Item	Description
Yellow	High pressure oil
Orange	Constant high pressure feedback (55 psi)
Purple	Low pressure (25 psi) control
Blue	Oil return low pressure

Lubrication System

Variable Displacement Oil Pump

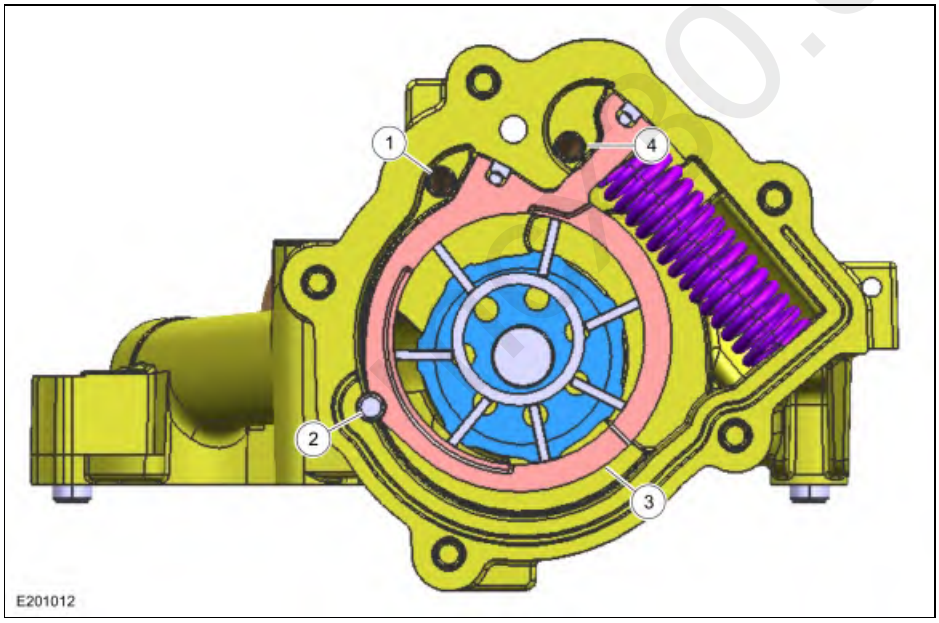
The variable displacement oil pump is designed to minimize energy loss. The active control matches the oil flow and pressure to the engine's need, eliminating excess oil flow, and reducing the load on the engine crankshaft to improve fuel economy.

The variable displacement oil pump works in two modes:

