



SURFACE VEHICLE INFORMATION REPORT

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Power Cylinder Oil Consumption: Problem Solving

RATIONALE

This Five-Year Review and update include additional detail and clarifications on how to solve potential oil consumption issues. Some of the updates are:

- Examples of key parameters to investigate in an oil analysis.
- A description that an intake air throttle can cause high oil consumption.
- An description of potential oil consumption measurement mistakes.
- New photos of carbon packing damage.
- A paragraph to ensure that components are made per their specification.
- A better description of the swapping technique for measuring evaluating high oil consumption.
- And various small editorial updates.

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1. SCOPE

This document describes methodologies to determine the causes of high oil consumption caused primarily by the power cylinder system.

1.1 Purpose

The oil consumption of an internal combustion engine is a significant performance attribute. The loss of engine oil through the combustion chamber is critical because it impacts the emissions signature of the engine and potentially poisons the exhaust gas after treatment devices. To the operator of the engine, the consumption of oil is an unnecessary and excessive cost of engine operation. While solving oil consumption problems, it is important to have a systematic way of determining the cause of the high oil consumption. Not all of the oil consumption problems are due to the power cylinder system. Other engine subsystems can contribute to the oil consumption of an engine which means that isolation of contributing systems is essential for diagnosing and eliminating the source of oil consumption. The purpose of this document is to review the various possible systematic methods for solving oil consumption problems.

2. REFERENCES

There are no referenced publications specified herein.

3. DEFINITIONS

There are no unique definitions.

4. LIST OF METHODS

The following is a list of the basic methods for determining the causes of high oil consumption:

- Check the history of the engine.
- Eliminate the simple possibilities.
- Eliminate the mistakes.
- Determine if oil consumption is a result of a failure.
- Modeling and mapping.
- Component swapping and variation techniques.
- System separation.

5. CHECK THE HISTORY OF THE ENGINE

High oil consumption may be a result of how the engine was operating. Make sure that the engine was run properly. Some of the areas to check on engine operation are:

- Check for changes to blow-by. This might indicate a problem in the engine.
- Check the history for changes in temperatures and/or pressures that might indicate incorrect engine operation or problems:
 - Oil
 - Coolant

- Intake
- Exhaust
- Check the condition of the oil for signs of potential problems. Example of lubrication conditions to analyze are:
 - Oxidation parameters
 - Viscosity
 - Wear metals (e.g., Al, Fe, Cr)
 - Contaminants (e.g., Si)
 - Elements from coolant (e.g., Na, K)
 - Fuel concentration
- Check for incorrect engine operation:
 - Speed
 - Load
- Check warranty data to determine if the engine has a history of problems and under what conditions.
- Check the history of past engine test done on the same engine configuration. Have things changed? Was the engine run differently?

6. ELIMINATE THE SIMPLE POSSIBILITIES (BEFORE ENGINE TEARDOWN)

When there is a problem with high oil consumption of an engine, it is important to eliminate the simple potential causes first. These are the things that are done prior to any engine teardown.

6.1 Check for Leaks

In any case where there is high oil consumption, an examination of leaks should be made. Look for oil on the ground or oil on the engine. The magnitude of the leak might be determined by catching the oil leaked over a period of time and measuring the final quantity.

6.2 Check for Problems with the Breather

Oil may exit through the crank case breather. In an open system, the oil may then accumulate on the ground. In a closed system, there may be oil in the intake system. Excessive oil through the breather might be an indication of various problems:

Design issues:

- Poorly designed breather.
- Incorrectly positioned breather.
- Plugged breather or valve (PCV).
- Missing breather or valve (PCV).

Problems:

- High blow-by may indicate a problem that is coming from the power cylinder.
- Unstable blow-by may be a cause or symptom of high oil consumption.

6.3 Check for Malfunctioning External Components

Components other than the power cylinder may contribute to high oil consumption. Check these components for signs of oil consumption problems.

