GREEN DIESEL ENGINEERING

2017 GM 2.8L Colorado Engine Failure Analysis

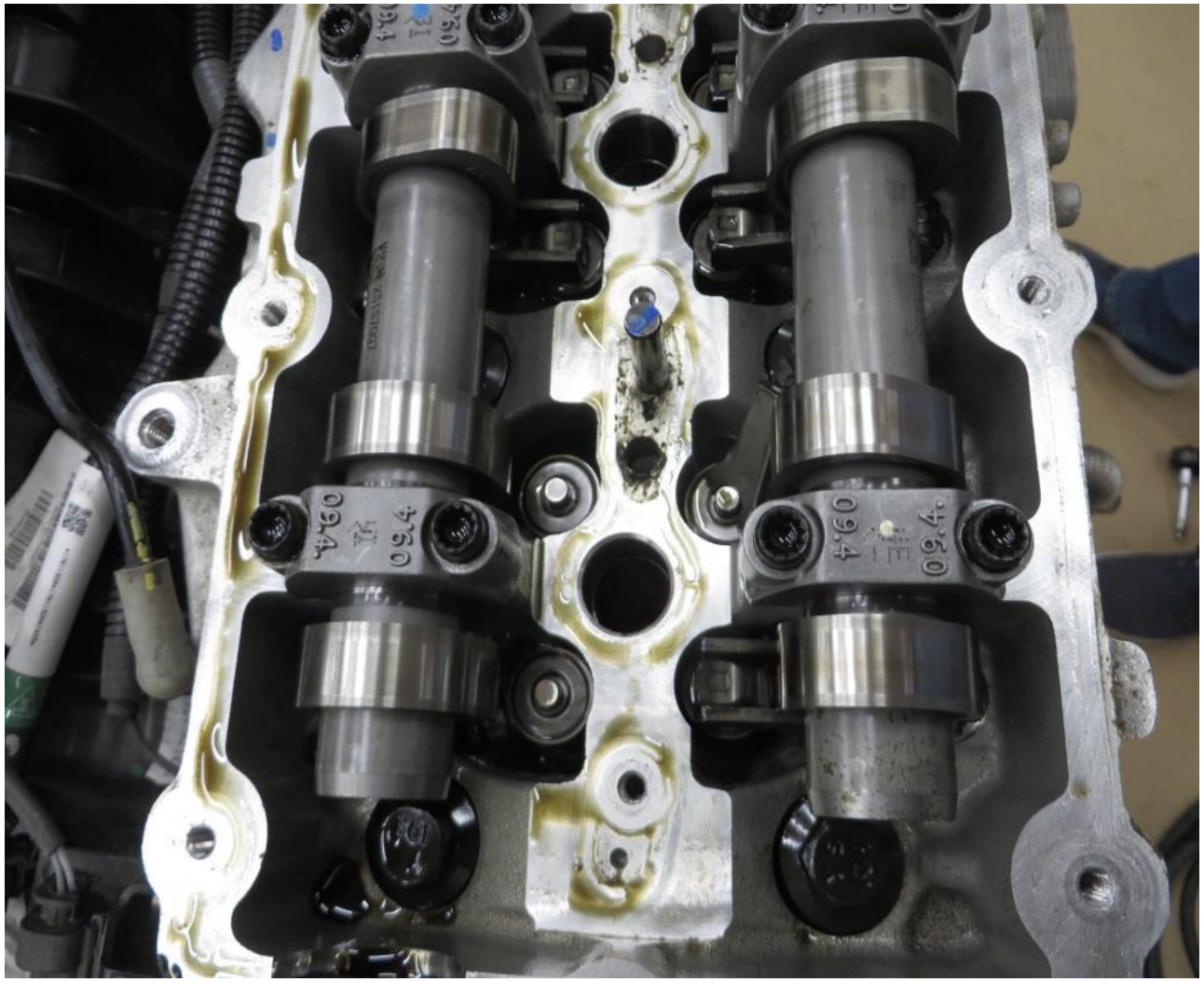
Background

- The engine had about 33,000 miles and failed #4 cylinder in city driving at 35 mph unloaded. The vehicle was using a GDE engine and trans tune.

- Upon receiving the engine, it was noted the block had a hole in it from the connecting rod. The owner used a torch to cut the connecting rod to allow the engine to rotate as it was jammed.

Teardown

- All four rocker arms on cylinder 4 were broke as shown in photo.
- This indicates hard contact with piston.
- #3 cylinder shows functional rocker arms.

