12 VOLTS

Installation
and
Operating Instructions

OIL X·CHANGE·R® SYSTEM

MANUFACTURED UNDER ONE OR MORE
OF THE FOLLOWING U.S. PATENTS
4,240,523 AND 5,203,429
OTHER U.S. PATENTS PENDING.

OR - REVERSO SRK 370 Oil Pump Kit

MODEL #946DT

IMPELLERS # 09-1077B-9

Ray Zager & Company
Marine Products Division
Post Office Box 7425
Jacksonville. FL 32238
(904) 389-4242

THIS PRODUCT IS NOT TO BE USED TO TRANSFER GASOLINE!

LIMITED WARRANTY

Your new *"X-Change-R"* Oil Change System is warranted by Marine Products Division, Ray Zager & Company, Attention: Customer Service. This warranty is extended to original purchasers only. This Warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

The oil change system (including any and only parts supplied by *"X-Change-R"*) is warranted to be free from defects in material or workmanship under normal use and service. The warranty period shall commence upon the installation of the system by the original purchaser through authorized dealers or if installed in a new vessel, the date of the initial launching, and shall end twelve (12) months thereafter. This limited warranty does not cover contingent or consequential liabilities of any kind. Our entire liability is limited to replacement or repair in the manner set forth below.

NEITHER THIS WRITTEN WARRANTY NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY, SHALL EXTEND BEYOND THE WARRANTY PERIOD. (Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitations of incidental or consequential damages, so the above limitations may not apply to you.)

Return unit to dealer or remove and return to customer service department, Marine Products Division, Ray Zager & Company, 4606 Shirley Avenue, Jacksonville, FL 32210. Delivery by United Parcel Service (UPS) is recommended. The unit will be repaired or replaced within a reasonable length of time and returned postage paid.

Do not attempt to repair unit as warranty *may be affected.*

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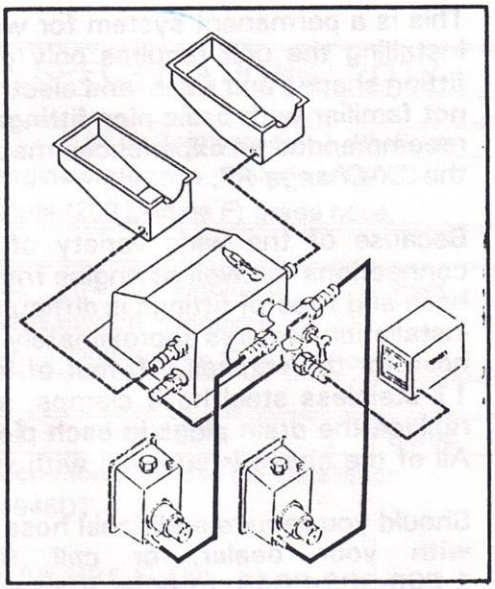
GENERAL DESCRIPTION



Your *"X-Change-R"* Model 946DT is designed to remove used crankcase oil from two engines and a generator *and* to remove approved oil from two transmissions.

It can also be used to refill each engine oil pan and the transmissions with fresh oil.

The *"X-Change-R"* is housed in a fire retardant, high impact, high gloss case. The solid brass pump has a nitrile impeller, is self-priming, and pumps immediately, whether in the **"drain"** or **"fill"** mode.

SPECIFICATIONS

System Components – Model 946DT	
MOTOR:	Heavy Duty, 15 Amp, 12 Volt DC (24 and 32 Volt Available)
PUMP:	Solid Brass, Self–Priming, Nitrile Impeller, Stainless Steel Shaft
HOUSING:	Non–Corrosive, High–Impact
HOSE:	Reinforced Rubber 200psi, 200 ° F
FITTINGS:	All Brass 3/8" NPT
FUSE HOLDER:	Built In
Dimensions	
Motor & Pump Housing and External Valve	Model # 946DT
WIDTH:	8.9 Inches
HEIGHT:	12.8 Inches
DEPTH:	6.6 Inches
WEIGHT:	7.2 Pounds
Features	
12 MONTH WARRANTY ON ENTIRE UNIT	
SERVICES 2 ENGINES, GENSET & 2 TRANSMISSIONS	

INSTALLATION

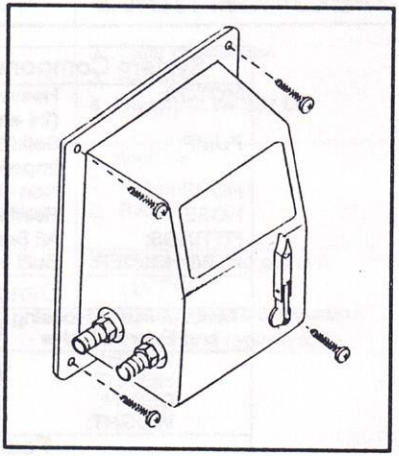
This is a permanent system for wall or bulkhead installation. Installing the unit requires only general knowledge of hose fitting shapes and sizes, and electrical wiring skills. If you are not familiar with basic pipe fittings or wiring techniques, it is recommended an experienced mechanic be engaged to install the *"X-Change-R"*.

Because of the wide variety of oil pan and transmission connections (as well as engine room layouts), the quantity of hose and type of fittings is difficult to estimate. The average installation requires approximately 12 feet of approved oil line hose for the engines, 10 feet of hose for the transmissions, 11 stainless steel hose clamps, and 5 brass hose barbs to replace the drain plugs in each piece of equipment serviced. All of the above is supplied with your unit.

Should you require additional hose or different fittings, check with your dealer, or call **Ray Zager & Company 1-800-383-9643**, to order from our parts list on page 22 of this manual.

MOUNTING THE "X-Change-R"

- Mount the **"X-Change-R" Pump Motor Unit** in a convenient, safe location where it will be easily accessible. Consider the piping, electrical and service requirements when selecting the location. Pump may be installed vertically (secured to vertical wall) or horizontally (secured to horizontal surface). Mounting screws are included.



Pump must be installed above the crankcase level!

INSTALLING "X-Change-R" HOSES

Because oil is a viscous fluid (particularly when cool) every attempt should be made to keep the length of hose runs at a minimum. Care should be taken to avoid sharp bends in the hose and exposure to hot surfaces. When installing hoses, design the layout symmetrically. It is easier to determine the location of lines and presents a neat appearance.

