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**HIGH VACUUM TRANSFORMER  
OIL DEGASIFIERS/PURIFIERS**

**MODEL VPH**

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## **1.0 GENERAL**

*It has been recognized that the over-all life of a transformer can be extended with regular purification of electrical insulating fluids within the transformer. Moisture, solids and gaseous contaminants can seriously affect the function of electrical insulating fluids as a coolant and insulator.*

*This specification describes the equipment as supplied by Filtrvac for the processing (degasification, dehydration, filtration and optional de-acidification) of transformer insulating oil. The VPH Purifier is designed for processing the transformer oil in workshops or in the field, in storage tanks, drums, directly in transformers or within Tap Changers/Circuit Breakers. Purification of oil in transformers can be carried out off-load or on-load (subject to the selection of Option LM) depending on customer's preference.*

## **2.0 OPERATING CHARACTERISTICS**

### **SCOPE OF SUPPLY:**

The scope of supply of this specification shall include the design, fabrication and factory testing of a **Vacuum Oil Purifier type VPH**. Filtrvac supplies stationary, portable or roadworthy mobile Vacuum Oil Purifiers depending on the customer's application. The equipment will be mounted on a common base or in a trailer and supplied in the form of a pre-piped and pre-wired packaged system and shall provide a fully workable unit in accordance with this specification when received by the purchaser.

### **OPERATING CONDITIONS:**

The installation shall be designed to operate satisfactory at ambient temperatures ranging from 0 deg. C(32 Deg.F) to 55 deg. C(130 Deg.F).

### **DRYING AND FILLING UNDER VACUUM:**

Treated oil flow shall be adjustable from 0 to maximum design flow. The quality of materials in contact with the oil is adequate for prolonged drying operations at 130 deg. C.

### **COMBINED OPERATIONS:**

The installation is designed and built to allow the following operations during combined operations of heating of oil:

- Degasifying, dehydrating of oil under high vacuum
- Removal of carbon/particulate contamination from the oil.

### **3.0 DUTIES AND PERFORMANCE**

Performance in single pass through the Purifier at full flow rate shall be as follows:

#### **WATER REMOVAL**

From 100 PPM down to less than 10 PPM as measured by ASTM Method D-1533.

#### **GAS REMOVAL**

From fully saturated with air (10 to 12% by volume) down to less than 0.25% as measured by ASTM Method D-2945.

#### **PARTICULATE MATTER REMOVAL**

With the use of a Filtrvac High Efficiency Filter Element, 99.5% of particles over 1.0 microns are removed.

#### **DIELECTRIC BREAKDOWN**

Dielectric breakdown voltage of oil will be increasing from 30 kV to 50 kV or better.

#### **ACIDITY CORRECTION**

With the addition of an optional Fullers Earth Filter (**Option XFEC or XFET**), the neutralization value of the oil can be reduced from 0.5mgr KOH/g to 0.05mgr KOH/g as measured by ASTM D-974 measuring method.

### **4.0 PROCESS DESCRIPTION**

Insulating oil is drawn into the system and is passed through an inlet strainer by the use of the vacuum created by the system's vacuum pump.

Before entering into the Processing/Vacuum Chamber, where water and gasses contained in the oil are thoroughly exposed to vacuum by efficient dispersion and removed through a Vacuum Pumping.

Filtrvac Oil Purifiers use porous cartridges (coalescers) inside the Vacuum Chamber for the maximum exposure of oil to the effect of vacuum. The efficiency of the Filtrvac Purifiers using coalescers surpasses any other known method of dehydration and degasification of oils. In fact, the oil at temperature of 70 deg. F can successfully be processed without elevating the oil temperature. Purified oil is then discharged by a pump through a Filtrvac High Efficiency Filter Element (1 micron absolute under ISO 4572 code) where a fine polishing of oil takes place. After passing through the "Fine" Filter, the oil flows through an optional Flow Meter (**Option FM**) before exiting through the outlet or re-circulation valve.