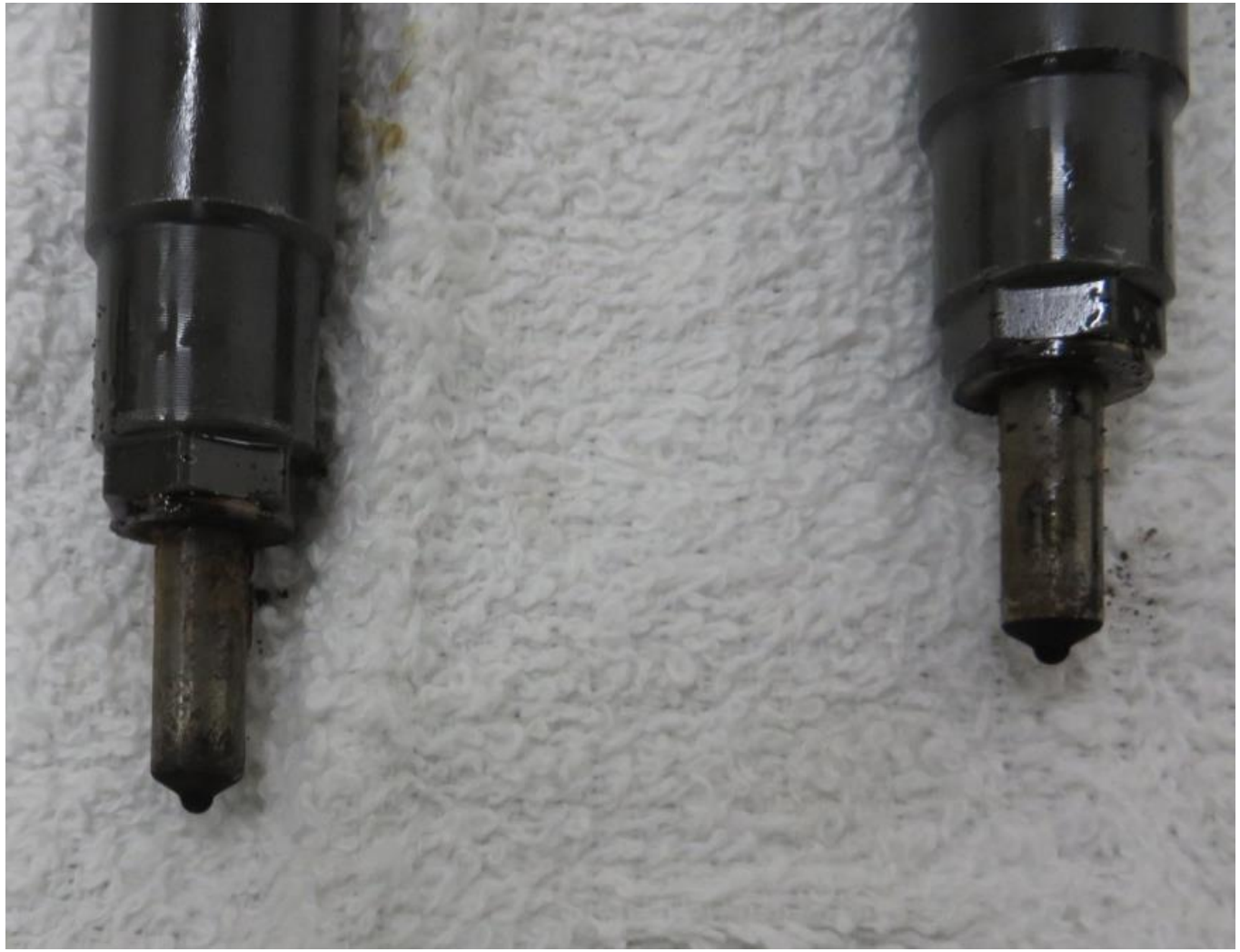


Teardown

- The head bolts still had proper break-away torque.
- The cylinder head seems in decent shape given the failure mode. It appears two valves are slightly bent from piston contact.
- The head gasket is in good shape and no signs of leakage.
- All four injectors are intact with no signs of tip damage. They still need to be sent out for flow testing.
- The glow plugs are also intact.

