

- ▶ GAS REMOVAL
- ▶ WATER REMOVAL
- ▶ PARTICULATE MATTER REMOVAL

- DEGASSIFICATION
- DEHYDRATION
- FILTRATION

November 2019

# VPH High Vacuum

ADDRESSING AND EXTENDING TOTAL UNIQUE ECONOMICAL, VALUE ADDED CUSTOMIZED GREEN SOLUTIONS IN THE WORLD OF OIL PURIFICATION / FILTRATION / DEGASSIFICATION & DEHYDRATION.

## Oil Purifier

*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.*

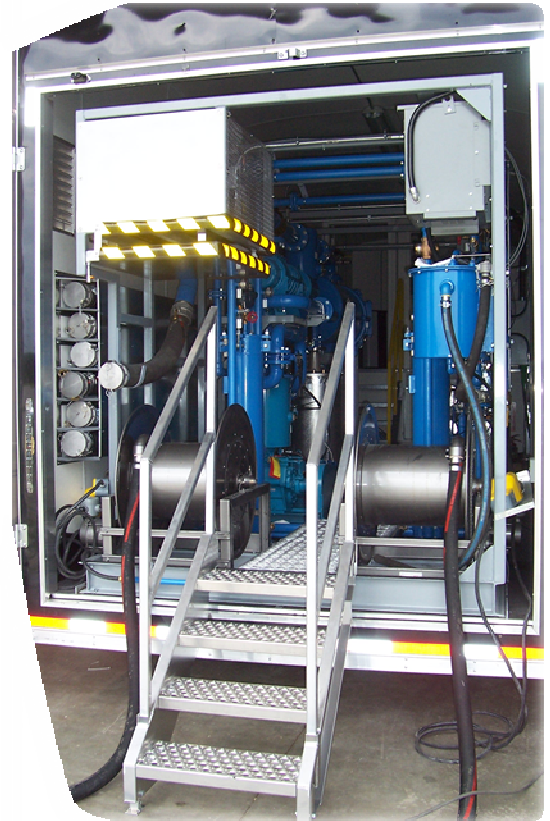
## Helping you achieve your goals

*directly in transformers or within Tap Changers/Circuit Breakers.*

*This specification describes the equipment as supplied by Filtervac for the processing (degassification, 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,*

*Filtervac offers 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.*

*Filtervac also offers its customer representatives with training based on Filtervac extensive experience in servicing and treating transformer oils especially in Live Transformer Operational Mode.*



## TECHNICAL SPECIFICATION



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# Scope of Supply

Stationary System -Transformer Manufacturer



Mobile System – Field Services



## 1. OPERATING CHARACTERISTICS

Filtervac 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; this unit will be 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 °C (32 °F) to 55 °C (130 °F).

### DRYING AND FILLING UNDER VACUUM:

Treated oil flow will be adjustable from 0 to maximum design flow. The quality of materials in contact with the oil is adequate for prolonged drying operations at 100 °C.

### COMBINED OPERATIONS:

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

- Degassing, dehydrating of oil under high vacuum
- Removal of carbon/particulate contamination from the oil.
- Depending on the vacuum package chosen, the VPH system can pull vacuum on the transformer and dry out the transformer. In addition the VPH system can vacuum fill a transformer.

*Filtervac offers a variety of options to meet the customer's specific requirements.*

*Filtervac's team of Sales Personnel, Engineers and Designers work together with customers with focus on:*

- *High safety standards*
- *Accessibility and serviceability*
- *Cost effective design*

*Using the most up to date mechanical design Software packages (3D & 2D) to create a real life image of the system before it is built.*

## 2. 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, 99.9% of particles over 5.1 Microns (0.5 Nominally rated) are removed.

