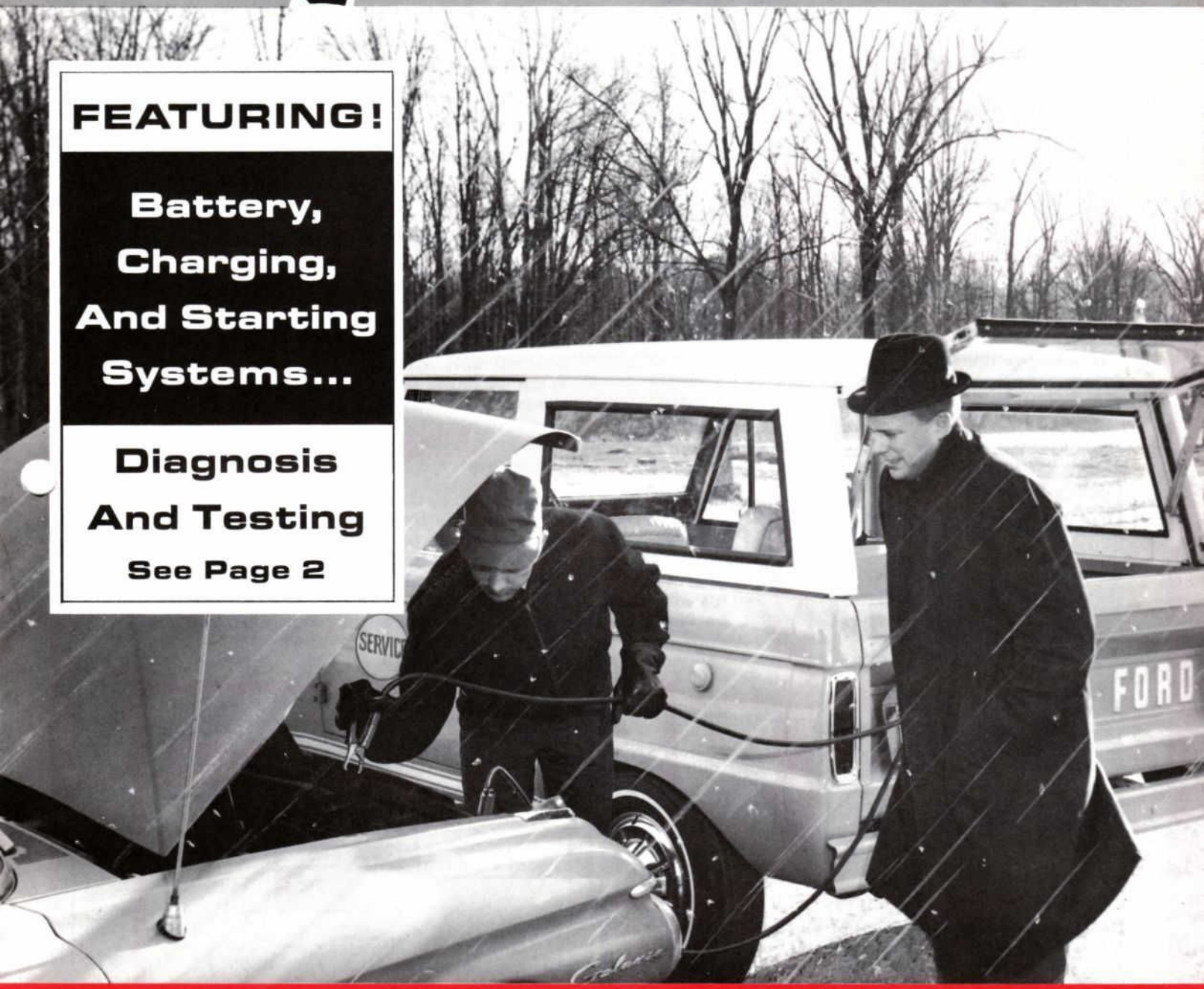
JANUARY, 1966

Shop Tips FROM FORD

VOL. 4, NO. 1

Technical parts and service information published by Ford Division to assist servicemen in Service Stations, Independent Garages and Fleets.



FEATURING!

Battery, Charging, And Starting Systems...

Diagnosis And Testing

See Page 2

From Your Ford Dealer

Be sure to file this and future bulletins for ready reference. If you have any suggestions for additional information that you would like to see included in this publication please write to: Ford Division of Ford Motor Company, Parts and Service Promotion and Training Dept., P. O. Box 598, Dearborn, Michigan 48121.

FoMoCo GENUINE PARTS

ROTUNDA

BATTERY, CHARGING, and STARTING

IN THIS ISSUE

The battery, charging and starting systems are all inter-related to each other, and each must perform its individual function to insure the complete system works properly.

The starter depends on the battery to supply the necessary power to crank the engine, and the battery depends on the charging system to keep it at peak performance to supply electrical energy not only to the starter, but to the ignition system and accessories.

A failure in any one system sooner or later leads to perhaps the most irritating of all automotive problems—"failure to start". Dead or low charged batteries, excessive use of water by the battery, slow cranking speeds, extreme headlight dimming on idle, ammeter or indicator lights showing little or no charge are all signs that a problem exists which should be found and corrected.

Periodic service can usually prevent a "failure to start", but if it does occur, the best procedure to follow is to trace the cause in a systematic diagnosis procedure as recommended in this article.

THE BATTERY

The battery is the heart of the electrical system, and is the logical place to start when looking for conditions that might cause an electrical or starting problem. This is especially true in cold weather, which has a great effect on battery efficiency. A fully charged battery at 0° Fahrenheit performs at only 40% of the capacity of a fully charged battery at 80° Fahrenheit. See Figure 1. It's easy to see that a partially charged battery that "got by" during warm weather is almost certain to cause trouble as the temperature drops.

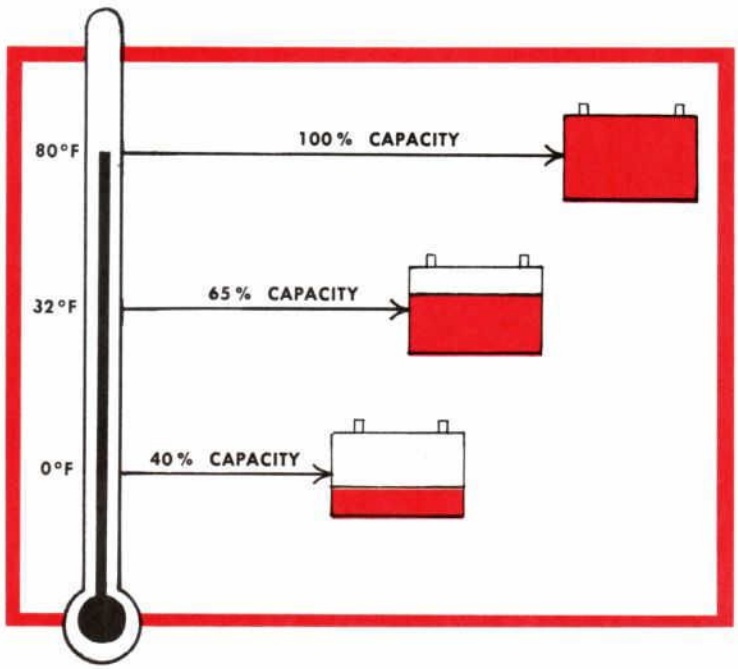


Figure 1—How Temperature Affects Battery Capacity

DIAGNOSIS AND TESTING

The best approach to troubleshooting battery problems is to find out as much information about it as possible.

1. What is the battery complaint?
2. How long has the battery been in service (miles-months)?
3. Is this the first incident of trouble? If not, how long has the battery failed to perform satisfactorily?
4. Were any electrical units left on inadvertently for an extended period?
5. What are the driving conditions?
6. If the battery failed previously, how was it charged (amperes and hours)?
7. Has the regulator setting been checked against specifications?

VISUAL INSPECTION

The first step is a visual inspection of the battery. The top must be clean and dry. If wet, dirty, or acid soaked there will be a constant discharge of electricity. Note the level of the electrolyte. If it is allowed to get below the top of the plates and water is not added, permanent damage can result and the battery can never be fully recharged. Check the battery case for damage or signs of cracks. If seriously damaged, it should be replaced. Also check the condition of the battery cables. Loose, worn or corroded cables can cause battery discharge.

CAPACITY TEST

The next and most important step is checking battery capacity, which is the ability to furnish current and maintain minimum necessary voltage. If the battery passes this test it is in satisfactory condition. However, it may require some additional charging to bring it up to peak performance. The test MUST be performed with the BATTERY SOLUTION between 60° F and 100° F, since temperature affects capacity. A high rate discharge tester, such as a Battery-Starter tester with a carbon pile resistor and a voltmeter is used to make the first part of the test.

