TECHNICAL DEMONSTRATION 3.

DIAGNOSTICS IN A WORKSHOP

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SYNOPSIS

This paper gives a brief overview of basic Workshop diagnostic practices then proceeds to outline some of the more specialised diagnostic equipment. It is hoped that each reader will find something of benefit to his current operations. Part One considers the impact of:-

a) "Tapping" the vehicle operator for information and testing to confirm suspicions before dismantling

b) Being prepared to diagnose by keeping effective historical records

c) Consulting the Service Manual when necessary

d) Knowing when to "back off" to reduce overall costs of diagnosis.

Part Two lists and explains some specialised equipment such as:-

a) Chassis Dynamometer

b) Fibre Optic Borescope

c) EMPA Oil Analysis

d) Electronic Compression Tester etc etc etc

For the small and medium sized operations it is crucial to make the most of simple diagnostic techniques but also to know when specialised help should be sought.

1.0 INTRODUCTION

Every repair job requires diagnosing. The technical difficulty of diagnosing mechanical problems ranges from the 'exceedingly simple' to the 'seemingly impossible'. Diagnostics requires patience, restraint, and objectivity; qualities which are not always easy to apply in difficult situations.

This paper defines a problem to be the cause of a difference between past and present performance of a machine. That difference in performance is the symptom. Take for example a truck with a flat tyre. The symptom of the problem can be seen, the tyre is now flat where before it was inflated. The problem might be that the tyre is punctured, in which case it is no use inflating the tyre until the puncture is repaired. Treating symptoms never cures problems.

This paper will deal predominantly with diagnostics as applied to Heavy Vehicle engines because this area often provides technically demanding problems.

Part one looks at the person doing the diagnosis and considers what can be done without the need for very expensive diagnostic equipment.

Part two introduces some of the expensive diagnostic equipment which is available to resort to should all else fail. Included in this section will be chassis dynamometer, fibre optic bore scopes, microscopes, flourescent tracer dyes, etc., etc.

2.0 PART ONE - THE MECHANIC

By far the most powerful diagnostic tool available is the human brain - learn to use it. Much of the initial stages of any diagnosis requires reason and research. In this section we will consider:

a) Operator

b) Records

c) Manuals

d) Priorities

2.1 OPERATOR

Ask the operator to describe the problem in terms that mean something. If the symptom is low oil pressure, ask 'how high was it?' and 'how low is it?'. Ask questions which may be related directly to the problem but also ask as many other questions about the vehicle's performance as there is time for. The reason for such an interrogation is that the oil pressure may have dropped from 70 psi to 50 psi. If 50 psi is still within specification then the mechanic may not continue to look for the problem unless he knows that it was 70 psi previously. Remember to ask the operator:

WHAT happened?

WHEN it happened?

WHERE it happened?

HOW it happened?

Take into account any other background information then diagnose:

WHY it happened?

Suspected causes should always be confirmed by testing before any engine is dismantled. Unnecessary 'strips' waste money!

2.2 RECORDS

It is sound practice to keep records of as much maintenance information relating to a vehicle as possible. Most helpful for diagnosing are fuel and oil consumption histories and records of component changes. Component changes may include, speedo or hubodometers, alternators, compressors, thermostats, etc. When problems arise , accurate records will point the diagnosing mechanic in the right direction.

2.3 SERVICE MANUALS

You must have service manuals for the engines you own!. Don't be afraid to consult the service manual when an engine problem is not immediately obvious. Take time to sit down and become familiar with the book so that when the pressure is on you know where to find the appropriate information quickly. Treat the manual as another tool of the trade, a tool that can save you money.

2.4 PRIORITIES

During steps 2.1, 2.2 and 2.3 always keep your priorities to the fore. Diagnostic priorities usually include speed, accuracy and cost, therefore, the simplest possible causes should always be investigated first. The overall cost is often a product of both speed and accuracy of diagnosis, however, it is important never to compromise accuracy for the sake of speed. An incorrect diagnosis is worthless, (except that it eliminates one possible cause of the fault). With large amounts of money tied up in heavy machinery it is very important to know when to stop and seek advice. Never risk doing more harm than good by getting far more involved than is necessary. There are limits beyond which specialised diagnostic equipment and personnel have their place.

