

TROUBLESHOOTING EQUIPMENT IN COMBAT UNITS



INTRODUCTION

The purpose of this pamphlet is to support the U. S. Army Command Maintenance Program (COMAINT). It is designed to provide supervisors and other users with a consolidated, simplified reference on use of troubleshooting equipment authorized at the organizational maintenance level.

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This pamphlet may be used in conjunction with a series of Army posters on how to use troubleshooting equipment. The posters are:

DA POSTER 750-53	Multimeter TS-352B/U
DA POSTER 750-59	Compression Gage
DA POSTER 750-52	Antifreeze/Battery Tester
DA POSTER 750-54	Dry Cell Battery Tester AN/PSM-13
DA POSTER 750-58	Tach-Dwell Meter
DA POSTER 750-50	Low-Voltage Circuit Tester
DA POSTER 750-56	Vacuum Gage
DA POSTER 750-55	Multimeter AN/URM-105
DA POSTER 750-57	Timing Light
DA POSTER 750-51	Spark Plug Cleaner-Tester

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YOU TOO CAN BECOME A . . .

UNIT DIAGNOSTICIAN

RX

Ever get frustrated when . . .
Your rig's lights won't work?
Or the battery won't turn over the engine?
Or the generator won't kick out enough juice?
Or your engine spits and sputters, coughs, lacks go-power?
Or you're not certain of the life left in your PRC-25 radio's battery?



Some people, when caught with these or similar equipment failures, have no shame. They leap right in and start yanking and replacing components until the problem's solved. Or until they throw up their hands in utter hopelessness when all the new parts don't fix the trouble.



Either way, a lot of good and useful parts get tossed aside, and many find their way to the scrap heap. Or they clog the supply pipeline when they're shuttled up to support for repair—where they're checked out and found to be serviceable.



It's the hit-and-miss or trial-and-error type of repair that runs parts costs and maintenance down-time sky high. And it points to a diagnostic method that's for the birds.

HEY, YOU DIAGNOSTICIAN
TYPES! EYEBALLS
HERE...

If you haven't yet won the "Order-of-the-Bolt with Crossed-Threads" for expert troubleshooting, maybe all you need is to brush up on working the diagnostic equipment that's holed up within your reach.

DIAGNOSTIC EQUIPMENT??

Yes! That's just the test equipment that's resting on the shelf in every unit's tool cage. It comes in tool sets or is provided by your TOE.

That test equipment can short-cut your troubleshooting chase and lead you straight to the trouble source.

IT'S RIGHT
HERE...

To qualify for the title of "Unit Diagnostician," brush up on the most common test equipment—equipment like

MULTIMETER



VACUUM
TESTER



AUTOMOTIVE
TEST SET
(LVCT)



CYLINDER
COMPRESSION
TEST SET



TIMING LIGHT



TACH-O-METER
TESTER



SPARK PLUG
CLEANER
& TESTER



NEXT PAGE

HERE'S THE TEST EQUIPMENT AND KNOW-HOW THAT'LL PUT YOU IN THE GROOVE...



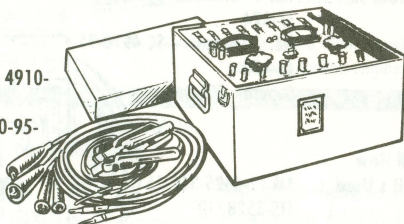
LOW-VOLTAGE-CIRCUIT TESTER (TEST SET, GENERATOR AND VOLTAGE REGULATOR)

FSN 4910-092-9136 OR 4910-270-3780



Found In

Tool Sets No. 1 Supplemental—SC 4910-95-CL-A73
No. 2 Common—SC 4910-95-CL-A72



Tell How

It's Used TM 9-4910-456-14

(Model 30-92)

TM 9-4910-472-10

(Model VAT-25)

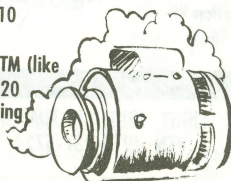
Equipment's -20 TM (like

TM 9-2320-218-20

Section VI) Training

Film 9-3536

Used For Testing the voltage setting, and amperage draw of the starter, battery, generator, alternator, and voltage regulator on all internal combustion engines. When used on 24-volt waterproof electrical systems, Adapter Kit FSN 4910-348-7600 is needed.



Test Prevents Unnecessary replacement of good starters, generators, alternators, switches, regulators, wiring cables and other charging system electrical components.



TEST SET, TACHOMETER & CAM DWELL:

FSN 4910-788-8549

Found In

Tool Sets No. 1 Supplemental—SC 4910-95-CL-A73
No. 2 Common—SC 4910-95-CL-A72

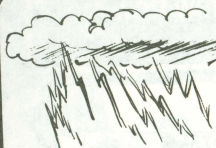
Tell How

It's Used TM 9-4910-416-12
Training Film 9-2193



Used For All gasoline engines to test or set the gap setting on the distributor points and the engine RPM.

Test Prevents Changing coil, distributor, spark plugs and other parts of the ignition system unnecessarily.



MULTIMETER:
 FSN 6625-543-1438 (SIMPSON TYPE OR
 TRIPLETT 666HH)
 FSN 6625-975-4482 (TRIPLETT 666RW)
 FSN 6625-553-0142 (TS-352B/U)
 FSN 6625-581-2036 (AN/URM-105)



Found In

Tool Sets

- No. 1 Common—SC 4910-95-CL-A74
- No. 2 Common—SC 4910-95-CL-A72
- Separate TOE item

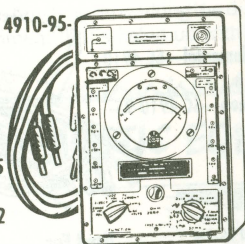
Used For

Testing and checking AC and DC voltages. And switches, batteries, alternators, lamps, cable connections, starters, wiring harnesses, etc., for continuity (open or short circuit). Also to test and check the resistance of various electrical components and circuits.

Tell How

It's Used

- TM 11-6625-366-15 (TS-3528/U)
- TM 11-6625-203-12 (AN/URM-105)
- Equipment's -20 TM (like TM-9 2320-218-20, Section VI)
- Training Film 11-1667



Test Prevents

All of the mentioned items from being removed as faulty when they are not.

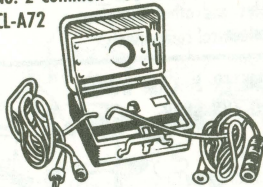


LIGHT, IGNITION TIMING:
 FSN 4910-937-5724

Found In

Tool Sets

- No. 1 Common—SC 4910-95-CL-A74
- No. 2 Common—SC 4910-95-CL-A72



Tell How

It's Used

- Vehicle/equipment -20 TM like TM 9-2320-218-20 (page 2-63)
- Training Film 9-2194

Test Prevents

Unnecessary changing of distributor points, spark plugs, ignition coil and even wiring harnesses.

Used For

Testing and setting ignition timing on most gasoline engines. One of the tests made when the engine spits and sputters.



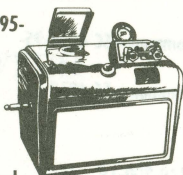
SPARK PLUG TESTER AND CLEANER: FSN 4910-261-5868

Found In

Tool Sets No. 1 Supplemental—SC 4910-95-CL-A73
No. 2 Common—SC 4910-95-CL-A72

Tell How

It's Used TM 9-4910-389-20P

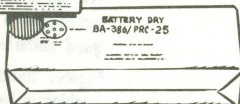


Test Prevents Throwing away good and hard-to-get spark plugs that have life left in them.

Used To test and clean spark plugs used in gasoline engines.



BATTERY TEST SET AN/PSM-13: FSN 6625-868-8344



Used For

Testing the batteries used in these radios: AN/PRC-6, 8, 9, 10, 25, 74, 77; AN/PRR-9, AN/PRT-4.

By battery number they are: BA-270/U, BA-279/U, BA-376/U, BA-377/U, BA-386/PRC-25, BA-398/PRC-25, BA-399/U and BA-505/U, BA-4386/PRC-25



Found In SB 11-623

Tell How

It's Used TM 11-6625-823-15

Test Prevents Throwing away good batteries that have many more hours of useful life. And keeps you from moving out on a mission with short-life batteries.



CYLINDER, COMPRESSION GAGE: FSN 4910-250-2423



Found In

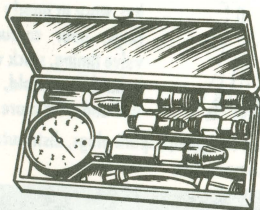
Tool Sets No. 1 Common—SC 4910-95-CL-A74
No. 2 Common—SC 4910-95-CL-A72

Tell How

It's Used TM 9-4910-430-10
TM 9-4910-433-10
Training Film 9-2194

Used For Testing all gasoline engines cylinders for the right pound per square inch pressure. It'll indicate which cylinder has bad rings, valves or leaky gasket.

Test Prevents Pulling and changing the carburetor, distributor, fuel pump etc., unnecessarily when engine cranks but fails to start due to low cylinder compression.



ANTI-FREEZE BATTERY TESTER

FSN 6630-105-1418

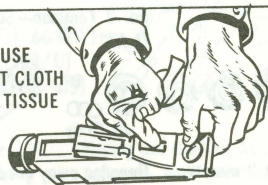
Found In

Tool Sets No. 1 Common—SC 4910-95-CL-A74
No. 2 Common—SC 4910-95-CL-A72

Tell How

It's Used TM 9-6140-200-14
TB 750-651
PS 244

USE
SOFT CLOTH
OR TISSUE



Used For Testing the specific gravity (battery charge) of the electrolyte (sulfuric acid and water solution) of lead-acid batteries. Lets you know which cell is bad, and when the battery needs charging.

Testing specific gravity of anti-freeze and water solution in engines having a liquid-type cooling system.

Test Prevents

Working or replacing parts on the equipment's charging system when the battery is at fault. Leaving a low charged battery out in cold to freeze. Scrapping good batteries.

Engines freezing up or block cracking in below freezing ambient temperatures.

INTERNAL COMBUSTION ENGINE GAGE: (VACUUM/FUEL PUMP GAGE)

FSN 4910-255-8673

Found In

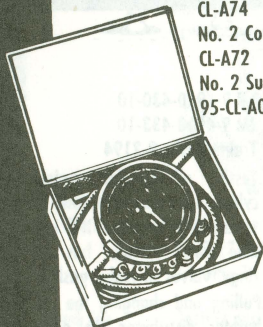
Tool Sets No. 1 Common—SC 4910-95-CL-A74
No. 2 Common—SC 4910-95-CL-A72
No. 2 Supplemental—SC 4940-95-CL-A08

Tell How

It's Used TM 9-4910-477-10 and every vehicle -20 TM.
Training Film 9-2194

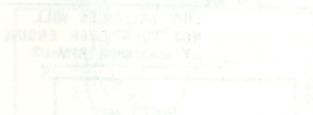
Used For

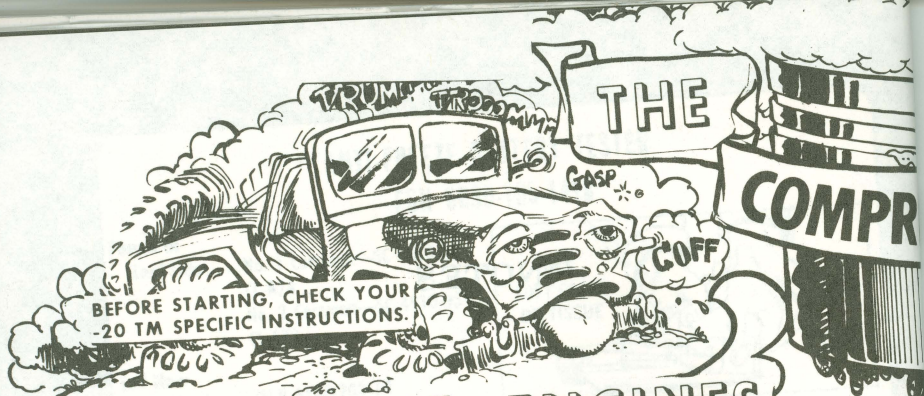
Checking the engine manifold vacuum and fuel pump pressure. It's a trouble-shooting aid to pin-point gasoline engine malfunctions like bad head gasket, worn or poorly fitted piston rings, poor carburetion, bad valve timing, stuck valves, leaks in intake manifold, clogged fuel line and a lot more.



Test Prevents Pulling and switching the carburetor, fuel pump, spark plugs, distributor because you think the trouble is in those components.

NOTES

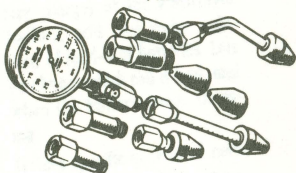




GASOLINE ENGINES

FIRST ... 1

ALL PARTS A-OK?



FSN 4910-250-2423

2

BATTERY FULLY CHARGED?

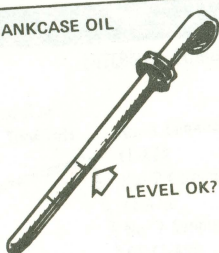


NORMAL READING
IGNITION "ON" ONLY.

LOW BATTERIES WILL
NOT TURN OVER ENGINE
AT MAXIMUM RPM

3

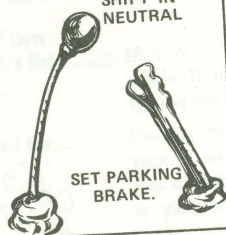
CRANKCASE OIL



LEVEL OK?

4

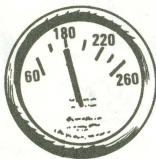
SHIFT IN
NEUTRAL



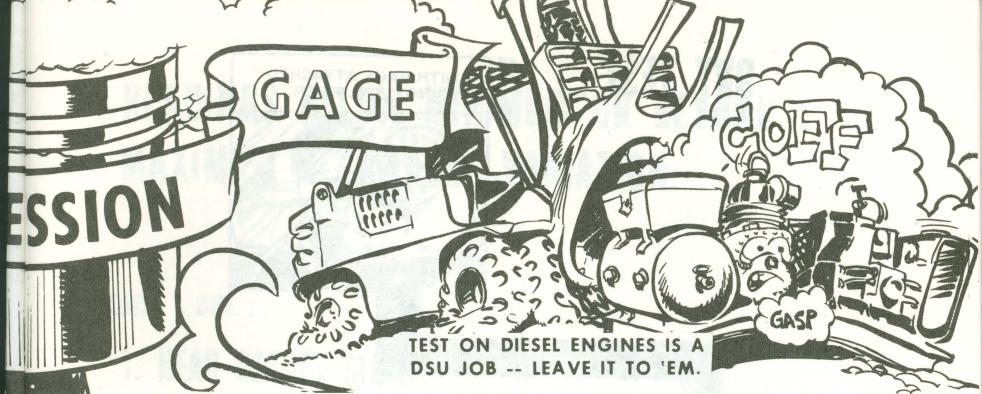
SET PARKING
BRAKE.

