Ford Motor Company

FCSD

Technical Training

INTERACTIVE STUDY GUIDE

FIRTFT
7.3L DIT TURBOCHARGER DIAGNOSIS AND REPAIR

FCS-13865-DL

Ford

FORDSTAR DEALER COMMUNICATIONS NETWORK

Ford Customer Service Division
Technical Training

MAY 20, 2003

COURSE CODE: 51G01F0

IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles, as well as the personal safety of the individual doing the work. This manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools and parts for servicing vehicles, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from instructions provided in this manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

As you read through the procedures, you will come across NOTES, CAUTIONS, and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in PARK unless instructed otherwise for a specific service operation. If you have a manual transmission it should be in REVERSE (engine OFF) or NEUTRAL (engine ON) unless instructed otherwise for a specific service operation.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on the vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle. Tie long hair securely behind your head.
- Keep hands and other objects clear of the radiator fan blades. Electric cooling fans can start to operate at any time by an increase in underhood temperatures, even though the ignition is in the OFF position. Therefore, care should be taken to ensure that the electric cooling fan is completely disconnected when working under the hood.

The recommendations and suggestions contained in this manual are made to assist the dealer in improving his dealership parts and/or service department operations. These recommendations and suggestions do not supersede or override the provisions of the Warranty and Policy Manual, and in any cases where there may be a conflict, the provisions of the Warranty and Policy Manual shall govern.

The descriptions, testing procedures, and specifications in this handbook were in effect at the time the handbook was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications, design, or testing procedures without notice and without incurring obligation. Any reference to brand names in this manual is intended merely as an example of the types of tools, lubricants, materials, etc. recommended for use. Equivalents, if available, may be used. The right is reserved to make changes at any time without notice.

WARNING: MANY BRAKE LININGS CONTAIN ASBESTOS FIBERS. WHEN WORKING ON BRAKE COMPONENTS, AVOID BREATHING THE DUST. BREATHING THE ASBESTOS DUST CAN CAUSE ASBESTOSIS AND CANCER.

Breathing asbestos dust is harmful to your health.

Dust and dirt present on car wheel brake and clutch assemblies may contain asbestos fibers that are hazardous to your health when made airborne by cleaning with compressed air or by dry brushing.

Wheel brake assemblies and clutch facings should be cleaned using a vacuum cleaner recommended for use with asbestos fibers. Dust and dirt should be disposed of in a manner that prevents dust exposure, such as sealed bags. The bag must be labeled per OSHA instructions and the trash hauler notified as to the contents of the bag.

If a vacuum bag suitable for asbestos is not available, cleaning should be done wet. If dust generation is still possible, technicians should wear government approved toxic dust purifying respirators.

OSHA requires areas where asbestos dust generation is possible to be isolated and posted with warning signs. Only technicians concerned with performing brake or clutch service should be present in the area.

Produced and Coordinated by
Technical Support Operations
Ford Customer Service Division

May 20, 2003

Ford Motor Company

CUSTOMER EXPECTATIONS

Customer Expectations: Service

1. Make it convenient to have my vehicle serviced at your dealership.
2. The Service Advisor should demonstrate a genuine concern for my service needs.
3. Fix it right the first time.
4. Complete servicing my vehicle in a timely and professional manner.
5. Provide me with a clear and thorough explanation of the service performed.
6. Call me within a reasonable amount of time after my service visit to ensure that I'm completly satisfied.
7. Be responsive to questions or concerns I bring to your attention.

Expectation 3

"Fix It Right The First Time, On Time."

Both service advisors and technicians are important players when it comes to Expectation #3.

Why

Customers tell us "Fixing It Right The First Time, On Time" is one of the reasons they would decide to return to a dealer to buy a vehicle and get their vehicles serviced.

Technician Training

It is our goal to help the technician acquire all of the skills and knowledge necessary to "Fix It Right The First Time, On Time." We refer to this as "competency."

Technician's Role

Acquire the skills and knowledge for competency in your specialty via:

STST

- Self Study
- FORDSTAR Broadcasts
- Ford Multimedia Training (FMT)
- Instructor Led

New Model

- Self Study
- FORDSTAR Broadcasts
- Instructor Led

The Benefits

The successful implementation of expectations means:

- Satisfied customers
- Repeat vehicle sales
- Repeat service sales
- Recognition that Ford and Lincoln/Mercury technicians are "the Best in the Business"

INTRODUCTION

LESSON 1: OVERVIEW

LESSON 2: PERFORMANCE

LESSON 3: NOISE

LESSON 4: OIL LEAKS AND OIL CONSUMPTION

TABLE OF CONTENTS

Ford Motor Company

FCSD

Technical Training

This distance learning course you are about to take is intended to give you new knowledge and information about diagnosing and servicing Ford vehicles. We hope you apply this knowledge and information to "Fix It Right The First Time" as part of our effort to satisfy our customers, the owners of Ford, Lincoln and Mercury products.

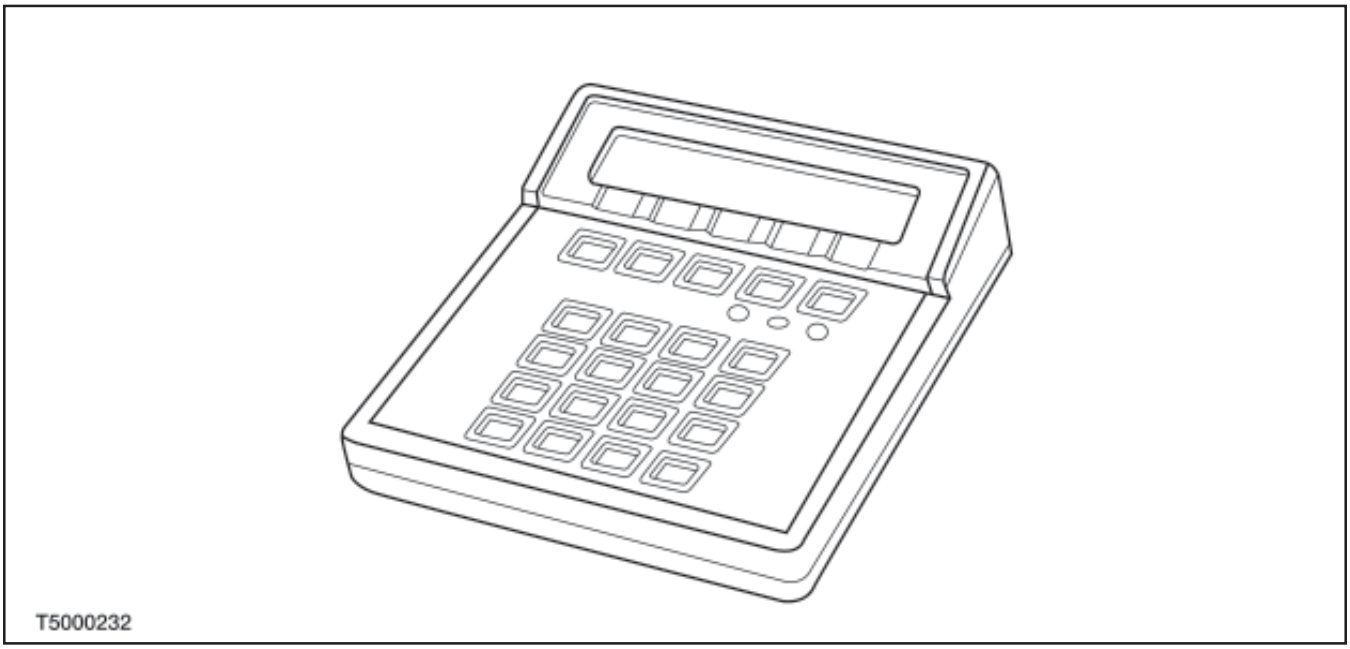
Ground Rules for Successful Completion

This course includes a Posttest.

Successful completion of this course requires you to correctly answer a minimum of 80% of the Posttest questions.

Other questions (warm-up and eval) asked during class are not counted toward your successful completion of this course.

LOGGING ON



Your response keypad transmits data and voice between you and the host site via telephone lines and satellite.

It is your “lifeline,” connecting you to the instructor as well as to other participants.

Using the keypad, you can become involved fully in the seminar, asking questions and contributing relevant comments.

To log on at the beginning of the broadcast session:

1. Enter your I.D. number (in response to the keypad prompt). If you press an incorrect key, press CLEAR and re-enter the numbers.
2. Press ENTER.
3. The system validates your I.D. number by displaying your name on the keypad. If your name does not appear on the keypad, re-enter your I.D. number.
4. If you cannot successfully log on, contact the FORDSTAR Help Desk:
   - USA dealers call 1-800-790-HELP (4357).
   - Canadian dealers call 1-800-467-8925.

KEYPAD OPERATION

CALL Key

- Press the CALL key if you have a question or comment. This places you in the call queue. The system indicates your name and location to the instructor.
- It takes approximately 60 seconds for the instructor to respond. If you change your mind about asking the question, simply press the CALL key again. As long as the instructor has not accepted your call, this takes you out of the call queue.

WAIT and SPEAK Lights

- The red WAIT light illuminates when your call is received and placed in the call queue.
- When the instructor calls on you, the green SPEAK light illuminates and your microphone is activated.
- The microphone is the gray dot between the SPEAK and WAIT lights. Speak in a normal tone of voice from a normal sitting position. The instructor will hear you, as will all the other students wherever they are located.

FLAG Key

- Use the FLAG key when requested by the instructor. The FLAG key is usually used to alert the instructor that you have completed a test or exercise.

PURPOSE

The purpose of this FORDSTAR course is to increase technician awareness of new diagnostic and repair procedures for 7.3L DIT Diesel engine turbocharger concerns.

BENEFITS

Upon completion of this course, technicians will have the knowledge to:

- Improve diagnostic performance.
- Provide more cost effective repairs.
- Improved Fix-It-Right-the-First-Time (FIRTFT) performance.

AGENDA

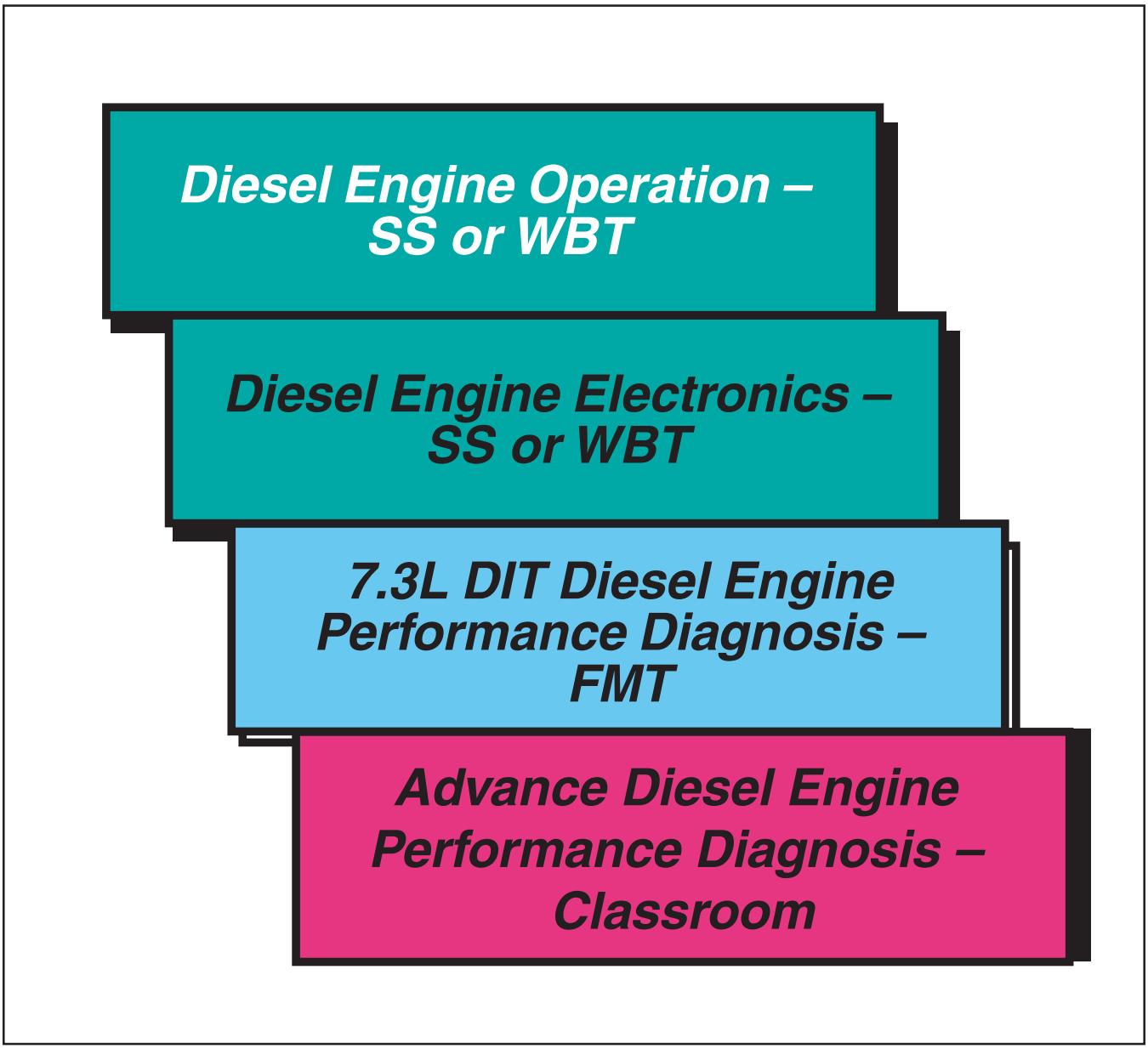
Following this introduction, information is arranged in the following order:

- Lesson 1: Overview
- Lesson 2: Performance
- Lesson 3: Noise
- Lesson 4: Oil Leaks and Oil Consumption
- Lesson 5: Aftermarket Modifications

ADDITIONAL 7.3L DIESEL FIRTFT COURSES

- FIRTFT Oil Leak Diagnosis and Repair
- FIRTFT High Pressure Pump Diagnosis and Repair
- FIRTFT Performance and Hard/No Start Diagnosis and Repair

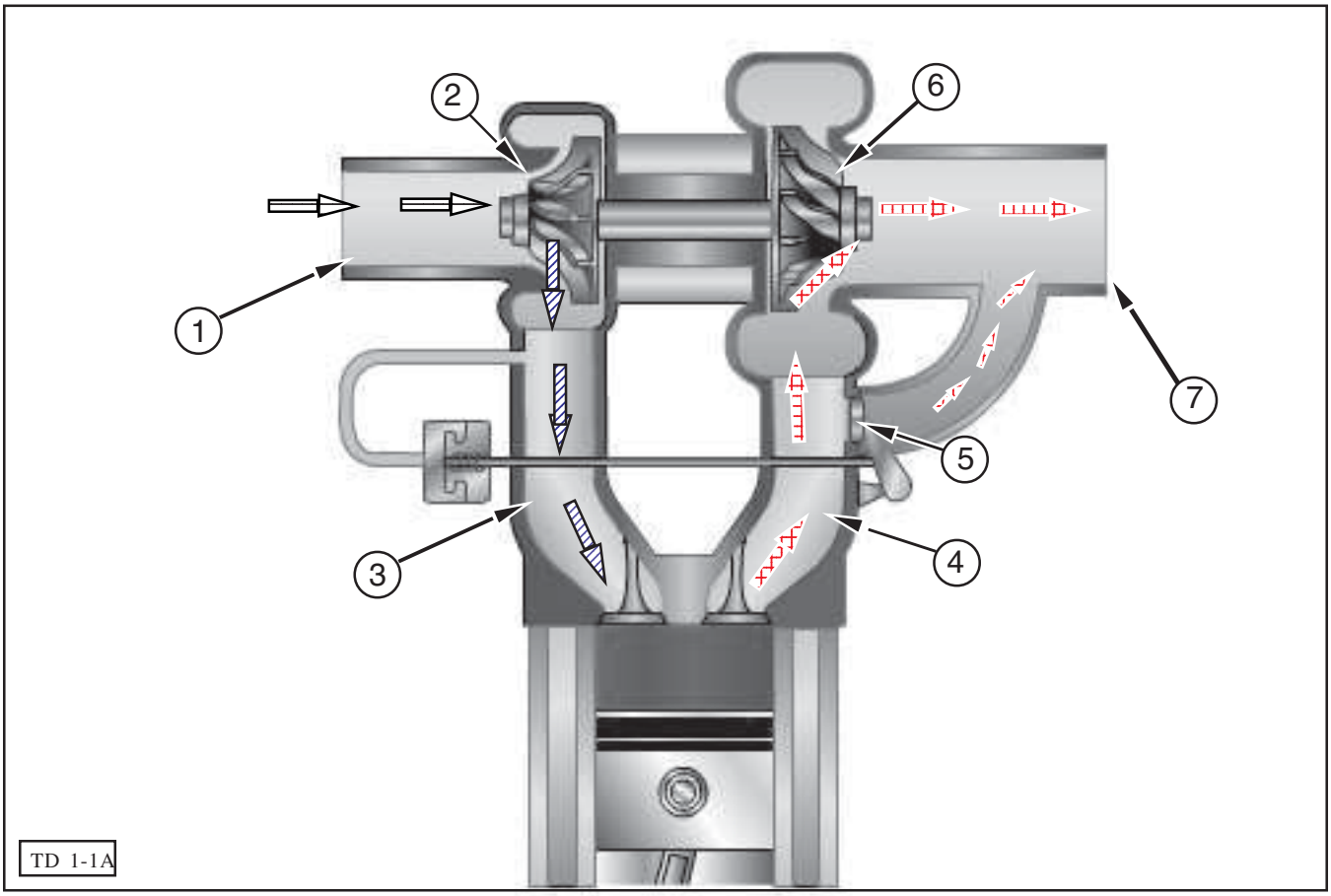
STST DIESEL TRAINING CURRICULUM



OBJECTIVES

- Describe turbocharger system components and operation.
- Identify normal and abnormal symptoms associated with turbocharger operation.
- Describe symptoms that may or may not be correctly attributed to the turbocharger.
- Use a logical diagnostic procedure to identify turbocharger and system related concerns.

TURBOCHARGER SYSTEM OPERATION



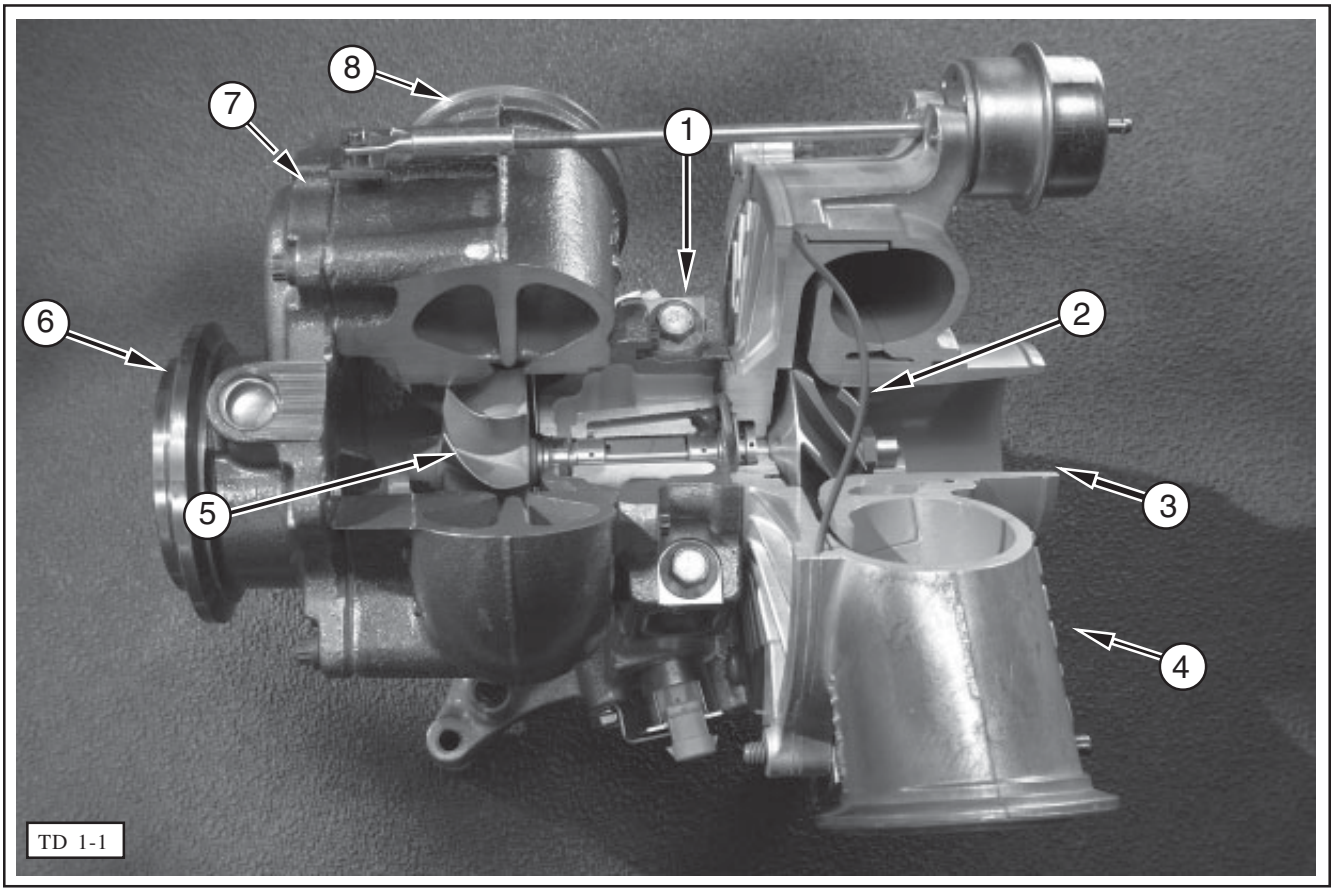
Turbocharger Operation

Item	Description	Item	Description
1	Air Inlet	5	Wastegate (F-Series)
2	Compressor	6	Turbine
3	Intake Manifold (Pressurized by Compressor)	7	Exhaust
4	Exhaust Manifold		

The turbocharger is a centrifugal air compressor that consists of a turbine wheel, and compressor wheel that are separately encased, but rotate with a common shaft.

- The turbine side of the turbocharger is placed in the exhaust stream where it can be exposed to the exhaust gases coming from the engine.
- The compressor wheel side is placed in the air inlet system. The power to drive the turbine comes from the hot expanding gasses within the exhaust.
- The higher the engine load, the more heat is created and the faster the turbine turns.
- The compressor, which is turning at the same speed as the turbine, takes in fresh air from the air inlet and compresses it into the intake manifold. This is referred to as boost pressure.
- To prevent overboosting, a wastegate allows exhaust gases to bypass the turbine wheel.

TURBOCHARGER CONSTRUCTION/COMPONENTS



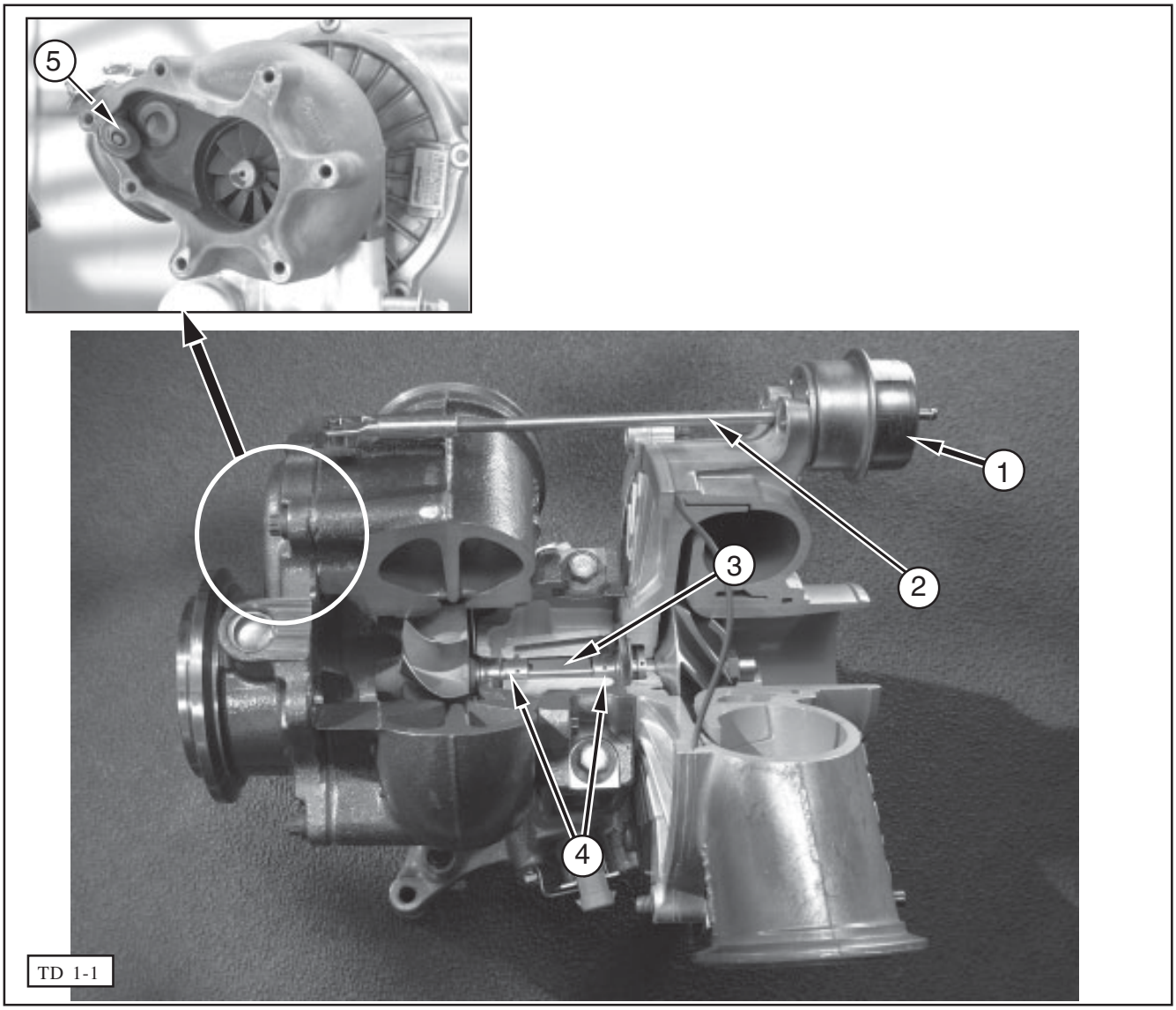
Turbocharger Cutaway

Item	Description	Item	Description
1	Center Housing	5	Turbine Wheel
2	Compressor Wheel	6	Turbine Outlet
3	Compressor Inlet	7	Turbine Housing
4	Compressor Housing	8	Turbine Inlet

Understanding how a turbocharger is part of a complete engine management system is essential in successfully diagnosing and repairing problems.