If **additional** corrective action is required for the removal of trace contaminants not removed by vacuum or mechanical filtration, an optional Activated Clay Filter can be provided through the optional Piping Manifold (See in Option Section).

## Operation and Maintenance

Filtervac Purifiers combine maximum simplicity with high safety standards. A number of sensing devices are built in, continually monitoring the most vital parameters (see par ALARMS). If any of these parameters deviate from normal operation, the purifier will shut down and diagnostic light will remain on to inform their operator what corrective action is required.

### **5.0 MAIN COMPONENTS**

a) **INLET STRAINER** - Filtervac utilizes a 40-mesh Y-strainer to remove any large particles that could cause premature damage to the inlet pump.

b) **INLET PUMP.** Positive displacement gear type pump or equivalent, complete with mechanical seal, is utilized to draw oil into the VPH System. The pump is direct driven by TEFC motor and is standard on all systems except as noted below.

**Note:** VPH 200 & 400 (200 & 400 USGPH) Systems do not utilize (Optional) an inlet pump but instead oil is pulled into the system by the means of the vacuum pump. However an inlet pump is required in the following cases: - If the application requires a pre-filter or  
- if the oil is being pulled from great distances  
- if the viscosity of the oil exceeds 100 SSU @250 Deg.C (100 Deg. F)

c) **ELECTRIC HEATER.** A low watt density heater is used to prevent the heat degradation of oil. Heater elements are encapsulated in steel tubes thus completely insulated from oil to prevent a fire hazard. The Heater is controlled by heavy-duty contractors and an electronic temperature controller. The oil temperature is thermostatically controlled from 20 to 120 deg. C.

d) **FLOW INDICATOR/SWITCH:** Flow Indicator/Switch is used to signal low flow conditions interlocked with the heater and shall require proper flow to engage the heater. Should a low flow condition exist while the heater is engaged, a signal is sent to the P.L.C., which then safely shuts down the heater and the system and illuminates an alarm signal located on the panel to notify the operator of a low flow condition.

e) **PROCESSING/VACUUM CHAMBER.**

**Construction:** Shell and all internal parts are made of carbon steel and come complete with view port. Vacuum chamber features heavy-duty design, suitable for mobile installation. Suitable flexible connections shall be provided to the discharge pump and vacuum pump shall be provided to minimize vibration.

**Internals:** Located in the chamber will be a series of coalescer filters (Number of coalescers directly related to flow rate) Also located inside the vacuum chamber will be a series Of level switches, one (1) optical probe and one (1) float actuated level controller which are explained in further details in other sections of this specification.

- f) **OIL LEVEL CONTROLLER** - Inside the Vacuum Chamber, a float actuated level control valve is utilized to control the proper oil level in the vacuum chamber. The control valve is fully modulating and will maintain an inlet flow equal to the capacity of the discharge pump.
- g) **VACUUM PUMP** Busch Rotary Piston Vacuum Pump is air-cooled c/w built in ballast. The pump is direct driven by TEFC electric motor.
- h) **OIL TRAP** - A Secondary Chamber, termed the "Oil Trap", that is connected to between the vacuum chamber and the vacuum pump is provided to ensure that no oil is pulled into the vacuum pump. The fool proof Oil Trap design employed by Filtrvac utilizes a set of baffles and comes complete with a High Level Switch that immediately shuts down the system upon the sensing of oil accumulation on the bottom of the Oil Trap. This Oil Trap is provided as a back up safety feature should all necessary level switches and optical probes located in the vacuum chamber fail.
- i) **OIL DISCHARGE PUMP** – Viking gear pump featuring high suction capabilities removes oil from the processing chamber and discharges the oil through a filter before it is directed either through the discharge port or is re-circulated within the system. Pump is directly driven by TEFC motor, is mounted on a common base and comes complete with a relief valve. A socket weld Y-Strainer is provided for start-up and flushing purposes to ensure that the discharge pump is not prematurely destroyed by initial welding slag and debris.
- j) **FINE FILTER** - Oil receives its final "polishing" treatment by passing through a FILTERVAC high performance element. The filter is rated to capture 99.5% of particles greater than 1 micron absolute under ISO 4572 element rating code.
- k) **SAMPLING PORTS** - Two (2) sampling ports shall be provided, one for the incoming oil and one for the processed oil.
- l) **INLET & DISCHARGE VALVES:** Manual ball valves (NPT Connection) are provided for the inlet and discharge connection.
- m) **MANUAL RE-CIRCULATION VALVE:** One manual ball valve (NPT Connection) is provided for re-circulation purposes.
- n) **PIPING:** All piping shall be carbon steel, sized for the designed flow rate, braced and supported to prevent vibration. Piping will be welded construction when possible, to minimize the potential for leaks.
- o) **TRANSFORMER DRY-OUT CONNECTION** – Depending on capacity of the system, a 2" or 4" Vacuum Connection is provided for customer hook up to transformer to pull vacuum on transformer. Several isolating Butter-Fly Valves are provided to isolate vacuum from vacuum chamber.  
Note: This is an optional feature for VPH System smaller than 900 USGPH (3400 LPH) or smaller and must be requested as an option

