ordering Information			
Size	Liter	Gallon	5 Gallon
CAT. No.	8995G-11	8995G-15	8995G-20



## VACUUM HOSE & CONNECTORS

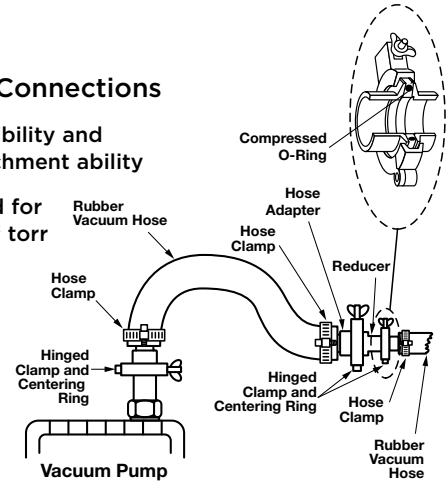
### Hose Nipple Connections

- Inexpensive
- Flexible
- For vacuum systems where the need for disassembly is infrequent
- Recommended for vacuum to  $10^{-3}$  torr

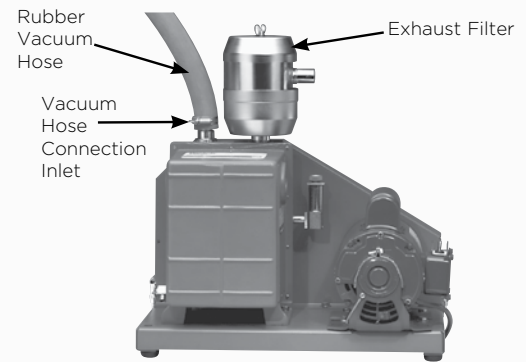
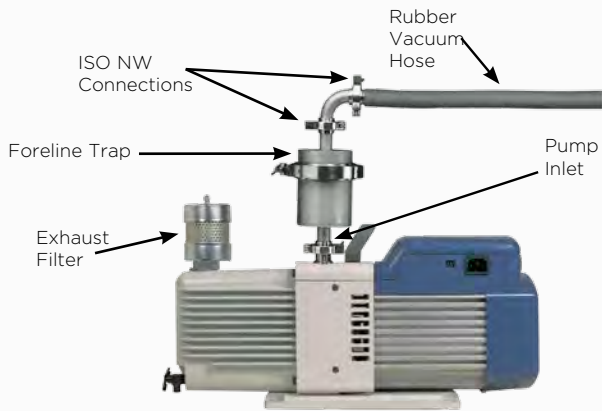


### Hose To ISO Connections

- Combines flexibility and frequent detachment ability
- Recommended for vacuum to  $10^{-3}$  torr



## VACUUM ACCESSORIES



**Exhaust Filter** - Connects to pump's outlet. Filters oil mist from the pump's exhaust to keep your working area clean and air quality healthful. A second option is an exhaust line to a vapor hood or other outside exhaust vent. This requires an adapter and air tight connections (see p. 40).

**Vacuum Oil** - Use of high quality vacuum oil is necessary for both vacuum performance and pump lifetime. With lesser quality oil the vacuum is degraded and pump lifetime is shortened. Welch offers three grades of vacuum oil designed especially for use in DuoSeal and Direct-Drive vacuum pumps (see p. 46).

**Foreline Trap** - Protects the vacuum pump from harmful substances present in the vacuum system and/or formed during the vacuum process. Can also block vacuum pump oil from back streaming into the system and contaminating samples (see p. 40 for Trap Selection chart)\*. Failure to use a foreline trap, when recommended, can result in serious damage to the vacuum pump. For trap selection advice, see your Welch representative at [www.welchvacuum.com](http://www.welchvacuum.com).  
\* Dry ice/Isopropanol - Liquid Nitrogen trap recommended to protect pump from condensable vapors.

For more information, see Vacuum Gauges, p. 41.

## Application Note | Protecting Your Vacuum Pump and Applications

### Protect Your Vacuum System

Foreline traps are used to prevent harmful substances generated or resident in vacuum systems from damaging vacuum pumps and/or your work.

### Pump Damage

Liquid, water, solvents, and acids can cause serious damage to a vacuum pump:

- Vapors can condense to liquids within vacuum pump as a natural result of gas compression
- Liquid can be accidentally aspirated into the pump
- Particulates can become lodged in a pump mechanism

For cold traps and acid neutralization traps, please see p. 39.

### Protect, Improve Your Vacuum Application

#### Oil Back Streaming

Oil molecules can migrate from an oil lubricated vacuum pump back into the vacuum system when operated at sustained vacuum levels of  $1 \times 10^{-2}$  torr ( $1.33 \times 10^{-2}$  mbar) or deeper for long periods.

#### Pump Shutoff Back Migration

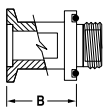
When a vacuum pump is shut off, contamination (oil, line substances) can back up into your work if unprotected by pump/system anti-suckback devices and traps.

#### Pump Efficiency

Cold traps lower vapor pressure, enabling higher vacuum with the same work from the pump.

## ISO NW INLET CONNECTORS FOR HIGH VACUUM PUMPS

- Aluminum with o-ring
- No sealant required for installation
- For pumps above listed serial number



ISO	Thread Size	Pump Model	Serial No.	B	CAT. No.
NW 16	3/4-20"	1399	>26461	1.12	1393F
NW 16	3/4-20"	1400, 1400N	>18069	1.12	1393F
NW 25	1-20"	1405	>77703	1.2	1393G
NW 25	1-20"	1380	>2114	1.2	1393G
NW 25	1-20"	1402, 1402N	>133218	1.2	1393G
NW 25	1-20"	1376, 1376N	>14594	1.2	1393G
NW 40	1.75-20"	1374	>73519	1.4	1393H
NW 40	1.75-20"	1397	>51217	1.4	1393H
NW 16	3/4-20"	8905	All	1.12	8905K-05
NW 25	1 1/8-20"	8907, 8912, 8917, 8920, 8925	All	1.4	8907K-05

## BRASS HOSE BARB

- Brass
- For use with ISO to female pipe adaptors



Hose Barb	Thread	Hose I.D.	CAT.No.
1/4"	1/4" NPT	3/16" and 3/8"	1393X

## RED VACUUM HOSE • HOSE CLAMPS

- Very thick walled hose for vacuum or pressure applications
- Convenient worm screw clamps hand tighten
- Hose comes in 5 ft. lengths (1.5m)



\*Hose works with pumps that accept 3/8 in. I.D. hose.  
\*\* 3/4" I.D. hose fits onto Welch 13/16" intake fittings.

