TRANS-VAC 500D

OPERATING INSTRUCTION MANUAL

APRIL 2000

WARNING

When skimming petroleum products, flammable vapors may be present within the receiving tank, at the vacuum pump discharge, and inside all piping.

WARNING

The unit must not be operated in the presence of flammable vapors, as uncontrolled engine overspeed can occur.

WARNING

If a small vessel is being used to carry the TRANS-VAC 500D to a remote recovery site, the vessel's carrying capacity must be sufficient to accommodate the load. The unit's weight, the weight of liquid within the tank, the weight of any recovered liquid to be stored on board, the weight of hose and accessory equipment, and that of all operating personnel should be considered. The TRANS-VAC weighs 7,500 lbs. empty, (3,400 Kg) and approximately 11,600 lbs. (5,260 Kg) when its tank is filled. This total weight could cause a marginally sized vessel to capsize.

INTRODUCTION

This manual is intended as a guide in using the **TRANS-VAC 500D OIL SPILL RECOVERY UNIT.** It contains information concerning maintenance, operation, and trouble shooting for the various components of the **TRANS-VAC SYSTEM**. Most information concerning repair and maintenance of the various system components is discussed in the "Component Manufacturers' Manuals" which are included. Before attempting operation of this machine, it is important to be familiar with its mechanisms and uses.

PURPOSE

The purpose of the **TRANS-VAC** is to supply the pumping power required for recovering oil spills. The **TRANS-VAC** is also useful as a transfer pump, and can be used for tank and sump cleaning.

Drawings 12B3703 and 12C2598D, respectively, should be referenced for piping and electrical schematics.

Basic components of the unit include a progressive cavity pump driven through a clutch by a diesel engine, and a rotary lobe vacuum pump driven by a second diesel engine. Suction is taken through floating skimming heads

PURPOSE (continued)

Attached to suction hose. Fluid, debris, and air are separated in a 500 gallon receiver tank. Large debris is screened out, and the liquid is transferred through the pump into a portable holding tank, or storage facility (not supplied with **TRANS-VAC**) where water and oil are allowed to gravity separate. Engines, pumps, tank, piping, and controls are mounted on a heavy duty, structural steel "oil field" style skid.

The suction and discharge rates are controlled by adjusting the engine speeds powering the transfer and vacuum pumps, and by admitting air through the fresh air inlet into the vacuum pump.

In addition to manual controls, the unit is equipped with an automatic vacuum breaking valve that has been pre-set to begin to admit air into the vacuum tank at 10" Hg of vacuum.

ENGINES

The **TRANS-VAC** is equipped with one John Deere Model 3015D 3 cylinder and one John Deere Model 4020D 4 cylinder, water-cooled, 4 cycle diesel engines. An "Operator's Manual" is included with these instructions.

These engines have tachometer, running hour meter, Murphy safety shutdown switch, and gauges for monitoring engine speed, water temperature, and oil pressure. To start the engines, it is necessary to depress the safety lockout button on the engine control panel and hold until oil pressure reaches normal operating level.

Before attempting to start either engine, the operator must be thoroughly familiar with the engine "Operator's Manual" included with these instructions.

VACUUM PUMP

The **TRANS-VAC** is equipped with an M-D Pneumatics, Inc., standard duty, 3-lobe rotary, positive displacement vacuum pump, Model 5509, rated for 650 CFM at 3000 RPM with direct engine drive.

Under most circumstances, normal operating temperature and pressure will not be exceeded by the vacuum pump. Insufficient airflow will cause the high temperature alarm switch to activate a red indicator light and an audible alarm on the control box. If the vacuum pump high temperature light illuminates, fresh air valve #1 should be opened to reduce the load and allow the airflow to cool the vacuum pump. This condition usually indicates a plugged skimmer head, hose or internal air piping. A dial

VACUUM PUMP (continued)

thermometer is installed on the discharge air stack to allow the operator to visually monitor the discharge air temperature. "Maintenance and Repair Instructions" for the vacuum pump are included with this manual.