Connecting Engine Oil Pan Hoses

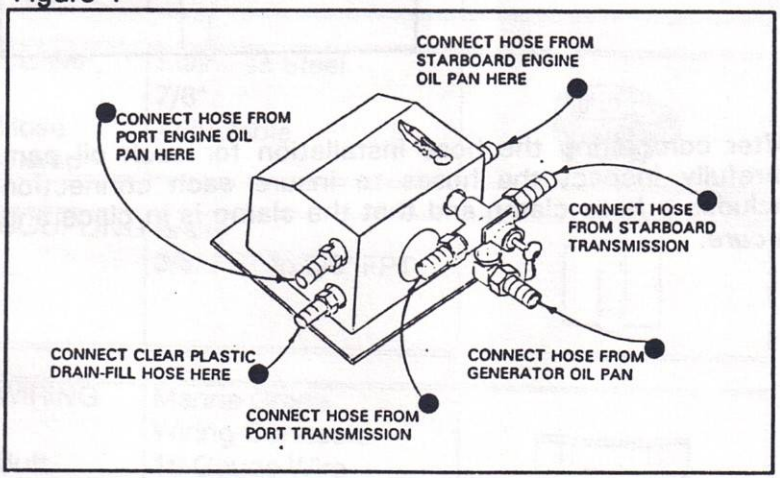
(SEE HOSE DIAGRAM - PAGE 5)

1. Drain oil from each engine in the usual manner.

2. If the engines are not equipped with a factory installed oil pan drain hose, replace each oil pan drain plug with a drain hose assembly supplied by the engine manufacturer, or install a compatible fitting that will accommodate a 1/2" ID oil drain hose. *An adaptor may be required.*

3. Connect properly measured lengths of approved 1/2" ID hose from each engine's oil pan drain to the appropriate hose barb on the *"X-Change-R"* as shown in Figure 1 below.

Figure 1



4. Connect the **Drain/Fill Hose** provided with your *"X-Change-R"* to the Drain/Fill outlet shown in Figure 2.

Figure 2

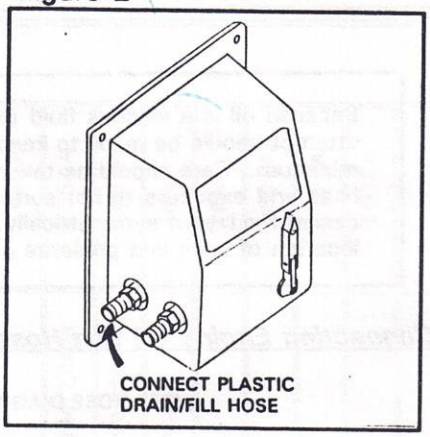
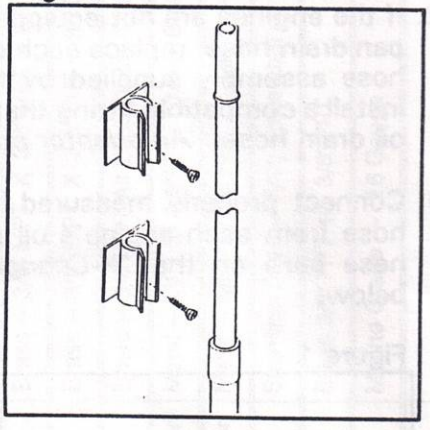


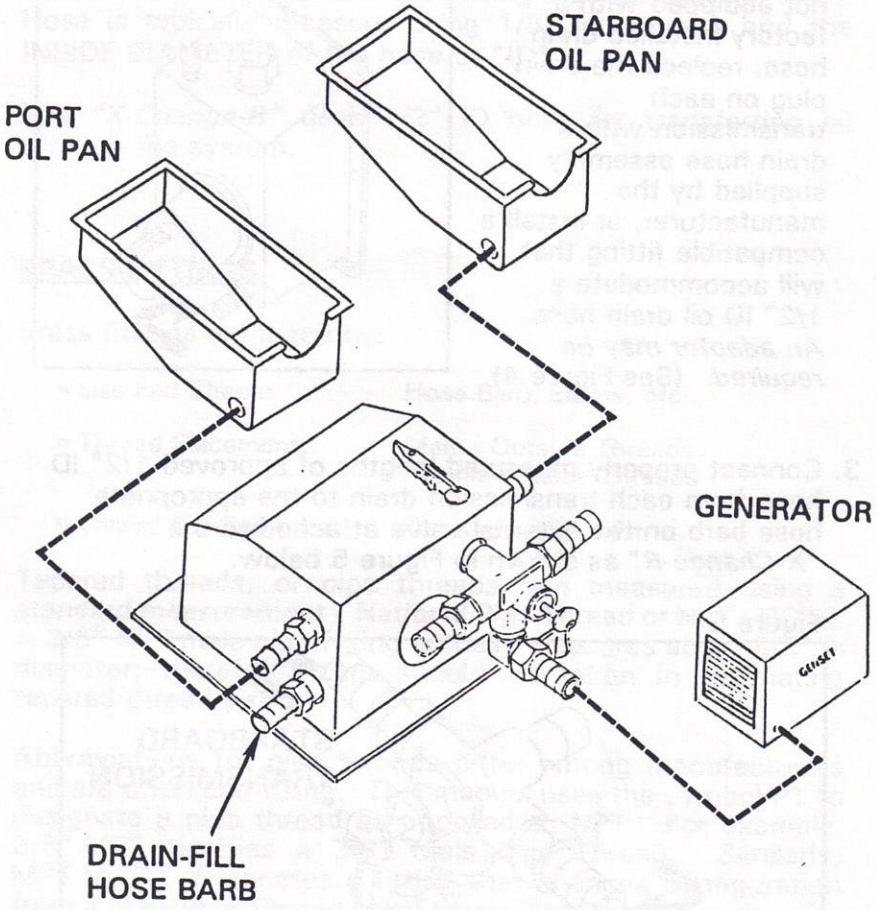
Figure 3



5. If your *"X-Change-R"* is equipped with a Drain/Fill Hose Wand (Part #93W), position the mounting clips to allow the wand to hang vertically. This will prevent leakage of oil remaining in the tube after use. Figure 3.