## HOSE ADAPTER KITS

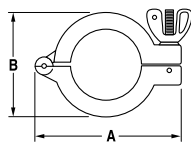
- Kits ensure proper sized tubing adaptors, and clamps for vacuum tight connections
- Kits include at least 5 ft.(1.5m) of thick walled rubber vacuum hose



1420H-01

## HINGED CLAMPS

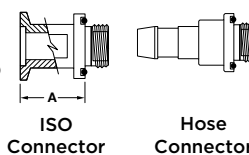
- Aluminum
- Closure by wing and nut bolt



Dimensions are in inches

## EXHAUST CONNECTORS FOR HIGH VACUUM PUMPS

- For adding an exhaust line to a pump
- Connectors for vacuum hose and ISO NW



Pump Models	Hose Connector		ISO Connector			
	Hose I.D.	CAT. No.	Thread Size	ISO NW	A	CAT. No.
1399, 1400, 8905, 8890	7/16"	1393J	3/4-20"	NW 16	1.12	1393F
1402, 1380, 1376, 8920, 8925, 8907, 8912, 8917, 1405	13/16"	1393K	1-20"	NW 25	1.2	1393G
1374, 1397	1-5/8"	1393L	1 3/4-20"	NW 40	1.4	1393H
1405, 1402	7/16"	1393M	1-20"	NW 25	1.2	1393G

## UNIBARB™ INLET CONNECTORS FOR HIGH VACUUM PUMPS

- Accepts two sets of tubing ID
- Aluminum with inlet screen



Thread Size	Pump Model	Hose I.D.	CAT. No.
3/4-20"	1400, 1399, 8905	3/16" & 7/16"	8905K-06
1 1/8-20"	8907, 8912, 8917	7/16" & 13/16"	8907K-06
1 1/8-20"	8920, 8925, 8917	9/16" & 13/16"	8920K-06
1 1/8-20"	8907, 8912, 8917	1/2" x 3/4"	8907K-07

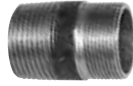
Specifications			Hose Kit CAT. No.				Clamps CAT. No.
I.D.	Wall Thickness	O.D.	5ft. Only	10 ft. Only	15 ft. Only	20 ft. Only	10/Pkg.
3/16"	5/16"	13/16"	331020-5	331020-10	-	-	305320
1/4"*	1/4"	3/4"	331030-5	-	-	-	305320
7/16"	5/16"	1-1/16"	331040-5	331040-10	-	-	305340
5/8"	3/8"	1-3/8"	331050-5	331050-10	-	-	305350
3/4"***	1/2"	1-3/4"	331060-5	331060-10	331060-15	331060-20	305360
1 5/8"	11/16"	3"	331080-5	331080-10	-	-	305380

Adapter Kits For Pump Models	Pump Inlet O.D.	Appliance Connector O.D.	CAT. No.
8890 (GEM)	3/8"	7/16" and 1/2"	1420H-01
1400, 1405, 1399, 8905	7/16"	1/4" and 3/8"	1420H-01
1402, 1380, 8907, 8912, 8917, 8920, 8925	13/16"	1/4" and 3/8"	1420H-02

ISO	A	B	Clamp Width	CAT. No.
NW 16	2.612	1.625	0.612	302201
NW 25	2.965	1.950	0.612	302202
NW 40	3.735	2.600	0.625	302203

## MALE NPT PIPE INLET AND EXHAUST ADAPTERS

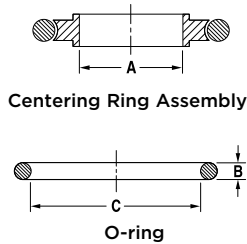
- Black Pipe
- Adapt inlet and exhaust to NPT Thread



Pump Model	Machine Thread	NPT Male Thread	CAT. No.
1400, 1399	3/4-20"	1/2"	1393N
1380, 1402, 1376, 1405	1-20"	3/4"	1393P

## CENTERING ASSEMBLIES • REPLACEMENT O-RINGS

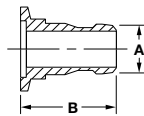
- Stainless steel centering ring with o-ring
- Replaceable Viton® o-ring seal



ISO	Centering Ring Assembly		Replacement O-Ring		
	A	CAT. No.	B	C	CAT. No.
NW 16	0.630	303101	0.210	0.725	304801
NW 25	0.984	303102	0.210	1.100	304802
NW 40	1.575	303103	0.210	1.600	304803

## RUBBER HOSE ADAPTERS

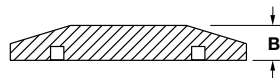
- ISO NW to rubber vacuum hose
- Aluminum



ISO	Hose I.D.	A	B	CAT. No.
NW 16	7/16"	0.625	1.65	501241
NW 16	5/8"	0.750	1.65	501251
NW 25	13/16"	0.875	1.73	501262
NW 40	1-5/8"	1.63	2.17	501283

## BLANK-OFF FLANGES

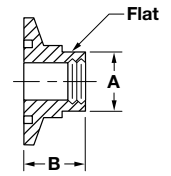
- Stainless steel
- To close off unused parts



ISO	B	CAT. No.
NW 16	0.20	388101
NW 25	0.20	388102

## FEMALE PIPE ADAPTERS

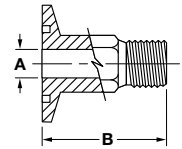
- Female threads have 1/4 in. to 1/2 in. NPT
- Stainless steel
- Can be used with brass hose barbs (see p. 36)



ISO	NPT	A	B	CAT. No.
NW 16	1/4"	0.62	0.50	506121
NW 25	1/4"	0.88	0.50	506122
NW 25	1/2"	0.88	0.50	506142

## MALE PIPE ADAPTERS

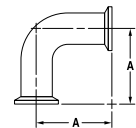
- Male stubs have 1/4 - 18 NPT
- Hex shank
- Stainless steel