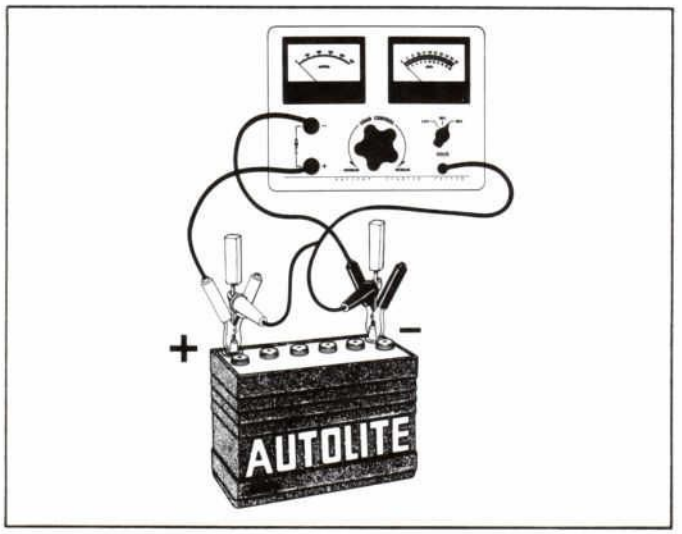


Figure 2–Capacity Test Connections

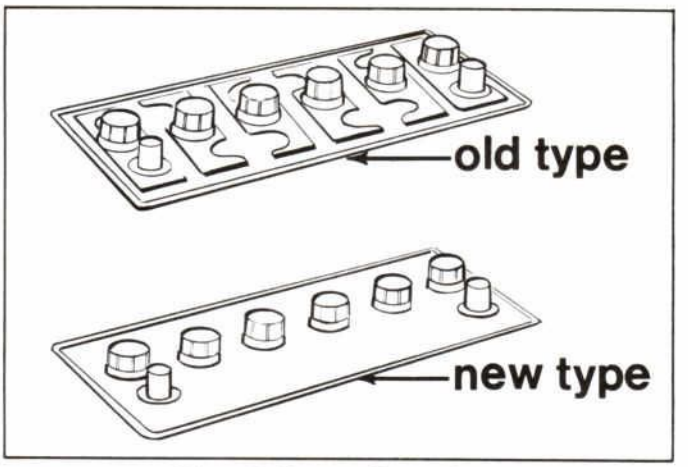


Figure 3–Battery Comparison

TEST CONNECTIONS

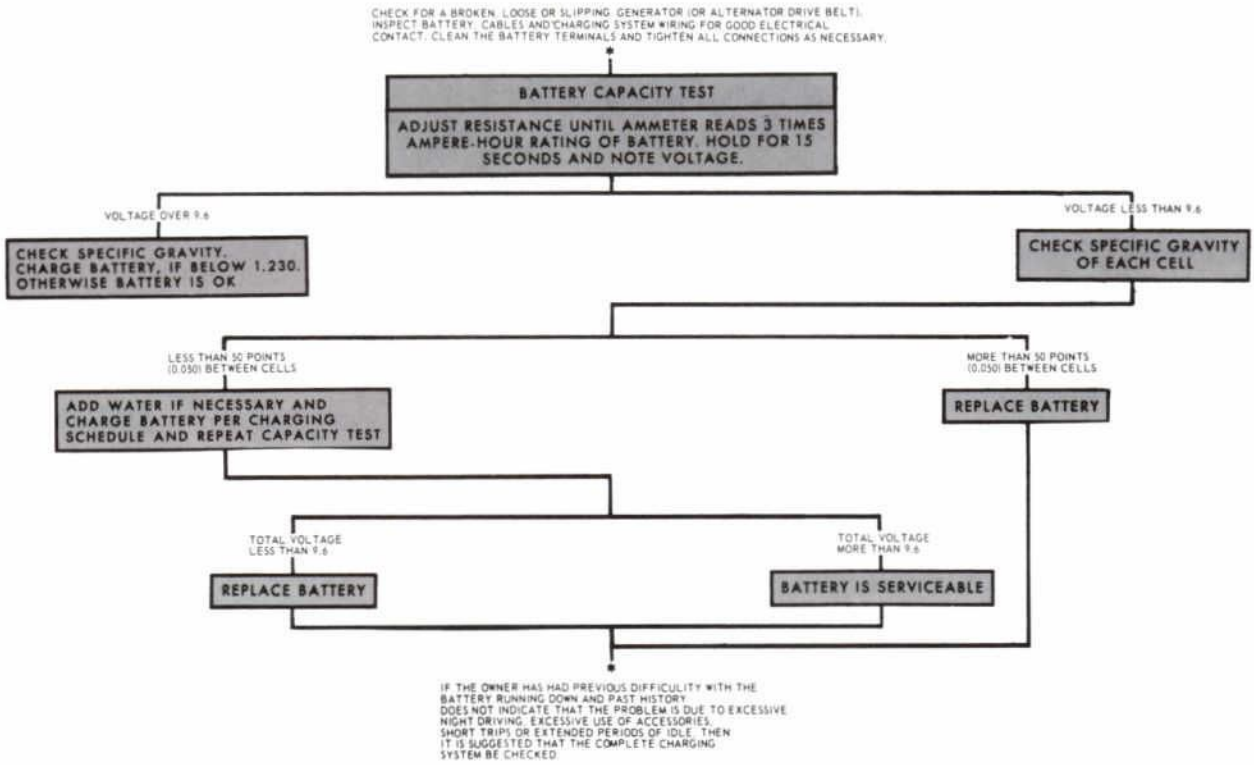
1. Connect the appropriate leads to the battery posts. (See Figure 2.) Be sure the voltmeter clips are connected DIRECTLY to the battery posts, and not to the heavy tester clips.
2. Adjust the carbon pile resistor until the ammeter reads 3 times the ampere-hour rating of the battery. (A 45 ampere-hour battery should read 135 ampere load).
3. Hold for 15 seconds and note the voltage reading. Avoid leaving the high discharge load on the battery more than 15 seconds.
4. If the voltmeter reading is 9.6 volts or more, the battery has good output capacity and should readily accept a charge, if required. If the voltmeter reads less than 9.6 volts, additional charging is required. Follow the procedure shown in the Battery Test Road Map, page 4.

SPECIFIC GRAVITY TEST

To complete the battery test, a hydrometer must be used to test specific gravity. NOTE—An open circuit voltage tester with probes to test individual cells must not be used in place of the hydrometer on batteries that have a completely sealed top. (Figure 3) The sealing compound must not be pierced with test probes, as the holes will cause battery self-discharge due to surface dirt, acid or contamination.

CAUTION: A specific gravity test should never be used by itself to determine if a battery is serviceable. The capacity test must be made first. The specific gravity test only indicates the strength of acid in the electrolyte and thus the degree of charge on the battery. Only the capacity test actually tests the condition of the battery to deliver current by putting a load on the battery. Only a capacity test can detect internal short circuits, excessive sulfation, and other types of internal, mechanical, and chemical damage that affect a battery's ability to deliver current. Such "old" or deteriorated batteries may pass the hydrometer test, but will soon become discharged again causing further electrical problems.

BATTERY TEST



The hydrometer measures the degree of charge on each cell by weighing the amount of acid in the electrolyte. The electrolyte consists of water and acid, and the acid is used up as the battery is discharged. When fully charged, electrolyte at 80° F has a specific gravity of 1.280 times that of water. Figure 4 shows specific gravities for various percents of discharge.

In reading a hydrometer, the barrel must be held vertically with the fluid at eye level. Readings taken at sharp angles usually are very inaccurate. Just the right amount of fluid must be drawn up into the barrel, with the bulb fully expanded to lift the float freely, so it neither touches the sides, top nor bottom of the barrel. Always use a hydrometer kept clean with soap and water so the float will not stick to the sides. The float should also be inspected for cracks, which would allow acid to enter the air tight float and make readings unreliable.

Also a temperature corrected hydrometer should be used, because specific gravity is affected by temperature. The standard is 80° F. The volume of acid expands when heated and shrinks when cooled. For every 10° F ABOVE 80° F, four gravity points (.004) must be added to compensate for expansion, and for every 10° F BELOW 80° F, four gravity points (.004) must be subtracted to compensate for contraction. Most hydrometers today include this feature.

If water is added to facilitate a specific gravity reading, or if the battery is in a low state of charge from a rapid discharge such as prolonged cranking, the battery must be charged until all the cells are gassing freely, before taking a specific gravity reading. Otherwise the readings will be unreliable.

BATTERY CHARGING

SLOW CHARGING is the only method which will fully charge a battery. Slow charging should be at a rate of 1 ampere for each positive plate per cell for a sufficient time to fully charge the battery. The battery is fully charged when the cells are all gassing freely and the specific gravity ceases to rise for three successive readings taken hourly. It may sometimes require more than 24 hours to fully charge a battery, since badly sulphated batteries require more charging time than normal batteries.