- The turbocharger system consists of the following components:
  - Center housing
  - Compressor wheel
  - Compressor housing
  - Compressor inlet
  - Turbine wheel
  - Turbine outlet
  - Turbine housing
  - Turbine Inlet

TURBOCHARGER CONSTRUCTION/COMPONENTS (CONTINUED)

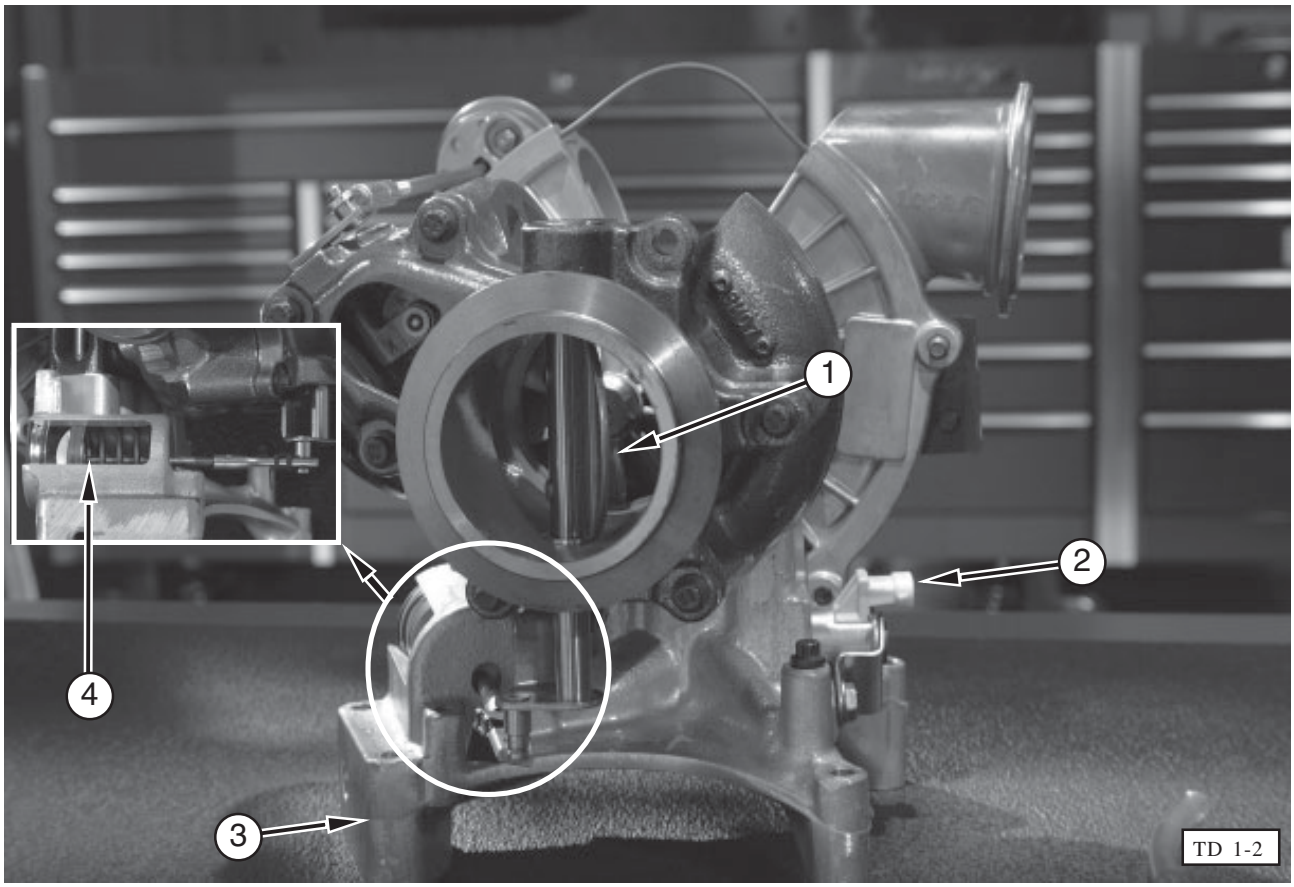


Turbocharger Cutaway

Item	Description	Item	Description
1	Wastegate Actuator	4	Turbo Shaft Bearings
2	Wastegate Linkage	5	Wastegate (open position)
3	Turbo Shaft		

- Wastegate actuator
- Turbo shaft
- Turbo shaft bearings
- Wastegate
- Wastegate linkage

TURBOCHARGER CONSTRUCTION/COMPONENTS (CONTINUED)

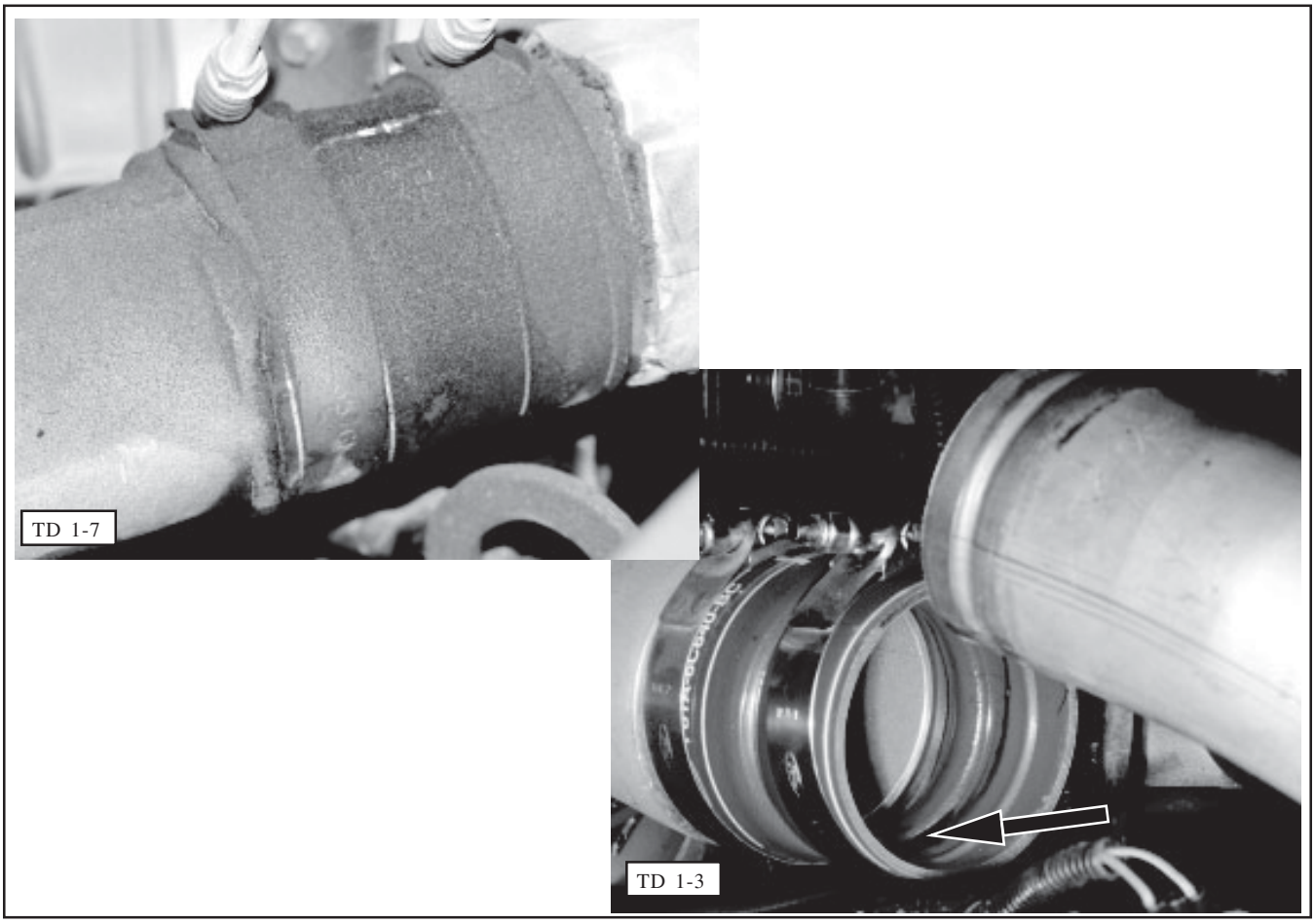


Cutaway Turbocharger (exhaust side)

Item	Description	Item	Description
1	Exhaust Backpressure (EBP) Valve	3	Turbocharger Pedestal
2	Exhaust Backpressure Regulator Solenoid Valve	4	Exhaust Backpressure Actuator Assembly

- Exhaust backpressure (EBP) valve
- Turbocharger pedestal
- Exhaust backpressure regulator solenoid valve
- Exhaust backpressure actuator assembly

NORMAL VS. ABNORMAL TURBOCHARGER OPERATION

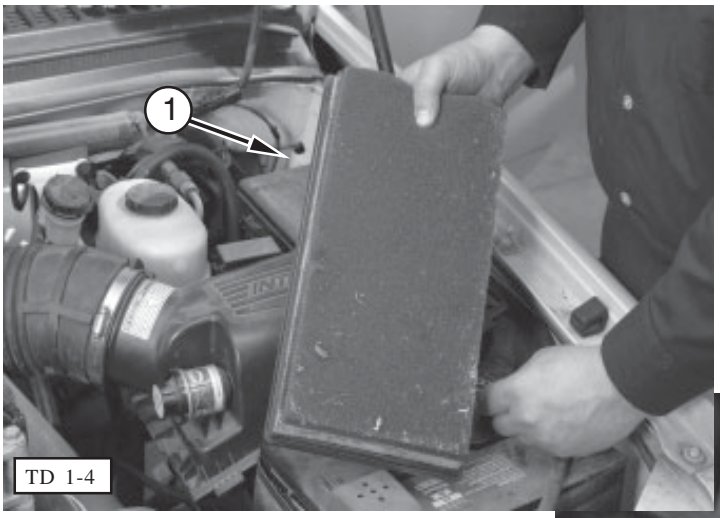


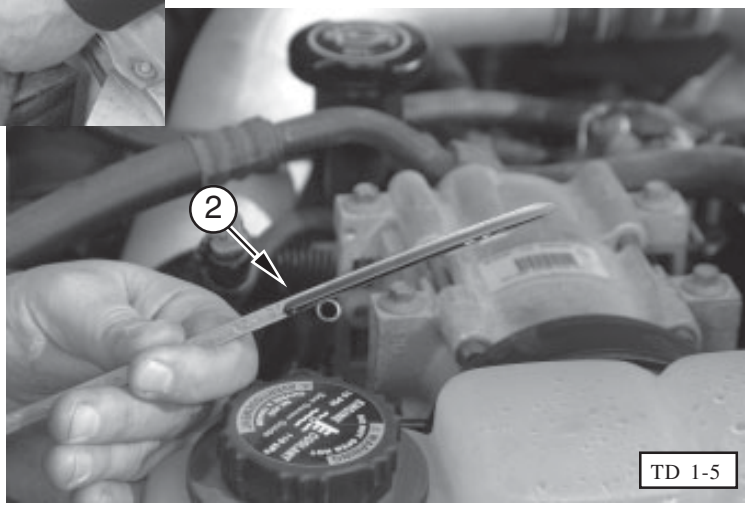
Normal Oil Seepage in Charge Air Cooling (CAC) Tube

Often poor power, noise, oil concerns and oil leak concerns are incorrectly attributed to the turbocharger. It is important to be familiar with the normal operating characteristics of a turbocharger system.

- Normal turbocharger characteristics include:
  - Some oil seepage
  - Oil in exhaust systems on new units
  - Minimal oil carry over
  - Some noise
  - Some turbo lag
- Abnormal turbocharger characteristics include **excessive**:
  - Oil consumption
  - Oil leaks
  - Noise
  - Turbo lag

NORMAL VS. ABNORMAL TURBOCHARGER OPERATION (CONTINUED)





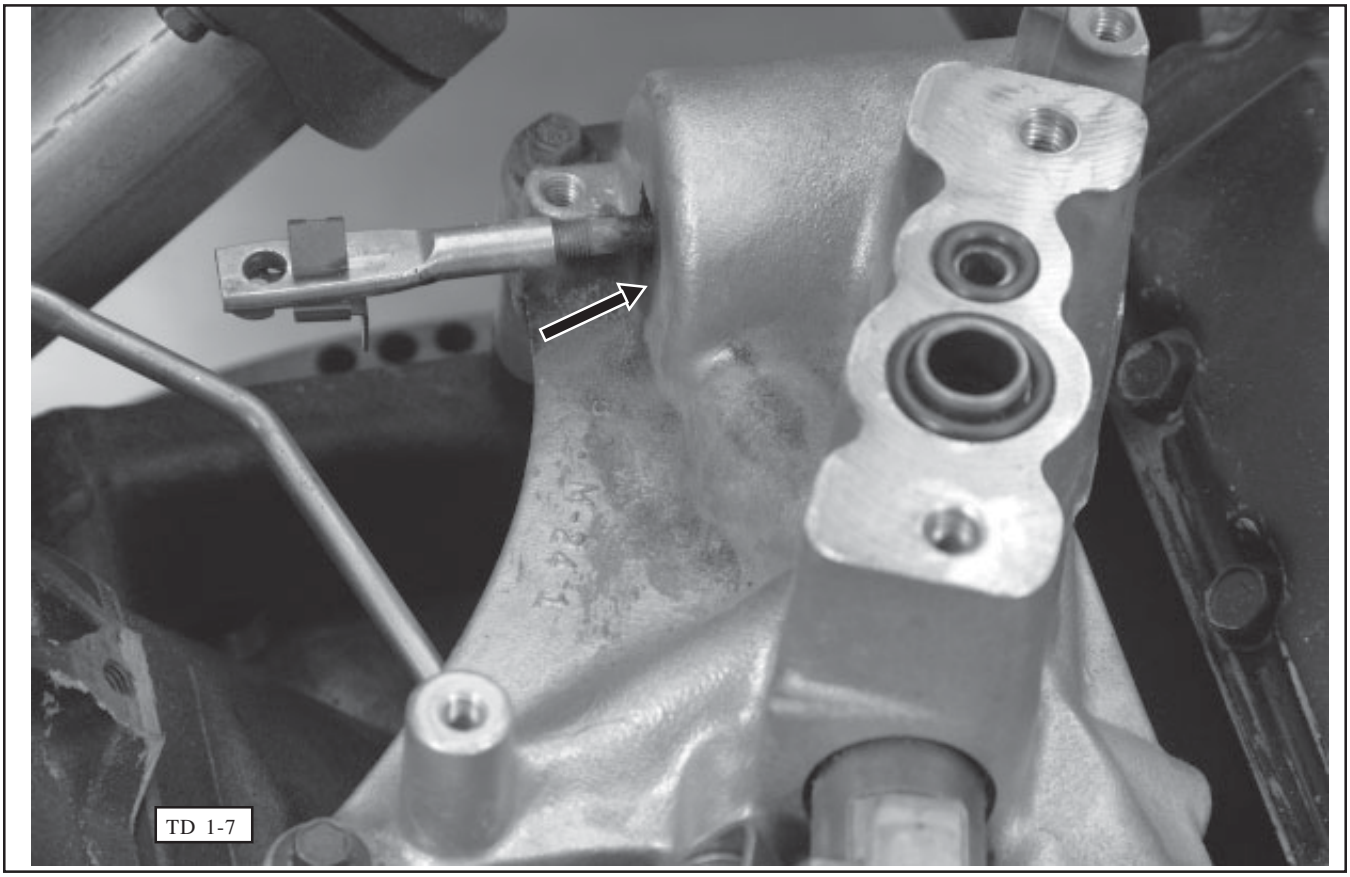
Examples of Poor Maintenance

Item	Description	Item	Description
1	Plugged Air Filter (Poor Maintenance)	2	Overfilled Oil (Poor Maintenance)

All too frequently, serviceable turbochargers are removed from engines before the cause of the problem has been determined. Always inspect and assess turbocharger condition before removal from the engine. A working turbocharger is very unlikely to be found defective at a later date. The speeds and temperatures normally seen in turbocharger operation usually will identify defects very quickly.

- Turbochargers are often replaced by mistake for the following reasons:
  - Poor performance
  - Oil leaks/oil consumption
  - Noise
- Most turbocharger failures result from:
  - Poor maintenance (air/oil)
  - Modifications (increasing turbocharger speed)

NORMAL VS. ABNORMAL TURBOCHARGER OPERATION (CONTINUED)



Normal Oil Seepage on Outside of Turbocharger Pedestal

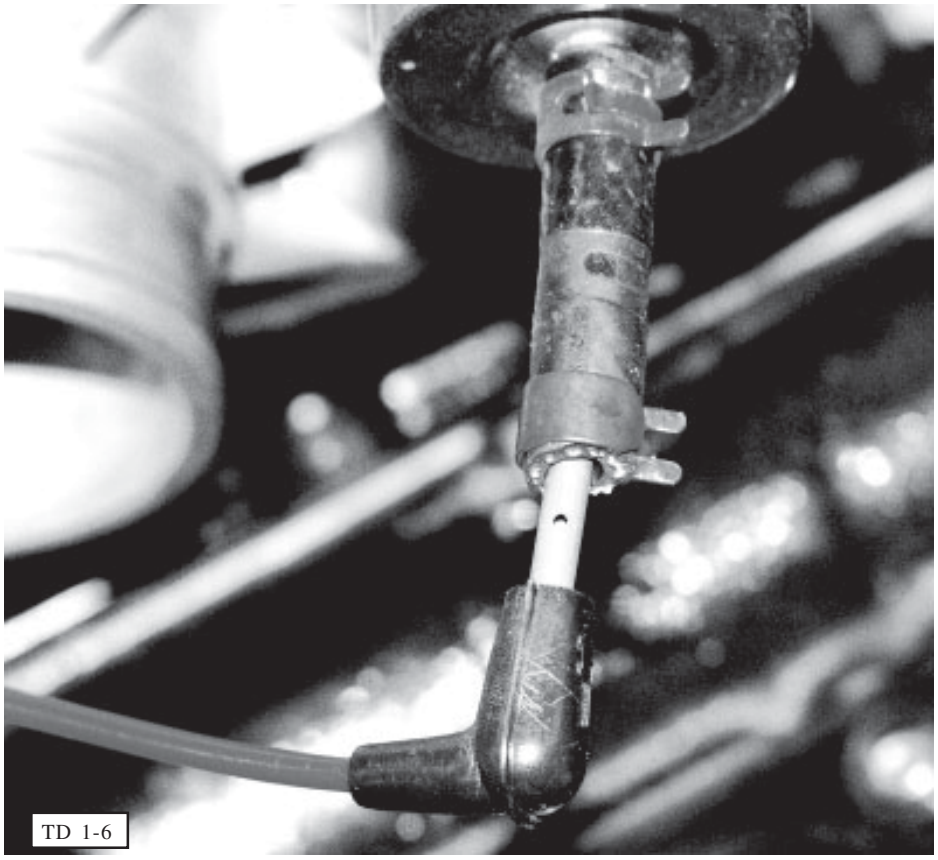
Oil Leaks

Another observation that has caused turbochargers to be replaced is oil leakage at the turbocharger.

- In many cases the turbocharger is not at fault but rather the O-ring seals between the turbocharger and the pedestal or the O-ring seal between the pedestal and the crankcase.
- These O-rings are available as service parts.
- If a leak is experienced at the EBP actuator, do not replace the turbocharger assembly. Replace the EBP actuator rod seal using the appropriate service part kit.

Note: It is normal to see some oil seepage past the seal on the EBP actuator rod.

NORMAL VS. ABNORMAL TURBOCHARGER OPERATION (CONTINUED)



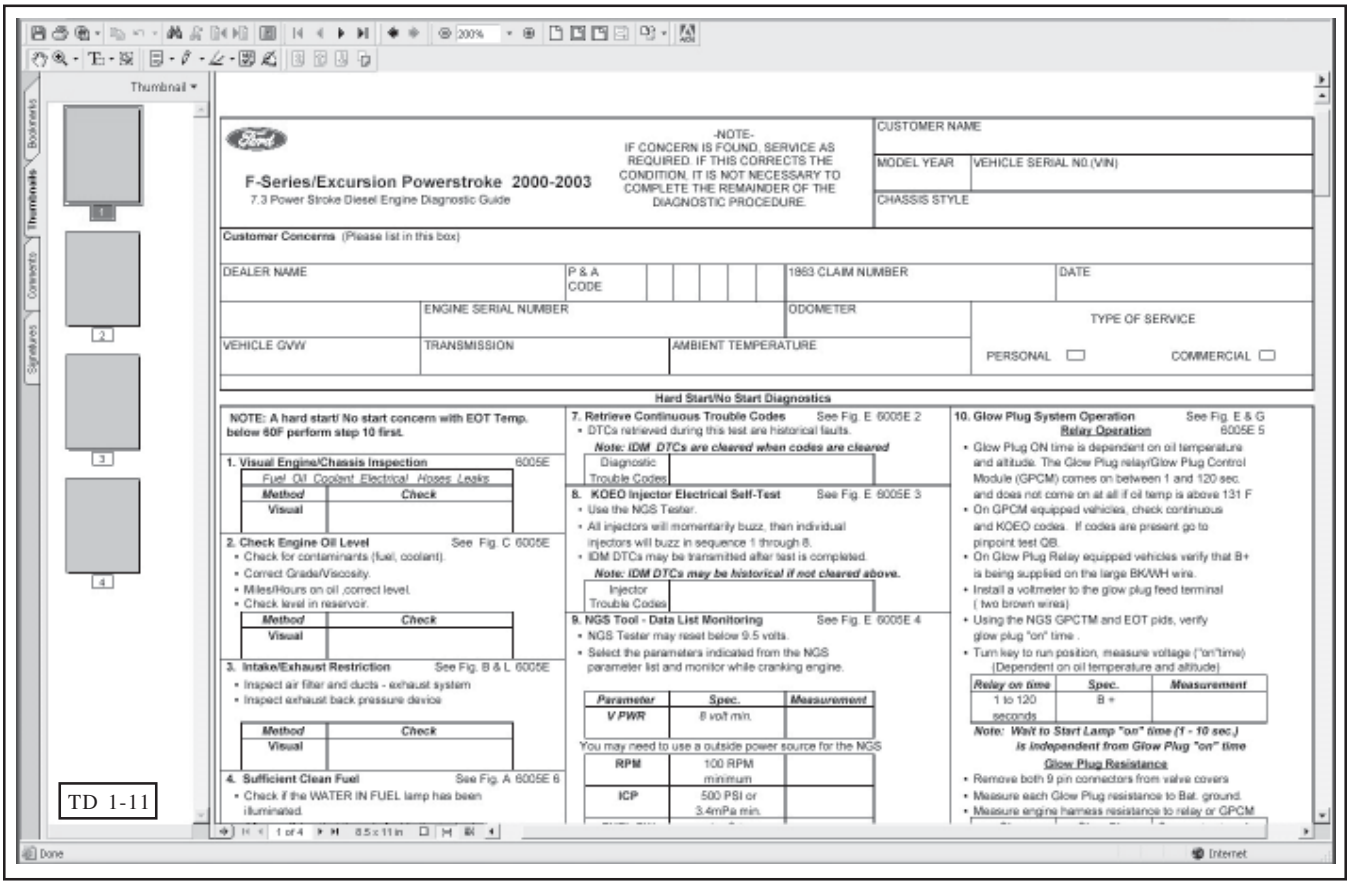
Wastegate Defeat Device

Aftermarket Modifications

Aftermarket performance enhancing PCM programs, wastegate actuator defeat devices, propane injection packages and modification to the exhaust system, may negatively affect the life of the turbocharger.

Note: Aftermarket modification may void the manufacturers warranty.

DIAGNOSTIC PROCEDURES



F-Series/Excursion Powerstroke 2000-2003
7.3 Power Stroke Diesel Engine Diagnostic Guide

-NOTE-
IF CONCERN IS FOUND, SERVICE AS REQUIRED. IF THIS CORRECTS THE CONDITION, IT IS NOT NECESSARY TO COMPLETE THE REMAINDER OF THE DIAGNOSTIC PROCEDURE.

CUSTOMER NAME
MODEL YEAR | VEHICLE SERIAL NO (VIN)
CHASSIS STYLE

Customer Concerns (Please list in this box)

DEALER NAME | P & A CODE | 1863 CLAIM NUMBER | DATE
ENGINE SERIAL NUMBER | ODOMETER | TYPE OF SERVICE
VEHICLE GVW | TRANSMISSION | AMBIENT TEMPERATURE | PERSONAL ☐ COMMERCIAL ☐

Hard Start/No Start Diagnostics

NOTE: A hard start/ No start concern with EOT Temp. below 60F perform step 10 first.

1. Visual Engine/Chassis Inspection 6005E
Fuel, Oil, Coolant, Electrical, Hoses, Leaks

Method	Check
Visual	

2. Check Engine Oil Level See Fig. C 6005E
- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/Hours on oil ,correct level.
- Check level in reservoir.

Method	Check
Visual	

3. Intake/Exhaust Restriction See Fig. B & L 6005E
- Inspect air filter and ducts - exhaust system
- Inspect exhaust back pressure device

Method	Check
Visual	

4. Sufficient Clean Fuel See Fig. A 6005E 6
- Check if the WATER IN FUEL lamp has been illuminated.

7. Retrieve Continuous Trouble Codes See Fig. E 6005E 2
- DTCs retrieved during this test are historical faults.

Note: IDM DTCs are cleared when codes are cleared

Diagnostic Trouble Codes	

8. KOEO Injector Electrical Self-Test See Fig. E 6005E 3
- Use the NGS Tester.
- All injectors will momentarily buzz, then individual injectors will buzz in sequence 1 through 8.
- IDM DTCs may be transmitted after test is completed.

Note: IDM DTCs may be historical if not cleared above.

Injector Trouble Codes	

9. NGS Tool - Data List Monitoring See Fig. E 6005E 4
- NGS Tester may reset below 9.5 volts.
- Select the parameters indicated from the NGS parameter list and monitor while cranking engine.

Parameter	Spec.	Measurement
V PWR	8 volt min.	

You may need to use a outside power source for the NGS

RPM	100 RPM minimum	
ICP	500 PSI or 3.4mPa min.	

10. Glow Plug System Operation See Fig. E & G 6005E 5
Relay Operation
- Glow Plug ON time is dependent on oil temperature and altitude. The Glow Plug relay/Glow Plug Control Module (GPCM) comes on between 1 and 120 sec. and does not come on at all if oil temp is above 131 F
- On GPCM equipped vehicles, check continuous and KOEO codes. If codes are present go to pinpoint test QB.
- On Glow Plug Relay equipped vehicles verify that B+ is being supplied on the large BK/WH wire.
- Install a voltmeter to the glow plug feed terminal (two brown wires)
- Using the NGS GPCTM and EOT pids, verify glow plug "on" time .
- Turn key to run position, measure voltage ("on"time) (Dependent on oil temperature and altitude)

Relay on time	Spec.	Measurement
1 to 120 seconds	B +	

Note: Wait to Start Lamp "on" time (1 - 10 sec.) is independent from Glow Plug "on" time

Glow Plug Resistance
- Remove both 9 pin connectors from valve covers
- Measure each Glow Plug resistance to Bat. ground.
- Measure engine harness resistance to relay or GPCM

TD 1-11

Diesel Diagnostic Sheet from PTS Website

The most effective way to accurately diagnose turbocharger concerns is to follow the service publication diagnostic procedures.

- The turbocharger should be visually and physically inspected for damage. Turbocharger failure analysis comes down to this basic premise:
  - If the turbine and compressor wheels turn freely and there are no visible signs of damage with either, the turbocharger is NOT at fault. However, the wastegate and the EBP valve should be inspected as well.

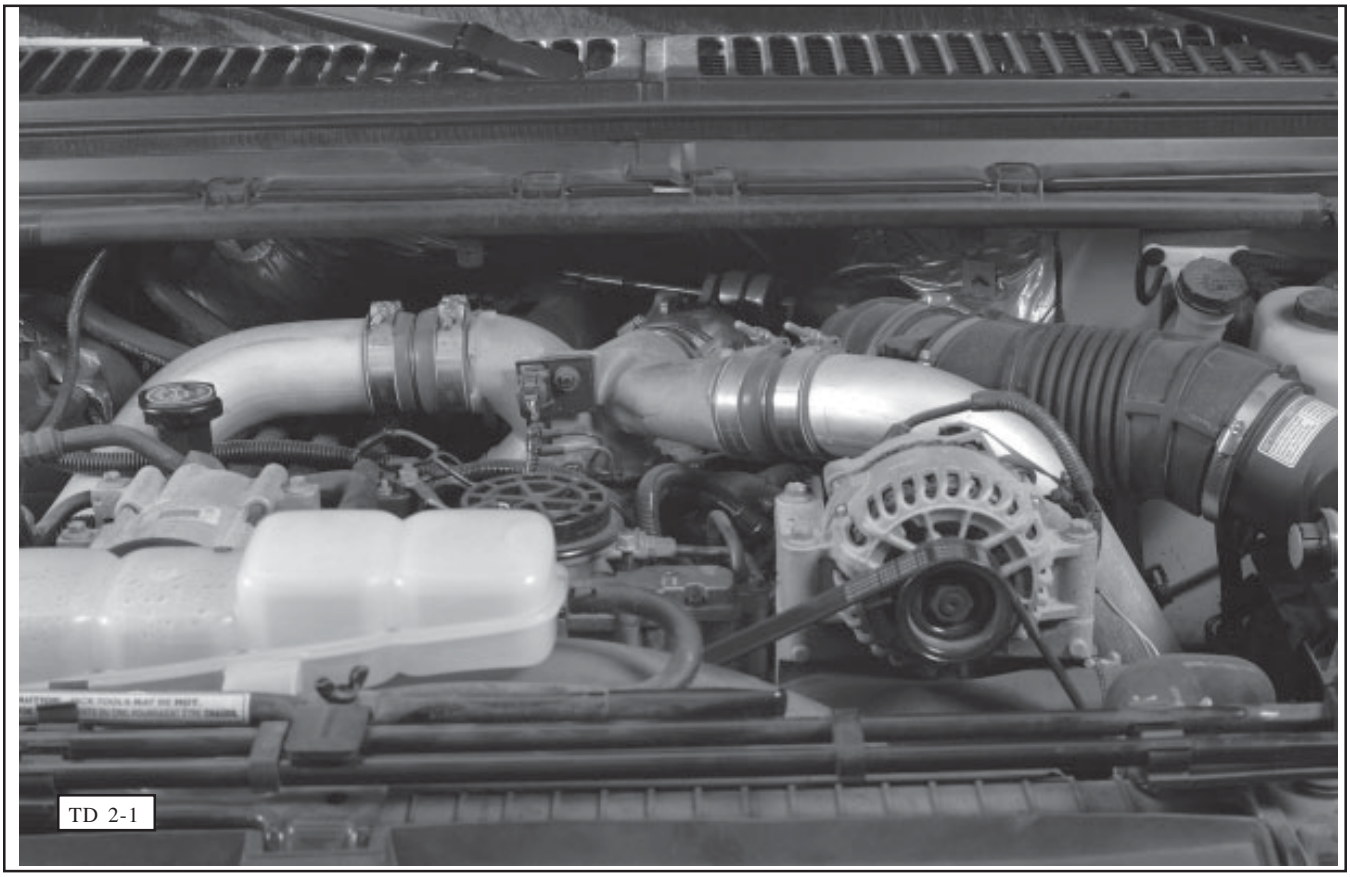
Note: Always use the Symptom-to-System-to-Component-to-Cause (SSCC) process to find the cause of a turbocharger concern.

