Volume 24, Issue 3

November 2026

Technicians Service Training

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Editor

"G" Jerry Truglia

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"Today's Fuel Systems Diagnosis Part II"

INJECTOR GURU TIPS CONTINUED

• **Cleaning Stage One -**Flush the rail and regulator with the engine off. Connect the cleaning machine per manufacturer's instructions. Use the cleaning machine pump to circulate the recommended fuel/cleaning fluid solution through the fuel rail with the engine off. Adjust the machine's delivery pressure higher than the fuel pressure regulator's normal pressure setting. This ensures a good flow of cleaning chemical through the regulator and helps to soften and wash away dirt and deposits from the injector inlet screens.

Let the cleaning machine run long enough to do a thorough job of dissolving and removing deposits. The engine-off cleaning works best on a warm engine. Cleaning times vary from 15-60 minutes, depending on vehicle make and model, mileage, and your own experience with the quality of the local fuel supply!

• **Step Two:** Clean the injectors. Start the engine and readjust the cleaning machine pressure slightly lower than vehicle's normal, regulated pressure. Lowering the pressure slightly causes the PCM to hold the injectors open longer during the cleaning process.

Cleaning the injectors in the engine also helps to remove carbon deposits from intake valves, the tops of pistons, and

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What is TST?

Why Join TST?

TST is a group of dedicated automotive technicians and instructors committed to the continuing education of our fellow technicians. We provide quality training seminars at a reasonable price, bringing our members nationally recognized instructors and state-of-the-art technical training.

Our Goals & Mission Statement

- **Keep technicians up to date** with the latest automotive technology, diagnostic strategies, and repair procedures.
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- **Deliver practical, relevant information** technicians can put to use immediately in their shops.
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"Today's Fuel Systems Diagnosis Part II" (con't from p. 1)

oxygen sensors.

Step Three: Clean the air passages. The PCV, throttle plate and idle air control valve/passages should be included in the cleaning process. Accumulated deposits in these passages strangle the engine. (We just improved fuel delivery by cleaning the fuel rail and injectors, why not make sure we have enough air to go with it!) Spray these areas with the cleaning solution or allow the fuel/cleaning solution to be sucked through the throttle in a running engine. This cleans the throttle plate, IAC, and crankcase ventilation system as the engine runs.

DIRECT FUEL INJECTION - GDI
(Non Diesels, Newer Domestic, European and Asian Vehicles)

Direct-injection has been around for many years on diesel engines.

Vehicles such as Audi, BMW, Ford, GM, Mercedes and Toyota, just to name a few are already selling most if not all of their models with direct injection.



With gasoline direct injection (GDI), the gasoline is injected directly into the combustion chamber. GDI allows for a very lean mixture (as much as 35:1) during cruising.

The direct injection (GDI) fuel system on Audi's is divided into two parts, the low side at 6 (87.02 psi) to 7 bar (101.52 psi) and the high side at 110 bar (1595.41 psi). Many newer GDI systems put out over 3000 psi.

The PCM controls each fuel injector with 65 V. This is controlled by a boost capacitor in the PCM.



(Con't on page 5)

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During the 65 V boost phase, the capacitor is discharged through an injector, allowing for initial injector opening. The injector is then held open with 12 V.

The fuel injector assembly is an electrical magnetic injector. The injector has six precision machined holes that generate a cone shaped oval spray pattern. The fuel injector has a slim extended tip in order to allow a sufficient cooling jacket in the cylinder head.

DIRECT FUEL INJECTION – GDI

When replacing a high pressure GDI fuel pump the following must be observed:



Using scan data make sure the fuel pressure is down to a safe level Make sure the bolts or nuts that are holding the pump in place are backed off evenly.

When installing a new GDI high pressure pump make sure that the cam lobe is off the high part of the lobe (on the round part not the high lobe).

High Pressure Stainless Steel Fuel Lines

Note: GM recommendations along with some other OEs are to replace the high pressure stainless steel fuel lines once they are loosen to prevent fuel leaks. Always check Service Information for recommendations.

Always check the GDI fuel pump end that contacts the cam follower or camshaft for damage. The pictures on the next page are a **badly worn pump** (left) and a **bad** and good cam follower (right).

(Con't on page 6)

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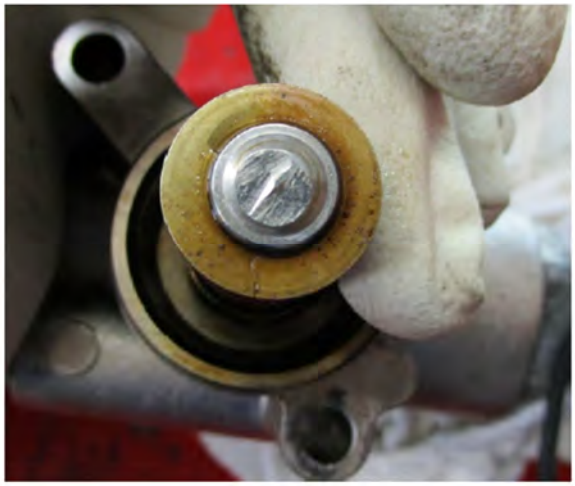



Important GDI Information

When removing GDI injectors carefully clean the manifold or engine bore with a soft brush to remove the carbon build up.