HIGH-RATE CHARGING can be accomplished with the battery in the car. High-rate chargers cannot be expected to fully charge batteries in an hour, but they do charge a battery sufficiently to allow continued service commensurate with its condition and state of charge. A high-rate charge should always be followed by slow charging to bring the battery up to full charge. High-rate chargers, can inflict irreparable damage on a battery if the safeguards provided by the manufacturer are ignored or circumvented by the operator. Therefore, the operating instructions issued by the manufacturer should be carefully followed.

SPECIFIC GRAVITY	STATE OF CHARGE
1.260—1.280	100% CHARGED
1.230—1.250	75% CHARGED
1.200—1.220	50% CHARGED
1.170—1.190	25% CHARGED
1.140—1.160	VERY WEAK
1.110—1.130	DISCHARGED

Figure 4—Specific Gravities For Percents Of Discharge

The charge rates and time schedules shown on page 5 are based on an average charge rate of 35 amps for the

recommended time. Charging equipment not capable of delivering these rates will necessitate extending the charge time until the specific gravity reaches 1.260 (Standard Battery) 1.250 (Sta-Ful Battery) at 80° F. This is not a fully charged battery, but is adequate for normal service.

BATTERY CHARGING PRECAUTIONS

1. Explosive hydrogen gas escapes out the vent caps during charging. Never smoke or allow a spark near the battery.
2. Avoid overcharging. Excessive charging will cause high internal temperatures which will expand and buckle plates. Never allow the internal temperature to exceed 125° F.
3. Allow the battery to warm up to 60° F before adding water, as the level will rise as water warms. Always use as pure a water as possible.
4. The sulphuric acid in the electrolyte can cause serious burns if spilled on skin or spattered in eyes. It should be washed away with large quantities of water. If spilled on clothing neutralize with ammonia or baking soda.

BATTERY DRAIN TEST

The battery drain test should be performed if the battery is discharging for unknown reasons, as it will determine if there are any shorts in the wiring harness, causing the battery to ground out and discharge.

Disconnect the negative battery ground cable and connect the positive lead of a voltmeter to the ground cable. Connect the negative lead of the voltmeter to the battery negative post.

With all circuits off, the meter should read zero. Any battery external load will cause the voltmeter to read full battery voltage.

When checking vehicles equipped with an electric clock, a full battery voltage reading doesn't necessarily indicate electrical trouble. Clock wind-up occurs approximately every two minutes. The meter will indicate full battery voltage until the clock is energized by touching the negative cable connector to the battery negative post. After the clock is energized, the meter should register zero for approximately two minutes, until the clock runs down again.

BATTERY REPLACEMENT

All batteries eventually deteriorate because of their chemical nature. While proper maintenance will insure the longest possible battery life, there comes a time when tests indicate the battery should be replaced. Since most customers can tell very little about a battery, it is most important that the servicing dealer guide the customer in selecting a battery of at least the same capacity as the original. If the dealer fails to recommend a battery with a rating equal to that of the original equipment battery, the customer is likely to encounter starting problems in cold weather.

Capacity is expressed in ampere-hour discharge for a specific period of time. A rate commonly used is the 20-hour rate. A battery starting at 80° F which is rated at 100 ampere-hour at the 20-hour rate should deliver 5 amperes continuously for 20 hours.

INSTALLATION AND PERIODIC SERVICE

To avoid excessive mechanical abuses which might lead to premature failure, the following points should be observed when installing a battery.

- Be sure the battery carrier is clean and the battery rests level on it.
- Tighten the hold-down evenly until snug. Do not tighten enough to distort or crack the battery case.
- Be sure the cables are in good condition and the terminal clamps are clean. Grease the battery posts and cables lightly to retard corrosion.
- Check polarity to be sure battery is not reversed with respect to the generating system.
- Connect ground terminal last to avoid arcing.

The following points should be observed when servicing a battery.

- Check the electrolyte level every 2000 miles or once a month. If necessary, add water; do not overfill and be sure the water is as pure as possible.
- Keep the top of the battery clean to prevent self-discharge. If necessary, wash with a solution of baking soda or ammonia and rinse with water.
- When using a booster battery to start car, be sure correct polarity is observed.
- If the battery is consistently undercharged, the alternator/generator drive belt should be checked.

ALLOWABLE BATTERY HIGH RATE CHARGE TIME SCHEDULE

		BATTERY CAPACITY—AMP HOURS					
Specific Gravity Reading	Charge Rate Amperes	40	45	55	65	70	80
		HIGH RATE CHARGING TIME					
1.125* to 1.150	35	1 Hr.	1 Hr. 5 Min.	1 Hr. 20 Min.	1 Hr. 35 Min.	1 Hr. 40 Min.	1 Hr. 55 Min.
1.150 to 1.175	35	45 Min.	50 Min.	1 Hr. 5 Min.	1 Hr. 15 Min.	1 Hr. 20 Min.	1 Hr. 35 Min.
1.175 to 1.200	35	35 Min.	40 Min.	50 Min.	1 Hr.	1 Hr.	1 Hr. 10 Min.
1.200 to 1.225	35	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.
Above 1.225	5	NOTE: Charge at low rate only (5 amps) until specific gravity reaches— 1.260 at 80°F (Standard Battery), 1.250 at 80°F (Sta-Ful Battery)					

*If the specific gravity is below 1.125, use the indicated high-rate charge, then use a low rate of charge (5 amperes) until the specific gravity reaches: 1.260 at 80°F (Standard Battery), 1.250 at 80°F (Sta-Ful Battery)

THE ALTERNATOR

If the battery passes the capacity test, but after a period of time loses its charge, then the trouble is probably in the charging system. The following symptoms can mean trouble in the alternator: Charge indicator light stays on; Charge Indicator gauge indicates constant discharge; Battery will not hold charge; Alternator has low or no output. See "Alternator Output Test".

TEST CONNECTIONS

Connect alternator tester to the charging system components, as shown in Figure 5. Remove the ground cable and the positive cable; then, install a battery post adapter switch. Open the switch and connect the ground cable. Connect the field leads to the regular plug with a jumper wire. Turn the field rheostat to Off. Connect a tachometer to indicate engine RPM.

Place the transmission in Neutral or Park and apply the parking brake.

TEST PROCEDURE

1. Close the battery post adapter switch and start the engine. Open the battery post adapter switch. (All electrical accessories must be turned off, including door operated interior lights.)
2. Increase the engine speed to specified RPM and observe voltmeter and ammeter.
3. Turn the field rheostat control knob clockwise until a reading of 15 volts is obtained.

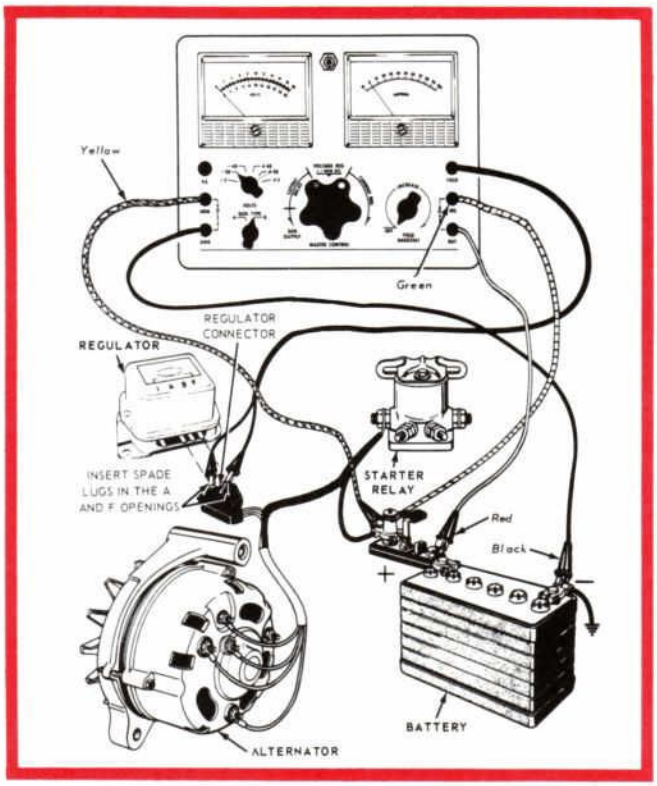
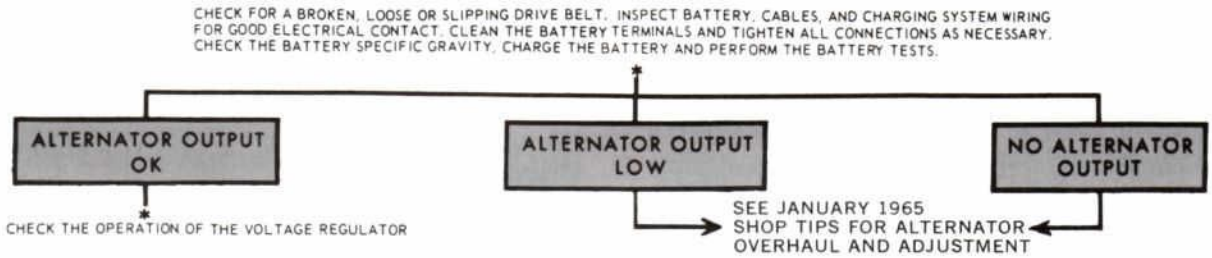