- p) **CONTROL PANEL INSTRUMENTATION, ALARMS & INTERLOCKS**  
Instrumentation & electrical controls are located in NEMA 4 type enclosure. The standard electrical control system utilizes an Allen Bradley Programmable Logic Controller (P.L.C.) and a series of instrumentations, alarms and interlocks to provide a fully automatic operation. Manual control of various functions is provided as required. Several Pilot Lights are provided to indicate operational status (on/off) of key components and alarm conditions.

### **STANDARD INSTRUMENTATION & CONTROLS**

**Temperature Controller (1)**      Electronic temperature controller featuring fail safe operation.

**Indicator Gauges**

- Differential Pressure Gauges/Switches for Polishing Filter is provided to monitor the status of the polishing or pre-filter cartridges
- Compound Gauge is provided to monitor the status of the dispersion coalescing filters.
- Vacuum Indicator Gauge is provided to determine level of vacuum within the chamber.

**Foam Control (1)**

Occasional foaming oil can develop under certain circumstances. If the Photo Eye Sensor, located in the Vacuum Chamber, detects high foam, a Solenoid Operated Valve will be actuated to break vacuum and thus the foaming will be reduced to acceptable levels. Plant operation is not affected, unless severe foaming conditions persist. If they persist, the system will safely shut down.

### **ALARMS & INTERLOCKS**

Filtervac has accounted for all potential scenarios that may be encountered out in the field and has provisions for automatic shut down of plant in the case of any alarm situation. The following alarms and interlocks ensure simple and safe automatic operation of purifier:

**Heater**      Heater is activated only when flow of oil is detected by a flow switch. Pre-set oil temperature is maintained within 2 deg F.

**Optical Probe**      Foam or oil overflow to vacuum pump is positively prevented by optical probe.

**Vacuum Break**      Automatic vacuum break with 5 sec. time delay to protect the vacuum pump during the occurrence of foaming.

### **Low Level Alarms**

One Low Level Switch is installed and is interlocked with the discharge pump to prevent it from operating unless sufficient oil head is present. If low-level condition is present for some pre-determined period of time, the system is shut down and a low-level alarm signal will communicate on the control panel.

### **High Level Alarms**

Should high-level condition occur in the vacuum chamber, the system will be stopped to prevent flooding of chamber. The High Level Alarm is effective in preventing flooding of vacuum chamber under the following conditions:

- i Acts as a back up to the Float Actuated Level Control Valve should it fail.
- ii Acts as a back up safety feature should the operator forget to open the discharge valve

Note: Foam Detector (Photo Eye) provides this function.

### **Overloads**






All motors protected by overloads


### **Sound Alarm**

Sound alarm is mounted within the control panel with silence button. Remote alarms can also be provided as option.