DISCHARGE PUMP

The **TRANS-VAC** is equipped with a progressing cavity discharge pump rated at 500 gpm at an engine speed of 3000 RPM. The discharge pump is driven by its engine through a lever operated, manual Rockford clutch and through a reduction gearbox with a ratio of 5.06:1. A pressure relief valve, set to open at 80 psig, is installed in the event that excessive discharge pressure is encountered during operation. After running the **TRANS-VAC 500D**, the drain valve on the pump's underside should be opened to clear as much liquid as possible from the pump cavity. The valve is then closed, and the unit again runs slowly while a small quantity of anti-freeze is injected into the pump through the receiver tank by opening the access hatch. This should displace any remaining water and coat the pump's interior, providing corrosion protection. The "Maintenance and Repair Instructions" for the discharge pump are included with this manual.

ELECTRICAL SYSTEM

The electrical system is a 12-volt D.C., negative ground, with independently operating engines. The system alarm circuit is powered from the vacuum pump engine ignition switch. The fuse panel is located inside the control box mounted on the tank.

The engines are each equipped with electric starters, alternator charging systems, and independent batteries. These systems are described in the "Operator's Manual". Operating level indicating lights are provided on the control box face mounted on the tank.

A. Operating Sequence

1. All lights off when liquid level in tank is less than 10 inches and vacuum pump temperature is within normal range.

2. Green light illuminates with approximately 10 inches of liquid in tank, and remains on while liquid level is above this point.

A. Operating Sequence (continued)

3. Amber light illuminates with approximately 18 inches of liquid in the tank, and remains on while liquid level is above this point.

4. Red light and horn activate with approximately 30 inches of liquid in the tank, and remain on while liquid level is above this point. Horn can be silenced by depressing alarm silence button mounted on the side of the control box.

5. The red light and horn (Hi Temp Vac Pump) activate when vacuum pump temperature exceeds set point. The horn can be silenced by depressing the alarm silencer button mounted on the side of the control box.

6. Vacuum pump engine will shut down when liquid level is within 6 inches of the tank top (no alarm).

FUEL SYSTEM

The engines are equipped with a 45 gallon diesel fuel tank and primary filter. Clean fuel must be used, the fuel strainers on each engine should be cleaned periodically, and water drained daily from the bottom of the primary filter located next to the fuel tank. Filter elements should be changed every 500 hours of operation.

TRANS-VAC OPERATION

The **TRANS-VAC** should be placed where it is to be used, and not moved during operation. It should be positioned above the high tide or water level on solid ground, or left on its trailer or truck bed with wheels "chocked." The unit should be upwind from the oil spill that is to be recovered and remote from any flammable vapors evaporating from the spill **(see warnings, Page 1)**.

Proper skimmer head selection is necessary. Under most circumstances, when more than 1 inch of oil is present on at least 12 inches of water a **High Capacity Skimming Head** is best. For less than 1 inch of oil and when debris is present, a **Rigid Manta Ray Head** is best because it is easily cleaned. However, the **High Capacity Skimming Head's Weir** can also be adjusted to efficiently skim thin slicks. A **Flexible Manta Ray** is best when waves are present because of its ability to conform to the surface. The Manta Ray Skimmers can be used in shallow water (less than 3 inches). The skimmer heads are connected to the suction hose (4 inches for High Capacity and 3 inches for Manta Rays), and the suction hose is connected to the **TRANS-VAC** at the inlet port. If a 3 inch suction hose is being used, a 4 inch x 3 inch reducer is required to connect the

TRANS-VAC OPERATION (continued)

suction line directly to the **TRANS-VAC.** To allow the 3 inch head to float at the proper altitude for the most efficient recovery, the skimmer head and at least two, 10 foot lengths (or one, 25 foot length) of suction hose with floats should be floating in the water. The suction head should be placed in the water at a position downwind from the oil slick's perimeter, or at the apex of deflection booms. This allows the wind or current to push the oil towards the skimmer heads, and improves the ratio of oil to water recovered.