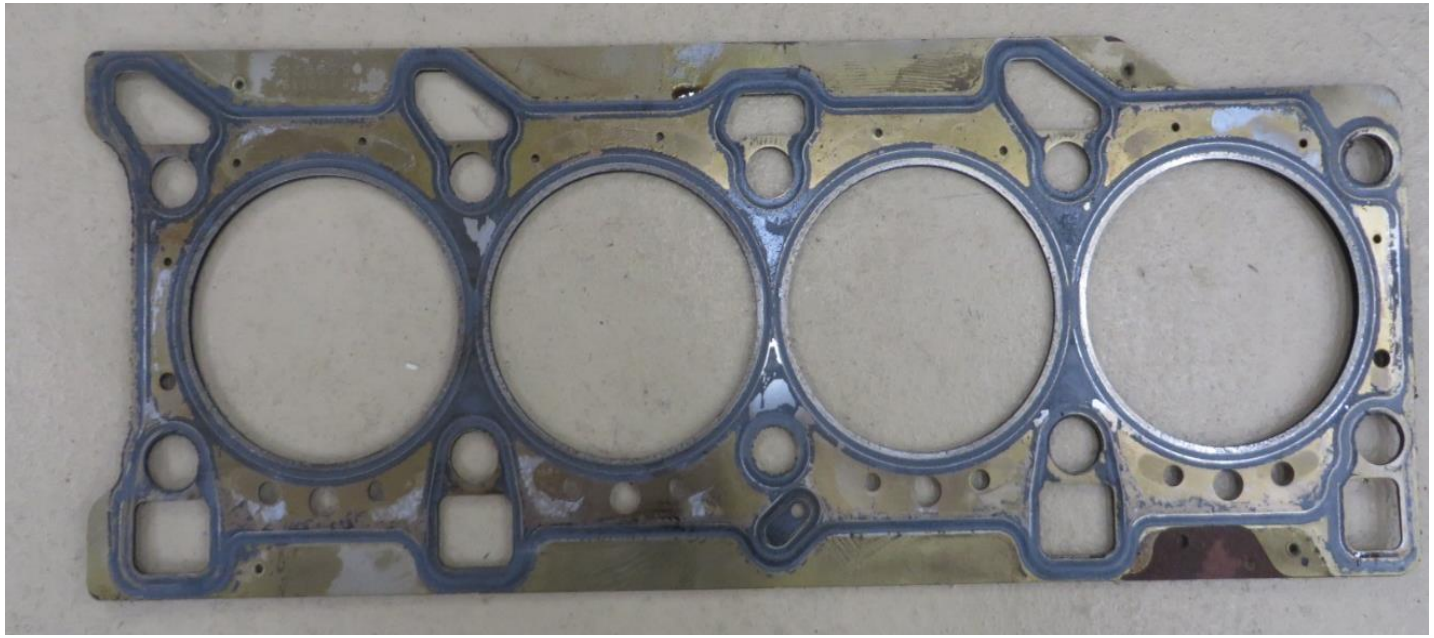
Teardown

- Two injectors tips from engine shown at right.



