

Engine Division

7100 E. 15 Mile Road
Sterling Heights, Michigan 48077
(313) 264-1200 (TLX 23-0435)

DATE: August 27, 1980

SUBJECT: Prestolite Distributor Housing - Excessive Moisture
and Rust Build-Up

MODEL(S) AFFECTED: All V-8 Gasoline Engines

In certain boat installations, complaints have been received of excessive moisture and rust build-up within the distributor housing.

Should you receive a complaint of poor engine performance, hard starting, and/or poor fuel economy, check the distributor housing for moisture or possible rusting or corroding.

Review of failed samples received to date indicate the problem to exist only in single-vent design Prestolite distributors. The reason the problem is isolated to the single-vent distributor is that this design has a limited ventilating capability which prevents quick dissipation of excessive moisture.

Therefore, if sign of moisture, oil or rust is present, check the following:

1. Water leaking from overhead hatch.
2. Excessive build-up of water in bilge.
3. Vent on distributor painted over or plugged with dirt.
4. Lack of proper maintenance.
5. Missing gasket on distributor cap.

If the above checks prove not to cure the problem, contact Crusader Service Department.

Engine Division

7100 E. 15 Mile Road
Sterling Heights, Michigan 48077
(313) 264-1200 (TLX 23-0435)

DATE: July 24, 1980

SUBJECT: Proper Distributor Timing

PROBLEM: Loss of Power and Poor Fuel Economy

ENGINES AFFECTED: All 229 C.I. V-6 Engines

Distributor installation on 229 C.I. V-6 engines is not the same as conventional breaker point equipped engines.

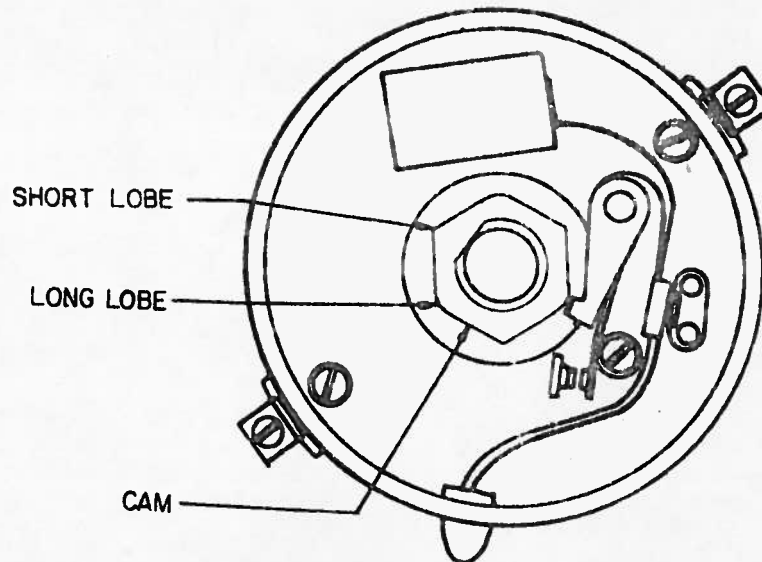
Whenever a distributor is removed it is very important that the proper lobe is used to set distributor timing. (See attached diagram.) The following procedure should be used to install distributor correctly:

LEFT HAND ROTATION (AUTO)

1. Set engine timing (#1 cylinder) at T.D.C. static. Note: Make sure cylinder is on power stroke.
2. Install distributor with rotor at 12 o'clock position, as looking at engine from rear.
3. Rotate distributor housing so breaker points open on long lobe of distributor cam.
4. Set point gap at .020 inch.
5. Start engine, check dwell reading and adjust to specification 39° , set timing 10° B.T.D.C. Set idle speed as necessary to obtain 500 RPM in forward gear.

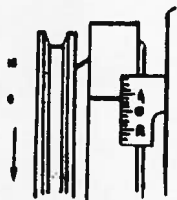
RIGHT HAND ROTATION (OPPOSITE)

Procedure is the same as for left hand, except step No. 3. Set breaker point rubbing block on short cam lobe to set point gap. Set dwell and timing - adjust idle speed.



LEFT HAND ROTATION (AUTO)

(FIG. 1)

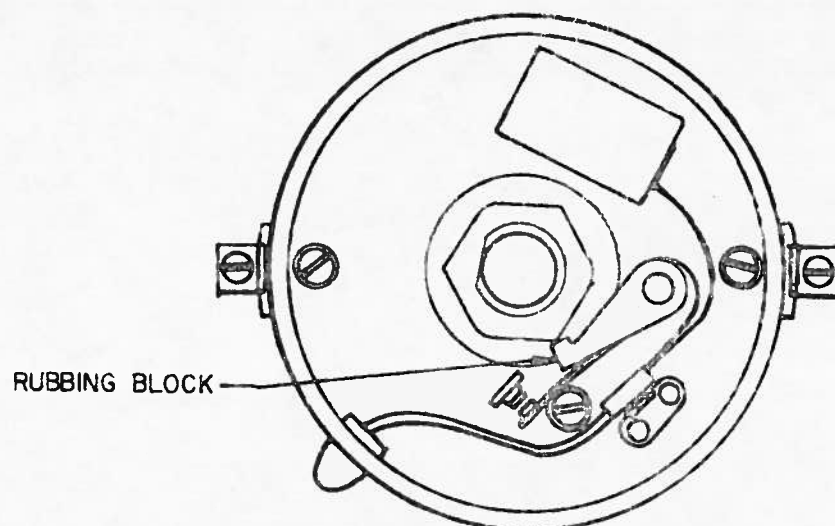


V-6 STATIC TIMING MARKS

(FIG. 2)

WITH ROTOR ON NUMBER ONE PLUG WIRE, THE RUBBING BLOCK SHOULD RIDE ON THE DISTRIBUTOR CAM IN THE FOLLOWING MANNER:

LEFT HAND ROT. - LONG LOBE
RIGHT HAND ROT. - SHORT LOBE



RIGHT HAND ROTATION (OPPOSITE)

(FIG. 3)

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(313) 264-1200 (TLX 23-0435)

