Vilter®

440 VMC® Ammonia And Halocarbon Compressors

For Single or Multiple Stage Systems

Vilter 440 VMC® Series of Reciprocating Compressors . . . For Dependable, Low Cost Refrigeration

Vilter's Multi-Cylinder 440 Series of compressors, long the industry standard, offers many attractive benefits for today's modern refrigeration equipment room.

EFFICIENT OPERATION

Over the years, refinements in the design of the 440 VMC series have brought these machines to an operating state that truly sets them apart from their competition as real energy savers. Their short 3½" (89 mm) piston stroke and subsequent low piston speed, moreover, assure long service life.

COMPACT DESIGN

Streamlined 440 VMC compressor frames provide strength without bulkiness and assure rapid heat dissipation without awkward arrangements that consume precious space.

RUGGED DURABILITY

To assure long life to cylinders, bearings and other parts, a positive action automatic oiling system is used on all 440 VMC's. Also available is an automatic return oil separator providing controlled oil return back to the compressor crankcase.

INSTALLED IN ANY SUITABLE LOCATION . . . AT MINIMUM COST

Can even be installed on an upper floor when no additional engine room space is available because:

- All moving parts are carefully balanced to reduce vibration to a minimum.
- All 440 VMC compressor units are factory mounted on a structural steel base along with the motor. No on-the-job assembly of components is required, thus reducing erection costs appreciably.
- Noise level is minimal on the smooth running 440 VMC due to light weight diaphragm discharge and plate type suction valves.

LOW MAINTENANCE

Interchangeability of most compressor components, and easy access and replacement of all parts subject to wear, mean less cost to you for cold system upkeep. For example, the double row roller bearing arrangement used on our crankshaft allows the shaft to expand freely, thereby preventing excessive thrust loads on the bearings — loads which would cause overheated bearings and compressor failure. Also, the crankshaft is fixed at the seal end bearing which eliminates any shifting of the shaft in respect to the seal parts. This results in a trouble-free shaft seal.

Features like spring loaded safety heads, connecting rod bearing inserts, and double row tapered roller bearings all assure the 440 VMC of dependable performance.

POWER COST SAVINGS WITH CAPACITY STEPS

To effectively reduce energy consumption, 440 VMC's are provided with built-in automatic capacity reduction steps (optional steps available) for operation at reduced loads as shown in the table below. At the same time, automatic cylinder unloaders allow the compressor to start partially unloaded, thus reducing peak power demands and eliminating the need for expensive high torque motors.

	STEPS OF CAPACITY REDUCTION		
No. of Cylinders	Standard	Option 1	Option 2*
2	0%	50%	100%
4	50%	25, 50, 75%	50, 100%
6	33, 66%	—	33, 66, 100%
8	25, 50%	25, 50, 75%	25, 50, 75, 100%
12	33, 66%	—	33, 66, 100%
16	25, 50%	25, 50, 75%	25, 50, 75, 100%

*100% internal capacity reduction option includes timer and high oil temperature cut-out to shut down machine.

440 VMC COMPRESSOR SPECIFICATIONS

REFRIGERANTS — R-717 (Ammonia), R-22 and R-290 (Propane)

OPERATING RANGE — From suction *temperatures* of far below zero to suction *pressures* up to 150 p.s.i.g. for special process work.

COMPRESSOR SIZES — 20 hp. through 250 hp. 2, 4, 6, 8, 12 and 16-cylinder units.

BORE AND STROKE — 4½" × 3½" (114 mm × 89mm).

OPERATING SPEEDS — Up to 1200 r.p.m.

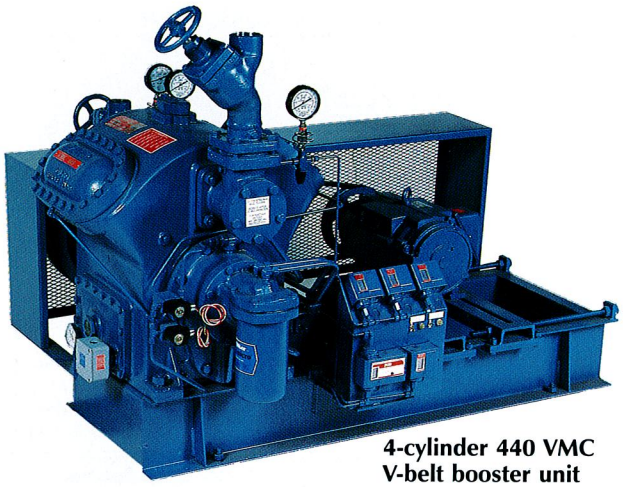
COMPRESSOR DRIVE — Direct-connected or V-belt drive.

MOTOR TYPE — *V-belt drive* — 1150 or 1750 r.p.m. (960 or 1450 r.p.m., 50 Hz) motor mounted on universal-type rails. *Direct-connected* — 1150 r.p.m. (960 r.p.m., 50 Hz) or lower, squirrel cage or synchronous motor drives compressor through flexible coupling with guard. Engine or turbine drive also available.