3.0 PART TWO - SPECIALISED EQUIPMENT

3.1 THE 80/20 RULE

It is probably fair to say that 80% of all diagnostic work can be done with 20% of the diagnostic equipment on the market today. However, at times we will need access to some of the more elaborate 'tools' available.

3.2 CHASSIS DYNAMOMETER

A chassis dyno allows a truck to run under full load conditions while sitting stationary on a set of rollers in the workshop. Resistance loading of the rollers is normally achieved by means of water turbines or electrical retarders. Either way a measure is made of the torque produced at the vehicle's wheels and this is combined with the indicated road speed to give a power reading. While the truck is running many other measurements may be taken and for that reason a Dyno bay is the ideal centre for all of your diagnostic work. An interesting technique which may be used when diagnosing low power problems shows:

i) power at the wheels

ii) power at the engine flywheel

iii) power loss through drive-train components

This 'Power Prover' technique was developed by Clayton Dynamometer manufacturers in the 1960's and still holds true today.

3.3 FIBRE OPTICS

The Industrial Borescope produced by Olympus is a strengthened version of that used by the medical profession. Basically, the borescope allows us to look inside any cavity which has an entrance hole diameter greater than 9mm. Industrial borescopes are used extensively by the aircraft industry, among other things, for periodic visual checks inside jet engines. There are two internal components in the scope tube:

a) optical fibres to carry light inside the cavity and

b) a set of lenses to give the observer a view inside the cavity.

Visual inspection may confirm or allay suspicions of possible problems and reduce the likelihood of removing major engine components in error.

3.4 CONDITION MONITORING

Condition monitoring involves graphs of fuel consumption, oil consumption and oil contaminants. Increasing trends in any of these areas are considered to be symptoms of problems. Early warnings such as these are more beneficial than the obvious symptoms which appear upon component failures because they give time to take action to prevent or postpone the failures. At the least these symptoms allow for minimum vehicle downtime if the failure is foreseen and prepared for (buy parts etc.). Monitoring contaminants is by far the most intricate and versatile of the three tools mentioned. Symptoms include:

water in the lubricant, dirt in the lubricant, overheated lubricant and diluted lubricant.

Investigating these symptoms leads to the early detection and remedy of engine problems.

3.5 WATER TEST STRIPS

These are 250mm x 10mm strips of specially coated paper which will dissolve if water is present, (in oil for example)

3.6 TRACER DYES

Flourescent dyes are useful for tracing the source of leaks, (water or oil). For example if oil appears in coolant water which is used to cool an engine and a transmission.

3.7 ELECTRONIC COMPRESSION TESTER

This machine is connected into a vehicles starting circuit and basically measures the variation in current draw as the engine is cranked over by the starter motor. A low compression cylinder may be pin-pointed by holding No.1 cylinder valves open throughout the test.

3.8 OTHERS

Smoke meter - a measure of incomplete combustion.

Thermidex strips - adhesive labels which indicate the hottest temperature reached by the surface to which they are attached.

Stethoscope - for pin-pointing noise sources.

Titration equipment - for testing coolant additive concentrations - (like chlorine concentration in a swimming pool).

Drop Ball Tester - to determine dilution of oil.

DZL Fuel Consumption Monitor - gives fuel consumption in any units required (lbs/hr, MPG etc) and may determine the effect of radial tyres versus crossply tyres, manual versus automatic transmission etc. also this may verify the manufacturer's fuel efficiency figures in lbs/hp hr.

Vibration Analyser - for vibration related problems.

Miscroscope - This is useful for examining debris from oil filter elements and magnetic diff plugs.

Hardness Tester - mainly used to check crankshaft journal hardness.

Crack Tester - under diagnostics this is not strictly a tool because cracked components don't usually cause trouble until they break. However if water is finding its way into oil then eventually it may be necessary to check for cracks say in the head of an engine in an attempt to diagnose the cause of the leak.

Accurate Tachometer - essential support equipment.

Tunescope - for test, accurate tuning of spark ignition engines, and accuracy tuning.

Exhaust Gas Analyser - for tuning power and economy into spark ignition engines.

Pressure gauges and manometers -

Temperature gauges -