Figure 5—Alternator Output Test Connections

ALTERNATOR OUTPUT TEST



ALTERNATOR SPECIFICATIONS

Type	Ford Part Number	Rating		Field Current Amps @ 12V	Cut-In Speed Engine RPM	Rated Output Speed Engine RPM	Slip Ring Turning (inches)		Brush Length (inches)		Pulley Nut Torque Ft. Lbs.	Belt Tension (Lbs.)	
		Amps @ 15V	Watts @ 15V				Min. Dia.	Max. Runout	New	Wear Limit		6 Cyl	8 Cyl*
Autolite	C5DZ-10346-B (Service) C6DF-10300-A,B,C C6TF-10300-A C6AF-10346-A	38	570	2.5	400	1500 Cold 2400 Hot	1.22	0.0005	½	5/16	60-100	60-90	80-110
Autolite	C5DZ-10346-B (Service) C6AF-10300-A,B,C,D,E C6AF-10346-A	42	630	2.9	400	1600 Cold 2900 Hot	1.22	0.0005	½	5/16	60-100	60-90	80-110
Autolite	C5TZ-10346-G (Service) C6GF-10300-A,B C6TF-10300-J C6TF-10346-A	45	675	2.9	400	1700 Cold 2900 Hot	1.22	0.0005	½	5/16	60-100	60-90	80-110
Leece-Neville	C5AZ-10346-B (Service) C5AF-10300-H, 90302, 6242-AA C5AZ-10346-C (Service) C5AF-10300-J, 90303, 6240-AA C5AZ-10346-D (Service C5OF-10300-A, 90332, 6258-AA	53	795	2.9	400	1700 Cold 2100 Hot	Light Cut	0.002	3/8	3/8	30-50	60-90	80-110
Autolite	C5TZ-10346-H (Service) C6AF-10300-F,G C6TF-10300-F C6TF-10346-B	55	825	2.9	400	1400 Cold 2900 Hot	1.22	0.0005	½	5/16	60-100	60-90	80-110
Leece-Neville	C5TZ-10346-D (Service) C5TF-10300-L, 90304, 7024-AA	60	840	2.9	400	1600 Cold 2000 Hot	Light Cut	0.002	½	5/32	30-50	60-90	80-110

*Used Belt (New Belt 100-140) A used belt is one that has been in operation more than 10 minutes

TEST PROCEDURE—Continued

4. Observe the ammeter reading. To obtain the total alternator output, add two amperes to this reading for vehicles equipped with conventional ignition, or six amperes for those with transistor ignition system.
5. If the battery is fully charged, it might not be possible to obtain maximum current output. If specified output is not obtained, make the following test before condemning the alternator:

   A) Turn the field rheostat control knob to the Off position. Rotate the master control knob to the Current Reg. position. Maintain the engine speed at the rpm used in Step 2.

   B) Turn the field rheostat control and the master control clockwise, maintaining a voltmeter reading of 15 volts maximum, until the field rheostat control is at its maximum clockwise position.

   C) Readjust the master control until the voltmeter reads exactly 15 volts. Observe the ammeter reading. Add two amperes to this reading for vehicles equipped with conventional ignition, or six amperes for vehicles equipped with transistor ignition to obtain total alternator output.
6. Stop the engine.

VOLTAGE REGULATOR TEST

(Mechanical Type)

VOLTAGE LIMITER TEST

The voltage limiter holds the alternator voltage within a predetermined range by controlling the amount of current supplied to the alternator fields. Calibration tests must be made with the cover and gasket in place and the regulator temperature must be normalized. If the vehicle hasn't been driven far enough to normalize the regulator, turn off all electrical accessories and operate the engine at approximately 2000 rpm for 20 minutes with the hood down. Only the lower set of contacts need be checked for proper calibration.

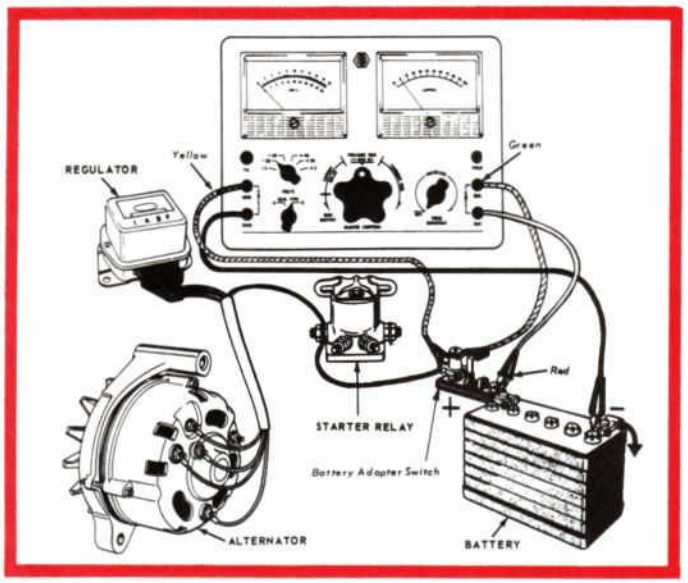


Figure 6–Voltage Limiter Test Connections

TEST CONNECTIONS

1. Disconnect both battery cables and install a battery post adapter switch to the positive post. See Figure 6.
2. Connect the voltmeter positive lead to the battery positive post cable clamp, and the voltmeter negative lead to the ground cable clamp. Set the voltmeter switch to the 20 volt position.
3. Connect the battery ground cable to the battery negative post.

TEST PROCEDURE

1. Close the battery switch and start the engine. Be sure all electrical accessories, including the door-operated interior lights, are turned off. Open the battery switch.
2. Operate the engine at 2000 rpm for 5 minutes with the tester control in the output relay position. If the ammeter indicates more than 10 amperes, stop the engine. Disconnect the battery cables, and charge the battery. When the battery is at least ¾ charged, repeat the temperature stabilizing procedure.
3. Cycle the regulator as follows (mechanical only): Close the battery switch and stop the engine. Start the engine and increase the speed to 2000 rpm. Open the battery switch.
4. Allow the battery electrolyte to normalize for a short time; then, read the voltmeter and the temperature next to the regulator with a thermometer. Voltage readings should compare with indicated thermometer readings, as shown in Figure 7. If not within specifications, make necessary adjustment as shown in Figure 8. The mechanical regulator must be cycled after each adjustment. Do not change the setting more than 0.5 volt from the original setting until a test period of actual vehicle usage has indicated a greater correction is required. All readings must be taken with the regulator cover in place.

AMBIENT AIR TEMPERATURE °F	VOLTAGE LIMITER SETTING (VOLTS)
50	14.3–15.1
75	14.1–14.9
100	13.9–14.7
125	13.8–14.6

Figure 7–Voltage Limiter Test Specifications

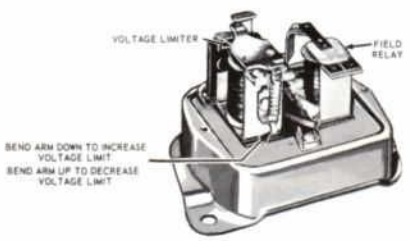


Figure 8–Voltage Limiter Adjustment

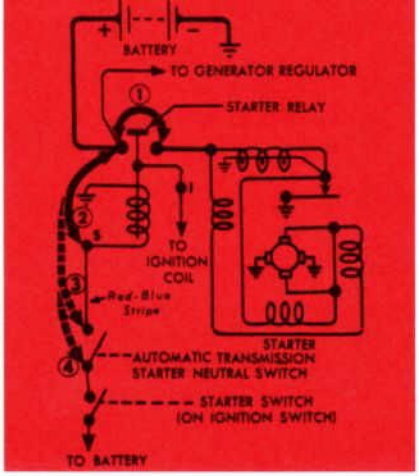


Figure 9–Starter Test Connections

BATTERY, CHARGING, and STAR

STARTING SYSTEM

Starting problems usually fall into one of the following categories: engine cranks at normal speed, but will not start, (which is usually caused by something other than the starting system); engine will not crank; and engine cranks at slow speed.