6. After completing the hose installation for each oil pan, carefully inspect the hoses to insure each connection includes a hose clamp and that the clamp is in place and *secure*.

OIL PAN HOSE DIAGRAM



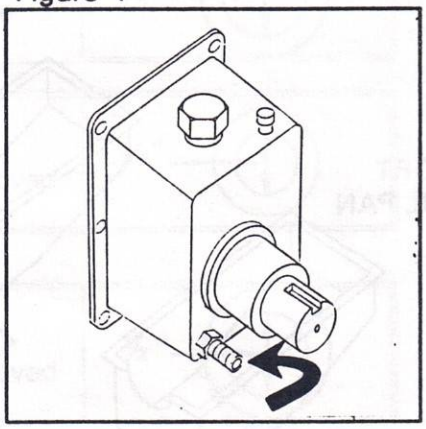
Connecting Transmission Hoses

(SEE HOSE DIAGRAM - PAGE 7)

1. Drain oil from each transmission in the usual manner.

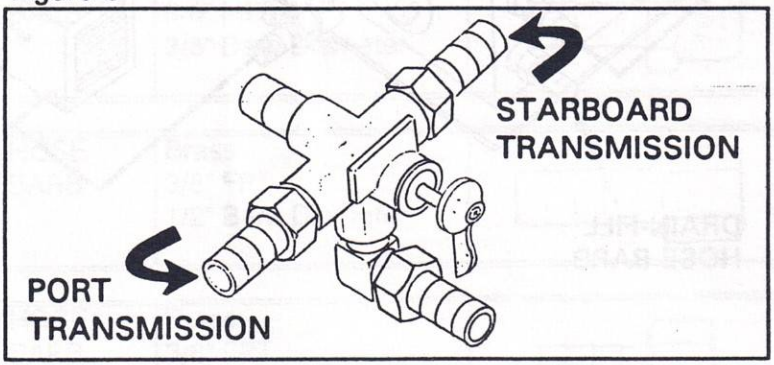
2. If the transmissions are not equipped with a factory installed drain hose, replace the drain plug on each transmission with a drain hose assembly supplied by the manufacturer, or install a compatible fitting that will accommodate a 1/2" ID oil drain hose. *An adaptor may be required.* (See Figure 4)

Figure 4



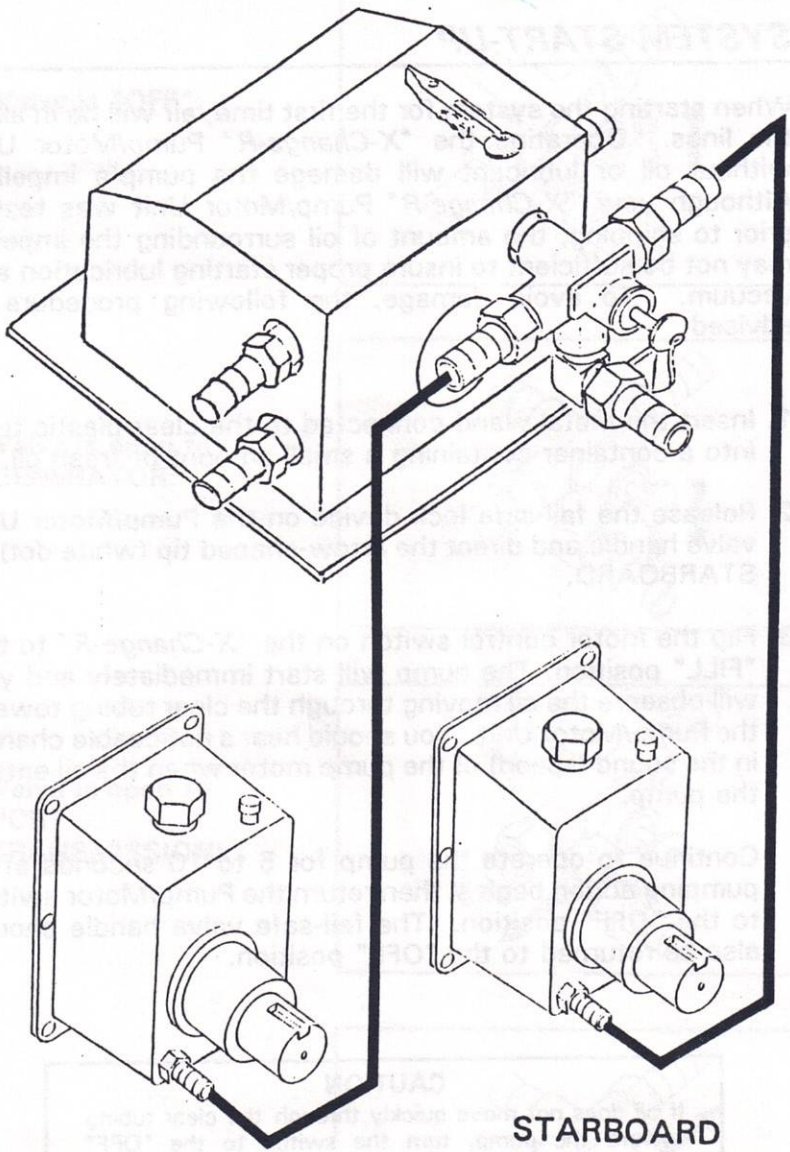
3. Connect properly measured lengths of approved 1/2" ID hose from each transmission drain to the appropriate hose barb on the external valve attached to the *"X-Change-R"* as shown in Figure 5 below.

Figure 5



After completing the hose installation for each transmission, carefully inspect the hoses to insure each connection includes a hose clamp and that the clamp is in place and *secure*.

TRANSMISSION HOSE DIAGRAM



OPERATING THE "X-CHANGE-R"

SYSTEM START-UP

When starting the system for the first time, air will be in all of the lines. Operating the *"X-Change-R"* Pump/Motor Unit without oil or lubricant will damage the pump's impeller. Although your *"X-Change-R"* Pump/Motor Unit was tested prior to shipping, the amount of oil surrounding the impeller may not be sufficient to insure proper starting lubrication and vacuum. To avoid damage, the following procedure is advised.