LUBRICATION — Force-feed circulating oiling system with automatically-reversing, positive-acting *gear pump* — driven directly from compressor shaft.

PRESSURE CONTROL SWITCHES — All units supplied with oil failure switch and dual pressure control. Factory mounted on compressor units with base.

8-cylinder 440 VMC high stage compressor



4-cylinder 440 VMC
V-belt booster unit

12-cylinder 440 VMC
V-belt compressor unit

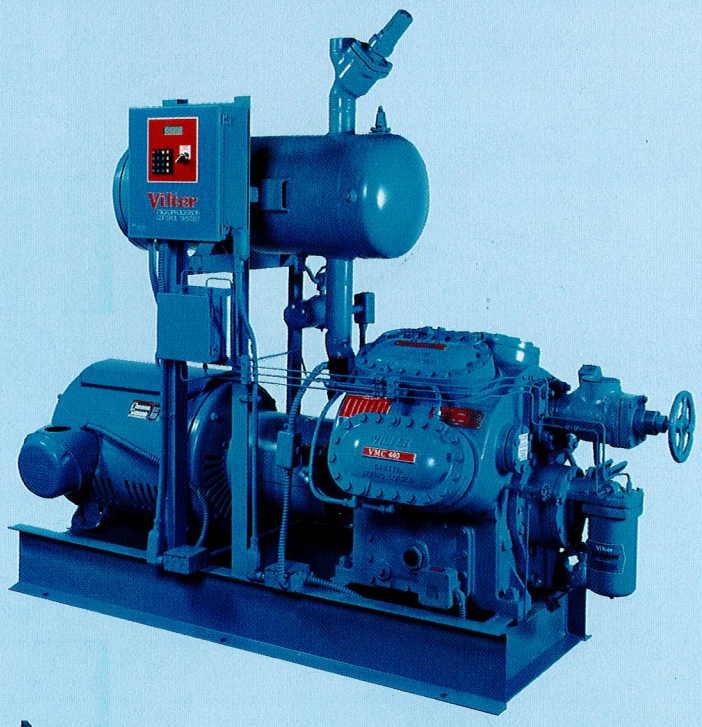
Other Ways The 440 VMC Can Work For You

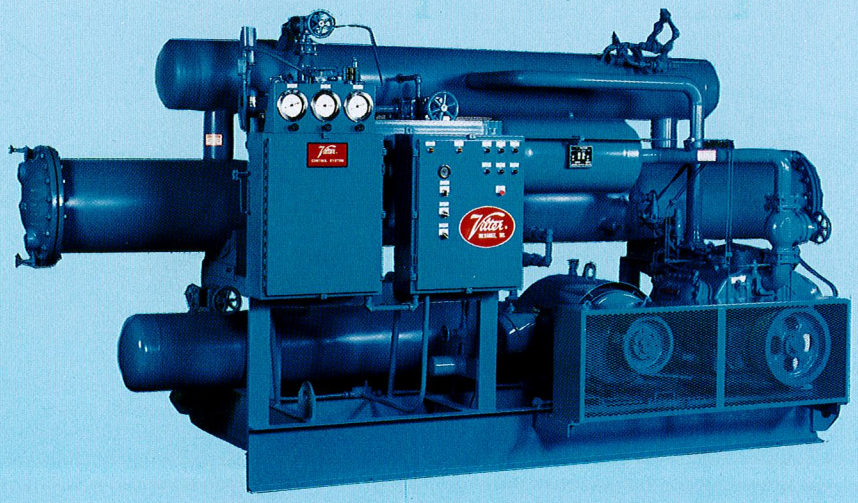
440 Compressor Packages With Microprocessor and Super Separator

Save time and money on your refrigeration requirements with Vilter's new VMC® 440 compressor packages. These standard packages consist of a 440 reciprocating compressor (with a 2-year warranty!), a Microprocessor Control with NEMA 12 (NEMA 4 optional) enclosure and Vilter's exclusive Super Separator® with flanged access cover. All of these components, plus all valving, piping and wiring are integrated into one compressor package on a single, structural steel base.

Prepackaging reduces field installation time, and the unit's compact design allows a 440 package to fit into the tightest of areas. With Vilter's efficient Super Separator — 99.9% efficient for particles down to 1 micron — oil loss is reduced to almost zero.

Vilter 440 packages are available in direct drive and V-belt configurations using either ammonia or R-22 refrigerants.





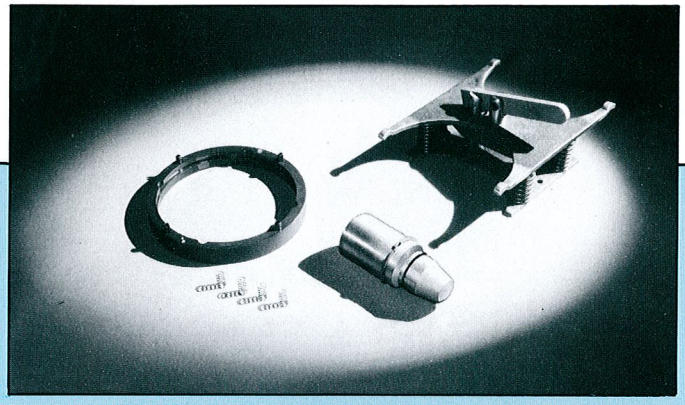
440 Chilling Packages

Vilter 440 custom packaged units can range all the way from a basic compressor unit to a complete packaged refrigeration "equipment room," depending on specific requirements. With Vilter custom packages everything is provided, including one or more compressors direct connected or V-belt driven by electric motors or heavy duty natural gas engines. Chillers, condensers and other auxiliary pressure vessels are provided as required . . . all conforming to ASME code. All controls and instrumentation are wired for completely automatic operation.