SERVICE NOTES (Figure 9)

Because the battery is the most important part of the starting system, it should be checked first as previously described and shown on the following Road Maps. If it checks out O.K. then follow the appropriate Road Map until the cause of the problem is found.

1. Do not attempt to start a car with an automatic transmission by pushing. Apply the brakes and attempt to start the engine while moving the selector lever through all ranges. This may determine if the problem is caused by a maladjusted or defective neutral-start switch. If a booster battery is used to start a car, be certain correct battery polarity is observed; positive to positive and negative to negative connection of auxiliary cables.
2. Connect a heavy jumper cable from the battery terminal of the relay to the starter terminal of the relay.
3. When performing the Starter Relay Test, connect a jumper from the battery terminal of the relay to the starter (ignition) switch terminal of the relay. If the engine does not start, the starter relay probably is at fault.
4. When performing a Starter Control Circuit Test, on vehicles equipped with an automatic transmission, if the engine cranks, connect a jumper from the battery terminal of the relay to the relay side of the neutral-start switch. If the engine does not crank, the wiring between the neutral-start switch and the relay is at fault. If engine cranks, connect a jumper from the battery terminal of the relay to the starter (ignition) switch side of the neutral-start switch. If the engine does not crank, the neutral-start switch is out of adjustment or defective. If the engine cranks, check for voltage at the battery terminal of the starter (ignition) switch wiring harness connector with a test light or voltmeter. If voltage is not available, the wiring between the battery terminal of the starter relay and the battery terminal of the starter (ignition) switch is at fault. If voltage is available, bypass ignition switch or replace with a known good one. If engine still will not crank, the trouble is in the wiring or connections between the ignition switch and the starter-neutral switch.

ENGINE CRANKS SLOWLY

CHECK THE BATTERY AND STARTER CABLES FOR GOOD ELECTRICAL CONTACT. LOOK FOR CORRODED OR LOOSE CONNECTIONS. IN PARTICULAR, ASSURE GOOD GROUND CONNECTIONS. CLEAN AND TIGHTEN THE CABLES AS NECESSARY. CHECK BATTERY SPECIFIC GRAVITY.

*

BATTERY SPECIFIC GRAVITY OK

BATTERY SPECIFIC GRAVITY LOW

* PERFORM BATTERY TESTS. CHARGE OR REPLACE THE BATTERY AS NECESSARY. CHECK THE BATTERY AND STARTER RELAY FOR EXCESSIVE RESISTANCE.

* CHECK THE STARTER CRANKING VOLTAGE AND CURRENT DRAW.

CURRENT DRAW LOW

CURRENT DRAW NORMAL OR HIGH

* REMOVE THE STARTER, INSPECT TEST AND REPAIR IT AS NECESSARY.

* REMOVE THE STARTER AND CHECK THE CURRENT DRAW AT NO LOAD.

CURRENT DRAW ABOVE OR BELOW SPECIFICATIONS

CURRENT DRAW IS NORMAL

* INSPECT TEST AND REPAIR THE STARTER AS NECESSARY.

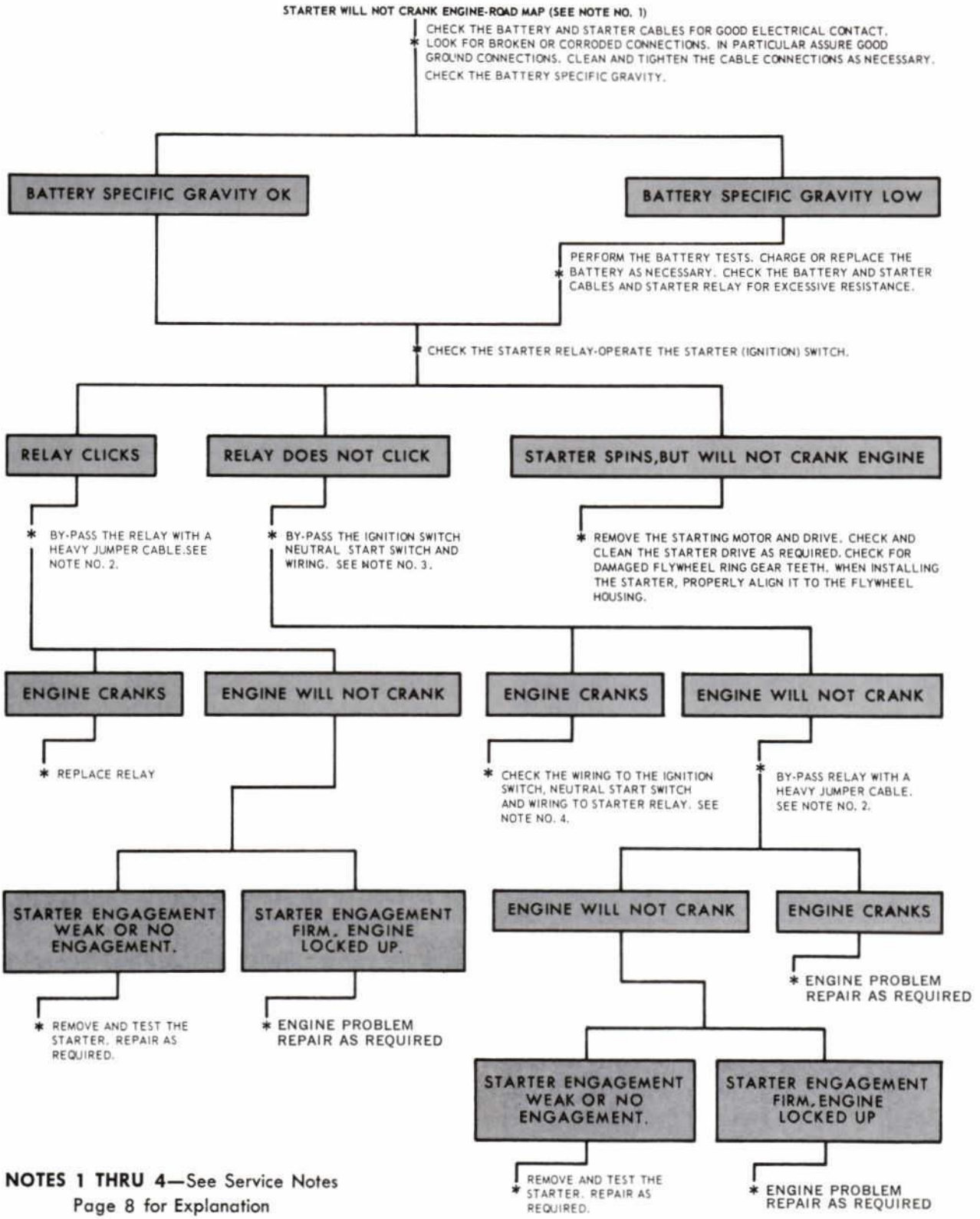
* ENGINE PROBLEM REPAIR AS REQUIRED

STARTER SPECIFICATIONS

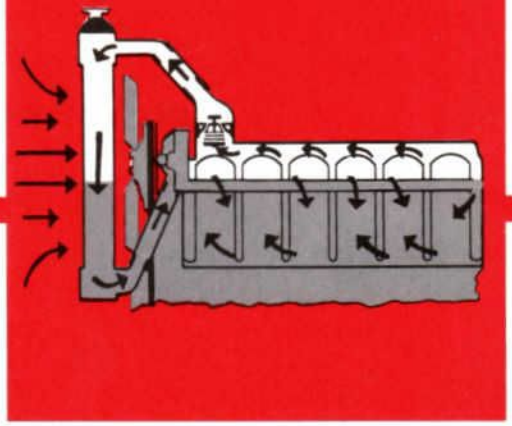
Type	Current Draw Under Normal Load (Amps)	Normal Engine Cranking Speed RPM	Minimum Stall Torque @ 5V Ft. Lbs.	Maximum Load Amperes	No-Load Amperes	Mfg. Length (inches)	Brushes Wear Limit (inches)	Brush Spring Tension (oz)
Ford Positive Engagement 4.5 inch Diameter	250	250-290	15.5	670	70	0.5	0.25	40

Maximum starting circuit voltage drop (battery + terminal to starter terminal @ normal engine temperature)—0.5 volt.

ENGINE WILL NOT CRANK



NOTES 1 THRU 4—See Service Notes Page 8 for Explanation



COOLING SYSTEM

INTRODUCTION

It is generally recognized that cooling system service is important in the summer when it must keep the engine from getting too hot. By getting rid of about ⅓ the heat generated by 3000 to 4000 degree temperatures created in the combustion chambers of the engine, the cooling system helps to avoid pre-ignition, detonation, burned and scored pistons and valves, and lubrication problems.

But equally important, and usually less understood, is the cooling system function of keeping the engine from operating too coolly, which becomes especially important in the winter. Engines that operate too coolly cause high fuel consumption, fouled plugs, excessive engine wear due to the formation of acids, and the formation of crankcase sludge.