To place the skimming head(s) into a boomed area, a floating hose bridge may be required. To carry the hose(s) over the boom the hose(s) should be placed between the bridge's hose guides, and then connected to the skimmer head and **TRANS-VAC** suction port(s). The hose should never be placed directly on the boom's flotation.

The discharge pump valve must be opened, and the discharge hose tightly connected to the coupling (cam handles against the hose). If the Gasket is not in place, the coupling will leak. Ideally, the discharge hoses are run to a barge inlet, fabric storage container, or tank truck inlet connection, and tightly joined. Under some circumstances, the discharge hose's end can be dropped into a tank truck hatch or placed in a temporary storage tank. If this is done, the hose must be securely tied to the tank to prevent the thrust generated from the discharge pump from pushing the hose out of the tank.

ASSEMBLING THE SKIMMING HEADS

A. The Manta Ray - Flexible and Rigid Heads

Flexible and Rigid Mantas arrive from the factory fully assembled. All Rigid Manta cover wing nuts should be checked for tightness prior to placing in the water. For the sake of uniformity of production, all suction hoses are furnished with hose floats symmetrically placed. However, when placed in operation, it is best if one extra hose float is placed at each skimming head. One float should be removed from the length placed next to the **TRANS-VAC** receiver tank and re-assembled next to the float located nearest the female fitting at the skimming head.

B. High Capacity Skimming Head

1. Floats and head should be removed from the boxes.

2. The head should be placed on its back with the front raised about 1 ft.

3. The float struts should be inserted in the slots provided on the bottom of the head. The tab on the side of the head should be in the hole on the strut.

4. The pin attached to the strut should be inserted through the hole in the tab to secure the floats to the head.

5. The head should be placed in the water with the adjustment rods pointed upward.

ADJUSTING THE SKIMMING DEPTH

Before making the depth adjustment on any of the skimming heads, the air must be evacuated from the system. The pump should be started and pumping allowed to continue until liquid passes from the discharge hose. The system must remain filled with liquid or the adjustment will be faulty. Skimming head adjustment should be made to match oil slick thickness. It must be remembered that as oil is recovered, the conditions will change. For maximum efficiency, the skimming heads should be adjusted as follows:

A. Flexible or Rigid Manta Ray Skimming Heads

The Manta skimming head must lie flat on the water surface. The following adjustments should be made while not pumping so that the fluid surface is at the top of the slots, just under the top cover (figure 1). Hose floats may be adjusted (see arrows) to maintain proper front-to-back skimming level. Twist of the skimmer head can be removed by loosening and re-tightening hose couplings.

The lower fluid level (Figure 2) illustrates the skimmer's operating level. This change in fluid level is caused by the entrance of air into the skimming head along with the oil causing the head and hose to rise.

B. High capacity Skimming Heads

For correct operation, the High Capacity Head must be adjusted for both cut and depth. To adjust, the following procedures should be followed:

1. Cut: The throat gate can be moved up or down to adjust the cut before launching the skimmer. To change the setting, the wing nuts securing the throat gate to the front edge of the head should be loosened. If the oil is less than 1" thick, the throat gate should be set in the up position, providing a 1/2" opening into the head. If the oil is greater than 1" thick, the throat gate should be in a lower position. The gate opening can be adjusted between 1/4" and 2". Ideally, the opening should be about half the thickness of the oil layer.

2. Depth: The depth setting must be done when the skimmer is afloat in the water and oil. The wing nut located on each float top must be adjusted in an upward or downward position while the skimming system is operating so as to position the skimmer's top cover just at or above the fluid surface.

PRE-STARTING CHECKLIST

Prior to operating the **TRANS-VAC's** engines and pumps, the following functions should be performed:

A. Engines must be filled to the proper oil level. (The "Operator's Manual" should be referenced to determine proper oil for prevailing conditions.) Radiator coolant level must be checked, and filled as needed. Engine coolant, as recommended by the manufacturer, should be used.