5

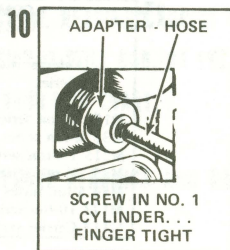
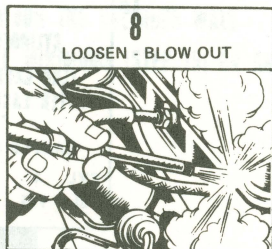
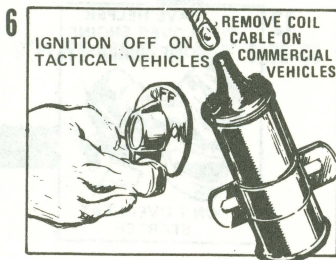
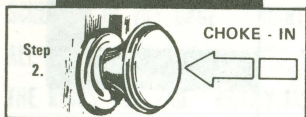
RUN ENGINE.



BRING TO
OPERATING TEMP.

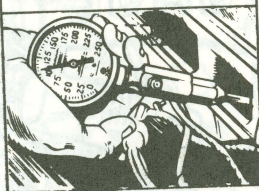


GET READY ...



DRY TEST ... 11

WITH GAGE ATTACHED
TO NO. 1 CYLINDER...



12

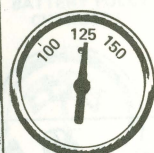
... HAVE HELPER
TURN OVER ENGINE
ABOUT 10 REVS.



DON'T OVERHEAT
STARTER

13

READ YOUR GAGE



WRITE IT DOWN ON
YOUR FORM 2404

14

DO ALL OTHER
CYLINDERS THE SAME.

ZERO GAGE AND CLEAN TIP
AFTER EACH CYLINDER TEST.

SAMPLE READINGS M151

CYL	1	2	3	4
PSI	115	125	120	100

15

COMPRESSION LIMITS FOR TACTICAL GASOLINE ENGINES

Vehicle Series	Allowable Minimum	Maximum Allowable Variation Between Low & High Cylinder
M151 ¼-ton series	85 PSI	25 PSI
M37 ¾-ton series	110 PSI	10 PSI
M715 1¼-ton series	120 PSI	15 PSI
M35 2½-ton series	90 PSI	10 PSI
M54 5-ton series	110 PSI	10 PSI
M123 10-ton series	100 PSI	10 PSI
M113 Carrier series	110 PSI	20 PSI

READINGS BELOW MINIMUM OR BEYOND MAXIMUM ALLOWABLE VARIATION. . .

CAUSE & CURE :

1. HEAD GASKET BLOWN

LOOK FOR SIGNS OF LEAKAGE. IF ANY, REPLACE GASKET IF MAC* SAYS SO.

2. BAD RINGS

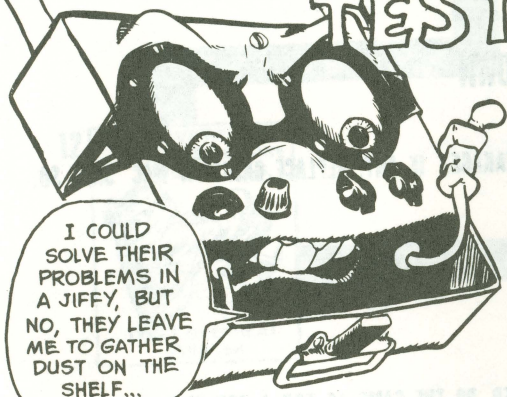
WET TEST EACH CYLINDER. DO THE SAME AS FOR A DRY TEST, BUT BEFORE SCREWING IN THE GAGE , SQUIRT A LITTLE OIL ON THE CYLINDER WALL -- ALL AROUND. IF THE PSI GOES TO ALLOWABLE MINIMUMS (STEP 15) OR ABOVE, THE RINGS ARE BAD. NOTIFY YOUR DSU.

3. BAD OR MISADJUSTED VALVES

OVERHEAD -- IF WET TEST DID NOT IMPROVE READINGS ADJUST VALVE CLEARANCES. IF COMPRESSION IS STILL BAD, DX THE HEAD OR CALL YOUR DSU. . .PER YOUR MAC CHART.

FLATHEAD TYPE -- IF WET TEST DID NOT IMPROVE READINGS AND GASKET IS OK, NOTIFY DSU.

THE TACH-DWELL TEST SET



The sets come in different sizes, shapes, and models, and their controls may differ a bit. But—you work'em all pretty much the same way.

To get fast, reliable results you have to really know your particular set and exactly what you can expect from it.

THE SET'S HANDY WHEN YOU'RE

- TROUBLESHOOTING OR REPLACING THE DISTRIBUTOR,
- CHECKING OR ADJUSTING THE POINTS.
- TROUBLESHOOTING THE ENGINE (IT'S BACKFIRING, MISSING, HAS STARTING TROUBLES.)
- PULLING A TUNE-UP JOB.
- TIMING THE ENGINE.

IN GENERAL HERE'S HOW THE BOX WORKS. . .

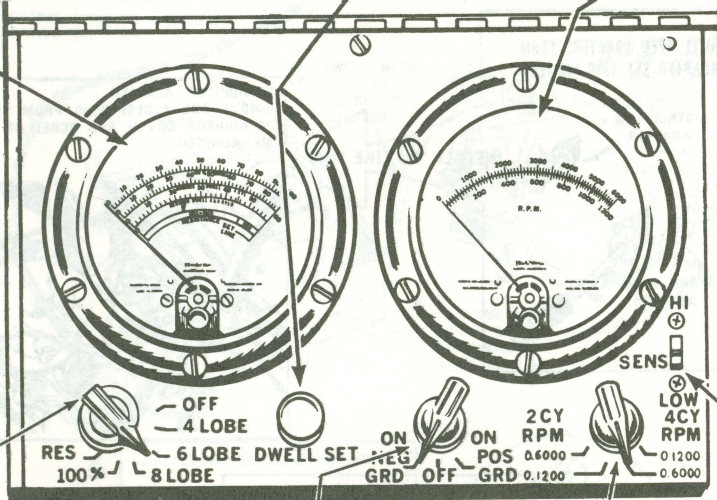
DWELL METER—Gives the distributor cam dwell reading. It may be a single-scale meter (0 to 50 degrees), or, a multi-scale meter. You have to calibrate the multi-scale meter (with its dwell set button), to a specified set-line (starting point) for type of engine (4, 6 or 8 cylinders) you're working on.

The multi-scale meter has 3 scales for taking dwell readings, and a red-green (GO-NO GO) scale for testing point resistance. This scale also tattles on other power-flow problems between the battery and the distributor (low battery, bum ground, broken wires or connections, etc.).

SENSITIVITY SWITCH—Keep it on Low. Only time you flip switch to HIGH is so's you can operate tach-meter when spark plug voltage is low.

TACH METER—Gives engine RPM. It covers 2 RPM ranges:
Minimum 0-1000 (or 1200 depending on your set) RPM.
Maximum 0-5000 (or 6000 depending on your set) RPM.

DWELL SET SWITCH (on multi-scale dwell meters)—For calibrating the meter, and spotting the set-line.



LOBE SELECTOR SWITCH—It lines up the dwell meter with the engine you're checking. You set it to match the number of cylinders—4, 6, or 8, on the engine.

If your set has a multi-scale dwell meter, flip this switch to RES, when you go to pull a point resistance check.

GROUND SELECTOR SWITCH—This matches the set's polarity to the polarity of the vehicle you're checking. (Some sets call it the polarity selector switch).

It has a negative and a positive setting, and it may also serve as the ON-OFF power switch for the set.

SPEED (OR ACH) SELECTOR SWITCH—Set it to match the type of engine (2- or 4-cycle) you're testing, and to the RPM range you'll need.

And, here's a big, fat caution on this switch—

Always set the switch on maximum RPM when you start the engine. After the engine's idling you can set the switch on minimum RPM, if that's the range you'll need. But, never start the engine with the tach switch on minimum RPM. Even if you're real light-footed, you're bound to race the engine a bit as you start it, and the meter's needle will ram the peg on its right as the engine RPM exceeds the meter's range. And, once a needle's pegged it'll not work right.



POWER SWITCH—Some sets have a separate ON-OFF power (toggle) switch. On other sets you control the ON-OFF power with the ground (polarity) switch.

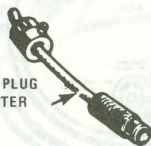
ON WATERPROOF IGNITION SYSTEMS . . .

YOU'LL NEED ADAPTERS FROM ADAPTER SET 4910-348-7600

DISTRIBUTOR ADAPTER



SPARK PLUG ADAPTER

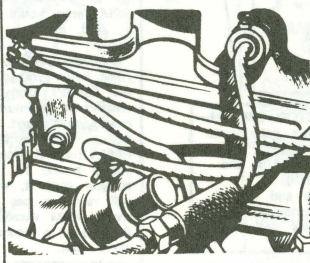


INSTALL 'EM LIKE THIS

DISTRIBUTOR ADAPTER . . .
REMOVE THE ACCESS PLUG FROM THE DISTRIBUTOR COVER AND SCREW IN THE ADAPTER

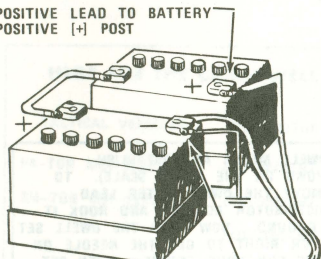


SPARK PLUG ADAPTER . . .
REMOVE CABLE FROM NO. 1 SPARK PLUG, ATTACH ONE END OF THE ADAPTER TO THE SPARK PLUG CABLE AND THE OTHER TO THE SPARK PLUG.

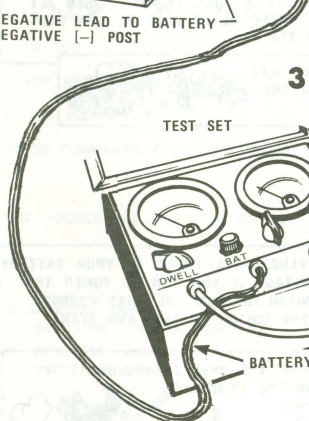


HOOK UP BOX LIKE THIS. . .

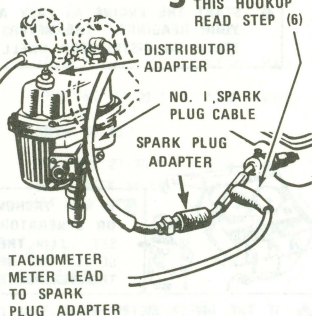
- 1** POSITIVE LEAD TO BATTERY
POSITIVE [+] POST



- 2** NEGATIVE LEAD TO BATTERY
NEGATIVE [-] POST



- 3** DWELL METER
LEAD TO
DISTRIBUTOR
ADAPTER



- 5** BEFORE MAKING
THIS HOOKUP
READ STEP (6)

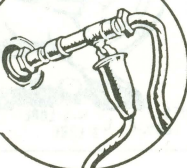
- 4** TACHOMETER
METER LEAD
TO SPARK
PLUG ADAPTER

6 --TACHOMETER LEAD HOOKUP--

--IF YOUR TEST SET HAS A SPLIT-SLEEVE CLAMP ON ITS TACH LEAD. NEVER HOOK IT UP TO THE TERMINAL OF THE SPARK PLUG ADAPTER--
--JUST CLAMP THE SPLIT-SLEEVE CLAMP OVER THE ADAPTER'S INSULATED WIRE . . . AND TAKE CARE THE CLAMP DOESN'T TOUCH ANY OTHER COMPONENT ON THE ENGINE.



YOU HOOK UP TO THE TERMINAL ON THE ADAPTER ONLY WHEN YOUR SET HAS A HEAVY TACH LEAD WITH A SMALL ALLIGATOR-TYPE CLAMP.



MAKING THE TEST. . .

ENGINE AT 800 RPM FOR THE TEST

- 1 SET ALL THE SWITCHES.
- 2 ZERO THE METERS WITH THE ADJUSTING SCREW.

- 3 CALIBRATE DWELL METER AND ESTABLISH SET LINE (SHOWN ON THE METER SCALE). TO DO THIS, REMOVE THE DWELL METER LEAD FROM THE DISTRIBUTOR ADAPTER AND HOOK IT TO A GOOD GROUND. NOW TURN THE DWELL SET SWITCH LEFT OR RIGHT TO GET THE NEEDLE ON THE "SET LINE" FOR YOUR ENGINE. WHEN SET REHOOK THE DWELL METER LEAD TO THE DISTRIBUTOR ADAPTER.

- 4 START THE ENGINE AS EASY AS YOU CAN AND TAKE YOUR READINGS. THE METERS WILL GIVE YOU THE SCORE ON DISTRIBUTOR DWELL AND RPM.



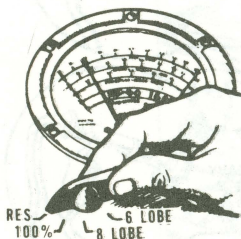
- 5 IF THE TACHOMETER POINTER FLUCTUATES, COULD BE YOUR BATTERY OR GENERATOR-REGULATOR VOLTAGE IS TOO LOW TO POWER THE SET. FLIP THE SENSITIVITY SWITCH TO HIGH. IF THAT DOESN'T SETTLE THE NEEDLE, RETURN THE SWITCH TO LOW, AND START TROUBLESHOOTING.