### **DIELECTRIC BREAKDOWN:**

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

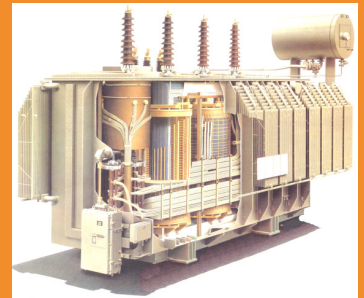
### **ACIDITY CORRECTION:**

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.

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### *Transformer Solid Insulation*

- *Life of transformer is highly effected by the life of insulation*
- *Insulation represents the weakest point in the transformer*
- *It is critical to maintain the insulation system in any transformer*
- *Damage is to insulating paper is irreversible*



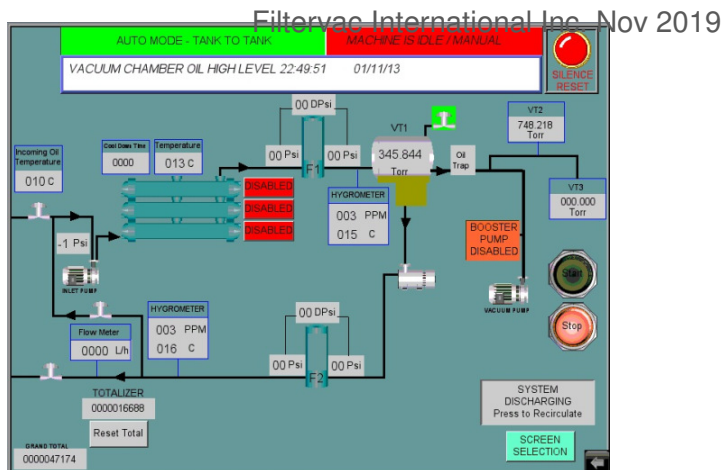
### 3. PROCESS DESCRIPTION

Insulating oil is drawn into the system via a positive displacement pump and is passed through an inlet strainer; optionally the insulating oil can be drawn into the system by the use of the vacuum created by the system's vacuum pump (specific to the application used).

Before entering into the Processing/Vacuum Chamber, where water and gases contained in the oil are thoroughly exposed to vacuum by efficient dispersion and removed through a Vacuum Pumping; the oil is heated by the electrical heater to the operator pre-set processing oil temperature.

Filtervac 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 Filtervac Purifiers using coalescers surpasses any other known method of dehydration and degasification of oils. In fact, the oil at temperature of 70 °F can successfully be processed without elevating the oil temperature.

Purified oil is then discharged by a pump through a Filtervac High Efficiency Filter Element (5.1 micron absolute under ISO 16889; 0.5 nominally rated) where a fine polishing of oil takes place. After passing through the "Fine" Filter, the oil flows through a highly accurate oval gear flow meter before exiting through the outlet or recirculation 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 paragraph 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.



*The System consists of the following components:*

- *Inlet Strainer*
- *Inlet Pump*
- *Oil Heater*
- *Pre-Filter*
- *Vacuum Chamber*
- *Vacuum Pump Package*
- *Outlet Pump*
- *Polishing Filter*
- *Flow Meter*
- *Control Panel with touch screen*
- *One button automatic operation*
- *Remote operation and diagnostics*
- *All above components are installed on a spill containment skid*

## 4. MAIN COMPONENTS

### A. 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

### B. ELECTRIC HEATER:

A low watt density immersion heaters (12 watts/sq. inch) is used to heat up the oil and prevent the heat degradation of oil. The Heater are controlled by heavy-duty solid state contactors and an electronic temperature controller. The oil temperature is thermostatically controlled from 20 to 100 °C. A high temperature cut out safety switch is also provided to ensure maximum safety.

### C. 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 PLC, which then safely shuts down the heater and the system illuminates an alarm signal located on the panel to notify the operator of a low flow condition.

### D. PROCESSING/VACUUM CHAMBER CONSTRUCTION:

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

Located inside the vacuum 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.