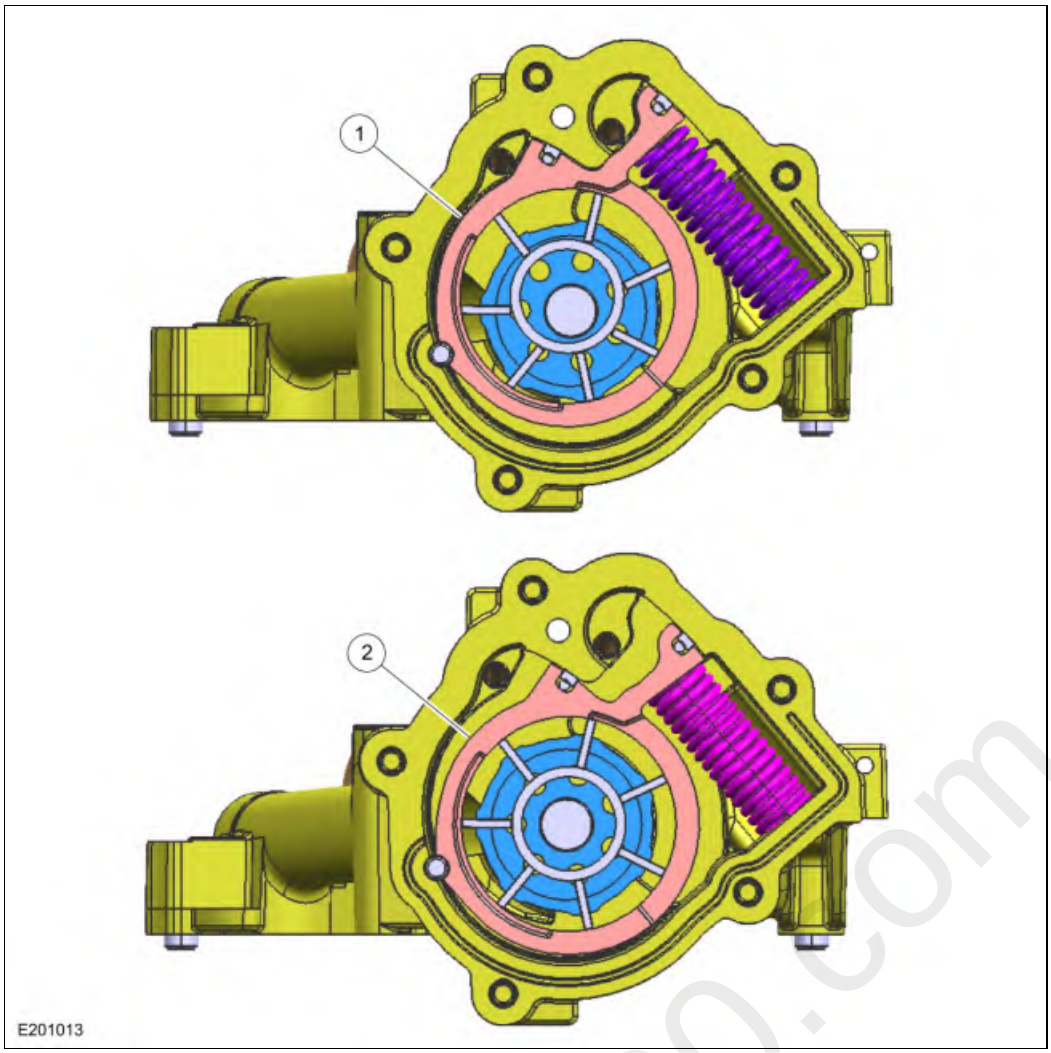
High pressure â€“ in this mode the engine oil pressure is regulated by applying engine oil pressure (force) against the pump slide. The pump performs in this mode from idle to maximum engine speed much like a conventional ge-rotor style oil pump. The main improvement in this mode is that the pump only produces enough oil flow to meet the engine oil gallery pressure requirement as opposed to a ge-rotor pump that displaces a fixed volume and recirculates any surplus volume back to the pump inlet. The variable displacement pump in high mode is therefore more efficient because it produces only the flow necessary to achieve the engine oil pressure target and does not waist energy producing and recirculating excess volume.

Low pressure â€“ in this mode a solenoid located in the front cover is energized. This solenoid allows oil pressure to be applied to a secondary pump port. This secondary force, further compresses the pump spring thereby allowing the pump to regulate to a secondary lower pressure setting. The pump becomes more efficient because it produces less flow and works against an even lower resistance.

Variable Displacement Oil Pump



Item	Description
1	Primary Port (always pressurized)
2	Pivot pin (slide pivots around pin in order to adjust the displacement of the rotating group)
3	Slide
4	Secondary Port (pressurized in low pressure mode, vented in high pressure mode)



Item	Description
1	Slide position at 100% displacement
2	Slide position at 0% displacement

