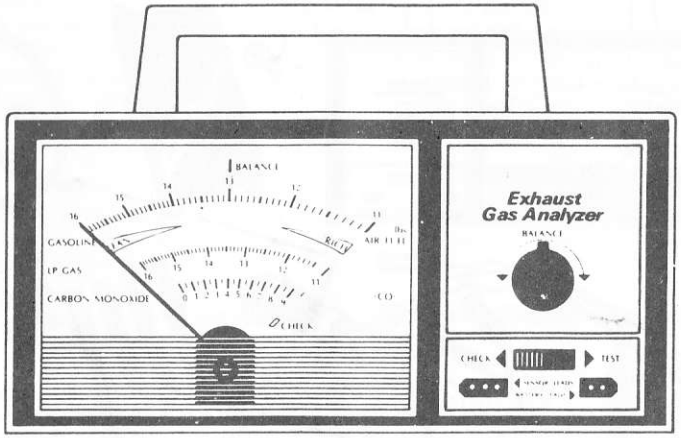
Hawk

OPERATING MANUAL

FOR

MODEL 766
FOR EXHAUST
GAS ANALYZER



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PURPOSE:

This instruction manual provides the necessary information for accurate and intelligent use of an exhaust gas analyzer. The equipment is used to provide a quick method of checking air/fuel ratio, Carbon Monoxide (CO%), and carburetor operation on internal combustion engines using gasoline or LP (liquefied petroleum) fuel.

EQUIPMENT FURNISHED WITH THIS INSTRUCTION MANUAL:

The 766 Exhaust Gas Analyzer (1) with the following accessories: see figure 1.

1 Exhaust Pickup (2)
1 Flexible Hose (3)
1 Exhaust Pickup Tube (4)
1 Cable Assembly (5)
4 Mounting Springs (6)
1 Power Cord (7)

INTRODUCTION:

The tests are accomplished by taking a sample of exhaust gas and measuring it by the use of a thermal conductivity cell.

This analyzer is powered by the vehicle power supply, either 6 or 12 volt. It can be operated by a separate 6 or 12 volt battery or a DC power supply.

The analyzer is fully transistorized, completely portable and can be operated while the vehicle is being driven. It has a fast, safe electrical pickup at the tailpipe so there is no exhaust gas in the car while road testing.

For motor vehicle pollution control standards, refer to applicable State of Federal specifications.

LIMITATIONS AND CLARIFICATIONS:

Lean air/fuel ratios greater than 15 to 1 on the gasoline scale have high Carbon Dioxide content and little or no Hydrogen content in the exhaust gases. This type of mixture reduces the thermal conductivity in the gas cell and the analyzer has a tendency to return toward the rich zone. If an extremely lean mixture is suspected, choking the engine slightly will return the meter to the rich reading with little change in engine rpm. If rpm increases, the mixture is too lean. Within the practical working range of Air/Fuel ratios, 11:1 to 16:1, the Exhaust Gas Analyzer will give very accurate results as each instrument is individually calibrated.

For any engine the readings at 2500 rpm should always be as low or lower than readings at idle.

766 will not function properly on engines with catalytic converters. Catalytic converter must be bypassed or disconnected for exhaust tests.

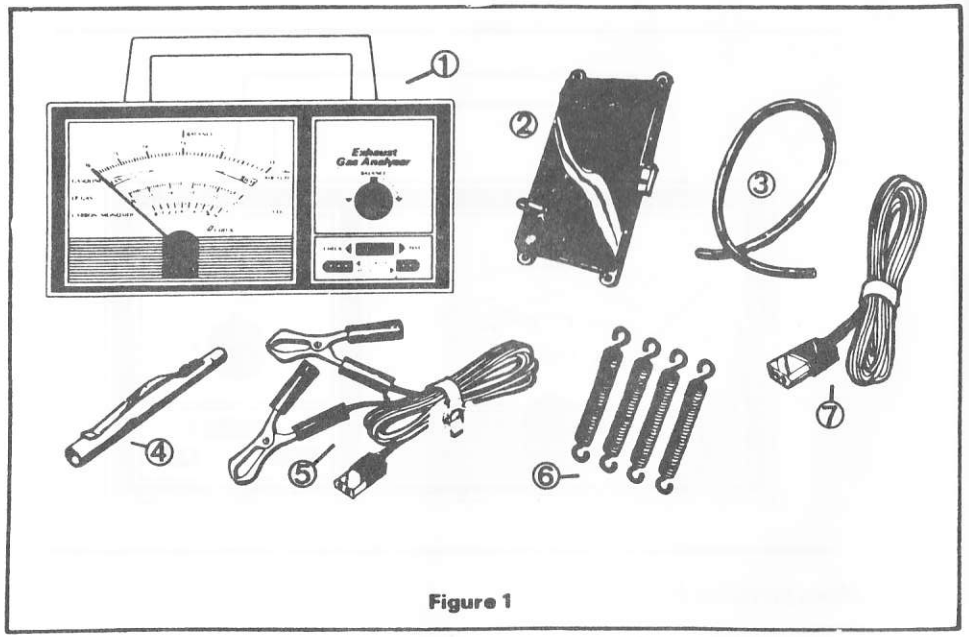

Figure 1

STANDARDS
(Federal Government)

1971 Models — 1.5%
1975 Models — 0.5% CO
1980 Models — 0.25% CO

1972 and later standards will be given in grams per mile but this will be converted mathematically in CO%, and percent will be used in field service by manufacturers' service personnel.