Note: It should be common practice to record test result values on the repair order and on the appropriate diagnostic sheet. Of course, only the test results for the tests required to repair the vehicle are necessary!

OBJECTIVES

- Describe vehicle systems that may cause vehicle performance concerns.
- Identify service materials and publications for 7.3L DIT turbocharger diagnosis and service.
- Explain diagnostic tests and procedures for 7.3L DIT engines.

TURBOCHARGER DIAGNOSIS



7.3L DIT Engine

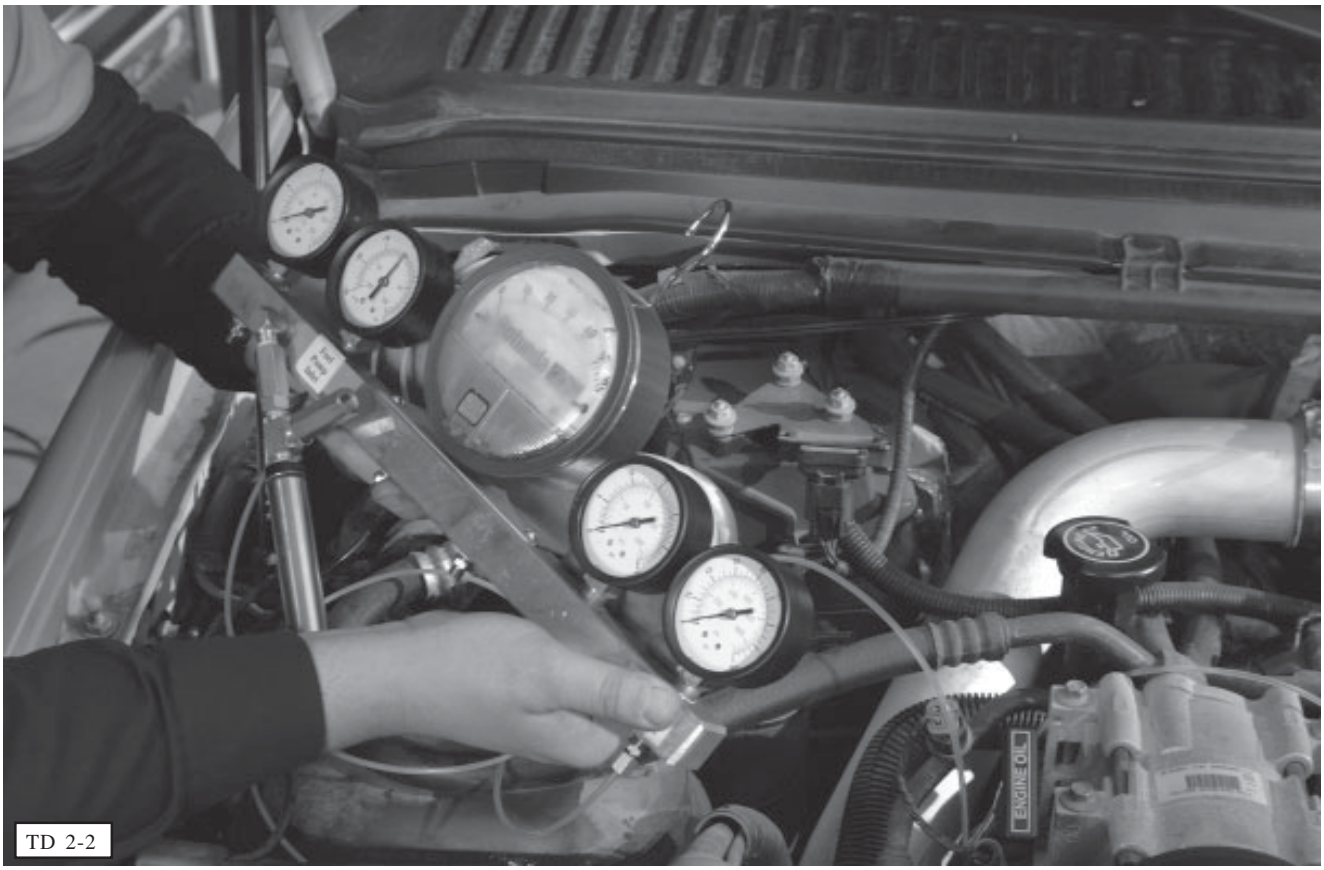
Diagnosing a concern on a 7.3L DIT engine requires skill, knowledge, and attention to detail. This is especially true when a turbocharger is suspected of causing a customer concern.

Suspected turbocharger symptoms can be caused by many other systems on the vehicle. One of the most common types of concerns that are attributed to the turbocharger are low or poor performance concerns.

When diagnosing low or poor performance concerns there are several systems that may cause a vehicle to display symptoms similar to a faulty turbocharger. These include:

- fuel injection/fuel quality concerns.
- air intake concerns.
- mechanical (base engine, transmission, dragging brakes, etc.).

FUEL SYSTEM DIAGNOSIS

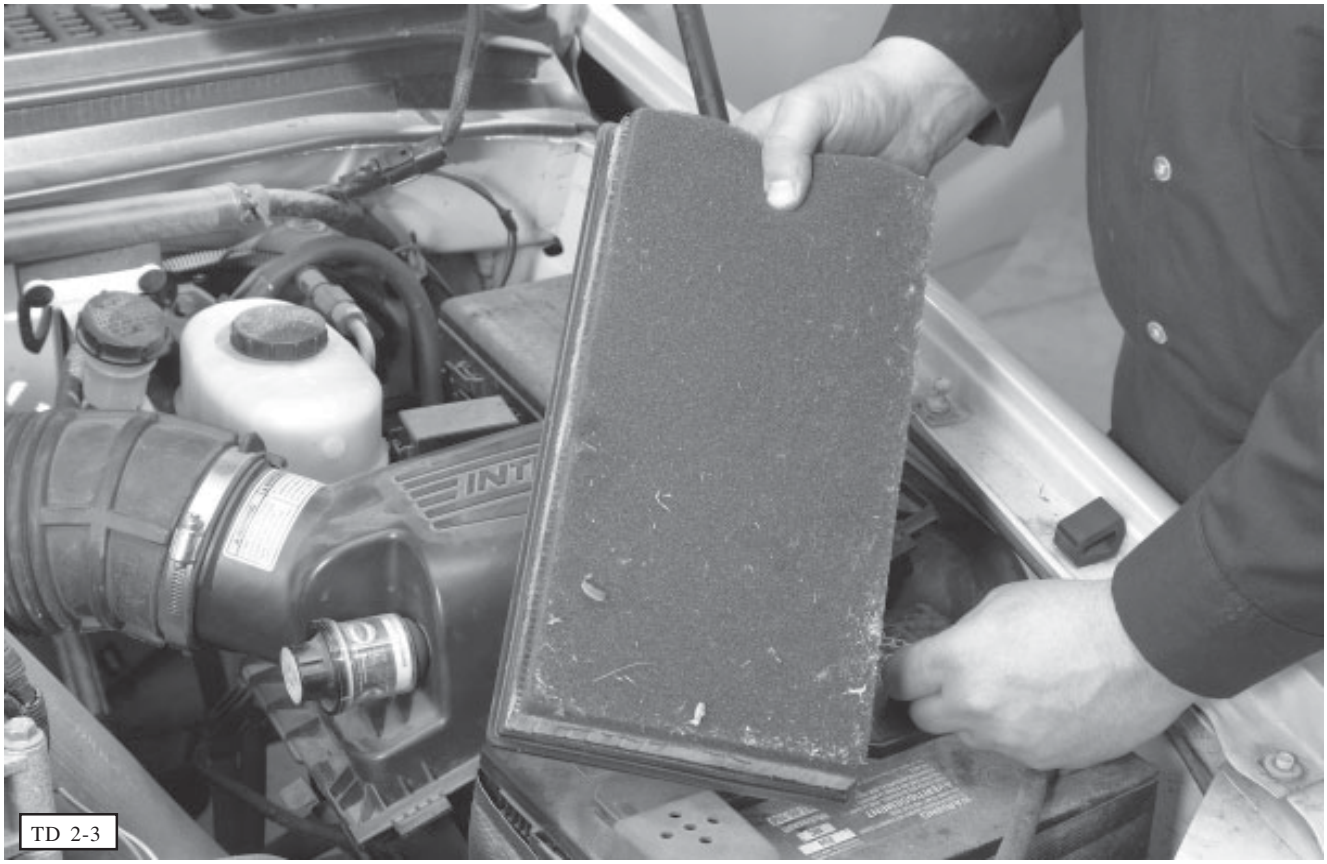


Technician Checking Fuel Pressure

Whenever a performance concern on a 7.3L DIT is diagnosed, the fuel system should be tested. Keep in mind that the 7.3L DIT fuel injection system depends on the correct operation of the high pressure oil system and 110 volt electrical system for injector operation. Areas that should be checked in the fuel system include:

- low fuel pressure.
- incorrect or contaminated fuel.
- faulty fuel injectors.
- low or erratic injection control pressure (ICP).

AIR INTAKE DIAGNOSIS



Technician Checking Air Filter

Air must easily move into a 7.3L DIT engine to ensure a correct air/fuel mixture for combustion. If any component of the air intake system is restricted or blocked, a performance concern can result. These concerns may be misdiagnosed as a turbocharger fault. Whenever diagnosing a performance concern always check for:

- dirty air filter.
- collapsed or damaged air intake tube.

MECHANICAL CONCERNS

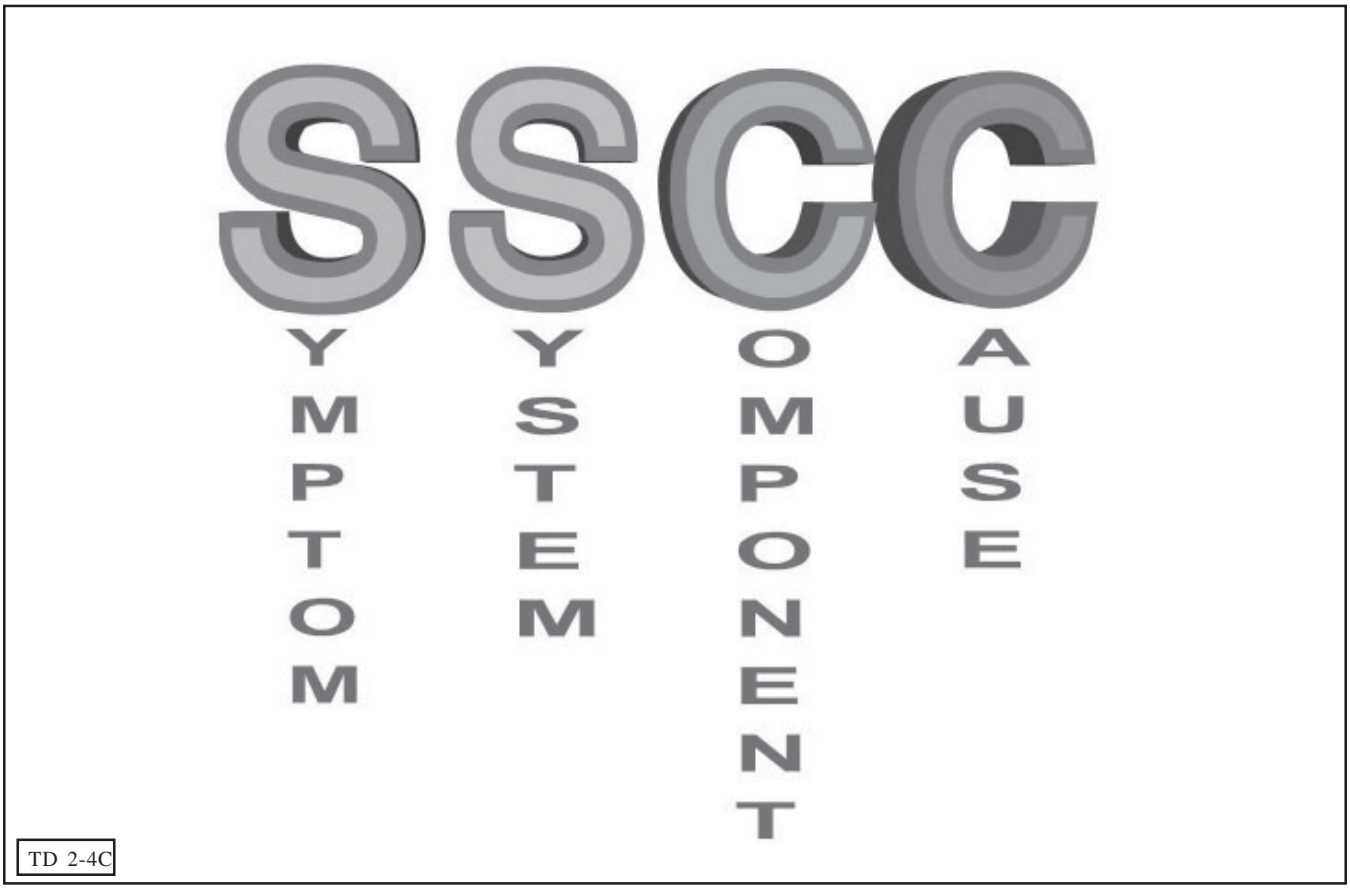
Checking for Dragging Brakes

There are many vehicle systems that have mechanical components which may cause a performance concern. Some of these systems are obvious and usually thought of whenever a vehicle is brought in with a performance concern (for example, most technicians think of a base engine failure when diagnosing performance concern). However, other systems that may cause a performance concern are often overlooked during diagnosis.

Whenever diagnosing a performance concern, you should check for:

- base engine failures.
- transmission slippage.
- dragging brakes.
- differential failure.
- plugged exhaust.

SSCC DIAGNOSTIC PROCESS

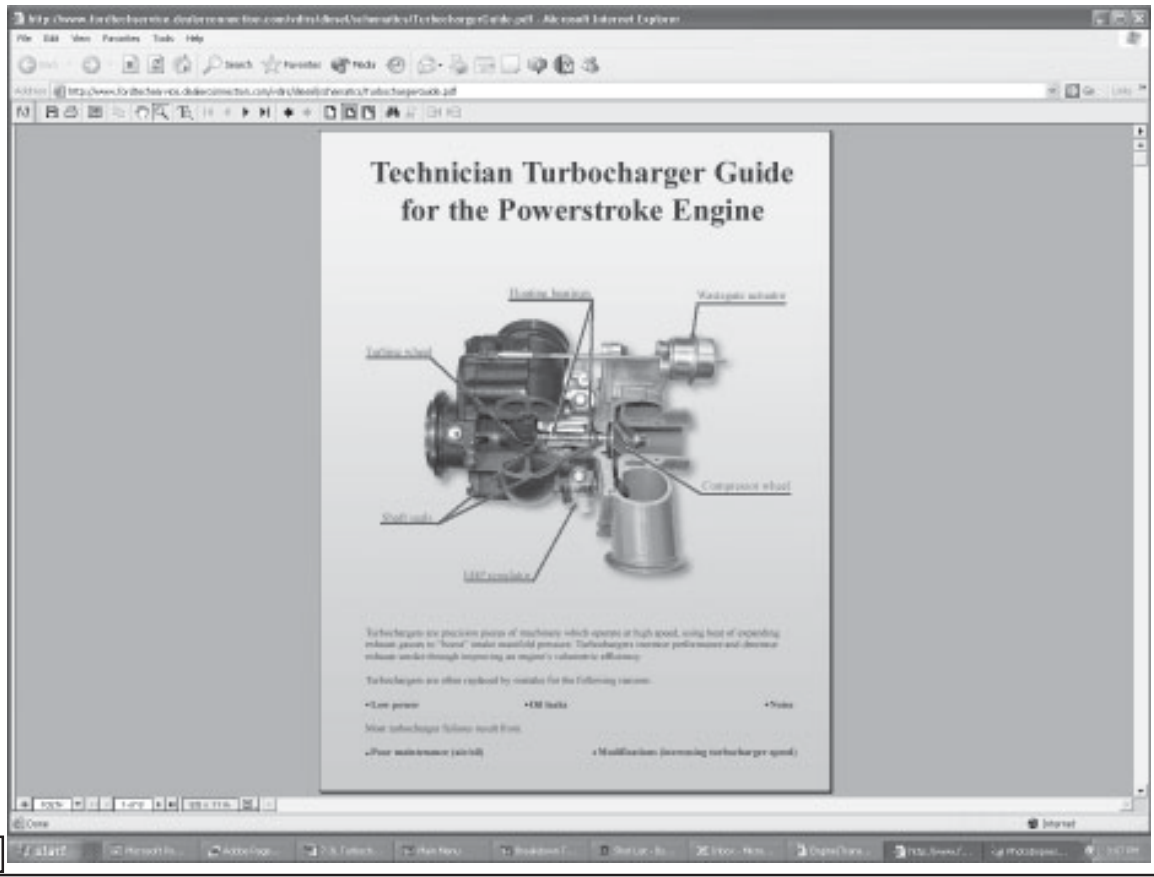


SSCC Diagnostic Process

Symptom-to-System-to-Component-to-Cause (SSCC) is the diagnostic process used by Ford Motor Company technicians to locate the cause of a customer concern. The SSCC process guides you in finding the root cause of the vehicle concern and helps ensure that you "Fix It Right The First Time On Time". As you have learned there are several systems that may falsely lead you to believe the vehicle you are diagnosing has a faulty turbocharger. For this reason the SSCC process is especially important during the diagnosis of a turbocharger system.

- First, confirm the "Symptom" of the customer concern.
- Next, determine which "System" on the vehicle could be causing the concern.
- Once the system has been determined, identify which "Component(s)" within the system could be the cause of the concern.
- Finally once the component has been determined, find the "Cause" of the failure.

SERVICE MATERIALS



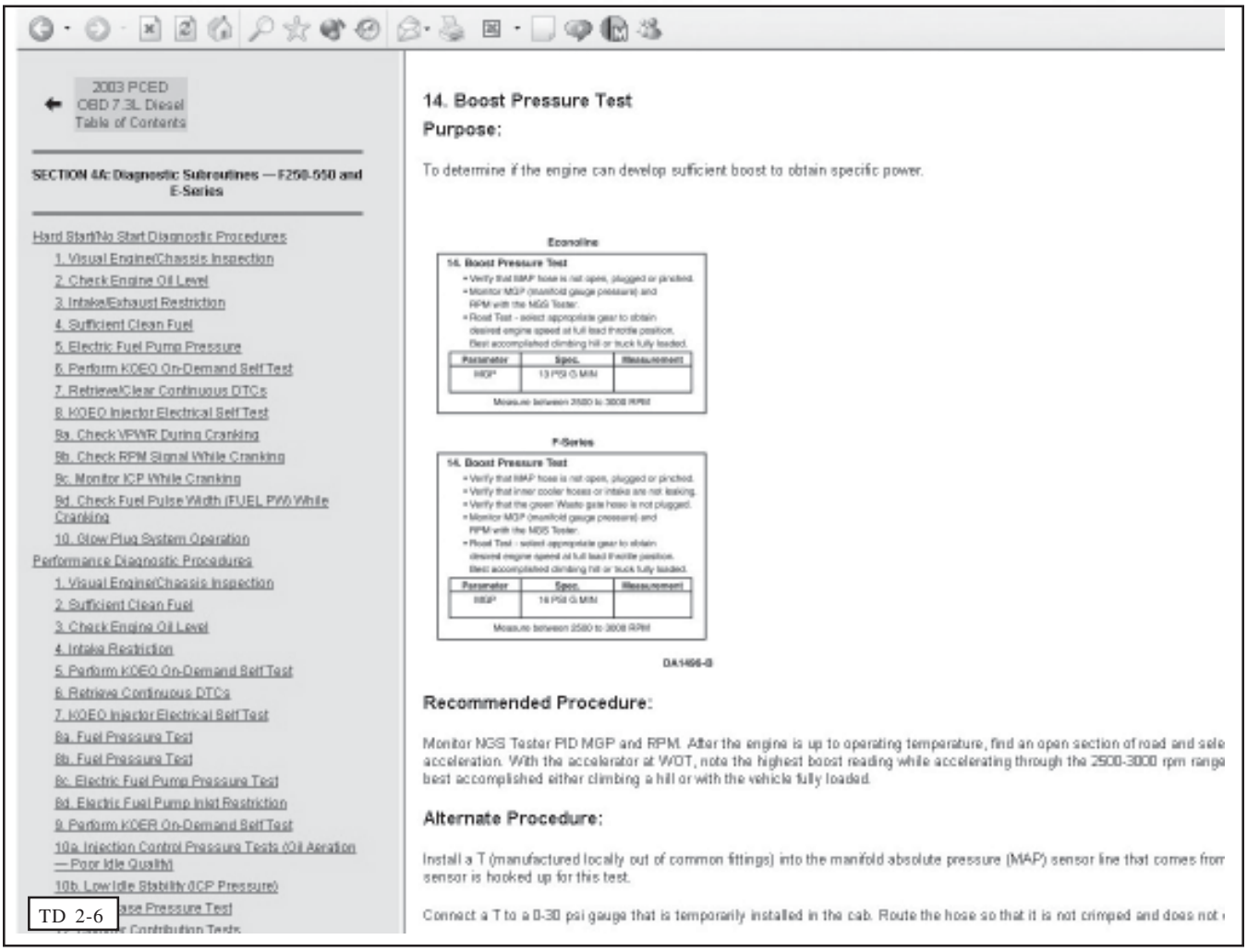
TD 2-5

Power Stroke Engine Turbocharger Diagnostic Guide

There are several service publications available to assist you with the diagnosis of a turbocharger system. The latest information and updated service publications are always available at the Professional Technician Society (PTS) Website.

- Powertrain Control/Emissions Diagnosis (PC/ED) Manual
  - The PC/ED manual provides engine driveability diagnostic and emission information.
- Workshop Manual
  - The Workshop manual provides detailed system specific information.
- Performance Diagnostic Sheets
  - Performance Diagnostic Sheets help aid the diagnostic process by providing a list of system tests that must be performed.
- Power Stroke Engine Turbocharger Diagnostic Guide
  - The Power Stroke Engine Turbocharger Diagnostic Guide provides turbo specific diagnostic information.

TURBOCHARGER BOOST TEST



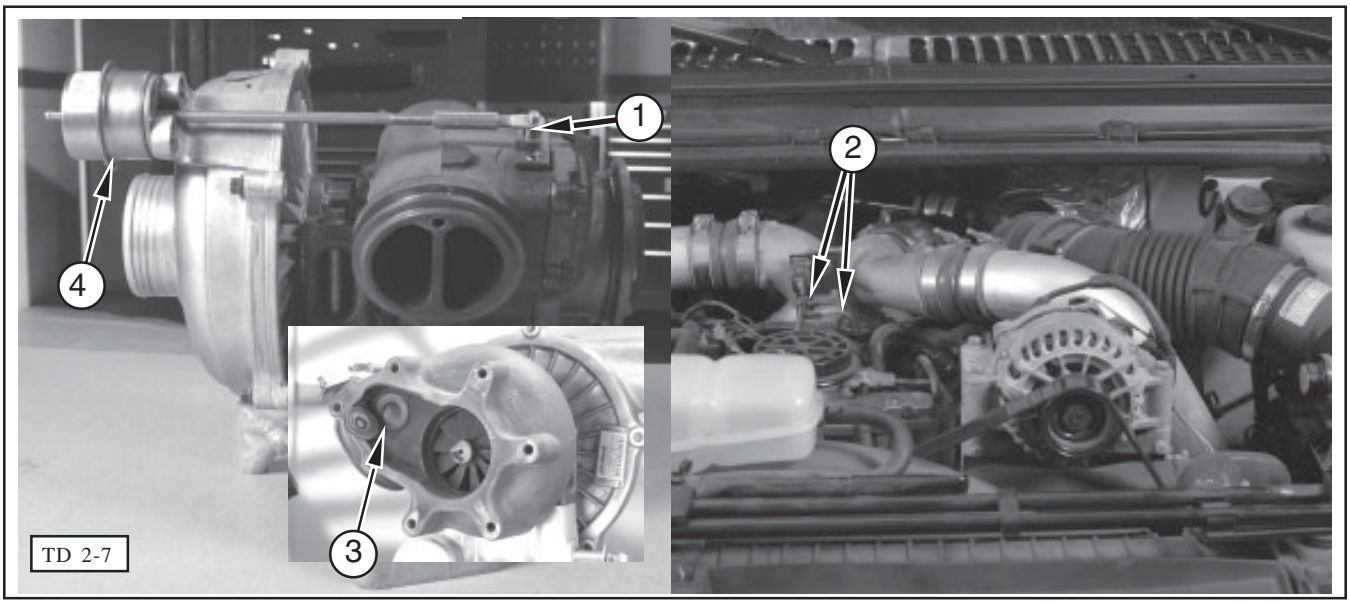
Boost Pressure Test

Turbocharging pressurizes the intake manifold. This "boost" in manifold pressure provides more engine power and results in more responsive acceleration, while maintaining fuel economy.

The purpose of the boost pressure test is to determine if the engine can develop sufficient "boost" (manifold pressurization) to obtain a specific amount of power. Low boost pressure will result in insufficient engine power. This condition can be caused by:

- MAP hose pinched or open.
- Leaking intake, hoses, or fittings.
- Base engine failure
- Defective turbocharger

TURBOCHARGER BOOST TEST (CONTINUED)



Wastegate Components

Item	Description	Item	Description
1	Wastegate Linkage	3	Wastegate (Open)
2	Wastegate Hoses	4	Wastegate Actuator

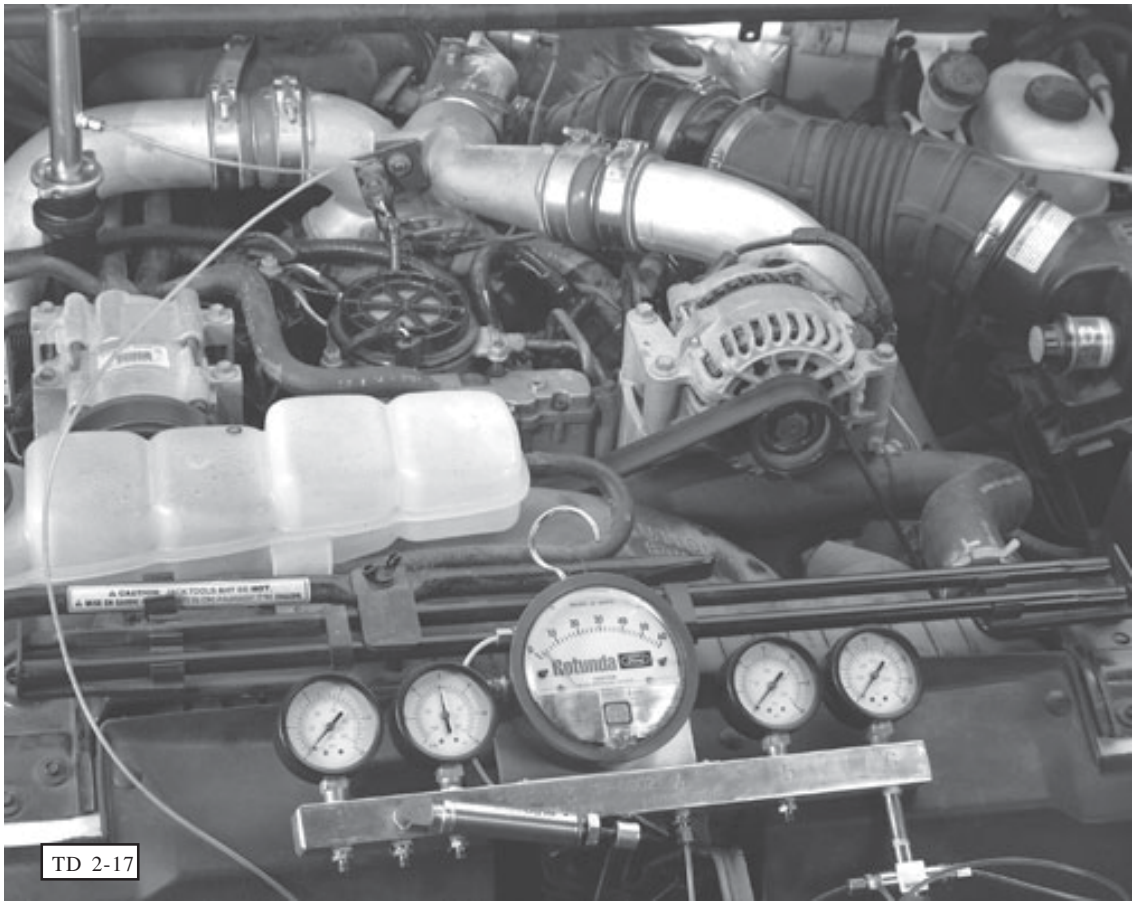
On F-Series and Excursion trucks, turbocharger boost pressure must be limited to prevent excessive intake manifold and combustion pressures from damaging engine components. To limit boost pressure, F-Series and Excursion trucks use a wastegate mechanism.