Vilter 440 packages can be designed as liquid recirculating, direct expansion, or flooded systems — or any combination thereof for all popular industrial refrigerants.

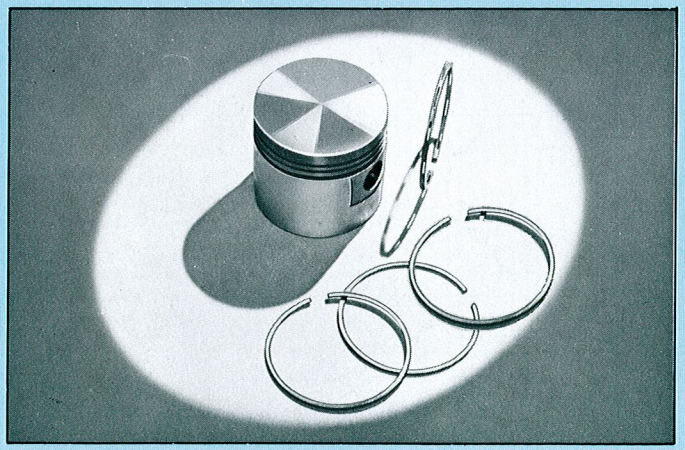
Compare These 440 VMC Features Against Comparable Competitive Models

ITEM	VILTER 440 VMC	COMPETITOR "X"	COMPETITOR "Y"	COMPETITOR "Z"
Shaft Seal	Double Seal	Single Seal	Single Seal	Double Seal
Main Shaft Bearings	Double Tapered Roller	Sleeve Type	Sleeve Type	Sleeve Type (Shaft End Roller Bearing 8 & 12 Cylinder)
Piston Rings	4	4	2	3
Oil Filtering	Tri-Micro Filter And Oil Strainer	Filter and Oil Strainer	Oil Strainer Only	Filter and Oil Strainer
Protection Against Slugging	Safety Head Springs	Safety Head Springs	None	Safety Head Springs
Connecting Rods	Replaceable Bearing Halves	Replaceable Bearing Halves	Integral Bearings (Non-replaceable)	Replaceable Bearing Inserts

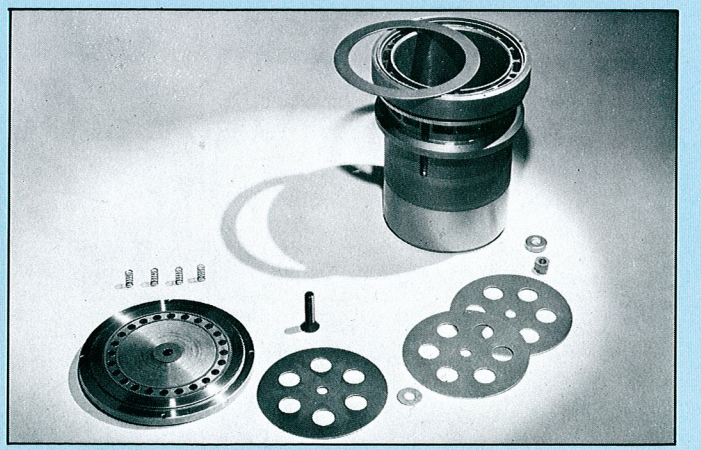


PISTON OPERATED SUCTION VALVE LIFTERS partially unload the compressor for starting. Capacity control is also provided through this mechanism. Each lifter operates a pair of cylinders. A suction pressure switch with solenoid valve controls the operation of each capacity control unit. High pressure gas or oil is metered into the operating chamber of the unloader piston through a small port, thereby depressing the piston to lower the suction valve plate, loading the compressor.

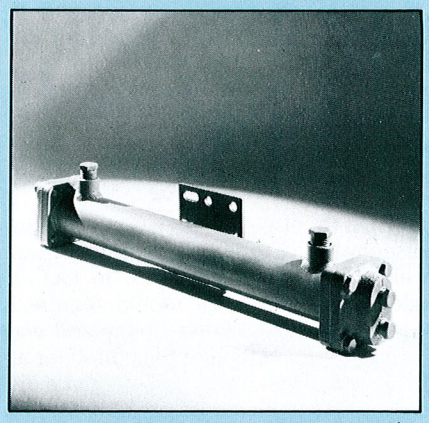
SPRING LOADED SAFETY HEADS provide protection against liquid slugs. In case of slugging, the springs can compress and safety heads rise to provide additional volume, thus avoiding the transmission of a heavy shock load to compressor parts. The extra space provided by this arrangement allows the liquid to be forced out of the cylinder more easily. These safety head springs also provide holding force for the cylinder liners.