Small 4 cycle engines, 13.4 - 14.0% CO. Diesel and two cycle engines, refer to manufacturer's CO% specifications.

When testing engines using butane or propane gases, the analyzer will read air/fuel ratios on the second scale from the top and CO% on bottom scale.

Air/Fuel Ratios for LP Gas Usually Are:

At engine idle	Butane	Propane
At 800 RPM to 1200 RPM	12.8 - 14.4	14.0 - 14.9
At 1500 RPM to 1800 RPM	13.35 - 14.0	13.6 - 14.35
At 2000 RPM to 2200 RPM	14.2 - 15.4	14.5 - 16.0

LP Gas will emit up to 15 times less carbon monoxide than a comparable gasoline powered engine. With engine at 2500 RPM, read CO% indicated on the bottom scale.

Let engine idle and read CO% indicated on the bottom scale. CO% idle should be no more than 5% and the readings at 2500 RPM should be lower than the reading at idle.

IMPORTANT

The booklet is divided into sections as shown in the Table of Contents, which will allow you to stop and start again as you wish.

Read and perform steps *one at a time*.

The steps are arranged in lettered and numbered sequence. This sequence is logical and efficient.

When directed to a specific step or page, be sure to read information (especially CAUTION notes and WARNINGS) preceding each step.

Where there is the possibility of personal injury or damage to equipment, a clear indication of this appears; WARNING if there is a possibility of personal injury, or CAUTION if there is a possibility of equipment damage.

The exhaust analyzer is a precision instrument and, like any precision instrument, must receive proper care and usage if long life and accuracy are to be obtained.

Do not use the exhaust analyzer on an engine while gum, solvents or oils are being introduced into the engine through the carburetor.

Do not use the exhaust analyzer on the engine that consumes excessive amounts of oil. The oil smoke will eventually affect the sensitivity of the pickup unit.

Do not disconnect exhaust pick-up lead from the Analyzer during testing. Disconnect battery leads first.

CAUTION: Engine gas analysis should only be performed in a well ventilated area.

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METER ZERO ADJUSTMENT

It may occasionally be necessary to adjust the meter pointer on scale (1). This adjustment is made as follows.

A. Hold analyzer upright or place on a level horizontal surface.

B. With leads disconnected, adjust meter zero adjustment screw (3) to left or right until pointer (2) is on 16. (See Figure 2.)

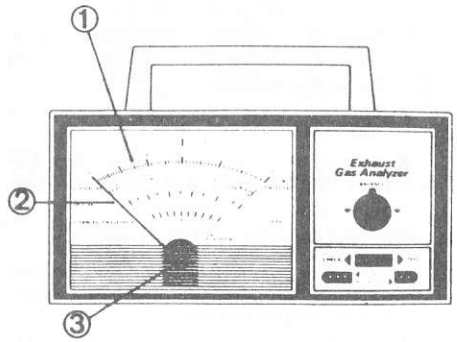

Figure 2

TEST PREPARATION

I. Pre-Test Checks — Vehicle

It is important that the following be checked carefully on the vehicle to insure accurate test results. Correct anything that is found to be defective:

A Fuel System:

1. Fuel tank
   (a) Check for clogged vent.
   (b) Tank must contain ¼ capacity or more for reliable test.
2. Fuel lines — check for kinks, pressure or suction leaks, poor connections and damaged lines.
3. Fuel pump — check for leaks, dirty filter, poor connections, loose bolts and capacity (volume).

B Air Cleaner — check for clogged or dirty condition.

C Carburetor — check for loose bolts, vacuum leaks, fuel leaks, bad linkage, and worn shafts. Check choke to make sure it is not binding or sticking and is properly adjusted.

D Intake Manifold — check for vacuum leaks, bad fittings or hoses, leaks in manifold gaskets and loose bolts.

E Heat Riser Valve — check to make sure heat riser valve is free and spring is not broken.

F Exhaust System — check for:

1. Holes in exhaust pipe.
2. Holes in muffler.
3. Holes in tailpipe.
4. Loose connections.

G Closed Crankcase Ventilation — Check to make sure vehicle is operating per manufacturer's specifications.