ISO	NPT	A	B	CAT. No.
NW 16	1/4"	0.281	1.1	505121
NW 25	1/4"	0.281	1.1	505122

## 90° ELBOWS

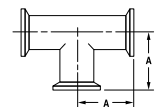
- Stainless steel
- Same size flange on both ports



ISO	A	CAT. No.
NW 16	1.50	383101
NW 25	2.04	383102

## TEES

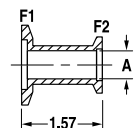
- Stainless steel
- Same size flanges on all ports



ISO	A	CAT. No.
NW 16	1.50	384101
NW 25	2.04	384102

## REDUCERS

- Makes differing sizes of ISO flanges
- Stainless steel



ISO F1	ISO F2	A	CAT. No.
NW 25	NW 16	0.555	387121
NW 40	NW 25	0.900	383102

Dimensions are in inches

## DRY ICE / ISOPROPANOL TRAP (-79°C)

- Recommended for freeze dryers, vacuum manifolds, concentrators, etc.
- Uses dry ice or liquid nitrogen as refrigerant
- Removable center make trapping surface easy to clean



DryIce/Liquid Nitrogen Cold Trap is an effective foreline cold trap for vacuum manifolds or Schlenk Lines. The trap has a large 3 quart (2.8 liters) center well for the dry ice/isopropyl alcohol slurry or liquid nitrogen; traps up to 1.5 liter condensate. With dry ice cold temperature may be maintained for up to 12 hours depending upon the vapor load. With liquid nitrogen cold temperature can be maintained for up to 2 hours depending upon the vapor load. See Applications Notes, p. 36 & 39 for configuration and usage information.

Tubing Needed	Diameter	Height	Diameter	In/Out Offset	CAT. No.
7/16" I.D.	10	8.25	10.75	3.5	1420H-14

Tubing CAT. No. 331040-5, gasket replacement kit 1420K-01.

## CAPTURE VAPOR RECOVERY SYSTEM

- Protects lab air quality
- Enables Cradle-to-Grave chemical handling
- Spatially efficient, easy to setup / clean-up

For more information, please see p. 40.



DRYFAST® & DRYFAST® ULTRA

## ACID NEUTRALIZATION TRAP

- ISO NW flange connection
- Calcium Hydroxide element
- Element changes from white to bluish-transparent when spent
- Configure with prior cold trap to reduce loading



ISO Size	Capacity	Trap	Repl. Element	Pump Connector Kit for Trap <sup>1</sup>	CAT. No.
NW 16	To 2 cfm (57 l/min.)	1420H-21	1420E-02	1420K-16	
NW 25	To 12 cfm (340 l/min.)	1420H-20	1420E-01	1420K-25	

Note:

1. Includes hinge clamp, centering ring and elbow. Use with CHEMSTAR® vacuum pumps.

## Application Note | Cold Traps

Cold traps employing a dry ice slurry or liquid nitrogen are effective as long as the refrigerant level is maintained. If the trap warms up while the pump is running, all of the trapped condensables will be ingested by the vacuum pump, contaminating the oil.

Cold traps must be cleaned out at the end of each day. If the pump is run overnight, the trapped condensables will ultimately be ingested by the pump as the trap warms up. Cleaning a Dry Ice Slurry/Liquid Nitrogen trap is easy. The steps are: 1. Turn off the pump. 2. Leak air into the trap from the application side. 3. Remove the center well and polypropylene ring to a hood. The center well can be washed off into a beaker or the condensables can be allowed to evaporate in the hood or added to the laboratory waste.

## PARTICULATE, HYDROPHOBIC IN-LINE FILTERS

The filters are an economical solution to protect your WOB-L® piston vacuum pump from fine particulates and aerosols to 0.2 microns in diameter.

Made of Polypropylene housing, CAT. No. 1475K-21 fits 1/4" to 3/8" and CAT. No. 1475K-23 fits 1/4" ID hose.

Made of SBS resin housing, CAT. No. 1475K-22 fits 3/8" to 7/16" ID hose.



Pump Model	Porosity	Pack Qty.	CAT. No.
2511, 2515, 2522, 2534, 2546	0.8 micron	10	1475K-21
2561, 2581, 2562, 2567	0.8 micron	1	1475K-22
2562, 2567	0.2 micron	1	1475K-23

## INLET/EXHAUST SEPARATOR JARS

230 ml glass jar assembly attaches to pump intake or exhaust to capture ingested liquids.



Pump Model	CAT. No.
All DryFast models	1423B
Replacement Jars	1415B
Glass, for pumps w/1423B assembly, models 2561, 2565, 2581, 2585 and Self Cleaning dry pumps.	
1415D is a polypropylene version of the 1415B glass jar.	1415D
Plastic vacuum jar, for pumps 2522, 2546, 2534	1415C

## REPLACEMENT JARS FOR ASPIRATION STATIONS

Spare receiver kit (1475K-20) includes a 1.2 liter autoclavable jar, 6ft. of tubing and two hydrophobic filters.



Pump Model	CAT. No.
2511B-75, 2511C-75, 2515B-75, 2515C-75	1475K-20

## OIL SEAL PUMPS

### STANDARD EXHAUST FILTERS

- Filters oil mist from pump exhaust
- Easy replacement of element
- Reduces pump noise
- Filters to 0.3 micron particle size
- Screw-in type



1417

Use With Pump Model	Diameter (in.)	Height	Filter w/ Case CAT. No.	Filter Element Only CAT. No.
8890 <sup>1</sup> , 8905, 1399, 1400, 1400N	2.5"	2.5"	1417	1417L
8907, 8912, 8917	2.5"	4.5"	1417P-7	1417R
8920, 8925, 1376, 1402, 1405, 1402N, 1376N	5.0"	6.25"	1417P-10	1417G
1397, 1374	5.0"	9.0"	1417P-20	1417H-01
8917A-80, 8947C-80	2.5"	4.5"	1417P-7	1417R

Note: 1. GEM<sup>®</sup> (8890) includes 1417 as standard equipment.

### EXHAUST OIL RECYCLER

Exhaust oil recyclers are recommended for vacuum systems with continuous pressure of 1 torr (1 mm Hg) or higher. 1. At these pressures, conventional exhaust filters quickly saturate. The Mist Eliminator System continuously separates oil mist from the vacuum pump exhaust and actively returns the oil to the pump.