During summer and winter, the cooling system must keep the engine operating at temperatures that are neither too hot nor too cold. And of course in the winter the cooling system must also provide for fast warm-up to supply heat to the heater and defroster, and be protected from freezing temperatures with anti-freeze.

OPERATION

Thermostats limit coolant circulation to provide for a quick warm-up and insure a minimum operating temperature. The flow of air past the radiator keeps the coolant from getting too hot. Most late model engines use thermostats that are fully open between 180 and 212 degrees depending on engine size. Since the engines are operating at temperatures near or above the boiling point of water (212 degrees at sea level), the cooling system must be pressurized to increase the boiling point. Modern engines also must operate at high altitudes which decrease the boiling point of water. This is further reason to pressurize the cooling system. The following charts show this effect.

BOILING POINT WITH VARIOUS PRESSURE CAPS

Pressure	Boiling Temperature
0	212
4	224
7	232
9	237
13	246
14	249

EFFECT OF ALTITUDE ON BOILING POINT

Altitude	Atmospheric Pressure	Boiling Temperature
Sea Level	14.7	212
2500	13.4	207
5000	12.1	202
7500	11.0	198
10000	10.0	193

Late model Ford passenger cars operate under a pressure of 12-15 lbs which is stamped on the radiator cap.

MAINTENANCE

The coolant level should be checked periodically. To avoid injury from steam or boiling water, the radiator cap should be carefully removed by first covering it with a rag and loosening the cap just enough to relieve any pressure, then remove the cap. Use a standard ethylene glycol hydrometer to check the degree of protection.

Whenever the system is completely refilled (such as the recommended 36,000 mile or two year interval) a can of Rotunda Radiator Rust Inhibitor should also be added.

DIAGNOSIS AND TESTING

Engine overheating and slow engine warm-up are the two troubles most commonly attributed to the cooling system.

Loss of coolant, a thermostat stuck in the closed position, or accumulation of rust and scale in the system are the main causes of overheating. Coolant loss may be due to external leakage at the radiator, radiator pressure cap, water pump, hose connection, heater or core plugs. Coolant loss may also be caused by internal leakage, due to a defective cylinder head gasket, improper tightening of cylinder head bolts, or warped cylinder head or block gasket surfaces.

Internal leakage can be detected by operating the engine at fast idle and looking for the formation of bubbles in the radiator. Oil in the radiator may indicate leakage in the engine block or a leak in the automatic transmission oil cooler. Water formation on the oil level dipstick could also be an indication of internal leakage.

Rust and scale that form in the engine water passages are carried to the radiator by coolant circulation. This clogs the radiator passages and causes overheating. Rust can be detected by a rusty or muddy appearance of the coolant.

A defective thermostat that remains open will cause slow engine warm-up.

DIAGNOSIS GUIDE

ENGINE OVERHEATS	Exhaust control valve sticking (except 240 engine). Belt tension incorrect. Radiator fins obstructed. Thermostat stuck closed, or otherwise defective. Cooling system passages blocked by rust, scale or other foreign matter. Water Pump inoperative. Faulty fan drive clutch. Ignition initial timing incorrect. Distributor advance incorrect.
ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE OR HAS WRONG INDICATED TEMPERATURE	Thermostat stuck open or of incorrect heat range. Temperature sending unit defective (causing gauge to indicate low engine temperature). Temperature gauge defective (not indicating true engine temperature) or incorrectly installed. Incorrect temperature gauge indication.
LOSS OF COOLANT	Leaking radiator, radiator supply tank, or transmission oil cooler loose or damaged. Water pump leaking. Cylinder head gasket defective. Improper tightening of cylinder head bolts. Cylinder block core plugs leaking. Cracked cylinder head or block, or warped cylinder head or block gasket surface. Radiator pressure cap defective or wrong type.

TESTING

Fan Drive Clutch Test

1. Run the engine at approximately 1000 rpm until normal operating temperature is reached (at least five minutes regardless of temperatures reached).
2. Stop the engine and, using a cloth to protect the hand, immediately check the effort required to turn the fan. If considerable effort is required, it can be assumed that the coupling is operating satisfactorily. If very little effort is required to turn the fan, it is an indication that the coupling is not operating properly, and should be replaced.

Cooling System Pressure Test should be performed for:

- Blowing or leaking cooling system sealing gaskets.
- Internal or external coolant leakage.
- Pressure cap malfunction.

Many types of pressure gauges are available. It is recommended that the gauge manufacturers' instructions be followed when performing tests. NEVER EXCEED THE RATED PRESSURE INDICATED ON THE RADIATOR CAP.

Thermostat Test should be performed whenever it is suspected of being defective, such as the engine running too cold, or excessive warm-up time. Remove the thermostat and immerse it in boiling water. Replace it if it doesn't open more than ¼ inch.

If the problem is insufficient heat, the thermostat should be checked for leakage. Hold it up to a lighted background and check for leakage of light around the valve (with thermostat at room temperature). Light at more than one or two spots is unacceptable and the thermostat should be replaced. Some slight leakage of light around the perimeter of the valve (one or two spots) should be considered normal.

NEVER ATTEMPT TO REPAIR A THERMOSTAT. IF IT DOESN'T OPERATE PROPERLY, IT SHOULD BE REPLACED–with a "poppet type" thermostat. (See Chart.)

THERMOSTAT APPLICATION

Car Line	Model Year	Engine Displacement (CID)	Part Number
Ford	1963-1964 1963-1964 1965-1966 1965-1966	223, 352, 390, 406, 427 260, 289 240, 289 352, 390, 427, 428	C3AZ-8575-B C3DZ-8575-A C5DZ-8575-A C5AZ-8575-A
Fairlane	1963-1964 1965-1966 1965-1966 1966	170, 200, 221, 260, 289 200 289 390	C3DZ-8575-A C3DZ-8575-A C5DZ-8575-A C5AZ-8575-A
Mustang	1965-1966 1965 1965-1966	170, 200, 260 289 (with generator) 289 (with alternator)	C3DZ-8575-A C3DZ-8575-A C5DZ-8575-A
Thunderbird	1963-1964 1965-1966	390 390, 428	C3AZ-8575-B C5AZ-8575-A
Falcon	1963-1964 1965-1966 1965-1966	144, 170, 200, 260 170-200 289	C3DZ-8575-A C3DZ-8575-A C5DZ-8575-A

OVERHEATING (1965 Passenger Cars) or loss of coolant may be caused by a distorted flange neck on the two (2) cam lock ramps of the radiator filler neck. To correct the condition, bend down the tabs to increase the vertical distance from the top of the filler neck surface to the bottom edge of the lock flange, until the cap will permit the system to maintain a pressure of 12-15 lbs.

To test the radiator neck sealing and the cap seating with the radiator in the car, it is necessary to pressurize the system from some point other than in the cooling system. One point can be from a heater hose by disconnecting the hose and blocking one end and attaching the pressure tester to the other end. Another point that can be used is the temperature sender unit hole - a B9AA-9288-A fuel pump inlet hose will attach to most pressure testers; the other end can be modified for a pipe fitting that will thread into the sender hole. If the system will not hold 12-15 lbs., recheck the cap, radiator filler neck, hose connections, and other areas for leakage.

BRONCO TOWING and LIFTING INSTRUCTIONS (All Models)

Before towing the Bronco, precautionary steps must be taken to avoid serious damage to the transmission, transfer case, and axles.

PRECAUTIONARY STEPS

First, check the rear axle. If the axle is damaged or not operating properly, follow the procedure under "Towing Backward with Rear Wheels Off Ground".

If the rear axle is ok, use any one of the following three procedures according to the method of towing desired.

TOWING FORWARD WITH FRONT WHEELS OFF GROUND

1. Release the parking brake, and shift the transfer case and transmission to neutral position.
2. Disconnect the rear drive shaft from the rear axle, and tie it up.

TOWING BACKWARD WITH REAR WHEELS OFF GROUND

1. Release the parking brake, and shift the transfer case and transmission to neutral position.
2. If the front axle is equipped with free running hubs (Hublok), unlock the hubs from the axle shaft by turning each actuating knob so that it is aligned with the letter "F" on the Hublok. If the front axle is not equipped with free running hubs, disconnect the forward drive shaft from the front axle, and tie it up.
3. Install a locking device to hold the front wheels in the straight-ahead position.

TOWING ON ALL FOUR WHEELS

1. Release the parking brake, and shift the transfer case and transmission to neutral position.
2. Disconnect the rear drive shaft from the rear axle, and tie it up.
3. If the front axle is equipped with free running hubs (Hublok) unlock the hubs from the axle shaft by turning each actuating knob so that it is aligned with the letter "F" on the Hublok. If the front axle is not equipped with free running hubs, disconnect the forward drive shaft from the front axle and tie it up.