- A wastegated turbo is designed to reach maximum boost sooner than a conventional turbo.
- The PCM will control the boost pressure by duty cycle to the wastegate control solenoid to maximize boosting performance.
- When pressure is supplied on the hose going to the actuator (solenoid NOT energized), the valve will open, dumping boost by allowing some exhaust to bypass the turbine wheel.
- When low or no pressure is on the hose going to the actuator (solenoid is being energized), the valve will stay closed.

The addition of wastegate systems to F-Series and Excursion turbochargers creates additional possible causes for low boost conditions. These include:

- Plugged wastegate hoses or port in the charge air intake to the turbo
- Wastegate control solenoid mechanically inoperative
- Wastegate actuator
- Wastegate valve
- Intercooler hoses leaking
- Turbocharger

CRANKCASE PRESSURE TEST



Reading Gaugebar During Crankcase Pressure Test

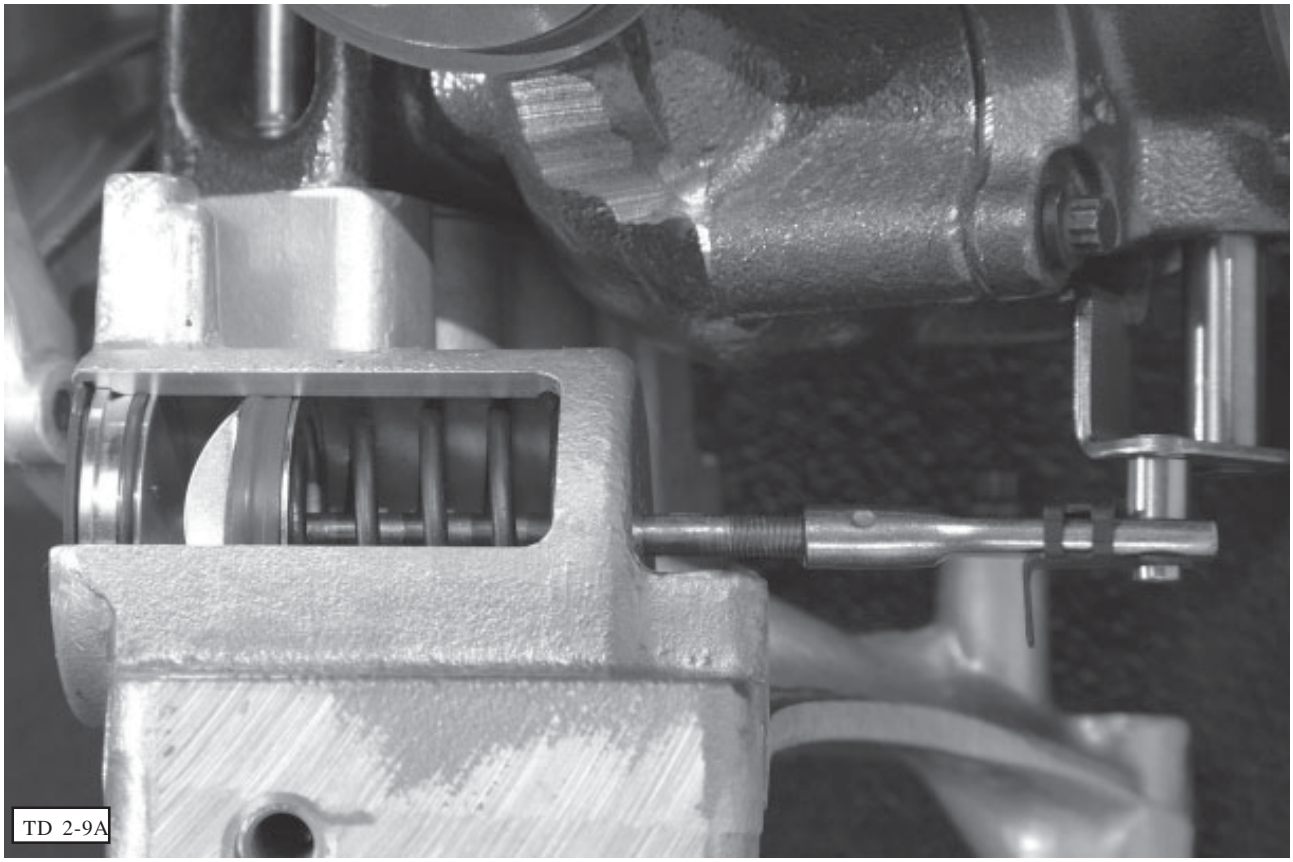
The crankcase pressure test measures crankcase pressure. Crankcase pressure is a measure of how well the cylinders are sealing.

High crankcase pressure can be caused by:

- Broken or worn compression rings.
- Polished cylinder bores.
- Leaking or bent valves.

Inspect the air induction system. If the air induction system allows dirt to enter the cylinders, it will quickly "dust" the engine causing high crankcase pressure.

EXHAUST BACKPRESSURE SYSTEM (EBP) TESTING

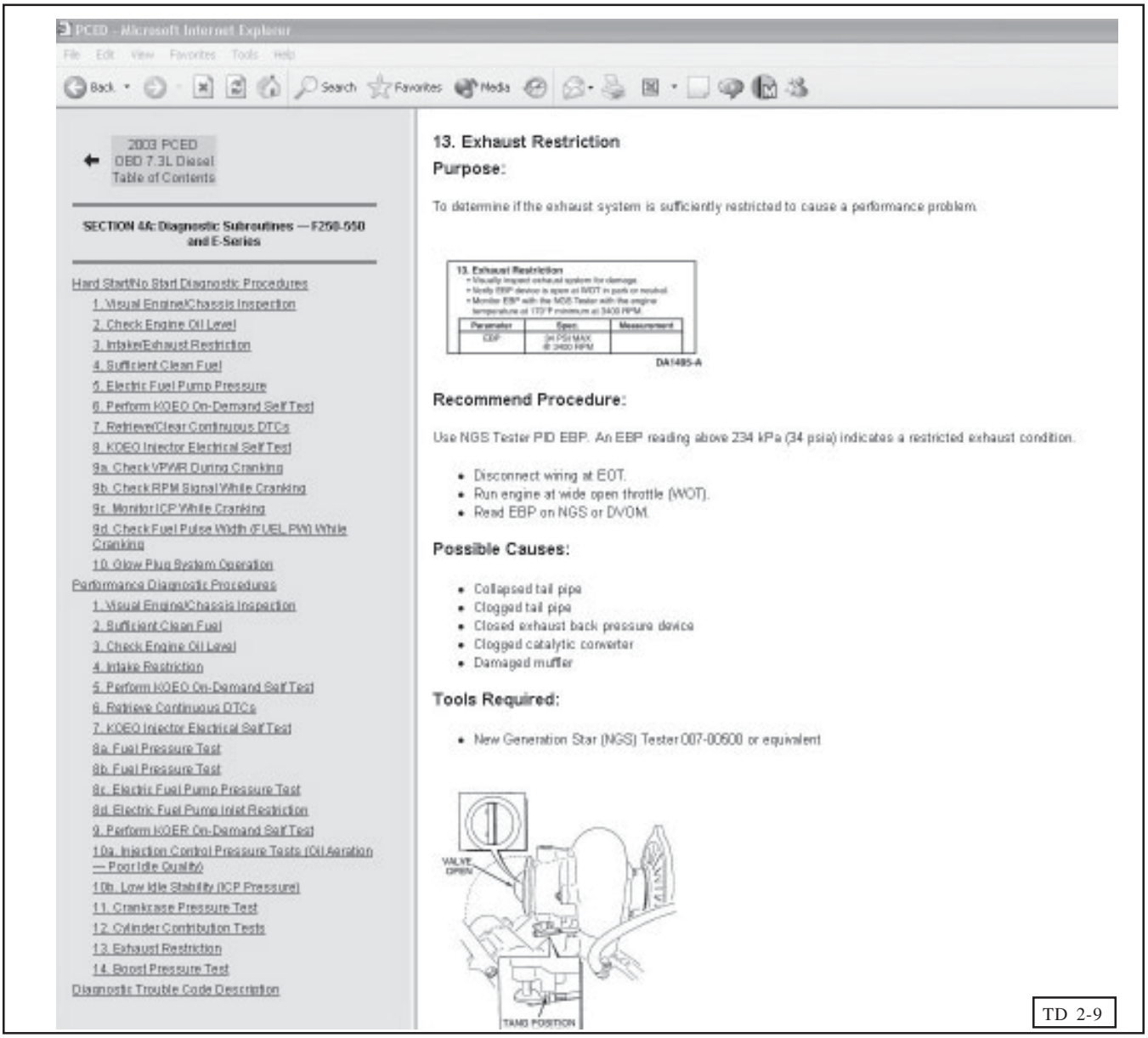


Cutaway of the EBP Valve and Linkage

The exhaust backpressure (EBP) system enables the 7.3L DIT engine to warm up quickly at low ambient temperatures.

If you suspect that the EBP system is the cause of a performance concern, test the system using the KOER self-test as described in section 4A of the PC/ED manual.

EXHAUST BACKPRESSURE TEST



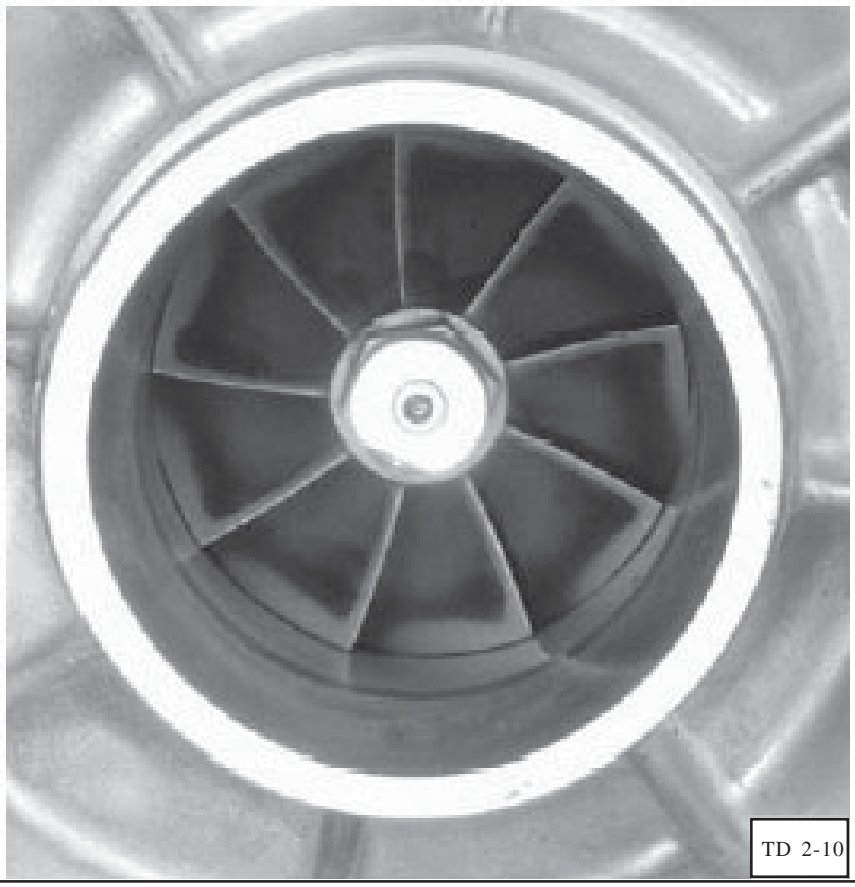
PC/ED Exhaust Backpressure Test

Turbocharger operation is dependent on the free movement of exhaust gases through the exhaust system. Whenever a performance concern leads you to suspect a turbocharger malfunction, you should first inspect the exhaust system to ensure that it is not restricted or plugged. This procedure not only includes a visual inspection of the exhaust system, but also requires using a scan tool to verify the that exhaust backpressure is not too high. The testing procedure is described in the PC/ED manual.

Components that may cause excessive exhaust backpressure include:

- Collapsed tail pipe
- Clogged catalytic converter
- Damaged muffler
- Clogged tail pipe
- Closed exhaust back pressure device

VISUAL INSPECTION OF TURBOCHARGER



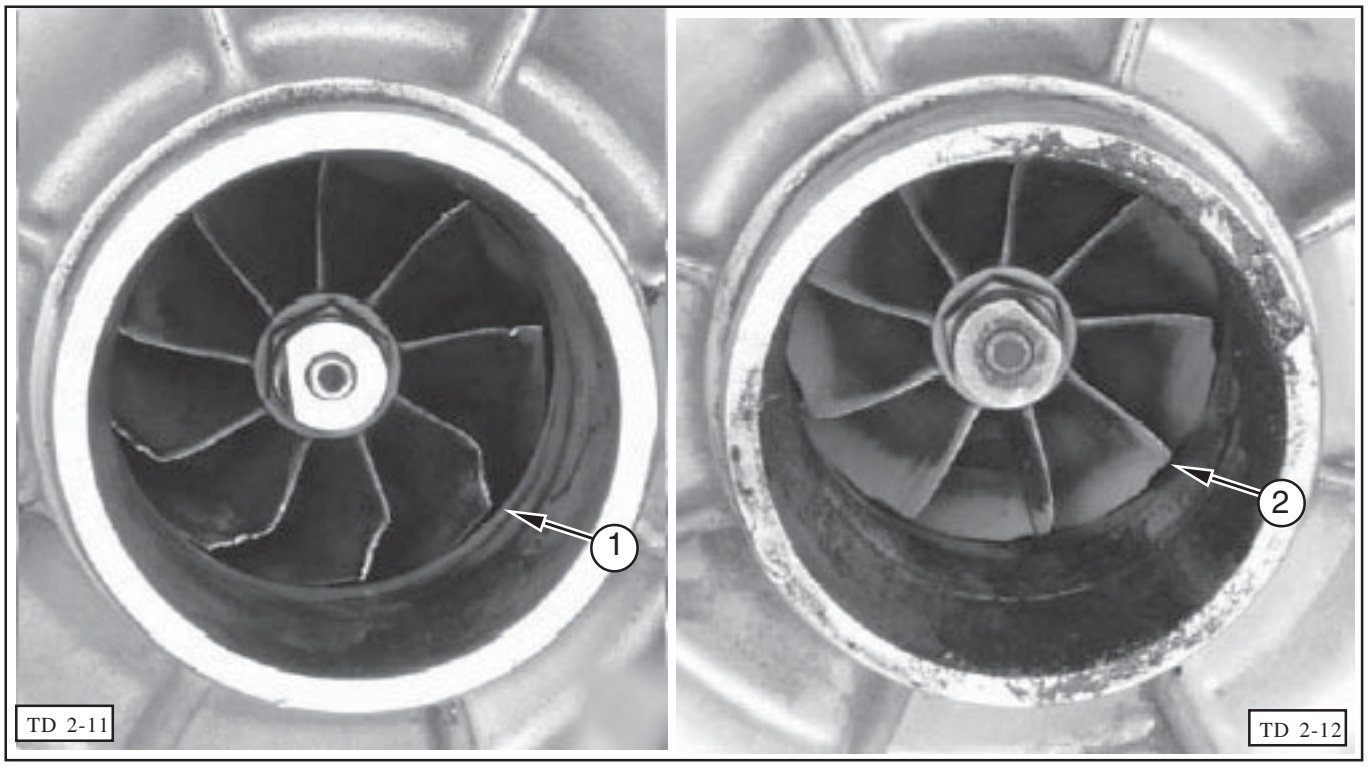
Good Turbocharger Compressor Wheel

When a turbocharger fault is suspected, a thorough visual inspection is essential. During the visual inspection, check the condition of the compressor wheel.

- A good compressor wheel will have blades that are clean and straight.
- There should be no large gaps between the compressor housing and the compressor wheel.
- No visible damage to the blades.

⚠ **WARNING: ALL VISUAL INSPECTIONS OF THE TURBOCHARGER MUST BE MADE WITH THE ENGINE OFF AND THE TURBOCHARGER NOT SPINNING. TURBOCHARGER COMPONENTS MAY BE EXTREMELY HOT. BOTH WHEELS ARE VERY SHARP.**

VISUAL INSPECTION OF TURBOCHARGER (CONTINUED)



Turbocharger Compressors Damaged by Foreign Object and Dirt Ingestion

Item	Description	Item	Description
1	Compressor Damaged by Foreign Object	2	Compressor Damaged by Dirt Injection (Dusted)

Foreign Object Damage

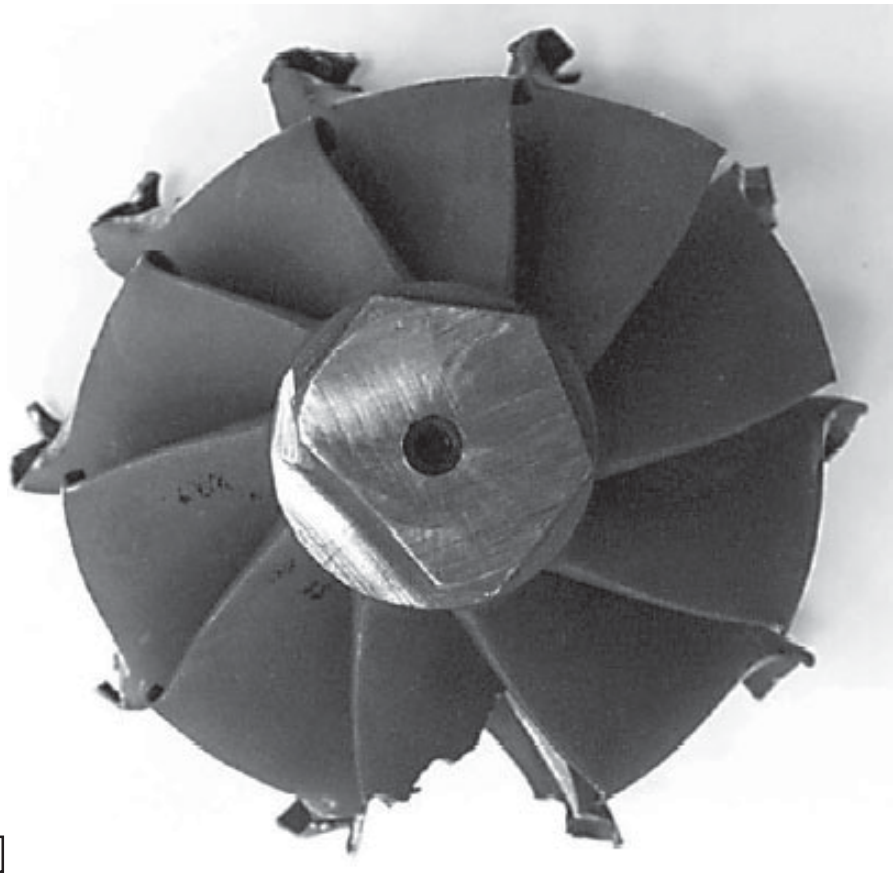
- Inspect for foreign object damage.
  - When inspecting the compressor wheel look for signs of outside objects (nuts, bolts, screws, etc.) coming in contact with the blades while they were spinning.
  - Damage to the wheel blade may be from overspeed conditions. This is usually a result of aftermarket modifications.

Dirt Ingestion

- Inspect for dirt ingestion (also called dusting).
  - The compressor wheel blades will show signs of erosion from dirt entering the intake air system. The blades will be rounded off and typically there will be dirt accumulation in the compressor inlet.
  - When dirt ingestion is discovered, check the filtration system for lack of maintanence, an aftermarket filter or no filter at all.

If damage to the compressor wheel is found, the intake air system should be cleaned and inspected for foreign objects, poor maintenance, broken components, or improper installation.

VISUAL INSPECTION OF TURBOCHARGER (CONTINUED)



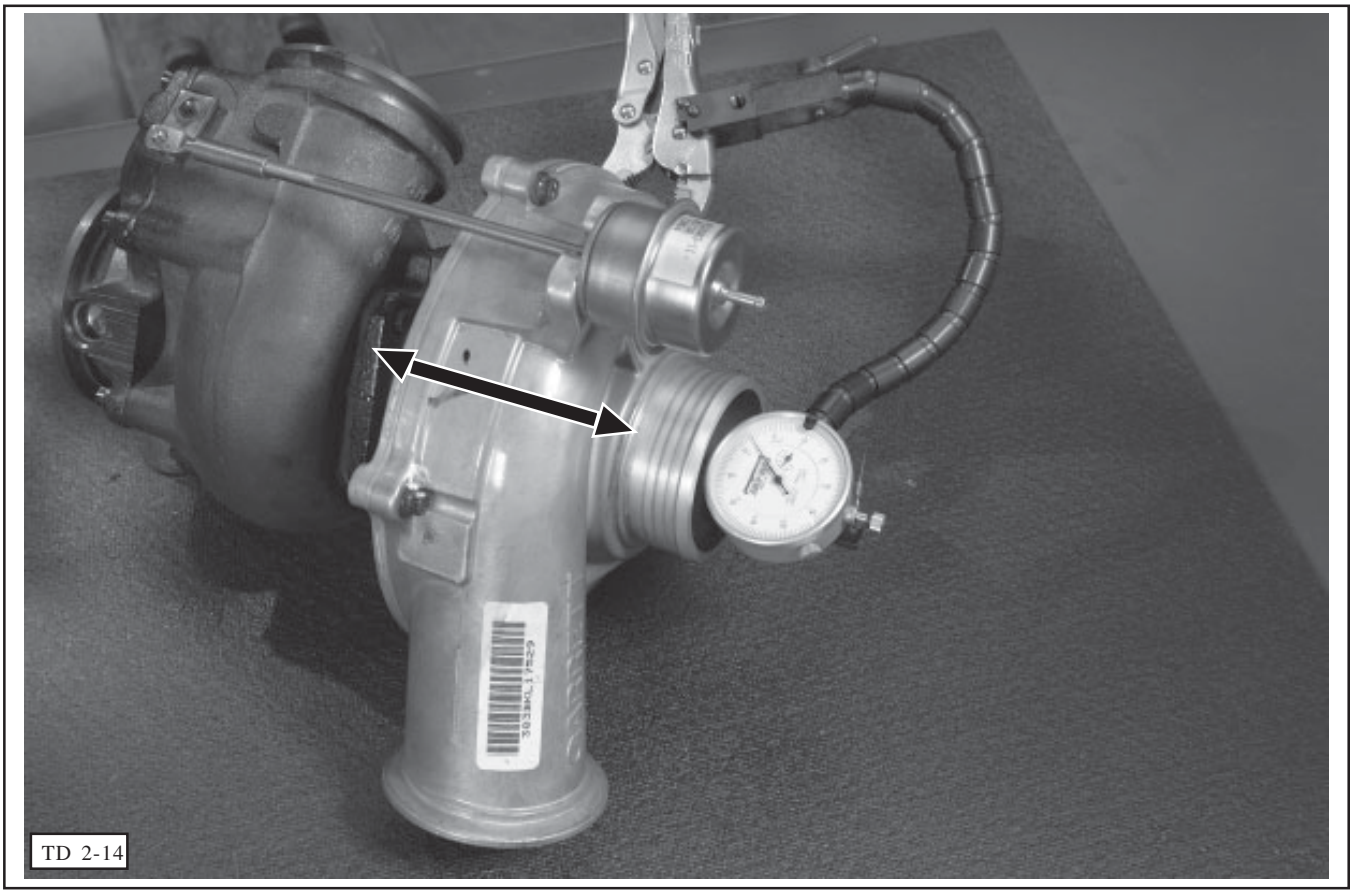
TD 2-13

Turbine Wheel Damaged by Overspeeding

Another concern that may be found during a physical inspection of the turbocharger is a damaged turbine blade.

- Structural damage to a turbine is likely to be the result of a PCM aftermarket modification that allows boost pressure or turbo speed that exceed design limitations.

VISUAL INSPECTION OF TURBOCHARGER (CONTINUED)



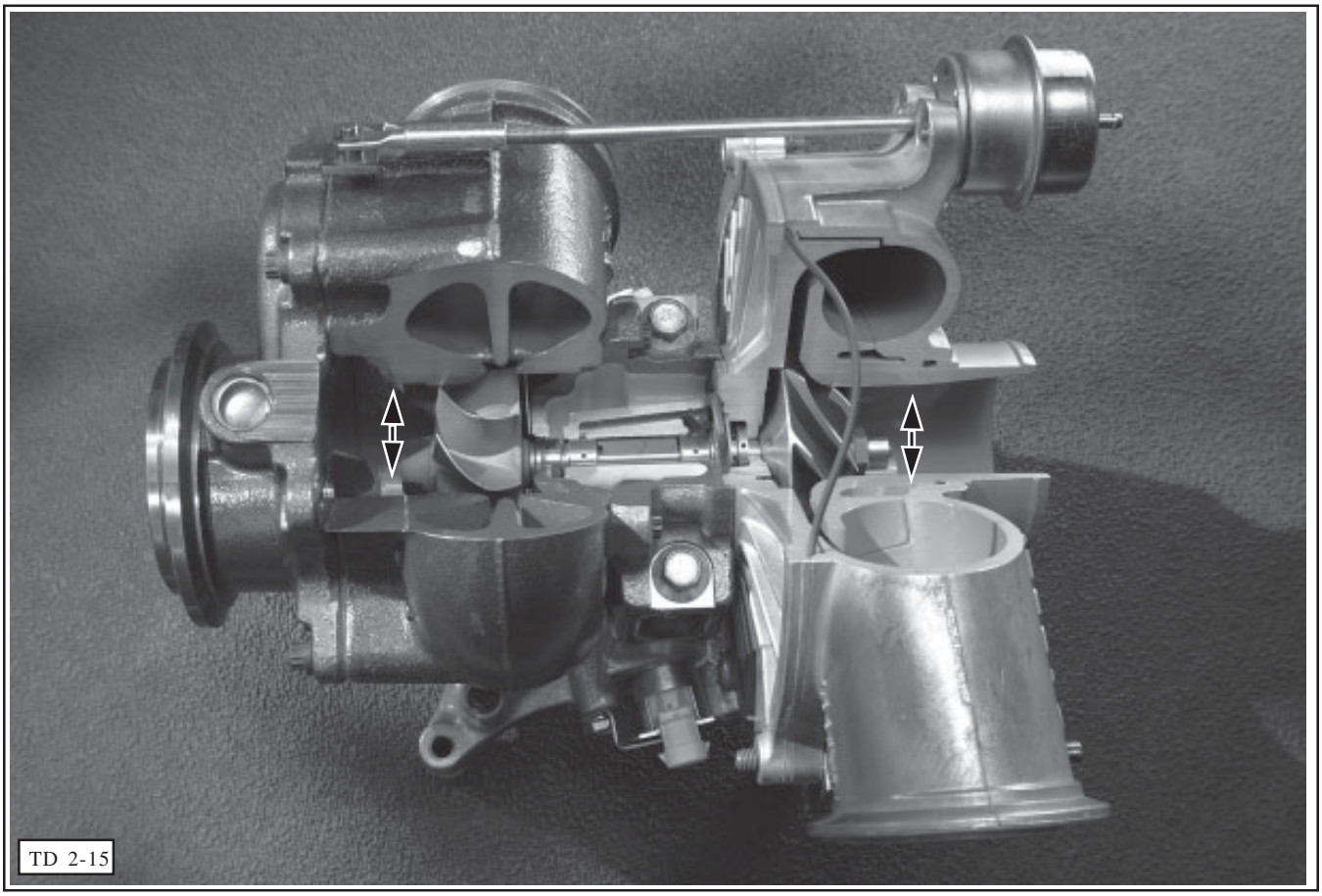
Measuring Axial End-Play

A proper physical inspection of the turbocharger compressor and bearings will include a bearing clearance check, which is a check for axial end-play.

- To properly check for axial end-play a dial indicator must be used.

1. Position the dial indicator on the turbine end of the turbo shaft and zero the indicator.
2. Move the turbo shaft back and forth by hand and record the reading.
3. If readings exceed specifications, install a new turbocharger.

VISUAL INSPECTION OF TURBOCHARGER (CONTINUED)



Checking Turbocharger Radial Play

Radial runout of the turbocharger shaft provides an indication of the condition of the turbo shaft support bearings. During operation these bearings spin on a layer of pressurized oil from the engine, therefore, some radial play will be noticed when the engine is not operating. However, excessive radial runout may indicate that the bearings are worn or damaged.

- When checking radial play it is important that both ends turbo shaft is moved up and down, in the same direction, at the same time.
- Do not check the radial play by rocking the shaft (moving one end up while pressing the other end down), as this may give a false impression of excessive play.