### E. 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.

### F. VACUUM PUMP:

As a standard vacuum pump, Filtrvac supplies Busch Rotary Vane Vacuum Pumps. These pumps are air-cooled and comes with a built in ballast. The pump is direct driven by TEFC electric motor.

#### INLET PUMP



#### ELECTRIC HEATER



#### FLOW INDICATOR/SWITCH



#### PROCESSING/VACUUM CHAMBER CONSTRUCTION



#### OIL LEVEL CONTROLLER



#### G. OIL TRAP:

A Secondary Chamber, termed the "Oil Trap", located 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 system utilizes a baffle and comes complete with two(2) High Level Switch implemented to immediately warn and shut down the system upon the sensing of oil accumulation at the bottom section of the Oil Trap. A series of valves are provided that allows for the oil trap to be drained without shutting down the system. The Oil Trap is provided as a backup safety feature should all necessary level switches and optical probes located in the vacuum chamber fail.

#### H. OIL DISCHARGE PUMP:

A positive displacement tri-screw 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. The pump is directly driven by a TEFC motor and is mounted on a common base. A relief valve is provided to prevent overpressurization of the piping. A strainer is provided upstream of the discharge oil pump to ensure that the discharge pump is not prematurely destroyed by initial welding slag and debris.

#### I. FINE FILTER:

Oil receives its final "polishing" treatment by passing through a FILTERVAC high performance element. The filter is rated to capture particles with rating of 5.1 micron absolute under ISO 16889. Note: Option to upgrade the polishing filter to be rated to 4.2 micron absolute is available upon request.

#### J. SAMPLING PORTS:

Two (2) sampling ports shall be provided, one for the incoming oil and one for the processed oil.

#### K. INLET & DISCHARGE VALVES:

Manual ball valves (NPT Connection) are provided for the inlet and discharge connection.

#### L. MANUAL RE-CIRCULATION VALVE:

One manual ball valve (NPT Connection) is provided for re-circulation purposes. Note: Option VFD exists to provide for automated flow control via Touch Screen

#### M. PIPING:

All piping will be fabricated using 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.

OIL TRAP



OIL DISCHARGE PUMP



FINE FILTER



SAMPLING PORTS



INLET & DISCHARGE VALVES



MANUAL RE-CIRCULATION



PIPING

## N. CONTROL PANEL INSTRUMENTATION, ALARMS & INTERLOCKS

Instrumentation & electrical controls are located in a NEMA 12 type enclosure. The standard electrical control system utilizes a Siemens Programmable Logic Controller (P.L.C.) combined with a Siemens Colour Touch Screen (HMI). A series of instrumentations, alarms and interlocks to provide a fully automatic operation.

Manual control of various functions is provided as required via the HMI. In addition Several Pilot Lights are provided to indicate operational status (on/off) of the system and alarm conditions.

Filtervac has accounted for all potential scenarios that may be encountered out in the field and has provisions for safety interlocks, automatic shutdown of the plant and alarm notification in the case of any abnormal operating condition.

### STANDARD INSTRUMENTATION & CONTROLS

- **Temperature Monitoring & Control:**

Thermocouples are provided on the inlet side of the system as well as outlet of the oil heater to provide oil temperature monitoring. Temperature control of the oil (+- 2 Deg C accuracy) on the outlet of the heater is monitored and controlled via P.L.C. control. A high temperature cut out switch (manual reset) is provided for extra safety protection.

- **Indicator Gauges:**

- Differential Pressure Gauges/Switches are provided to monitor the status of the pre-filter & polishing filter cartridges and provide alarms when the filters need replacement.
- Compound Gauge is provided to monitor the status of the dispersion coalescing filters and also to provide pressure status of the Inlet pump/strainer assembly.
- Pressure gauges are provided on the discharge side of each of the oil pumps.
- Vacuum transmitter is provided to determine level of vacuum within the chamber. Optional vacuum transmitters are provided for the vacuum booster (Option B) and for the providing reading of vacuum level in the transformer (Option V2).

