(The following report is provided by Aerospace Engineer Jeff Janusz from the Wichita Aircraft Certification Office. Affected Cessna models are the 310, 320, 321, 335, 340, 401, 402, 404, 411, 414, and 421 Series aircraft. This counsel is published as received, along with contact information at the article's end.)

This article provides needed attention to the severe consequences of failing to properly maintain exhaust systems on Cessna twin engine airplanes. All owners, maintenance technicians, and inspectors are encouraged to reacquaint themselves with the requirements of Airworthiness Directive (AD) 2000-01-16.

The twin engine, Cessna design is unique—having its turbocharger hard-mounted to the airframe. Consequently, the exhaust system must accommodate the movement of the engine on its shock mounts by a system of ball and slip joints. If those joints stiffen up in service (as they do), significant stress may be transferred to exhaust components aft of the slip joints (specifically elbows and the Wye duct header bolted under the turbocharger). This can result in fatigue failure, particularly at the flanges where the components are joined by V-band clamps. The twin Cessna's exhaust is also unique in that the exhaust plumbing passes through tunnels in the canted airframe bulkhead (via elbows), and through the engine nacelles (via tailpipes). They are quite difficult to inspect visually. This is why the pressure test and tailpipe removal mandated by AD 2000-01-16 is so critical.

Additionally, unlike other manufacturers' aircraft, the twin Cessna models mount their engines on aluminum box beams passing through the firewall and tying into the wing structure. The exhaust plumbing passes very close to these aluminum engine mount beams. An exhaust failure in this area can burn a hole in this part, allowing hot exhaust gas to flow through the beam—routing behind the firewall in proximity to the aluminum cross-feed fuel lines. This scenario can lead to overheating and rupture of the fuel-cross feed line and result in an uncontrolled, fuel-fed fire. This failure has led to a number of fatal accidents. Additionally, 300 series and early 400 series Cessna twins are not equipped with cross-feed shutoff valves, so in the event of an in-flight fire it is impossible to shut off the fuel supply to these cross-feed lines.

The Cessna twin exhaust systems have been the subject of numerous FAA AD's and NTSB Safety Recommendations since the 1970's. AD 2000-01-16 was developed through an FAA/Industry effort in the late 1990's to address numerous exhaust system failures and fatal accidents (30 fatal in 30 months). With the development of the AD, the FAA elected to manage an unsafe condition on these products by means of mandatory repetitive inspection requirements as defined in the directive. It is critical that it be understood—these exhaust system failures can result in an undetected and uncontrolled fuel-fed fire, resulting in engine beam, canted bulkhead and/or firewall damage, and potentially catastrophic wing failure.

Nine years after the implementation of AD 2000-01-16, there is evidence the AD required inspections are not being conducted properly—or not at all. "Pencil-whipped" is the ubiquitous term often suggested as cause for this problem. It means, of course, "...failure to perform." There may also be a lack of understanding of the AD requirements, experience with the AD, or the criticality to safety these required exhaust system inspections pose.

There is safety data indicating the AD has been effective, but only when accomplished properly. The AD is lengthy, detailed, and has repetitive inspection requirements that cover many aspects of the exhaust system. The AD requires diligence to accomplish properly and offers few opportunities for carelessness without serious consequence. The criticality of this safety issue

warrants direct, careful adherence to the AD, without short cuts or deviations which may lead to exhaust system failure.

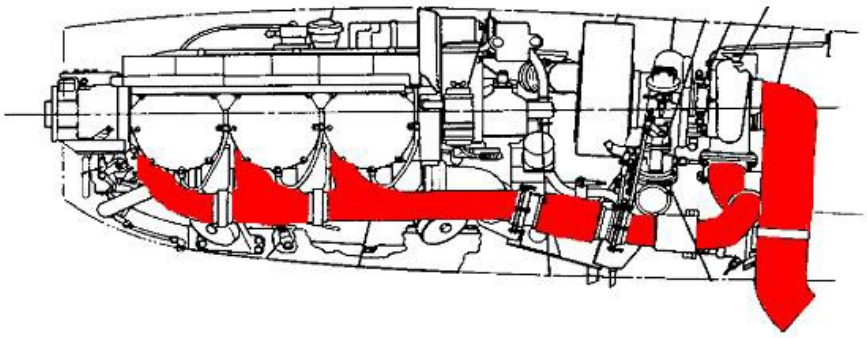
New evidence indicates exhaust system parts have failed after satisfactorily passing numerous inspections and being *signed off* with no discrepancies noted. The failures appear to be due to improper assembly of the exhaust system after engine or exhaust system inspection, repairs or overhaul. The improper installation resulted in the parts being preloaded (pre-stressed), eventually leading to fatigue failure. These failures had also gone undetected through multiple inspection cycles.

