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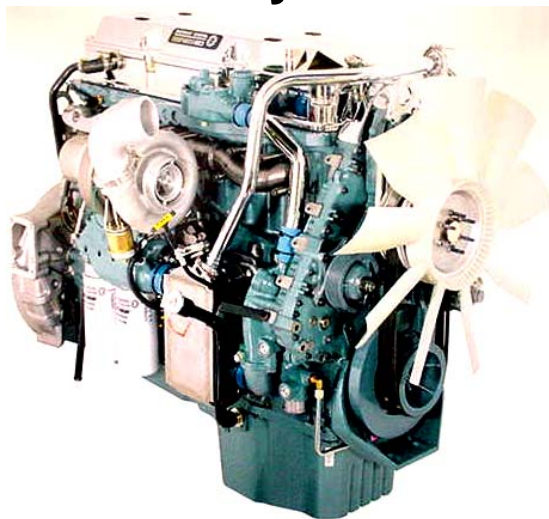
DaimlerChrysler Powersystems

DETROIT DIESEL

A DaimlerChrysler Company



Series 60 Cylinder Kits



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Detroit Diesel has established an initiative to review warranty concerns at the distributor and dealership level in order to provide a better product to the customer and to control costs. This is being done because business conditions have changed.

In 1997, the Environmental Protection Agency forced a Consent Decree with the major North American Heavy Duty diesel manufacturers as a result of a change in the way they enforce the emissions regulations on these companies. With this change, the manufacturers introduced new technology for the 1998 model year. These releases were done with limited time for validation because the EPA shortened the implementation horizon.

The products in 1998 caused a number of warranty issues.

In the year 2000, the truck market collapsed and manufacturers were producing approximately half the volume they had produced in earlier years. Coming with that was a reduction in sales at dealerships. This change in the business structure resulted in repairing outlets examining the way they do business and concentrating more on warranty work. With this concentration, there was a move to volume increases in order to ensure employment and continue a revenue stream to compensate for lost revenue from lost truck sales.

At the same time warranty activity was increasing in the field, the manufacturers were reducing headcount which could examine failed material. This left the horizon open for questionable activity with minimal failure analysis and review.

Upon examination of the situation, Detroit Diesel determined that material analysis is a significant point of control as well as development of expertise at the repairing outlets. At the same time, items which are not warranty can only be controlled through material analysis. For this reason, there has been a change in the way Detroit Diesel looks at warranty to ensure proper diagnosis and repair as well as to control costs.

A number of issues have had significant concern as a result of this; we want to make sure everyone understands those items which will be covered by warranty and those items which are customer responsibility. We have a specific approach to these.

CYLINDER KITS

A number of questions have come up regarding cylinder kits conditions. The biggest issue has to do with a determination of what is normal wear and tear.

The Series 60 engine will provide long life for a customer if oil, coolant, and duty cycle are maintained properly. Obviously higher horsepower and higher duty cycle tends to increase all engine wear factors.

Gross vehicle weights greater than 80,000 pounds
Average miles per hour greater than 55 mph
Average load factor greater than 54%

As any or all of these factors increase, the amount of total fuel associated with engine life to overhaul will decrease. Guidelines for this type of engine life measurement, based on total fuel consumption, would be 75,000 gallons for applications operating above these factors and 125,000 gallons for applications operating below these factors. This information can be read from DDEC provided the ECM has never been changed, or it can be calculated from current trip data if the ECM is not the original.

There is an effect on engine life from a number of operational conditions. Increasing fuel use – load factor, increasing vehicle weight and increasing road speed all have an effect of reducing engine life to wearout. Even keeping these conditions to a minimum, eventually the engine will require an overhaul.

The following guidelines can be used in dealing with customer concerns about wearout and guidelines for determining if an overhaul is required.

SERIES 60 ENGINE WEAROUT AND OVERHAUL

Provided is a list of nine criteria that bear heavily on whether or not an overhaul is recommended, and other information to assist in the determination of engine life with respect to wear. An overhaul is recommended only if **at least six** of the following criteria are met:

- Blue smoke that continues at idle or under load for several days.
- White smoke, a thick white plume that continues for more than 60 seconds after engine start-up under ambient weather conditions between 20° F and 40° F.
- Low power on a dynamometer, less than 70% of the rated horsepower after allowing for driveline losses.
- Poor fuel economy, 20% worse than the fleet average.
- Hard starting in combination with excessive white smoke after starting.
- Low compression in the cylinders with readings below 350 PSI.
- High crankcase blowby above five inches of water column pressure measured at the dipstick tube.
- High oil consumption below 300 miles per quart.
- High wear metals in the oil analysis above engine trend line.

CUSTOMER ASSESSMENT AND INITIAL WEAROUT CHECKLIST

1. First and foremost, treat the customer with the utmost respect. Be prepared to compare the customer's expectations to the facts associated with wear.