Exhaust Mist Eliminator shown installed on pump with oil return line.

Vacuum Pump Model No.	CAT. No.
8890 (GEM)	1416B
8905	1416H
8907, 8912, 8917, 8920, 8925	1416C
1400, 1400N	1416H-01
1376, 1376N, 1402, 1402N, 1405	1416C-01

Note: 1. CAUTION: Two stage vane vacuum pumps such as models 8905, 8907, 8912, 8920, 8917, 8925, 1400, 1402, 1376, 1405, 1400N, 1402N and 1376N should not be operated continuously at pressures above 10 torr.

## DRY (OIL-FREE) PUMPS

### INLET/EXHAUST SEPARATOR JARS

230 ml glass jar assembly attaches to pump intake or exhaust to capture ingested liquids.



Pump Model	CAT. No.
All DryFast <sup>®</sup> models	1423B
Replacement Jars	1415B
Glass, for pumps w/1423B assembly, models 2561, 2565, 2581, 2585 and Self Cleaning dry pumps.	
1415D is a polypropylene version of the 1415B glass jar.	1415D
Plastic vacuum jar, for pumps 2522, 2546, 2534	1415C

### DIRECTIONAL EXHAUST FILTERS

- Large, high capacity
- 360° Swivel outlet with tubing connector
- Screw-in type
- Continuously separates oil mist from the vacuum pump exhaust and by gravity returns the oil to the pump



1417A

Use With Pump Model	Diameter x Height (in.)	Outlet Tube O.D.	Filter w/ Case CAT. No.	Filter Element Only CAT. No.	Gasket Repl. CAT. No.
8907, 8912, 8917, 8920, 8925, 1376, 1380, 1402, 1405, 1402N, 1376N	5.0" x 7.5"	1.0"	1417A	1417G	1417A-01
1374, 1397	6.5" x 10.0"	2.0"	1417B	1417H	1417B-01

### HERMETICALLY SEALED OIL MIST ELIMINATORS

When attached to an effective exhaust line, the hermetically sealed oil mist eliminator prevents corrosive vacuum pump exhaust gases from escaping into the room. It also coalesces oil mist from the pump exhaust and allows it to drain back into the pump. Coalescing the oil mist prevents loss of oil and the frequent need to add expensive vacuum fluids. Stainless steel construction with borosilicate microfiber element and fluoroelastomer gaskets. Requires, but does not include pump adapter kit. Dimensions of CAT. No. 1416D: 5"x7-3/4"(WxH); 1416F, 5"x13-3/8"(WxH). 1416D exhaust port accepts 13/16" I.D. hose.



Use With Pump Model	Mist Eliminator CAT. No.	Pump Adapter Kit CAT. No.	Repl. Element CAT. No.
1400N	1416D	1416E-01	1417Y-05
1402N, 1376N	1416D	1416E-02	1417Y-05

### EXHAUST SILENCER

- Standard Duty (WOB-L)

Exhaust silencers are installed in the exhaust port of the pump to reduce pump noise.



1412C

Pump Model	CAT. No.
2565, 2585	1412C
2561	1412D
2581	1412E



1412D / 1412E

Prevent harmful solvent vapors from escaping into the lab. The CAPTURE recovery system mounts easily to your DryFast or Self-Cleaning vacuum pump to enable solvent condensation and environmentally responsible materials control. Requires cooling water for condenser.

Ordering Information	
Description	CAT. No.
Includes condenser, 1 liter round bottom flask, tubing support and clamps.	1420H-18

### CAPTURE VAPOR RECOVERY SYSTEM

- Protects lab air quality
- Enables Cradle-to-Grave chemical handling
- Spatially efficient, easy to setup / clean-up



DRYFAST<sup>®</sup> & DRYFAST<sup>®</sup> ULTRA



## HANDHELD VACUUM GAUGES



Kit 1520K-10

1520 torr Range  
(in optional frame case)

### Torr Range (1 to 760 torr)

Convenient handheld vacuum gauge connects quickly with 3/8" vacuum hosing to trouble shoot vacuum systems. Resolution = 1 torr. LCD readout, 9 VDC or AC adapter operation. Kits include carrying case, length of hose, and flip-stand frame case, and AC adapter.

Meter Catalog Nos.		
Meter	Meter W/Kit	Range
1520B-01	1520K-10	1 to 760 torr
1520C-02	1520K-11	1 to 1013 mBar



### Millitorr Range (10<sup>-3</sup> to 1 torr) With Graphic / Status Diagnostics

Handheld gauge displays not only digital vacuum levels, but also graphic and status icon displays of system performance. Powered by (4) AA Batteries or Micro-B USB. Vacuum gauge includes sensor, protective shell with folding stand, carrying case, batteries.

Meter Catalog Nos.		
Meter W/ Case	Spare sensor	Range
1526K-10	1526A	10 <sup>-3</sup> to 1 torr

#### Applications

- System leak detection / rates
- System pump-down profiles
- System outgassing profiles
- Pump operation verification



### Wide Range (10<sup>-3</sup> to 760 torr)

Handheld gauge accurately displays from deep vacuum (1 millitorr) readings to atmospheric pressure (760 torr). 2 meter sensor cord, NW16 connection. Sensor and 9VDC battery included. Select Chem Duty version for harsh chemical fume measurements.

Meter Catalog Nos.		
Meter	Spare sensor	Range/ Duty
600072	620002-01	10 <sup>-3</sup> -760 torr/ Std
600074-US	620002-03	10 <sup>-3</sup> -760 torr/ Chem

## THERMOCOUPLE VACUUM GAUGE



- Vacuum measurement to low millitorr (micron) range
- Rugged, reliable thermocouple gauge sensor tube

Analog gauges provide an accurate, reliable measurement of vacuum. Self-contained gauges with solid-state electronics for rapid response time, long life and low maintenance. Comes with a 0 to 10 VDC recorder output. The gauge sensor tubes are designed to assure maximum sensitivity over the entire vacuum range. Gauge sensor tube connected to system via 1/8" NPT thread. Each gauge comes with one sensor tube and one cable. Dimensions of 7"Lx5"Dx5.6"H (17.8x12.7x14.1); Weight 2 lbs.(0.9kg).