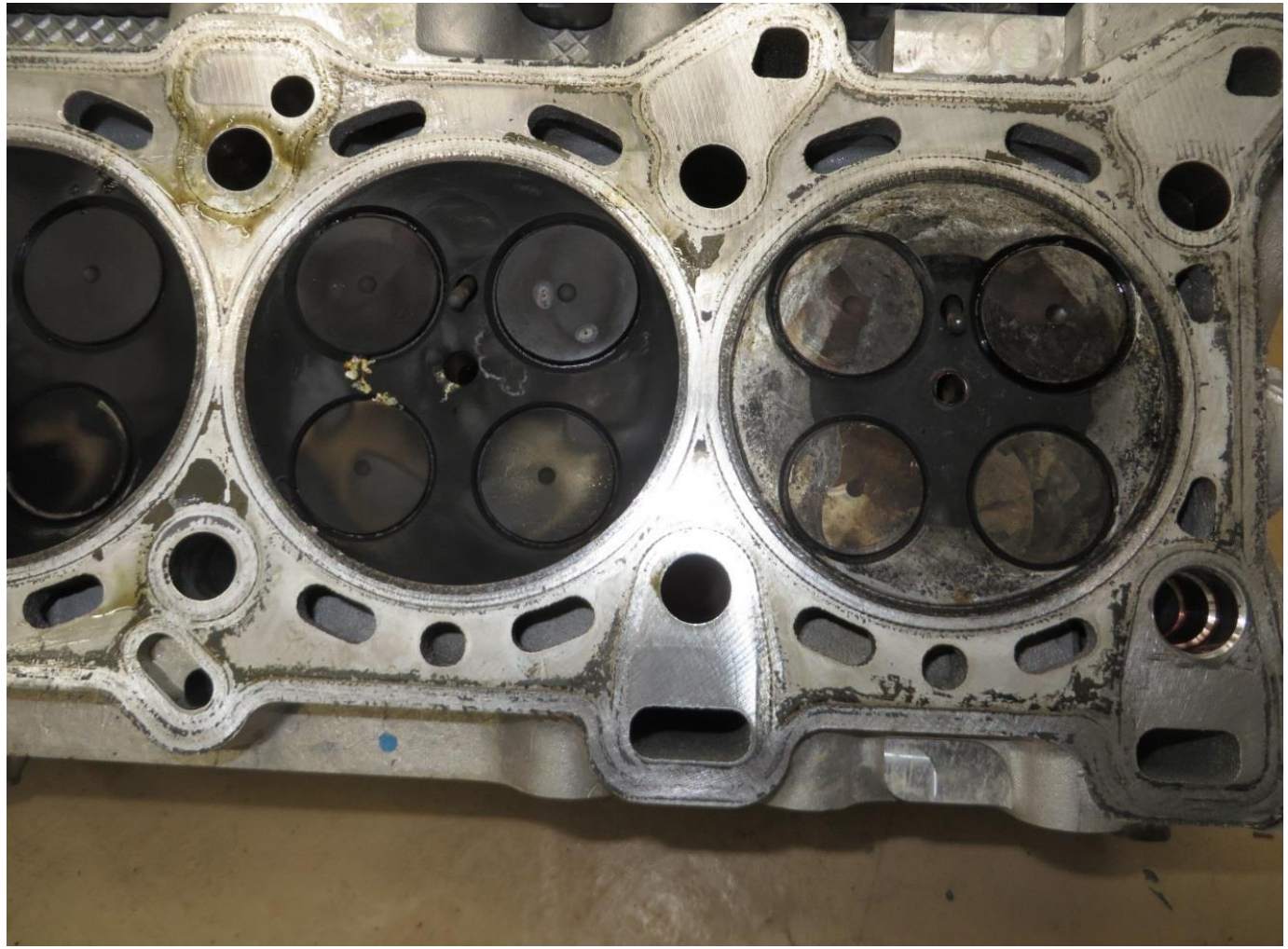
Teardown

- Head gasket shows no signs of leakage.