1. Insert the metal wand connected to the clear plastic tube into a container containing a small amount of fresh oil.

2. Release the fail-safe lock device on the **Pump/Motor Unit** valve handle and direct the arrow-shaped tip (white dot) to STARBOARD.

3. Flip the motor control switch on the *"X-Change-R"* to the "FILL" position. The pump will start immediately and you will observe the oil moving through the clear tubing toward the Pump/Motor Unit. You should hear a noticeable change in the sound (speed) of the pump motor when the oil enters the pump.

   Continue to operate the pump for 5 to 10 seconds after pumping action begins, then return the Pump/Motor switch to the **"OFF"** position. The fail-safe valve handle should also be returned to the "OFF" position.

CAUTION

If oil does not move quickly through the clear tubing toward the pump, turn the switch to the "OFF" position, elevate the clear tubing until oil nears the entrance of the pump, then flip the switch to the "FILL" position again. This will lubricate the pump and insure a good starting vacuum.

DRAINING USED OIL FROM ENGINE

To insure the engine oil maintains proper viscosity during the removal process, it is recommended the operator *run the engines long enough to permit the engine block to become warm - at least 140° F.* Shut the engines down and allow ample time for the circulated oil to return to the oil pan.

Draining Port Engine

1. Warm engine to at least 140° F, then turn engine off.

2. Insert the end of the **Drain/Fill Hose** into a container suitable for waste oil collection. (***Remember, it is a legal requirement to dispose of waste oil in a responsible manner***).

3. Loosen the oil filler cap on the engine or remove the dip stick to allow air to enter the crankcase

4. Release the fail-safe lock device on the **Pump/Motor Unit** valve handle and direct the arrow-shaped tip (white dot) to "PORT ENGINE".

5. Flip the motor control switch on the *"X-Change-R"* to the **"DRAIN"** position. The pump will start immediately. You should hear a noticeable change in the sound (speed) of the pump motor when the used oil enters the pump.

6. Continue to operate the pump until there is a noticeable change in the sound (speed) of the pump motor, which is an indication air is being drawn into the crankcase oil hose and that the specified crankcase is now empty. Oil is drained at the rate of about one gallon each 22 seconds.

Return the pump motor control switch to the "OFF" position when crankcase is empty and point the fail-safe switch device to "OFF".

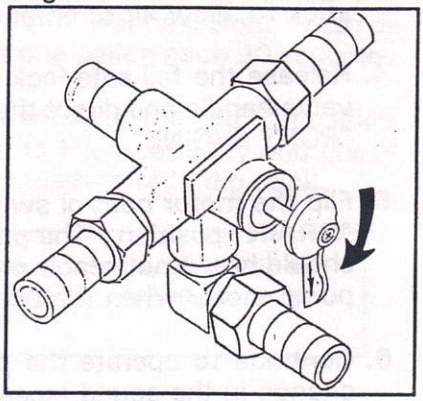
Draining Starboard Engine

- Repeat each of the steps outlined on page 9 after directing the arrow-shaped tip (white dot) on the valve handle to STARBOARD ENGINE.

Draining Generator

1. Warm generator to at least 140° F, then turn engine off.
2. Insert the end of the **Drain/Fill Hose** into a container suitable for waste oil collection.
3. Loosen the oil filler cap on the generator or remove the dip stick to allow air to enter the crankcase
4. Release the fail-safe lock device on the **Pump/Motor Unit** valve handle and direct the arrow-shaped tip (white dot) to "GENERATOR".

Figure 6



5. Treating the selector handle on the externally mounted valve as a pointer, point the tip of the handle toward the hose leading to the **Generator** as shown in Figure 6.
6. Flip the pump motor control switch on the *"X-Change-R"* to the **"DRAIN"** position. The pump will start immediately. You should hear a noticeable change in the sound (speed) of the pump motor when the used oil enters the pump.
7. Continue to operate the pump until there is a noticeable change in the sound (speed) of the pump motor, which is an indication air is being drawn into the oil hose and that the specified crankcase is now empty. Oil is drained at the rate of about one gallon each 22 seconds. **Return all switches and valves to their "OFF" position when finished.**

FILLING THE ENGINES

> If you are using the system to fill the engines for the first time, be sure you have carefully followed the "Start-Up" instructions on page 8.

Before attempting to fill an engine, make certain the engine has been completely drained or is in need of a measured amount of additional oil. DO NOT OVER FILL!

Next, determine the type and the *amount* of oil recommended by the manufacturer for each engine. Remember, FOUR QUARTS = ONE GALLON!

There are two commonly used methods to determine when the proper amount of oil has been delivered to the engine.

- **Pre-Measured Method** This method requires the operator to set aside a known quantity of oil prior to filling. For example, if the engine requires 22 quarts of oil, the operator may want to pump from a full 5-gallon container, adding 2 additional quarts as the container empties.

- **Timed Method** The timed method is used when pumping from a container of unknown capacity, or a reservoir. The flow of oil through the system varies primarily with the viscosity and temperature of the oil. Under normal conditions (75°- 85° F), the system pumps four quarts of 40 weight oil (1 gallon) in approximately 90 seconds.

Filling time is a function of several factors, including the oil temperature and weight. Oil (40 weight) at 85°F pumps approximately 20% faster than the same oil at 75°F.

FRESH OIL SHOULD BE 75°F OR WARMER BEFORE PUMPING!

Filling Port Engine

1. Loosen the oil filler cap on the engine or remove the dip stick to allow air to enter the crankcase.

2. Insert the end of the **Drain/Fill Hose** into a container of fresh oil.

3. Release the fail-safe lock device on the **Pump/Motor Unit** valve handle and direct the arrow-shaped tip (white dot) to "PORT ENGINE".

4. Flip the pump motor control switch on the *"X-Change-R"* to the **"FILL"** position. The pump will start immediately and you will observe the oil moving through the clear tubing toward the Pump/Motor Unit. You should hear a noticeable change in the sound (speed) of the pump motor when the oil enters the pump.

5. Continue to operate the pump until a measured amount of oil has been pumped into the engine's crankcase. Fresh oil is pumped at the rate of about one gallon each 90 seconds.

6. Flip the pump motor control switch to the **"OFF"** position when the oil pan nears its filled capacity and check the proper oil level with the engine's dip stick (or other measuring device supplied with the engine).