Gauge CAT. No.	Range (millitorr)	Voltage	Protective Trap CAT.No.	Repl. Sensor Tube CAT.No.
1515	0 to 5000	115V, 60 Hz 1Ph	1515B	1515A

## VACUUM GAUGE



Inexpensive gauge for measuring vacuum level. Not an absolute pressure gauge. Gauge uses atmospheric pressure as reference.

Dial Diameter	Units of Measure	Connection	CAT.No.
2" O.D.	in. Hg, cm Hg (Brass)	1/8" male NPT	726021
2.5" O.D.	in. Hg, mm Hg (Brass)	1/4" male NPT	726020
2" O.D.	in. Hg (Stainless)	1/8" male NPT	726023
2" O.D.	mbar/kPa (Brass)	1/8" male NPT	726024
2" O.D.	psi/kg cm <sup>2</sup>	1/8" male NPT	726025

## VACUUM REGULATOR WITH INLET SEPARATOR JAR



2585K-50 /  
2565K-50

The 2585K-50 and 2565K-50 include an inlet trap to help prevent ingestion of fluids into the pump, a dial gauge for continuous vacuum level monitoring and a regulator bleed valve to adjust vacuum levels. Both models have 3/8" inlet hose barb, 2585 has 3/8" NPT male mount and 2565 has 1/4" NPT male mount.

Pump Model	Connection	CAT. No.
2585, 2581, 2580	3/8" inlet borse barb, 3/8" NPT male mount	2585K-50
2567, 2563, 2562, 2561	3/8" inlet borse barb, 1/4" NPT male mount	2565K-50

## VACUUM AND PRESSURE REGULATOR FOR WOB-L<sup>®</sup> VACUUM PRESSURE STATIONS



2522K-05



2522K-06

The 2522K-05 vacuum regulator is designed to run from slightly below atmospheric to the maximum vacuum level of the pump.

The 2522K-06 pressure regulator is designed to control from atmospheric to the maximum rated pressure of the pump.

Pump Model	Connection	CAT. No.
2522, 2534, 2546	1/4" male NPT, to vacuum inlet	2522K-05
2522, 2534, 2546	1/4" male NPT, to pressure inlet	2522K-06

## VACUUM REGULATOR



1421



1421D

Model 1421 replaces inlet barb on pump model 8890 and allows easy regulation of vacuum level. Includes an easy to read dial gauge. CAT. No. 1421D all stainless steel construction.

Pump Model	Connection	CAT. No.
8890	1/4" NPT male mount	1421
Generic	1/4" NPT male mount	1421D

Caution: Do not use with DuoSEAL<sup>®</sup>, CHEMSTAR<sup>®</sup> or Direct-Drive pumps.

## VACUUM REGULATOR WITH DIAL GAUGE



700458

Chemical resistant vacuum bleed valve regulators with stainless steel gauges, polypropylene construction with PVDF hose barb for 1/4" ID vacuum hose.

Pump Model	Connection	CAT. No.
2052,2054	1/4" SPT male mount	700458

## Model 1640 Universal Vacuum Controller

- Easy to set-up, program and operate
- Rack mountable to save hood space
- Corrosion resistant

The compact Model 1640 Vacuum Controller is designed to regulate vacuum level for any apparatus with any vacuum pump. Typical applications include rotary and centrifugal evaporations. Vacuum level can be regulated by the Model 1640 Controller from 2 torr to atmospheric pressure, precise to +/- 1 torr. Optional user defined programs can control evaporation of 2-solvent systems for walk-away process convenience. Up to 5 programs can be stored.

The 1640 Controller works with direct or belt-drive oil-seal vacuum pumps up to 100l/min, diaphragm vacuum pumps, WOB-L\* piston vacuum pumps, water aspirators, or house vacuum systems. 12V DC controller comes with universal adapter 100-240V AC, 50/60Hz.

### Operation of Model 1640 Controller

The Model 1640 Controller continually receives pressure readings from an internal piezoelectric sensor. The Controller microprocessor combines user-specified control parameters with this system feedback to control application vacuum level using a PTFE solenoid valve.

The 1640 Controller can be placed on a bench surface or mounted on a hood rack with the provided thumbscrew fitting.

### User Interface with 1640 Controller

The CAT. No. 1640A-01 has a membrane keypad and intuitive menus to enable easy vacuum control and process programming. Readout is a large LED display. Vacuum levels can be simply entered for real-time interactive control or continuous process vacuum control. The user can also utilize one of 5 user-defined programs to designate timed vacuum control runs to achieve reproducible evaporation results.

The 5 user defined programs enable the user to designate 1 or 2 point vacuum level setpoints to control evaporation processes. Each of these vacuum levels is held for a user designated period of time. At the end of the time period, the controller progresses to the second (higher vacuum) setpoint or turns off vacuum control at the conclusion of the evaporation.

#### Application Note | Vacuum Controller

Deep vacuum pumps (e.g. oil-seal rotary vane models) controlling in torr range applications are basically "blanked" off during much of the control period. This blank off allows the pump to run primarily in the millitorr range they are designed to operate in. This prevents pump overheating and oil mist.



**WORKS WITH ANY VACUUM PUMP**  
 Rotary Evaporators  
 Centrifugal Evaporations • Vacuum Ovens



Specifications	
Display	OLED, (128x64 mm)
Selectable Vacuum Pressure Units	torr, mbar, pascal
Accuracy	+/- 1 torr
Hose Connector in.(mm)	1/4 (7)
Set Point Range	2 torr(2 mbar) to Atm
Weight lbs. (kg)	2(0.9)
Overall Dimensions LxWxHin(cm)	7.3x5.2x5.6x5.2 (18.7x13.3x14.2)
Shipping Dimensions LxWxHin(cm)	12x9x12 (30.7x23.0x30.7)
Shipping weight lbs.(kg)	6(2.7)
Ordering Information	
115/230V @ 50/60 Hz	<b>CAT. No.</b> 1640A-01

## CHEMICAL DUTY DRY PTFE DIAPHRAGM PUMPS - DRYFAST® & DRYFAST ULTRA®



Pump Model	No. Heads on Pump	Kit No.	Description
2014	1	2047K-01	One head service kit
2032	2	2047K-01	One head service kit
2034	2	2037K-01	One head service kit
2037	2	2037K-01	One head service kit
2042	2	2047K-01	One head service kit
2044	2	2037K-01	One head service kit
2047	2	2047K-01	One head service kit