Engine Oil Filter and Housing

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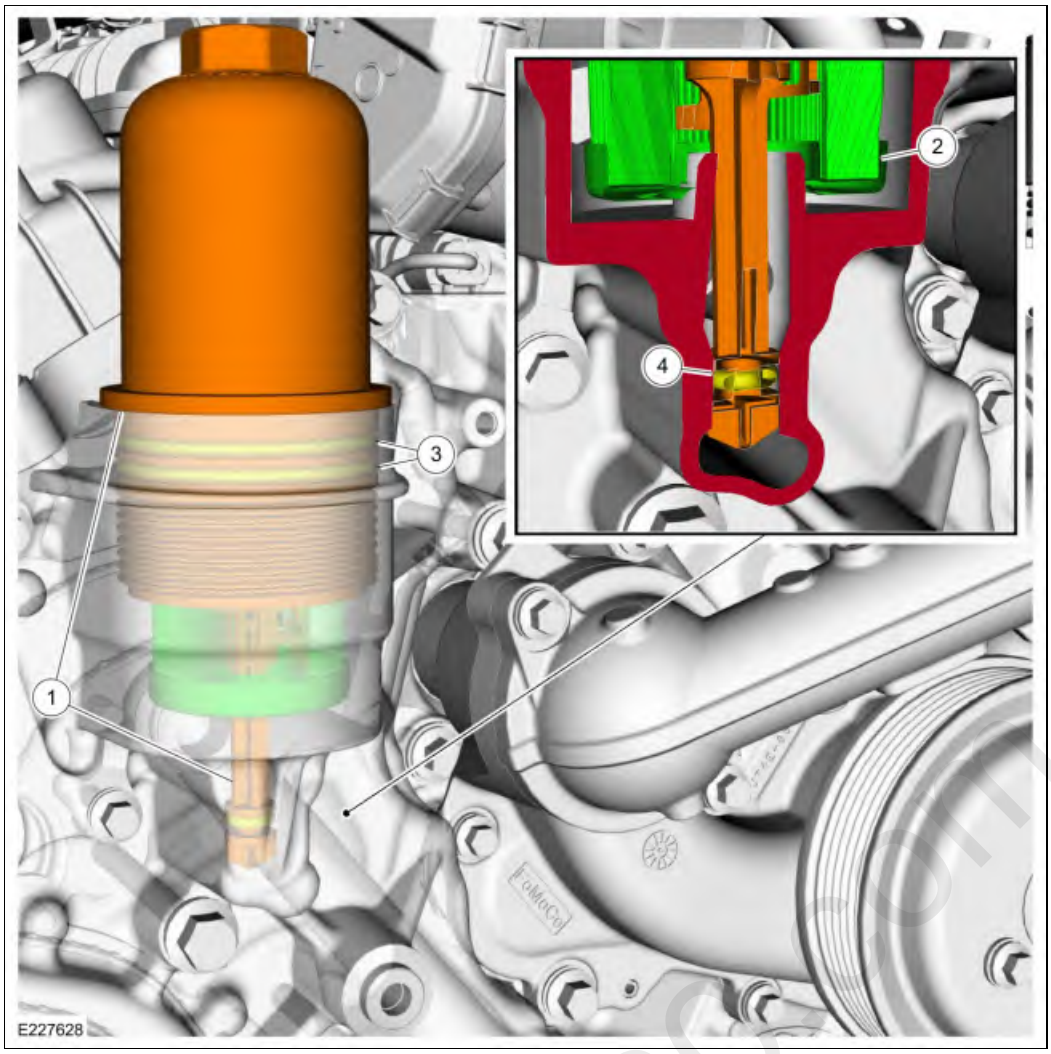

Item	Description
1	Oil filter housing assembly (includes oil filter reservoir and stem)
2	Oil filter
3	Oil filter housing-to-engine front cover seals (requires 2, included with service filter)
4	Oil filter housing stem-to-oil reservoir drain port seal (included with service filter)

During oil filter removal and installation:

- The oil filter housing and stem must be inspected for damage including cracks or separation of the stem from the housing. If damaged, a new oil filter housing assembly must be installed.
- The 2 oil filter housing-to-engine front cover seals are included with the service filter and must be replaced to prevent oil leakage.
- The oil filter housing stem-to-oil reservoir drain port seal is included with the service filter and must be replaced. If this seal or filter housing stem is damaged or missing, the oil will flow through the reservoir drain port and a **loss** of engine oil pressure will occur.

Ti-VCT

Twin Independent Variable Cam Timing (Ti-VCT)

The twin independent VCT system allows variable control of the valves which optimizes combustion at full load providing improved power and low speed torque (broadening the torque curve) which enables variable valve overlap which provides better fuel economy and emissions and provides optimized cold start operation with improved exhaust emissions.

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Diagnosis and Testing

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Engine

1. For basic mechanical concerns.
   REFER to: Engine (303-00 Engine System - General Information, Diagnosis and Testing).
   For driveability concerns. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

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