B. Vacuum pump, transfer pump must be filled with oil. (Pertinent operating manuals should be referenced to determine proper oil for prevailing conditions.)

C. Fuel tank should be full. The engine "Operator's Manual" should be checked for proper diesel fuel grade.

D. Fuel filter bowl must be free of dirt and/or water, and drained as necessary.

E. The alarm and safety shutdown circuits should be tested by reaching into the tank hatch and raising each float approximately 2 inches (4 floats). The bottom float will activate the green liquid level light; the second float the amber light; the third float will activate the red light and sound the alarm horn; the fourth (top) float will shut down the vacuum pump engine. If any of these floats do not function as described, the alarm safety shutdown system should be inspected and repaired.

F. Receiver tank end door must be closed and dogged.

G. All suction hoses and skimming heads must be cleared of debris. To prevent leakage, the rubber gaskets within all hose and piping quick connect fittings must be in place prior to use. Skimming head(s) must be free floating in the water (oil), and hoses connected to receiver tank inlet fittings! Plugs must be in place on unused inlets.

STARTING THE TRANS-VAC UNIT

A. The clutch that drives the main discharge pump must be disengaged, and the fresh air inlet valve #1 to the vacuum pump opened, thus allowing the engines freedom to turn, while not overloading the starters. The engines can then be started. (The "Operator's Manual" should be referenced for starting and operating instructions.)

B. Engines must be allowed to run for several minutes before proceeding. After engines reach an operating temperature of 160ºF, the sump valve #3 under the tank is checked to make sure it is closed, this is necessary in order to build vacuum. Any suction ports not being used must also be plugged so that vacuum can be raised. Vacuum relief valve # 4 should be closed. Air outlet valve # 2 should be open. Air inlet valve #1**(Caution Air inlet valve # 1 must allow enough fresh air through the system to ensure the unit does not overheat watch your stack temperature closely and if it starts to rise above normal air flow temperatures open slightly to allow more air through the pump)** is then partially closed, starting suction to the tank. When the yellow tank level light illuminates, (green = normal, yellow = warning, red = high) the discharge pump suction valve # 3 is to be opened and the clutch is engaged and engine accelerated until the discharge rate is approximately equal to the suction rate. Under normal operating conditions, tank vacuum will remain between 10 and 12 inches of mercury.

C. After the receiver tank has started to fill with liquid and the green level light illuminates, it will be necessary to partially open fresh air inlet valve #1 and completely open Valve # 3 (Discharge pump suction) The vacuum pump engine speed can be adjusted to maintain the tank vacuum between 10" and 12" of mercury. Airflow is required through the vacuum pump for cooling. If the airflow is too low, the high temperature alarm will activate. There is a stack thermometer which will also allow the operator to visually check the airflow temperature. Airflow temperatures typically are 120ºF (50ºC) under normal skimming conditions.

D. The pumping rate must be adjusted to maintain a constant level within the receiver tank. This can be accomplished by changing the pump engine speed so that the green level light and yellow light on the control box is illuminated, but no other lights are on. If the red light illuminates, this indicates that the fluid level is has risen within the tank, and it will be necessary to increase the pump speed and/or open the pump discharge valve completely. If the pump speed is not sufficiently increased to equal the suction rate, the red level light will illuminate and a horn will sound. At this time, vacuum relief valve (#4) should be opened and the pump engine should be run at a higher speed to lower the fluid level within the tank as quickly as possible. If the fluid level reaches the top float of the level indicator assembly, it will interrupt the vacuum pump engine's safety shutdown circuitry, thereby, shutting it down.

SKIMMING PROCEDURE

All hose connections must be checked for tightness before skimming can begin. With the aid of an attached rope, the skimming head should be directed to the area of greatest oil accumulation. As skimming proceeds, the oil layer thickness will decrease. Adjustment should be made to maintain the optimum oil/water ratio by slowing the pumping rate, if using Manta skimming heads, or by reducing the throat opening of the High Capacity skimming head until an opening of approximately 1/4" remains (1/8" below water). The bridge, if used, can be moved by pulling with the line or pushing it along the oil boom, as required. When the skimming operation has been completed, a sorbent material may be used to remove any remaining sheen that the skimmer was unable to recover.