DATE: August 19, 1980

SUBJECT: Cylinder Head Assemblies

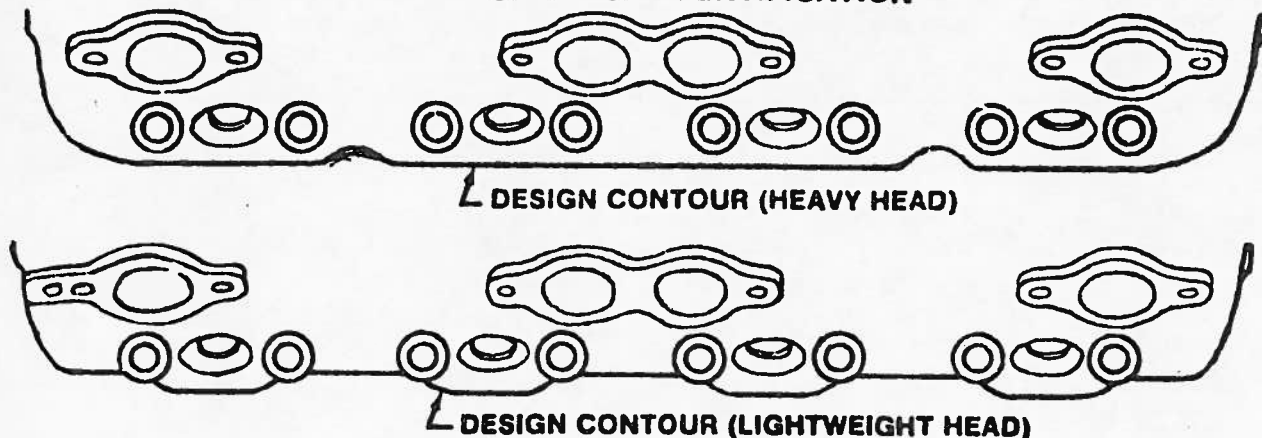
ENGINES AFFECTED: Crusader Models 190-220-270

New, lightweight cylinder heads for the above Crusader V-8 engines were released for 1978 production. The new heads are approximately 6 pounds lighter than earlier style heads, due to water passage internal coring changes and slight outer configuration modifications.

These lightweight heads were used, together with the earlier style or "heavy" heads, because of production requirements and limited machining capacities at the manufacturer's casting and machining plants. Therefore, the subject Crusader (1978) V-8 engines may have been assembled with either "heavy" or "light" heads or one of each type.

Also, the lightweight heads consist of two designs (from differences in the machining of the exhaust valve spring seats). Identify these cylinder heads from the following information:

CYLINDER HEAD IDENTIFICATION



LIGHTWEIGHT HEAD - 1ST DESIGN

Exhaust valve seats are machined to "heavy" head specifications (uses 33241 valve spring assembly for inlet valve and 33312 valve spring assembly for exhaust valve).

LIGHTWEIGHT HEAD - 2ND DESIGN

Incorporates machining that allows inlet valve spring assembly (33241) to be used at both inlet and exhaust valve locations.

The valve springs can be identified by paint stripes and measurements, as follows:

33241 Inlet Spring - (One lavender stripe) approximately 2.03" (2-1/32" or 5.16 cm) free height.

33312 Exhaust Spring - (2 light green stripes) approximately 1.91" (1-29/32" or 4.85 cm) free height.

The cylinder heads can be identified by measuring from the top of the exhaust valve guide to valve spring seat (exhaust only).

If the dimension is .75" (3/4" or 1.91 cm), use 33312 valve spring (1st design head).

If the dimension is .84" (27/32" or 2.14 cm), use 33241 valve spring (2nd design head).

Service cylinder heads must be identified by this method to insure correct valve spring usage prior to installation.

EXHAUST VALVE STEM DIAMETER/GUIDE BORE

All early style "heavy" cylinder heads have exhaust valve guide bores machined to accept .341" (8.661 mm) exhaust valve stems. (Exhaust valve 33160).

Late style "lightweight" cylinder heads were manufactured with both .341" (8.661 mm) and .397" (9.449 mm) exhaust valve stem diameters.

305 C.I. models with "lightweight" cylinder heads use exhaust valves with .341" (8.661 mm) stem diameter (33334).

Crusader 350 C.I. models with "lightweight" cylinder heads normally use exhaust valves with .372" (9.449 mm) stem diameter (33335); HOWEVER, there have been instances where small diameter .341" (8.661 mm) exhaust valve (33334) stems and guide bores have been found in these models. It is imperative, therefore, that precise measurements of exhaust stem/guide dimensions be taken when ordering replacement exhaust valves for these models.

REPLACEMENT CYLINDER HEADS

When ordering replacement cylinder heads, use the information in this bulletin to determine if early style "heavy" or late style "lightweight" cylinder heads are required, then order from the following chart:

<u>MODEL</u>	<u>"HEAVY"</u>	<u>"LIGHTWEIGHT"</u>
190	33210	33342
220	33210	33342
270	33210	33343

If "lightweight" service replacement cylinder heads of "2nd design configuration" are required for an engine, that is originally equipped with a 1st design "lightweight" cylinder head, new exhaust valve springs (33241) also must be installed (4 required per cylinder head).

In addition, all "lightweight" service replacement "2nd design" cylinder heads use exhaust valves with .372" (9.449 mm) stem diameter. Because of this, when installing a replacement "lightweight" cylinder head on a "190-220", new exhaust valves (33335) also must be installed.

Any model V-8 engines (referred to in this bulletin), which was originally equipped with an early style "heavy" cylinder head, can be converted to late style "lightweight" cylinder head only if the proper exhaust valves and exhaust valve springs also are installed (in accordance with the information in this bulletin).

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SUBJECT: Engine Oil Recommendations

MODELS AFFECTED: All Gasoline Engines

All Crusader Marine engines are shipped with Break-in oil to be changed at 25 hours of operation.

After 25 hour break-in, follow the chart listed below regarding oil recommendations:

Average Daytime Temperature During Boat Operation	Viscosity and API Classification	Oil & Oil Filter Change Intervals
0° (-18C) to 32F (0°C)	SAE 20W "SE"	50 Hours of Operation or 30 Days, whichever occurs first.
32°F (0°C) to 90°F (32°C)	SAE 30 "SE"	50 Hours of Operation or 60 days, whichever occurs first.
90°F (32°C) and Above	SAE 40 "SE"	50 hours of operation or 60 days, whichever occurs first.