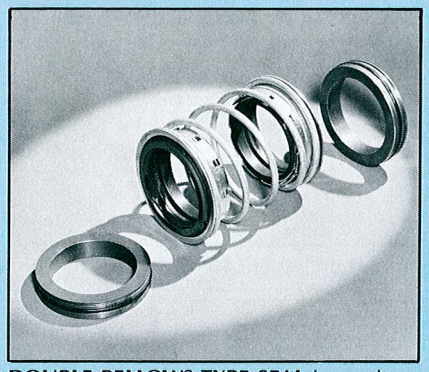
ALUMINUM AUTOMOTIVE-TYPE PISTONS. Rings are of special, close-grained cast iron, moly-coated and heat treated for longer wear. The ring set consists of three compression rings and one oil ring for all speeds. A relief around the piston pin helps prevent piston seizure under severe operating conditions by reducing the surface contact area between the piston and the cylinder wall. The entire piston is tin-plated to prevent scuffing it or its liner during the break-in period.



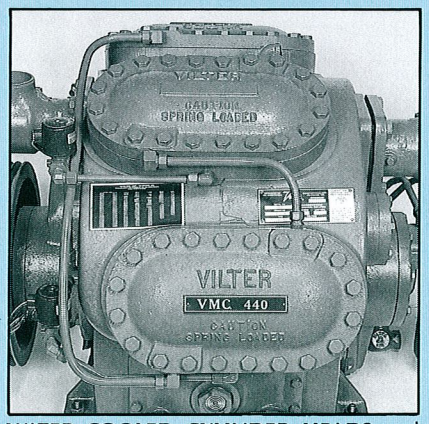
CYLINDER LINERS are of cast alloy iron. They are easily replaced when necessary and held in place by the safety head springs. The liners are heat treated for better wearing qualities. Suction valves are of the single ring plate type which seat on the accurately machined and lapped surface of the cylinder liners. The discharge valve consists of three alloy steel diaphragms attached to the safety head. The bottom diaphragm seats only on the lapped surface of the safety head.



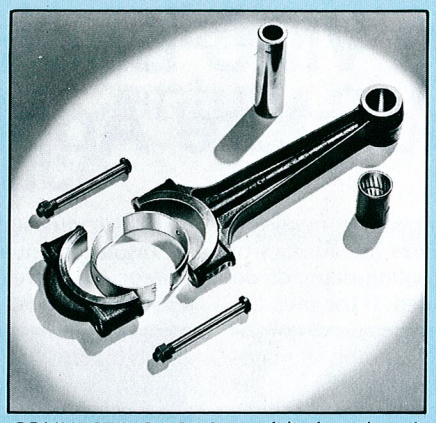
SHELL AND TUBE TYPE OIL COOLER designed for 300 psig working pressure on the tube (coolant) side as well as on the shell (oil) side to permit either fresh water, sea water (shown above), or refrigerant to be used as the coolant. Whenever the coolant to be used is the refrigerant, special piping is required. When sea water is to be the coolant, sacrificial metal anodes are factory-installed in the inlet head of the oil cooler.



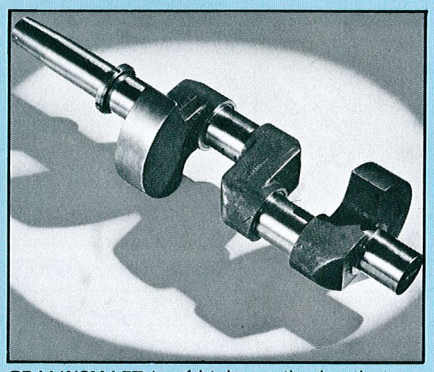
DOUBLE-BELLOWS TYPE SEAL is a unit assembly consisting of two opposed seals, one sealing to the atmosphere and the other to the crankcase. The mating seal surfaces are lubricated and cooled by circulated oil. Principal seal parts consist of flexible synthetic bellows and a stationary floating seat which mates against the rotating washer.



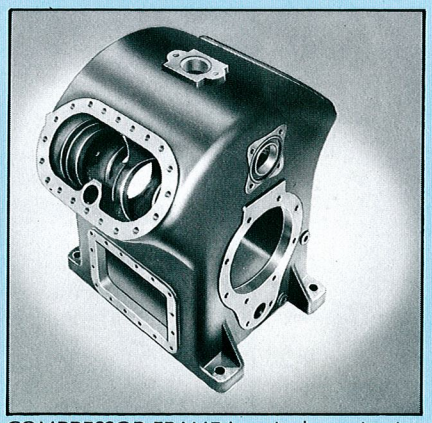
WATER COOLED CYLINDER HEADS and the necessary water connections. This arrangement prevents the machine from running too hot and causing the break-down of the oil which would lead to above normal expansion of some parts, increasing their wear and shortening their effective life. Booster compressors are available with water cooled heads but they are normally not required. Optional Vilter-patented high pressure liquid refrigerant cooling system also available.