- 6 IF THE DWELL METER GIVES YOU THE RIGHT READING, THE NEEDLE SHOULDN'T VARY MORE 'N A FEW DEGREES (AS WHEN YOU GUN THE ENGINE.)

- 7 TAKE THE DWELL READING AT 800 RPM.



POINT RESISTANCE TEST



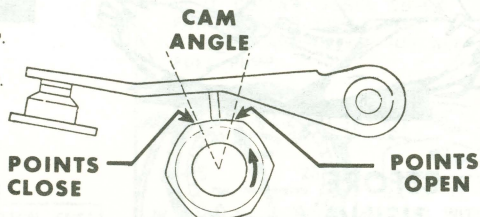
1. ENGINE OFF.
2. BREAKER POINTS CLOSED.
3. IGNITION SWITCH ON.
4. FLIP LOBE SWITCH TO RES.
5. READ GO NO-GO GAGE.
6. IF NO-GO, TURN OFF IGNITION.
7. CHECK POINTS, CAN BE PITTED, BURNED, ETC.
8. IF POINTS ARE OK, CHECK CIRCUIT FROM BATTERY.

HERE ARE THE CAM-DWELL ANGLES FOR MOST TACTICAL VEHICLES.

TACTICAL VEHICLES	DISTRIBUTOR	MAKE	CAM DWELL ANGLE	POINT GAP
1/4-TON M151-SERIES	IAU-4020-UT	AUTO-LITE	39-46 °	0.017 - .022
3/4-TON M37-SERIES	IAU-4005-UT	AUTO-LITE	37-40 °	0.020 ± 0.002
	IAU-4007-UT	AUTO-LITE	37-40 °	0.020 ± 0.002
1 1/4-TON M715-SERIES	IDA-4601-UT	PRESTOLITE	38-44 °	0.020 ± 0.002
2 1/2-TON M35-SERIES	III5561	DELCO-REMY	31-37 °	0.022
5-TON M54-SERIES	III556	DELCO-REMY	31-37 °	0.022
10-TON M123-SERIES	III605	DELCO-REMY	28-30 °	0.016 - 0.019
XM706 COMMANDO CAR	IDA-4801-UT	PRESTOLITE	ONE SET 27-30 °	0.016 - 0.021
			BOTH 34-40 °	
M113 CARRIER SERIES	1BF-4004-UT	AUTO-LITE	ONE SET 27-30 °	0.016 - 0.021
			BOTH SETS 34-40 °	
			(AT 1000 RPM)	

TO INCREASE ANGLE . . .
DECREASE BREAKER POINT GAP.

TO DECREASE ANGLE . . .
INCREASE BREAKER POINT GAP.



THE ANGLE AT WHICH POINTS REMAIN CLOSED IS CALLED "CAM" OR "DWELL ANGLE"

How TO USE YOUR VACUUM GAGE

THE GAGE'LL TIP YOU OFF TO WHETHER THE ENGINE IS OK... NEEDS ADJUSTMENT... NEEDS FURTHER TESTING... ESPECIALLY WHEN SEARCHING OUT CAUSES OF EXHAUST AIR POLLUTANTS.



INTERNAL COMBUSTION ENGINE GAGE

in Tool Sets...

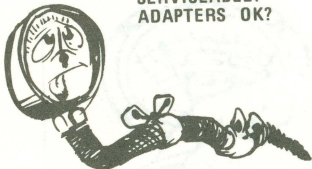
No. 1 Common — SC 4910-95-CL-A74

No. 2 Common — SC 4910-95-CL-A72

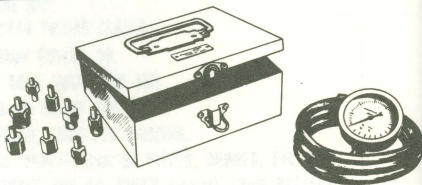
No. 2 Supplemental — SC 4940-95-CL-A08

BEFORE USING

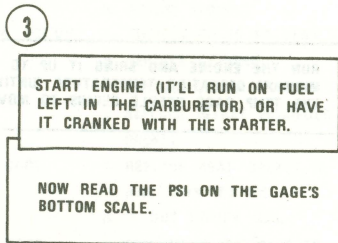
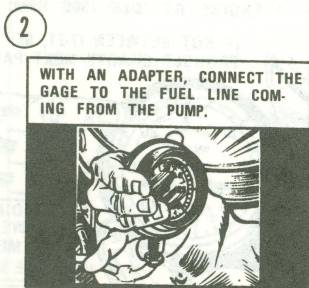
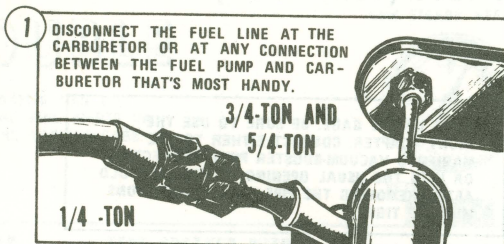
IS GAGE CALIBRATED?
SERVICEABLE?
ADAPTERS OK?



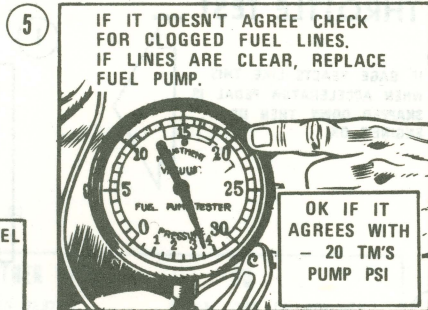
TEST WITH VEHICLE'S — 20 TM
IN HAND, LOOK FOR
SPECIFIC INSTRUCTIONS.



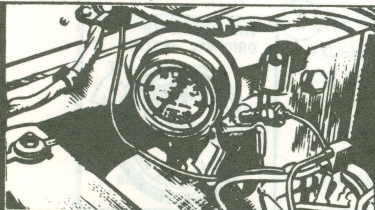
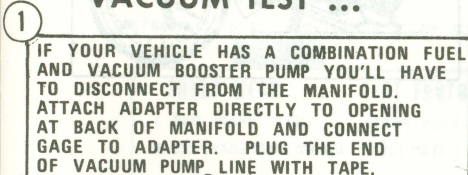
FUEL PUMP TEST ...



4



VACUUM TEST ...



VACUUM-BOOSTER PUMPS ARE ONLY MOUNTED ON VEHICLES HAVING VACUUM WINDSHIELD WIPERS ... LIKE THE M151 AND M151A1.

VACUUM TEST (continued)

2

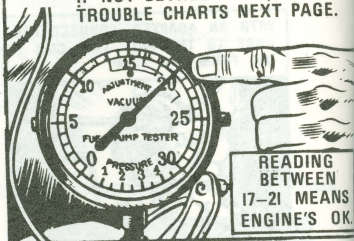
HOOK UP THE GAGE. BE SURE TO USE THE RIGHT ADAPTER. CONNECT EITHER TO THE MANIFOLD VACUUM-BOOSTER PUMP CONNECTION OR INTO THE USUAL OPENING IN THE MANIFOLD AFTER REMOVING THE PIPE-PLUG. CONNECTIONS MUST BE TIGHT.

3 RUN THE ENGINE AND BRING IT UP TO ITS MINIMUM OPERATING TEMPERATURE (UNTIL THE TEMP GAGE NEEDLE BEGINS TO MOVE).

4

ENGINE AT IDLE (600 RPM)

IF NOT BETWEEN 17-21, SEE TROUBLE CHARTS NEXT PAGE.



NOT OVER $\pm 1''$ FLUCTUATION. ADJUST CARB MIXTURE SCREW FOR HIGHEST READING.

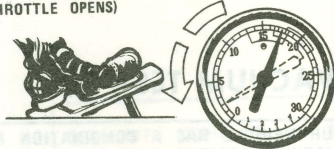
THROTTLE TEST ...

IF GAGE REACTS LIKE THIS WHEN ACCELERATOR PEDAL IS SNAPPED DOWN, THEN UP ... ENGINE'S OK.



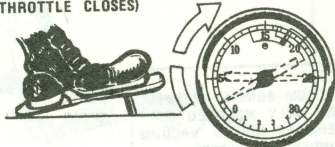
1

SNAP DOWN. . . SHOULD DROP TO ABOUT 2" (THROTTLE OPENS)



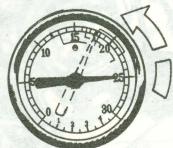
2

SNAP UP . . . JUMPS UP TO ABOUT 22-25 (THROTTLE CLOSES)



3

THEN BACK TO ORIGINAL SETTING



TROUBLE

TM 9-4910-477-10 (JAN 67)
GIVES THE FINE POINTS ON
USING THE VACUUM GAGE.

LOW STEADY NEEDLE



BETWEEN 17" & 2"

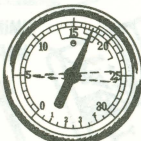
COULD MEAN . . . TEST FURTHER WITH . . .

- | | |
|--------------------------|--|
| 1. BAD TIMING | a. TACH DWELL METER |
| 2. INTAKE MANIFOLD LEAKS | b. TIMING LIGHT
LOOK FOR LEAK - USE OIL |
| 3. POOR COMPRESSION | COMPRESSION GAGE |
| 4. LOOSE VALVE GUIDES | COMPRESSION GAGE |

DO . . .

- a. REPLACE DISTRIBUTOR.
- b. ADJUST TIMING.
- a. TIGHTEN BOLTS AT LEAK.
- b. REPLACE LEAKING VACUUM LINES.
- c. REPLACE INTAKE MANIFOLD GASKET.
- a. REPLACE HEAD GASKET IF MAC*SAYS IT'S OK.
- b. IF NOT NOTIFY DSU.
- a. REPLACE IF MAC*SAYS SO.
- b. IF NOT NOTIFY DSU.

NEEDLE FLUCTUATING



BETWEEN 17" & 5" (MORE THAN 2" OR 3")

COULD MEAN . . . TEST FURTHER WITH . . .

- | | |
|--------------------------|--|
| 1. BAD SPARK PLUGS | SPARK PLUG TESTER |
| 2. BAD SPARK PLUG WIRING | MULTIMETER |
| 3. BAD CARBURETOR | LOOK IT OVER FOR CRACKS,
EXCESSIVE GUM, DIRT OR
GAS LEAKAGE. |
| 4. TIMING OFF | TIMING LIGHT |
| 5. HEAD GASKET BLOWN | COMPRESSION GAGE |
| 6. BAD PISTON | COMPRESSION GAGE |

DO . . .

- CLEAN, TEST OR REPLACE.
REPLACE IF FAULTY.
- REPLACE IF FAULTY.
- ADJUST TIMING.
- a. REPLACE IF MAC*SAYS SO.
- b. IF NOT NOTIFY DSU.
- NOTIFY DS MAINTENANCE.

Using **YOUR** Timing Light

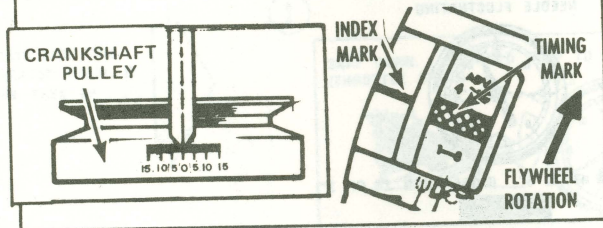
BEFORE HOOKING UP. . .

- 1** CHECK CAM DWELL ANGLE . .
GAP AND ADJUST POINTS IF NEEDED.



FOR CAM DWELL
CHECK, SEE
TACH-DWELL
TEST CHART.

- 2** FIND & CHALK TIMING MARKS

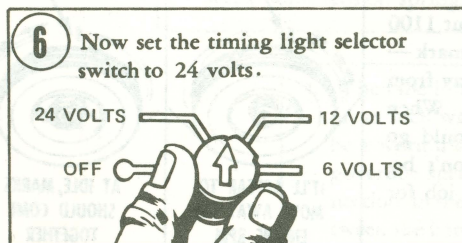
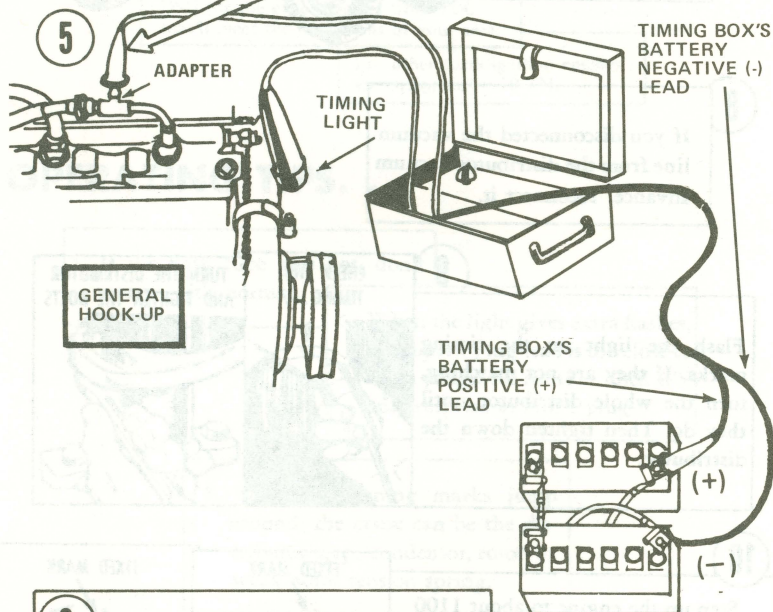
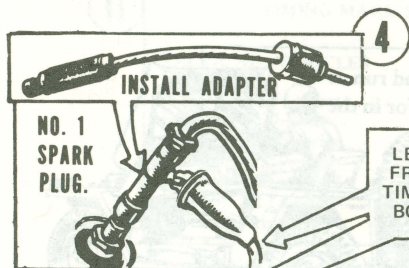


3



Find a safe place to stand
and a spot to hold the light while
it flashes on the damper—clear of
the whirling fan.

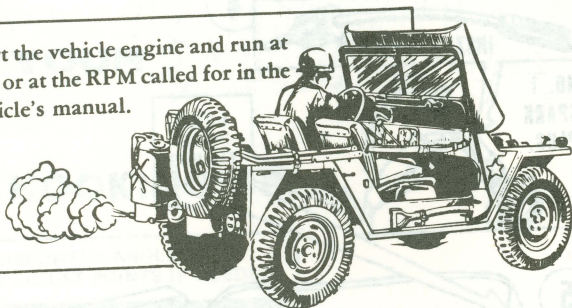
HOOKING UP...



