

## APTB 01/09 R1

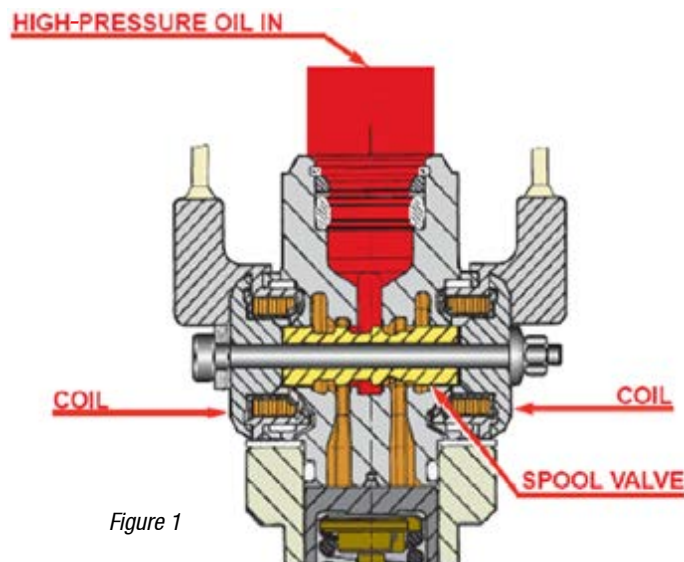
# SUBJECT: 6.0 L Injector Stiction Discussion and Recommendations January, 2009

Reference [TSB 08-26-3](#)

### 6.0 L Injector Spool Valve Operation (refer to Figure 1)

The spool valve is located in a bore in the stator housing; coils and coil housings positioned on both ends of the stator housing serve as end caps to seal the assembly and limit spool valve travel (0.432 mm). An open coil on one side of the stator housing and a closed coil on the other are alternately energized during engine operation to move the valve horizontally. The spool valve has two positions—movement of the valve positions the valve over drillings in the stator housing which either (1) allow high-pressure oil from the oil rail into the injector high-pressure oil pumping chamber, or (2) allow pressure in the high-pressure oil chamber to collapse and oil to exhaust from the injector. Open coil energization allows high-pressure oil into the high-pressure oil pumping chamber; close coil energization allows oil to exhaust from the pumping chamber; when neither coil is energized, the valve will remain where it was last positioned (in Figure 1, below, the close coil is shown on the left side, and the spool valve is in the closed position; also note the gap between the spool valve and the open coil on the right side).

Unlike HEUI® injection pulse width strategy, in which the duration of the solenoid energization determines fuel delivery, 6.0 L fuel delivery is determined by the duration between coil open and close commands from the ECM/FICM. Under normal operating conditions, when energized, each coil has enough time, and creates enough magnetic force, to overcome the static inertia of the spool valve and move the valve the total travel distance.



### Stiction:

As applied to 6.0 L Injectors, the term is used to describe the condition when static friction (i.e., stiction), in addition to normal static inertia, is greater than the force of either injector coil, resulting in a delayed spool valve response or a stuck spool valve. Stiction can be either a momentary or permanent condition, but is most often momentary. Because the spool valve is operating in an engine oil environment, stiction is usually temperature related increased oil viscosity as a result of cold temperature will exacerbate stiction causing conditions, leading to an increase in stiction severity; decreasing oil viscosity as the engine warms up often leads to a decrease of cessation of stiction symptoms.

## Stiction Driveability Symptoms:

Any one, or a combination, of the following symptoms may indicate a stiction issue:

- Hard start or no start
- Runs rough or sluggish performance
- White smoke or exhaust odor
- Multiple cylinder miss
- Stumbles and misses on acceleration
- Excessive white or black smoke on acceleration
- Miss at high engine RPM

**Note:** When the symptom(s) above occur with a cold engine, and improve, or are eliminated, when the engine warms up, it indicates a stiction problem with virtual certainty.

## Common Stiction Causes:

- **Extended oil change intervals** are the leading cause of 6.0 L injector stiction. High soot content or other contaminants in the engine oil will increase friction between the spool valve and the spool valve bore. In addition, oil additives and oil age can increase oil's viscosity.
- **Cold weather spool valve latching.** Stiction can occur at the site of the close coil and the spool valve, due to hydraulic affinity or latching, especially after long shutdown, such as overnight (the valve will remain on the close coil side following engine shutdown). Because this condition is worsened by cold weather, Ford® has issued a procedure (TSB 08–26–3) to perform a FICM calibration that adds inductive heating of the injector coils to locally heat the oil in the injectors until normal operating conditions are achieved (refer to Alliant Power Technical Bulletin [APTB 02/08 R1](#)).
- **Using the wrong oil viscosity**, especially in cold climates.
- **Long idle times** increase the amount of soot in the engine oil and also prevent the engine from reaching proper engine operating temperatures.
- **Unaided cold starting**, including a malfunctioning glow plug system, the operator not waiting for the glow plug light to go out before starting, or not using a block heater in cold weather.