CONNECTING RODS are of die forged steel, accurately bored and provided with replaceable precision-made bearing shells of steel backed babbitt. The connecting rods are rifle drilled for pressure lubrication to the piston pins. The piston pins are of case hardened steel, ground and polished to proper size. The piston pin bushings are of steel backed bronze and are grooved.

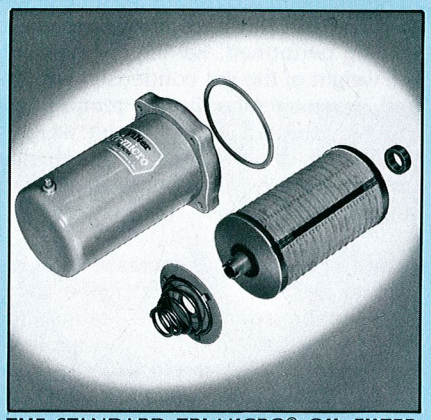


CRANKSHAFT is of high tensile ductile iron with integral counterweights. Bearing surfaces are carefully ground and polished in two directions to close tolerances. The shafts are dynamically balanced, assuring minimum vibration. Crankshafts are drilled for pressure lubrication. In the case of the 12 and 16 cylinder units, a center sleeve bearing helps support the shaft.



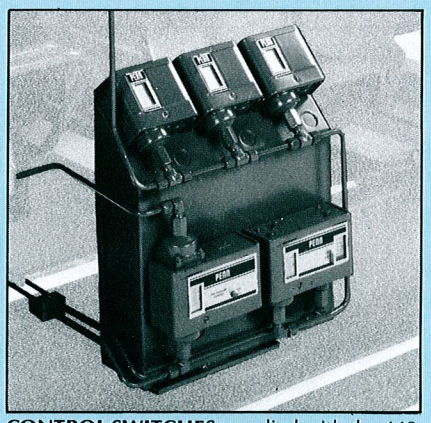
COMPRESSOR FRAME is a single casting incorporating the suction and discharge manifolds and bearing supports.

The frame is cast from a very special iron, Viltrite®. This material is exceedingly tough, withstands the severest wear, heat and pressure, and is particularly free from porosity and internal stress. From the thinnest to the thickest section, a casting of Viltrite will show a consistently uniform metal structure.



THE STANDARD TRI-MICRO® OIL FILTER is a unique innovation which sets a Vilter compressor unit far ahead of all competitors. It was designed especially for Vilter and is supplied exclusively by Vilter. The standard Tri-Micro combines an extreme filtering capability (nominal 3 micron rating) with the convenience of a throw-away filter element. Allows full flow of oil at all times, resulting in reduced wear on the compressor components and increased longevity of the compressor itself.

A Vilter Improved Tri-Micro® oil protection system, offered as an optional feature on 440 VMC Series compressors, includes a special no-bypass Tri-Micro filter (absolute 3 micron rating) which precludes any possibility of dirty oil bypassing the filter element and getting into the internal working parts of the compressor.



CONTROL SWITCHES supplied with the 440 VMC are conveniently mounted on a control panel. Standard control arrangements will vary for booster or high pressure operation; however, all machines include an oil failure switch which stops the machine if oil pressure drops below a safe minimum.

A typical control arrangement for a high pressure machine also includes low pressure controls to regulate capacity reduction and a dual pressure control which protects against low suction or high discharge pressures. Booster compressors include high pressure controls.

Save With 440 VMC Boosters On Low Temperature Applications

In refrigeration it is not the volume of gas pumped nor the piston displacement of the compressor that determines the amount of cooling performed. Rather, the amount of cooling depends on the weight of the gas condensed and evaporated. If the pressure and, consequently, the gas temperature of the cooling coils is lowered, the volume of a unit weight of refrigerant increases greatly out of proportion to the change of pressure. This is set forth graphically in the portion of the table below covering single stage operation.

Note the tremendous increase in H.P. required per ton as the suction pressure, and with it the gas temperature, of a single stage compressor decreases. For instance, lowering the ammonia suction pressure from 20 lb. to 0 lb., at a constant discharge pressure of 175 lb., results in an increase of 85% in H.P. per ton. This is not efficient operation. As the suction pressure is further decreased, conditions grow steadily worse. At 10" vacuum, 147% more H.P. per ton is required than at 20 lb. suction.

Now compare this with a 2-stage ammonia system.

At 20 lb. suction a saving of 11.8% in H.P. per ton can be effected. At a 10" vacuum, the saving in power cost is 25%. Note that power savings increase as the suction pressure decreases.

At 10" vacuum suction and 175 lb. discharge pressure, compressor displacement and horsepower per ton of a single stage compressor are increased well beyond practical limits. In fact, at these conditions, a single stage compressor would require a compression ratio of 19 to 1, a practical impossibility and way above the 8:1 ratio we normally recommend as maximum for an ammonia system. Multi-staging makes savings possible since displacement and power requirement increases are not as pronounced. In addition, multi-staging decreases the compression ratio of each compressor.