TIMING. . .

7

Start the vehicle engine and run at idle or at the RPM called for in the vehicle's manual.



8

If you disconnected the vacuum line from the distributor vacuum advance, reconnect it.

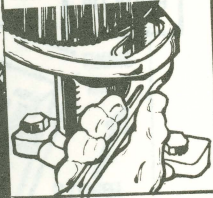
9

Flash the light on the timing marks. If they are not matching, turn the whole distributor until they do. Then tighten down the distributor.

CHECK THE
TIMING . . .



TURN THE DISTRIBUTOR
AND TIGHTEN THE BOLTS



10

Step up the engine to about 1100 RPM. Watch the timing mark — it will appear to move away from the fixed timing pointer. When you drop to idle they should go back together. If they don't behave this way then it's a job for your support.

FIXED MARK



IT'LL APPEAR TO
MOVE AWAY AS
ENGINE RPM
GOES UP . . .

FIXED MARK



AT IDLE, MARKS
SHOULD COME
TOGETHER

TIMING MARK SETTINGS

TACTICAL VEHICLES	SETTING
¼-Ton M151-series	6° BTDC
¼ Ton M37-series	2° BTDC
1¼-Ton M715-series	5° BTDC
2½-Ton M35-series	4° BTDC
5-Ton M54-series	5° BTDC
10-Ton M123-series	4° BTDC
M113 Carrier-series	10° BTDC

Extreme high altitudes will change (retard) the above settings. See your DSU for the exact degrees from TDC that'll meet the conditions of your area.

For other spark-ignition engines, see equipment's -20 TM.

OPERATING TIPS. . .

1. If the flash tube gets hot, don't worry—it's normal.

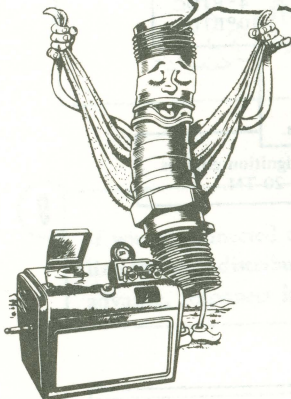
2. When the light gives extra flashes, your spark plug lead is too close to other plugs. Re-route it until it'll only respond to No. 1 plug.

3. When the timing marks jump around, the cause can be the distributor gap, condensor, rotor or weak point tension spring.

4. When the line looks like a blur—or an inch wide—the cause may be a worn distributor shaft, weak governor springs, or a loose connection in the primary circuit between the battery and distributor.

Using Your... **SPARK PLUG** **CLEANER** AND **TESTER**

ANY DIRTY AND FOULED SPARK PLUG THAT'S BASICALLY HEALTHY CAN BE CLEANED UP AND PUT BACK TO WORK.



OPERATING AIR PRESSURE: MINIMUM 100 PSI



FIRST...
EYEBALL THEM FOR:

1. Chipped or cracked insulators (In barrel or base)
2. Crossed threads
3. Mashed or bent barrel
4. Bent center electrode
5. Electrode burned halfway through

FIND ANY?
TOSS 'EM OUT!

THE GOOD ONES . . .

OILY? DUNK 'EM IN SOLVENT.



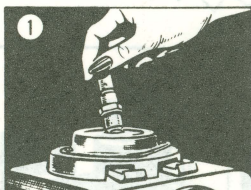
CLEAN THE THREADS
WITH A WIRE BRUSH



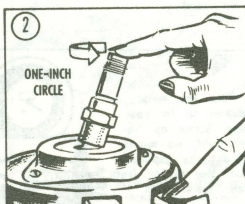
← DRY WITH A SQUIRT OF COMPRESSED AIR. BE SURE THE PLUG IS FREE OF OIL. AN OILY PLUG IN A SPARK PLUG CLEANER WILL CLOG WITH ABRASIVE-OR CLOG UP THE ABRASIVE WITH OIL.

NOW SANDBLAST 'EM

CAREFUL--WEAR GOGGLES



Now you put the plug in the rubber adapter of the spark plug cleaner... be sure the adapter's the right size. The right one fits nice 'n' tight... most adapters are marked for size... so check first.

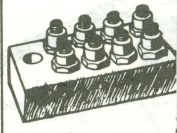


Put your finger on top of the plug, and swing it in a one-inch circle while pressing the abrasive blast valve of the cleaner... A three second blast is enough.

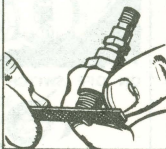


After each 3-second blast... press the air blast valve for about a second... be careful not to thrust plug in the adapter.

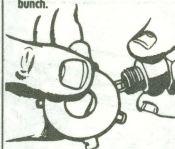
4 Clean all the plugs from one engine at one run. That way they don't get mixed with plugs from some other engine. Keep them in racks as you go.



5 A flat-face ignition-point file helps dress plug electrodes—but no major surgery.



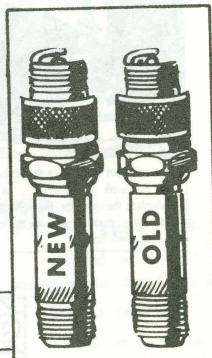
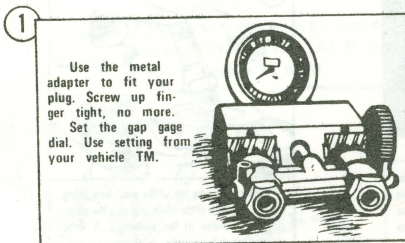
6 When you get a set of plugs blast-cleaned, gap-test the bunch.



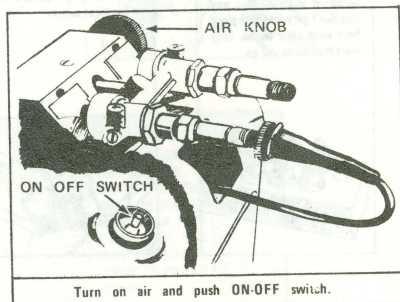
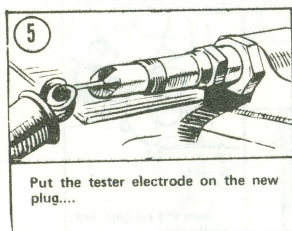
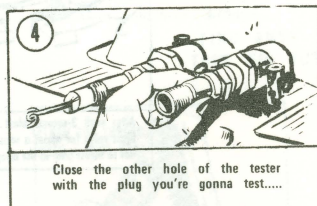
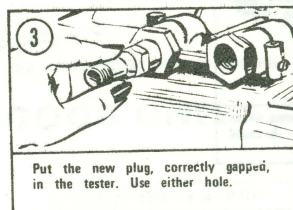
Round-wire gap gages beat the flat kind.

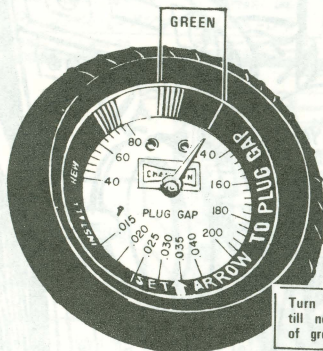
TESTING

You can find plug adapter set
FSN 4910-348-7600 in your
No. 1 Common Tool Set.

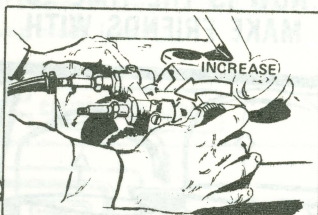


2 Get a new plug of the same type





7

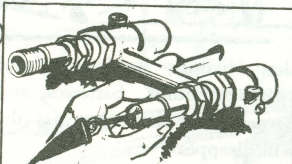


Increase air until plug stops sparking....
Then back it down to highest pressure
at which plug fires with a steady spark.

8

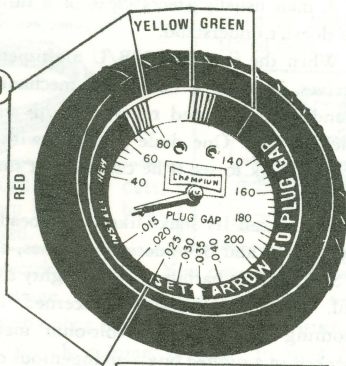
Turn dial of spark indicator
till needle is on right edge
of green. Do not move dial.

9



Put electrode on old plug. Repeat Step 7
for steady spark.

10



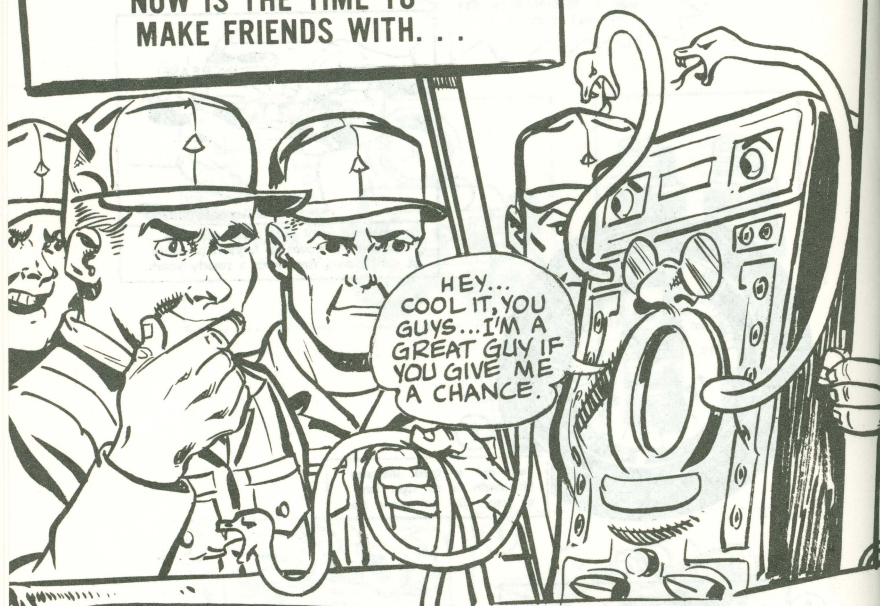
The indicator reading will tell
good (green), fair (yellow) or
replace (red).

AFTER 350 PLUGS-REPLACE
BLAST NOZZLE AND ABRASIVE (GRAIN),
FSN 5350-222-0581

VARIOUS MAKES AND MODELS OF THE CLEANER-TESTER WORK ABOUT THE SAME WAY

**CALLING ALL AUTOMOTIVE MECHANICS!
NOW IS THE TIME TO
MAKE FRIENDS WITH...**

YOUR TS-352 B



A man usually steers clear of a thing he doesn't understand.

When the first TS-352B/U multimeter arrives in shop a couple of mechanics stand well back and regard it with suspicious eyes. One dude prods it with a forked stick to see if he can make it snap back.

But for all its snake-like leads, beady-eyed jacks and bewildering switches, the TS-352B/U is harmless—and mighty useful. As far as you're concerned it's nothing more than a volt-ohm meter packed in a rugged box—an ingenious device for troubleshooting 28-volt electrical circuits.

Using it is your better way to cure an ailing electrical system. It's lots better

than blindly replacing alternators, switches, bulbs, batteries and wiring harnesses in the hope that the trouble will disappear.

Several automotive -20 TM's give good rundowns on checking out automotive circuits with a less complicated-looking commercial type multimeter. But since the TS-352B/U, a military design job, is about the only meter available in your automotive maintenance organizational No. 1 and No. 2 common tool sets, it's time to dispel any hocus-pocus beliefs that keep you from using it.

When making voltage, resistance and continuity tests that're spelled out in your automotive -20 TM's, rig your TS-352B/U multimeter like this . . .

MULTIMETER

FIRST THINGS FIRST

Before using the multimeter make certain it's been calibrated in the last 6 months. Then give it a hawk eye to see if it's in working order. Like . . .

U. S. ARMY CALIBRATION SYSTEM (TM 38-750)	
1. JAN TYPE/MFR & MODEL TS-352 BU	2. CALBR DUE 1 NOV 73
3. SERIAL NUMBER 4132	4. DATE CALBR 1 MAY 73
5. NAME/REPORT NUMBER SFC JOHN WELCH	6. SUPPORT UIC WLEX-04
DA LABEL 80 1 JAN 70	

CALIBRATION LABEL

Meter — Glass and pointer not broken. Pointer should be resting over the zero marks at left side of the scales.

Switches — Work freely without binding or scraping.

Test prods — Tight on cable, tip free of paint or anything that may be an insulator.

Jack sockets — Open and dirt-free.

Batteries — Not corroded or leaking; installed right.

Jack plugs — Tight on cable, prods clean.

Cables — No cuts, sharp kinks, nor badly frayed.

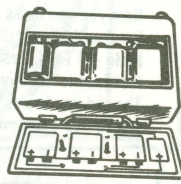
AT EASE

Don't let the many jack and switch positions throw you. Although the TS-352/BU is made for testing a wide range of electrical and electronic circuits, you can ignore most of them when it comes to dealing with 28-volt DC automotive

electrical circuits. You can make all your voltage, resistance and continuity tests with only a few jack and switch positions.

Which column of jacks to use? No sweat. When testing any automotive 28-volt circuit, use the 20000 OHMS PER VOLT DC (left) side.

Here's the way it's done . . .

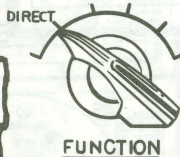


DC VOLTAGE TESTS



Used to measure battery voltage, charging system output voltage and voltage drops at various test points

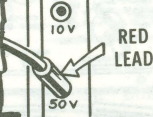
1. Set the FUNCTION switch on DIRECT.



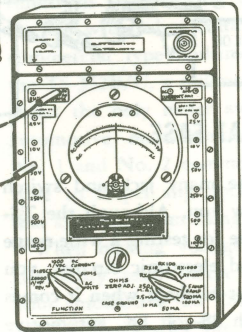
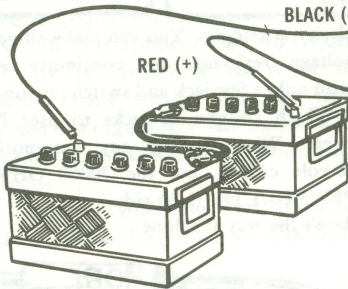
2. Plug the black (-) test lead into the OHMS - DC \pm AC jack. It's at the upper left. This jack is the meter circuit's common ground.



