



# BENT ROD WITH A TWIST OF SWIRL



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No this issue's headline is not a reference to some fancy new cocktail!

Recently, my wife and I attended an event and I overheard my wife explaining to someone at our table how I do my diagnostics. A wonderful insight, here's my wife complimenting my ability to picture myself in the technicians' shoes. Jodi made mention of times she walks into my office whilst I'm on the phone assisting our members and notices I have my eyes closed during the conversation.

Not only do I picture myself doing the diagnostics, but I also see the images of the engine and operations of how it all works.

This issue's Vehicle Diesel System Problem sure had some twists and turns. The Intake Swirl Flaps, Exhaust Gas Recirculation valve (EGR) and its operating system played a big role in the issue, throwing in some conflicting yet influential results taking me to a successful outcome. There were no fault codes, no scan tool data provided by our Diesel Help member and no scope procedure that could find this fault that I am aware of.



Swirl Flaps

**Diagnosis and/or early detection of the fault:** Before beginning your diagnostics, ensure that all modifications such as EGR blanking plates, EGR deletes and or remapping has been reset to standard. Otherwise diagnosing this fault will be difficult.

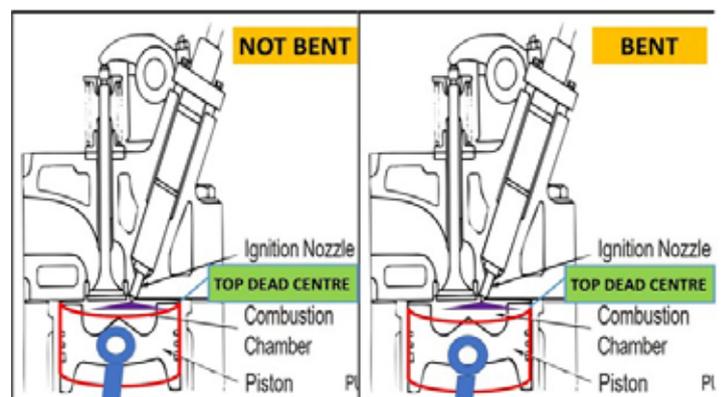
To assist with the diagnostics, you need to understand the influences of the connecting rod and its function and operation.

The conrod connects the piston to the crankshaft. At each end of the conrod there are bearings lubricated by the engine oil. This connecting enables the piston to move freely on a moving axis from top to bottoms within the bore. Each manufacturer has their own specific stroke in which the piston moves from bottom dead centre to top dead centre. What a manufacturer does not plan to happen is the maximum distance of the stroke to change as a result of a bent rod. Top dead centre position of the piston has now changed the point of the combustion ignition.

The symptom I focus on is particularly the white smoke. I know this is the immediate result of incorrect or incomplete combustion otherwise known as unburnt fuel. A fault code is not evident because the engine computer unit (ECU) only detects the position of the crank angle via the crank angle sensor and pickup wheel on the crank not each individual piston of where it is located at the time in its bore. Refer to the image with 'not bent' and 'bent'. Bent image displays a significantly lower position of the piston to the not bent image. It may not look like a much, but it certainly has a great impact.



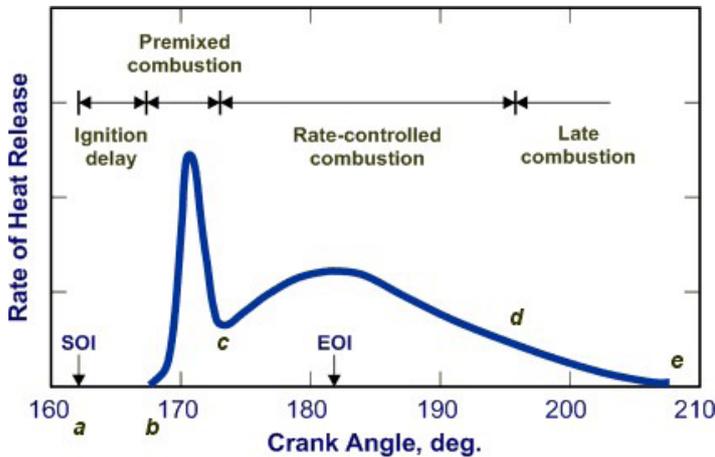
**Vehicle:** A 2009 Mazda BT50 with the 3.0L WEAT Bosch CRD, EGR and intake manifold fitted swirl flaps. I mention Swirl Flaps because they're a vital component that must be clarified of their presence and location before any diagnosis. A different swirl flap design intake is shown here.





The ECU receives data from when the injector is commanded to inject fuel and the microphone knock sensor receives the combustion noise and adjusts the amount of fuel by compensation.

This compensation will only reduce the fuel in the underperforming cylinder, not remove it completely. This enables the engine to continue running and as a result, reduces the potential damage. Note the image below shows how late combustion can occur.