2. Assess the symptoms and determine the nature.
3. Offer to check power as a means to determine overall engine condition.
4. Check for condition of turbocharger and air compressor.
5. Print out DDEC total fuel, average speed, and average load.
6. Record mileage.
7. Check for overhaul criteria.
8. If the assessment determines conditions are within specifications, advise the customer an overhaul is not required and the unit may be returned to service.

CRANKCASE PRESSURE GUIDELINES

1. Crankcase pressure: Full load, maximum KPa (in. H₂O) operating limits @ Rated speed = 1.25 KPa (5.0 inches H₂O column).

Note: New engines from DDC production line would typically represent a reading of (1.6 to 2 inches H₂O column).

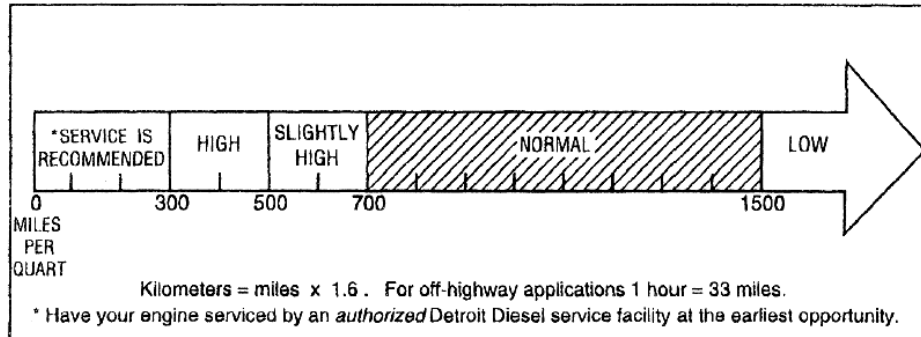
2. Detroit Diesel has been receiving inquiries about the condition of Series 60 engines that exhibit crankcase pressure beyond the limits specified in the Series 60 Service Manual, publication 6SE483 when examined at time of vehicle trade. In some cases customers are concerned there is no clear description of what conditions to expect and in the extreme case, an overhaul is done based on high crankcase pressure measurement when a simpler repair may have remedied the condition and saved the customer a large sum of money.
3. When a Series 60 engine has high crankcase pressure, but yet the engine pulls good power, the high crankcase pressure could be telling us any one of the following potential conditions exist in the engine:
 - Breather obstruction
 - Worn or damaged air compressor
 - Worn turbocharger seals
 - Worn or broken compression rings
 - Worn or broken oil control rings
 - Worn valve guides

Note: On engines built with the dipstick located in the bottom of the oil pan. Do not use the dipstick to measure crankcase pressure.

OIL CONSUMPTION GUIDELINES

Refer to Operator's Guide, Page 31, P/N 6SE484 - date 0106

All diesel engines are designed to use some oil, so the periodic addition of oil is normal. See Figure 12 below, "Engine Oil Consumption Guidelines", to determine the degree of oil usage.



Items to check:

- Mis-calibrated dipstick
- External oil leaks
- Air compressor leak
- Turbocharger leak
- Valve guide seals

Item to be completed by Owner:

- Fully completed "Oil Consumption Sheet"

HEAVY FUMES/VAPOR FROM CRANKCASE BREATHER

Questions to ask customer:

1. What brand name of oil are they using?
2. What is oil change interval?

It may be necessary for customer to change oil brand and oil change interval and recheck for reoccurring problem:

Note: refer to pages 9-11 in the DDC Lubricating Oil, Fuel & Filters booklet for recommended:

- Brand Name Approved Lubricants
- Oil Change Intervals

Also, refer to page 26 "Statement of Detroit Diesel Corporation Warranty"

SERIES 60 CYLINDER LINER WEAR

Cylinder scuffing is a transfer of metal from piston to liner I.D. If this occurs during the engine warranty, it is generally a covered repair. Repair expense for normal cylinder liner wearout is not covered under P-3.

From the Detroit Diesel Series 60 "P3" Power Protection Plan Agreement under C. COVERAGE LIMITATIONS, item #10 reads as follows:

Cylinder liner, piston and piston ring failures attributable to wear-out are specifically excluded from this agreement. The wear rate of parts in any engine, and especially those parts within the combustion area, will vary depending on operating conditions and operating environment. Conditions such as load, trailer configuration, road speed and road conditions, as well as the quality of air, fuel, lube oil and lube oil filters bear a direct relationship to the wear rate and resulting life of parts. Depending upon the severity of these various conditions, parts wear and resulting failure could occur within the limitations of this coverage.