- **Foam Control:**

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.

- **Level Switches:**

- High and low level switches are provided in the vacuum chamber to prevent of flooding the vacuum chamber and from running the outlet pump dry.
- A series of level switches are provided in the oil trap.
- To provide for monitoring of leaks within the oil spill containment skid

### STANDARD OFFER: CONTROL PANEL WITH TOUCH SCREEN OPTION



### OPTIONS: CONTROL PANEL WITH HMI & LAPTOP/DESKTOP OPTION



### CONTROL PANEL WITH SCADA CONTROL VIA LAPTOP OR DESKTOP (Option MMI/2)



## 5. OPTIONAL EQUIPMENT

### Option MC COMPACT MOBILE INSTALLATION/SINGLE AXLE TRAILER

Filtervac International Inc. Nov 2019

The 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 late to provide for a weather resistant trailer. The braking system consists of electric brakes and a safety feature is provided should the system break free from the towing vehicle.



Option MC

### Option MC1

### COMPACT MOBILE INSTALLATION/DOUBLE AXLE UTILITY TRAILER

The system is placed in a roadworthy, weatherproof double axel 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 either electric or hydraulic brakes and a safety feature is provided should the system break free from the towing vehicle.

Option MC1



### Option MCT/2

### MOBILE INSTALLATION/DOUBLE AXLE CARGO TRAILER

The system is placed in a roadworthy, weatherproof double axel Cargo Trailer 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.

Option MCT/2



### Option MCT/3

### MOBILE INSTALLATION/TRIPLE AXLE CARGO TRAILER

The system is placed in a roadworthy, weatherproof Triple Axel Cargo Trailer 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.

Option MCT/3



### Option MT

### 5th WHEEL TRAILER

The system is placed in a roadworthy, weatherproof double axel 5TH Wheel Trailer. The system is designed to be operated from inside of the trailer. To access and monitor components on the VPH System, the trailer is equipped with rear barn doors and one (1) side door. The side door access an office area or storage area of the trailer, where the operator can either store equipment or monitor the status of the system. The outer walls of the trailer/doors are constructed of Aluminum sheet. The braking system consists of electric/hydraulic braking system. Standard length of trailer is 25-30FT depending on customer's requirements & options chosen.

Option MCT/3





<b>Option MT1</b>	<b>SEMI TRAILER</b>
<p>The VPH System is mounted on a double axle, super single or double wheeled semi-trailer. The trailer comes complete with two (2) side door entrances and one (1) aluminum staircase (c/w rail) that is safely stored and easily removed from under the trailer. Built in furniture is provided in this option for the computer system and the operator. Length of trailer ranges from 25-40FT depending on the customers' requirements &amp; options chosen.</p>	

<b>Option P</b>	<b>PORTABLE INSTALLATION</b>
<p>Two (2) swivel and two (2) fixed hard rubber castors or pneumatic tires are utilized to enable the purifier to be moved around the customers' 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.</p>	

<b>Option XTSL1</b>	<b>TRAILER SPECIFIC LAYOUT ONE</b>
<p>For VPH systems that are to be provided within any trailer installation, Filtervac provides a design/layout that provides a horse shoe front section layout with good access to main front skid components. The back system components are accessed through the back trailer door.</p> <p>Note: This option is available when trailer Option MCT/2, MCT/3 or MT or MT1 is selected. Customers looking to install the system in their own trailers may also select this option.</p>	

<b>Option XTSL2</b>	<b>TRAILER SPECIFIC LAYOUT TWO</b>
<p>For VPH systems that are to be provided within any trailer installation, Filtervac provides a design/layout that is specifically suited for a trailer installation. The design/layout has a center access walkway to provide for easy access to all components of the VPH System that are required for the operation and maintenance of every device on the system. In addition this layout ensures that the skid's weight is properly distributed to ensure trouble free towing of the trailer.</p> <p>Note: This option is available when trailer Option MCT/2, MCT/3 or MT or MT1 is selected. Customers looking to install the system in their own trailers may also select this option.</p>	