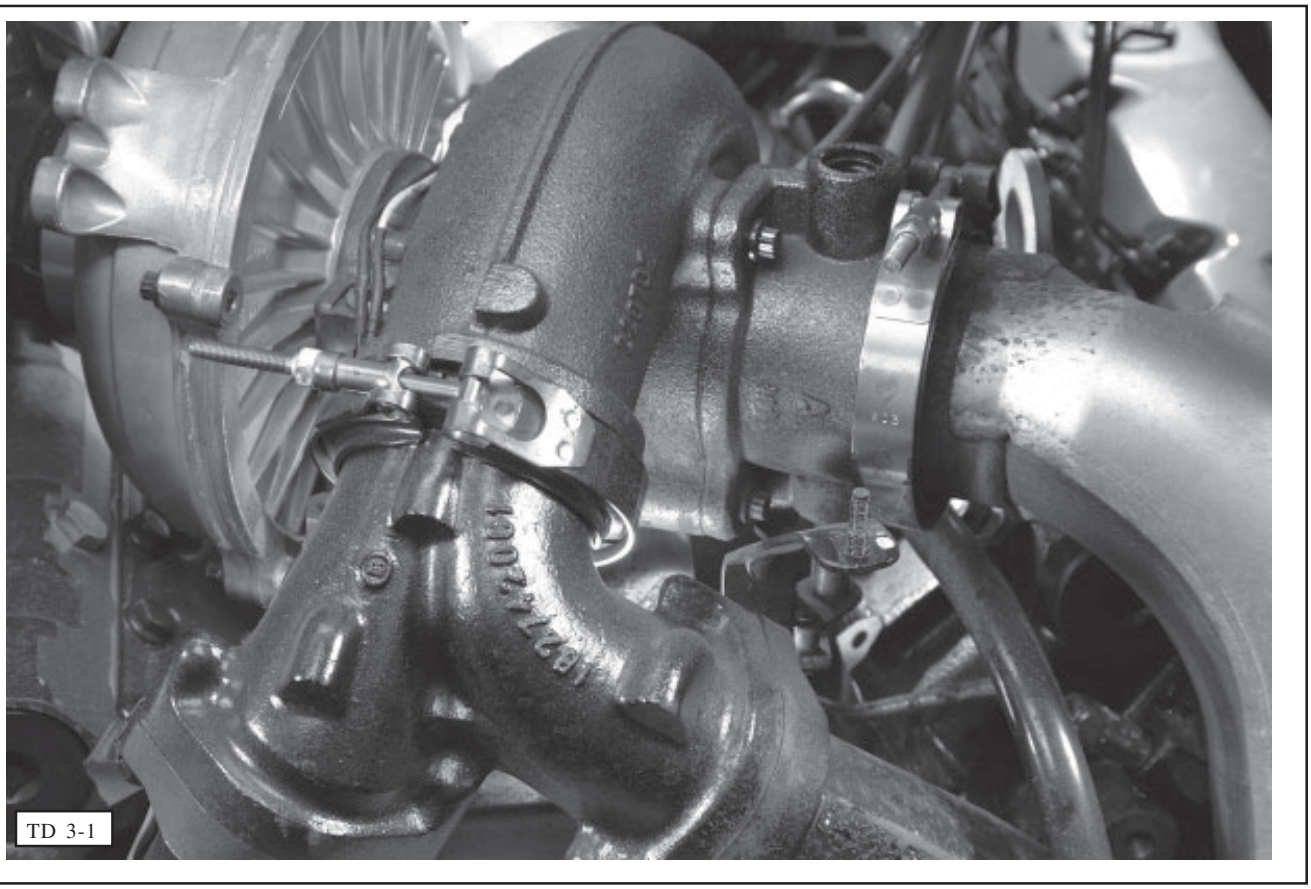
TURBOCHARGER REPLACEMENT

- Turbochargers **should only** be replaced under the following conditions:
  - The compressor wheels rub against the turbo housing.
  - The compressor blades are damaged.
  - The shaft and wheels **do not** spin freely.
  - Axial endplay exceeds specifications (usually less 0.01mm (0.004 in.)).
- If a vehicle equipped with a turbocharger has a low performance concern the likely cause will be:
  - Low fuel delivery.
  - A restriction or leak in the intake or exhaust systems.
  - Worn engine components.

OBJECTIVES

- Identify normal and abnormal turbocharger noises.
- Explain turbocharger noise diagnostic procedures.
- Identify turbocharger inspection and service procedures.

NORMAL VS. ABNORMAL TURBOCHARGER NOISE

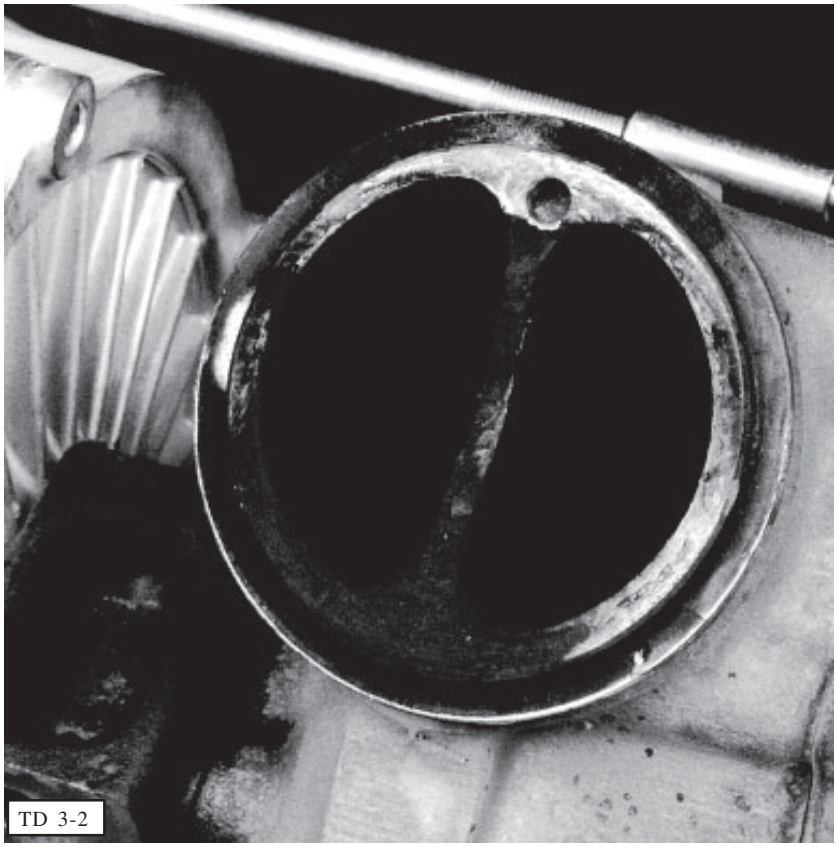


Exhaust and CAC Tubes and Clamps are Common Sources for Noise Concerns

Abnormal noise is usually one of the first alerts that there is a concern with a vehicle. So whenever a customer brings a vehicle in for diagnosis it is crucial to be able to distinguish a "normal noise" compared to an "abnormal" noise. Because turbochargers operate at a high rpm they are especially prone to customer noise concerns.

- Normal turbocharger noise may include:
  - Exhaust backpressure (air rush noise)
  - Wastegate actuating (chirping or blast of compressed air)
- Some common customer concerns of abnormal turbocharger noise include:
  - Whine
  - Harmonics resulting from imbalance
  - Exhaust flow/exhaust leaks
  - Hum or whine from loose or perforated CAC tubing
- Possible causes of excessive noise under boost include:
  - Worn bearings
  - Intake noises (hum or whine)
  - Foreign object damage to turbine or compressor blades

TURBOCHARGER VISUAL INSPECTION

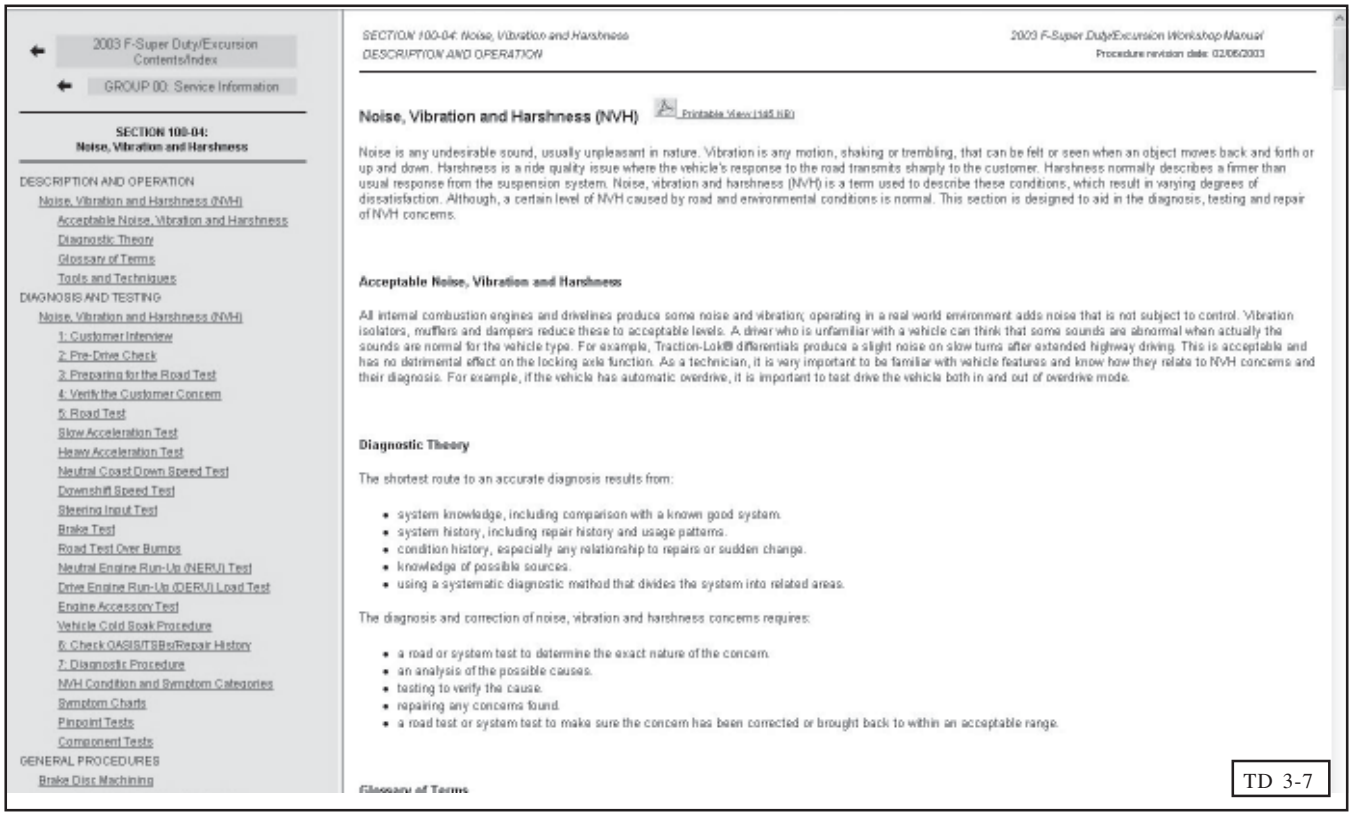


Turbine Inlet Exhaust Leak Due to Loose Marmon Clamp

Whenever an abnormal noise is present your first step should be to perform a thorough visual inspection. A visual inspection will usually identify the cause. Be sure to check the condition and security of the turbocharger components carefully. Numerous turbochargers have been replaced simply because one or more of the Marmon clamps were loose.

- The turbocharger should be visually and physically inspected for damage. Turbocharger diagnosis comes down to this basic premise:
  - If the turbine and compressor wheels turn freely and there are no visible signs of damage, the turbocharger is NOT at fault. However, the wastegate and the EBP valve should still be carefully inspected.
- When performing a visual inspection on the turbocharger system, look for the following:
  - Damaged intake hoses
  - Loose hose clamps
  - Loose exhaust clamps
  - Damaged turbocharger
  - Restricted intake or exhaust

NVH DIAGNOSIS



NVH Section of Workshop Manual

Noise Vibration and Harshness concerns can be among the most difficult to diagnose and repair. For this reason it is essential that a logical system diagnostic process be used.

- Each vehicle workshop manual contains an NVH section to aid in diagnosis.
- Customers that are not familiar with the characteristics of 7.3L DIT equipped vehicles may mistake normal operation for a vehicle malfunction.
- When in doubt about weather or not a vehicle concern is actually a normal operating characteristic, drive and compare a similar vehicle.

NOISE CONCERNS

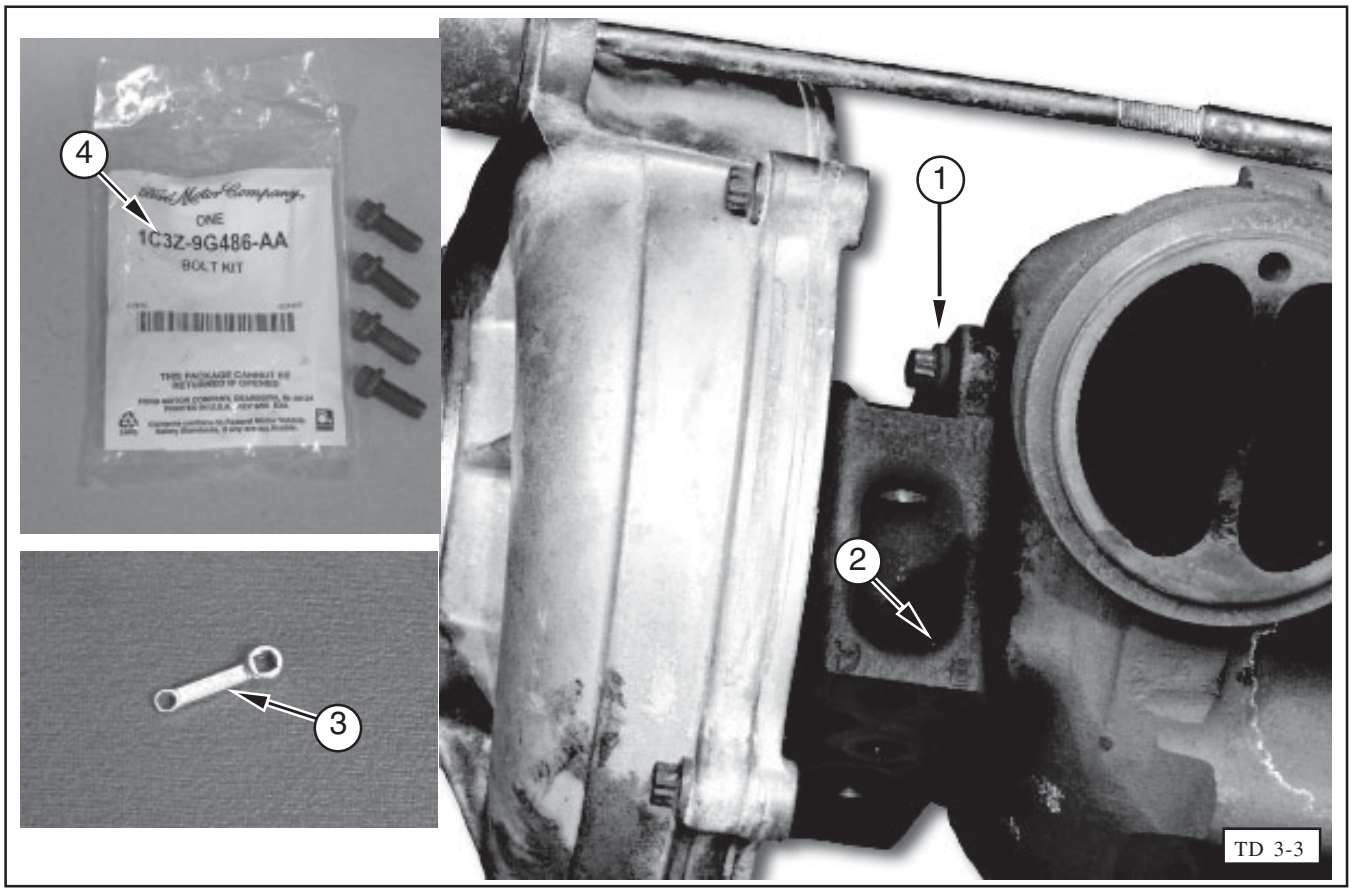
Misaligned Turbine Inlet Locating Dowel

Noise Concerns

The vehicle's exhaust connections are another area that must be carefully inspected. Misalignment at the connections has led to needless turbocharger replacement. On turbo equipped vehicles be sure:

- the exhaust connection at the inlet to the turbine housing is secure.
- the turbine exhaust outlet to exhaust pipe connection is secure.
- that if the turbocharger itself is responsible for excessive noise, expect to find wheel to housing rub and bearing failure.

NOISE CONCERNS (CONTINUED)



Loose and Missing Turbine Housing Bolts

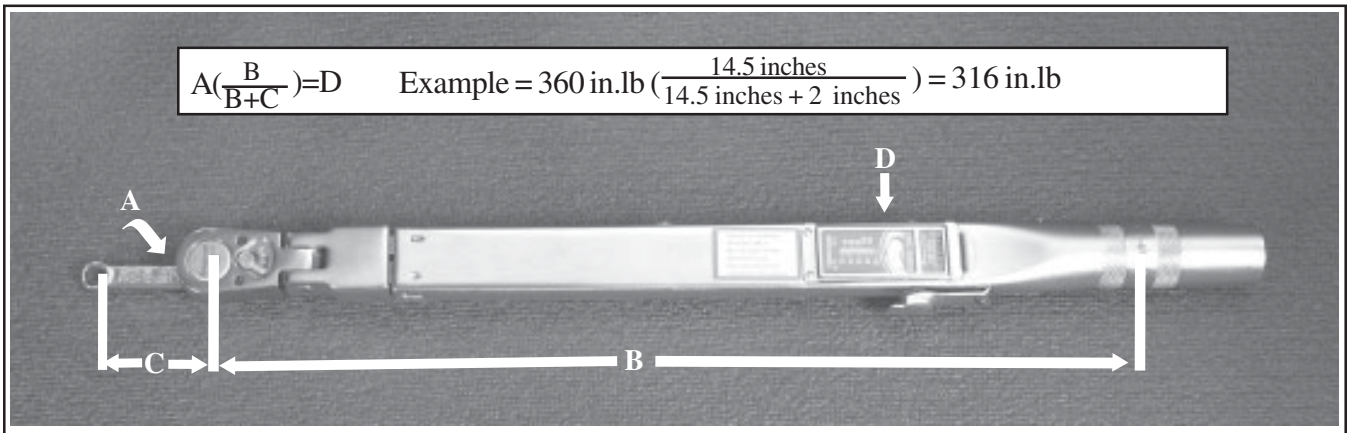
Item	Description	Item	Description
1	Loose Turbine Housing Bolt	3	Snap-On Torque Wrench Adapter
2	Missing Turbine Housing Bolt	4	Turbine Housing Bolt Replacement Kit

During the visual inspection be sure to check the turbine housing mounting bolts. Sometimes these bolts can back out. The turbocharger does not need to be replaced for this condition unless the turbine wheel has contacted the housing and has been damaged.

- If loose or missing bolts are found, use the replacement bolt kit.
  - The part number for this bolt kit is 1C3Z-9G486-AA.
  - These bolts have an interference thread for improved retention.
  - In order to correctly tighten the new bolts, you must use an adapter similar to the Snap-On torque wrench adapter (FRDH101).

Note: The turbine housing bolt kit must be used to repair loose or missing turbine housing bolts. Replacement of the complete turbocharrger assembly to repair loose or missing turbine housing bolts is not an acceptable practice.

INSTALLING TURBO MOUNTING BOLTS



- A = desired torque at end of extension
- B = length of torque wrench
- C =length of adapter
- D = torque wrench setting

TD 3-8

Torque Wrench with Adapter Formula

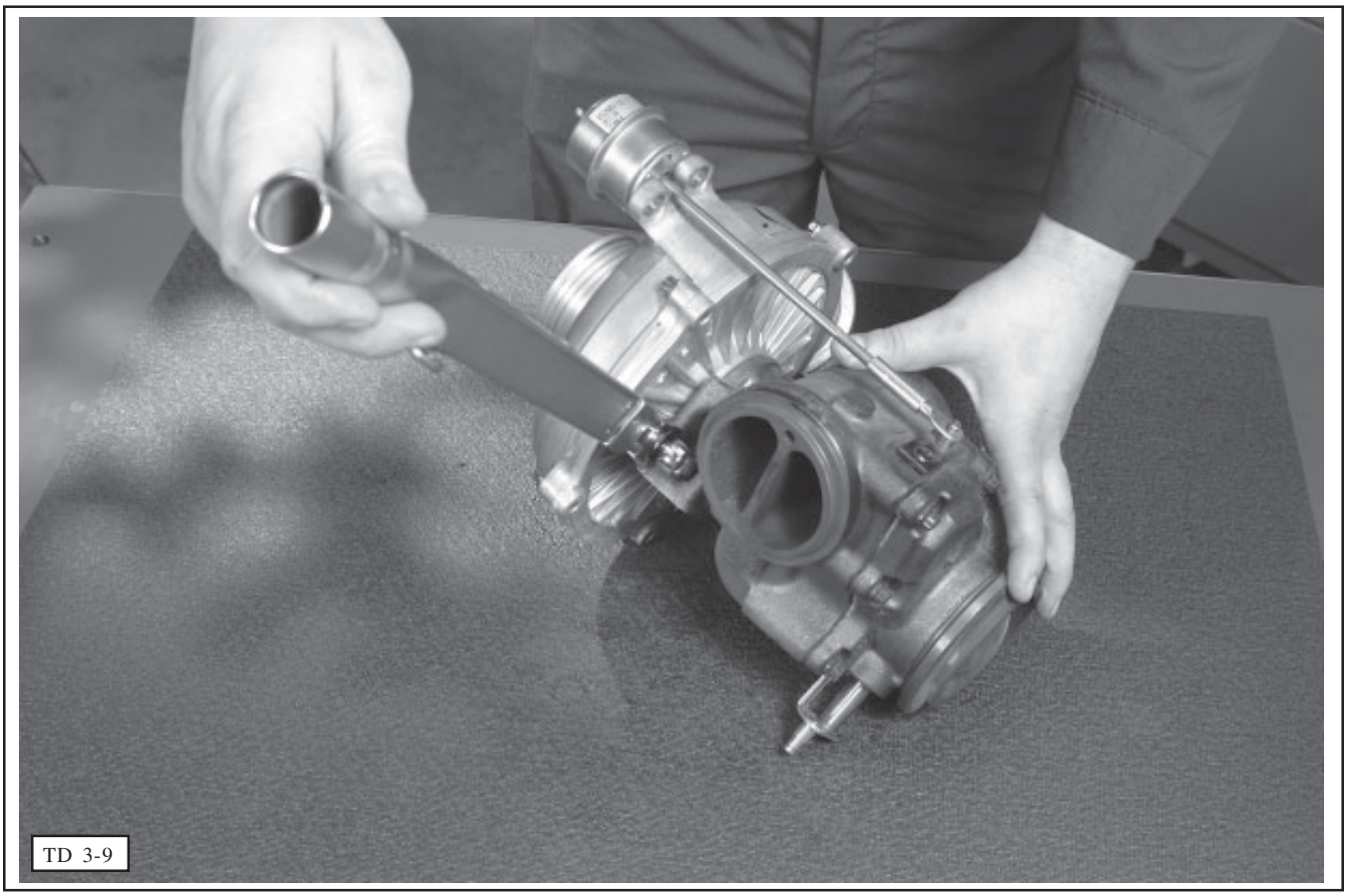
It is not possible to reach the turbo mounting bolts directly with a conventional torque wrench.

A torque adapter, such as Snap-On No.FRDH101, can be used to reach the bolt heads with a torque wrench. The bolt head is an 8mm 12-point, and the adaptor is 5/16". 8mm and 5/16" are very close to the same dimension.

Since the torque adapter increases the distance from the center of the fastener to the handle on the torque wrench, some calculations must be done in order to determine the setting of the torque wrench when the desired torque on the fastener is known.

- With the adapter installed the setting on the torque wrench (shown in the illustration above) will be 316 in.lb. However, due to the change in length of the torque wrench by the adapter, the actual torque on the bolt will be 360 in.lb.

INSTALLING TURBO MOUNTING BOLTS (CONTINUED)



Installing Turbo Mounting Bolts

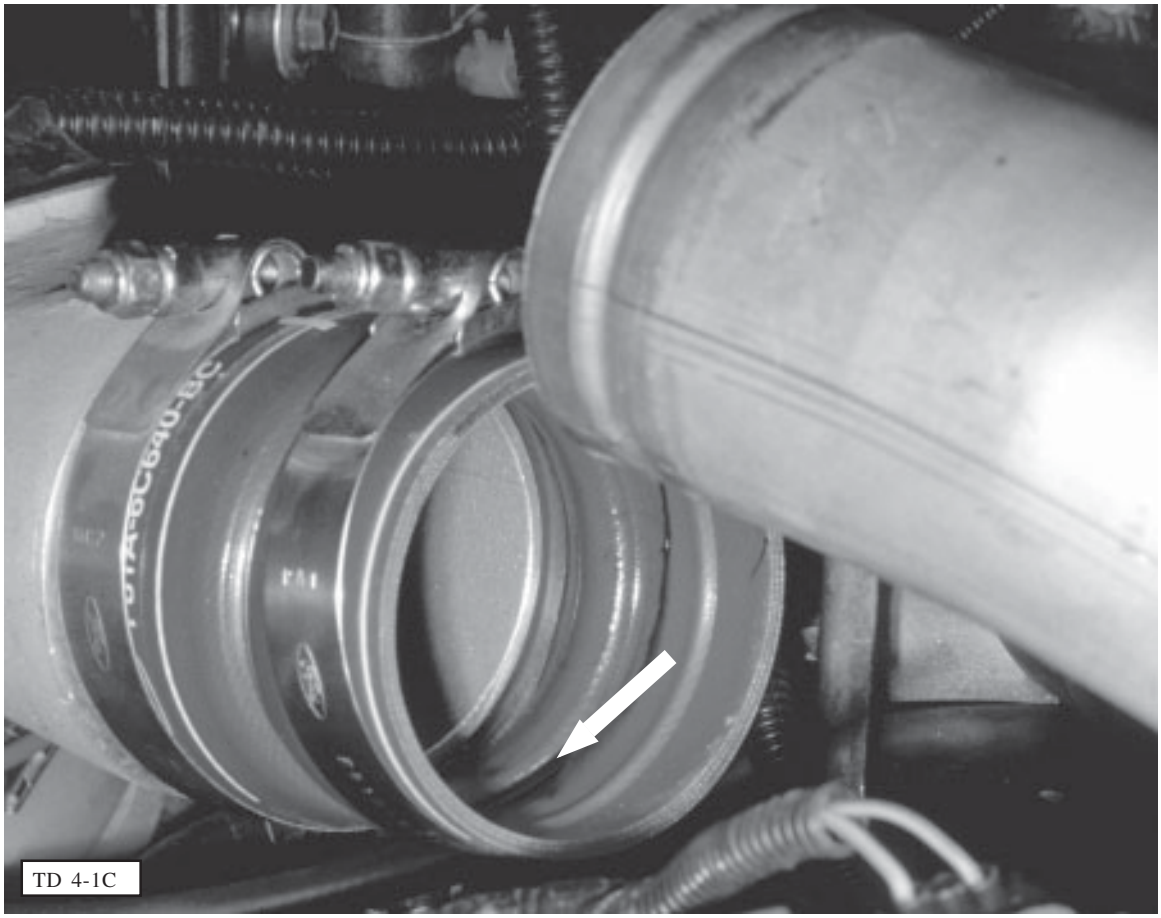
After determining the correct torque for your torque wrench, remove and install the four mounting bolts one at a time, working diagonally across the face of the turbine housing.

- After the fourth bolt has been installed and torqued, reinstall the turbocharger, following the procedure in the workshop manual.
- To verify the repair, take the vehicle for a brief road test.

OBJECTIVES

- Explain normal oil consumption.
- Describe oil leak inspection and identification procedures.
- Identify potential leak points on the 7.3L DIT turbocharger.
- Describe service procedures for correcting 7.3L DIT turbocharger oil leaks.