DEFINITION OF COMMON TERMS USED TO DESCRIBE CYLINDER KITS IN FAILURE ANALYSIS

Plume Wear – Normal wear near the top of the liner and due to the combustion process. (These wear points are directly proportional to load factors and operating conditions.) This condition is normal wear and tear and is not mission disabling and therefore is not covered in the extended service coverage period.

Carbon Raking – Visual vertical lines seen on the liner wall without change to the liner wall surface. This is a normal condition caused by carbon being raked down the liner.

Scoring – Scratches in the surface of the liner aligned with the direction of piston movement and are produced without change of the general form of the liner. Usually caused by dirt or foreign material entering the cylinder. (No raised metal.) This condition would be considered customer responsibility.

Scuffing – Slight transfer of metal from one surface to another due to a lack of sufficient lubrication or clearance from overtemp. (If allowed to continue, galling will occur.)

Galling – High transfer of metal from one surface to another due to a lack of sufficient lubrication or clearance from overtemp. (The excessive heat will usually lead to seizure.)

Dust Out – A condition where the cylinder kit is severely worn from the ingestion of dirt through the air intake system. This is common with a breach in the air inlet piping or poor air filter maintenance.

Quarter Point Scuffing – This scuff is usually the result of an air bound coolant system. When air is trapped around the liners on an initial coolant fill and the engine is started, the heat from combustion and friction can not be dissipated. Because of the piston pin hole in the skirt area, the skirt will expand in such a manner that it resembles a square. When there is a square (of the skirt) inside the circle (of the liner) the scuff will occur at the four corners of the skirt and have distinct burn lines on the outside of the liner. This type of scuff is seen more on engines with aluminum skirts that are not properly filled with coolant do to the difference in the expansion rates of aluminum and iron. Extra precaution to bleed the air from the coolant system on initial fill should be taken.

Plume Wear

This liner displays evidence of plume wear at the top ring turnaround area and also shows evidence of carbon raking further down the bore.

This liner is not failed, but may be a condition of wear out.



Carbon Raking

This liner displays evidence of carbon raking (vertical streaks). Carbon raking occurs when carbon deposits on the piston contact the liner bore causing light polishing.

Carbon raking is not a failure.



Scuffing

This liner displays scuffing and the metal transfer can be seen on the piston dome as well as on the liner.



Fire ring scuff will show near the top of the liner at the ring reversal area. This is the hottest part of the combustion process.

This condition will be covered under warranty during the coverage period.

Quarter Point Scuffing

This is a skirt to liner scuff and usually occurs immediately after a complete coolant system fill where the coolant system is air bound. Typically happens more with aluminum skirted engines do to the expansion rate of aluminum being twice the expansion rate of iron. A more server scuff will follow in a short drive time after the quarter point scuff occurred because the initial transfer of aluminum is slight and will aloud the piston rings to past over the scuff areas until distress overcomes performance.

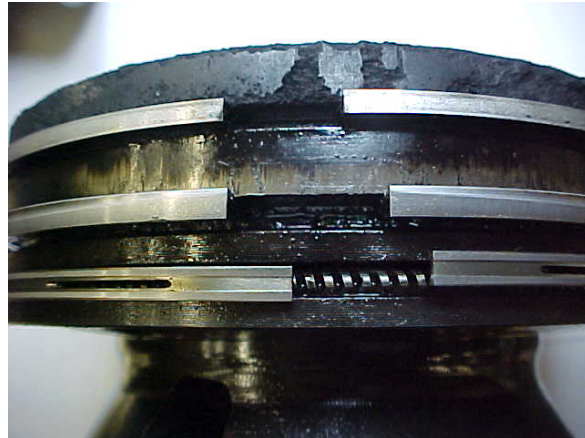


Quarter point scuffing is an assembly error and is not a warrantable failure.

Dust Out

Typically there are several components that will indicate dust out of an engine, and depending on the amount of dirt, type of dirt, and the length of time the engine was operated in the adverse condition will determine the severity and shorten life of the components.

Flattened scraper edges of the oil control ring are an indicator of dust out. Also look for vertical scratches on chrome fire rings, and the top & bottom ridges on the HVOF fire rings.



Cloudy piston pin surface in the area that the piston dome rides is also an indication that abrasive material has entered the engine.

Faint copper showing on main & rod bearings in the loaded area is another indication of dust out.



Wear steps may be present on the liners depending on how much damage had occurred, and dust outs are not covered by engine warranty.

Liner Cavitation

Liner cavitation is the result of an improperly maintained coolant system. Without proper inhibitor packages with sufficient nitrite levels a wet liner could pit through in as little as 50,000 miles.

Stray electrical current in the coolant system is another concern which may rapidly deplete the inhibitor package and then cause parts to pit.

This is customer responsibility

Read Tech Service Letter (**99 TS-3**) for more information on stray voltage and how to measure it.