The use of multi-staging on low temperature applications also results in longer equipment life with less maintenance. At low suction pressures, the temperature of the discharge gas in a single-stage compressor is considerably higher than the temperature of the gas in a multi-stage system. This means that the working parts of the single-stage compressor are hotter and consequently operate under greater stress. Oil breakdown, resulting in poor lubrication and carbonization, is also a constant danger because of the high temperature. Further, if a cold refrigerant slug should get back to the compressor, the sudden contraction of the hot valves might result in breakage. The lower discharge gas temperature in a multi-stage system minimizes these dangers to effect maintenance savings.

POWER SAVING THROUGH USE OF TWO-STAGE COMPRESSION (AMMONIA)

OPERATING CONDITIONS		SINGLE STAGE OPERATION		TWO-STAGE OPERATION
Suction Pressure and Temperature	Discharge Pressure	Horsepower* per Ton	Increase in H.P. per Ton (%)	Power Saving (%)
20 Lb. Gauge, +5.5°F	175 Lb.	1.44	—	0%
10 Lb. Gauge, −8.4°F	175 Lb.	1.96	36%	6.5%
0 Lb. Gauge, −28°F	175 Lb.**	2.81	95%	9.7%
10" Vacuum, −42 °F	175 Lb.**	3.76	161%	15.3%

*Based upon requirements of 60 ton multi-cylinder compressor.

**These operating conditions are not possible for single-stage operation since compression ratio is above 8:1.

6-cylinder unit. Also available as a 12.

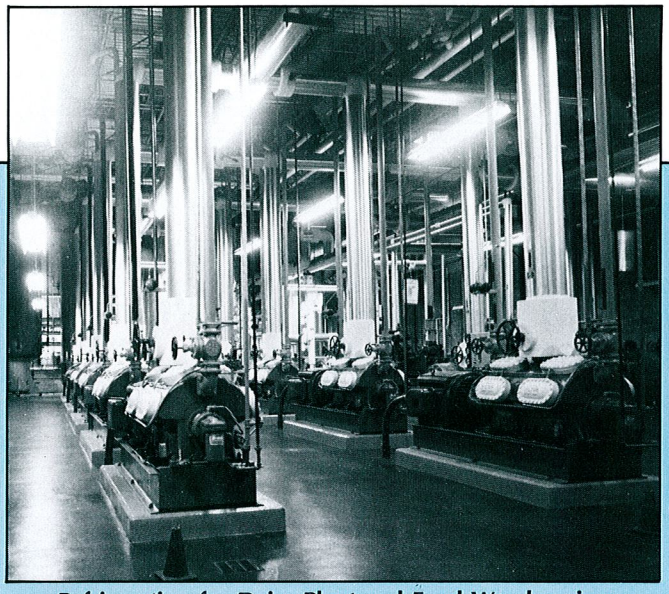
Two-Stage 440 VMC Compressors

Two of the 440 VMC sizes described in this bulletin, namely the 6 and 12-cylinder units, lend themselves to being internally partitioned to form two-stage compressors and develop from 3 to 80 tons (10-280 kW) capacity, depending upon the operating conditions. The advantages of a two-stage compressor are readily recognizable: savings in space, lower material cost and reduced erection expense because the intercooler is factory mounted.

Details on how two-staging is accomplished in a single machine are available in Vilter Bulletin #537.

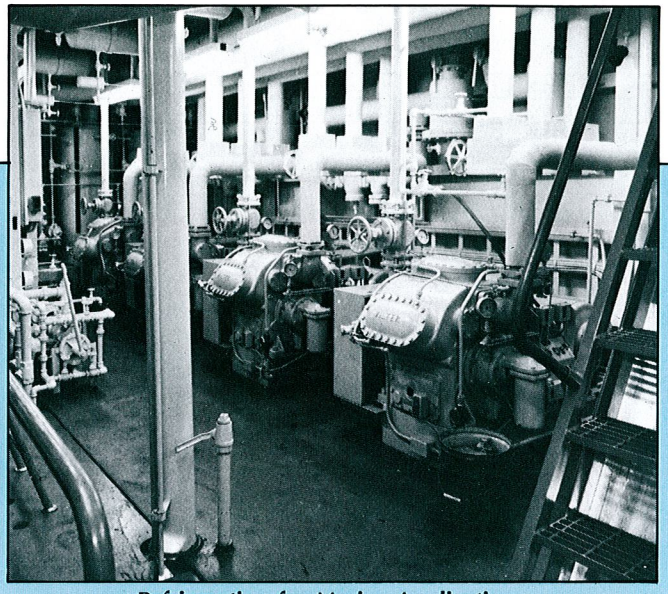
Vilter 440 VMC Installations ... Based on Over a Century of Cold System Design Experience

Here are just some examples of the many Vilter 440 VMC cold system applications that have won customer confidence throughout the world for dependable low cost refrigeration.