## SELF CLEANING CHEMICAL DUTY DRY VACUUM SYSTEM



Pump Model	No. Heads on Pump	Kit No.	Description
2025	2	2037K-01	One head service kit
2026	2	2047K-01	One head service kit
2027	2	2047K-01	One head service kit
2028	2	2047K-01	One head service kit

## WELCH PUMPS



Pump Model	Kit No.	Description
301 E	402046-US	Complete diaphragm, valve and o-ring replacement kit
601 E, 301 Z, 301 Z ef	402041-US	Complete diaphragm, valve and o-ring replacement kit
2054B-01, 2052B-01	402042-US	Complete diaphragm, valve and o-ring replacement kit
2064B-01, 2067B-01, 2062B-01	402043-US	Complete diaphragm, valve and o-ring replacement kit
ALL Welch DIAPHRAGM PUMPS	402106-US	Tool Kit, 19 mm wrench, Allen key and adjustable spanner wrench

## STANDARD DUTY DRY PISTON PUMP KITS



Pump Model	Kit No.	Description
2522	2522K-03	Complete Rebuild Kit
2534B-01	2534K-03	Complete Rebuild Kit
2534C-01, -02	2546K-03	Complete Rebuild Kit
2546	2546K-03	Complete Rebuild Kit
2580, 2585	2585K-03	Two Head Service Kit, 2585
	2585K-04	Seal Service Kit, 2585
2562, 2567	2567K-03	Two Head Service Kit, 2562/67
	2567K-04	Seal Service Kit, 2562/67
2561 Note: Models older than and including Dec. 2007, date code 1207xxxx.	2561K-03	Two Head Service Kit, 2561
	2561K-04	Seal Service Kit, 2561
2561 Note: Models newer than and including Jan 2008, date code 0108xxxx.	2563K-03	Two Head Service Kit, 2567 (Includes Seal Service Kit)
	2563	2563K-03
2581	2581K-03	Two Head Service Kit, 2581
	2581K-04	Seal Service Kit, 2581
All Models WOB-L® Dry Pump	2500K-04	Service Kit for Feet Pump

## DuoSEAL® VACUUM PUMPS



Pump Model	Kit No.	Description
1400	1400K-03	Minor repair kit, 1400
	1400K-04	Major repair kit, 1400
1402, 1405	1402K-05	Minor repair kit, 1402 & 1405
	1402K-06	Major repair kit, 1402 & 1405
1376	1376K-05	Minor repair kit, 1376
	1376K-06	Major repair kit, 1376
1397, 1374	1397K-07	Minor repair kit, 1397 & 1374
	1397K-08	Major repair kit, 1397 & 1374
1399	1399K-03	Minor repair kit, 1399
	1399K-04	Major repair kit, 1399
1373	1373K-05	Minor repair kit, 1373
	1373K-06	Major repair kit, 1373

## CHEMSTAR® VACUUM PUMPS



Pump Model	Kit No.	Description
1400N	1400K-09	Minor repair kit, CHEMSTAR 1400N
	1400K-10	Major repair kit, CHEMSTAR 1400N
1402N	1402K-09	Minor repair kit, CHEMSTAR 1402N
	1402K-10	Major repair kit, CHEMSTAR 1402N
1376N	1376K-09	Minor repair kit, CHEMSTAR 1376N
	1376K-10	Major repair kit, CHEMSTAR 1376N

## DIRECT-DRIVE VACUUM PUMPS



Pump Model	Kit No.	Description
8890	8890K-02	Minor repair kit, 8890
8905	8905K-02	Minor repair kit, 8905
	8905K-03	Shaft seal repair kit, 8905
8907, 8912, 8917	8917K-04	Minor repair kit, 8907, 8912, 8917
	8917K-05	Shaft seal repair kit, 8917
8920	8920K-02	Minor repair kit, 8920
8925	8925K-02	Minor repair kit 8925
8917A-80, 8917C-80	1420E-03	Replacement element oil sump



Pump Model	Rotary Vane Pump repair kit	Diaphragm Pump repair kit
8960	302076	402008-01
8965	302079	402041-02
8970	302080	402041-02



# Vacuum Pump Oils

## GOLD VACUUM PUMP OIL



- Exceptionally low vapor pressure
- High stability in chemical environments
- No additives or inhibitors
- Recommended for Welch belt-drive and direct-drive pumps

A double distilled synthetic hydrocarbon oil designed for excellent resistance when pumping corrosive gases or vapors. A synthetic base stock that has no aromatic compounds or sulfur which accelerate varnishing, sludging and carbon build-up when pumps are used to pump corrosives. Gold oil will give a longer service life and superior protection for the internal metal components of a pump in corrosive pumping applications compared to DuoSEAL® and Premium Oil. Gold Oil offers excellent vacuum pressure in both belt-driven and direct-driven vacuum pumps over time. Gold Oil is miscible with conventional hydrocarbon oils and can be used without rebuilding the pump. The oil is clear and colorless.

### Ordering Information

Size	Liter	Gallon	5 Gallon
CAT. No.	8995G-11	8995G-15	8995G-20

## PREMIUM VACUUM PUMP OIL



- Low vapor pressure
- Designated for high RPM direct drive vacuum pumps
- No additives or inhibitors
- Recommended for Welch direct-drive vacuum pumps

A triple-distilled hydrocarbon oil using severely hydrotreated base stock is designed to resist breakdown at higher RPMs and operating temperatures of direct-drive vacuum pumps. The hydrotreating virtually eliminates aromatics and sulfur to give good resistance to sludge and varnish formation overtime in corrosive environments. Premium enables direct-drive vacuum pumps to maintain the highest vacuum performance over time. The oil is light yellow.

### Ordering Information

Size	Liter	Gallon	5 Gallon
CAT. No.	8995P-11	8995P-15	8995P-20

## DuoSEAL® VACUUM OIL



- Low vapor pressure
- Ideal viscosity for belt-drive vacuum pumps
- High consistency
- Recommended for DuoSEAL belt-drive pumps

A specially fractionated oil for DuoSeal belt-driven pumps is designed to ensure the highest vacuum performance. The oil is tested to high vacuum levels to meet rigid requirements for vapor pressure, vacuum level stability, and viscosity. DuoSeal oil is famous for its quality and consistency.