OIL CONSUMPTION



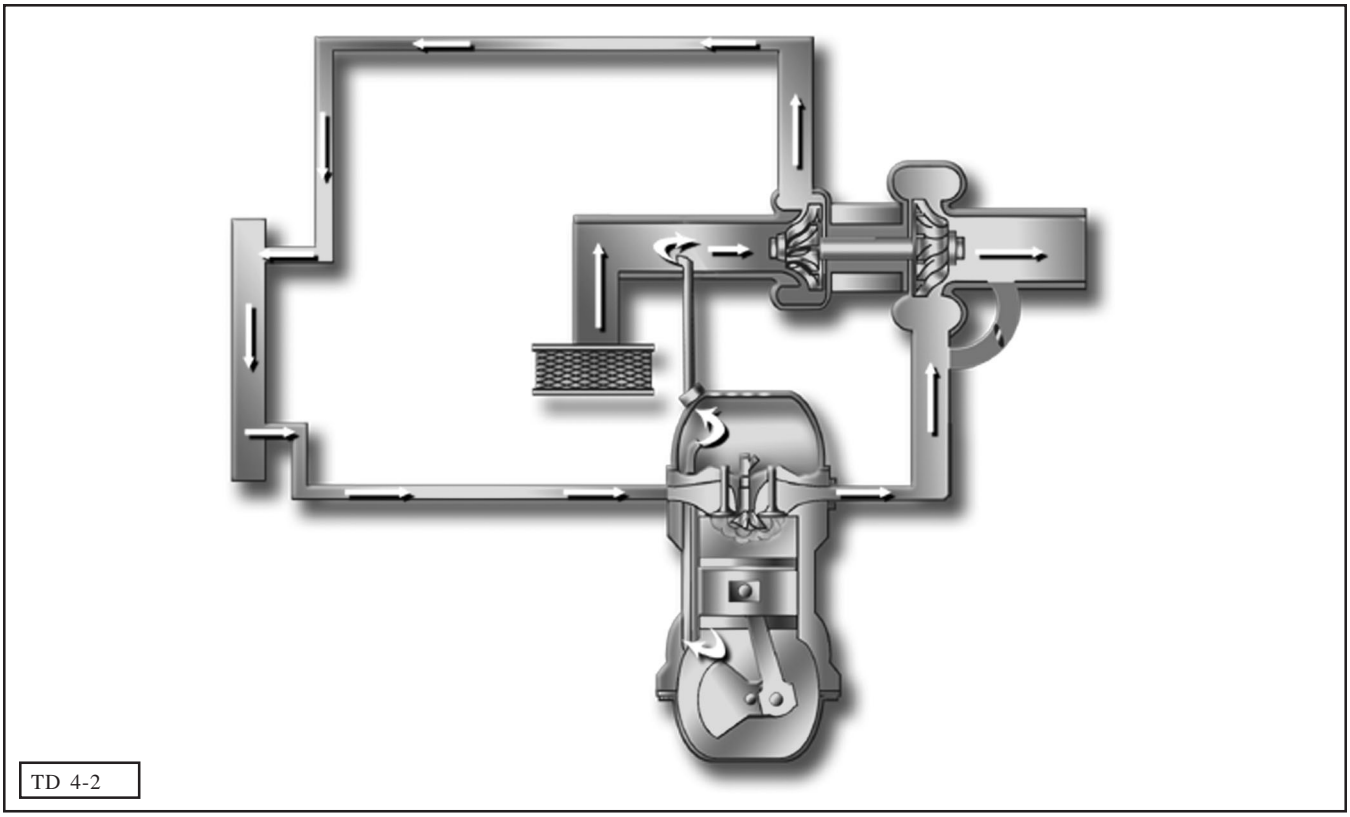
Normal Amount of Oil in CAC Tube

Oil is "consumed" by migrating from the engine crankcase to the combustion chamber, where it is partially or completely burned, and the products of combustion are discharged through the vehicle exhaust system.

Migration paths that result in oil consumption are:

- Cylinder walls
  - Although the piston rings create a good seal between the crankcase and combustion chamber, some oil will pass the rings. The amount of oil will depend on the condition of the engine.
- Clearance between the valve stems and valve guides
  - Only a small amount of oil will migrate across the valve stems on a turbocharged engine because a positive pressure is maintained in the intake manifold and combustion chamber during the intake stroke.
- Crankcase ventilation system
  - Crankcase vapors, containing a small amount of engine oil, are vented into the air intake system and burned in the combustion chamber. However, F650/750 use road draft tubes that vent crankcase vapors to the atmosphere.

Oil Consumption Specifications



Oil System Schematic

Remember that some oil consumption is normal, and is characteristic of all conventional piston-type internal combustion engines.

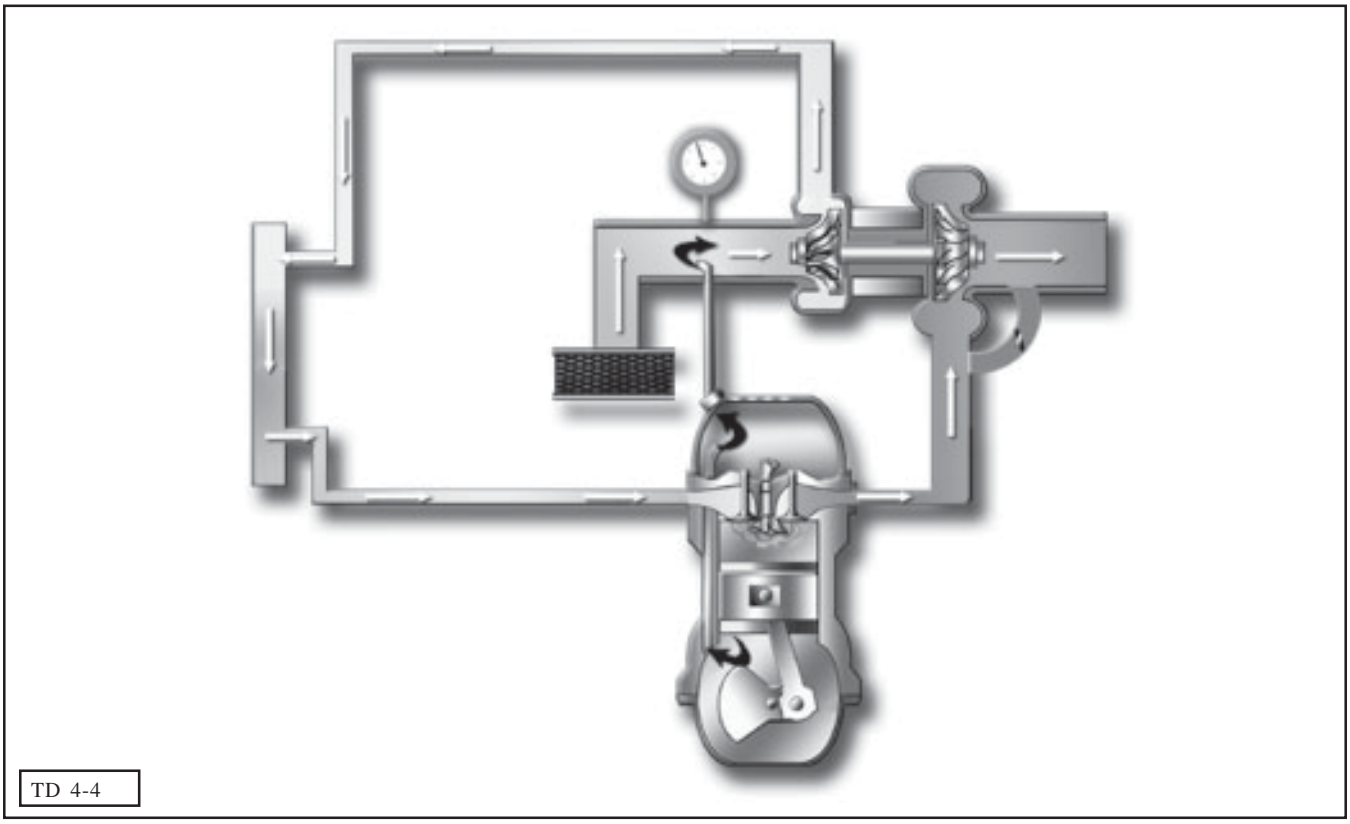
- Oil use is normally greater during the first 12,000 km (7,500 miles) of service.
- As mileage increases, oil use generally decreases.
- Vehicles in normal service should get at least 1,611km per liter (1,000 miles per quart) after 12,000 km (7,500 miles) of service.
- A detailed oil consumption test procedure can be found in the service publications.
- Before conducting the oil consumption test procedure, verify that there are no external engine oil leaks.

Causes of Excessive Oil Consumption

There may be several causes for excessive oil consumption on a 7.3L DIT engine. These include:

- Clogged air cleaner element or restriction upstream of compressor
- Engine wear (piston rings, valve guides)
- Turbocharger oil seals leaking
- Injector or injector O-ring leaking
- Overfilled crankcase
- Incorrect type or grade of oil
- Extended oil change intervals

Causes for Excessive Oil Consumption (continued)



Oil Schematic with Restricted Air Filter

A critical maintenance item that can cause increased oil consumption is the air filter.

- Failure to properly maintain the air filter results in reduced pressure in the inlet area between the filter and the turbocharger - the area where crankcase vapors enter the inlet system.
- The reduced pressure results in a greater volume of crankcase vapors, containing engine oil, to be drawn into in the inlet system.

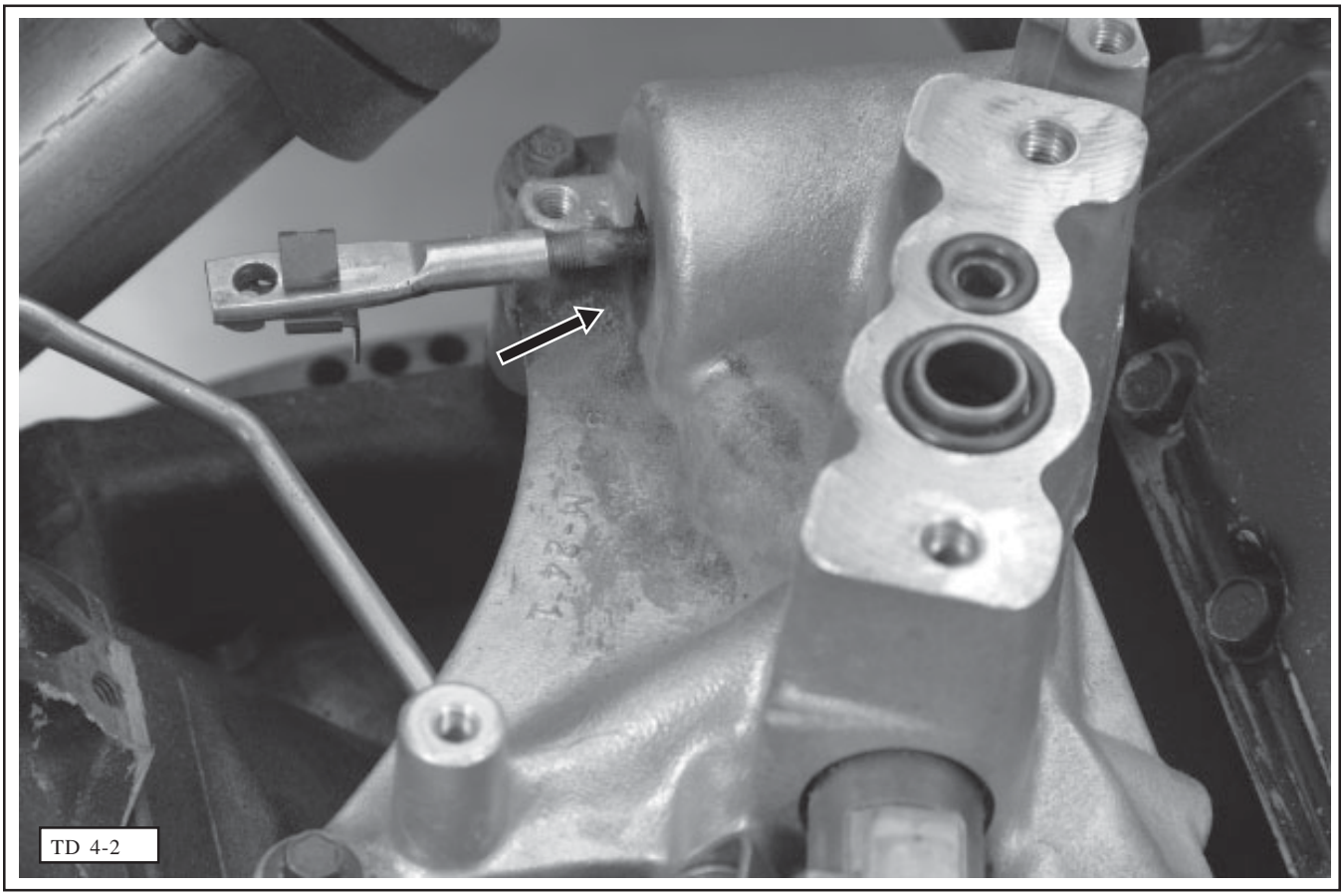
Another cause of excessive oil consumption is overfilling the crankcase.

- Overfilling increases the agitation of the oil.
- This results in a higher level of oil within the crankcase vapors.
- The oil separator will be unable to function correctly resulting in more oil than normal entering the inlet air and CAC system.

Other causes of excessive oil consumption include:

- Worn valves seals
- Worn engine cylinder walls
- Worn piston rings
- Leaking turbocharger seals

OIL LEAKS



Dirt Buildup Indicates Oil Seepage on Turbocharger Pedestal

As with all engines, identifying engine oil leaks on the 7.3L DIT engine requires close attention to detail.

It is important to identify the difference between normal engine seepage, and leaks that require service.

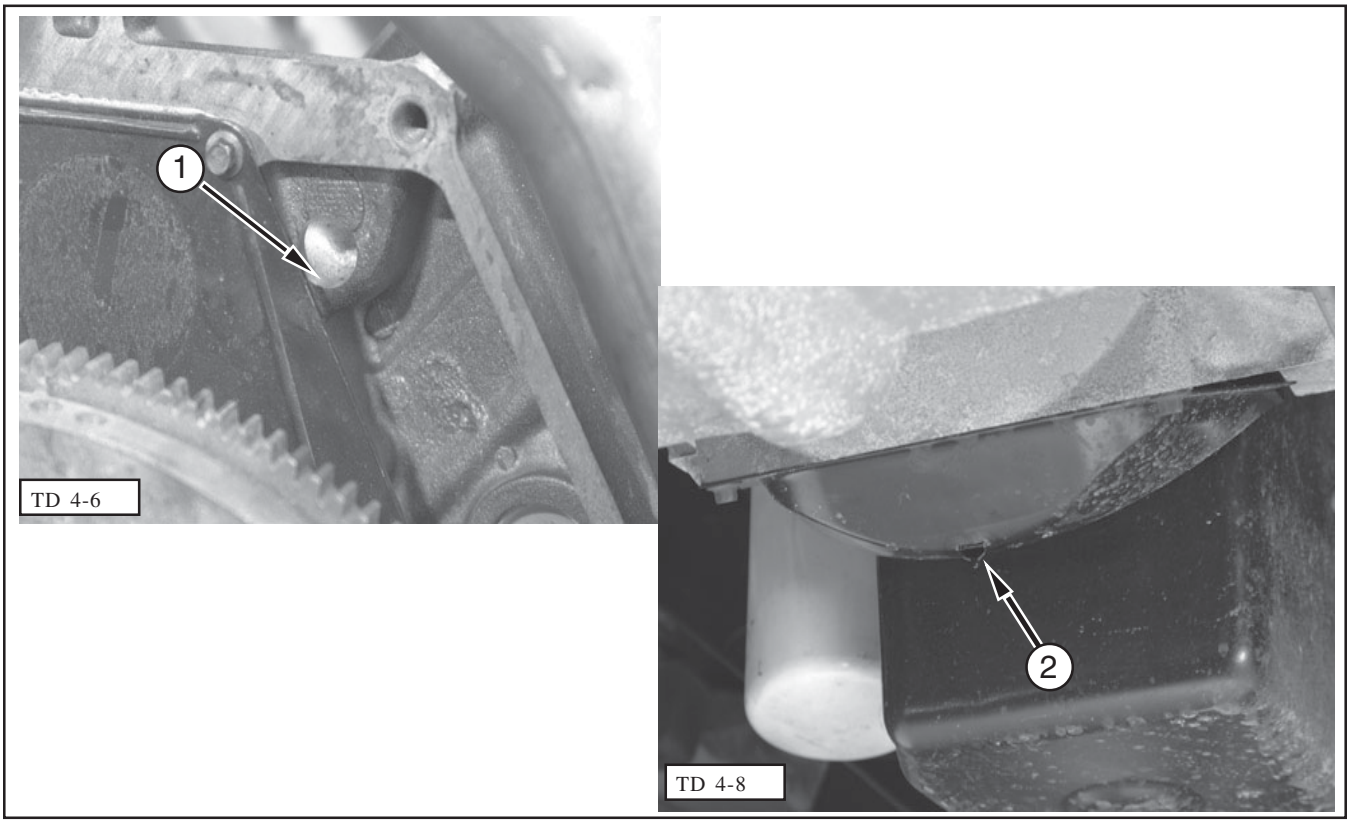
An oil leak is defined as:

- The presence of oil in a liquid (runny) state outside the component or assembly; in this case, the engine.
- The quantity of oil present at a leak is sufficient that, if placed on a vertical surface, will run or sag.

Compare this with the definition of oil seepage:

- Seepage produces a minute oil film on exterior surfaces, not of sufficient quantity to appear as a black liquid. The oil film often collects some dust, depending on the operating environment.
- Slight seepage is considered normal, and is present on many mechanical products. It is nearly impossible to locate and correct all sources of seepage, and the exercise should not be attempted.

Diagnosing Oil Leaks



Oil Leak from Top of Engine Drips from Bottom of Torque Converter Shield

Item	Description	Item	Description
1	Leaking oil at top of engine exits at drain hole	2	Oil drains down back of engine and drips at torque converter cover

When diagnosing engine oil leaks, the source and location of the leak must be positively identified before making repairs. The dripping oil from a leak can occur a considerable distance from the leak's source.

For example:

- Oil from a leak at a turbo pedestal seal O-ring can collect in the valley of the engine
- It will then pass through a round opening at the rear of the cylinder block and run down the back of the engine.
- The oil will then drip from the torque converter cover at the lower rear of the engine.

Diagnosing Oil Leaks (continued)

UV Leak Detector

A UV Leak detector can aid in locating the source of an oil leak. The UV detector is particularly helpful in diagnosing a slow leak.

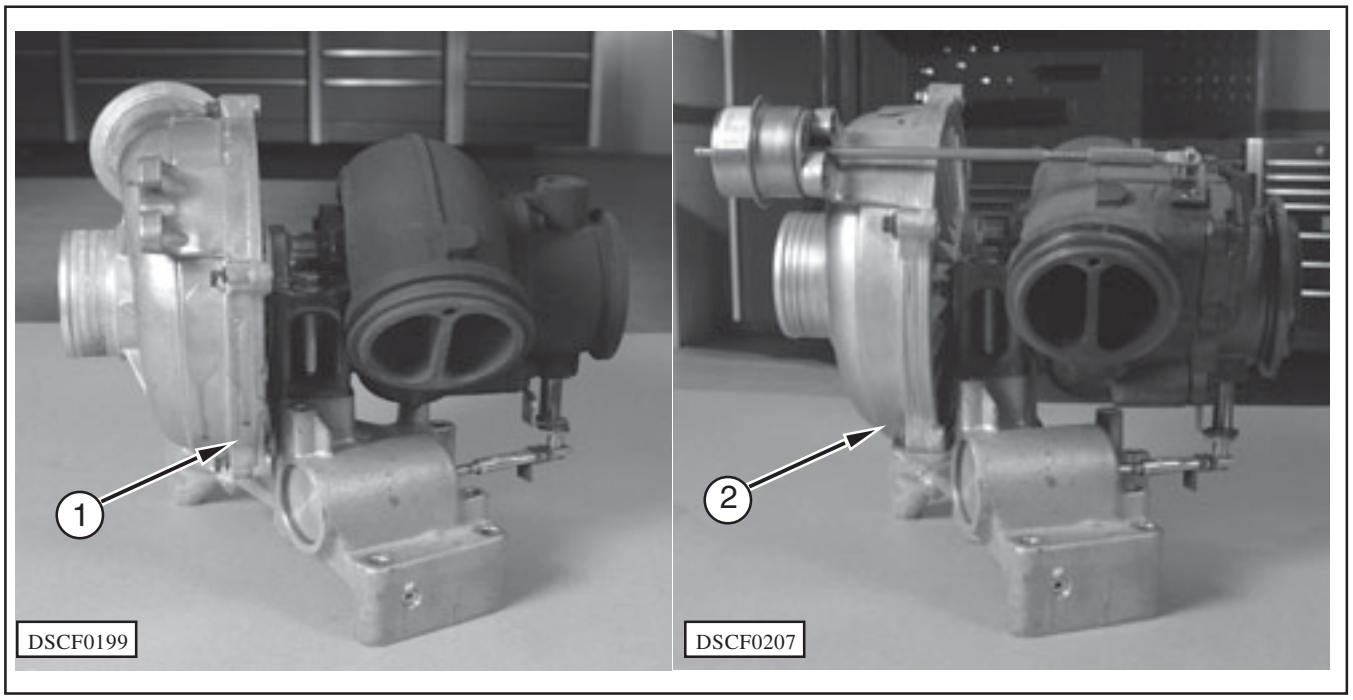
To use the leak detector:

- Add engine oil dye.

Note: Be sure that the oil dye is compatible with diesel engine oil.

- Use a minimum 14.8 ml (0.5 ounce) to a maximum 29.6 ml (1 ounce) of fluorescent additive to all engines. If the oil is not pre-mixed, fluorescent additive must first be added to crankcase.
- Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the UV Leak Detector Kit. A clear bright yellow or orange area will identify the leak. For extremely small leaks, several hours may be required for the leak to appear.
- Once the source of an oil leak has been determined, conduct the repair and recheck for leaks.

PEDESTAL ASSEMBLY



Non-Wastegate and Wastegate-Equipped Turbochargers

Item	Description	Item	Description
1	Turbocharger without Wastegate	2	Turbocharger with Wastegate

The turbocharger takes advantage of the heat energy contained in the exhaust gas to compress the intake air. This compressed intake air causes more engine power output, better fuel efficiency and better engine performance at higher altitudes.

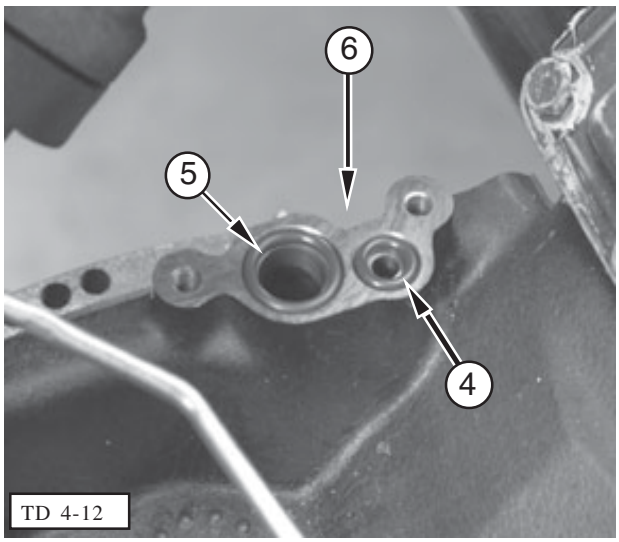
- The F-Super Duty 250-550 and Excursion turbocharger, shown on the right above, employs a wastegate along with a Charge Air Cooling (CAC) system, also known as an air-to-air intercooler.
- The turbocharger for the Econoline, shown on the left, does not use a wastegate or an intercooler.
- Oil flow through the pedestal and turbocharger is identical between the non- and with-wastegate turbochargers.
- The turbocharger and pedestal are actually two separate assemblies.
- The pedestal serves as a support base for the turbocharger, providing a mounting surface above the engine vee and a path for engine oil flow to and from the turbocharger.

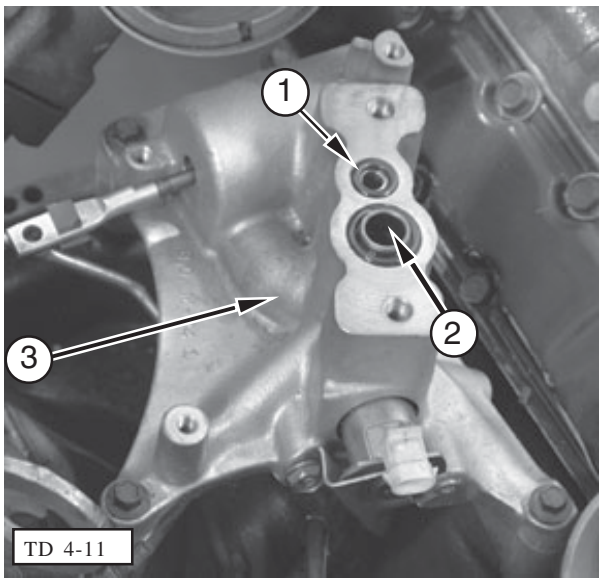
Pressurized engine lubrication oil, 40-70 psi (276-482 kPa) nominal pressure, is used in the turbocharger assembly for two purposes:

- Provide lubrication and cooling for the turbocharger shaft bearings.
- Hydraulically actuate the EBP control cylinder, which in turn operates the EBP valve.

Note: Some 7.3L DIT applications, such as F-650/F-750, and F-Super Duty with "Cold weather package delete" option, are not equipped with the EBP system.

Oil Passages





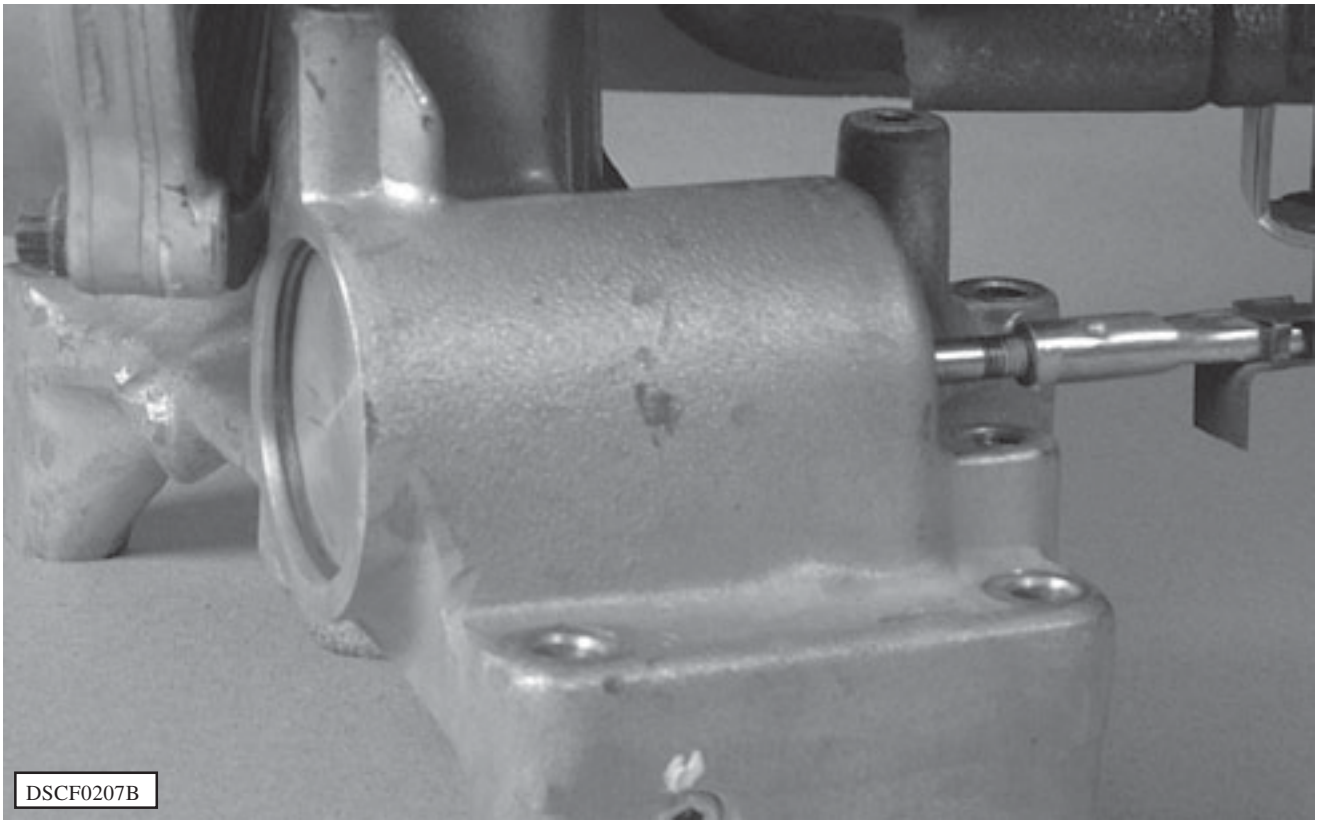
Pedestal and Turbocharger Oil Passages

Item	Description	Item	Description
1	Oil Feed Passage	4	Oil Feed Passage
2	Oil Drain Passage	5	Oil Drain Passage
3	Pedestal	6	Rear of Engine

Engine oil is routed across mating surfaces, and sealed by O-rings, at two points.

- Cylinder block-to-pedestal
- Pedestal-to-turbocharger
- These mating surfaces are not particularly prone to leaks, however slight oil seepage at the turbocharger is a normal condition.
- Replacement of the O-rings between the turbocharger and pedestal is recommended but not required.
- The same O-ring seals (one for feed and one for drain) are used at both mating surfaces.
- The O-ring seals are available separately through Service Parts, and are also included in the EBP actuator rod seal kit that is discussed on the following pages.