> If you have over-filled an engine, you may simply flip the motor control switch to the "DRAIN" position for a few seconds to remove the overage.

Filling Starboard Engine

- Repeat each of the steps outlined above after directing the arrow-shaped tip (white dot) on the valve handle toward STARBOARD ENGINE.

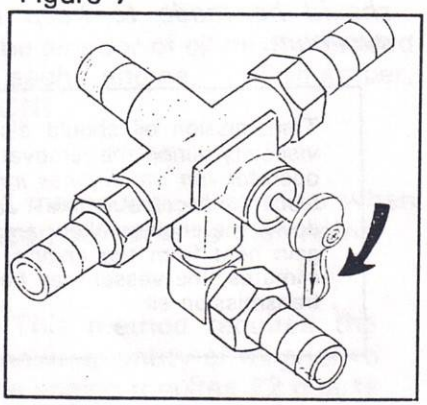
Filling Generator

1. Loosen the oil filler cap on the generator or remove the dip stick to allow air to enter the crankcase

2. Insert the end of the **Drain/Fill Hose** into a container of fresh oil.

3. Release the fail-safe lock device on the **Pump/Motor Unit** valve handle and direct the arrow-shaped tip (white dot) to **"GENERATOR"** or **"GENSET"**.

Figure 7



4. Treating the selector handle on the externally mounted valve as a pointer, point the tip of the handle toward the **hose** leading to the generator as shown in Figure 7.

5. Flip the pump motor control switch on the *"X-Change-R"* to the **"FILL"** position. The pump will start immediately and you will observe the oil moving through the clear tubing toward the Pump/Motor Unit. You should hear a noticeable change in the sound (speed) of the pump motor when the oil enters the pump.

6. Continue to operate the pump until a measured amount of oil has been pumped into the engine's crankcase. Fresh oil is pumped at the rate of about one gallon each 90 seconds.

7. Flip the pump motor control switch to the **"OFF"** position when the oil pan nears its filled capacity and check the proper oil level with the engine's dip stick (or other measuring device supplied with the engine).

WHEN FINISHED, SECURE THE FAIL-SAFE SWITCH LOCKING DEVICE IN THE LOCKED "OFF" POSITION, PLACE THE EXTERNAL VALVE HANDLE IN THE "OFF" POSITION, AND REPLACE ALL LOOSENED FILLER CAPS OR DIP STICKS.

PREPARING TO DRAIN TRANSMISSIONS

Model 946DT is recommended for use *only* with transmissions which utilize *motor oil* as a lubricant. It is not recommended for use with engines having transmissions that use specially designed fluids as a lubricant.

When changing transmission oil *or* engine oil, a small amount of waste oil will return to the system along with the fresh oil. This is acceptable for hose runs of 15 feet or less. Hose runs of 20 feet or more should be avoided, especially when connected to transmissions or small engines. *Every attempt should be made to keep the length of hose runs at a minimum.*

> Transmission oil should also be warmed to insure proper viscosity during the removal process, it is recommended the operator *run the engines long enough to permit the engine block to become warm - at least 140° F.* After shutting down the engines allow ample time for the transmission oil gain heat from the engine - about 10 minutes. In cooler climates, the vessel may have to be operated to warm the transmission oil.

DRAINING TRANSMISSION OIL

(SEE PAGE 17 FOR PROPER POSITIONING OF EXTERNAL VALVE HANDLE)

Draining Port Transmission

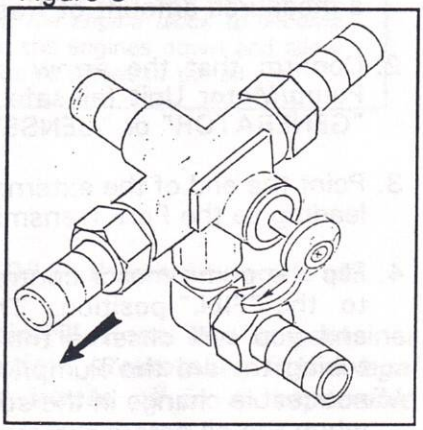
1. Check engine oil level in each engine before attempting to start the engine. Operate the engine until transmission housing is warm, then turn engine off.

2. Insert the end of the **Drain/Fill Hose** into a container suitable for waste oil collection.

3. Vent the transmission if required. (Most transmissions are equipped with a breather cap. If you are not certain your transmission is equipped with a breather cap, remove the dip stick from the transmission to allow air into gear box).

4. Release the fail-safe lock device on the **Pump/Motor Unit** valve handle and direct the arrow-shaped tip (white dot) to "GENERATOR" OR "GENSET".

Figure 8



5. Treating the selector handle on the externally mounted valve as a pointer, point the **tip** of the handle toward the hose leading to the **Port Transmission** as shown in Figure 8.

6. Flip the pump motor control switch on the *"X-Change-R"* to the **"DRAIN"** position. The pump will start immediately. You should hear a noticeable change in the sound (speed) of the pump motor when the used transmission oil enters the pump.

7. Continue to operate the pump until there is a noticeable change in the sound (speed) of the pump motor, which is an indication air is being drawn into the transmission hose and that the specified transmission is now empty. Oil is drained at the rate of about one gallon each 22 seconds.

   Return the pump motor control switch to the "OFF" position when transmission is empty.

Draining Starboard Transmission

- Repeat each of the steps outlined above after pointing the end of the external valve handle toward the hose leading to the Starboard Transmission.

  Return the pump motor control switch to the "OFF" position when transmission is empty.

FILLING THE TRANSMISSIONS

Filling Port Transmission

1. Insert the end of the **Drain/Fill Hose** into a container having a measured amount of fresh transmission oil.

2. Confirm that the arrow shaped tip (white dot) on the **Pump/Motor Unit** fail-safe lock device is pointed toward "GENERATOR" or "GENSET". If not, complete this step.

3. Point the end of the external valve handle toward the hose leading to the Port Transmission, as shown on page 17.

4. Flip the pump motor control switch on the *"X-Change-R"* to the **"FILL"** position. The pump will start immediately and you will observe the oil moving through the clear tubing toward the Pump/Motor Unit. You should hear a noticeable change in the sound (speed) of the pump motor when the oil enters the pump.

5. Continue to operate the pump until a measured amount of oil has been pumped into the PORT transmission. Fresh oil is pumped at the rate of about one gallon each 90 seconds.