<b>Option B</b>	<b>VACUUM BOOSTER</b>
<p>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. An oil overflow device is incorporated to prevent the oil from transformer entering into booster. Recommended for flow rates greater than 900GPH.</p>	

<b>Option RPVP</b>	<b>ROTARY PISTON VACUUM PUMP</b>
<p>To provide a deeper vacuum capability required on transformer dry out applications (ultimate pressure obtainable is 0.01 Torr or 0.013 mbar), Filtervac provides a Kinney Rotary Piston Vacuum Pump instead of the standard Rotary Vane Vacuum Pump. The Kinney Piston Pumps also come with the ability to handle large vapour utilizing a variety of inherent built-in design features. For most applications, water cooling is not required for the pumps.</p>	

**Option MT1**



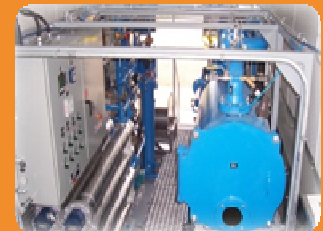
**Option P**



**Option XTSL1**



**Option XTSL2**



**Option B**



**Option RPVP**



**Option SVP****SCREW TYPE VACUUM PUMP**

For larger systems (VPH 1800 and VPH2400), Filtervac also offers a screw type vacuum pump. The main advantage of this pump, other than being able to reach high vacuum levels (0.0075 Torr or 0.01mbar), is that this pump has very low maintenance requirement and ensures downtime is minimal. One other attractive design feature useful for transformer dry out application, the pump is equipped with a separate oil compartment from where the water vapour is passed through; thus eliminating issues of contaminated vacuum pump oil that is faced with using a Rotary Piston or Vane Vacuum Pumps.

**Option SVP****Option XFET****FULLERS EARTH TOWERS (Option XFET)**

Two (2) large Fullers Earth Towers are provided to allow for bulk processing of Transformer Oil. These towers are equipped with an electro-hydraulic tilt or a 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.

Valves are 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 of the towers and also for removing the residual oil from within the used clay.

**Note:** Please refer to the additional data sheet for detailed technical specification on the Fullers Earth Tower Features and different capacities available.

**Option XFET****Option XFEC****FULLERS EARTH CARTRIDGE (Option XFEC)**

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, an Ecoil Regeneration System (**Model RS-M or SRS**) or option **XFET** is recommended.

**Option XFEC****Option PF****PRE-FILTER**

To prolong the life of the polishing fine filter and to offer a more efficient filtration process, a Pre-Filter can be installed prior to the polishing fine filter. 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.

**Option PF****Option AI****DBPC ADDITIVE INJECTOR**

The Additive Injector package is supplied to replace the additives removed in the Fuller's Earth filtration process. This package is located inside the plant and includes the following components:

- 100 or 200 Litre Tank (26 or 53 USGPH; Depending on the size of the system) complete with low and high level switches along with a sight glass assembly.
- One (1) positive displacement gear pump.
- One (1) mixer assembly with a stainless steel propeller and a TEFC Motor.

**Option AI****Option FM****FLOW METER**

Description: Burkert totalizing flow meter is provided on the discharge side of the system. The meter comes with a readout in either liters per minute (LPM) or US gallons per minute (USGPM) and provides a six digit readout.

**Flow Meter**

### Option MMI-1 MACHINE MAN INTERFACE – Level 1 - Panel View Screen

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 will be located on the flow diagram with the appropriate identification for all of the major function providing control and adjusting capability through a touch screen keypad. For more details, please consult our engineers.