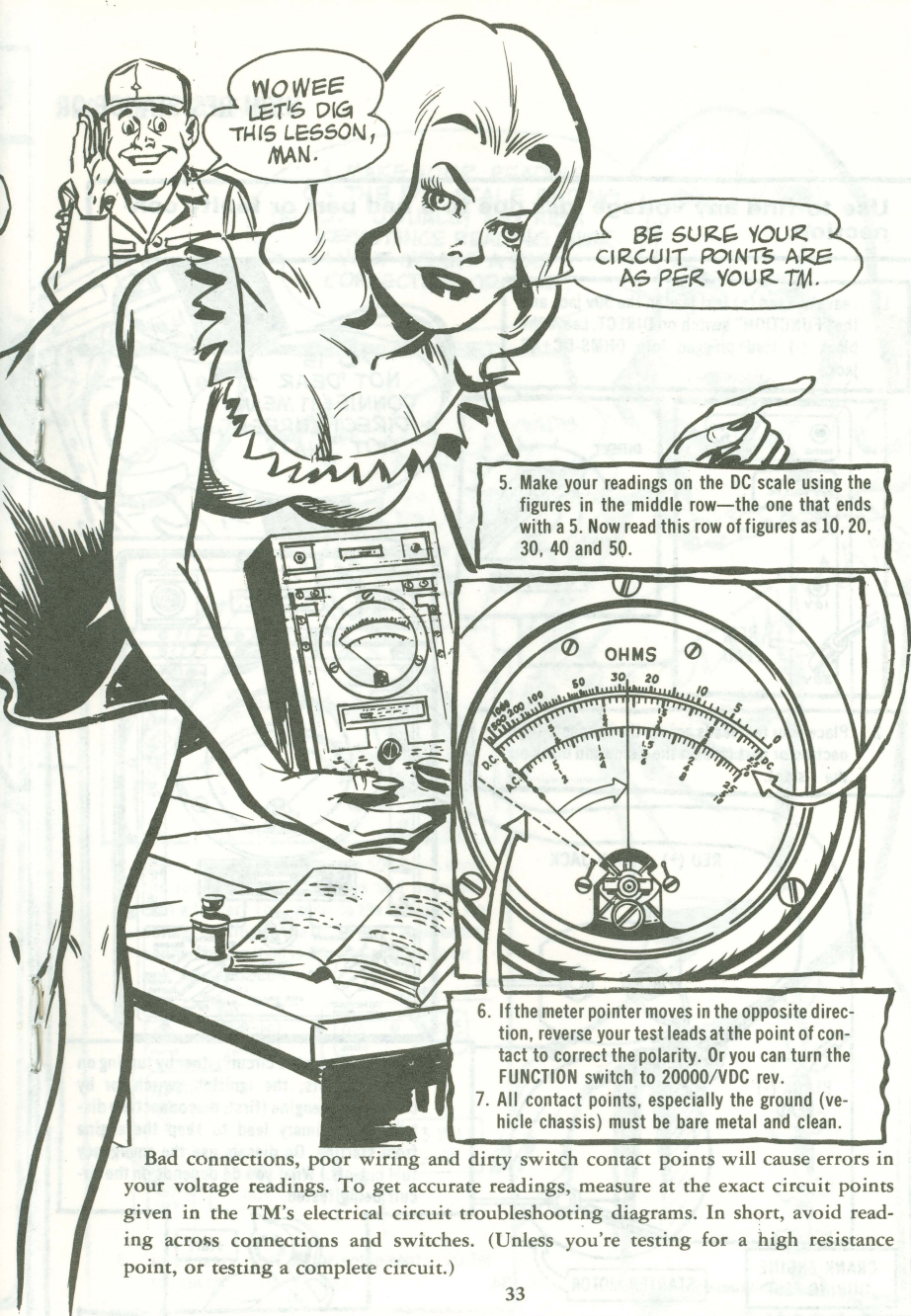
3. Plug the red (+) test lead into the 50V jack that's in the 20000 OHMS per volt DC column.



4. Now you can make all the DC voltage tests outlined and shown in your tactical or combat vehicle -20 TM's. Just keep in mind that the black test lead is negative (-) and goes to the ground. The red one is positive (+) and goes to the point where you measure the voltage.



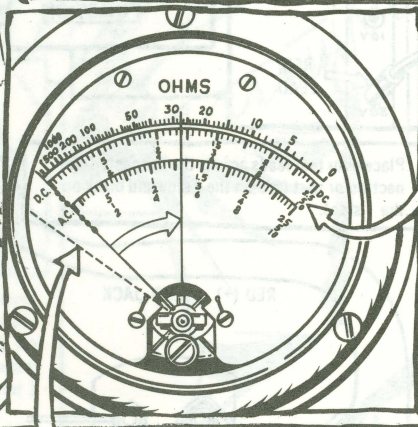
OH-WOW!
THAT'S SOME
VOLTAGE TEST!



WOWEE
LET'S DIG
THIS LESSON,
MAN.

BE SURE YOUR
CIRCUIT POINTS ARE
AS PER YOUR TM.

5. Make your readings on the DC scale using the figures in the middle row—the one that ends with a 5. Now read this row of figures as 10, 20, 30, 40 and 50.

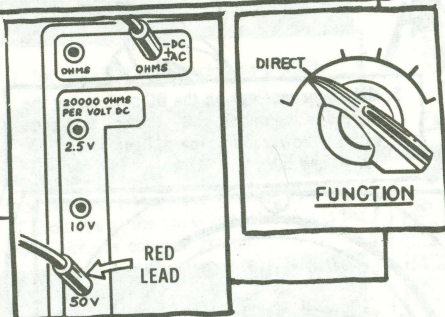


6. If the meter pointer moves in the opposite direction, reverse your test leads at the point of contact to correct the polarity. Or you can turn the **FUNCTION** switch to 20000/VDC rev.
7. All contact points, especially the ground (vehicle chassis) must be bare metal and clean.

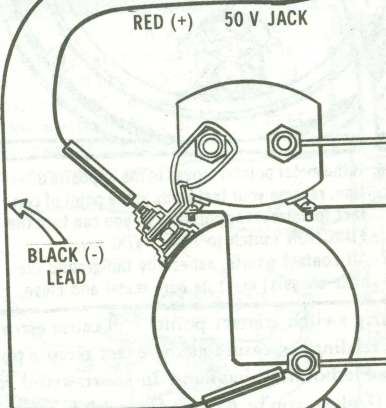
Bad connections, poor wiring and dirty switch contact points will cause errors in your voltage readings. To get accurate readings, measure at the exact circuit points given in the TM's electrical circuit troubleshooting diagrams. In short, avoid reading across connections and switches. (Unless you're testing for a high resistance point, or testing a complete circuit.)

Use to find any voltage loss due to a bad part or faulty connection.

1. Leave the red (+) test lead in the 50v jack and the "FUNCTION" switch on DIRECT. Leave the black (-) lead plugged into OHMS-DC±AC jack.



2. Place your test leads across the suspected connection or part (red on the + side and black on the - side).

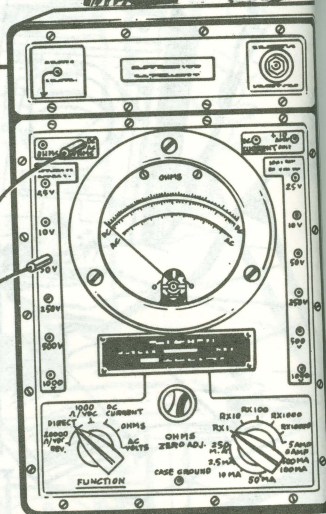


CRANK ENGINE
DURING TEST

STARTER MOTOR

34

DC IS
NOT 'DEAR
CONNIE!' IT MEANS
DIRECT CURRENT,
GOT THAT?

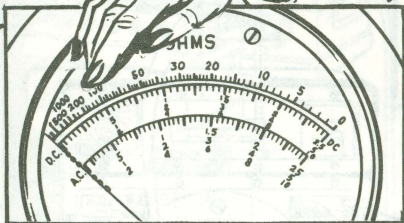


3. Now load down the circuit either by turning the headlights, the ignition switch, cranking the engine (first, disconnect the distributor's primary lead to keep the engine from starting. On diesels use the emergency fuel cut-off.) What you do depends on the circuit being tested.

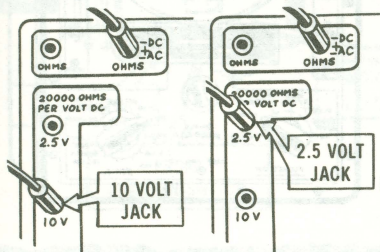


4. MAKE YOUR READING ON THE DC SCALE ENDING IN 5. USUALLY ANY HIGH RESISTANCE READING OVER 1 VOLT MEANS A BAD CONNECTION OR PART.

GADS!
A
SNAKE...



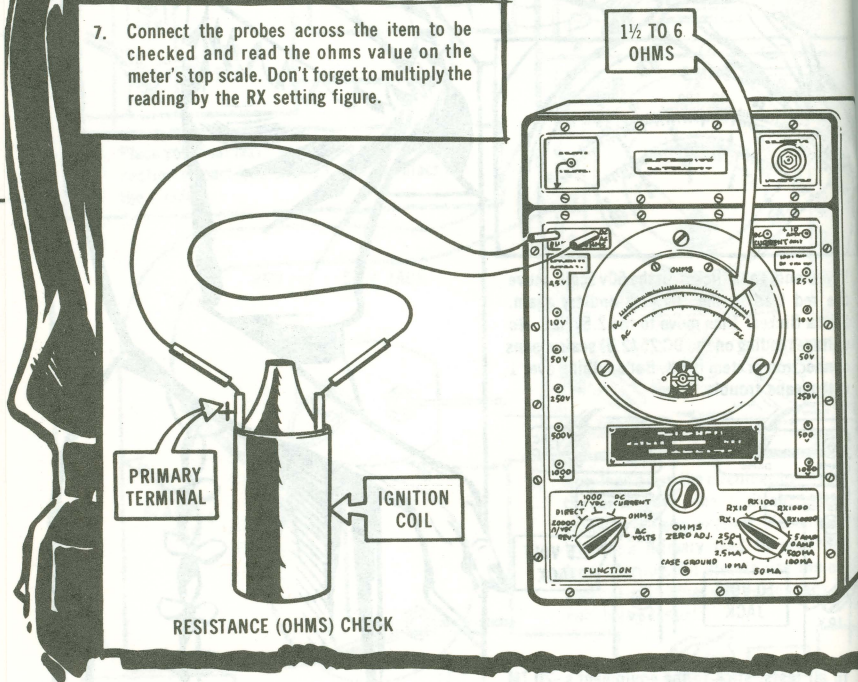
5. If you only got a flicker on the 50v scale, move the red lead to the 10v jack and try again. Still a flicker? Then move to the 2.5v jack. No voltage reading on the DC 25 (2.5) scale means connection or item is OK. But anything over 1 volt means trouble.

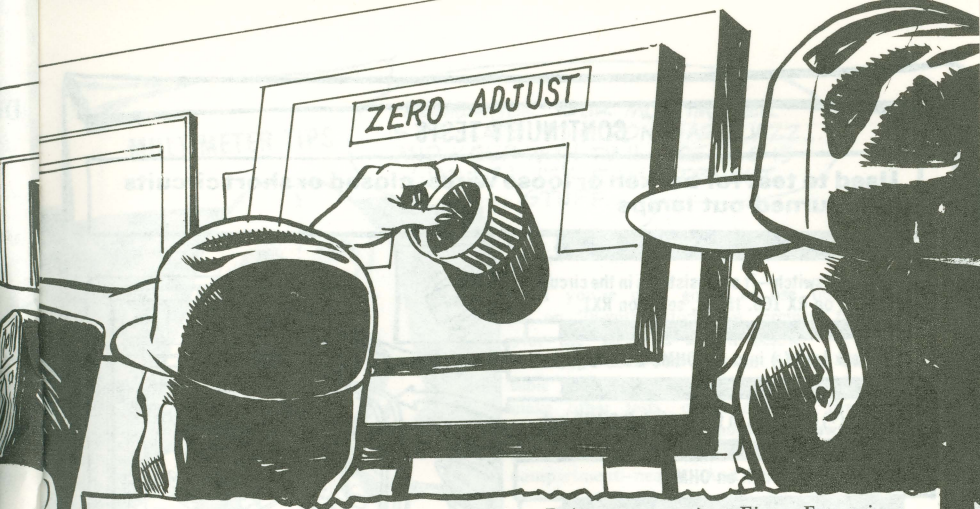


6. In all tests, stick to the equipment's -20 TM for specifics. Don't guess.



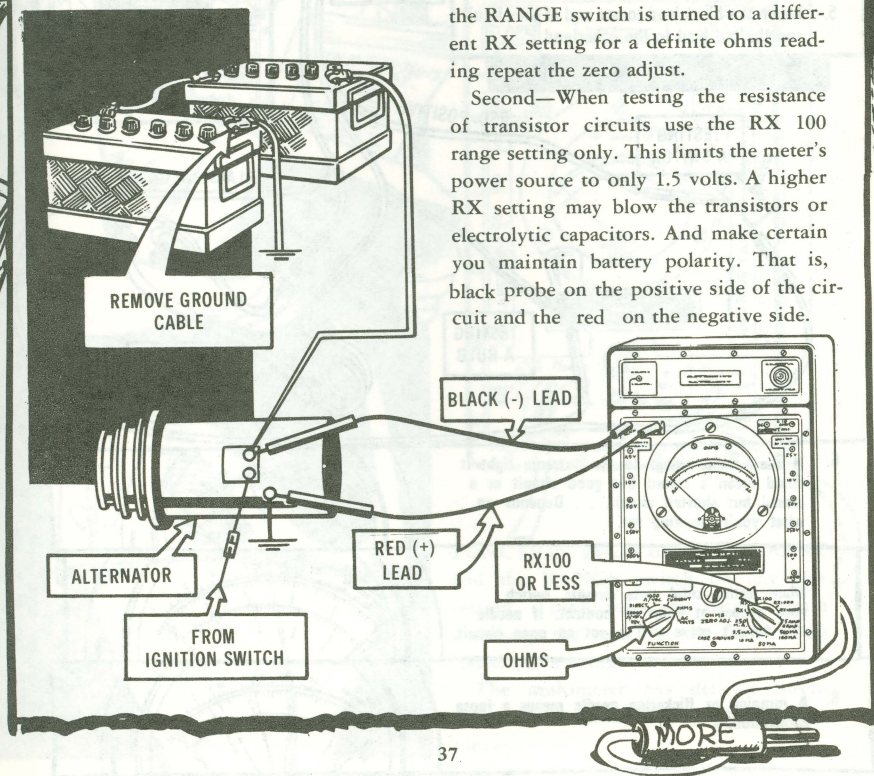
7. Connect the probes across the item to be checked and read the ohms value on the meter's top scale. Don't forget to multiply the reading by the RX setting figure.