GDI fuel injection pulse width or on time is much lower than conventional fuel injection. GDI on time at idle 0.4 to less than 2 mS compared to 3 to 5 mS.

GDI injector are low resistance injector about 1 ohm rather than 14 ohms for conventional injectors.

GDI injector use 65 volts due to a boost converter (capacitors) that takes 12 volts and boost it to 65 volts.



Keep GDI in order is an important step, especially if the injector is a piezo style. If the injector is a piezo style the injector would have to be programmed or coded if the injector was replaced or moved to a different location.

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GDI

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"Today's Fuel Systems Diagnosis Part II" (con't from p. 6)

Another important step is to cap all injectors and fuel rail connections as seen in the pictures below to prevent debris from entering.





GDI injector seals removal has to be done with care not to scratch the injector body surface where the seal sits. A special seal cutter should be used like the one pictured below in the AGA GDI Kit.



This AGA tool kit includes the seal cutter (upper left), 2 flexible GSI nut sockets (upper right), injector puller (middle), seal cone (brass – mid left) and 2 seal compressors (bottom left).

Seal Removal and Installation





Make sure all GDI engine ports are clean to prevent injector seal problems. Use a soft brush to clean all the port making sure no debris is left behind can damage the injector seals.



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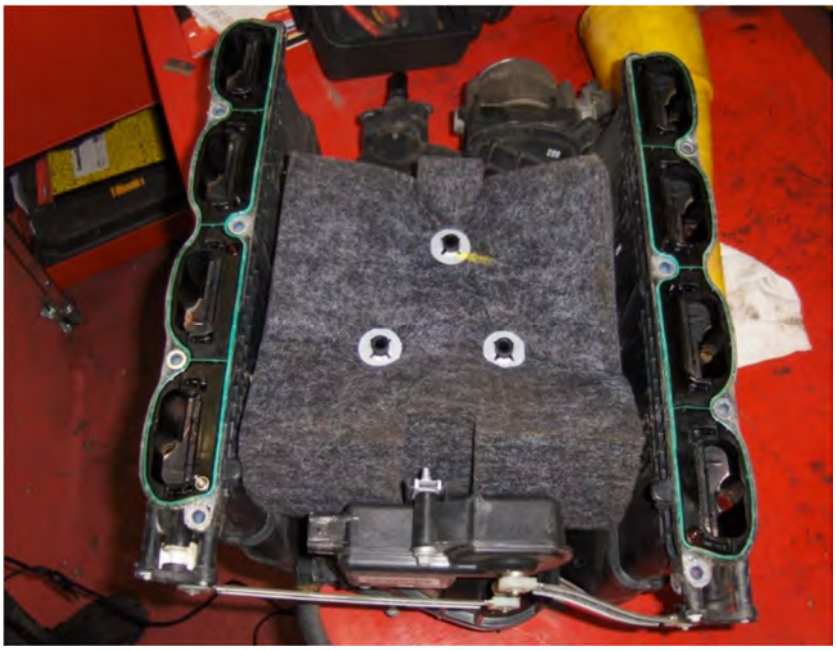
ONE MORE THING

An increasing number of new engines use dual intake manifold runners controlled by butterfly valves that can jam and stick from intake manifold deposits. Problems include hard starting, poor performance, increased oil consumption and, of course, DTC's and the illumination of the "check money" light. Always check the rods that are connected to the motor and runners. In many cases the rods have been known to disconnect or break off. Some motors are vacuum operated, while others are electric operated and in some case there is the combination of both vacuum and electric.



The improvement in engine breathing is usually an eye opener in itself. If equipped with an IAC motor counts that had been hovering in the 40+ range commonly drop to 25 or so. That's why you'll want to double check the minimum idle and adjust it if necessary, followed by the appropriate idle relearn for the vehicle. If the engine has an electronic throttle APP (accelerator pedal position) setup, make sure that the throttle plate is clean and opens and closes properly. If the throttle plate needs to be cleaned follow the OE recommendations that usually includes adjusting the throttle plate after disconnecting or cleaning. In many cases a scan tool is needed to relearn the APP.