REMEMBER: DO NOT OVERFILL

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SUBJECT: Gear Lubricant Usage

MODELS AFFECTED: All Gasoline Engines

The following is a list of recommended lubricants used in various transmission and "V" drive combinations used in Crusader Marine production:

1. Crusader Model 4500 Remote "V" Drive
 - A. 80W - 90 Gear Oil
2. Borg-Warner "V" Drive (Integral)
 - A. ATF: Type A - Suffix A
 - B. Dextron II
3. Walters "V" Drive (Direct Mount)
 - A. 80W - 90 Gear Oil
4. Borg-Warner Marine Transmission (Direct & Reduction)
 - A. ATF: Type A - Suffix A
 - B. Dextron II

IMPORTANT: Crusader Marine reserves the right to refuse warranty on parts which are damaged by using improper lubricants.

This bulletin supercedes all previous recommendations.

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SUBJECT: MOUNT ADJUSTING TOOL PART NUMBER 22165

MODELS AFFECTED: ALL GAS ENGINES

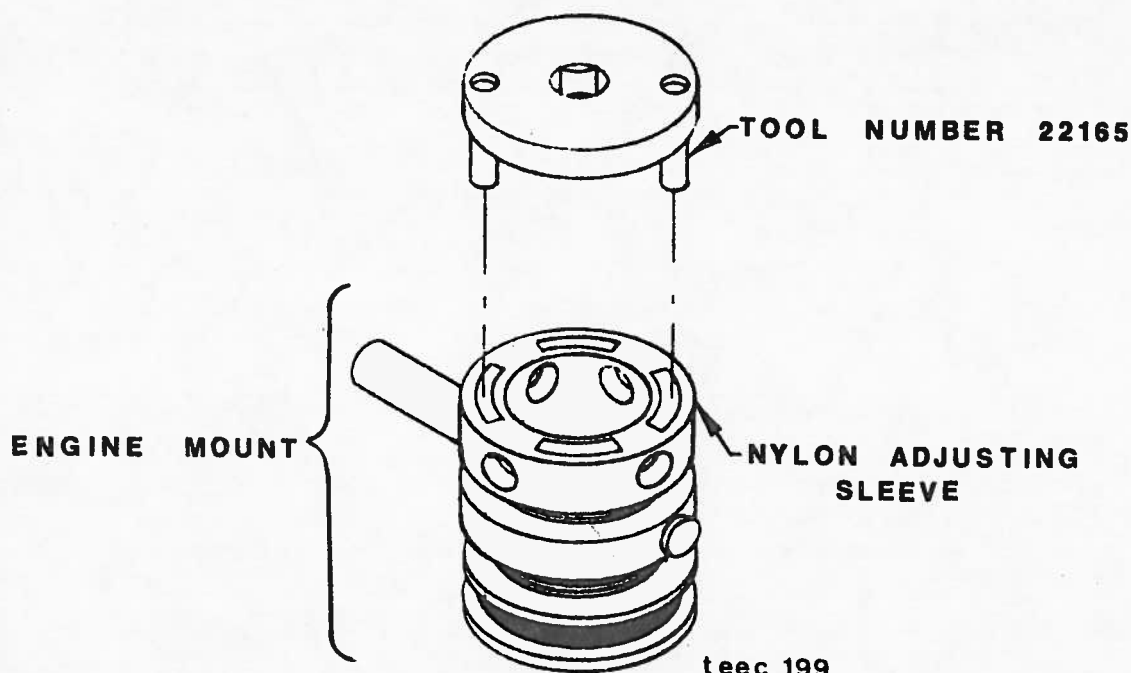
It has been brought to our attention that the nylon adjusting sleeve on the engine mounts have been breaking when making final engine alignment adjustments. We have found this happens most often on applications where there is not sufficient clearance to rotate the nylon sleeve with a adjustment rod incerted through "both" sides of the adjustment sleeve.

A NEW mount adjusting tool (part number 22165) is now advailable from Crusader Marine to correct this problem.

The tool is used by placing it on top of the nylon adjusting sleeve where two drive pins engage the shoulders of the sleeve. This allows the use of a ratchet wrench on applications where working room is limited.

The engine mount adjusting tool is available from Crusader Marine or your local engine distributor.

MOUNT ADJUSTING TOOL (part number 22165)..... \$14.50 net.