Points to remember: First—Every time the RANGE switch is turned to a different RX setting for a definite ohms reading repeat the zero adjust.

Second—When testing the resistance of transistor circuits use the RX 100 range setting only. This limits the meter's power source to only 1.5 volts. A higher RX setting may blow the transistors or electrolytic capacitors. And make certain you maintain battery polarity. That is, black probe on the positive side of the circuit and the red on the negative side.



CONTINUITY TESTS

Used to test for broken or loose wires, closed or short circuits and burned-out lamps

1. RANGE switch—If a transistor is in the circuit set it on RX 100. If not, set it on RX1.

RX 1

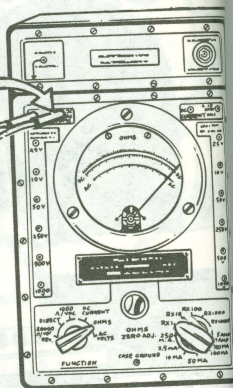
2. Black lead (-) into the OHMS-DC \pm AC jack.

3. Red (+) lead goes in the upper left OHMS jack.

4. FUNCTION switch on OHMS.

5. Touch the black lead to one end of the circuit and the red lead to the other end.

OHMS



RED POSITIVE LEAD

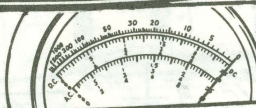
BLACK NEGATIVE LEAD

TESTING
A SWITCH

TESTING
A BULB

TESTING AN
ELECTRICAL
CABLE

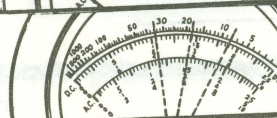
6. If the needle swings to the extreme right it could mean a closed but good circuit or a closed but shorted circuit. . . Depends on what you're looking for.



7. When testing solid state circuits, switch your probes at point of contact. If needle still doesn't move you've got an open circuit.



8. A jumping or flickering needle means a loose connection.



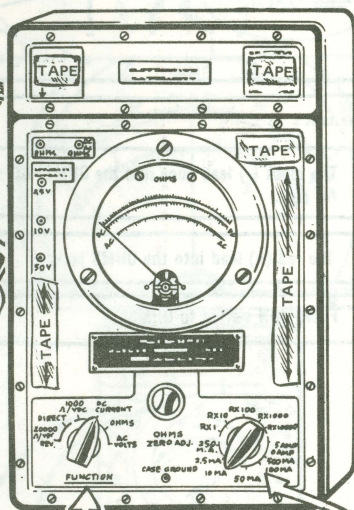
MULTIMETER TIPS

REMEMBER YOUR MULTIMETER
IS DELICATE. NO STRONG-ARM JAZZ...
AND KEEP WITH TM 11-6625-366-15
(JAN. 67)...IT'S REAL STRAIGHT
STUFF...

If you're only going to use the TS-352B /U on 28-volt automotive circuits, tape over the jacks as shown below.

TM 11-6625-366-15 (Jan 67) is the bible for the TS-352B/U. If you want to make other tests, check this TM first.

When putting the multimeter away, stow all the test leads in their proper compartment—neatly. And set the

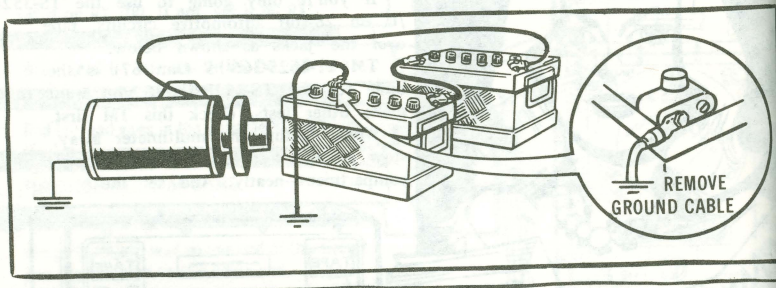


FUNCTION switch on **DC CURRENT** and the **RANGE** switch on any **MA** setting. This'll stop any battery drain and keep the meter needle from being jolted while being carried.

The multimeter has delicate mechanisms so be gentle. No rough handling, please!

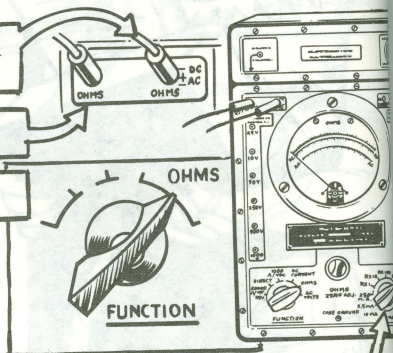
Used to measure resistance of coils and resistors

Before you start—make sure no battery voltage is connected to the circuit to be tested. Use the meter to see if any voltage is present. Or better yet—disconnect the battery ground cable. This'll stop a possible meter burnout.

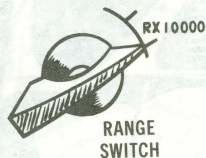


To test . . .

1. The black (-) lead goes into the OHMS -DC \pm AC jack.
2. The red (+) lead into the OHMS jack.
3. FUNCTION switch to OHMS.



4. If you know the approximate ohms rating of the circuit to be tested, set the RANGE switch to that RX-value.
5. If you don't know the rating, set the RANGE switch to RX10000.



(OHMS) TESTS

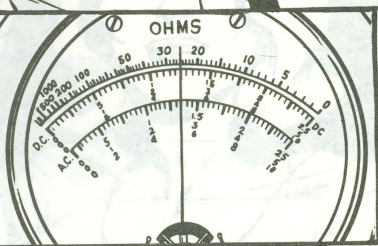
YOU LADIES
WILL HAVE NO
RESISTANCE
FROM ME.

COOL IT, DUDE,
LET'S CONCENTRATE
ON TH' TESTS.

TAKE IT EASY
ON THE RANGE
SWITCH...ONE
RANGE AT A
TIME.

6. Connect the test probes across the item to be checked.

7. Turn the Range switch counterclockwise one range-step at a time until the needle is on the meter.

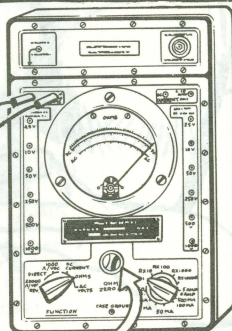


8. Now ZERO adjust the meter. Touch the 2 test probes together and turn the OHMS ZERO ADJ. knob until the needle settles right over "0" that's on the right side of the very top meter scale.

TOUCH
PROBES



OHMS
ZERO ADJ.



MORE

USING THE.

AN/URM-105

MULTIMETER

- TO TEST ..
- DC VOLTAGE
 - AC VOLTAGE
 - RESISTANCE (OHMS)
 - CONTINUITY

HERE'RE THE
BASICS ON USING THE
AN/URM-105
MULTIMETER .



Never measure an AC circuit when the multimeter is set on DC Volts—or vice versa or with the selector switch on OHMS. Measuring a circuit when on the wrong setting can burn out a resistor. So check your switch setting first, then measure the voltage.

FIRST THINGS FIRST . . .

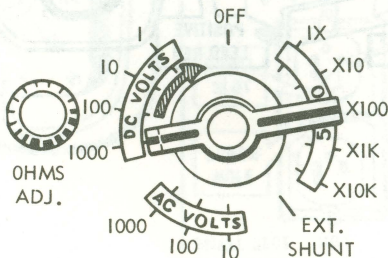
BEFORE USING THE URM-105, CHECK ITS BATTERIES. IF THEY'RE WEAK YOUR READING WILL NOT BE TRUE.

- ① Set the switch to OHMS X1.
- ② Touch the tips of both test prods; the needle should swing to the right.
- ③ Turn OHMS ADJ completely clock-wise. The needle should go to "0" or beyond on the ohms (top) scale.
- ④ If the needle does not go all the way to the right, the 2 BA-58/U, 1.5-volt batteries (FSN 6135-120-1030) need changing.
- ⑤ Now switch to OHMS X1K; keep the prod tips together and the OHMS ADJ knob turned completely clock-wise.
- ⑥ The needle should again go to the extreme right. If it doesn't, the BA-261/U, 22.5-volt battery (FSN 6135-160-7159) needs changing.

DC VOLTAGE MEASUREMENTS

USED TO TEST BATTERY VOLTAGE, CHARGING SYSTEM OUTPUT AND VOLTAGE DROPS AT BAD CONNECTIONS.

- ① Set selector switch in DC VOLTS 1000 position.

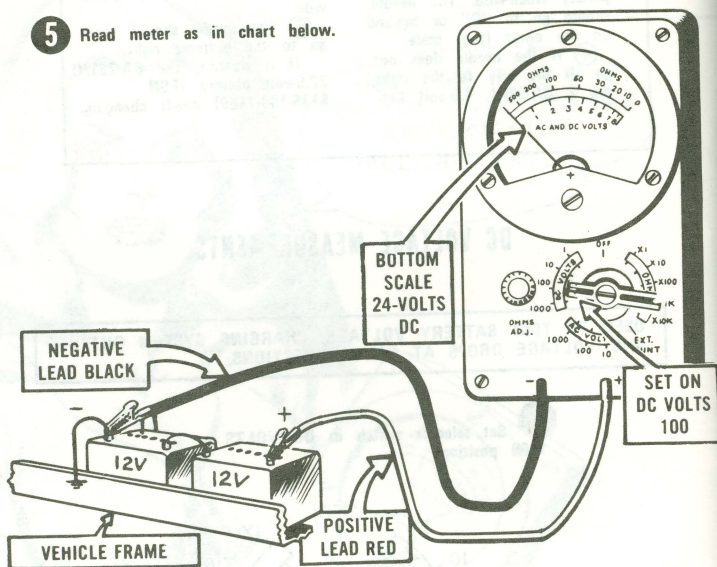


- ② Connect red lead to positive (+) connection in circuit to be measured.
- ③ Connect black lead to negative (-) connection.

- 4 Move selector switch to 100, 10, or 1 setting to get reading near center of scale (dropping from high to low settings on switch protects meter. Overloads can ruin it).

CHECKING YOUR VEHICLE'S 24-VOLT BATTERY SYSTEM

- 5 Read meter as in chart below.



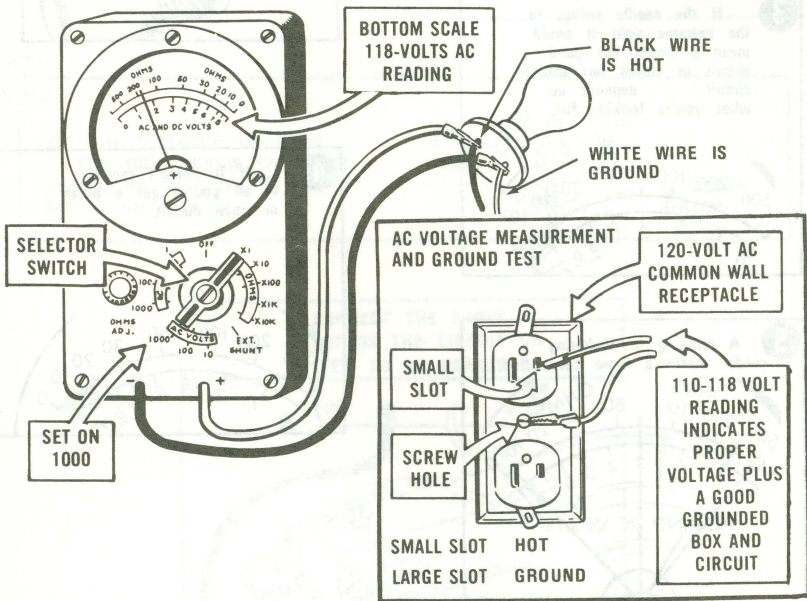
Switch setting	Range	You do
1	0 -1 volt	Divide the readings by 10.
10	0 -10 volts	Use direct meter reading.
100	0 -100 volts	Multiply meter reading by 10.
1000	0 -1000 volts	Multiply meter reading by 100.

AC VOLTAGE MEASUREMENTS

USED TO TEST VARIOUS WALL RECEPTACLES FOR PROPER OUTPUT
NEEDED TO OPERATE ELECTRIC TOOLS AND MOTORS.

FIRST, SET SELECTOR SWITCH
IN AC VOLTS 1000 POSITION.

- ② Connect leads to points to be checked (with AC voltage you can use black or red leads with no concern about polarity).
- ③ Move selector switch to 100 or 10 position for center scale reading.
- ④ Read meter as in chart below.



Switch Setting	Range	You Do
10	0-10 volts	Use red line reading
100	0-100V	Multiply reading by 10
1000	0-1000V	Multiply reading by 100

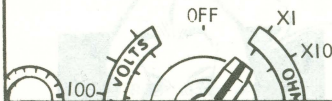
CONTINUITY TESTS

USED TO TEST FOR BROKEN OR LOOSE WIRES, CLOSED OR SHORTED CIRCUITS AND SWITCHES, PLUS TESTING FOR BURNED-OUT BULBS.

MAKE CERTAIN NO VOLTAGE IS CONNECTED TO CIRCUIT TO BE TESTED FOR CONTINUITY

1

Set selector switch to X1 ohms position.