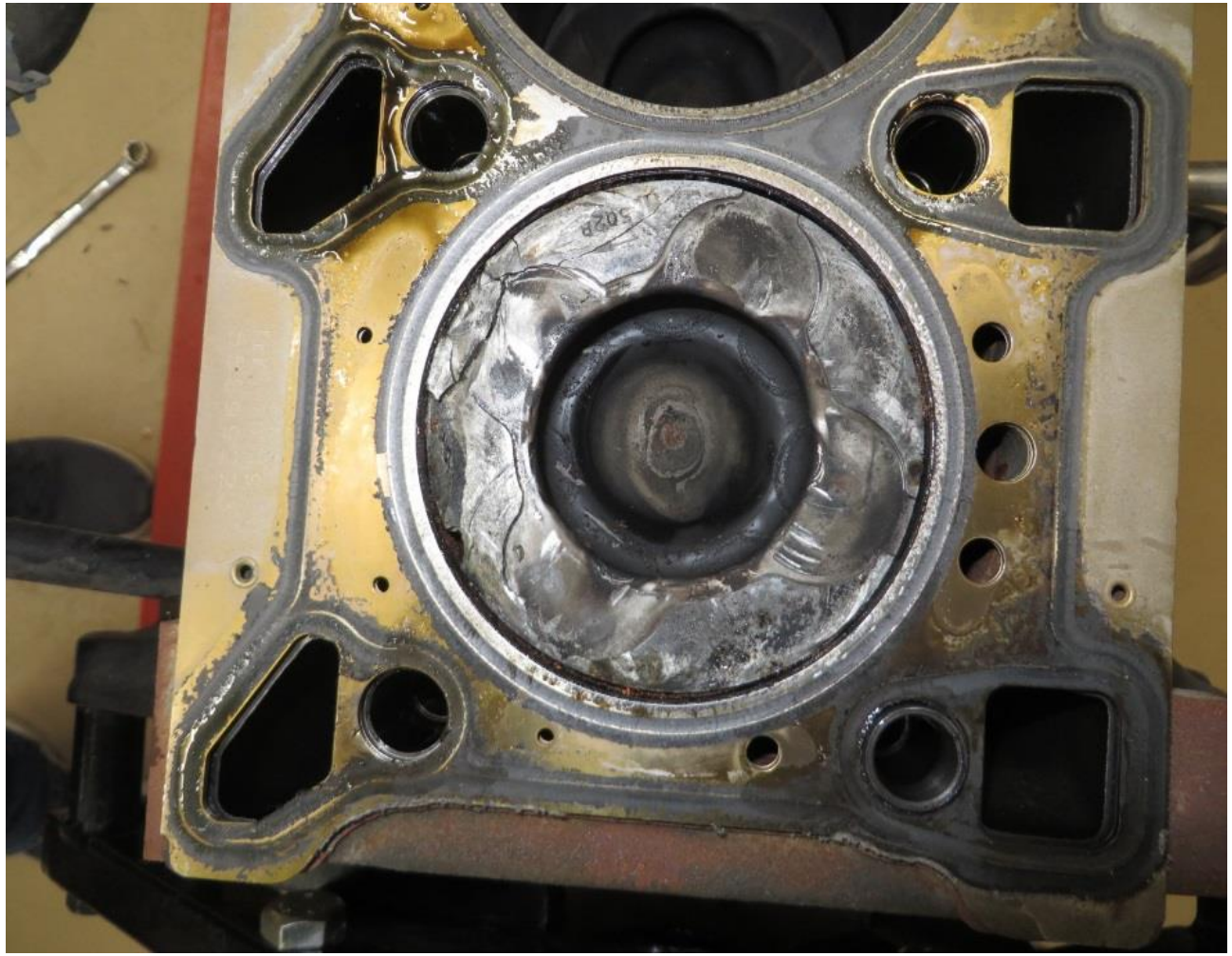
Teardown

- You can see the impression from the piston getting pushed into the head.
- This indicates failure on the bottom side of the piston as it let go from connecting rod.