### Ordering Information

Size	Liter	Gallon	5 Gallon
CAT. No.	1407K-11	1407K-15	1407K-20

## MAKE THE CLEAR CHOICE



8995G-11

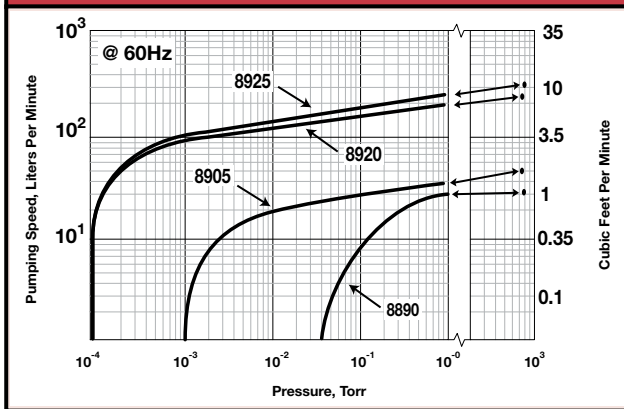
### Pump Oil Condition Color



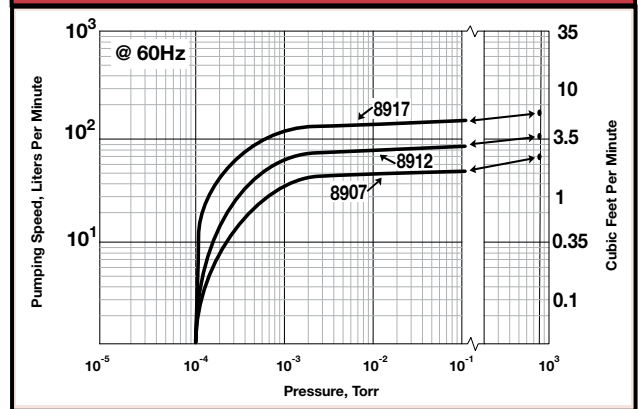
The choice is clear. Pump oil can become contaminated with ingested fluids and vapors. Use recommended pump oil and change your pump oil regularly. Cloudy and discolored oil will lead to premature pump failure.

**Make the clear choice and change your oil regularly.**

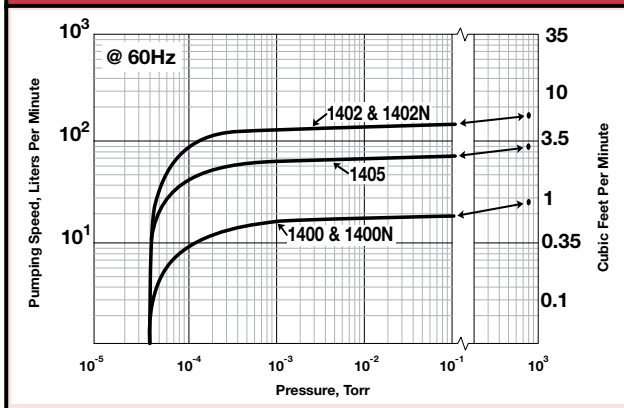
**8890, 8905, 8920, 8925**



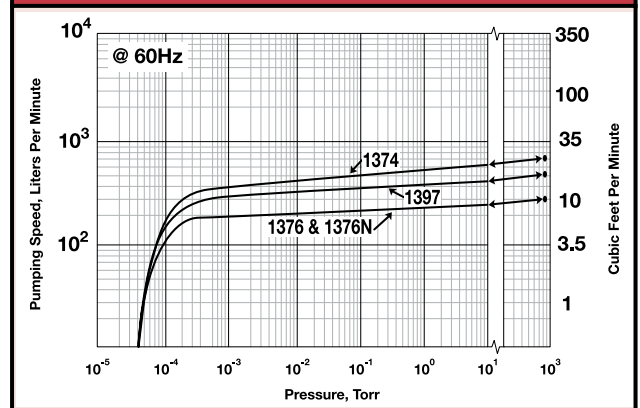
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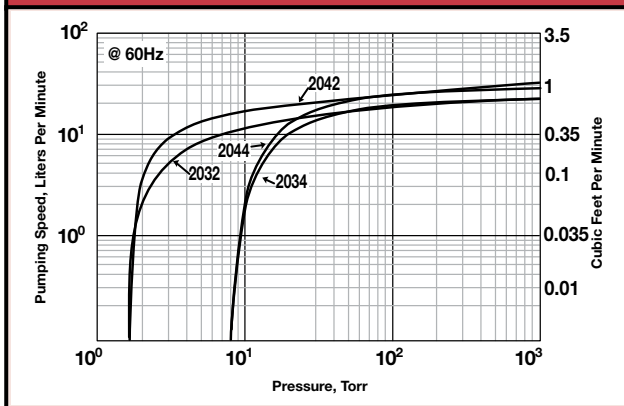
**1400, 1400N, 1405, 1402, 1402N**



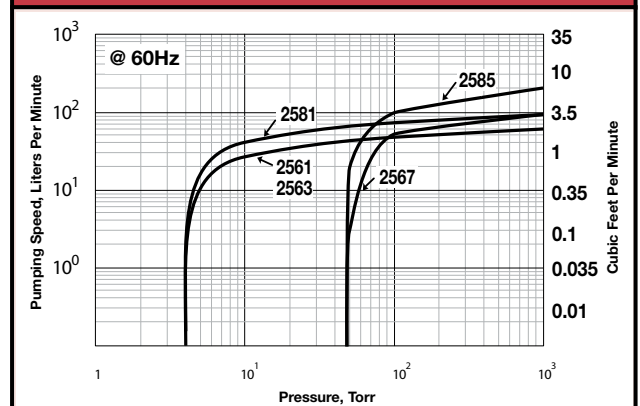
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## HOW TO ORDER FOR U.S. CUSTOMERS

### From Welch Dealers:

Welch Vacuum Technology products can be ordered from authorized laboratory dealers. Please check the Welch website at [www.welchvacuum.com](http://www.welchvacuum.com) or call (847-676-8800) or fax for a list of Welch dealers in the United States, Canada, and other locations.