Turbocharger/supercharger: Can often be isolated from the main engine to determine the turbocharger/supercharger contribution to oil consumption. Oil tracks might also be seen in the outlet if there is a broken seal.

Air compressor: Might be able to remove from the engine to check for its contribution to oil consumption.

Valve guides: There may be oil leaking down the valve stems. Replace the valve stem seals if possible.

Fuel pump: The fuel pump or fuel injectors may leak oil into the fuel. The oil will then be burnt with the fuel.

Intake air throttle: The intake air throttle can cause a vacuum in the cylinder that can cause oil to be sucked upwards causing high oil consumption.

6.4 Check for Coolant in the Oil

Coolant in the cylinder will vaporize causing high blow-by. Also, it will affect lubricity of the oil and result in high wear of the cylinder walls that will affect blow-by and oil consumption. Coolant in the oil could also indicate a failed cylinder head gasket which could cause high blow-by and/or oil consumption. Also a failed oil cooler could cause coolant to into the cylinder.

Coolant in the oil can be determined by an oil analysis. Foam on the oil or increasing sump levels can be a sign of coolant in the oil.

6.5 Check for Fuel in the Oil

Fuel in the oil will affect the lubricity of the oil and result in high wear of the cylinder walls that will affect blow-by and/or oil consumption. Fuel in the oil can be determined by an oil analysis. Low oil viscosity or increasing sump levels can be signs of fuel in the oil.

6.6 Measure Blow-by

Measure blow-by in the problem solving efforts. High blow-by might be an indicator of power cylinder issues that might result in high oil consumption also. These issues could include:

- Broken ring.
- Broken piston.
- Scuffed cylinder.

6.7 Compression Check

A compression check can help to determine if there is a problem with the rings or pistons that might be causing high oil consumption.

6.8 Leak Down Test

A leak down test can follow a compression check to identify the source of the leak. Look for signs of leaking in the intake ports, exhaust ports, crankcase, or coolant. Signs for leaks may be leakage noise in the ports and crankcase, or gas bubbles in the coolant. This test makes it possible to better understand whether the power cylinder (piston and rings) is the source of blow-by that might be affecting oil consumption.

6.9 Borescope the Engine

A borescope of the cylinder will help to identify if there has been scuffing or piston damage that might explain the cause of high oil consumption.

6.10 Examine the Color of the Exhaust

The color of the exhaust gases might indicate problems:

- Excessive white smoke might indicate coolant in the cylinder.
- Excessive black smoke might indicate excessive fuel.

6.11 Complete an Oil Analysis

Analyze the oil for signs of potential problems. Analyze viscosity change and base number change for oil degradation. Check for wear metals (iron, chrome, etc.) in the oil for indications of failures occurring within the engine. The oil should also be analyzed for contaminants such as fuel and coolant. Excessive fuel or coolant in the oil may diminish the lubricity which will cause excessive wear or scuffing of the cylinder. This can result in high oil consumption.

6.12 Verify the Oil Consumption was Measured Correctly

Oil consumption is very difficult to measure. Various methods of measurement can be found in SAE J2796. However, it is possible to make mistakes in all techniques for measuring oil consumption. Verify that the measurements are accurate. Below are some items that could affect the measurements:

- Oil level in the crankcase is too high or too low.
- An obstructed or blocked oil filter.
- Oil that has exceeded the oil drain interval.
- Insufficient oil drainback.

7. ELIMINATE THE POTENTIAL MISTAKES (AFTER ENGINE TEARDOWN)

7.1 Incorrect or Missing Components

Verify that there are no incorrect or missing components in the engine.

7.1.1 Incorrect or Missing Piston Rings

Check each ring. Have all the rings been installed on each piston? Have the correct piston rings been used? Make sure that the oil rings are installed with all the pieces. A missing piece can be detrimental to oil consumption.

7.1.2 Incorrect Dipstick

An incorrect dipstick may result in the engine being overfilled with oil. This might result in high oil consumption.