6. Flip the pump motor control switch to the **"OFF"** position when the transmission nears its filled capacity and check the proper oil level with the transmission's dip stick.

> If you have over-filled a transmission, you may simply flip the motor control switch to the "DRAIN" position for a few seconds to remove the overage.

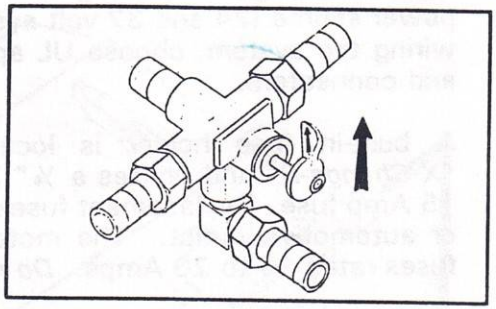
Filling Starboard Transmission

- Repeat each of the steps outlined above after pointing the tip of the external valve handle toward hose leading to the Starboard Transmission.

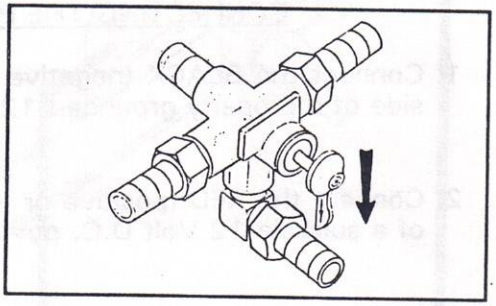
WHEN FINISHED, SECURE THE FAIL-SAFE SWITCH LOCKING DEVICE IN THE LOCKED "OFF" POSITION, PLACE THE EXTERNAL VALVE HANDLE IN THE "OFF" POSITION, AND REPLACE LOOSENED FILLER CAP OR DIP STICK.

EXTERNAL VALVE HANDLE POSITIONS

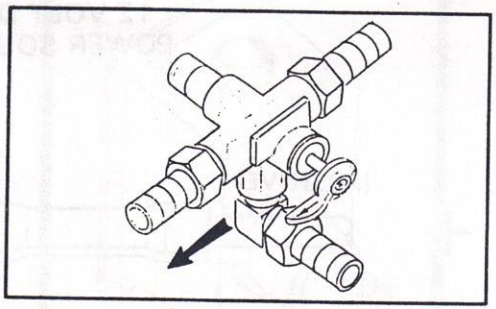
Valve is "OFF":



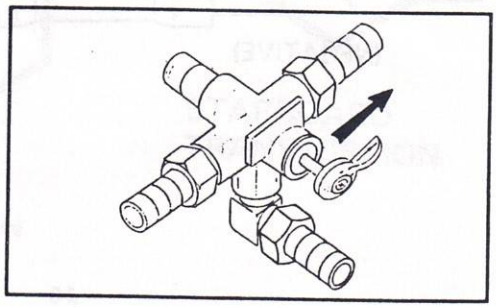
Valve is open to GENERATOR:



Valve is open to PORT TRANSMISSION:



Valve is open to STARBOARD TRANSMISSION:



ELECTRICAL WIRING PROCEDURE

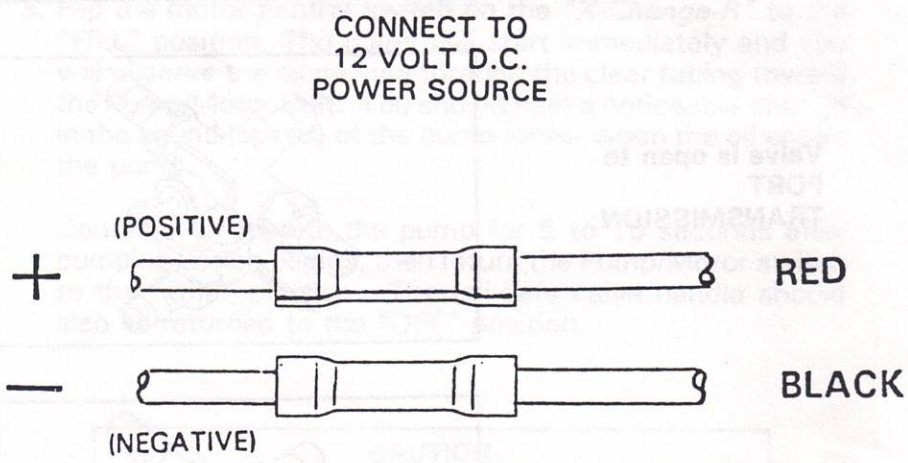
Your *"X-Change-R"* is designed for use with a 12 Volt, D.C. power source (24 and 32 volt systems are available). When wiring the system, choose UL approved, marine-grade wire and connectors.

A built-in fuse holder is located on the side of the *"X-Change-R"* and utilizes a ¼" X 1¼" glass, fast acting, 15 Amp fuse. Replacement fuses are available at any marine or automotive outlet. The motor will safely operate with fuses rated 10 to 20 Amps. *Do not exceed 20 Amps.*

CONNECTING THE POWER LEADS

1. Connect the BLACK (negative or -) lead to the negative side of a properly grounded 12 Volt D.C. power source.

2. Connect the RED (positive or +) lead to the positive side of a suitable 12 Volt D.C. power source.



PARTS TERMINOLOGY AND USE

HOSE SIZES

Hose sizes for transfer of oil and fuel vary widely among boats, with 3/8", 1/2" and 5/8" being the most popular sizes. Hose is typically measure using 1/8" increments and the INSIDE DIAMETER of the hose or "ID".

The *"X-Change-R"* uses 1/2" ID hose for transferring oil through the system.