Engine Division

7100 E. 15 Mile Road
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(313) 264-1200 (TLX 23-0435)

SUBJECT: IGNITION COIL CONVERSION KIT NUMBER 22308

MODELS AFFECTED: ALL GAS ENGINES - SERIAL NO. 26000 and BELOW

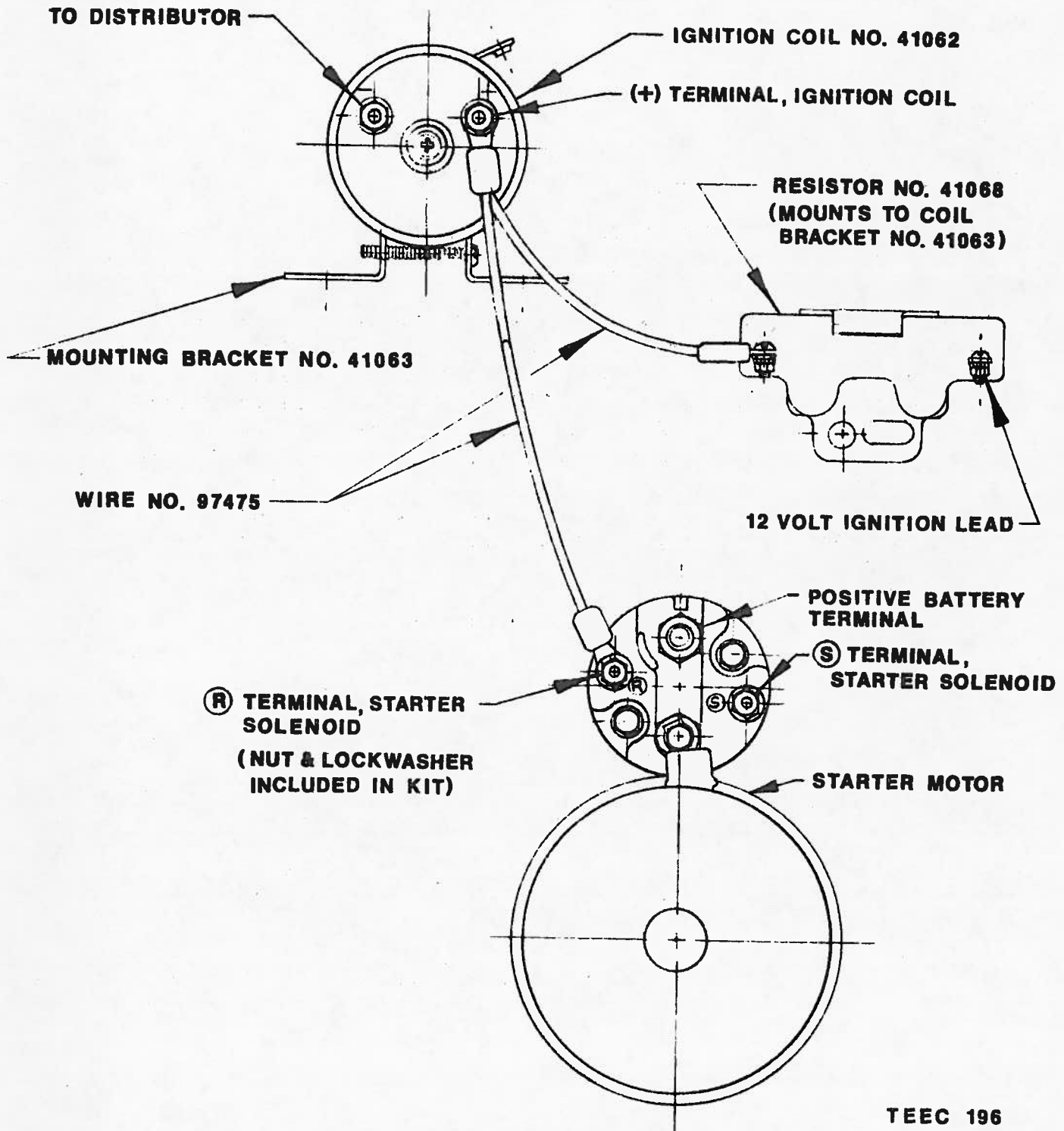
We have noticed some confusion about the availability of the Delco ignition coil, part no. 91412. This coil is no longer available from Crusader Marine. In order to improve engine starting performance we have replaced the 91412 ignition coil with coil conversion kit part no. 22308. The new kit uses a external resistor with a ignition bypass wire from the starter solenoid directly to the coil to deliver a higher voltage in the starting mode only. The kit includes a new style coil with external resistor and all necessary mounting hardware to install on the affected engine.

The 22308 kit includes the following parts:

<u>QUANTITY</u>	<u>PART NUMBER</u>	<u>DESCRIPTION</u>
1	41062	Ignition Coil
1	41068	Resistor
1	41063	Mounting Bracket
1	97475	Wire
1	112432	Nut
1	455348	Lockwasher
1		Instructions

This kit will replace all Delco ignition coil assemblies. It is further suggested that the complete ignition system be checked and engine tuned-up if needed to further protect against engine starting failure.

INSTALLATION OF COIL CONVERSION KIT NO. 22308



7100 E. 15 Mile Road
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(313) 264-1200 (TLX 23-0435)

SUBJECT: NEW METRIC STARTER MOTOR

ALL GAS ENGINES SERIAL NO. 37372 AND ABOVE

All Crusader gas engines now being built are equipped with new Delco Remy "metric starter" motors which use metric fasteners and a shorter solenoid. Check the Delco number before ordering replacement parts to assure ordering correct replacement parts, as engines may be equipped with either starter motor.

CRUSADER MARINE STARTER MOTOR IDENTIFICATION

Old Part Number

LH - 42084
Delco No. 1109485

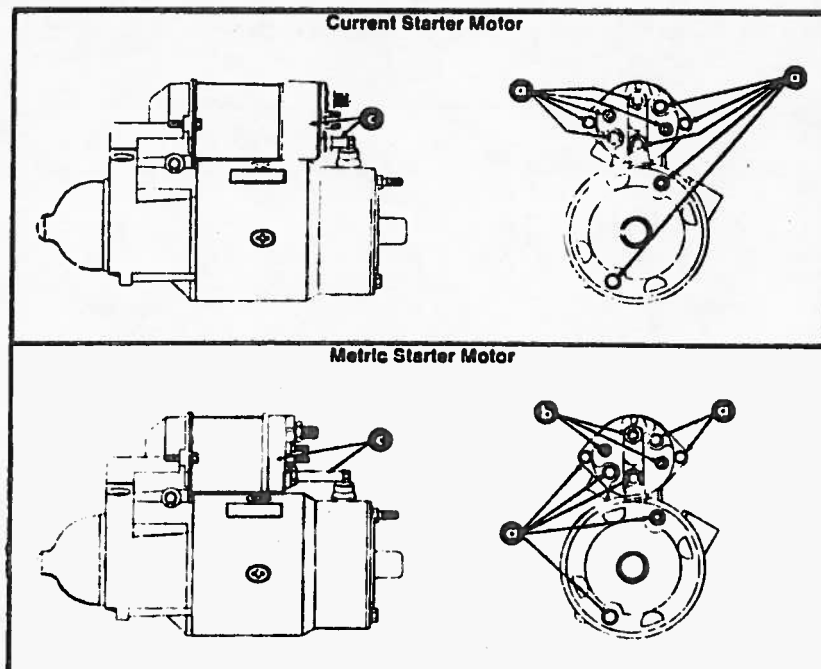
RH - 42083
Delco No. 1109484

New Part Number

LH - 42091
Delco No. 1998316

RH - 42090
Delco No. 1998315

The new "metric starter" will be used as replacements and will backfit any installation which used the standard Delco Remy starter motor.



a - English Thread b - Metric Thread c - Difference in Solenoid Length

Figure 1. Delco-Remy Starter Motor Identification

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SUBJECT: CHANGE IN THERMOSTAT HOUSING

ALL GAS ENGINES SERIAL NO. 34646 AND ABOVE

To make installation of the thermostat easier the counterbore for locating the thermostat assembly has been moved from the upper cover to the lower thermostat housing. Whenever replacing one of these components, it is important that the correct housing be installed to insure proper thermostat location as old and new style housings are not interchangeable and must be serviced with correct thermostat top cover. To identify which style is on engine, visually check location of the thermostat counterbore and order the correct replacement part shown below:

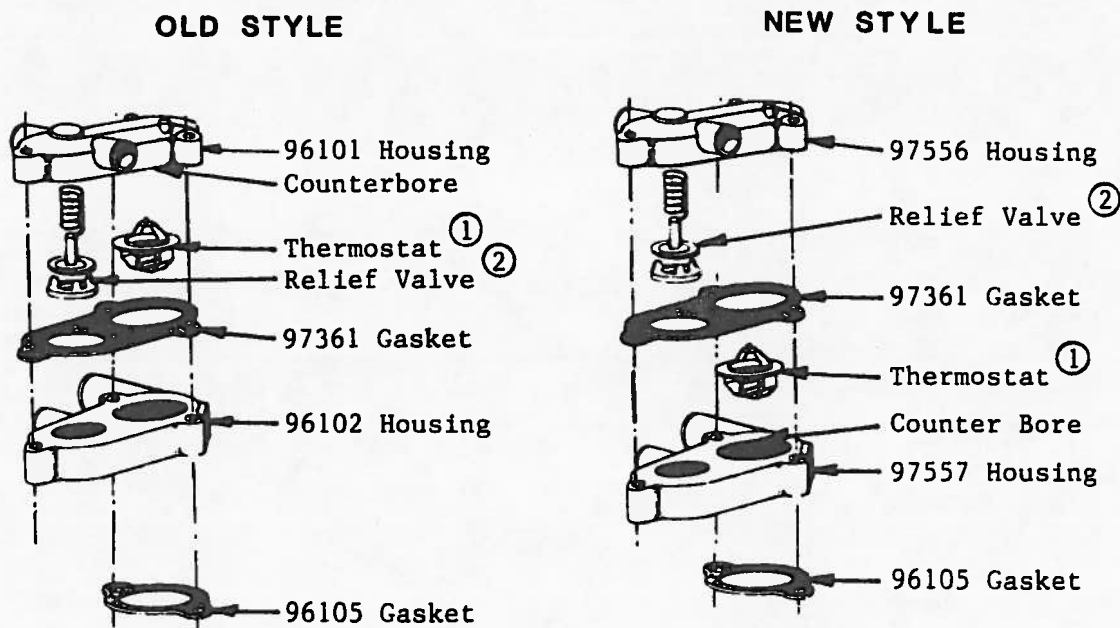


Figure 1

- NOTE:**
- 1.) Thermostat - Raw Water Cooling 143° - Part No. 96319
- Fresh Water Cooling 160° - Part No. 96358
 - 2.) Relief valve is replaced by restrictor part No. 97436 on engines equipped with fresh water cooling.

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SUBJECT: NEW CARBURETOR AND FUEL LINES

ALL CH-350 ENGINES SERIAL NO. 35923 AND ABOVE

Effective with engine serial number 35923 and above a new carburetor and 3/8" fuel lines were installed to improve overall engine performance. The new carburetor can be used as a replacement on all 454 CID engines and will improve low end acceleration and wide open throttle operation. On engine serial number 35922 and below, it will be necessary to replace the carburetor fuel inlet fitting with the one from the original carburetor as these engines were equipped with 5/16" fuel lines instead of the now current 3/8" fuel lines.

Listed below are the old and new fuel system components used on CH-350 engines:

<u>Old Part No.</u>	<u>Description</u>	<u>New Part No.</u>
45345	Carburetor	45355
97183	Fuel Line (Pump to Carb.)	97651
97340	Fuel Line (Filter to Pump)	97779
143343	Fitting (Fuel Pump)	30573
187343	Fitting (Fuel Pump)	30572
143343	Fitting (Fuel Filter)	30571
N.A.	Adaptor (Fuel Filter)	30575

When ordering parts be sure to check engine serial number to order the correct corresponding parts.

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SUBJECT: INSTRUMENT PANEL AND EXTENSION HARNESS IDENTIFICATION

ALL ENGINE MODELS

The following is a rundown of instrument panels and extension harnesses available from Crusader Marine. Whenever ordering panels make sure you use the correct extension harness as these are not compatible with older styles.

ALL GAS ENGINES

Instrument Panels:

- | | |
|--|----------------|
| 1.) Single station lower or
dual upper station. | Part No. 97490 |
| 2.) Dual station lower. | Part No. 97491 |

Extension harnesses used between engine and instrument panel and also between upper and lower instrument panel:

- | | |
|---------------------------|----------------|
| 1.) 15' Extension Harness | Part No. 97768 |
| 2.) 20' Extension Harness | Part No. 97482 |
| 3.) 25' Extension Harness | Part No. 97481 |

9.0 LITER DIESEL

Instrument Panels:

- | | |
|--|----------------|
| 1.) Single station lower or
dual station upper panel. | Part No. 11193 |
| 2.) Dual station lower. | Part No. 11273 |

Extension harness between engine and instrument panel, also between instrument panels:

- | | |
|---------------------------|----------------|
| 1.) 15' Extension Harness | Part No. 11191 |
| 2.) 20' Extension Harness | Part No. 11192 |

3.5 LITER DIESEL

Instrument Panels:

- | | | |
|-----|--|----------------|
| 1.) | Single station lower or
dual station upper. | Part No. 14058 |
| 2.) | Dual station lower. | Part No. 14059 |

Extension harness between engine and instrument panels and also between instrument panels:

- | | | |
|-----|-----------------------|----------------|
| 1.) | 15' Extension Harness | Part No. 14066 |
| 2.) | 20' Extension Harness | Part No. 14067 |

- NOTE: 1.) When making a dual engine installation with dual control stations, a total of four (4) control panels must be ordered.
- 2.) Longer length extension harnesses are available on request. Contact the factory for availability and cost.