### Mail:

**Gardner Denver Thomas Inc.**  
1601 Feehanville Drive, Suite 550  
Mt. Prospect, IL 60056, USA

### Payment Terms:

Net 30 days with approved credit; Mastercard, Visa or American Express are accepted for your convenience.

**Minimum Order: \$50.00**

## WELCH REPAIR SERVICE

### All Returns - Warranty and Non-Warranty

A Return Authorization (RA) number is required for all returns. Product returns without an RA will be refused at dock.

1. Go to [www.welchvacuum.com](http://www.welchvacuum.com) to fill out and submit a Safety Service form online. This form lists chemicals that could be equipment contaminants and is required for the safety of repair personnel.
2. After reviewing your Safety Service form, the Welch Repair Department will provide you with the RA number and shipping instructions.
3. Decontaminate the equipment as needed and package properly. Damage caused by improper equipment packaging is the customer's responsibility. Insure the equipment against loss or damage. Prominently write the RA number on the outside of the packaging and again on the packing slip inside. Ship the equipment to the address provided by the Repair Department. Contact the Repair Department at 847-676-8800 with any questions you may have.

### Non-Warranty Returns and Repairs

The Customer pays for freight charges to and from Welch; freight charges to Welch must be prepaid. In addition to an RA, all paid repairs must come with a purchase order (P.O.) or a credit card number. All paid repairs come with a 90 day warranty. A nominal fee is assessed for equipment that is inspected but not repaired at the customer's discretion.

### Warranty Returns and Repairs

Freight charges to Welch are prepaid by the Customer; Welch pays for return freight charges.

For Repair Service Inquiry:

Email: [gdwelchvacuum@gardnerdenver.com](mailto:gdwelchvacuum@gardnerdenver.com)

Fax: 847-677-8606

Call: 847-676-8800

Business Hours: 8:00 a.m. to 4:30 p.m. Central Time

### From Welch in the U.S.A and Canada:

To order your vacuum pumps, parts and accessories:

### Order:

**Online @** [www.welchvacuum.com](http://www.welchvacuum.com)

**E-mail:** [welch.na@gardnerdenver.com](mailto:welch.na@gardnerdenver.com)

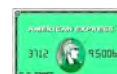
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### Technical Assistance:

**Call:** (847) 676-8800

**Fax:** (847) 677-8606

**Business Hours:** 8:00 a.m. to 4:30 p.m. Central Time



### WARRANTY

This Welch product is warranted to be free from defects in material and workmanship. The liability of Gardner Denver Thomas, Inc. under this warranty is limited to servicing, adjusting, repairing or replacing any unit or component part which in the judgment of Gardner Denver Thomas, Inc. has not been misused, abused or altered in any way causing impaired performance or rendering it inoperative. No other warranties are expressed or implied. The method of executing this warranty: servicing, adjusting, repairing or replacing shall be at the discretion of Gardner Denver Thomas, Inc. Vacuum pumps that have been used for any period, however short, will be repaired under this warranty rather than replaced.

The warranty is effective for one year from the date of original purchase when:

1. The warranty card has been completed and returned.
2. The product is returned to the factory or other designated service centers, freight prepaid.
3. The product in our judgment is defective through no action or fault of the user.

If the product has become defective through misuse, abuse, or alteration, repairs will be billed regardless of the age of the product. In this event, an estimate of the repair costs will be submitted and authorization of these charges will be required before the product is repaired and returned. To reduce additional charges and delays either within or outside of the warranty period, contact Welch at (847) 676-8800 for a return authorization number. Products without a return authorization number will be refused by our receiving department. Before shipping, properly pack the pump, insure it against loss or damage, and on the outside of the pump packaging and the packing slip write in the return authorization number. Pumps damaged due to improper packaging are the customer's responsibility.

**For Complete Welch Terms and Conditions see:**  
[www.welchvacuum.com](http://www.welchvacuum.com)

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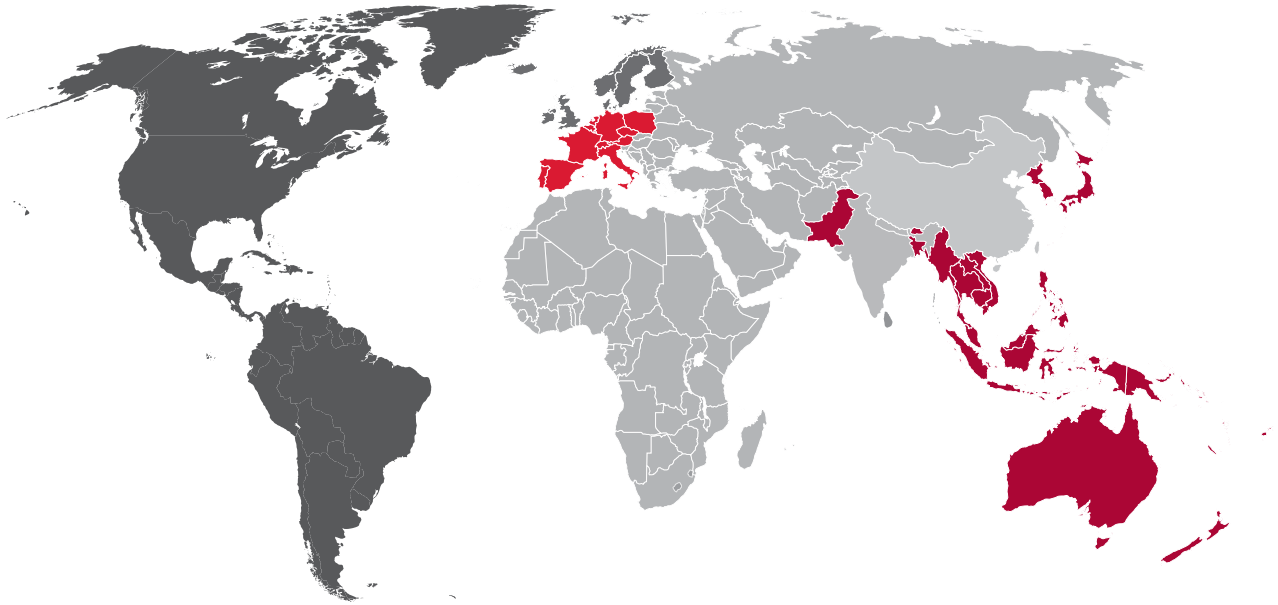
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