BRASS FITTINGS

Brass fittings are listed by:

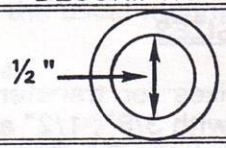
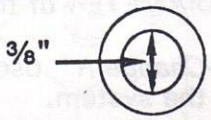
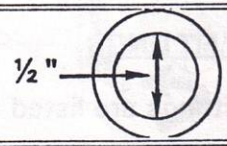
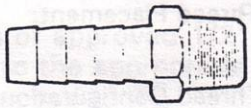
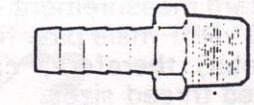
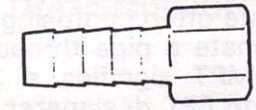
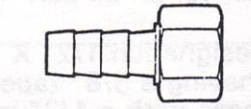
- Use and Shape: Hose Barb, Elbow, etc.
- Thread Placement: Male - Outside Threads
Female - Inside Threads
- Thread Configuration: Tapered or Straight

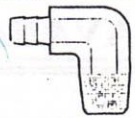
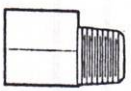
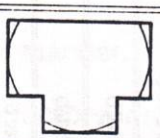
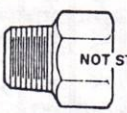
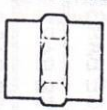
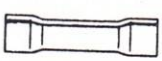
Tapered threads, or pipe threads, are measured using a standard measurement - National Pipe Thread or NPT. NOTE: A 3/8" NPT male pipe fitting actually measures about 5/8" in diameter; therefore, care should be taken in estimating tapered thread sizes.

Abbreviations for pipe threads differ among manufacturers and are often confusing. This manual uses the symbol PT to designate a pipe thread as opposed to NPT. For example, 3/8" MPT signifies a 3/8" Male Pipe Thread. Similarly, MPT to FPT designates a fitting that changes configuration from a Male Pipe Thread to a Female Pipe Thread, such as an adaptor for an oil pan fitting.

The designation 1/2" X 3/8"MPT Hose Barb describes a hose barb having a 3/8" tapered male pipe thread and designed to fit a hose with a 1/2" inside diameter.

FITTING TYPES AND DESCRIPTION

PART	SPECIFICATIONS	DESCRIPTION
HOSE Oil Transfer	1/2" ID Reinforced High Temperature Oil Resistant	
HOSE Fuel Transfer	3/8" ID Reinforced Diesel Fuel Approved	
HOSE Fuel Transfer	1/2" ID Reinforced Diesel Fuel Approved	
HOSE BARB	Brass 3/8" MPT 1/2" Barb Diameter	
HOSE BARB	Brass 3/8" MPT 3/8" Barb Diameter	
HOSE BARB	Brass 3/8" FPT 1/2" Barb Diameter	
HOSE BARB	Brass 3/8" FPT 3/8" Barb Diameter	

PART	SPECIFICATIONS	DESCRIPTION
HOSE BARB 90 Degree Elbow	Brass 3/8" FPT 1/2" Barb Diameter	
ELBOW 90 Degree Elbow	Brass 3/8" MPT to 3/8" MPT	
ELBOW 90 Degree Street Elbow	Brass 3/8" MPT to 3/8" FPT	
TEE Tee Block	Brass 3/8" FPT All Ends (Hose barbs connect to each open end)	
ADAPTOR Oil Plug Adaptor	Metal Male Pipe Thread MPT to 3/8" FPT	 NOT STOCKED
ADAPTOR Oil Plug Adaptor	Metal Male Straight Thread to 3/8" FPT	 NOT STOCKED
CLAMP Hose Clamp	Stainless Steel 7/8" Adjustable	
COUPLING	Brass 3/8" FPT to 3/8" FPT	
WIRING Butt Connector	Marine Grade Wiring Connector 16 Gauge Wire	

AVAILABLE PARTS LIST

PART	SPECIFICATIONS	UNIT PRICE
HOSE – Oil Transfer	1/2" ID – Reinforced, 200 Degree F. Temp., Oil Resistant	$1.85 /FT.
HOSE – Fuel Transfer	1/2" ID – Reinforced, Diesel Approved	2.20 /FT.
HOSE – Fuel Transfer	3/8" ID – Reinforced, Diesel Approved	1.55 /FT.
HOSE BARB – Male	Brass – 3/8" MPT X 1/2" Hose Barb	1.35 EA.
HOSE BARB – Male	Brass – 3/8" MPT X 3/8" Hose Barb	1.25 EA.
HOSE BARB – Female	Brass – 3/8" FPT X 1/2" Hose Barb	1.65 EA.
HOSE BARB – Female	Brass – 3/8" FPT X 3/8" Hose Barb	1.60 EA.
HOSE BARB – 90 Degree	Brass – 3/8" MPT X 1/2" Hose Barb – 90 Degree Elbow	2.40 EA.
HOSE BARB – 90 Degree	Brass – 3/8" MPT X 3/8" MPT – 90 Degree	2.65 EA.
HOSE BARB – 90 Degree	Brass – 3/8" MPT X 3/8" FPT – 90 Degree Street Elbow	2.25 EA.
TEE – (Tee Block)	Brass – 3/8" FPT All Ends Open (3/8" FPT at each end)	3.35 EA.
ADAPTOR – Oil Plug Adaptor	Metal – MPT to 3/8"FPT (Male "Straight" Thread)	N/A
ADAPTOR – Oil Plug Adaptor	Metal – MPT to 3/8"FPT (Male "Pipe" Thread)	N/A
CLAMP – Hose Clamp	Stainless Steel – 7/8", Adjustable	0.60 EA.
COUPLING	Brass 3/8" FPT to 3/8" FPT	1.25 EA.
WIRING Butt Connector	Marine Grade – 16 Gauge	0.60 EA.

PARTS REQUIRED FOR INSTALLATION

PART	SPECIFICATIONS	QTY.
OIL HOSE	(1/2" ID Reinforced)	12 Feet
Used for draining and filling engine crankcase. Requires 1/2" ID reinforced, moderate temperature (200 Degree F) grade hose.		
TRANSMISSION HOSE	(1/2" ID Reinforced)	10 Feet
Used for draining and filling transmission. Requires 1/2" ID reinforced, moderate temperature (200 Degree F) grade hose.		
HOSE BARB	3/8" MPT	5 Barbs
Two types of hose barbs are commonly used in the installation of the "X–Change–R" Model 946DT. – 90 Degree Hose Barb 3/8 MPT X 1/2" – Straight Male Hose Barb 3/8 MPT X 1/2" 5 * * Used instead of 90 degree hose barb.		
HOSE CLAMPS	Stainless Steel Clamp	11 Clamps
Used to secure the oil hoses to engines and "X–Change–R". and to transmissions.		
ADAPTOR**–OIL PAN	MPT to FPT	3 Adaptors
Special fitting adapted to fit the oil pan drain and the hose barb. Often has straight threads for oil pan and tapered for hose barb. ** Not stocked because of infinite variety.		
COUPLING	FPT to FPT	3
Couplings are often used to connect existing oil pan drain hoses supplied with newer engines to the oil drain hose.		
BUTT CONNECTOR	Electrical Connector	2
Plastic covered, crimp–type connector for electrical hookup. Any marine grade connector may be used.		