Zero meter: Touch prods together. Turn OHMS ADJ till needle is over "0" in top scale.

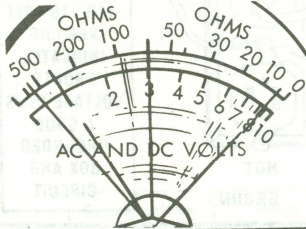
3

If the needle swings to the extreme right it could mean a closed but good circuit or closed but shorted circuit . . . depends on what you're looking for.



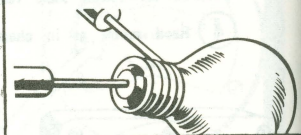
5

A jumping or flickering needle means a loose connection.



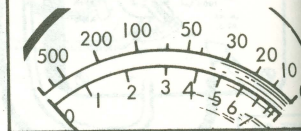
2

Now just touch the prods across the bulb, switch, cable or circuit that's acting up.



4

If it doesn't move at all you've got a break or open circuit.



ALWAYS MAINTAIN METER BATTERY POLARITY WHEN CHECKING CONTINUITY OF ALTERNATORS AND SOLID STATE CIRCUITS. YOU DO THIS BY USING THE RED AS NEGATIVE (-) AND BLACK PROD AS POSITIVE (+).

CAUTION

TO MAINTAIN METER BATTERY POLARITY WHEN WORKING ON ALTERNATORS AND SOLID STATE CIRCUITS USE THE RED PROD AS NEGATIVE(-) AND THE BLACK PROD AS POSITIVE (+).

WHY? BECAUSE THE RED LEAD IS CONNECTED TO THE (-) SIDE OF THE METER'S BATTERIES AND THE BLACK LEAD TO THE (+) SIDE.

RESISTANCE (OHMS) MEASUREMENTS

USED TO MEASURE THE OHMS RESISTANCE IN COILS, RESISTORS AND VARIOUS ELECTRICAL CIRCUITS.

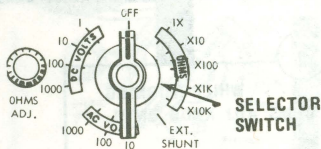
MAKE CERTAIN NO DC OR AC VOLTAGE IS CONNECTED TO THE CIRCUIT BEING MEASURED. MAKE A VOLTAGE TEST BEFORE SWITCHING METER TO AN OHMS SETTING.

● WHEN MEASURING RESISTANCE OF TRANSISTOR CIRCUITS USE THE X1, X10 AND X100 SETTINGS ONLY. THIS'LL LIMIT THE METER'S POWER SUPPLY TO 1.5 VOLTS. THE HIGHER SETTINGS PUT 22.5 VOLTS IN THE METER CIRCUIT AND THIS CAN BLOW TRANSISTORS OR ELECTROLYTIC CAPACITORS.

**AND YOU MUST MAINTAIN
METER BATTERY POLARITY!**

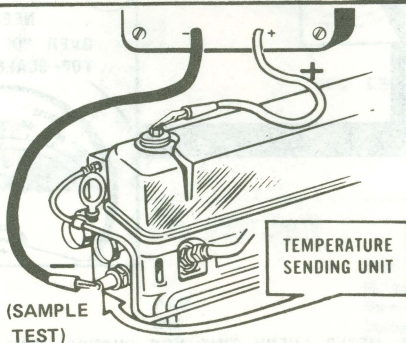
1

SET THE SELECTOR ON OHMS.
IF YOU DON'T KNOW THE OHMS
RATING OF THE CIRCUIT, SET THE
SWITCH ON X10K.



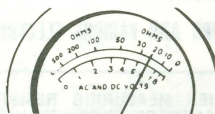
2

CONNECT THE PRODS
ACROSS THE CIRCUIT OR
ITEM TO BE MEASURED.



3

TURN THE SWITCH
COUNTERCLOCKWISE
UNTIL THE NEEDLE
MOVES ONTO THE
SCALE.



4

NOW ZERO THE METER.
TOUCH THE 2 PRODS
TOGETHER



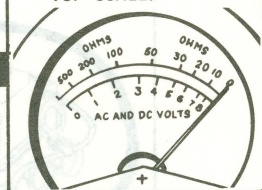
5

... WHILE TURNING
OHMS ADJ KNOB UNTIL ...



6

... NEEDLE IS
OVER "0" ON THE
TOP SCALE.

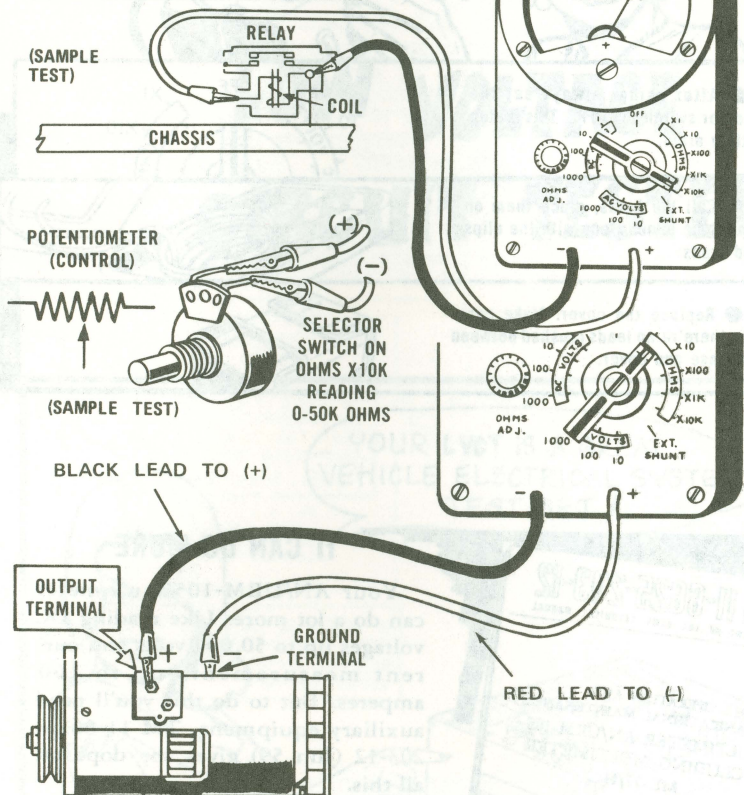


NOTE --- ZERO METER EVERY TIME YOU CHANGE OHMS SETTING.

7

CONNECT THE TEST PRODS ACROSS THE ITEM OR CIRCUIT TO BE MEASURED AND READ THE VALUE ON THE TOP SCALE. DON'T FORGET TO MULTIPLY THE READING BY THE "X" SETTING FIGURE AS IN CHART BELOW.

EVERY TIME THE SELECTOR SWITCH IS SET ON ANOTHER OHMS "X" SETTING, REPEAT THE ZERO ADJUST.



Ohms Switch Setting

X1
X10
X100
X1K
X10K

You Do

Read number on scale
Multiply reading by 10
Multiply reading by 100
Multiply reading by 1000
Multiply reading by 10000

(Remember: K=1000)

TAKE GOOD CARE OF THIS VERY HELPFUL PIECE OF TEST GEAR.

MULTIMETER CARE:

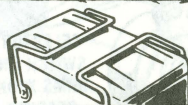
- After using, always set the selector switch to "OFF". This'll stop battery drain.



- Coil the leads, place them on top of the panel along with the clips and prods.

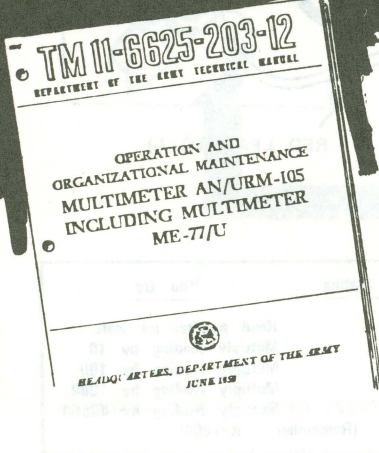


- Replace the cover. Make certain there're no leads crushed between the case and cover.



IT CAN DO MORE

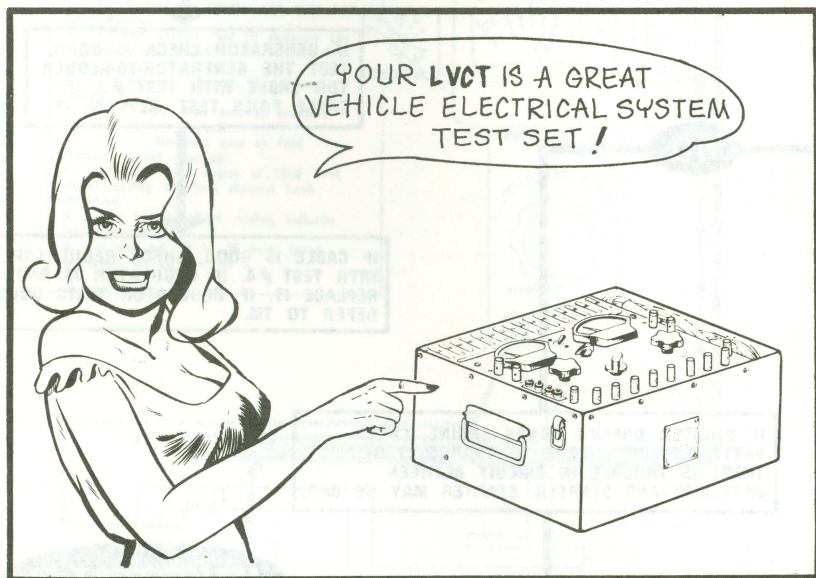
Your AN/URM-105 multimeter can do a lot more. Like reading DC voltages up to 50,000 volts and current measurements up to 100 amperes. But to do this you'll need auxiliary equipment. TM 11-6625-203-12 (Jun 59) gives the dope on all this.



ELECTRICAL SYSTEM TROUBLESHOOTING *

WITH YOUR

LOW VOLTAGE CIRCUIT TESTER



DOES STARTER CRANK THE ENGINE?

YES

TURN ALL SWITCHES AND ACCESSORIES OFF (ENGINE, TOO).
DISCONNECT BATTERY CABLE AT NEGATIVE POST. CHECK FOR ARC.

YES

IF ARC OCCURS, CHECK WIRING
AND ACCESSORIES FOR SHORT.

NO

IF NO ARC, RECONNECT CABLE; START
ENGINE. DOES BATTERY/GENERATOR INDICATOR
MOVE TO GREEN AT 1000 RPM?

YES

IF INDICATOR IS ON GREEN MARK,
GENERATOR AND REGULATOR CIRCUITS
ARE OK. CHECK BATTERIES WITH
TEST #1.

NO

IF INDICATOR DOESN'T MOVE TO GREEN,
CHECK GENERATOR WITH TEST #2. IF GENERATOR
FAILS CHECK, REPLACE IT.

IF GENERATOR CHECK IS GOOD,
TEST THE GENERATOR-TO-REGULA-
TOR CABLE WITH TEST #3. IF
CABLE FAILS TEST, REPLACE IT.

NO

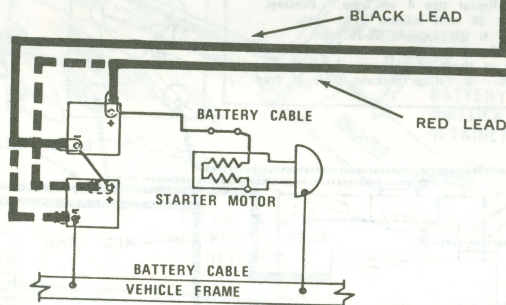
IF CABLE IS GOOD, CHECK REGULATOR
WITH TEST #4. IF REGULATOR IS BAD,
REPLACE IT. IF REGULATOR TESTS GOOD,
REFER TO TM.

IF STARTER DOESN'T CRANK ENGINE, CHECK
BATTERIES FOR CHARGE. IF CHARGE IS OK,
THERE IS TROUBLE IN CIRCUIT BETWEEN
BATTERIES AND STARTER. STARTER MAY BE BAD.

MAKE TEST #1

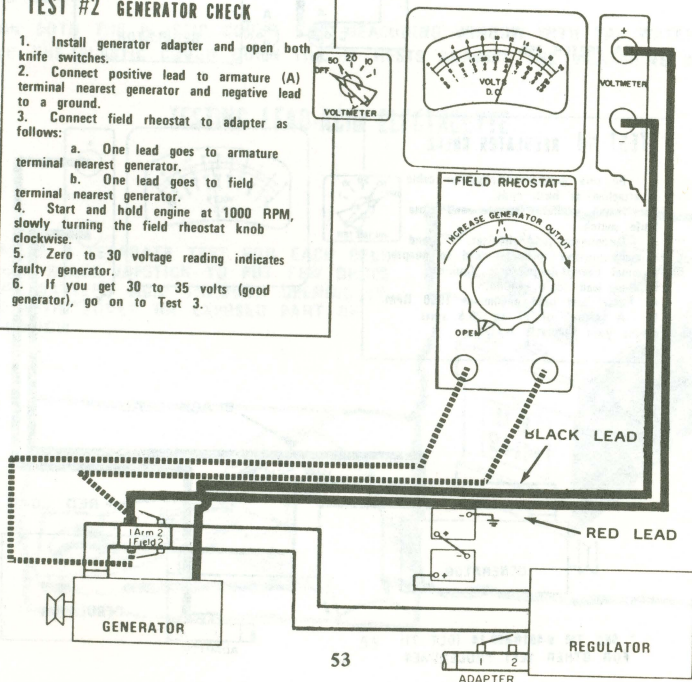
TEST #1 BATTERY CHECK

1. Take voltage reading of each battery. Add readings together for accurate total.
2. Connect voltmeter leads to LVCT positive and negative terminals. Attach + lead to - post.
3. Turn voltmeter selector switch to "20".
4. With ignition off (STOP handle out on multi-fuels), attempt to start engine. Voltmeter should read at least 9 volts per battery.
5. Repeat test on each battery in set.
6. If battery voltage is at least 9 volts per battery check battery cables and starter.