EBP Actuator Cylinder

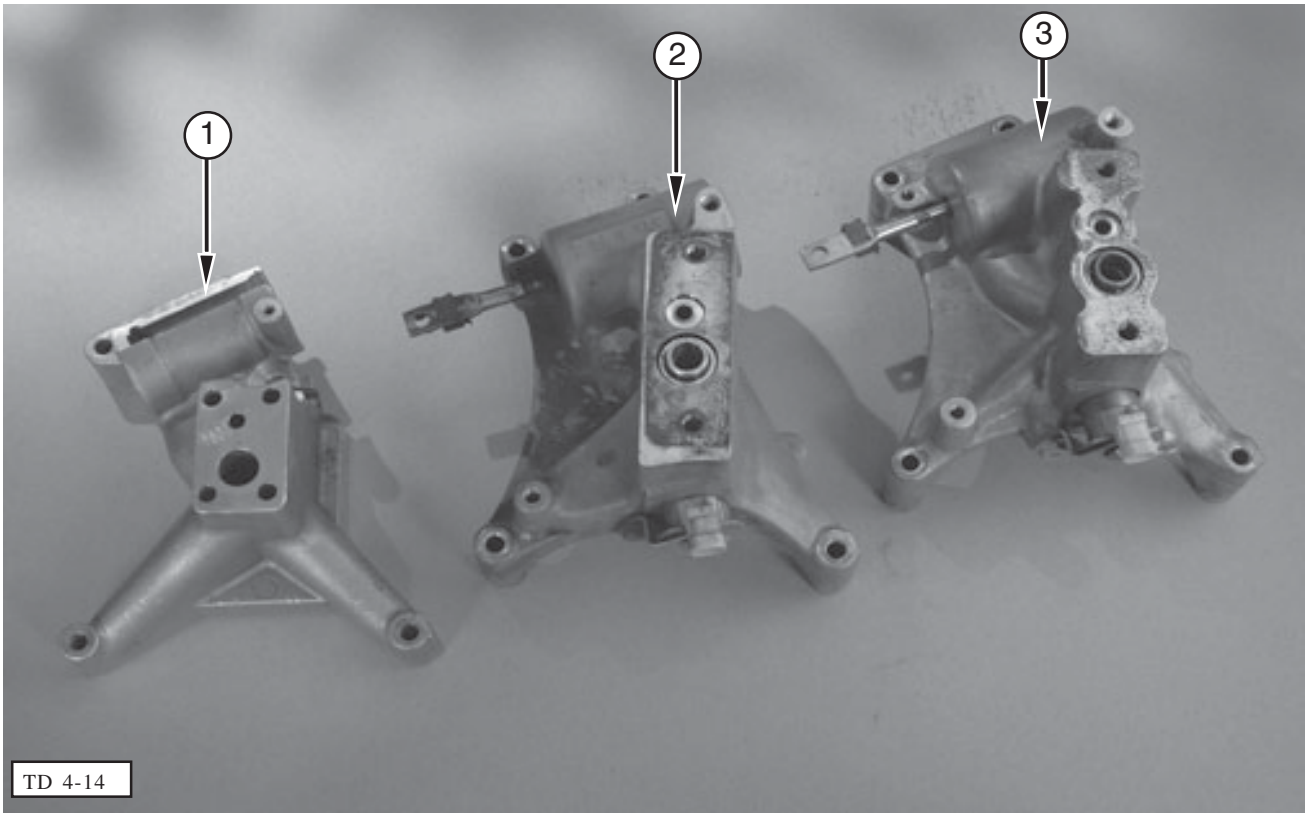


EBP Actuator Cylinder

The EBP actuator cylinder is a single-acting hydraulic cylinder. The cylinder is part of the pedestal casting.

- Engine oil pressure is used to extend the cylinder, closing the back pressure valve.
- Spring force is used to retract the cylinder, opening the back pressure valve.
- Oil flow to the cylinder (EBP ON) as well as venting to sump (EBP OFF) is accomplished by the EBP solenoid, which in turn is controlled by a signal from the PCM.

Pedestal Design



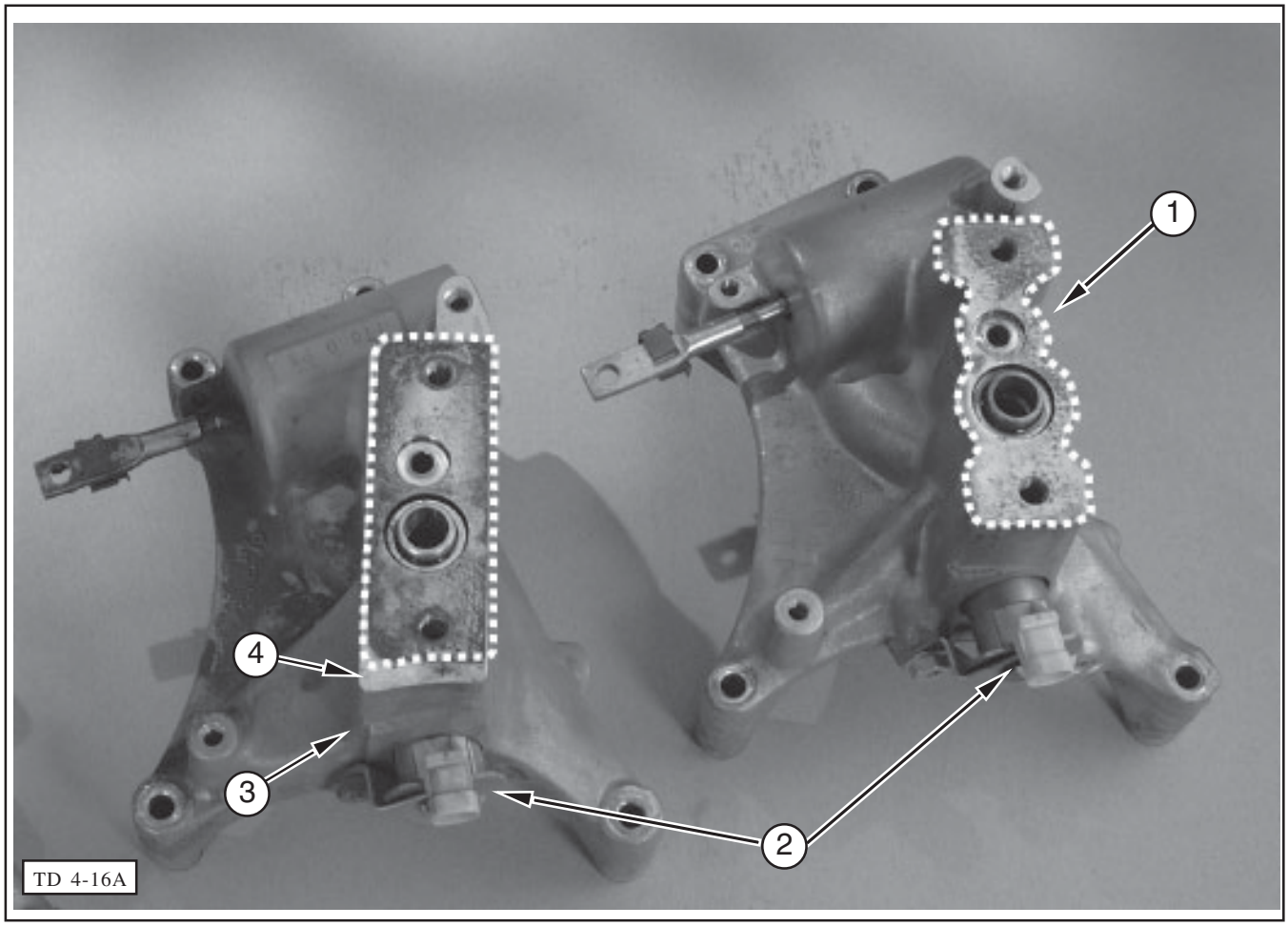
Turbocharger Pedestals

Item	Description	Item	Description
1	Model Years 1994-1997 Engine S/N 661894 and earlier	3	Model Years 1998 and later Engine S/N 661895 and up (hourglass design)
2	Model Years 1998 and later Engine S/N 661895 and up (block design)		

The engine production range, and production pedestal design, must be established in order to determine which of the two available seal kits can be used.

Production Range	Kit Part Number
Model Years 1994-1997 Engine S/N 661894 and earlier	2C3Z-9P466-BA
Model Years 1998 and later Engine S/N 661895 and up	2C3Z-9P466-AA
Model Years 1998 and later Engine S/N 0843990 through 1825359 with hourglass only	Not Applicable Pedestal replacement required for these S/Ns with hourglass only

Pedestal Design



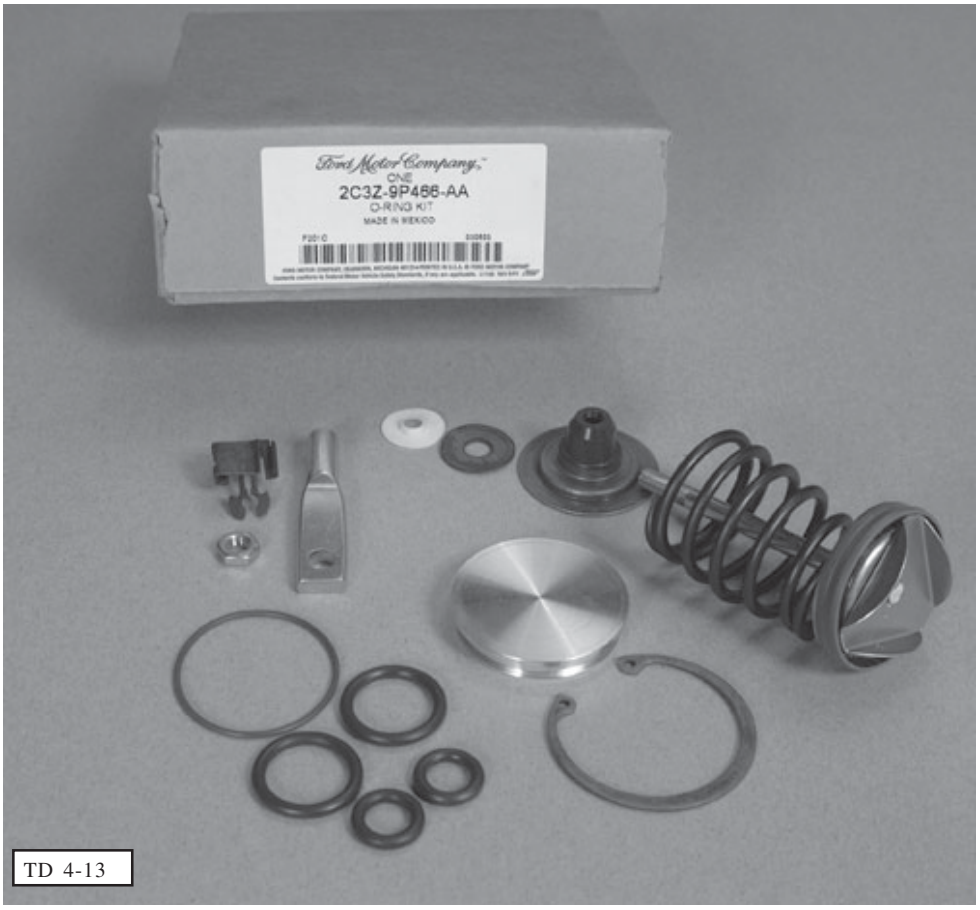
Block-shaped and Hourglass-shaped Pedestals

Item	Description	Item	Description
1	Hourglass Shaped Pedestal	3	Block Shaped Pedestal
2	EBP Regulator Solenoid	4	Visible Ledge (with turbo installed)

Later-style pedestals, engine S/N 661895 and above, may have either a block-shaped or hourglass-shaped pedestal. The pedestal style can be identified without removing the turbocharger.

- The block-shaped pedestal has a visible ledge that protrudes beyond the turbocharger base, as shown in Item 4 above.
- The EBP regulator control solenoid, Item 2 above, is mounted deeper in the block-shaped pedestal than on the hourglass shaped pedestal.
- The new seal kit can be installed on all block-shaped pedestals.
- The new seal kit cannot be installed on hourglass-shaped pedestals used on engine serial number range 0843990-1825359.
- Engines in S/N range 0843990-1825359 only with hourglass-shaped pedestals require replacement of the pedestal assembly to correct EBP actuator piston rod leak concerns.

PISTON ROD SEAL KIT



Piston Rod Seal Kit

EBP Actuator Piston Rod Leaks

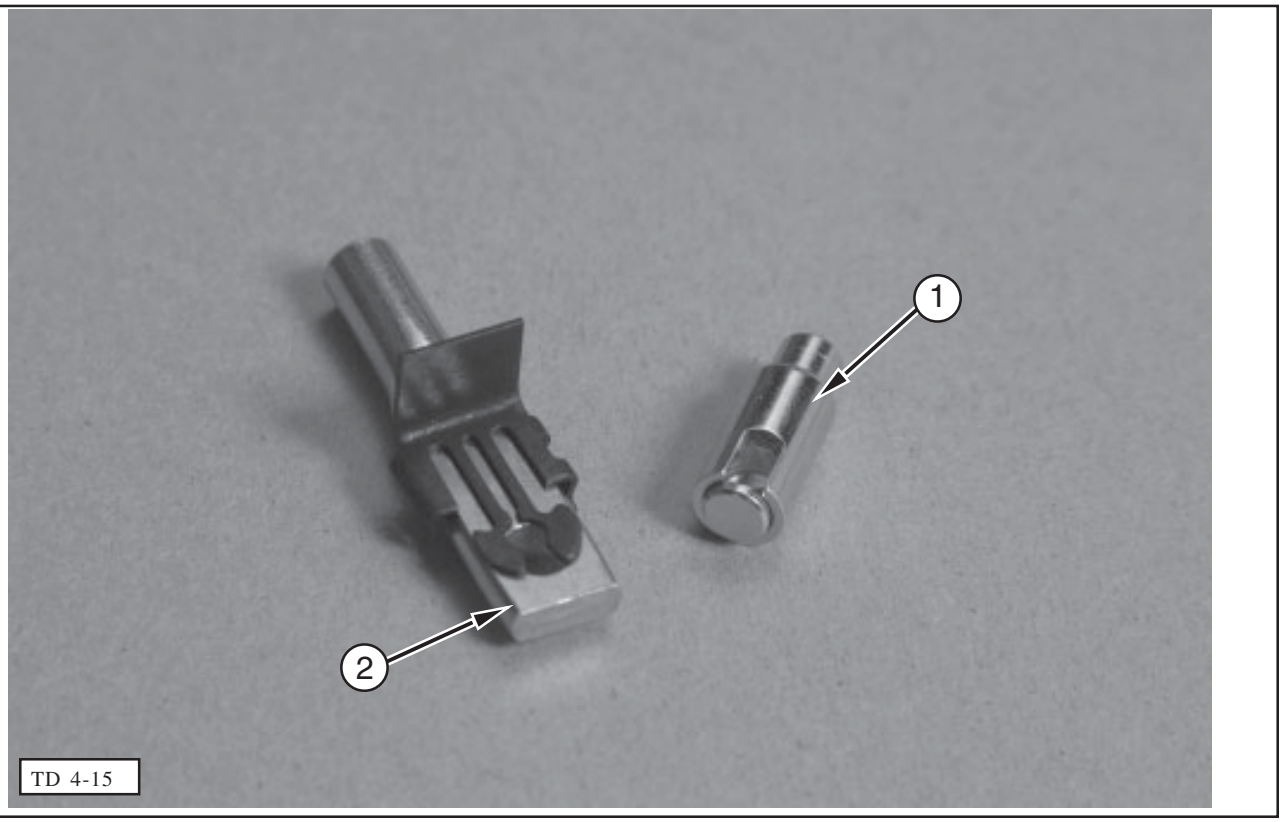
- Leaks can develop at the actuator rod opening in the EBP cylinder.

Piston Rod Seal Kit

- An improved boot-type seal has been phased into production in 2002.
- The improved seal is also contained in the piston rod seal kit, shown above.

Note: The piston rod seal kit must be used to repair pedestal leaks. Replacement of the complete pedestal assembly to correct piston rod seal leaks is not an acceptable practice.

PISTON ROD SEAL KIT INSTALLATION



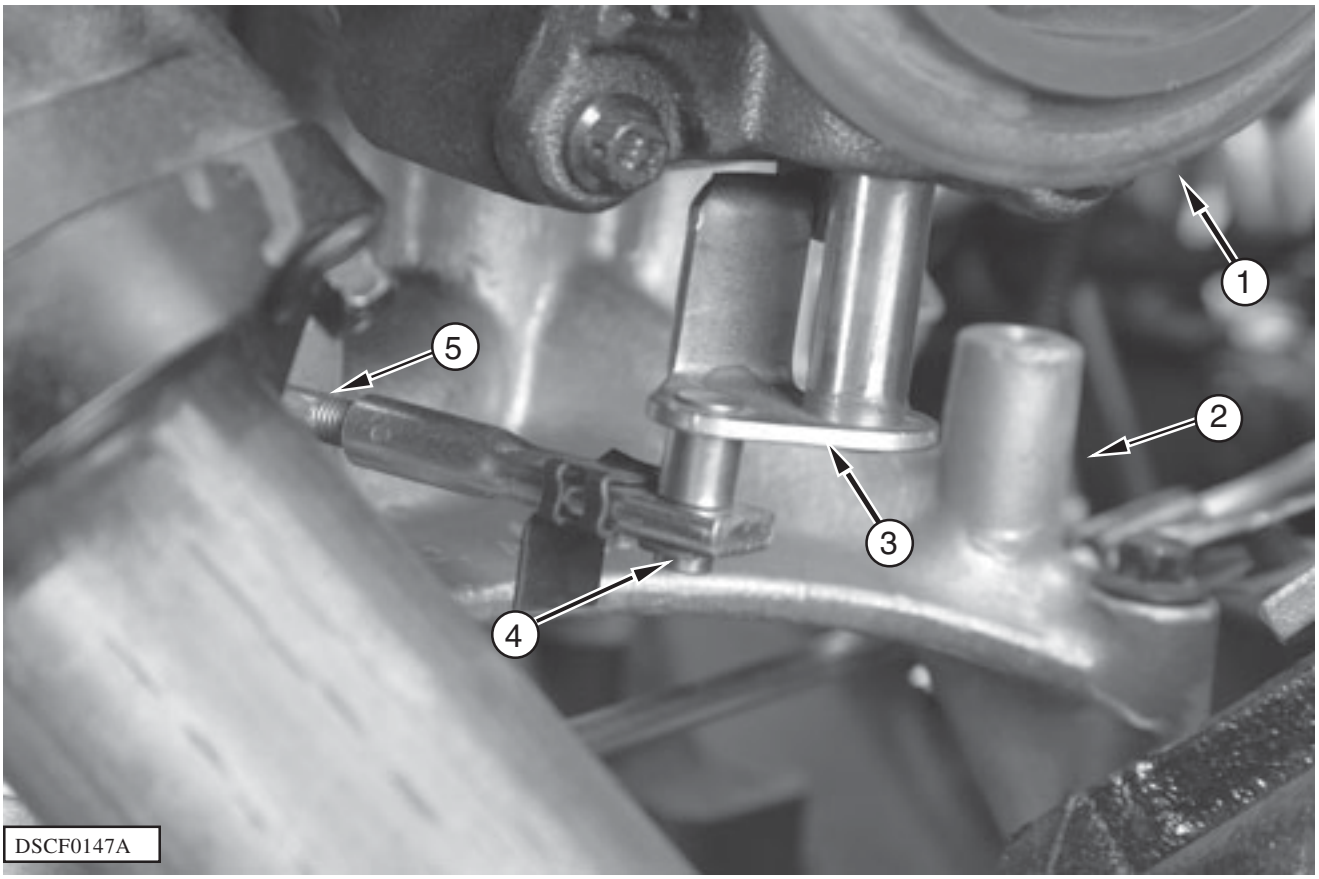
Actuator Rod Latch

Item	Description	Item	Description
1	Early style latch, part of kit P/N 2C3Z-9P466-BA	2	Late Model Latch, part of kit P/N 2C3Z-9P466-AA

This course will demonstrate installation of Seal Kit P/N 2C3Z-9P466-AA, used on later production engines. Early and late kits are very similar, with the following significant differences:

- On early engines (1994-1997), the turbocharger and pedestal are removed from the engine as one assembly. On later engines, the turbocharger is removed first, followed by the pedestal. For that reason, on early engines, the turbocharger can remain mounted to the pedestal on the bench while the seal kit is installed.
- The actuator rod latch design is different, as shown above.

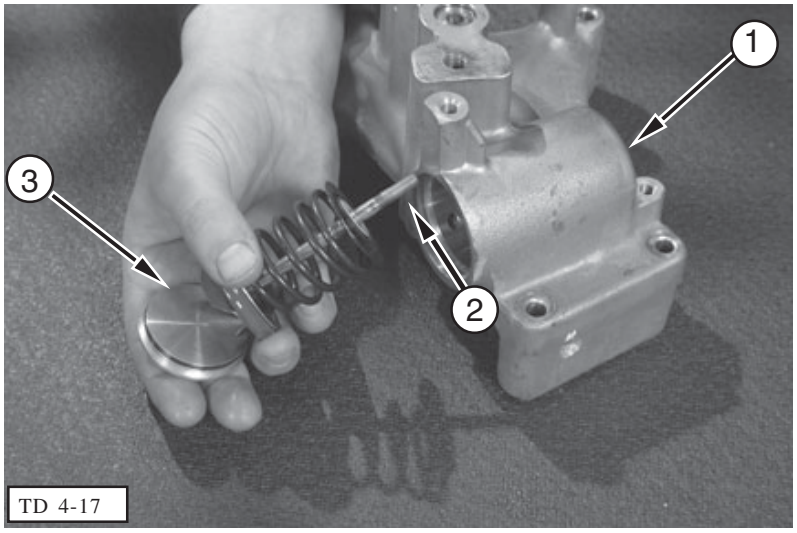
PISTON ROD SEAL KIT INSTALLATION (CONTINUED)



Removing Turbo and Pedestal

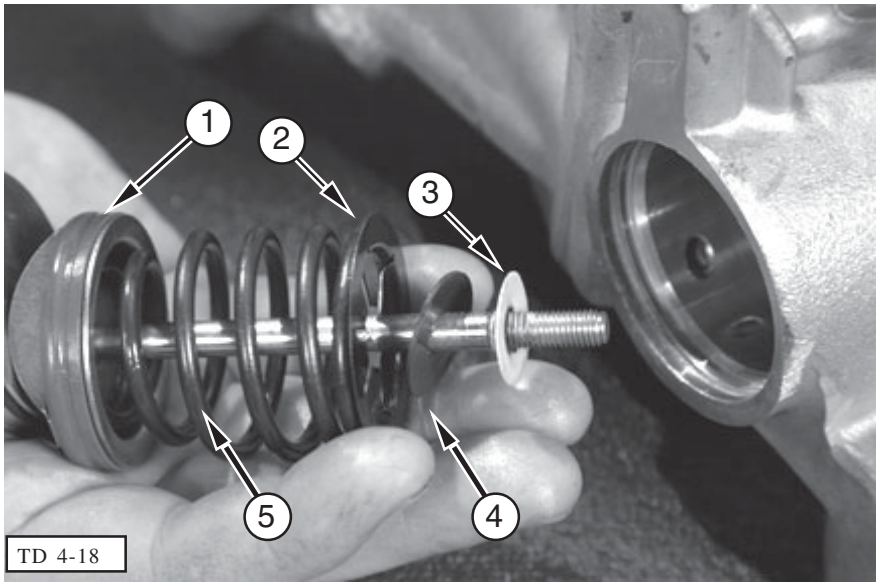
1. Disconnect the piston rod (5) from the control valve (3) by moving the slide lock back and unhooking the latch end (4) from the control arm.
2. Remove the turbocharger (1) from the pedestal (2).
3. Remove the pedestal (2) from the engine.
4. Unscrew the latch end (4) (and jam nut, if equipped) from the piston rod (5).
5. Hold the piston rod (5) securely while unscrewing the latch end (4). The original latch end is crimped to the piston rod.
6. Remove the retaining ring from the end of the EBP housing.

PISTON ROD SEAL KIT INSTALLATION (CONTINUED)



Removing EBP Piston from Cylinder

7. Remove the end cover (3) from the housing (1) by gently tapping on the threaded end of the piston rod (2).

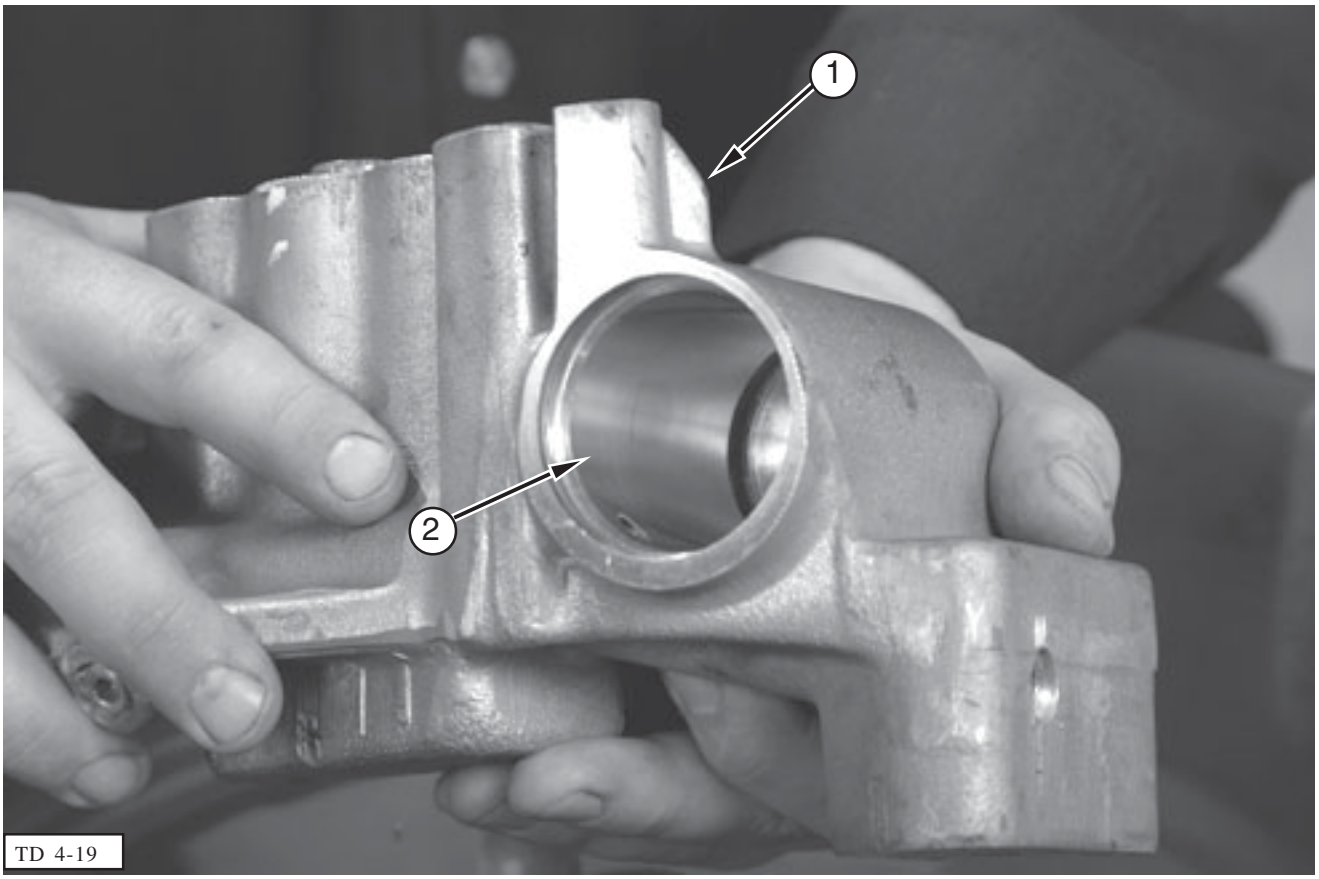


Components of EBP Piston Assembly

8. Remove the piston (1), spring (5), spring seat (2) and one black (4), one white (3) wiper seals as an assembly from the housing.

- Be sure that the white and black wiper seals come out with the assembly.
- Discard the EBP piston assembly. The kit contains a complete new EBP piston assembly.