SUCTION LINE BLOWBACK

If any skimming head or suction hose becomes clogged with debris or other foreign matter, the normal pulsing that occurs in the suction hose line will discontinue. Also, line flow will not be evident in the sight glasses. An increase in vacuum and rise in air temperature on the vacuum pump discharge may also be noticed. To blow back the suction lines, tank vacuum should be reduced by opening the fresh air inlet butterfly valve #1 and the vacuum relief valve #4; thereby, relieving the vacuum within the tank. The discharge pump clutch must be disengaged or it will maintain tank vacuum. When the vacuum gauge indicates "0", the clogged suction line can be disconnected from the tank and attached to the suction line blowback fitting after removal of its plug. The air inlet valve #2 is then closed. The vacuum pump engine should be accelerated until the air pressure blows the suction line free.

WARNING

Air inlet valve #2 should not be closed until the vacuum pump engine has been set to idle and skimmer blow back line plug has been removed from its quick connect fitting. Personal injury from the blow back line plug can result if there is pressure in the line when the plug is removed.

If the suction hose is not freed by the use of air pressure, dismantling will be necessary. In most circumstances, clogs or "birds' nests" occur at the skimmer heads or suction line connections, at a 4 inch to 3 inch reducer, or at the suction inlet port. To avoid future contamination, debris removed from the system should not be returned to the water. After the suction line has been re-assembled, it should be re-connected to the inlet port. Valve #2 should be opened and valves #1 and #4 closed. Skimming may now resume.

WARNING

When petroleum products are skimmed, flammable vapors may be present within the receiving tank, at the vacuum pump discharge, and inside all piping. Open lights, matches, and flames should never be allowed near this unit.

DISCHARGE LINE DRAW-BACK

The discharge pump should be shut down and valve #5 opened until all liquid in the pump discharge hose is drawn back into the tank. Valve #5 is now closed and the discharge line disconnected.

TANK CLEAN-OUT

The debris that accumulates on the grate inside the receiver tank must be periodically removed. The vacuum pump must be shut down and pumping continued until all liquid is discharged from the tank. The discharge pump should not run dry for more than a few seconds. Valve #4 is opened to relieve the vacuum, and the tank end door is then opened. A small hand rake is ideal for scraping the debris from within the tank. The debris should be stored in a basket or bag for proper disposal. After cleaning, a final check should be performed to ensure that there is no interference with the travel of the level circuit indicators within the tank. A prestart alarm and shutdown circuit test should be performed (See Paragraph E, Page 8.)

TRANSFER OPERATIONS

The **TRANS-VAC** System can be used to transfer liquid from tank-to-tank without flowing the liquid through the vacuum tank. To accomplish this, the suction hose should be attached to the auxiliary pump suction fitting, and valve #3 should be closed. The Discharge Pump should be disengaged with the diesel engine at an idle. The pump discharge valve should be closed. Open valve # 5 and use the vacuum pump to draw water into the discharge pump. This is done by drawing a vacuum in the tank (follow normal procedure for raising a vacuum) which draws water up to the discharge pump. The discharge pump valve can now be opened and the pump engaged. It is now necessary to close valve # 5. Watch the pressure gauge located to the left of the pump if their is no pressure reading you must disengage the pump, close the discharge valve and repeat the process. If the gauge has a reading it will be necessary to open valve # 4 to relieve the tank of vacuum and shutdown the vacuum pump diesel. This should leave you with direct source suction and discharge.

Trans-Vac Trouble Shooting (continued)

A. When Engines Will Not Start

"Operator's Manual" should be ready for complete engine trouble shooting details.

B. Most Common Causes of Engine's Failure to Start Are:

1. No fuel
2. Dead batteries
3. Air bound fuel system
4. Safety shutdown button not held in
5. Blown fuse in safety shutdown circuit

If the vacuum pump engine will not start and there are no obvious reasons, the automatic shutoff on the tank over fill should be checked. It may be stuck in the closed (shutdown) position (top float in the upward position).