H Exhaust Emission Control System — vehicles equipped with pump type exhaust emission control systems must be disconnected to check air/fuel ratio.

I Tune Up — Valid exhaust readings analysis can only be obtained from properly tuned engines.

J Chrysler "CAP" (Clean Air Package) — see Test I-A.

K Engine must be at operating temperature with parking brake set and transmission in "neutral."

II. Pre-Test Checks — Gas Analyzer

All above vehicle Pre-Test Checks must be "performed" prior to conducting an exhaust gas test on the vehicle.

A Connect cable (2) to exhaust pickup (1) and the analyzer (3) as shown in Figure 3

B Attach exhaust pickup (1) to rear bumper of vehicle, using 4 springs provided.

NOTE: DO NOT insert exhaust pickup tube into tailpipe until instructed to do so.

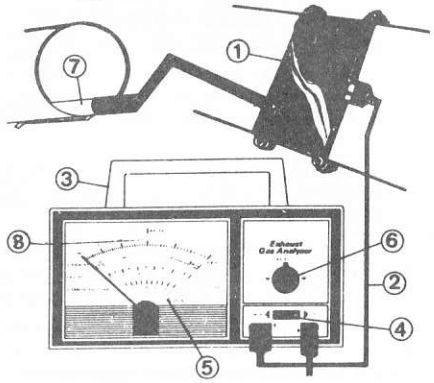

Figure 3

C Connect battery lead to car battery (6 or 12 volt) or any other 6 or 12 volt power source.

1. Red clip to positive (+)
2. Black clip to negative (-)

D Permit analyzer to warm up for one minute.

E Switch (4) to Check on analyzer. Pointer must read in green Check area (5) on right side of meter scale. Return switch to test position.

F **Adjust Balance knob (6) until pointer is in the "Balance" position (8).**

G Insert exhaust pickup tube (7) into tail pipe *AFTER* engine is at operating temperature.

H If vehicle has a dual exhaust, use the tail pipe without a heat riser valve.

Instrument is now ready for performing test.

TEST I — CARBURETOR IDLING TEST (All cars without Chrysler "CAP.")

I. Adjust throttle to idle in accordance with manufacturer's specifications (usually 400-700 rpm).

A. Analyzer should read between 11.5 - 13.2 with a steady pointer. (See Figure 4 "a") High compression engines usually use a richer fuel mixture, while low compression engines, conversely, usually use a leaner mixture.

B. If the reading is too high or too low, adjust idle mixture screws to determine if a minor adjustment will correct readings.

NOTE: Carburetor needs repair if idle screw must be turned beyond manufacturer's specification. (Usually ¼ to 2½ turns open to obtain above reading.)

NOTE: For cars with smog devices, check manufacturer's specifications for special instructions.

C. Check tachometer while making adjustments to obtain even reading.

D. Recheck Analyzer and Tachometer readings to secure air/fuel ratio of 11.5 to 13.2 at manufacturer's recommended idle speed.

E. If correct readings cannot be obtained keeping idle adjustment screw(s) within manufacturer's specifications, carburetor needs repair.

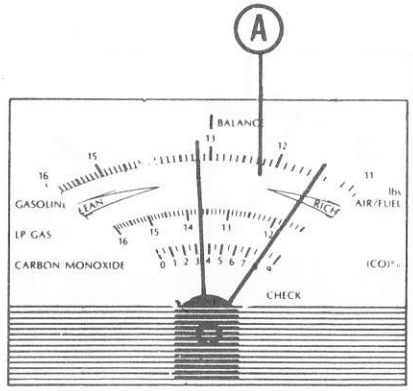

Figure 4

TEST 1-A — CARBURETOR IDLING TEST (Cars with Chrysler "CAP" — Clean Air Package)

II. Carburetor adjustment on these cars should always be done with the gas analyzer and a tachometer hooked up. It is very important to set timing according to manufacturer's specifications. The vehicle's engine MUST be at operating temperature.

A. Connect tachometer.

B. Connect gas analyzer as shown in Figure 3.

C. On six-cylinder engines only, turn headlights on high beam.

D. On cars with air conditioners, be sure air conditioner is turned off.

E. Place clamp on hose between distributor vacuum control valve and intake manifold.

F. Adjust idle speed to manufacturer's specification.

READING:

1. Turn idle mixture screw out until reading of 12.4 - 12.7 is reached.

   NOTE: Turn each screw at 1/16 of a turn out, allow 10-15 seconds to give the engine and gas analyzer time to stabilize. (See Figure 5 "a")

2. Turn idle mixture screw in until gas analyzer reads 14.2. **(See Figure 5 "B")**

   NOTE: Turn each screw at 1/16 of a turn in, allow 10-15 seconds to give the engine and gas analyzer time to stabilize.