LIFTING AND FASTENING TOWING CHAINS OR CABLES

Attach the towing chains or cables to the end of each frame rail where the bumper is attached. Route each chain through the opening in its respective frame rail and under the bottom edge of the bumper. The chains or cables should be covered with shielding where they contact the bumper. Lift the vehicle to the desired height for towing.

LIFTING THE BRONCO ON A HOIST

TWIN POST HOIST

The front post assembly should contact the front bumper. Contact at the front axle could damage the differential and create a safety hazard for the operator (Figure 1).

The rear post assembly should contact the rear axle as shown in Figure 2.

FRAME CONTACT HOIST

The front contacts should be made at the extreme forward ends of the radius arms (Figure 3). Contact farther back could damage the arms.

The rear contacts should be made under the forward spring hanger of each rear spring. (Figure 4)

This article provides towing instructions and recommended points of contact for either a frame contact or twin post type hoist.

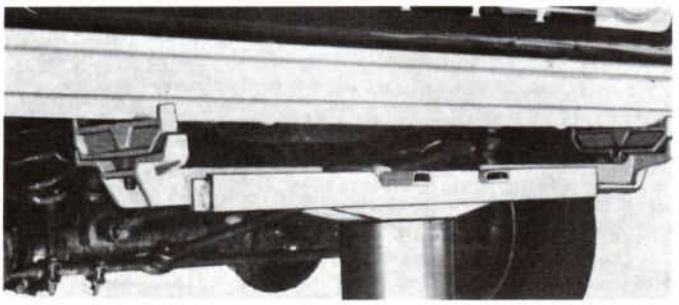


Figure 1–Front Hoist Contact Area

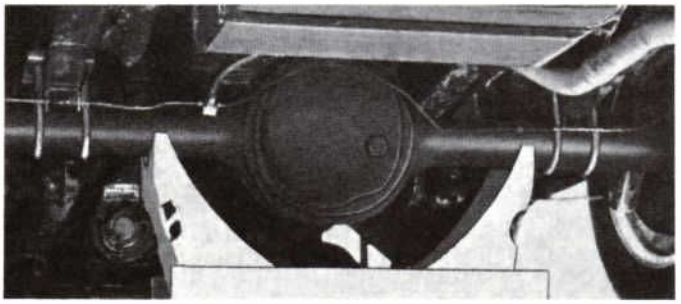


Figure 2–Rear Hoist Contact Area

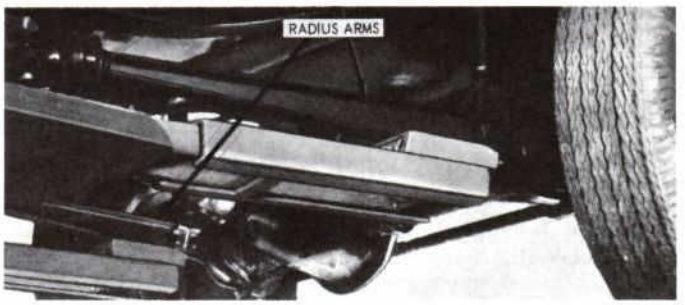


Figure 3–Front Hoist Adapter Pad Position

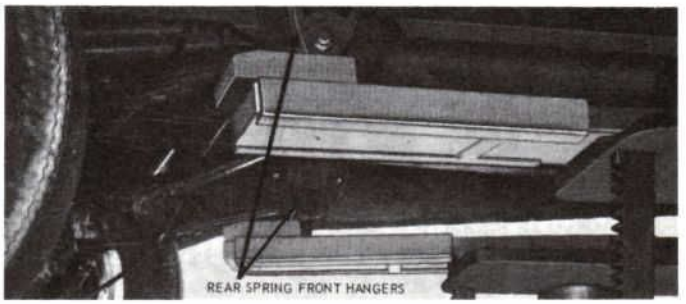
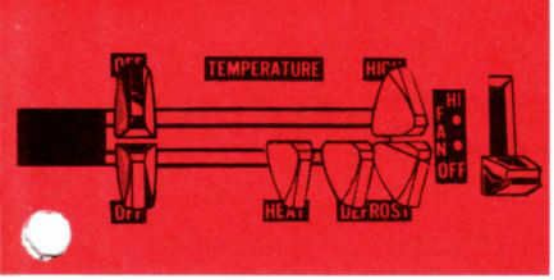


Figure 4–Rear Hoist Adapter Pad Position



HEATER and DEFROSTER Diagnosis and Testing

All late model Fords use a "blend air" heater system (Figure 1). Outside air is drawn into the blower housing from the cowl, forced through and/or around a heater core (which is always hot because no water valve is used to control the amount of water passing through, as in earlier recirculating type heaters or as in present integral heater —A/C systems) mixed, and then discharged through heater and defroster outlets. Air temperatures are controlled by the amount of hot air mixed at the heater core with the cooler air. Since the temperature of the heater core should always be the same as that of the engine coolant, most heater problems are caused by maladjusted or inoperative doors within the heater, inoperative blower motor and controls, or air duct leaks, or controls from the instrument panel. See Figure 2. Bowden cables can be adjusted at the control head or the heater, in the "Off" position. Proper routing must be maintained to insure against binding or kinked cables.

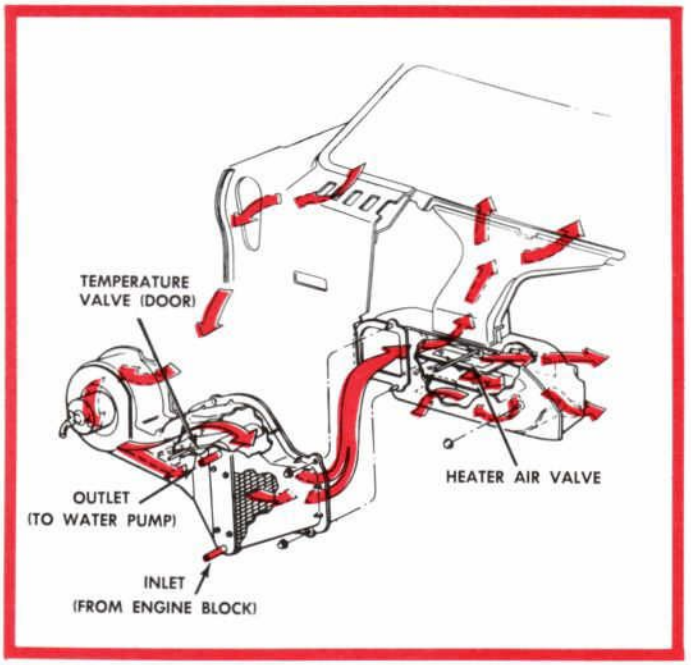


Figure 1—Blend Air Heating System

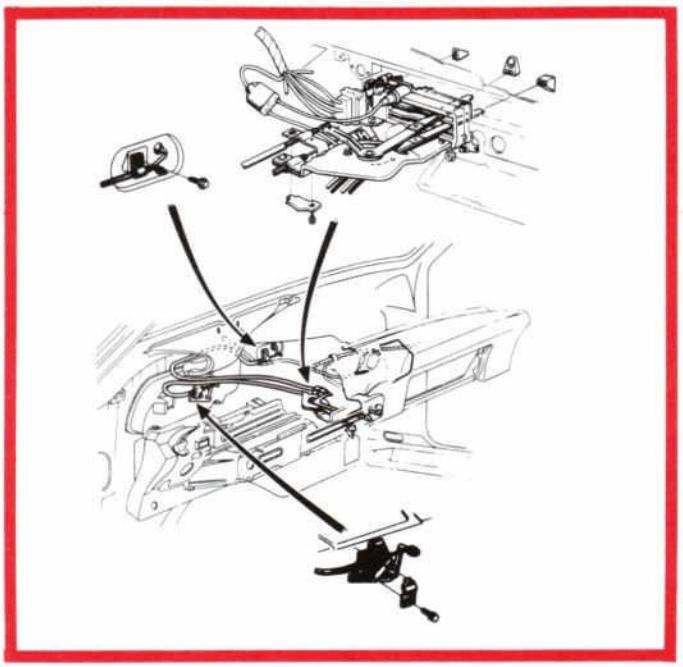


Figure 2—Instrument Panel Controls

HEATER AND DEFROSTER DIAGNOSIS GUIDE

INSUFFICIENT OR NO HEAT	Burned out fuse or loose wires to the heater blower. Defective motor ground. Fan loose on motor shaft or motor stalled. Defective heater blower switch. Defective blower motor. A kinked, clogged, or collapsed water hose.	Improperly connected heater hoses. Plugged heater core. Improperly installed or defective engine thermostat. Incorrectly installed and adjusted control cables. Air leaks in the body.
INSUFFICIENT OR NO DEFROSTING	Improperly adjusted defroster control cable. Disconnected defroster hose. Binding defroster valve.	Plugged or loose defroster nozzle. Obstructed defroster openings at windshield.
TOO MUCH HEAT	Check for an incorrectly adjusted blend-air valve.	