## 6.0 OPTIONAL EQUIPMENT:

### TRAILERS & PORTABILITY OPTIONS:


<p><b>Option MC</b></p>  A white, single-axle utility trailer with a blue canopy and a red fire extinguisher mounted on the side. The trailer is shown from a three-quarter front view.	<p><b>MOBILE INSTALLATION/SINGLE AXLE UTILITY TRAILER</b></p> <p>System is placed in a roadworthy, weatherproof single axle trailer and the system is designed to be operated and accessed from the outside of the trailer. To access and monitor components on the VPH System, the trailer is equipped with lift up(Pneumatic Shock Type) rear door(Qty 1) and side doors(Driver and Passenger Side). The outer walls of the trailer/doors are constructed of white aluminum walls to provide for a weather resistant trailer.</p> <p>The braking system consists of electric brakes and a safety feature is provided should the system break free from the towing vehicle.</p>
<p><b>Option MC1</b></p>  A white, double-axle utility trailer with a blue canopy and a red fire extinguisher mounted on the side. The trailer is shown from a three-quarter front view.	<p><b>MOBILE INSTALLATION/DOUBLE AXLE UTILITY TRAILER</b></p> <p>System is placed in a roadworthy, weatherproof double axle trailer and the system is designed to be operated and accessed from the outside of the trailer. To access and monitor components on the VPH System, the trailer is equipped with lift up(Pneumatic Shock Type) rear door(Qty 1) and side doors(Driver and Passenger Side). The outer walls of the trailer/doors are constructed of white satin steel sheets to provide for a sturdy weather resistant trailer. The braking system consists of hydraulic brakes and a safety feature is provided should the system break free from the towing vehicle.</p>
<p><b>Option MCT/2</b></p>  A red, double-axle cargo trailer with a white door and a white roof-mounted ventilation fan. The trailer is shown from a three-quarter front view.	<p><b>MOBILE INSTALLATION/DOUBLE AXLE CARGO TRAILER TRAILER</b></p> <p>System is placed in a roadworthy, weatherproof double axle CargoTrailer and the system is designed to be operated and accessed from the inside of the trailer. To access the trailer two(2) side man doors and one rear barn door is provided. In addition one(1) roof mounted ventilation fan is provided to allow for proper ventilation within the trailer. The braking system consists of electric brakes.</p>
<p><b>Option MT</b></p>  A white, 5th wheel trailer with a blue canopy and a red fire extinguisher mounted on the side. The trailer is shown from a three-quarter front view.	<p><b>5<sup>th</sup> Wheel Trailer</b></p> <p>System is placed in a roadworthy, weatherproof double axle 5<sup>TH</sup> Wheel Trailer and is designed to be towed by a 1 Ton Pick Up Truck or Single Axle Tractor. The system is designed to be operated from the inside of the trailer. To access and monitor components on the VPH System, the trailer is equipped with rear barn doors(Qty 1) and one(1) side door. The side doors access an office area or storage area of the trailer, where by the operator can either store equipment or monitor the status of the system. The outer walls of the trailer/doors are constructed of Aluminum type material. The braking system consists of electric /hydraulic braking system. Standard Length of Trailer is 25-30FT depending on customer's requirements &amp; options chosen.</p>
<p><b>Option MT1</b></p>  A white, semi-trailer with a blue canopy and a red fire extinguisher mounted on the side. The trailer is shown from a three-quarter front view.	<p><b>Semi-Trailer</b></p> <p>The VPH System is mounted on a double-axle, super single or double wheeled semi-trailer. Trailer comes complete with two(2) side door entrances and one(1) aluminum staircase(c/w rail) that is easily safely stored and removed from under the trailer. Built in furniture is provided in this option to house the computer system and the operator. Length Ranges from 25-40FT depending on customers requirements &amp; options chosen</p>

<b>Option P</b>	<b>PORTABLE INSTALLATION</b>
	Two (2) swivel and two (2) fixed hard rubber castors or pneumatic tires are utilized to enable the purifier to be moved around the customer's plant. Portability Kit includes a convenient push/pull bar and J type hooks to allow for local storage of hoses and power source cable reel.