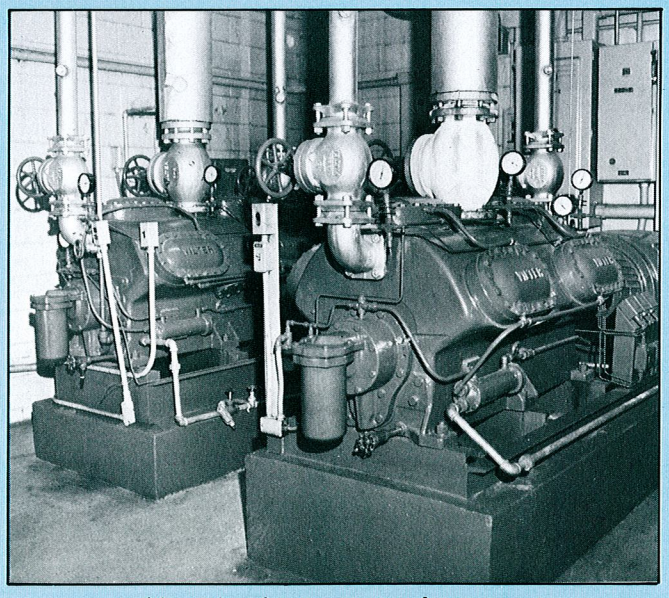
Refrigeration for Dairy Plant and Food Warehousing

The 440 VMC's shown above serve a combination dairy plant and frozen food distribution facility. In this installation, several 16-cylinder, direct-drive compressor units provide over 1,500 tons of refrigeration capacity.



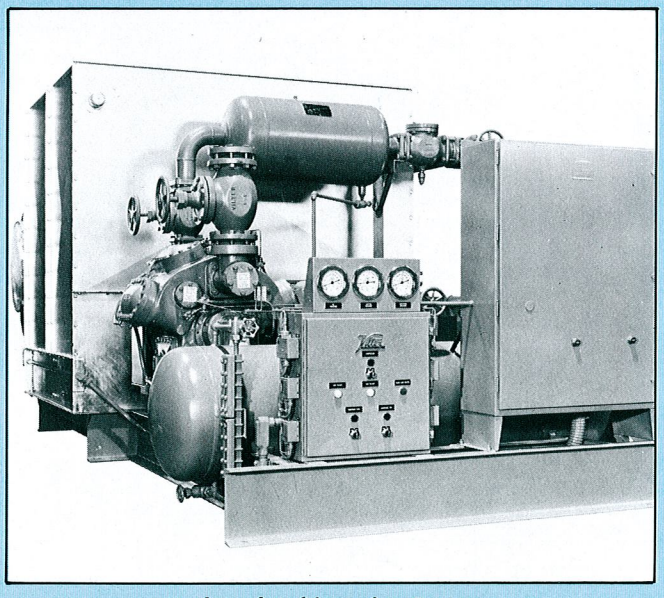
Refrigeration for Marine Applications

Fishing vessel owners and on-shore processing plants rely on Vilter compressors for cooling and freezing their valuable catches. Included in this vessel installation are two 6-cylinder and two 8-cylinder V-belt compressor units.



Refrigeration for Frozen Food Processors

These 12-cylinder compressor units are part of a Vilter two-level, ammonia refrigeration system used to handle a frozen food processor's medium and low temperature requirements. The system consists of several Vilter high stage compressors, condensers, receivers and intercoolers.

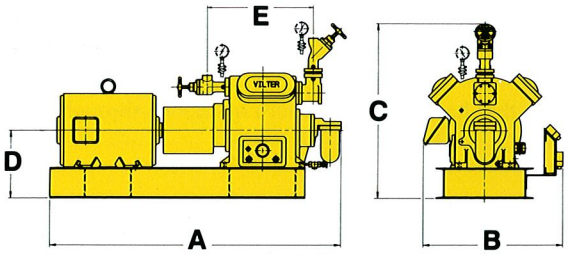


Packaged Refrigeration Systems

In addition to on-site installations of Vilter compressors, Vilter can also provide complete, factory-packaged refrigeration systems complete with compressors, controls, oil separator and other required equipment. Shown above is a water chilling unit used in precooling freshly picked fruit.

Space Requirements For 440 VMC Models

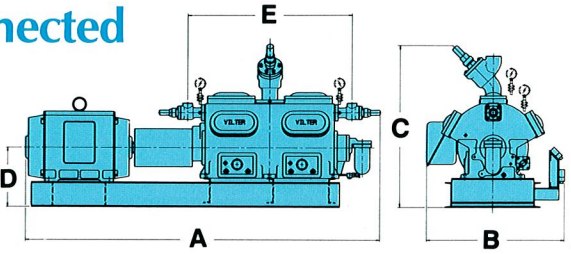
Direct-Connected



Cyls.	A (Max.)	B	C	D	E
2	79"(2007)	41"(1041)	50"(1270)	20"(508)	29"(737)
4	87"(2210)	42"(1067)	52"(1321)	20"(508)	32"(813)
6	93"(2362)	42"(1067)	40"(1016)	20"(508)	34"(864)
8	96"(2438)	45"(1143)	39"(991)	20"(508)	35"(889)

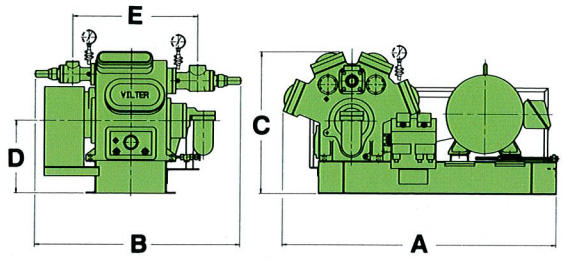
Space needed to remove flywheel: 7" (178mm). Space needed to remove crankshaft from either end of compressor — 65.5" (1664mm): 2-8 cyl.; 72.0" (1829mm): 12/16 cyl.