Presented below is a single incident based on an airplane that went through the multiple AD required inspection cycles satisfactorily with no discrepancies. The story is presented in photographs (1 thru 6) of the exhaust *Wye* from the incident airplane. Unexplained loss of manifold pressure at high altitude prompted an owner's demand for a reexamination of the turbocharger and exhaust systems per the AD. The exhaust system *Wye* (on which the turbocharger is mounted) was found to have potentially catastrophic fatigue and burn through failures. This airplane had also satisfactorily completed two annual inspections. The *Wye* had 40 hours time since its last inspection. It was made of stainless steel and had no record of any weld repairs.

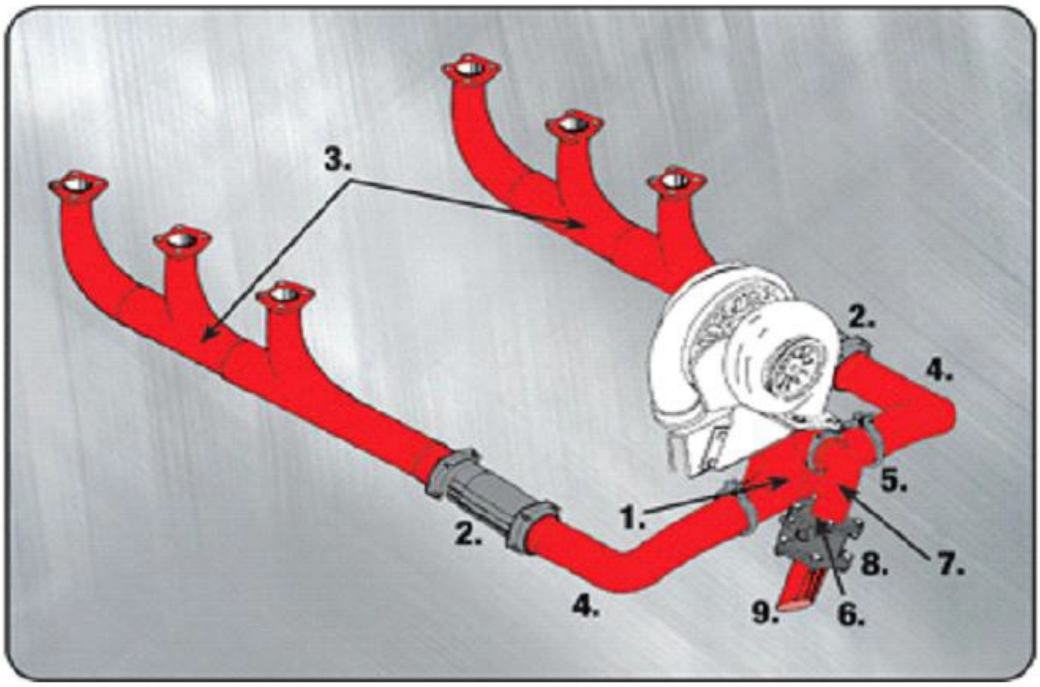
The owner, operator and maintenance community must be aware of the extreme importance of conducting detailed inspections per the AD, and taking the necessary corrective action. For example, when conducting the AD required pressure test, be sure all nacelle/cowling pieces, heat shields, inspection access panels (and the like) are removed. There should be a complete and unimpeded view of all joints and components being inspected or pressure tested. When conducting the required pressure test, be certain there leak-check fluid is being used. Be careful to not mask or miss serious problems by using a noisy, unregulated source of air in an attempt to listen for “hissing” from an exhaust joint.

It is extremely important all exhaust system components removed or replaced for any reason be installed carefully and without preload, using approved, accepted methods and techniques. Cessna has available service manual information and numerous service publications which address exhaust systems. These exhaust systems have a very good safety record if regularly and properly inspected, but the importance of these inspections to safety-of-flight cannot be overstated.

FAA would like to thank Byron Allen (340A owner/operator), Mike Busch (Savvy Aircraft Maintenance Management/Savvy Aviator, Inc.), John Frank and the Cessna Pilots Association for their assistance in bringing this significant and potentially catastrophic safety issue to the forefront again.