C. No Vacuum in Receiver Tank

1. The fresh air valve #1 is completely open and should be partially closed.

2. The clean-out door is leaking - The gasket seat should be cleaned and door closed "and dogged".

3. Suction ports open, but not connected to a skimmer hose--ports should be closed with a plug.

4. Vacuum relief valve #4 is open and should be closed.

5. Drawback valve #5 is open and should be closed.

D. Excessive Suction

Excessive vacuum, i.e., over 18 inch mercury, is generally the result of clogged suction lines or a suction lift that is too high. High suction will result in vacuum pump overheating and unnecessary wearing of the vacuum pump engine. The suction hoses/skimmer heads should be checked for clogging.

E. Vacuum Pump Overheating

If the vacuum pump overheats, the fresh air valve #1 must be opened to reduce the load and allow the airflow to cool it. This condition is usually an indication of insufficient airflow caused by a plugged skimmer head, hose, or internal air piping.

F. Vacuum Pump Pressure Relief Valve Opening

If blowback fitting plug is in place and atmosphere valve #2 is closed, the vacuum pump pressure relief valve will open. This condition will be evidenced by a loud, metallic buzzing or "popping" noise. Valve #2 must be opened to discharge pressure into the atmosphere.

Trans-Vac Trouble Shooting (continued)

G. Discharge Pump

If there is no discharge, the clutch may be disengaged, and must be manually re-engaged. This is accomplished by manual force to the red lever between the Engine and Pump.

If the tank is empty, it may be the result of a loss of suction, clogged suction lines, or improperly adjusted skimmer heads that are not taking in liquid. The clogged lines must be cleared and checked for suction leaks; and if necessary, the position or amount of "cut" of the skimmer heads readjusted.

H. Tank Overfilling

The tank will overfill as a result of the following:

1. The suction rate is set faster than the discharge rate. This problem is resolved by increasing the discharge pump speed, and admitting more air through the vacuum pump's fresh air inlet #1 and reducing the vacuum pump engine's RPM.

2. If sump valve #3 under the tank is closed, pump suction will be prevented. This valve should be completely open during all skimming operations.

3. If the pump becomes clogged, all liquid must be removed, even if it requires pumping at a reduced rate. The tank sump valve #3 must be closed, the short length of pipe at the inlet to the discharge pump removed, and foreign matter cleaned out.

   After the pump suction line is cleaned, the tank should be emptied, then the tank door can be opened. All debris within the tank must be removed.

   When pumping is resumed, suction rate should be set not to exceed the discharge rate. This can be monitored through the tank level indicator lights on the control box. Level between green light remaining on and orange light off should be maintained.

SHUTDOWN PROCEDURES

A. Both diesel engines should be slowed to a fast idle of approximately 800 RPM. This will allow the engine sufficient time to cool.

B. The fresh air inlet valve, #1, should be completely opened to allow the incoming air to cool the vacuum pump.

C. The vacuum release valve, #4, should be opened. This will release the vacuum from the receiver tank.

D. The control box liquid level lights will shut off as the liquid level within the tank falls. After the green light goes out, the transfer pump should be run until the discharge pressure falls to 0. At this time there may be a change in the sound coming from the discharge pump. This indicates that the pump is running dry.

E. After the tank is empty, the transfer pump clutch should be disengaged.

F. Both engines should be allowed to idle for several additional minutes, then engines should be stopped by turning off key switch.

G. If the **TRANS-VAC** unit is shut down for an extended period, (over 12 hours) the receiver tank and transfer pump should be drained and flushed (Tank Clean-Out, Page 11, should be referenced).

H. A routine inspection of all fluid levels should be performed, and the tank diesel fuel and engine oil level in both engines checked and filled as necessary. The vacuum pump and discharge pump levels should also be checked, and grease added to the transfer pump seals as required.