Dimensions shown are approximate and may vary depending on refrigerant and/or motor used. These dimensions are not to be used for construction, for which certified prints will be furnished. Dimensions are in inches followed in parentheses by millimeters — in.(mm).

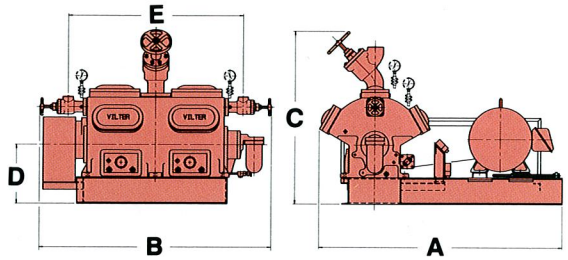


Cyls.	A (Max.)	B	C	D	E
12	129"(3277)	50"(1270)	60"(1524)	22"(559)	60"(1524)
16	129"(3277)	50"(1270)	63"(1600)	22"(559)	60"(1524)

V-Belt Driven



Cyls.	A	B	C	D	E
2	69"(1753)	48"(1219)	50"(1270)	20"(508)	29"(737)
4	74"(1880)	49"(1245)	52"(1321)	20"(508)	32"(813)
6	76"(1930)	56"(1422)	40"(1016)	20"(508)	34"(864)
8	76"(1930)	57"(1448)	39"(991)	20"(508)	35"(889)



Cyls.	A	B	C	D	E
12	83"(2108)	80"(2032)	58"(1473)	20"(508)	60"(1524)
16	83"(2108)	80"(2032)	62"(1575)	20"(508)	60"(1524)

Engineering Specifications (For the aid of Architects and Engineers)

The Contractor shall furnish and install where shown on the plans and specifications a Vilter 440 VMC Reciprocating Compressor(s) model in accordance with the following specifications.

All materials shall be new and of the highest quality and shall be installed by the Contractor in a neat, workmanlike manner, and shall conform with all state and local codes.

The compressor(s) shall be of the heavy duty, reciprocating, multi-cylinder open type. The compressor shall have double shaft seal; double tapered, roller main shaft bearings; Tri-Micro® oil filter and oil strainer that removes 95% of contaminants as small as 3 microns in size; dynamically balanced crankshaft of ductile iron; spring safety heads; die-forged, steel connecting rods with replaceable bearing halves; aluminum type heat treated pistons with three compression rings and one oil ring; piston operated suction valve lifters to unload the compressor for starting and to provide capacity control.

The compressor(s) shall be equipped with the additional following standard equipment: oil failure switch; suction, discharge, and oil pressure gauges complete with Stedy-Mounts® and shut-off valves; water (or refrigerant) cooled cylinder covers; and water (or refrigerant) cooled oil cooler.

Compressor(s) shall come complete with structural steel base, and be driven by a ____ HP, ____ RPM, ____ volt, ____ phase ____ cycle motor with direct coupling and coupling guard or V-belt drive with flywheel, belts and motor sheave for ____ RPM. Compressor(s) shall have a capacity of not less than ____ tons when operating at ____°F. suction temperature and ____ psig condensing pressure. Compressors are to be manufactured by Vilter Manufacturing Corporation, Milwaukee, Wisconsin, or equal as approved.

General Specifications

440 VMC Model	Maximum RPM	Displacement at Maximum RPM (Cu. Ft./Min.)	Tons* Refrigeration			Connections (Line Size) Inches (Millimeters)		Oil Charge (Gallons)	Approximate Shipping Weight in Lbs. (Kg.) Less Motor and Starter	
			R-717	R-22	R-290	Suction	Discharge		Bare Compressor	Complete Compressor Unit
442	1200	78	18	23	12	2½ (64)	2 (51)	5	1200(544)	1900(862)
444	1200	155	36	47	25	3 (76)	2½ (64)	7	1600(725)	2700(1225)
446	1200	232	54	70	37	4 (102)	3 (76)	7	1900(862)	3100(1406)
448	1200	309	72	93	49	4 (102)	3 (76)	7	2200(998)	3400(1542)
4412	1200	464	108	140	73	5 (127)	(2)3 (76)	14	3600(1633)	5300(2404)
4416	1200	619	144	186	98	6 (152)	(2)3 (76)	14	4000(1814)	5800(2630)

*Tons R-717 @ 10°F. suction and 185 psig discharge and 1200 RPM.
Tons R-22 @ 20°F. suction, 95°F. discharge and 1200 RPM.
Tons R-290 @ 0°F. suction, 95°F. discharge and 1200 RPM.

Vilter reserves the right to make changes in specifications and design without notice.

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