### Option MMI-1



### Option MMI-2 MACHINE MAN INTERFACE – Level 2 – Desktop Computer

In conjunction with the Allen Bradley PLC, an industrial touchscreen panel mounted computer or desktop computer can be provided with a SCADA System. The SCADA system provides for a very detailed flow diagram to be shown providing maximum feedback and interface capability for the operator. All operating controls will be located on the flow diagram with the appropriate identification for all of the major function providing control and adjusting capability through the screen/mouse of the desktop computer. For more details, please consult our engineers.

### Option MMI-2



### Option V1, V2 and V3 VACUUM CONTROLLER

A Pirani Vacuum Gauge is offered as an option for Systems at following locations:

- V1: at the vacuum chamber to measure level of vacuum in chamber
- V2: at the electrical transformer to measure level of vacuum in transformer
- V3: at the header close to the vacuum booster pump

### Options V1, V2 and V3



### Option LM LEVEL MONITOR & RE-CIRCULATION ASSEMBLY (Required for Oil Treatment on Energized Transformer)

#### Level Monitor:

The VPH Transformer Oil Purification System does not alter oil level in the 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. Filtrvac supplies a Valve Assembly Box that contains a set of automatic valves, manual valves and automatic air eliminators. This Portable Valve Box Assembly to be located adjacent to the transformer, is connected 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 Filtrvac and is to be inserted by the customer into any opening in the transformer. If a low level condition should occur, a signal will be sent to the System's PLC and this signal will be relayed to an automatic valve located on the Valve Assembly Box (suction side), in this case the discharge valve will be closed preventing 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 Filtrvac 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.

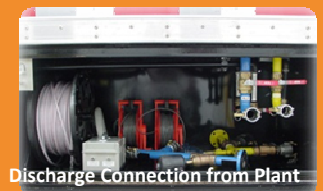
To ensure all air is eliminated from the system, the Valve Assembly Box also comes complete with a set of manual and automatic air eliminators.

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.

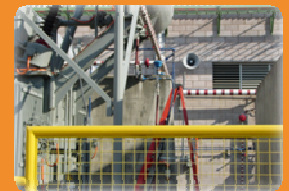
**Note:** This option is only available in conjunction with Option MMI

### Option LM

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



Discharge Connection from Plant



Suction Line Connection to Plant



<b>Option X1/S</b>	<b>SPRING REWIND REEL AND HOSES</b>
<p>Two flexible hoses of 10M in length, with couplings and Spring Return winding storage reels.</p> <p>Filtervac can provide other length subject to customer preference and technical feasibility specific to hose size limitations.</p>	

<b>Option X1/M</b>	<b>MANUAL HOSE REEL AND HOSES</b>
<p>Two flexible hoses of 10M in length, with couplings and manual wind storage reels.</p> <p>Filtervac can provide other length subject to customer preference and technical feasibility specific to hose size limitations.</p>	

<b>Option X1/ME</b>	<b>MOTORIZED REEL AND HOSES</b>
<p>Two hoses of 10M in length, with couplings and motorized storage reels.</p> <p>Filtervac can provide other length subject to customer preference and technical feasibility specific to hose size limitations.</p>	

Note: If a reel is required to store a longer length of hose, please speak with our inside sales person and we can provide a solution to suit your needs.

**POWER SOURCE OPTIONS:**

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

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

<b>Option XCR1</b>	<b>POWER SOURCE MOTORIZED CABLE REEL &amp; REEL</b>
<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.</p> <p><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>	

Option X1/S



Option X1/M



Option X1/ME



Option XC



Option XCR



Option XCR1



**Option PG****POWER GENERATOR**

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 amp meter. In addition this option includes stainless steel flexible exhaust connector, critical grade exhaust muffler & rain cap.

**Option PG****TRANSFORMER EVACUATION OPTIONS:**

Note: For systems with flow rates of 1200 USGPH (4000 LPH) or higher, dry out connections are offered as a standard feature. For systems with flow rates of less than 1200USGPH (4000 LPH) or less, Option XDC must be requested.