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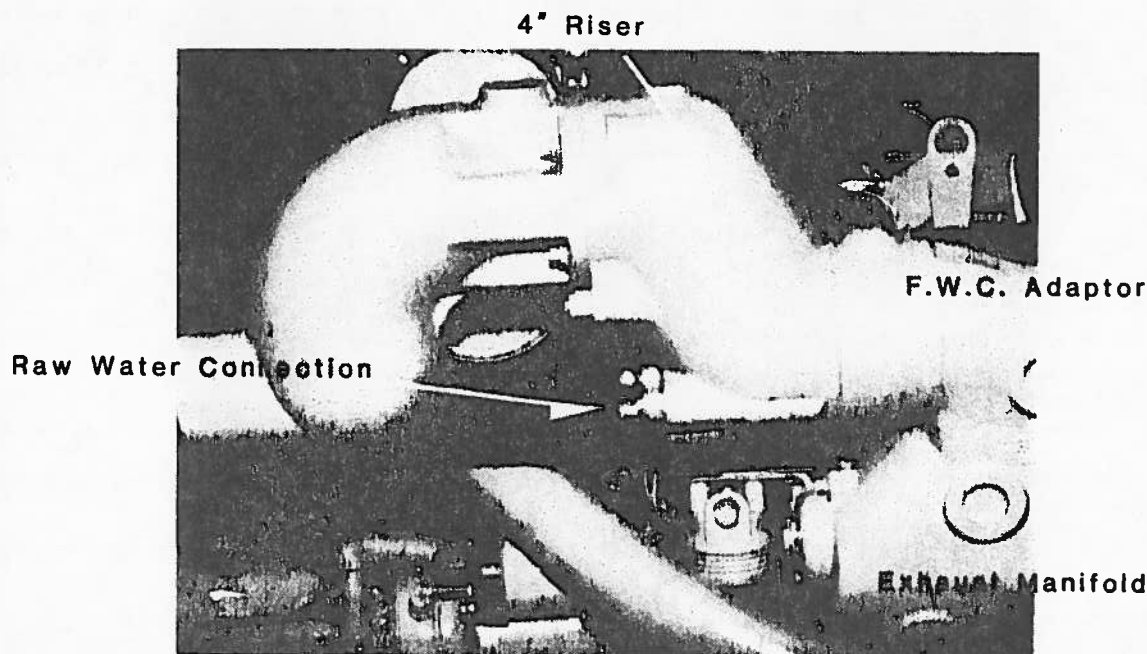
SUBJECT: NEW 4" RISER PART NUMBER 97772.

ALL ENGINE APPLICATIONS SERIAL NO. 37871 AND ABOVE

A new 4" riser has been developed and released to production which will standardize all fresh water cooling installations. The new riser is no longer part of the F.W.C. system, as in the past. This new riser is now raw water cooled as are the 8" and 12" risers. This change should stop confusion about the location of the fresh water take-off adaptor which will now be installed between the exhaust manifold and the exhaust riser on all applications.

This change will not affect any raw water cooled applications and will also backfit all previous fresh water cooled engines which used the old style 4" riser, part no. 96419. Interchangeability with older units will not be affected.

Old style riser (part no. 96419) cannot be used to replace 4" riser no. 97772 in fresh water cooled installations, but will work as a replacement on raw water applications only.



4" RISER INSTALLATION

Engine Division

7100 E. 15 Mile Road
Sterling Heights, Michigan 48077
(313) 264-1200 (TLX 23-0435)

SUBJECT: MALLORY IGNITION DISTRIBUTOR (part no. 37061)

ALL V-8 ENGINES SERIAL NUMBER 38579 and ABOVE

Effective with the above listed serial number, all current production V-8 engines will be equipped with a Mallory distributor (Part No. 37061) in place of the Prestolite distributor (Part No. 41075). This new Mallory distributor is of conventional design and without the tack drive option.

The Prestolite distributor (Part No. 41075) will remain available for service replacement requirements.

TUNE-UP SPECIFICATIONS:

Listed below are the current tune-up specifications on engines equipped with standard Mallory distributor (Part No. 37061):

Point Gap .020	Point Dwell - 28° - 31°	Timing - 10° BTDC
----------------	-------------------------	-------------------

SPARK PLUG REQUIREMENTS:

Normal Service - AC MR44T or Champion RBL-8, Part No. 97782

Severe Service - Champion RBL-9Y, Part No. 97783

7100 E. 15 Mile Road
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(313) 264-1200 (TLX 23-0435)

SUBJECT: PISTON DAMAGE DUE TO DETONATION and/or PREIGNITION
MODELS AFFECTED: ALL GAS ENGINES

Detonation, commonly called "fuel knock" or "spark knock", is abnormal combustion of the fuel which causes the fuel to explode violently within the combustion chamber.

Normal burning or combustion in a four-cycle engine starts at the spark plug, and a wave of flame moves across the combustion chamber. This results in a smooth pressure rise in the combustion chamber which pushes the piston downward.

Detonation starts out as normal combustion with the spark ignited flame progressing across the combustion chamber while applying heat and pressure to the unburned portion of fuel. Then, instead of continuing to burn smoothly and evenly, the last portion of fuel explodes violently, causing overheating of spark plugs, pistons, and valves.

Detonation can occur at any speed and at times only during acceleration and is often not detected because of normal operation noises and, also, better insulated engine compartments. Undetected detonation may result in serious engine damage.

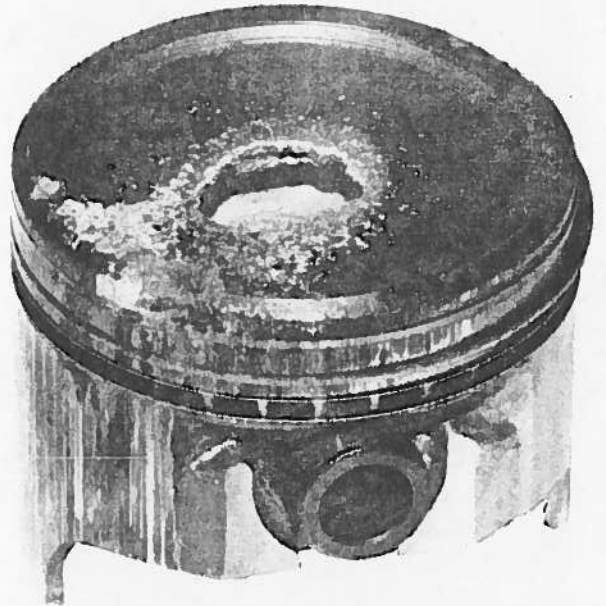
The use of low octane fuel is one of the most common causes of detonation. Even when using proper fuel, detonation can occur if engine maintenance is neglected. Other causes of detonation are as follows:

- 1.) Over-advanced ignition timing.
- 2.) Lean fuel mixture at or near full throttle caused by carburetor or leaking intake manifold.
- 3.) Inadequate cooling of engine by deterioration of cooling system.
- 4.) Excess accumulation of deposits on piston and/or combustion chamber.
- 5.) Cross-firing spark plugs.
- 6.) Improper engine RPM at wide open throttle.

The accompanying photos show the type of piston damage caused by detonation.

SERVICE PERSONNEL TAKE NOTE:

ENGINE DAMAGE CAUSED BY THE AFOREMENTIONED CONDITIONS IS NOT CONTROLLABLE BY CRUSADER MARINE ENGINE DIVISION, AND THEREFORE, NO WARRANTY WILL APPLY TO FAILURES WHICH OCCUR UNDER THESE CONDITIONS.