**FILTER VESSEL OPTIONS:**


<b>Option PF</b>	<b>PRE-FILTER</b>
	<p>To prolong the life of the polishing fine filter and offer a more efficient filtration process, a Pre-Filter can be installed prior to the polishing fine filter vessel. The Pre-filter would be placed after the heater and the polishing fine filter would be relocated after the discharge pump. This scenario is shown in the flow diagram.</p> <p>The Pre-Filter Vessel comes complete with a differential pressure gauge/switch and comes complete with a manual air vent. In addition this option includes one(1) 5 Micron Nominal rated filter element.</p>


**VACUUM PUMP OPTIONS:**

<b>Option B</b>	<b>VACUUM BOOSTER</b>
	For transformer evacuation and dry-out, vacuum booster (Roots Rotary Blower) is recommended. Vacuum Booster and pump combination is less sensitive in pumping large amounts of water vapor which is the case in transformer dry outs. Oil over flow device is incorporated to prevent oil from transformer entering into booster. Recommended for flow rates greater than 900GPH.


**ACIDITY RECTIFICATION/REMOVAL OPTIONS:**


<b>Option XFEC:</b>	<b>FULLERS EARTH CARTRIDGE (Option XFEC)</b>
	Disposable and easy to change Fullers Earth Filters are used to remove a multiple of contaminants from old oils. The use of these filters is only practical for small quantities of oil. If the application calls for regeneration of large quantities of transformer oils, a regeneration system ( <b>Model RS-M or SRS</b> ) or option <b>XFET</b> is recommended.

<b>Option XFET</b>	<b>FULLERS EARTH TOWERS</b>
	<p>Two (2) large Fullers Earth Towers are provided to allow for bulk processing of Transformer Oil. These towers are equipped with electro-hydraulic tilt or manual tilt design depending on the capacity of the towers. In addition the towers come available with electro-pneumatic or manually opening bottom covers, which allows for easy change outs of used Fullers Earth.</p> <p>Valving is provided to allow processing of oil in parallel or in series. In addition the skid is equipped with an optional vacuum pump to allow for filling the towers and also for removing residual oil from within the used clay.</p> <p><b>Note:</b> Please refer to additional data sheet for detailed technical specification on Tower Features and different capacities available.</p>


<b>Option AI</b>	<b>DBPC ADDITIVE INJECTOR</b>
	Additive Injector package is supplied to replace additives removed in the process. This package is located inside the plant and is part of the system.


## SYSTEM OPERATOR INTERFACE OPTIONS:


<p><b>Option MMI-1</b></p> 	<p><b>MACHINE MAN INTERFACE – Level 1 - Panelview Screen</b></p> <p>In conjunction with the Allen Bradley PLC, a panel mounted Panel View Screen is installed and programmed to provide a simplified flow diagram showing all major components and valves. All operating controls shall be located on the flow diagram with appropriate identification and major function are controlled and adjusted by the touch of keypad. For more details, please consult our engineers.</p>
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<p><b>Option MMI-2</b></p> 	<p><b>MACHINE MAN INTERFACE – Level 2 - Computer Screen</b></p> <p>In conjunction with the Allen Bradley PLC, an industrial touch screen panel mounted computer or desk top computer can be provided with a SCADA System. The SCADA system provides for a very detailed flow diagram to be shown and allows for maximum feedback and interface for the operator. All operating controls shall be located on the flow diagram with appropriate identification and major function are controlled and adjusted by the touch of the screen/mouse. For more details, please consult our engineers.</p>
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## VACUUM CONTROLLER, HYGROMETER & FLOW METER OPTIONS:

<p><b>Option V</b></p> 	<p><b>VACUUM CONTROLLER</b></p> <p>Pirani Vacuum Gauge is offered as an option for Systems with flow rates greater than 900 GPH.</p> <p><b>Note:</b> This option is standard for all models with flow rates larger than 900 GPH (3400 LPH).</p>
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<p><b>Option H1</b></p> 	<p><b>HYGROMETER (1 Probe)</b></p> <p>One (1) General Electric Moisture probe is installed on the discharge side of the VPH System. The reading is transmitted to the VPH System's P.L.C. whereby providing a reading of moisture content (in ppm) within the oil to be calculated and displayed on the system's Panelview Screen (Option MMI must be chosen). The readings are allow for operators to accurately monitor the moisture level within the oil when the oil temperature is maintained at 50 Deg. C (125 Deg. F).</p> <p><b>Note:</b> This option is only available if Option MMI is chosen.</p>
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<p><b>Option H2</b></p> 	<p><b>HYGROMETER (2 Probes)</b></p> <p>Two (2) General Electric Moisture probes are installed on both the inlet and discharge side of the VPH System. The reading is transmitted to the VPH System's P.L.C. whereby providing a reading of moisture content (in ppm) within the oil to be calculated and displayed on the system's Panelview Screen (Option MMI must be chosen). The readings are allow for operators to accurately monitor the moisture level within the oil when the oil temperature is maintained at 50 Deg. C (125 Deg. F).</p> <p><b>Note:</b> This option is only available if Option MMI is chosen.</p>
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<p><b>Option X/DH1</b></p> 	<p><b>DOBLE DOMINO HYGROMETER SYSETM (1 Probe)</b></p> <p>One (1) Doble Domino Moisture Analyzer is installed on the discharge side of the Ecoil System. The sensor consists of a stainless steel probe that is inserted into the discharge line of the system and a cable that connects the probe to the Doble supplied transmitter/display. The Doble Domino transmitter/display, which is mounted within the Ecoil System, provides a reading of moisture content (in ppm) within the oil as well as relative saturation and temperature of the oil. In addition the Domino System is able to provide an output that can be displayed on the Ecoil Computer Screen. The Doble Analyzer is the most accurate moisture analyzer on the market (+/- 1%) and provides accurate readouts for a complete range of oil temperatures up to 160 Deg. C.</p>
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**Option XH1 or Option XH2**

**GENERAL ELECTRIC HYGROMETER ANALYZER**



General Electric Infrastructure Sensing Moisture Analyzer, panel mounted, provides for a digital readout for monitoring water content in the transformer oil, complete with one(1) probe(Note: 2 Probes are provided if option XH2 is chosen), cable, sampling cell, cooling coil. Contact is provided for high humidity alarm.

**Note:** Option MMI is not required with this option.

**Option FM**

**FLOW METER**



Burkert totalizing flow meter is provided on the discharge side of the system. The meter comes with a capacity of 9,999 liters and is installed to register only the oil delivered at the outlet. The flow meter is designed to provide system flow rate registration (in GPM) and also provides batch and system totalizing capabilities.

Note: For systems utilizing Option MMI(Machine Man Interface), the flow rate and flow meter totalizing is displayed on the screen.

**VPH USE ON ENERGIZED TRANSFORMER OPTION:**

**Option LM**

**LEVEL MONITOR & RE-CIRCULATION ASSEMBLY  
(Required for Oil Treatment on Energized Transformer):**



**Level Monitor Assembly & Required Hose Reels(For Pneumatic and Electrical Connection of Remote Level Monitor Assembly)**

Level Monitor:

The VPH Transformer Oil Purification System does not alter oil level in transformer but it is important to monitor the oil level in the transformer to avoid any potential oil drainage from the transformer while it is energized.

Filtervac supplies a Valve Assembly Box that contains a set of automatic valves and manual and automatic air eliminators. This Portable Valve Box Assembly is located adjacent to the transformer is connected to the to the inlet and outlet of the transformer as well as to the System's inlet and outlet hoses.

To monitor the oil level in the transformer, a level transducer is provided by Filtervac and is to be inserted by the customer into any opening in the transformer. If a low level occurrence should occur, a signal will be sent to the System's P.L.C. and this signal will be relayed to an automatic valve located on the Valve Assembly Box (suction side) which will close the discharge valve and will not allow oil drainage from transformer to occur. Simultaneously the system will safely shut down and will notify the customer of the alarm.