## Corrective Procedures to Eliminate Stiction:

One thing we don't recommend is automatic replacement of injectors (whether in or out-of-warranty). Similar to a head and rotor seizure or a failed turbo, if you don't correct the source of the stiction problem, it's bound to reoccur with the replacement injectors (furthermore, most stiction afflicted injectors haven't been damaged). Stiction must be eliminated by applying corrective procedures to the source of the stiction cause, which can most often be accomplished with existing injectors.

In the Common Stiction Causes section above, the causes of stiction can generally be considered to be the result of oil issues and/or cold engine driveability. Therefore, when confronted with stiction symptoms, we suggest starting corrective action with the following two procedures:

1. Ensure engine oil is clean, is the correct viscosity for the temperatures it will be operating in (refer to Figure 2 on the next page) and has the recommended API service category rating (we advise using CJ–4 or CI–4 PLUS, although Ford allows CI–4).

6.0 L and 7.3 L Power Stroke® customers should be reminded to adhere religiously to Ford's minimum recommended lube oil and filter change intervals (7,500 miles normal duty; 5,000 miles severe duty).

## 6.0 L DIESEL OIL GUIDE

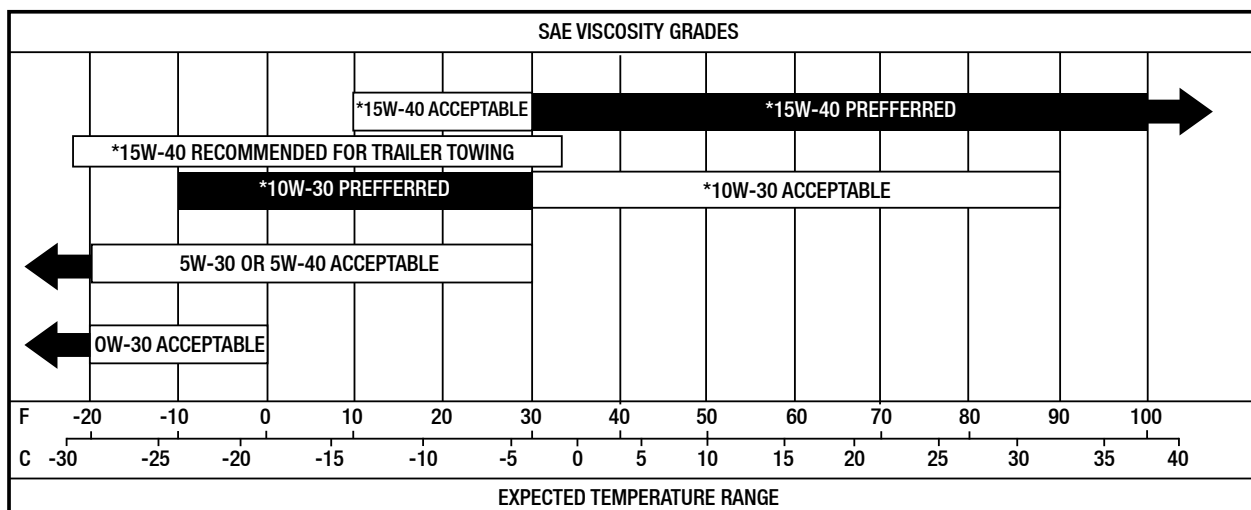


Figure 2

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2. Perform the FICM calibration called for in TSB 08–26–3. Ford defines cold engine operating conditions to be whenever engine oil temperature is less than 70° F, which includes pretty much all of North America, therefore this bulletin applies to virtually all Alliant Power customers.

It's important to note inductive heating resulting from the FICM recalibration only works after the engine starts. The click/buzz test doesn't energize the injector coil long enough to overcome cold (engine oil temperature <80° F) stiction. Therefore, engine tests such as click/buzz or power balance to diagnose stiction will give misleading results and should not be used to identify stiction injectors on a cold engine.

### Non–Stiction Related Conditions:

The following conditions may be mistakenly attributed to stiction:

- Slow cranking (i.e., low batteries, bad starter, poor connections)
- Low oil pressure during cranking
- Low injection control pressure (ICP)
- Poor fuel quality (i.e., low cetane or contaminated fuel: waxed filters or gelled fuel in cold weather)
- Electrical issues (i.e., no power or ground to ECM or FICM, poor connections to injectors)

### Warranty Considerations:

When stiction afflicted injectors are submitted to Alliant Power for warranty, we reserve the right to request proof that the engine has clean and fresh oil (i.e., a receipt for an oil change showing a recent date and mileage) and that TSB 08–26–3 calibration has been performed (i.e., a receipt for the procedure). If these procedures cannot be verified, injectors will be flushed and flowed and returned without labor reimbursement.

Assuming we can be certain the engine has clean and fresh engine oil and TSB 08–26–3 calibration has been performed, Alliant Power will continue to provide full warranty coverage for injectors diagnosed to have failed due to stiction the first time they're submitted from any vehicle on a policy basis (not due to workmanship or material failure). Alliant Power reserves the right to deny warranty for subsequent stiction related failure claims submitted for injectors from the same vehicle.

*R1–Referenced TSB 08–26–3, which supersedes TSB 07–5–4; the new TSB includes procedures to test the FICM, in addition to performing the FICM calibration (program module installation) to incorporate cold injector inductive heat calibration.*