CAUTION: During the above adjustment procedure, the engine must maintain the correct idle speed or readjustment must be made. If the idle is rough, the screws may be adjusted independently to obtain a smooth idle. However, the air/fuel ratio must be held at 14.2.

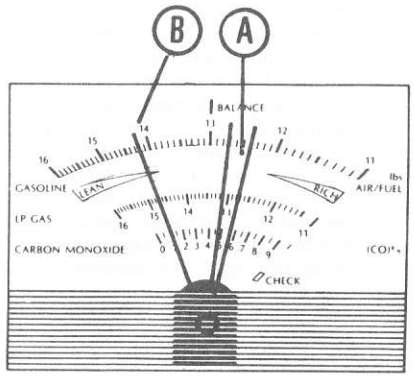

Figure 5

TEST II — HIGH SPEED TEST FOR ALL CARS

I. The high speed test, without load, can be accomplished with the vehicle stationary. But a high speed test, with load, to check power system operation must be done on a dynamometer or by road test.

A. Adjust engine speed to 1800 to 2400 rpm.

READING:

1. The instrument should read between 12.5 - 14.7 with steady pointer. (See Figure 6 "a"). (High compression engines will usually read in the high area and low compression engines in the low area.)
2. If reading is too low (mixture rich), remove air cleaner.

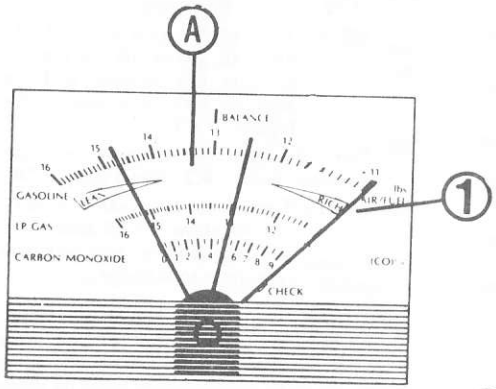

Figure 6

If this corrects the reading, air cleaner is restricted and requires cleaning or replacement. If the reading is still low, the carburetor needs repair or adjustment.

3. If the reading is 14.7 or higher, it may be a "reverse reading" which is characteristic of most gas analyzers. To check for a "reverse reading," remove the air cleaner and cover the carburetor air horn to make the mixture rich and force the instrument to read rich (1) (low). Then uncover the air horn and watch the reading. If it comes back to 15.0 or higher you have not experienced a "reverse reading." The carburetor is too lean and needs repair.

CAUTION: Do not let the engine run with too lean a high speed or road load mixture as indicated by a reading of 15.3 or more. Engine damage may result, as a lean mixture causes excessive combustion temperatures.

II. For the Road Test and Dynamometer Test, the reading on a cruise (light load) road test or on a dynamometer will usually be at least a couple of increments leaner than on a stationary test.

The proper air/fuel ratio LOAD test on passenger cars is best determined by consulting specific manufacturer's specifications.

TEST III — ACCELERATOR PUMP TEST

A. Adjust speed to 1000 rpm and allow the meter reading to stabilize.

B. Open throttle quickly and close it instantly.

READING:

1. Pointer steady between 13.0 - 14.4 approx. (See Figure 7 "a")
2. Pointer should swing to the rich (low) reading and come back to the original reading.

NOTE: If the above does not occur, the accelerator pump circuit or the power circuit is not working properly and the carburetor needs repair or adjustment.

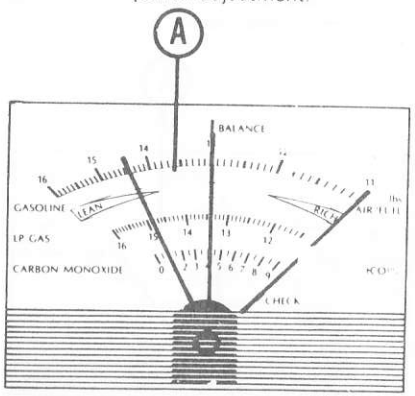

Figure 7

TEST IV — CARBON MONOXIDE TEST

A. Set up and connect tester and tachometer. Let engine idle. Record CO% from the bottom scale (1) (See Figure 7).

B. Hold engine at 2500 RPM. Record CO% from bottom scale. Compare the reading by using the following as a guide:

1. For non-emission controlled engines CO% at Idle RPM should be no more than 6%.
2. For emission controlled engines CO% at Idle RPM should be no more than 3%.

AFTER COMPLETION OF TESTS

A. Readjust engine speed to the manufacturer's specified idle rpm and turn ignition off.

B. Remove exhaust pickup tube from tailpipe and disconnect hose from exhaust pickup and pickup tube. Drain water from pickup and hose.

C. Turn pickup on its side to drain any water that may have condensed in the gas cell.

D. Store analyzer in a dry place.