1966 BRONCO FRONT WHEEL ALIGNMENT SPECIFICATIONS

Caster and Camber are built into the Bronco and are not adjustable. Toe-in is adjustable and should be 1/16 inch to 1/4 inch (with 1/8 inch the desired setting). If toe-in needs adjusting, loosen the clamp bolts at each end of the spindle connecting rod tube. Rotate the tube until the correct toe-in (1/8" desired) is obtained, and torque the clamp bolts to 25-35 ft-lbs. Recheck toe-in to make sure no changes occurred when bolts were tightened. The clamps should be positioned 3/16 inch from the end of the rod with the clamp bolts in the vertical position, in front of the tube, with the nut down.

DISC BRAKE TORQUE REVISION (1966 Ford)

The torque specification for the Caliper to Spindle Mounting Bolt has been revised to 90-115 ft. lb.

REVISED TIRE PRESSURE (1965 Light Duty Trucks)

To insure good load carrying capacity and proper handling and ride characteristics, tire pressure should be adjusted as shown in the following chart.

Truck Model	G.V.W.	Tire Size	Tire Pressure	
			Front	Rear
E-100	3600	6.50 x 13— 4 PR-PT	28	28
	4350	6.95 x 14— 8 PR-PT	30	36
	4930	7.35 x 14— 8 PR-PT	34	44
	4930	7.00 x 14— 8 PR-TT	35	50
E-100 Supervan	3600	6.95 x 14— 4 PR-PT	30	30
	4350	6.95 x 14— 8 PR-PT	30	36
	4930	7.00 x 14— 8 PR-TT	35	60
	4930	7.00 x 14—10 PR-TT	40	60
F-100	4200	7.75 x 14— 4 PR-PT	30	30
	4500	7.75 x 15— 8 PR-PT	30	30
	4800	8.15 x 14— 8 PR-PT	30	36
	5000	6.50 x 16— 6 PR-TT	32	40
F-250	4800	6.50 x 16— 6 PR-PT	36	45
	5500	7.00 x 16— 6 PR-TT	35	45
	6000	7.50 x 16— 6 PR-TT	35	45
	6700	7.50 x 16— 8 PR-TT	35	60
	7500	7.50 x 17— 8 PR-TT	40	65
F-350	6000	8.00 x 17.5—6 PR-TT	40	45
	6900	7.50 x 17— 8 PR-TT	40	55
	8000	8.00 x 19.5—10 PR-TT	40	80
	9000 DR	7.00 x 16— 6 PR-TT	35	45
	10000 DR	7.50 x 16— 6 PR-TT	35	45

Legend: PT—Passenger Type PR—Ply Rating
TT—Truck Type DR—Dual Rear Wheels

SPEEDOMETER DRIVEN GEAR REPLACEMENT (1963 Fairlane; 1964 Ford, Falcon, Fairlane and Thunderbird)

In the event the subject vehicles' speedometer driven gear fails or is noisy, it is recommended the original 15 tooth driven gear be replaced with a 16 tooth driven gear as shown in the following table.

Remove 15 Tooth Gear	Install 16 Tooth Gear	Part Name
C3OA-17271-A (Brown Color)	CODD-17271-A (Wine Color)	GEAR-SPEEDOMETER DRIVEN (R.H. Helix)
C3DA-17271-A (Brown Color)	C2DA-17271-E (Wine Color)	GEAR-SPEEDMOETER DRIVEN (L.H. Helix)

BAND ADJUSTING SCREW LOCK NUT (1964-1966 C4 and C6, Three Speed Automatic Transmissions)

The band adjusting screw lock nuts used for locking the band adjusting screws to the case, have an integral molded seal element, which prevents leakage past the screw threads.

Experience has revealed that once the nut has been torqued to specification for any length of time, and then loosened, the sealing material will not always form a positive seal when re-torqued. Therefore, to prevent the possibility of fluid leakage, it is recommended that the nut be replaced whenever a service operation (band adjustment, overhaul, etc.) is performed which requires loosening of the nut. Replacement nuts are listed below.

Transmission	Part Number	Part Name
C4	380850-S	LOCK NUT-2 Req'd
C6	375185-S100	LOCK NUT-1 Req'd

FAIRLANE 390 ENGINE SPECIFICATIONS

2 Venturi Carb.

Brake Horsepower .....265 at 4400 rpm
(Cruise-O-Matic) .....275 at 4400 rpm
Maximum Torque (lbs.-ft.) .....401 at 2600 rpm
(Cruise-O-Matic) .....405 at 2600 rpm
Ignition Timing .....10 degrees
(Thermactor Equipped) .....6 degrees

4 Venturi Carb.

Brake Horsepower .....315 at 4600 rpm
Maximum Torque (lbs.-ft.) .....427 at 2800 rpm
Ignition Timing .....10 degrees
(Thermactor Equipped) ..... 6 degrees

4 Venturi Carb. (GT & GTA Only)

Brake Horsepower .....335 at 4800 rpm
Maximum Torque (lbs.-ft.) .....427 at 3200 rpm
Ignition Timing .....10 degrees
(Thermactor Equipped) .....10 degrees

SERVICE BRIEFS

REVISED THERMACTOR EQUIPPED ENGINE SPECIFICATIONS

ENGINE IDLE RPM (Car and Light Truck)

Manual Shift Transmission with lights on	
170, 200, 240, and 300 6 Cyl. Engines	575-625 rpm
289, 352, 390 and 428 V-8 Engines	610-635 rpm
Automatic Transmission in Drive with Lights on	
170, 200, 240 and 300 6 Cyl. Engines and 289 (Mustang 4V) and 428 Police Engine	475-525 rpm
289 (Ex. Mustang 4V), 352, 390 and 428 (Exc. Police)	525-550 rpm

On vehicles equipped with air conditioning, the engine idle speed should be set with the air conditioner in operation for a minimum of twenty minutes.

IGNITION TIMING BTDC**

Passenger Cars	Manual	Automatic
170, 200, 289-2V, and 289-4V	0°	0°
240	0°	4°
352	—	10°
390-2V, 390-4V, and 428-4V	6°	6°
390-4V, (Fairlane GT & GTA)	10°	10°
428-4V (POLICE	12°	12°
Trucks		
Econoline, Bronco, and Light Duty	0°	0°

**If the individual requirements of the vehicle and/or the use of substandard fuel dictate, the timing may have to be retarded from the normal setting to eliminate detonation. If retarding is necessary, it should be performed progressively and not exceed 2 degrees BTDC.

BRAKE ADJUSTMENT PROCEDURE WITH METAL KNOCKOUT PLUGS IN BRAKE BACKING PLATE (All 1965 Vehicles Except Thunderbird)

Current production backing plates omit the adjusting slot for manual brake adjustment. A partially stamped knockout slot, for use ONLY when the brake drums cannot be removed in a normal manner, is provided instead. Once the slotted access is opened, a rubber plug (Ford Part Number 8A-2092) should be installed to prevent entry of dirt.

When servicing customer complaints requiring brake adjustment, the metal knockout plugs should not be removed, but rather the drum assemblies should be removed and the brakes inspected for a malfunction. Although the brakes are self-adjusting an initial adjustment will be necessary after brake repair, such as relining or replacement. Initial brake adjustments can be obtained by a new adjustment procedure outlined as follows:

1. Use a brake shoe adjustment gauge to obtain the drum inside diameter. Tighten the adjusting knob on the gauge to hold this setting.
2. Use the opposite side of the gauge to set the cage diameter of the lining. Adjust the shoes by turning the adjuster screws manually until contact is made with the gauge. This method will automaticaly set the brakes to specification.
3. Install the brake drum and wheels.
4. Final brake adjustment is made by making several forward and reverse stops for maximum pedal height.

OVERSIZE SPINDLE BOLT AND BUSHING KITS FOR LIGHT TRUCKS

.010 oversize Spindle Bolt and Bushing Kits are now available for the prior model light trucks listed below. Installation of these parts requires the reaming of the axle bores and the installed bushings to the dimensions shown in the chart.

MODEL	FORD PART NO.	AXLE (REAM) DIAMETER	PRESS BUSHING IN SPINDLE AND REAM TO DIAMETER
1961-63 Econolines	C1UZ-3111-D	.7530—.7515	.735—.752
1957-64 F100-250 1957-66 P-100	B7TZ-3111-E	.8710—.8695	.870—.871
1957-64 F-350 1957-64 P-350, 400, 3500,4000	B8Y-3111-A	.9335—.9320	.9325 —.9335

1965 SHOP TIPS • YEARLY INDEX

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