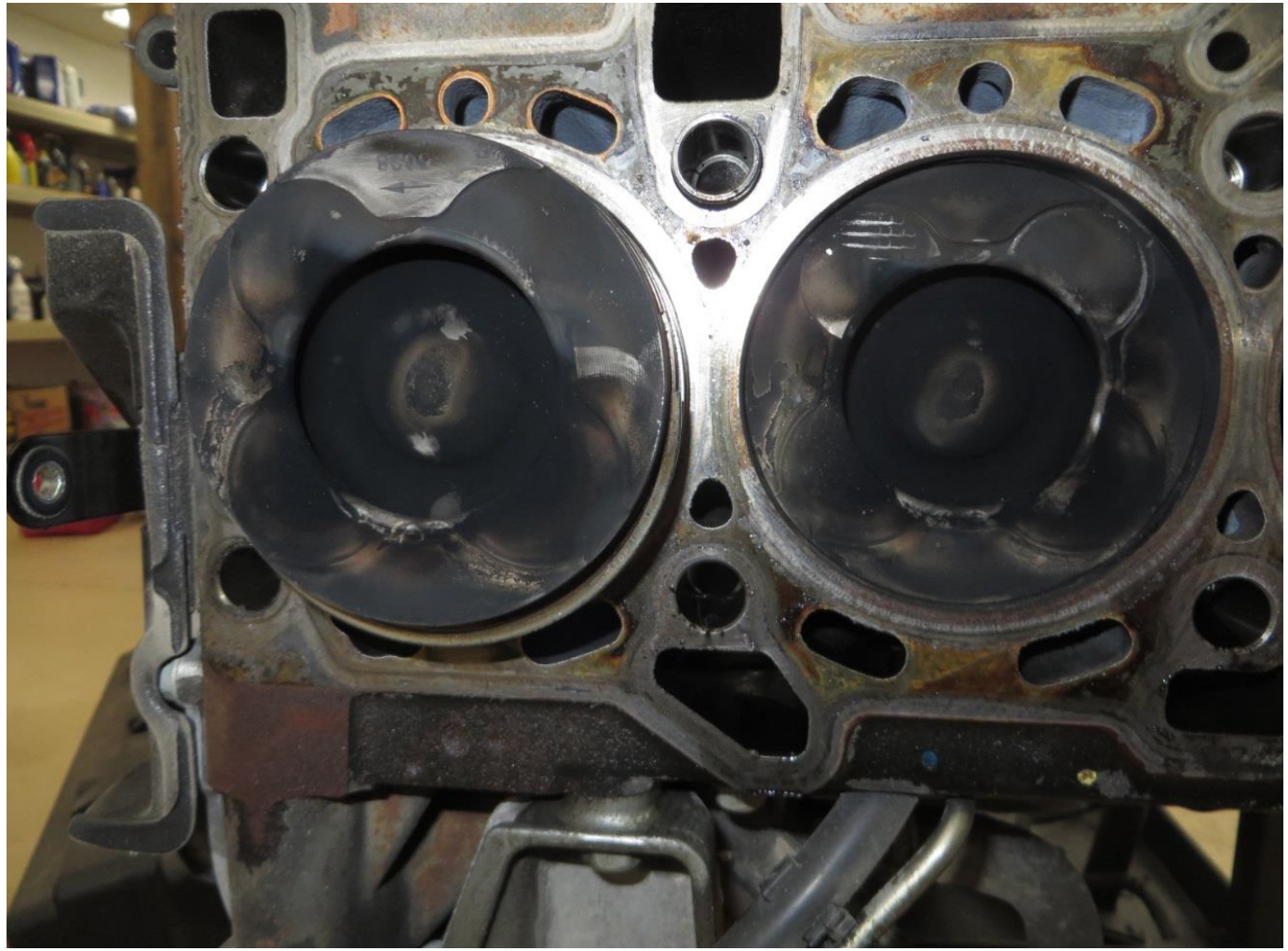
Teardown

- After removing cylinder head, the piston is visible and still somewhat intact, albeit cracked in many pieces. It fell apart when knocked out of cylinder.
- The other three pistons looked fantastic and show normal wear for a low mileage engine.



Teardown

- Cylinders 1 and 2 are in very good shape with normal wear.



Teardown

- One of the good pistons was cleaned to see the spray contact pattern.
- The pattern shows the timing is in a good zone as the spray zones are inside and up to lip of bowl area.
- Early combustion will show spray zones further out on top of piston.
- Piston failures from timing advance tend to fail with a longitudinal crack propagating across piston. There is no evidence of that type of failure here.

Teardown

- Piston skirts show normal wear

Teardown

- Large end of the connecting rod bearings show normal signs of wear.

Teardown

- The small end of the connecting rods are in good condition.
- The failed connecting rod did not have the small end attached and it was missing from engine.

Teardown

- The piston from the bottom view shows the severity of the damage.
- It appears the failure occurred in the wrist pin to piston connection.

Teardown

- After removing the piston from cylinder bore, the little fractures fell off.
- This also shows the injector spray pattern well.

Teardown

- The oil jets spray into a hole in underside of piston to supply oil cooling internally. This oil also dribbles down through a weep hole to lubricate the small end of connecting rod.
- The oil jets have a ball valve to stop oil flow at low pressure.
- Pictured are the #2 cylinder and #4 failed cylinder.

Teardown

- See the larger holes for oil jet spray (in/out).
- The small hole near center of piston is where oil dribbles out to lubricate the small end of connecting rod.
- This is the underside of #3 piston.

Teardown

- The wrist pin fracture is concerning. It shows signs of fatigue failure (lip in fracture zone on right side of picture) and then it reached a point where the pin split in two, note the clean fracture on most of the surface area.
- The galling on the finished surface is also indicative of some material issues.

Failure Assessment

- There was a quality issue on the wrist pin due to poor heat treatment when the part was manufactured. The bad heat-treat leads to a weak wrist pin and eventual failure on a stock or tuned engine.
- We are sending the failed wrist pin and a few good ones for metallurgical analysis for confirmatory testing.

Appendix

- We did some investigating on other similar failures in the field on the 2.8l (single failed cylinder). There have been a few single cylinder failures on stock and tuned engines.
- Failed engines on this application commonly have an injector tip failure or a piston failure.
- Below are a few pictures of a failed engine with 45,000 miles and stock tuning 2016 model.

Appendix

- This stock engine also had a failure of the wrist pin.
- Similar dent in center of pin that initiates a fatigue failure.
- The pin failed before it cracked the piston.

Appendix

- Only one side of the piston was blown out.
- If the engine was run a bit longer the failure would have propagated fully.

Appendix

- Note the groove cut into bushing. It lines up with the wrist pin fracture point.