## How does this differ from a non CRD engine without an EGR/Swirl Flaps?

On early diesel engines without swirl flaps and electrically controlled injectors, a bent conrod would have similar symptoms but at a different stage of engine operation. It would start well, no smoke during cranking, idle well, no misfire or smoke. These symptoms would begin to occur when the engine was at full operation temperature. Reason being is the engine doesn't have anything changing to air induction environment other than expansion of the cylinder increasing compression as it warms.

## The diesel engine with EGR

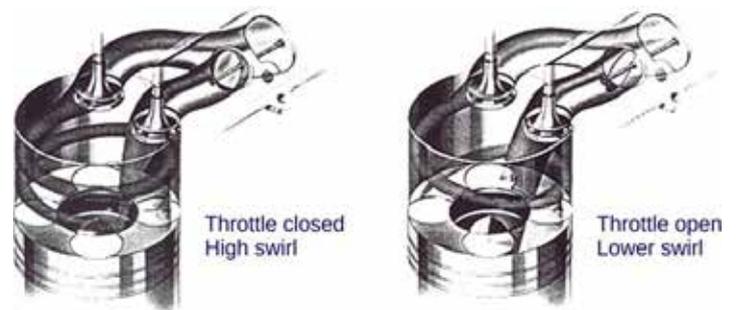
A diesel is a thermal combustion engine requiring only fuel and air to operate. A diesel engine warms up much quicker than a petrol engine. The air (oxygen) is required to burn the fuel, meaning they're dependent on good air induction and compression to create the heat to combust the fuel effectively and cleanly. Clean meaning lower emissions. It is important that the EGR is active to reduce harmful emissions. When the engine is cold and not under load such as low idle or even high RPM without load, there is increased harmful emissions. Operating the diesel in these conditions, to assist in reducing emissions the EGR is active (open).

## Swirl Flaps: How they contribute to intermittent symptoms

When a diesel engine uses EGR and swirl flaps, during cranking of the engine the EGR is closed, and the swirl flaps remain open. At this stage it's replicating a non CRD engine. As soon as the speed sensor confirms the engine speed is at idle and temperature is still cold, the EGR is activated to the open position and the swirl flaps engages thus creating the swirl for effective combustion. The partial restriction in one intake port created by the swirl flap, enables swirl to create a venturi which assists recirculating exhaust gases via the EGR valve into the air intake. On most CRD engines, the engine will be required to reach the engine operating temperatures before the EGR closes and open

the swirl flaps. Often this has been at idle between 30 to 60 seconds from the initial startup.

The swirl assists with increasing the combustion efficiency under load. At idle the swirl flaps are only effective if the EGR is open. So, in the situation when the EGR is closed due to engine temperatures effectively reducing the emissions, swirl flaps will also be inactive and bent conrod symptoms will become less evident proving to be increasingly difficult to diagnose.

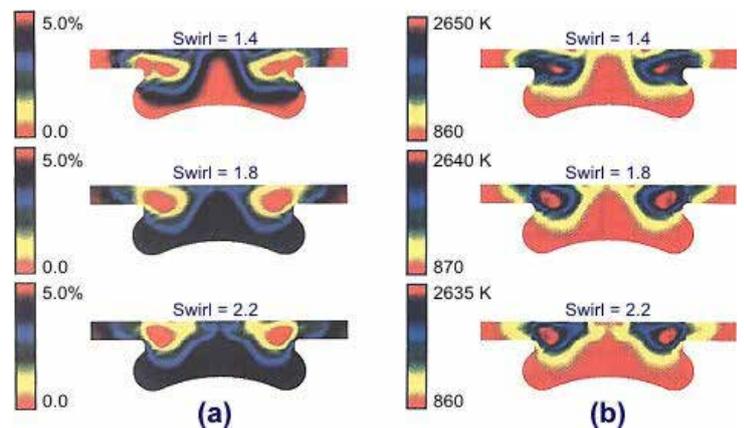


Swirl itself

Influence of swirl on oxygen field (a) and gas temperature field (b) during expansion stroke.

## Utilizing EGR and Swirl Flaps to assist with the diagnostics

Opening the EGR and engaging the swirl flaps will assist with diagnosing a bent conrod. Several scenarios may affect the outcome or prevent a successful diagnosis. A restricted intake manifold will reduce the air intake, though this can be diagnosed by holding the swirl flaps in the open position but would require full removal and cleaning to diagnose other faults.



Influence Of Swirl

The most difficult would be a remapped or deleted EGR and/or swirl flap system. Due to each manufacturers changing designs of a diesel engines piston combustion bowls, a remapped engine is easily capable and if anything, more prone to bending a conrod or becoming low on compression. So, by making these alterations against the manufacturers engineering, not only would this hinder diagnosis, but the problems will also be hidden thus preventing the early detection of a major failure.

Combustion in a Direct Injection diesel engine is heavily dependent on the quality of the mixture formation process. For

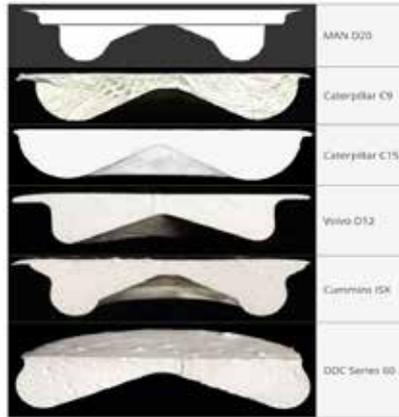
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a given combustion bowl design, mixture formation is determined primarily by the intake swirl intensity and the fuel injection process.