Automatic Re-Circulation:

One important requirement that is required when treating oil in an Energized Transformer is that all air and gases entrapped in the System's piping and hoses must be removed prior to exposing the transformer to the initial surge of oil in the system. To accomplish this, the Filtervac Oil Purification System is connected by hoses to the transformer in a closed loop arrangement and the entire system, including hoses, is filled with oil before processing is initiated. Once the oil is filled, the oil is automatically re-circulated for a minimum of 10 minutes through the inlet and outlet hoses via the use of the automatic valves located on the Portable Valve Assembly Box.

To ensure all air is eliminated from the system, the Valve Assembly Box also comes complete with a set of manual and automatic air eliminators. After ten (10) minutes of automatic re-circulation of the oil in the system, the oil in the transformer is ready to be processed and with the use of the automatic valves located on the Valve Box Assembly, the processing begins automatically. This procedure occurs after any start-up including a provision for automatic re-circulation after a temporary power loss.

**Note:** This option is only available in conjunction with Option MMI





**Discharge Connection from Plant**




**Suction Line Connection to Plant**


**HOSE REEL & HOSE OPTIONS:**


<p><b>Option X1/S</b></p>	<p><b>SPRING REWIND REEL AND HOSES</b></p>
	<p>Two flexible hoses of 15M(50FT) in length are provided with quick disconnect camlocks and are stored on spring rewind hose storage reels.</p>


<p><b>Option X1/M</b></p>	<p><b>MANUAL HOSE REEL AND HOSES</b></p>
	<p>Two flexible hoses of 15M(50ft) in length are provided with quick disconnect camlock connections and are stored on manual wind storage reels.</p>


<p><b>Option X1/ME</b></p>	<p><b>MOTORIZED ELECTRIC HOSE REEL AND HOSES</b></p>
	<p>Two flexible hoses of 15M(50ft) in length are provided with quick disconnect couplings and are stored on motorized rewind storage reels.</p>

**POWER SOURCE OPTIONS:**

<p><b>Option XC</b></p>	<p><b>POWER SOURCE CABLE</b></p>
	<p>Filtervac provides 15M (50Ft) power source cable required to operate the system and provides conveniently placed hooks to store the required cable. This option is recommended for low amp rated systems only.</p>

<p><b>Option XCR</b></p>	<p><b>POWER SOURCE SPRING LOADED CABLE REEL &amp; REEL</b></p>
	<p>Filtervac provides a spring loaded cable reel that would be capable of handling 15M (50ft) of power source cable  <b>Note:</b> Option includes 15M of power source cable with open end for customer to connect with appropriate plug.</p>


<p><b>Option XCR1</b></p>	<p><b>POWER SOURCE MOTORIZED CABLE REEL &amp; REEL</b></p>
	<p>Cable would be stored on a motorized cable reel and is designed to hold 15M (50ft) in length. Filtervac is able to provide optional upgrade to a cable that is capable of storing up to 100M of power source cable.  <b>Note:</b> Lengths of cable and hoses supplied loosely or with the hose/cable reel assemblies can be offered in longer lengths but must be specified by the customer and is subject to an adder price. If a certain length is specified and the Filtervac issued quotation refers to that length, the quotation overrides the technical specification in terms of the length of oil hose or power source cable supplied.</p>

<b>Option PG</b>	<b>POWER GENERATOR</b>
	Power diesel generator (Indoor Generator Set) is provided to allow for plant operation without requirement for external power source. This option would include a Fuel tank designed to allow for 24 hour usage of the generator and would include a panel which includes feature as, but not limited to, a voltmeter and ammeter. In addition this option includes stainless steel flexible exhaust connector, critical grade exhaust muffler & rain cap.

**TRANSFORMER EVACUATION OPTIONS:**

Note: For systems with flow rates above 900 USGPH(3400 LPH), dry out connections are offered as a standard feature. For systems with flow rates of 900 USGPH(3400 LPH) or less, Option XDC must be requested.