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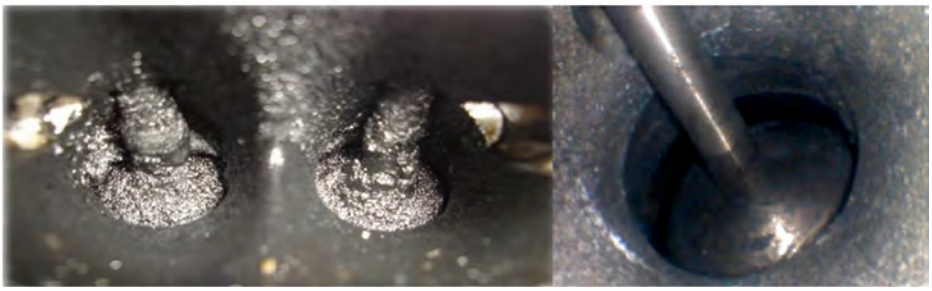
GDI CARBON BUILD UP CLEANED WITH ATS 3C MACHINES







GDI carbon is different and harder to clean than other fuel injection systems carbon deposits. There are a couple of other different methods to clean GDI carbon. The most common method is walnut blasting that is labor intensive and can possibly cause damage if any shells remain in the engine. The other method is by removing the manifold and hand cleaning the carbon build up by using a hard plastic tool. You can use a door panel tool that can be reduced in size so it can be used to scrape the carbon. To prevent damage to components never use any metal tools for carbon removal. The other tools that are needed are intake cleaner, air vacuum, soft brush and a container to place the carbon in. Both of the prior mention are labor intensive. The ATS 3C is quick and easy that takes about 15 minutes to complete with excellent results.

Article by
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TST Founder- President - ASE Master Technician

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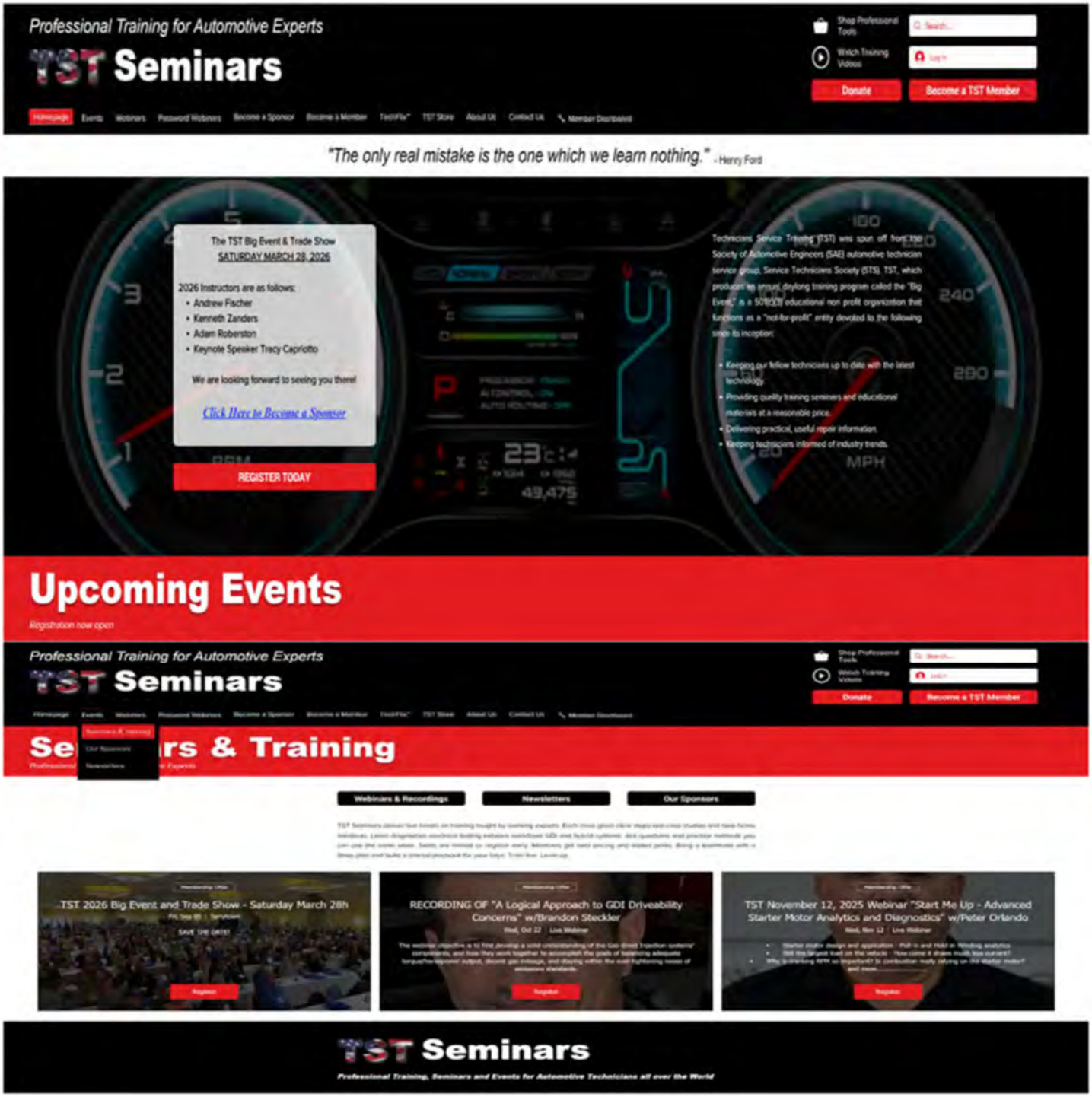

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