7100 E. 15 Mile Road
Sterling Heights, Michigan 48077
(313) 264-1200 (TLX 23-0435)

SUBJECT: STARTER MOTOR FAILURE

MODELS AFFECTED: ALL GAS ENGINES

We have been receiving a large quantity of starter motors back from the field with exploded armatures.

Investigation has shown a large amount have failed due to being engaged with the engine flywheel with the engine running. This excessive RPM then causes the commutator to fly apart and effectively destroys the starter motor.

This failure is normally caused by one or more of the following problems:

- 1.) Key switch sticking in the start position.
- 2.) Low battery voltage on start-up.
- 3.) Loss of ground on starter motor or auxiliary relay.
- 4.) Water inside starter solenoid housing.

Failures of this type are not covered under terms of "Crusader Engine Division-Limited Product Warranty".

Dealers submitting starters and claims which show this type of failure will find the starter motor returned and claim denied.

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WARRANTY REGISTRATION CARDS

We are receiving Warranty Registration Cards which are not completely filled out or are illegible. A large amount of time is being spent correcting these cards before they can be processed. In several instances, we must contact the selling dealer or the boat owner for the required information. This is very time consuming and prevents the owner from getting his or her Registration Card quickly.

Below is a copy of a correctly filled out Warranty Registration Card. While all this information is important, the most commonly omitted information is "Date of Sale" and "Zip Codes". The information can be either typed or written, just so it is legible and complete.

CRUSADER MARINE WARRANTY REGISTRATION CARD


Owners Name Joe Boater
Address 123 Main Street
City Anyplace,
State USA Zip 00000
Engine Model No. CH-350
Gear Model 10-18-005 (Day)
Date of Sale (M O) APRIL
Boat Mfr. Day Cruiser
Boat Size 31 x 12

Selling Dealer ABC Marine
Address 456 Boat Drive
City Anyplace,
State USA Zip 00000
Engine Serial No. 45555
Gear Serial No. 3456
Hull I.D. No. 21 (Yr.) 84
Engine Installation ☐ Single ☒ Dual

THE BOAT DEALER MUST
FILL IN ALL INFORMATION
AND MAIL WITHIN TEN
DAYS OF THE DATE OF
SALE.

PLEASE TYPE OR PRINT IN
INK.

FAILURE TO FOLLOW THESE INSTRUCTIONS
WILL CAUSE DELAYS IN PROCESSING
ANY REQUIRED WARRANTY CLAIMS.


Crusader
MARINE ENGINES

I CERTIFY THAT I AM THE ORIGINAL PURCHASER OF THIS ENGINE AND HAVE COMPLETELY READ AND UNDERSTAND THE
TERMS OF THE ENGINE MANUFACTURER'S WARRANTY, AND THAT I HAVE RECEIVED THE ABOVE ENGINE IN SATISFACTORY
RUNNING CONDITION

OWNER'S SIGNATURE _____ DATE SIGNED 9/82

These cards must be filled out by the Selling Dealer and submitted within 10 days of date of sale.

The "FEDERAL BOAT SAFETY ACT" requires registration lists be maintained by both dealer and manufacturer on products sold in the United States. Please complete these cards completely and quickly, as it will benefit us all.

7100 E. 15 Mile Road
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SUBJECT: FUEL FILTER CONVERSION KIT

Part Number 22378

MODELS AFFECTED: ALL V-6 ENGINES S/N 43028 and BELOW

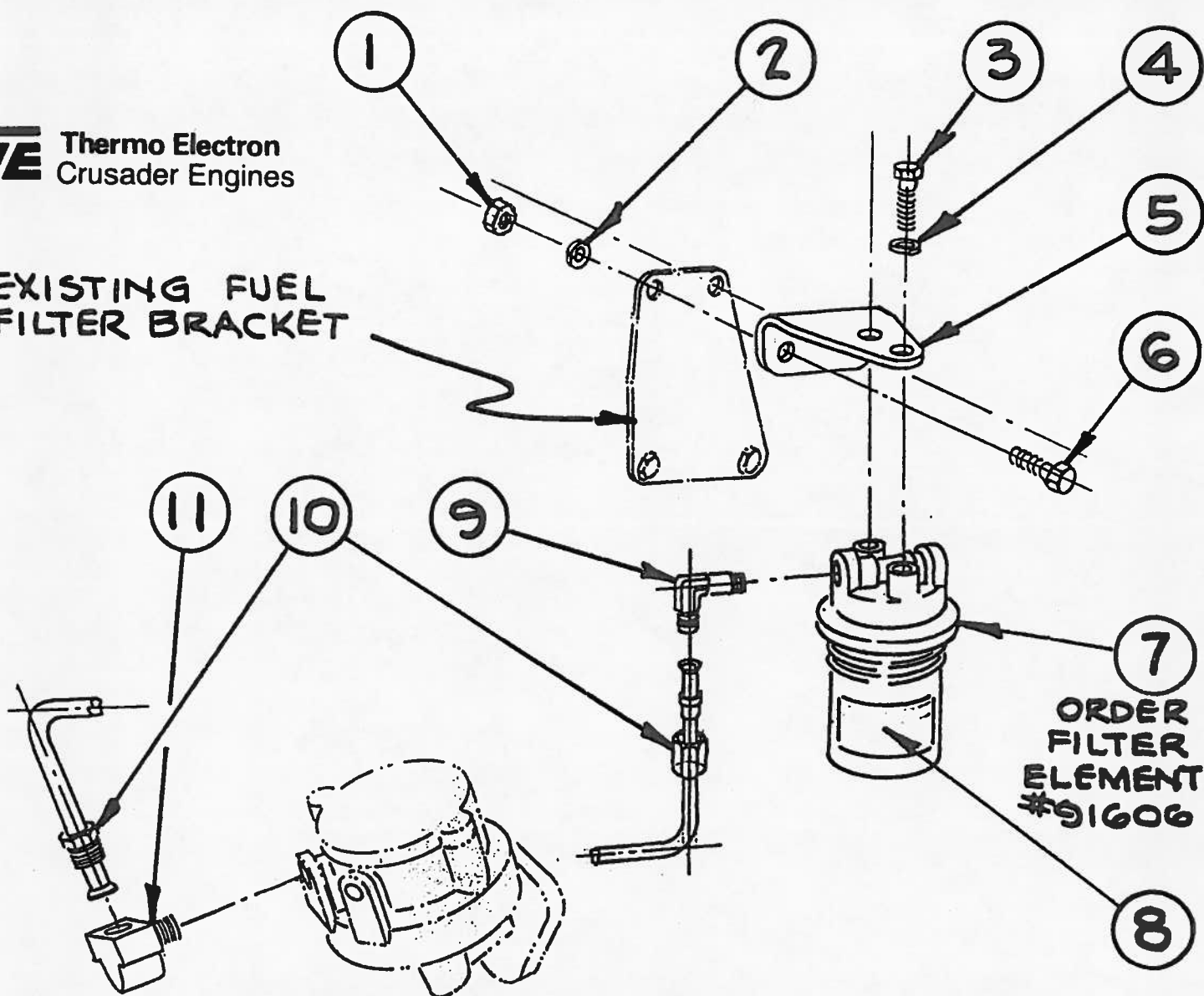
In some engine applications it has been found that the standard fuel filter has not performed up to specification, thus allowing certain types of foreign material to pass through to the carb filter and cause a fuel restriction, leading to poor idling and/or loss of W.O.T. operation. This material is silicones, waxes and strands of glass used in the construction of fiberglass boats and most notably, fiberglass fuel tanks.