TROUBLE SHOOTING CHART

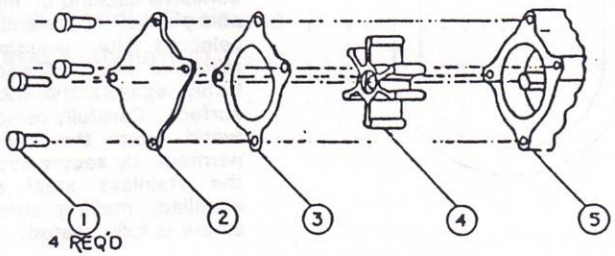
SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
Pump will not prime or retain prime after operating	1. Air leak in suction line 2. Defective cam or impeller 3. Seal worn 4. O–ring leaking 5. Suction lift too high 6. Hose kinked 7. Hose fitting not tight on head 8. Groove worn in shaft at seal area	1. Repair or replace 2. Replace 3. Replace 4. Replace 5. Lower pump 6. Straighten hose 7. Tighten hose fittings & clamps 8. Replace motor
Pump runs but no fluid is discharged	1. Faulty suction piping 2. Defective cam or impeller 3. Suction lift too high 4. Discharge height too high 5. Clogged inlet 6. Pump too far from liquid	1. Repair or replace 2. Replace 3. Lower pump 4. Lower height 5. Clean or replace 6. Relocate
Motor runs too hot	1. Voltage incorrect 2. Excessive discharge pressure 3. Impeller swollen 4. Liquid too viscous 5. Plugged or kinked discharge 6. Insufficient air flow to motor	1. Supply to be 12V DC 2. Reduce pressure 3. Replace 4. Reduce viscosity of liquid 5. Examine and repair 6. Be sure ample fresh air is available to the motor
Flow rate is low	1. Piping or hose is fouled or damaged 2. Clogged impeller 3. Worn impeller 4. Voltage incorrect	1. Clean or replace 2. Clear obstruction 3. Replace 4. Supply to be 12V DC
Seal leaks	1. Seal worn out 2. Shaft grooved 3. Pump head loose on motor	1. Replace 2. Replace motor 3. Repair
Pump will not run	1. No power 2. Impeller jammed 3. Motor has open circuit	1. Determine that outlet is 12V DC 2. Clear possible obstruction 3. Check and replace fuse

IMPELLER INSTALLATION

HOW TO REPLACE AN IMPELLER

Replace impeller every 500 hours, unless the impeller has been damaged by foreign objects, improper liquid or dry running prior to the 500 hours of normal operation.

1. Remove four screws (Ref. #1)
2. Remove cover plate (Ref. #2) and old gasket (Ref. #3).
3. Using your fingers, remove damaged or worn impeller (Ref. #4).
4. Clean the inside of the pump head and remove any foreign materials which will obstruct the impeller's operation. (Note: Also check for foreign material in the brass hose barbs and/or tubing leading from the pump).
5. Apply vaseline or a similar lubricant to both the inside of the pump head (Ref. #5) and to the outside diameter of the impeller (Ref. # 4).
6. Align the flat surface on the inside of the new impeller with the flat surface on the motor shaft. Push into place while twisting blades in a clockwise direction.
7. Place new gasket (Ref. # 3) on pump body face, align holes and replace cover (Ref. #2).
8. Tighten all four screws evenly and snugly.



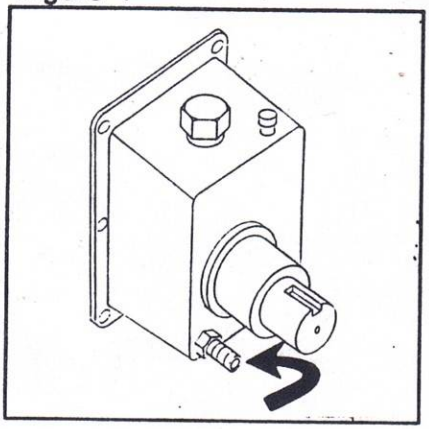
Connecting Transmission Hoses

(SEE HOSE DIAGRAM - PAGE 7)

1. Drain oil from each transmission in the usual manner.

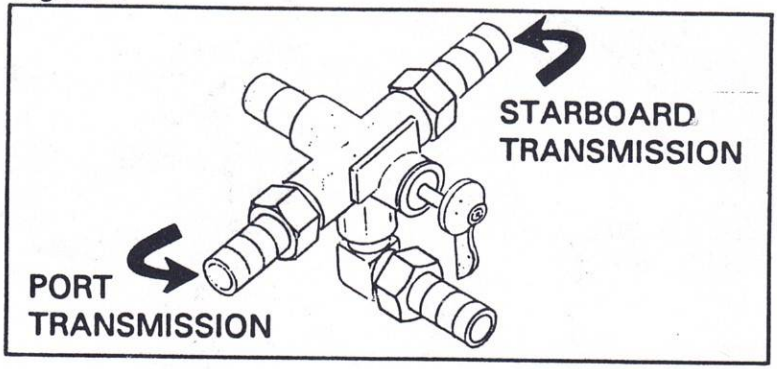
2. If the transmissions are not equipped with a factory installed drain hose, replace the drain plug on each transmission with a drain hose assembly supplied by the manufacturer, or install a compatible fitting that will accommodate a 1/2" ID oil drain hose. *An adaptor may be required.* (See Figure 4)

Figure 4



3. Connect properly measured lengths of approved 1/2" ID hose from each transmission drain to the appropriate hose barb on the external valve attached to the *"X-Change-R"* as shown in Figure 5 below.

Figure 5



After completing the hose installation for each transmission, carefully inspect the hoses to insure each connection includes a hose clamp and that the clamp is in place and *secure*.

TRANSMISSION HOSE DIAGRAM