EQUIPMENT CLEANING PRIOR TO STORAGE

After use, it is essential that the equipment be thoroughly cleaned. There are several easy steps that should be followed to ensure equipment readiness for future use. The skimming system should be dismantled, and all equipment placed on an impervious surface with troughs for collection of contaminated water or oil from the **TRANS-VAC** Skimming Unit.

WARNING

Aromatic solvents, such as methyl ethyl ketone, ethers, or aldehydes, should never be used to clean the equipment. The result could be permanent damage or total destruction of the skimmer heads and hoses. Solvents also present serious explosion and/or fire hazards.

Diesel oil may be used to clean heavy oil from the equipment.

A. Skimming Heads

A tray large enough to hold the Flexible Manta Skimmer should be half filled with cold water and detergent or dispersant added. Both the interior and exterior of each skimming head must be cleaned. A long wire handled soft brush can be used for cleaning the interior. Care should be taken not to tear or gouge the Manta's interior rubber spacers. Detergent or dispersant should be completely rinsed with clean water, and the skimming heads allowed to thoroughly dry before storing.

Manta Ray Heads must be stored lying flat to remain in an operable condition. This storing method prevents distortion that could result in faulty performance. Flexible Manta Ray Skimmers should be stored upside down.

B. Hoses

The same procedure should be repeated. The hoses should then be thoroughly rinsed with fresh water, allowed to dry, and all metal parts coated with a lubricant before stowing. Female couplings should be inspected for missing gaskets, and gaskets replaced where necessary.

C. Trans-Vac 500D

Upon completion of use, the **TRANS-VAC** should be thoroughly cleaned by removing oil from all exterior surfaces. All water and debris must be removed from inside the receiver tank and transfer pump to avoid corrosion, which could cause pump damage.

1. Plugs from all three skimmer hose inlet fittings should be removed, liquid drained from the inlet pipes, and plugs replaced. This procedure must be done even when only one skimmer was used because liquid will splash into the unused pipes and remain there during the **TRANS-VAC's** storage if not drained.

2. The plug should be removed from the auxiliary pump suction fitting, all liquid drained from the pipe, and plug replaced.

3. The receiver tank should be opened and debris removed from the trash grate. After all trash has been physically removed, the interior of the tank should be hosed down with fresh water, the discharge pump engine started and run at idle, the clutch engaged, and all water and particulate matter discharged from the unit.

4. The drain located under the pump should be opened before the pump is stopped. A bucket should be placed beneath the drain to contain residual liquid coming from the pump. The pump should be stopped by disengaging the clutch, and the drain closed when liquid stops flowing.

5. After all liquid has been drained from the system (as in 1 through 4 above) approximately 20 gallons of light lubricating oil or permanent antifreeze (ethylene glycol) should be poured into the receiver tank (save a pint). The hatch should be closed and dogged, sump valve #3 opened, and drawback valve #5 opened. The clutch should then be engaged and engine run at idle speed for approximately 15 to 20 seconds to circulate the oil or antifreeze fluid through the pump and its adjacent piping. The clutch should be disengaged, engine shut off, and valves #3 and #5 closed. The oil or antifreeze will remain in the pump to minimize corrosion during storage. A tag should be placed on the pump engine control panel and hatch advising of oil within the unit.

6. With the vacuum pump engine running at idle and fresh air inlet valve #1 open, approximately one pint of light lubricating oil or permanent antifreeze fluid (ethylene glycol) should be sucked from a shallow container into the vacuum pump inlet. The fluid will coat the pump rotors and interior of the piping and muffler to minimize corrosion. The engine should then be shut off.

C. Cleaning Prior to Storage (continued)

7. All diesel engine, discharge pump, and vacuum pump fluid levels should be checked, and fluid replaced as required. The coolant within the engine radiators should also be checked, and coolant added as required. The fuel system's filters should be drained and filters changed. The engines should be run for a few minutes at idle after changing the filters to ensure that the fuel system is not air bound.

8. All gaskets in quick connect couplings should be checked to ensure they are in place so that the system is ready for emergency operation.

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