The combustion bowl (top of piston) images shown here were specifically designed for Euro 4 engines fitted with EGR valves.



The final step is to confirm the conrod is bent. This requires removal of the injector and seat washer. Inspect the seat is clean and pick one spot where you will check the height on each cylinder. Looking from the front of the engine, rotate the engine in a clockwise direction until the piston is visible near the top of the engine/top of its stroke. Using a solid steel rod, lower down onto the top of the piston and rotate the engine slightly back n forth to locate the highest point. Place a texture mark on the steel rod. Preferably a fine paint pen, each cylinder a different colour. Whilst you have the injectors out, perform an engine compression test. This will ensure you've covered all basis especially if your customer decides not to proceed and just wants you to slap it back together.

You should not see a greater measurement of more than 0.1mm.

In many cases a compression test does not show a greater difference between each cylinder and therefore has taken the attention away from the engine. An engine with a bent rod yet only 20psi difference is acceptable minimum difference in

compression. An engine with a difference of 30 to 50psi is a concern, with or without a bent conrod.

**Special notes:**

The colour of the smoke is not so much the issue, it's what the white smoke represents. Incomplete combustion, highly corrosive for metal components leading to catastrophic engine failure and fumes contributing the increased risk of cancer and/or respiratory issues.

- A bent rod should not affect swirl as the piston shape and valves have not changed
- Swirl can be interrupted by a restricted intake manifold
- Low engine compression is rarely evident when a bent rod is diagnosed
- Swirl can be reduced as a result of low engine compression

**Solution: Remove the engine for a full overhaul or replacement from a reputable engine reconditioner.**

**Likely causes of bent connecting rods, conrods, etc.**

- Leaking EGR cooler- water entering cylinder
- Leaking head gasket- water or oil entering cylinder
- Leaking injector washer- excessive oil entering cylinder
- Stuck open injector- excessive fuel entering cylinder
- Driving through water
- Spraying unnecessary chemicals into diesel intakes
- Incorrect valve clearance

**For further info, visit [www.dieselhelp.com.au](http://www.dieselhelp.com.au)**

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Arguably Australia's most comprehensive range of climate control parts, tools and equipment for automotive air conditioning specialists and general repairers, Alcius, has launched a national trade promotion running from November 1, 2021 to January 31, 2022 across its entire product range.

Ensuring that automotive service and repair centres and air conditioning specialists have the parts they need when they need them throughout the busy summer months, any Alcius purchases over \$200 earns a trade customer an entry to win the Ultimate Summer Set up, along with weekly prize draws from November 1st until the end of January.

The major prize on offer to one lucky

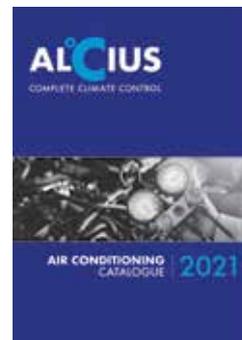


Alcius Complete Climate Control trade customer is the Ultimate Summer Set Up, valued at \$19,165 and it includes:

- Gasmate Galaxy Black Hood LPG Outdoor Kitchen
- Samsung 65-inch The Terrace 4K QLED Smart TV
- Marquise 9-Piece Outdoor Rectangular Dining Setting
- Cyrus 300cm Square Cantilever Outdoor Umbrella
- Masport Woodfire Pizza Oven with Cover
- Fire Pit BBQ 30-inch Grill / Portable Fireplace

Bapcor trade customers who select Alcius parts tools and equipment of over \$200 in value during the promotion period will also be in the running to win a host of weekly quality outdoor entertainment products. These include Alcius BBQ Kits, Beefeater BBQs and Husky 46L fridges during the promotion period.

Since the release of the Alcius Complete Climate Control product catalogue Bapcor's Thermal Parts Program has



introduced more than 500 new parts to meet demand.

The Alcius range now includes more than 1,500 compressor applications, including a major injection of new models, consisting of quality Alcius aftermarket and OE Genuine brands.

The Alcius and Genuine brand TX Valve and Receivers / Driers range has expanded to meet

growing compressor application listings with more than 600 condenser applications now included in the range, including matching radiator and condenser fans.

After making Alcius product purchases from Bapcor network suppliers including Burson Auto Parts, BaxtersMTQ, WANO and JAS Oceania of \$200 or more, Bapcor trade customers simply enter online at [www.alcius.com.au](http://www.alcius.com.au) to place themselves in the draw for the weekly or major prizes during the promotion period.

To learn more about the range or for terms and conditions visit [www.alcius.com.au](http://www.alcius.com.au). Alcius products are supported by Bapcor trade outlets including BaxtersMTQ, Burson Auto Parts, JAS Oceania and WANO.