**XVH****VACUUM HOSE**

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.

**Option XVH****XVP****SECONDARY VACUUM PUMP**

To allow for the ability to process oil within the vacuum chamber under vacuum while simultaneously pulling vacuum on the transformer, Filtervac provides an additional supply of a vacuum pump. In addition piping is provided to allow for both pumps to be used when pulling vacuum on a transformer.

**Option XVP****XDVP/B****DUAL VACUUM PUMP/BOOSTER ASSEMBLY**

To allow for the ability to process oil within the vacuum chamber while simultaneously pulling vacuum on large transformers, Filtervac provides two (2) sets of vacuum pump and booster pump assemblies. In addition piping is provided to allow for both pump sets to be pumping down one transformer at the same time or to pump down multiple transformers at the same time. This feature is provided to allow an operator to quickly reduce pump down times on a transformer.

**Option XDVP/B****XCT and XCT65****COLD TRAP**

XCT: operating temperature of -45 °C

XCT65: operating temperature of -65 °C

Cold Trap would be located between the dry-out connection and the vacuum pump assembly. The Cold Trap assembly consists of an upper tank, 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.

**Option XCT**

**XBP/C****OIL BOOSTER PUMP - CENTRIFUGAL**

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:****Option TH****THERMIC BOILER HEATER**

Instead of utilizing an electric heater to heat the oil, Filtevac 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%.

**Option H and H2****HYGROMETERS**

H1: Provides one Doble Domino Hygrometer on the discharge oil line to measure the water content in the oil.

H2: Provides two Doble Domino Hygrometers on the inlet and discharge oil lines to measure the water content in the oil.

**Option VG****VITON GASKETS**

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.

**Option CB****CIRCUIT BREAKERS**

All fuses are replaced by circuit breakers within the control panel.

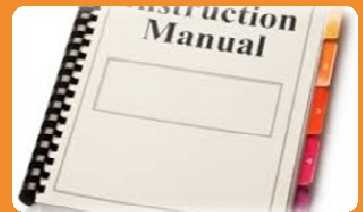
**Many other options available upon request such as:**

- Air Dryer Package with compressor.
- Enhanced Vacuum Package for faster transformer evacuation
- 4 way valve connected between inlet and discharge oil line allowing the draining of oil lines.
- Installation of variable speed drives on the booster pump to increase transformer evacuations.
- 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.

**Option XBP/C****Option TH****Option H1 and H2****Option VG****Option CB****Other Options**

## 6. GUARANTEES & DOCUMENTATION

- Filtrvac 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. Filtrvac 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 Filtrvac for additional charges.



## 7. MODEL NOMENCLATURE CHART ( Oil Purifier)

VPH -   /  /  /  /  

  /  /  /  /  

CODE	✓	GPH	LPH	CODE	✓	LPH	GPH
150		150	500	1600		1600	6000
200		200	750	1800		1800	6900
300		300	1000	2100		2100	8000
400		400	1500	2400		2400	9000
600		600	2300	2650		2650	10000
800		800	3000	3200		3200	12000
1050		1050	4000	3600		3600	13600
1200		1200	4600				

CODE	✓	MOBILITY OPTIONS
S		Stationary
P		Portable with Caster Wheels
C20		Integrated inside 20ft container
C40		Integrated inside 40ft container
C/C		Inside Custom sea container
AE		Aluminum enclosure
MC1		Mobile Single Axle Utility Trailer
MC2		Mobile Double Axle Utility Trailer
MCT/2		Mobile Double Axle Cargo Trailer
MCT/3		Mobile Three Axle Cargo Trailer
MT		Mobile 5th Wheel Trailer
MT1		Mobile Semi Trailer

CODE	✓	POWER OPTIONS
223		220V/3PH/60Hz or 50 Hz
383		380V to 415V /3PH/60Hz or 50 Hz
463		460V to 480V /3PH/60Hz or 50 Hz
573		575V to 600V /3PH/60Hz or 50 Hz