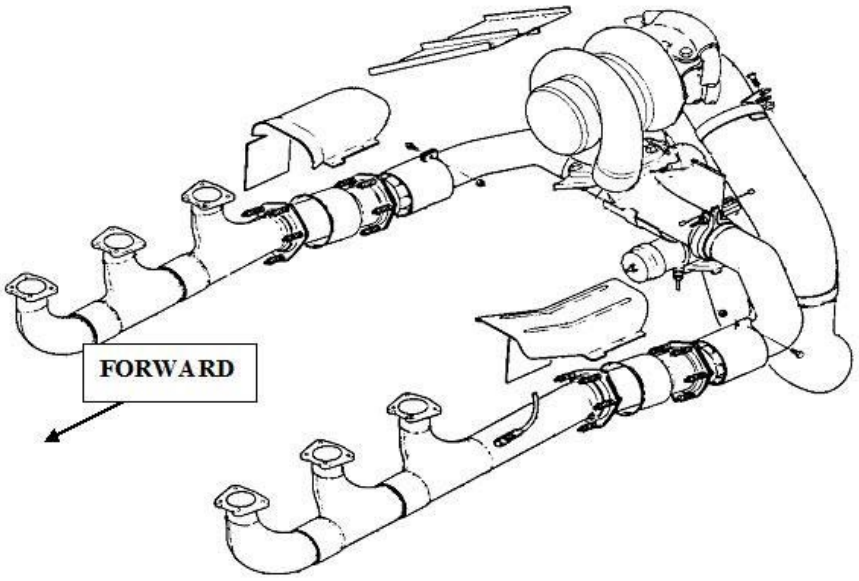


Typical Cessna twin exhaust installation shown in red above and below.

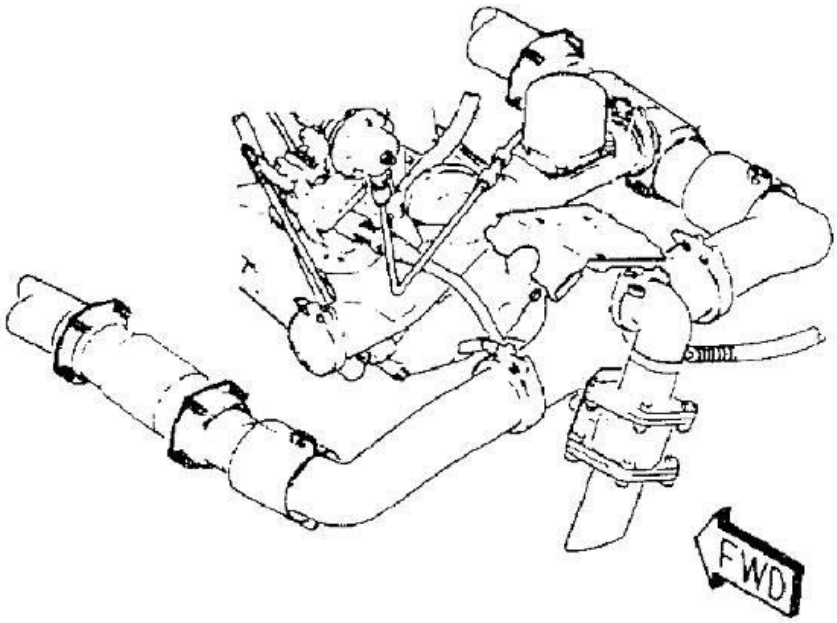


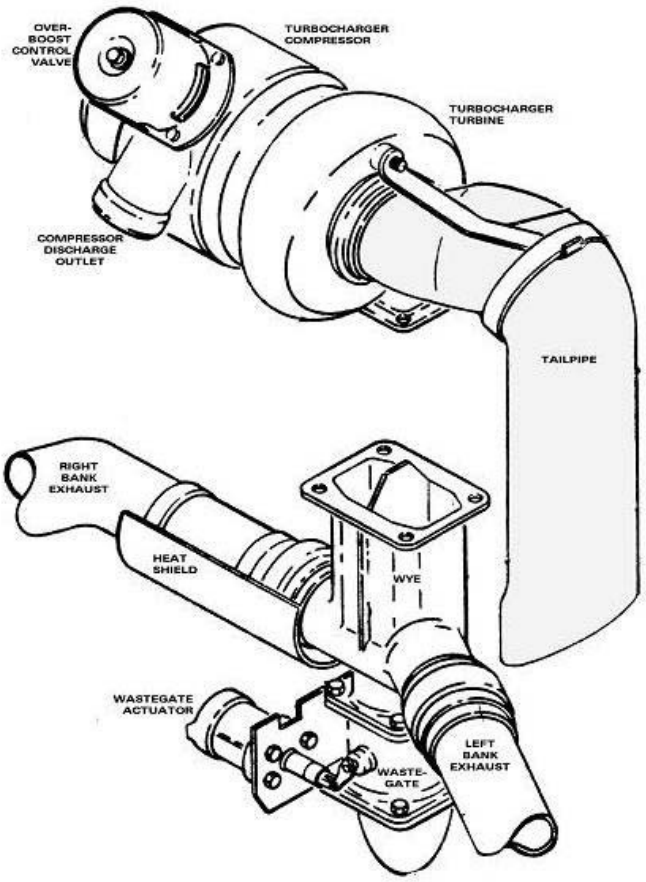
KEY

1. Wye duct, header assembly
2. Slip joint, ball joint
3. Riser
4. Elbow, manifold
5. Clamp
6. Waste-gate inlet
7. Wye to waste-gate elbow
8. Waste-gate valve
9. Waste-gate discharge