When dealer service people are checking out the above complaint, they are finding the bronze filter in the carb restricted. In that they can't see any foreign material on the filter, it is then mistakenly thought the problem is the bronze filter itself and therefore removed and not replaced. This is IMPROPER! In these applications the bronze filter is working and catching the material which is passing unrestricted through the primary filter.

Removal of the bronze filter will lead to this material entering the carburetor itself and plugging internal passages again leading to idling problems, flooding and fuel starvation at W.O.T.

To correct this problem a fuel filter conversion kit has been developed to replace the original filter. The kit consists of new fuel filter assembly, fuel line and filter bracket. The new filter will catch the material used in fiberglass production.

EXISTING FUEL
FILTER BRACKET



**A-C FUEL FILTER CONVERSION KIT #22378
FOR 229 C.I.D. V-6 ENGINE - MODEL 165**

ITEM	QTY.	PART NO.	DESCRIPTION
1	2	109184	1/4-20 HEX. NUT
2	2	103319	1/4 LOCKWASHER
3	2	181339	5/16-24 HEX. BOLT x 1" LONG
4	2	103320	5/16 LOCKWASHER
5	1	97816	FUEL FILTER ADAPTER BRACKET
6	2	179797	1/4-20 HEX. BOLT x 1" LONG
7	1	91365	FUEL FILTER ASSEMBLY
8	1	22115	DECAL "WARNING NOTICE"
9	1	30592	90° LONG ELBOW 3/8 TUBE x 1/4 PIPE
10	1	97817	FUEL LINE ASSEMBLY
11	1	30573	90° ELBOW 3/8 TUBE x 1/4 PIPE

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SUBJECT: USE OF UNLEADED FUELS IN CRUSADER ENGINES

Much is being said today about the Environmental Protection Agency (EPA) recent mandate regarding the reduction of lead in gasoline. The EPA has just ruled that the lead content in regular grades of gasoline must drop from the current 1.1 grams/gal. to 0.1 grams/gal. by January 1, 1986.

With 0.1 grams/gal. as an average, it is likely some, if not all fuel refiners will decide to market only unleaded gasoline which by law is required to average less than 0.05 grams/gal.

The use of unleaded fuels in Crusader Marine Engines built since 1971 should not produce any adverse effects except some durability in the valve seat area. The average boater most likely will not notice any effects from the use of unleaded gasoline during day to day operation.

To assist our engine owners, Crusader Engines offers the following recommendations on fuel usage:

1. Use regular leaded fuels as long as it is available.
2. Avoid alcohol enhanced unleaded fuels, especially those containing Methanol alcohol additives.
3. Ask your gas dock operators what type fuel they are selling, most are aware of problems of alcohol based fuels and will avoid alcohol blended fuels.
4. Make regular inspections of the fuel system components on your boat to make sure of the integrity of the fuel system.

The complete effects of unleaded fuels is still being evaluated and future bulletins will keep you advised of changes or problems which may arise.

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SUBJECT: ALCOHOL BASED GASOLINE AND GASOHOL

It is not generally known to the public that much of today's gasoline contains large amounts of alcohol, although it is not sold as Gasohol.

Some gasolines contain Ethanol (ETHYL ALCOHOL) which is made from grain. Other gasolines contain Methanol (METHYL ALCOHOL) which can be produced from natural gas, coal, trees, vegetation or even garbage.

Alcohol in gasoline can have a deteriorating effect on certain fuel system components and cause engines to "Vapor Lock" easier. Floats (OTHER THAN METAL) can swell or shrink. Seals on accelerator pumps can swell and cause "Bog" on acceleration. Fuel pump check valves can swell or diaphragms distort, causing a loss of fuel pump pressure. All other rubber or Neoprene composition parts in the fuel system can be affected also.

CRUSADER MARINE DOES NOT RECOMMEND THE USE OF GASOLINES THAT CONTAIN METHANOL !

Fuels containing alcohol have the ability to absorb moisture slowly from the air. At first this moisture will remain in solution. Once the alcohol absorbs water to it's maximum, around 1%, a phenomenon known as phase separation can occur. When this happens the alcohol-water mixture settles to the bottom of the fuel tank and the engine will not run on it. Before the engine can be restarted, it will be necessary to remove the separated layer from the tank and flush out the fuel system with clean fuel.

In cars, alcohol blend fuels normally are burned before they can absorb enough moisture to cause trouble, but boats often sit idle long enough for separation to take place. If you do operate your marine engine on gasoline which contains alcohol, storage of this type of gasoline in the fuel tank for periods of more than a few days must be avoided in high humidity climates.

In view of the preceding information, your customers should be advised to avoid all alcohol enhanced fuels, especially those containing Methanol alcohol additives.

**** SAFETY WARNING !! ****

Make regular inspections of the boat's fuel system components to make sure of the integrity of the system. Fuel leakage from the boat's permanent fuel system may occur while the system is in use, in transit or in storage. Fuel leakage can contribute to an explosion or fire causing serious bodily injury or death.

The complete effects of Methanol and Ethanol in gasolines on boat fuel system components are still being evaluated. Future bulletins will keep you advised of these effects and any problems which may be caused.