CODE	✓	LAYOUT DESIGN
SL		optimized compact Standard Layout
XTSL1		Horseshoe
XTSL2		Central walkway

CODE	✓	POWER SOURCE OPTIONS
XC		Power Source Cable
XCR		Power Source Spring Loaded Cable Reel
XCR1		Power Source Motorized Cable Reel
PG		Power Generator

CODE	✓	VACUUM OPTIONS
B		Vacuum Booster Pump
B/2		Dual Roots Vacuum Booster Pump
NB		No Vacuum Booster Pump
RVVP		Rotary Vane Vacuum Pump
RPVP		Rotary Piston Vacuum Pump
SVP		Screw Vacuum Pump
D		Dual Vacuum Pumps

CODE	✓	INSTRUMENTATION OPTIONS
V1		Vacuum Controller Single Probe
V2		Vacuum Controller Two Probe
DM		Dew Point Monitor
H1		Single Domino Hygrometer
H2		Double Domino Hygrometer
FM		Flow Meter
MMI/1		Machine Main Interface Screen
MMI/2		Machine Main Interface Computer

CODE	✓	HOSE OPTIONS
X1/S		Spring Rewind Reel & Hose
X1/M		Manual Hose Reel & Hoses
X1/ME		Motorized Electrical Hose Reel & Hoses
XHS		Hose storage in pvc piping / metal frame
XVH		Vacuum Hose
XOH		Oil Hoses

CODE	✓	DRY-OUT OPTIONS
XCT		Cold Trap Refrigerant -45 °C
XCT65		Cold Trap Refrigerant -65 °C
XCTN		Cold Trap Nitrogen

CODE	✓	MISCELLANEOUS OPTIONS
XFET		Fullers Earth Towers
XFEC		Fullers Earth Cartridge
AI		DBPC Additive Injector
LM		Level Monitor & Recirculation Assmb'y
TH		Thermic Boiler Heater
VG		Viton Gaskets
CB		Circuit Breakers
XBP/C		Oil Booster Pump
4WV		Four Way Valve for Hose Draining

Filtervac International Inc. Nov 2019

Please tick (✓) in the respective boxes for options required. Check for other customized requirements if not covered above.



# 8. FLOW DIAGRAM

**SYMBOL DESCRIPTION**

- BP BOOSTER PUMP
- CG COMPOUND GAUGE
- DPS DIFFERENTIAL PRESSURE SWITCH
- SV ELECTRIC SOLENOID VALVE
- F FILTER
- FG FLOW SIGHT GLASS
- FM FLOW METER
- FS FLOW SWITCH
- HLS HIGH LEVEL SWITCH
- LLS LOW LEVEL SWITCH
- NRV NON-RETURN CHECK VALVE
- P PUMP
- PG PRESSURE GAUGE
- RV PRESSURE SAFETY RELIEF VALVE
- STR STRAINER

- TAS TEMPERATURE ACTUATED SWITCH
- TC TEMPERATURE CONTROLLER
- TG TEMPERATURE GAUGE
- BV VALVE BALL (OTHERWISE NOTED)
- TWV THREE WAY VALVE
- VT VACUUM TRANSDUCER
- VP VACUUM PUMP
- HTG HTGROMETER
- HTC HIGH TEMP CUT-OFF SWITCH
- GV GLOBE VALVE
- AV AIR VENT ASSEMBLY

CABLE REEL WITH PEDAL  
C/W 15M/50FT CABLE  
1/2HP/1PH/220V

MANUAL HOSE REEL  
C/W 15M/50FT HOSES  
(INLET AND OUTLET)

- STRAINER FLANGE
- SIGHT GLASS
- STRAINER
- HOSE CONNECTION
- CABLE REEL
- HOSE REEL (MANUAL)