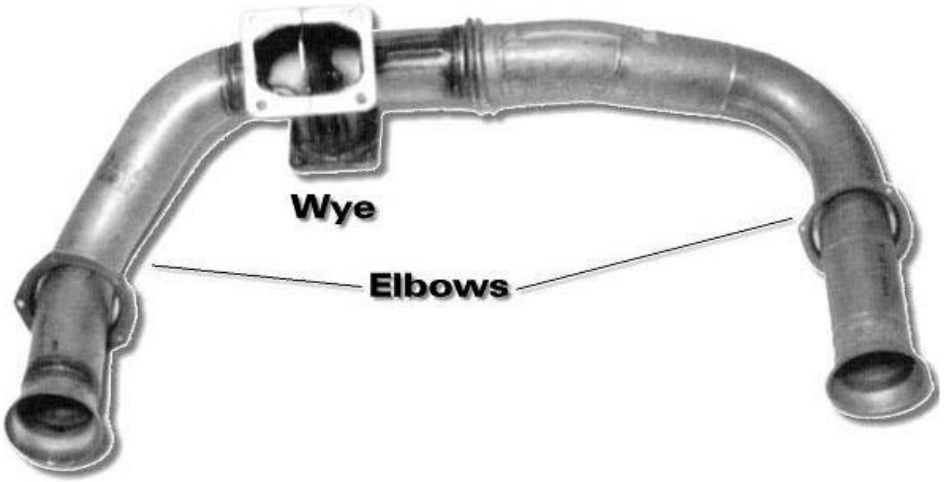


Typical Cessna twin exhaust system components with turbocharger installed above and without the turbocharger installed, below.
Refer to the applicable model Service Manual and Illustrated Parts Catalog for specific components.





Typical Cessna twin exhaust system components aft of the slip joints.



Typical Cessna twin exhaust system aft of the slip joint

New wye duct (header assembly); viewed as installed, looking forward.

Photo 1: Wye, with failed internal baffle.

Photo 2: Wye waste-gate elbow attach flange fatigue failure.

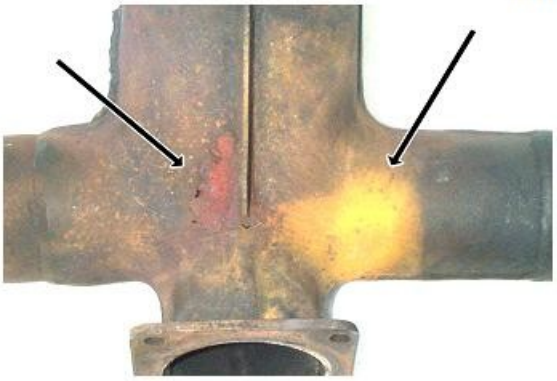
Photo 3:

Photo 4:

Photo 5: 3° deflection of the wye waste-gate attach flange due to preloaded installation and subsequent fatigue failure.

Photo 6:

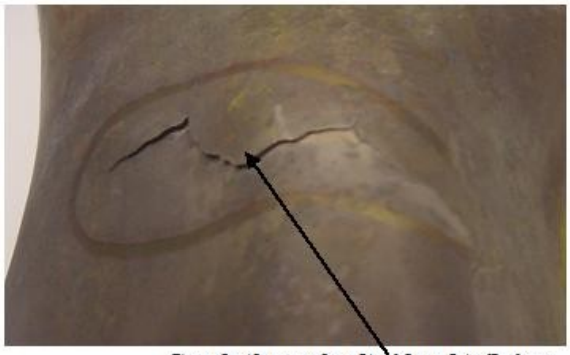
Another typical wye which appears normal until thorough inspection reveals a burn through hole on the aft side (arrow)



Another example of wye forward surface with pin holes through (left arrow) and staining (right arrow).

A tailpipe; with arrow pointing to crack through forward surface.

Crack through forward side of tailpipe.



Crack through aft side of tailpipe

Part Total Time: (n/a).