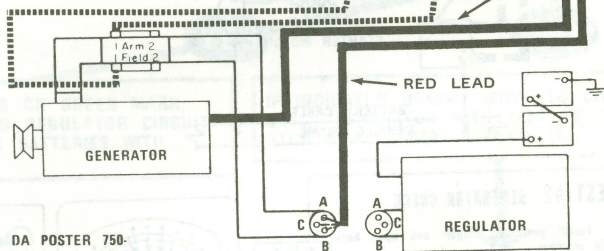


TEST #2 GENERATOR CHECK

1. Install generator adapter and open both knife switches.
2. Connect positive lead to armature (A) terminal nearest generator and negative lead to a ground.
3. Connect field rheostat to adapter as follows:
 - a. One lead goes to armature terminal nearest generator.
 - b. One lead goes to field terminal nearest generator.
4. Start and hold engine at 1000 RPM, slowly turning the field rheostat knob clockwise.
5. Zero to 30 voltage reading indicates faulty generator.
6. If you get 30 to 35 volts (good generator), go on to Test 3.

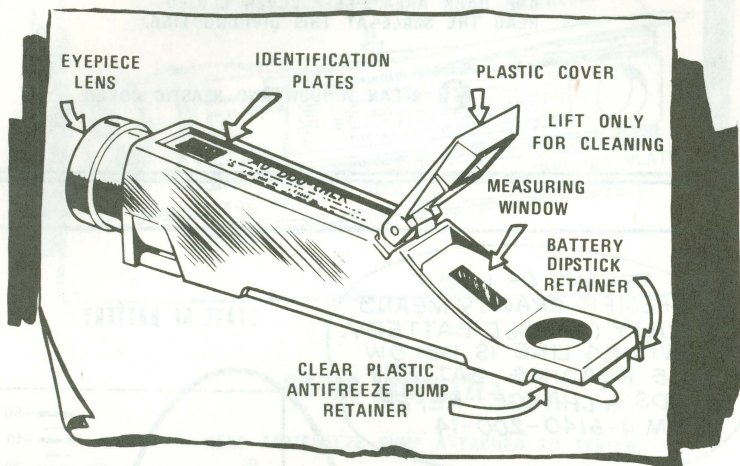


-
- The diagram shows a control panel with a voltmeter at the top, a field rheostat in the middle, and a black lead connection at the bottom. The voltmeter scale ranges from 0 to 16 volts. The field rheostat has a knob with an arrow pointing to 'INCREASE GENERATOR OUTPUT' and a label 'OPEN' with an arrow pointing to the left. A black lead is connected to the bottom terminal of the field rheostat.



-
- Diagram illustrating the voltage regulator circuit. The voltmeter scale ranges from 0 to 15V DC. The circuit includes a transformer with a primary connected to 115V AC and a secondary with terminals 1 and 2. The regulator is connected to the secondary terminals. A black lead connects the positive terminal of the voltmeter to the positive output of the regulator. A red lead connects the negative terminal of the voltmeter to the negative output of the regulator.

OPTICAL ANTIFREEZE / BATTERY TESTER

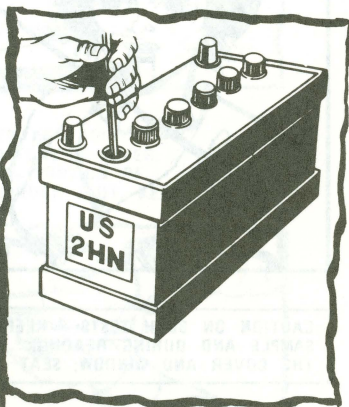
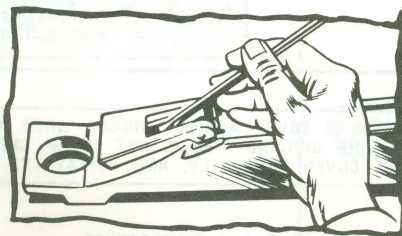


BEFORE USING . . .

1. CLEAN BOTH THE PLASTIC COVER AND MEASURING WINDOW WITH TAP WATER-THEN DRY.
2. SWING THE PLASTIC COVER DOWN TILL IT RESTS AGAINST THE MEASURING WINDOW.

TESTING LEAD-ACID ELECTROLYTE

- 1 MAKE A SEPARATE TEST FOR EACH CELL. USE BLACK DIPSTICK TO PUT FEW DROPS OF BATTERY ACID THROUGH OPENING IN PLASTIC COVER ON EXPOSED PART OF WINDOW.

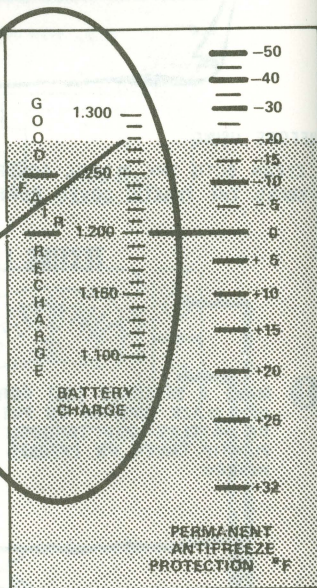


2 POINT THE TESTER TOWARD A BRIGHT LIGHT. LOOK THROUGH THE EYEPIECE AND READ THE SCALE ON THE LEFT SIDE. LIQUID SAMPLE WILL DIVIDE SCALE, SHOWING LIGHT AREA AND DARK AREA.* KEEP COVER CLOSED. READ THE SCALE AT THIS DIVIDING LINE.

3 CLEAN WINDOW AND PLASTIC COVER.

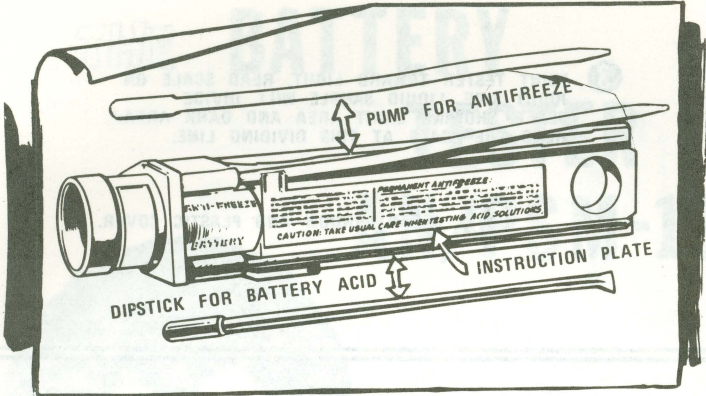
READING OF 1.280
SPECIFIC GRAVITY MEANS
A FULLY CHARGED BATTERY.
IF DIVIDING LINE IS BELOW
1.225 READING, BATTERY
NEEDS A CHARGE. REFER
TO TM 9-6140-200-14.

STATE OF BATTERY



CAUTION ON BOTH TESTS: KEEP PLASTIC COVER AGAINST WINDOW WHEN INSERTING SAMPLE AND DURING READING. IF THE DIVIDING LINE IS NOT SHARP, CLEAN THE COVER AND WINDOW; SEAT THE COVER CAREFULLY, AND REPEAT THE TEST.

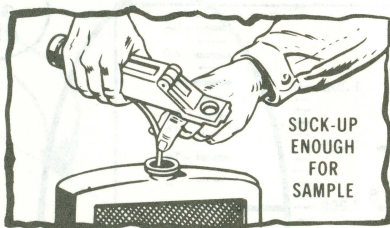
*YOU DON'T HAVE TO ADJUST FOR TEMPERATURE.



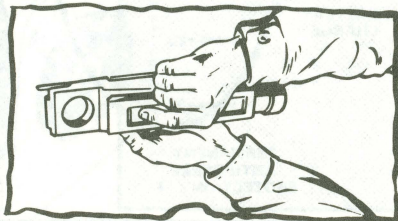
TESTING ANTIFREEZE

KEEP ANTIFREEZE PUMP ATTACHED TO TESTER.

- 1 RELEASE PUMP TIP FROM RETAINER CLIP. INSERT PUMP END AN INCH OR SO INTO LIQUID IN RADIATOR. SQUEEZE PUMP BULB TO DRAW UP SAMPLE.



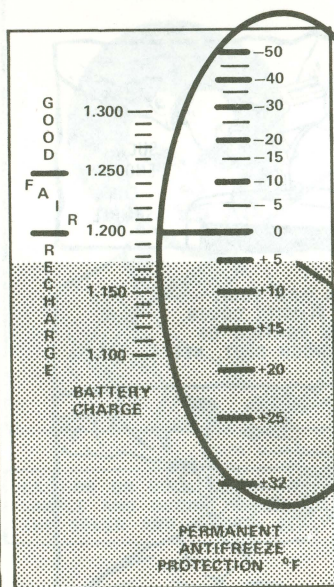
- 2 BEND PUMP TUBE AROUND TESTER AND POINT PUMP END THROUGH OPENING IN PLASTIC COVER. PUT A FEW DROPS OF SAMPLE ON PORTION OF MEASURING WINDOW EXPOSED THROUGH SLOT. KEEP COVER CLOSED.



- 3 POINT TESTER TOWARD LIGHT, READ SCALE ON RIGHT SIDE. LIQUID SAMPLE WILL DIVIDE SCALE, SHOWING LIGHT AREA AND DARK AREA.* READ THE SCALE AT THIS DIVIDING LINE.

- 4 CLEAN WINDOW AND PLASTIC COVER.

ANTIFREEZE PROTECTION



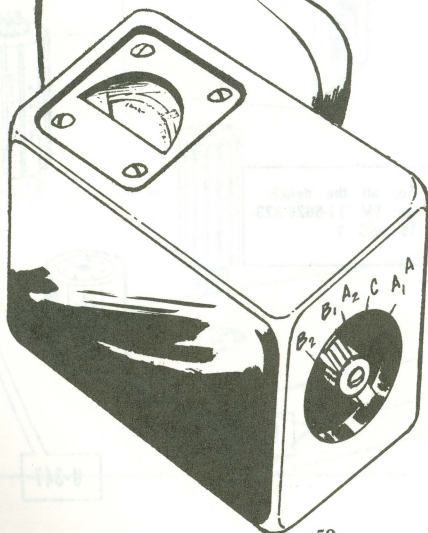
DIVIDING LINE SHOWS YOUR COOLING SYSTEM IS PROTECTED TO +5 DEGREES F. FOR PROPER PROTECTION. SEE TB 750-651, AND, DON'T LET THE SCALE FOOL YOU. IT'S DIFFERENT FROM A THERMOMETER, SO GO BY THE PLUS AND MINUS SIGNS.



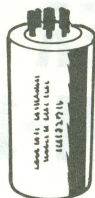
THE BATTERY TESTER AN/PSM-13



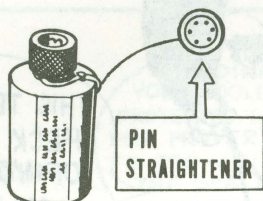
THIS TESTER IS USED TO
CHECK THE CONDITION
OF YOUR RADIO DRY
CELL BATTERIES.



SIX ADAPTERS COME WITH EACH TESTER—
EACH ONE FOR A SPECIFIC BATTERY.



U-240



PIN
STRAIGHTENER

U-241



U-297



U-314

For all the details
see TM 11-6625-823-
15 w/C 1.



U-315

U-347

HERE'S HOW IT'S DONE. . .

1

Select correct adapter for your battery.

2

Connect adapter to tester.

3

Connect adapter/tester to battery.

4

Set tester switch for your battery, according to chart on next page.

5

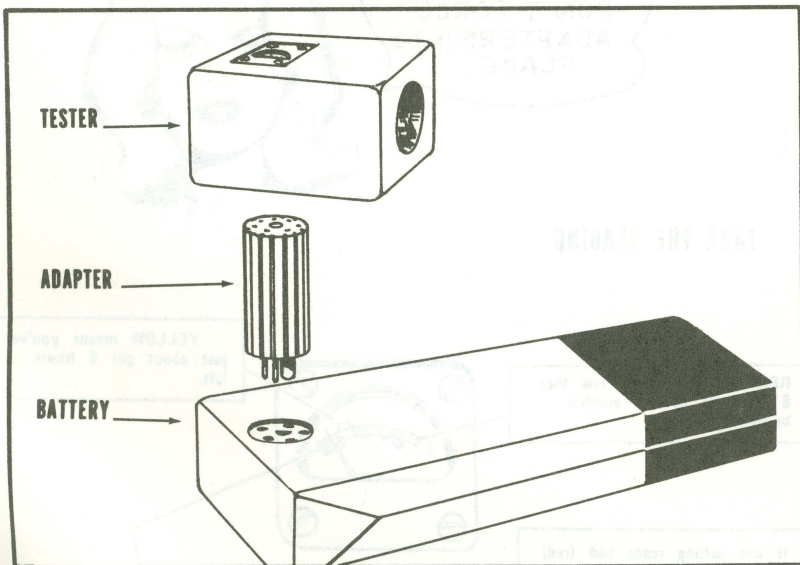
Wait 15 seconds after setting switch. . . and read meter. Allow 15 seconds after each setting.



TESTER

ADAPTER

BATTERY



By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:

VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution: Active Army, NG & USAR: TOE 6-365 (10); TOE 7-45 (10); TOE 17-35 (10).

GO!...OR NO-GO



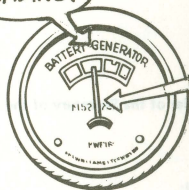
Your Battery-Generator Indicator lets you know!

HERE'S
HOW
YOU
TEST
IT!

1st TEST

IGNITION ON,
ENGINE OFF.
ALL ELECTRICAL
UNITS OFF...

NORMAL
READING.

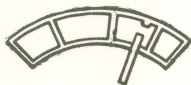
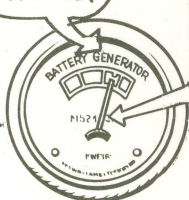


NEEDLE SHOULD
REST HERE

2nd TEST

ENGINE RUNNING
SMOOTHLY AT HIGH
IDLE AND WARM; ALL
ELECTRICAL UNITS ON..

NORMAL
READING.



NEEDLE SHOULD
REST HERE...

NEEDLE IN ANY OTHER
AREA MEANS NO-GO
UNTIL A MECHANIC CHECKS OUT
BATTERY AND CHARGING SYSTEM