<b>XVH</b>	<b>VACUUM HOSE</b>
	Filtervac provides 15M(50ft) of lightweight vacuum hose that is capable of withstanding high vacuum and hot/cold temperature requirements. Each side of the hose comes complete with quick disconnect camlock connections

<b>XVP</b>	<b>SECONDARY VACUUM PUMP</b>
	To allow for the ability to process oil within the vacuum chamber while simultaneously pulling vacuum on the transformer, Filtervac provides an additional supply of a vacuum pump.

<b>XCT</b>	<b>COLD TRAP</b>
	Cold Trap would be located between the dry-out connection and the vacuum pump assembly. The Cold Trap assembly would consist of an upper tank and would come complete with appropriate Inlet/Outlet Camlock connections and a sight-glass. The bottom of the tank would be supplied with a ball valve that would dump the contents of the tank into a plastic container. The refrigeration system would be located at the lower level and would utilize R134A Freon, which has no ozone CFC chemicals. The assembly would have the suction refrigeration pressure gauge to ensure proper running indication and would be provided with all refrigeration controls (ie. Power on light to indicate unit is under power). At the end of the process cycle, the refrigeration cycle would be turned off and the heater would be turned on and after a period of time, the contents would be drained into the container (calibrated to show volume) where the operators would measure the moisture removed from the transformer

<b>XBP/C</b>	<b>OIL BOOSTER PUMP - CENTRIFUGAL</b>
	Centrifugal pump is provided with a pumping capacity to match the VPH System's main inlet oil pump and is to be located near the transformer. The portable pump skid includes the following: - Y-strainer, vacuum gauge, discharge pressure gauge, external and flow sight(Spinning type). two(2) isolating ball valves & quick disconnects with caps & plugs. Nema IVX enclosure is provided with motor circuit switch and Protection. 50FT of power cord is provided and convenient hooks are provided on the pump skid to store the cable.

## **OTHER SPECIAL FEATURE OPTIONS:**

<b>Option TH</b>	<b>THERMIC BOILER HEATER</b>
	Instead of utilizing an electric heater to heat the oil, Filtervac substitutes the use of a Thermic Boiler Heater (Hot water heating medium) and high efficiency heat exchanger assembly to provide precise and cost efficient heating of the oil. The Thermic Heater is supplied with modulating burner and can operate between LO-33% and HIGH –100%.

<b>Option VG</b>	<b>VITON GASKETS</b>
	Viton gaskets, O-Rings and seals are utilized on the Vacuum Oil Purification System instead of the standard Buna-N material. This option provides extra protection against degradation of seals due to special dielectric fluids or high temperature applications.

<b>Option CB</b>	<b>CIRCUIT BREAKERS</b>
	All fuses are replaced by circuit breakers within the control panel.

Many other options available upon request such as:

- Enhanced Vacuum Package for faster transformer evacuation
- Split Skid Vacuum/Booster Pump Skid(Removable Skid allowing for use near transformer during evacuation)
- Hot/Cold Weatherproofing & Extreme Hot/Cold Weatherproofing of Trailers.
- On-Board Holding Tanks
- 20 or 40ft Customized Sea Freight Container Installations
- On-Line Gas Analyzer
- Full Oil Testing Equipment available

## **7.0 GUARANTEES & DOCUMENTATION:**

Filtervac warrants the plant supplied under this specification against defects in material and workmanship under normal use and service for a period of sixteen (16) months from date of shipment or twelve (12) months after the start up of the system. FILTERVAC's obligation under this warranty is limited to repairing or furnishing, without charge F.O.B. point of manufacture, a similar part to replace any part, which was proven to be defective within warranty period. Filtervac shall not in any event be held responsible for any indirect or consequential damages. The Performance Guarantee will be within limitations as detailed in Duty & Performance paragraph of this specification.

Two (2) copies of Operating & Maintenance Manual are supplied with each purifier. These systems are designed to operate with the utmost simplicity and therefore typically they do not require any prior training to operate. If any training is required, please contact Filtervac for additional charges.