PISTON ROD SEAL KIT INSTALLATION (CONTINUED)



Pedestal without EBP Piston Installed

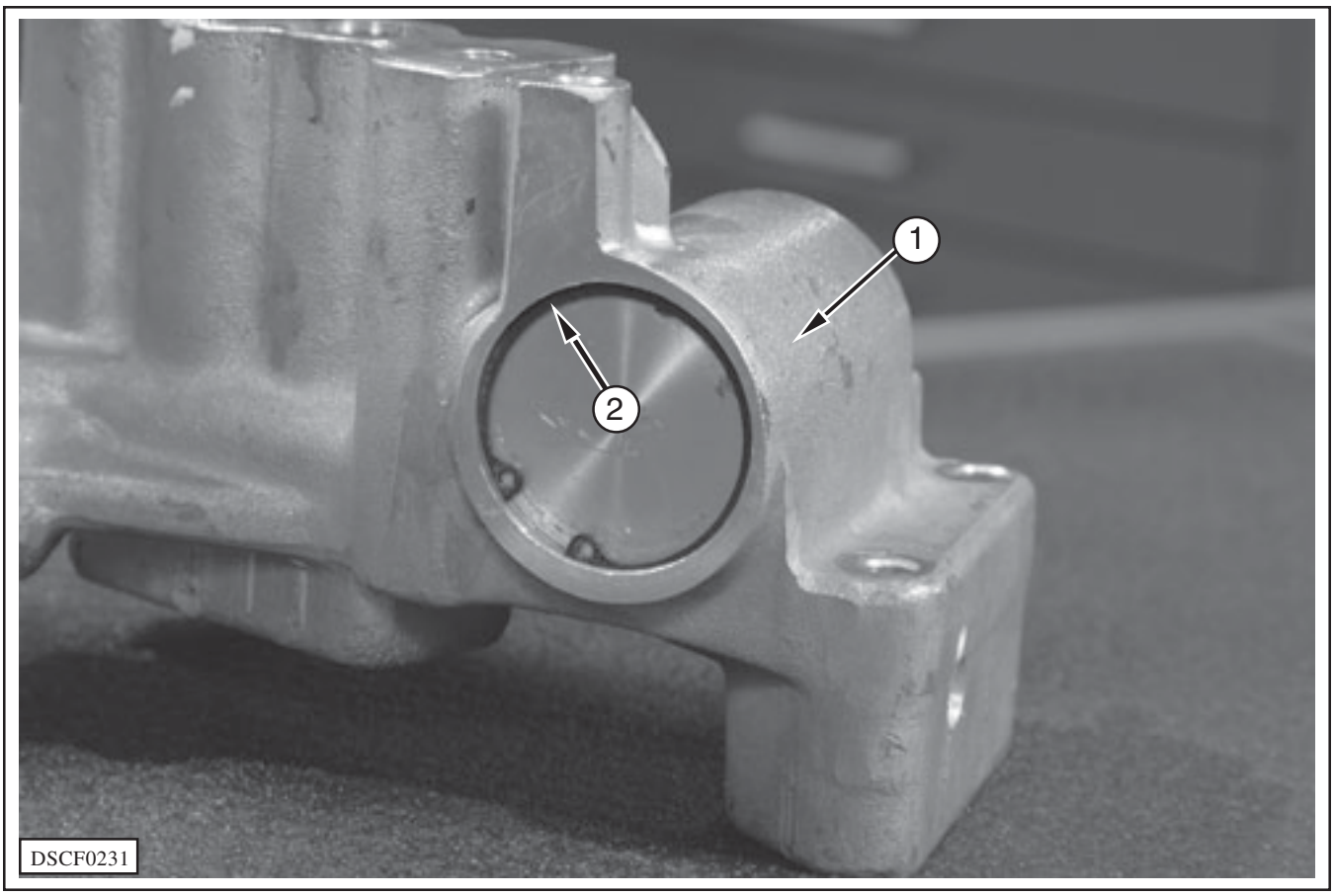
9. Thoroughly clean the pedestal (1) and the inside of the housing.

- Check the EBP piston bore (2) for axial scoring

10. Lubricate the inside of the housing and the outside of the new EBP piston with clean oil.

11. Install the new EBP piston rod assembly (without the jam nut and latch end) into the housing. Install the O-ring on the piston cover.

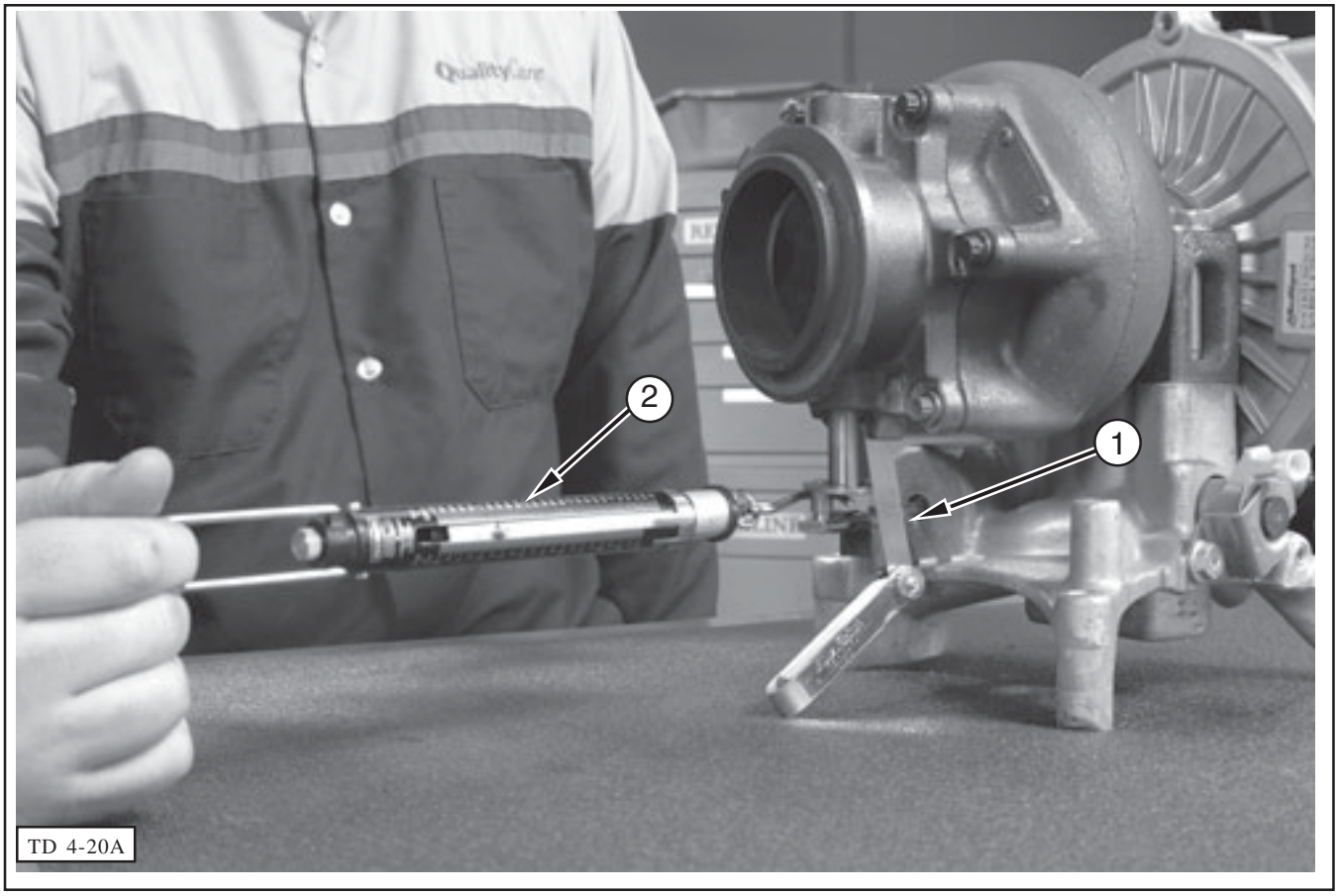
PISTON ROD SEAL KIT INSTALLATION (CONTINUED)



Installed Retaining Ring on EBP Housing

12. Lubricate the O-ring on the piston cover with clean oil. Install the end cover and retaining ring (2) in the housing (1).
13. Install the jam nut and latch end on the threaded end of the piston rod. Install the new slide lock on the latch end

PISTON ROD SEAL KIT INSTALLATION (CONTINUED)



Adjusting EBP Piston Preload

14. Adjust the preload of the EBP piston rod on a workbench as follows:

    a. Install the turbocharger onto the pedestal on a workbench. Tighten the mounting bolts.

    b. Connect the latch end of the piston rod to the control arm. Do not close the slide lock.

    c. To determine when the EBP control valve moves, insert a 0.01 in feeler gauge (1) between the control valve stop and the stop on the turbocharger housing.

    d. Attach a spring scale tester (2) to the control arm and pull on the tester. When the feeler gauge falls out, take the reading on the spring scale tester.

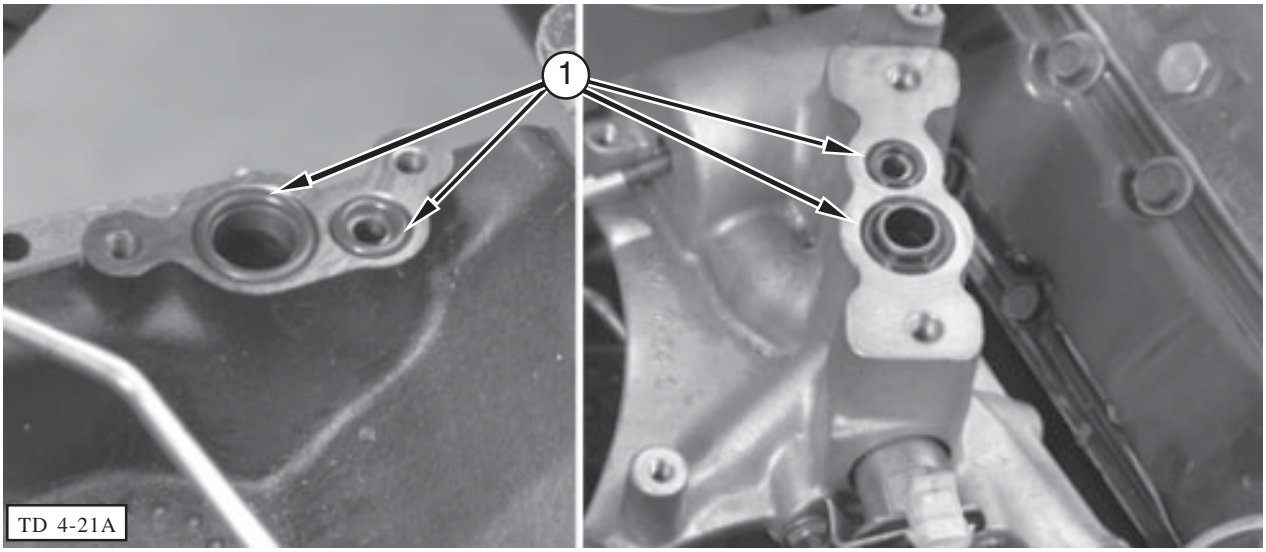
       The reading on the spring scale tester should be 44.5 N (10 lb) when the feeler gauge falls out.

    e. If the preload of the EBP piston rod does not meet this specification, shorten or lengthen the piston rod by screwing the latch end in or out.

       Repeat the test procedure.

    f. When the proper preload is achieved, lock the jam nut against the latch end.

PISTON ROD SEAL KIT INSTALLATION (CONTINUED)



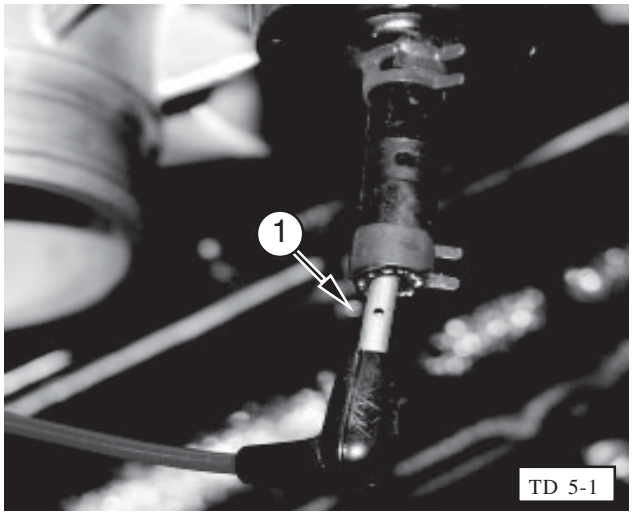
Install O-Rings on Engine and Pedestal

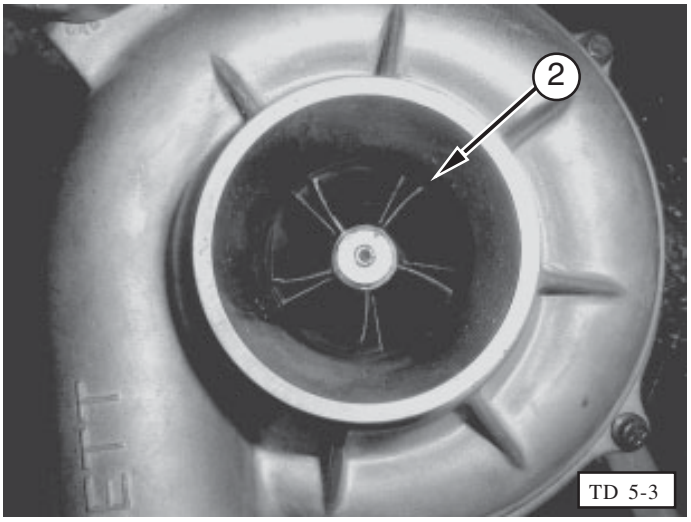
15. Disconnect the piston rod from the control arm.
16. Remove the turbocharger from the pedestal.
17. Install the pedestal on the engine. Use new oil feed and oil drain O-rings (1) (contained in the kit) between the pedestal and the crankcase.
18. Install the turbocharger on the pedestal. Use new oil feed and oil drain O-rings (contained in the kit) between the turbocharger and the pedestal
19. Connect the latch end of the piston rod to the control arm. Close the slide lock.
20. Reinstall any components removed to necessitate the repair.
21. Verify the repair.

OBJECTIVES

- Identify various aftermarket performance modifications that may negatively affect turbocharger longevity.
- Describe the affects aftermarket modifications have on performance and reliability.
- Describe possible warranty implications resulting from customer use of aftermarket modifications.

AFTERMARKET MODIFICATIONS





Aftermarket Devices for 7.3L DIT

Item	Description	Item	Description
1	Wastegate Defeat Device	3	Aftermarket Exhaust System
2	Aftermarket Turbo Compressor		

Aftermarket modifications may negatively affect the life of the turbocharger. Concerns with aftermarket components can be increased in high altitudes where the “thin air” offers less resistance for the wheels to turn.

- Some of the aftermarket modifications include:
  - modified PCM programming.
  - turbocharger modifications.
  - wastegate actuator defeat devices.
  - exhaust system modifications.
  - propane injection

AFTERMARKET MODIFICATIONS (CONTINUED)

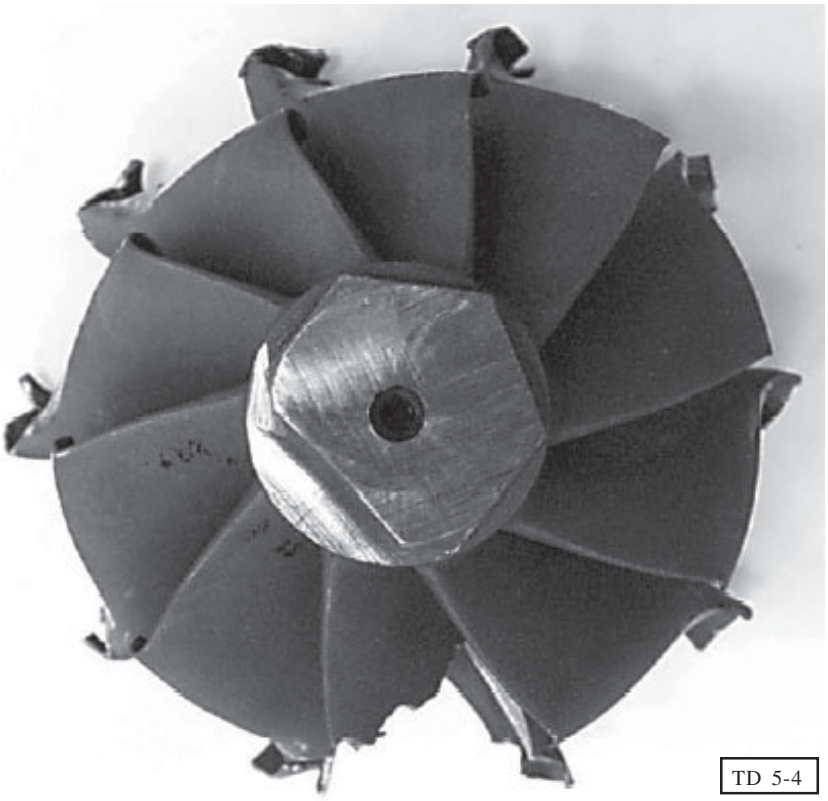
TD 5-1

Propane injection kit

The following are some of the concerns that may result from the use of aftermarket modifications.

- PCM programming modifications are often made through the use of aftermarket "chips" that are installed into the vehicle PCM. This modified programming will often cause the turbocharger to overboost in high load situations. This can result in failure of the compressor and/or turbine and may create noise concerns during normal operation. Modified PCMs are difficult to detect, however, DTC P0605 (internal control module ROM error) or DTC P0603 (internal control module KAM error) stored in the PCM's memory often indicate that the PCM has been modified.
- Turbocharger modifications can result in premature turbo failure. This is caused by the increased pressure in the intake and on the turbo shaft bearings.
- Wastegate actuator defeat devices attempt to prevent the wastegate from opening and allowing excess exhaust pressure from bypassing the turbine. This will usually lead to turbo damage and may cause engine damage as well.
- Exhaust system modifications vary from installation of an exhaust system that lowers engine backpressure to compression braking devices. These changes in exhaust flow can cause the turbine to overspeed causing turbo damage.
- Propane injection kits increase engine loading beyond design specifications. As a result, they may cause the engine to blow head gaskets, damage the pistons, and cause turbocharger failure.

AFTERMARKET MODIFICATIONS (CONTINUED)



Turbine Wheel (structural failure)

The implications of aftermarket modifications to a turbocharger are always present in the way of stress related engine failure or detonation because of lean air fuel ratios or heat and timing problems. Aftermarket modifications always lead to an increased risk of problems.

- Some of the affects aftermarket modifications have on performance include:
  - The higher wheel speeds created by the “thin air” and the performance enhancers typically result in a fractured turbine wheel blade.
  - Wheels with blades missing on “modified “ engines will cause low power, vibration, and ultimately turbocharger failure.
  - Over-speeding the turbocharger may also cause turbocharger thrust bearing failure, increasing the axial endplay of the turbocharger shaft, and wheel to housing contact.

OBJECTIVES

- This appendix provides a summary, and in some cases additional information, for each of the five lessons.

Lesson One - Overview

PTS Website

The PTS website can be accessed at:

- www.proservicetech.com (login with password required).

Service resources available on the PTS website include:

- Workshop Manual
- PC/ED Manual
- EVTM
- Oasis Reports
- TSBs and SSMs
- Diesel Diagnostic Guides
- Special Guides for components such as the Turbocharger and High Pressure Oil Pump

Turbocharger System

The turbocharger is a centrifugal air compressor that consists of a turbine wheel, and compressor wheel that are separately encased, but rotate with a common shaft.

- The turbocharger system consists of the following components:
  - Center housing
  - Compressor wheel
  - Compressor housing
  - Compressor inlet
  - Turbine wheel
  - Turbine outlet
  - Turbine housing
- Normal turbocharger characteristics include:
  - Some oil seepage
  - Oil in exhaust systems on new units
  - Minimal oil carry over
  - Some noise
  - Some turbo lag

Lesson One - Overview (continued)

- Abnormal turbocharger characteristics include **excessive**:
  - Oil consumption
  - Oil leaks
  - Noise
  - Turbo lag
- Turbochargers are often replaced by mistake for the following reasons:
  - Poor performance
  - Oil leaks/oil consumption
  - Noise
- Most turbocharger failures result from:
  - Poor maintenance (air/oil)
  - Modifications (increasing turbocharger speed)

Lesson Two - Performance

When diagnosing low or poor performance concerns there are several systems that may cause a vehicle to display symptoms similar to a faulty turbocharger. These include:

- fuel injection/fuel quality concerns.
- air intake concerns.
- mechanical (base engine, transmission, dragging brakes, etc.).

Several publications are available from the PTS website to aid in diagnosing turbocharger concerns. These include:

- Powertrain Control/Emissions Diagnosis (PC/ED) Manual
  - The PC/ED manual provides engine driveability diagnostic and emission information.
- Workshop Manual
  - The Workshop manual provides detailed system specific information.
- Performance Diagnostic Sheets
  - Performance Diagnostic Sheets help aid the diagnostic process by providing a list of system tests that must be performed.
- Power Stroke Engine Turbocharger Diagnostic Guide
  - The Power Stroke Engine Turbocharger Diagnostic Guide provides turbo specific diagnostic information.

Turbocharger Replacement

- Turbochargers **should only** be replaced under the following conditions:
  - The compressor wheels rub against the turbo housing.
  - The compressor blades are damaged.
  - The shaft and wheels **do not** spin freely.
  - Axial endplay exceeds specifications (usually less than 0.01 mm (0.004 in.)).
- If a vehicle equipped with a turbocharger has a low performance concern the likely cause will be:
  - Low fuel delivery.
  - A restriction or leak in the intake or exhaust systems.
  - Worn engine components.

Lesson Three - Noise

- Normal turbocharger noise may include:
  - Exhaust backpressure (air rush noise)
  - Wastegate actuating (chirping or blast of compressed air)
- Some common customer concerns of abnormal turbocharger noise include:
  - Whine
  - Harmonics resulting from imbalance
  - Exhaust flow/exhaust leaks
  - Hum or whine from loose or perforated CAC tubing
- Possible causes of excessive noise under boost include:
  - Worn bearings
  - Intake noises (hum or whine)
  - Foreign object damage to turbine or compressor blades
- The turbocharger should be visually and physically inspected for damage. Turbocharger diagnosis comes down to this basic premise:
  - If the turbine and compressor wheels turn freely and there are no visible signs of damage, the turbocharger is NOT at fault. However, the wastegate and the EBP valve should still be carefully inspected.
- When performing a visual inspection on the turbocharger system, look for the following:
  - Damaged intake hoses
  - Loose hose clamps
  - Loose exhaust clamps
  - Damaged turbocharger
  - Restricted intake or exhaust

Loose or Missing Turbine Housing Bolts

Turbocharger bolts becoming loose has caused some noise concerns. A service kit, with special prevailing torque bolts is available to address this concern.

- The service kit is Part Number 1C3Z-9G486-A.
- The kit can be used on all Power Stroke engines from 1994 through 2001, after which the new bolts were incorporated into production.

Lesson 4 - Oil Leaks and Oil Consumption

All engines consume some oil.

Maximum acceptable oil consumption under normal operating conditions is:

- One quart per 1000 miles (one liter per 1,611 km).
  - Oil consumption can be somewhat higher during the first 7,500 miles (12,000 km) of service.

Some factors that may result in greater oil use include:

- High speed driving
- Towing
- High ambient temperature

Detailed acceptable oil consumption specifications are in the Warranty and Policy Manual. The procedure for accurately measuring oil consumption can be found in the Workshop Manual.

Oil Leaks and Oil Seepage

Oil leaks are indicated by the presence of liquid oil that will eventually pool, stream and run.

- Oil leaks can and should be repaired.
- It may be necessary to use a UV light source, with dye, to locate the source of oil leaks.

Oil seepage is indicated by the presence of a slight film of oil that may collect dust.

- Slight seepage is considered normal, and is present on many mechanical products that contain oil. It is nearly impossible to locate and correct all sources of seepage, and the exercise should not be attempted.

Some oil in the CAC system on all 7.3L Power Stroke engines, except F-650/F-750, is normal, since the closed crankcase ventilation system is vented into the air inlet system upstream of the intercooler.

Two conditions can result in excessive oil in the CAC system:

- Poor air filter maintenance
- Engine crankcase overfill

Lesson 4 - Oil Leaks and Oil Consumption (continued)

NOTE: The service kits described below must be used to repair leaks from the EBP actuator piston rod. Replacement of the complete pedestal assembly is not considered an acceptable practice, and may result in a warranty chargeback.

Oil Leak from the EPB Actuator Piston Rod

An improved seal was released into production in late in the 2002 Model Year, and is also available in a service kit.

Production Range	Kit Part Number
Model Years 1994-1997 Engine S/N 661894 and earlier	2C3Z-9P466-BA
Model Years 1998 and later Engine S/N 661895 and up	2C3Z-9P466-AA
Model Years 1998 and later Engine S/N 0843990 through 1825359 with hourglass only	Not Applicable Pedestal replacement required for these S/Ns with hourglass only

Lesson 5 - Aftermarket Modifications

Aftermarket modifications may negatively affect the life of the turbocharger, particularly in high altitudes where the “thin air” offers less resistance for the wheels to turn.

- Some common aftermarket modifications include:
  - modified PCM programming.
  - turbocharger modifications.
  - wastegate actuator defeat devices.
  - exhaust system modifications.
  - propane injection.

TOOL LIST

- Vise-Grip Type Dial Indicator 134-R0199
- New Generation Star (NGS) Tester 418-F052
- Worldwide Diagnostic System (WDS) 418-F224
- 88 Digital Multimeter 105-R0053
- Flex Probe Kit 105-R025B
- 104-Pin Breakout Box 014-00950 or equivalent
- 5/16-inch Fuel Line Disconnect Tool (Gray) 310-040 (T90T-9550-B) or equivalent.
- 3/8-inch Fuel Line Disconnect Tool (Blue) 310-041 (T90T-9550-C) or equivalent.
- Oil Pressure Leakage Test Adapters Set 303-5626.
- Fuel Pressure Adapter 310-D007 (D94T-6600-B) or equivalent.
- Fuel Pressure Adapter 310-D008 (D94T-6600-C) or equivalent.
- Crankcase Pressure Test Adapter 5631 or equivalent.
- Glow Plug Injector Adapter 134-00132 or equivalent.
- 7.3L Crankcase Test Adapter 014-0743 (D87T-6582-A) or equivalent.
- ICP/EBP Adapter Cable 418-D003 (D94T-50-A) or equivalent.
- Pressure Test Adapter Kit 014-00761 or equivalent.
- R134A Manifold Gauge Set 176-R932A or equivalent.
- Non-powered test lamp.
- Vacuum/Pressure Tester 164-R0253 or equivalent. Range 101.3 kPa (0.30 in-Hg). Resolution 3.4 kPa (1 in-Hg).
- Fuel/Oil/Turbo Protector Cap Set T94T-9395-AH or equivalent.

Rotunda
EQUIPMENT AND SPECIAL SERVICE TOOLS

ORDER FORM

FAX NUMBER 1-800-762-6181

QTY.	ITEM NUMBER		ADDITIONAL SPECIFICATIONS (if required)		OPTIONAL: CATALOG PAGE NO.	DESCRIPTION	UNIT PRICE	EXTENDED TOTAL
	PREFIX	BAL. OF NO.	COL. 1	COL. 2				
							TOTAL	

PART I

Dealer Parts Code #: _____

Dealer Name: _____

Address: _____

City, State, Zip: _____

Phone #: _____

Fax #: _____

Attention: _____

Order Date: _____

Ship to arrive by (Date or ASAP): _____

Address: _____

City, State, Zip: _____

PART II

Buyer, having been quoted both an installment Price and a lesser Cash Price, hereby purchases from Seller on installment price basis, upon the terms and conditions set forth on the face hereof, the equipment to be delivered and installed at Buyer's premises, as described above and agrees to pay Seller the Installment Price therefore as so set forth until paid in full.

❑ 30 Day Open Account

Installment Plan (Fixed Rate)

❑ 12 Mo. (Minimum $1,000) ❑ 24 Mo. (Minimum $3,000) ❑ 36 Mo. (Minimum $5,000)
❑ 48 Mo. (Minimum $10,000) ❑ 60 Mo. (Minimum $15,000)
(Reverse side must be completed)

❑ 90 Days Same as Cash (Minimum $1,000)

Notice To Buyer:

1. *Do not sign this contract before you read it or if it contains any blank spaces.*
2. *You are entitled to an exact copy of the contract you sign.*
3. *Under the law you have the right to pay off in advance the full amount due and under certain circumstances to obtain partial refund of the time charge.*

BUYER ACKNOWLEDGES RECEIPT OF A TRUE AND COMPLETELY FILLED IN COPY OF THIS CONTRACT AT THE TIME OF SIGNING.

PART III

(ORDERS OVER $4,000)

_____

FCSD CREDIT MANAGER APPROVAL

_____

PRINT NAME

_____

AUTHORIZED DEALERSHIP SIGNATURE (BUYER)

September 1999 315-195 Prices subject to change without notice

DEALER: Be sure you have completed Parts I and II for all orders, Part III for Installment Plan Orders 315-195 (Previous editions may not be used)

FOR TELEPHONE ORDERS USE THE ROTUNDA TOLL-FREE NUMBER 1-800-ROTUNDA (768-8632)

TERMS & CONDITIONS

1. Payment and Terms of Payment.

a. If Buyer has requested the Dealer Open Account payment plan via the Ford Dealer Statement in Part II of the order form, and Seller agrees to sell pursuant to such plan, then Buyer shall pay the total purchase price shown on the invoice.

b. If Buyer has requested the Installment Plan (Fixed Rate) in Part II of the order form, and Seller agrees to sell pursuant to such Plan, then Buyer shall pay the Down Payment (if any), and the Time Balance in equal monthly installments in accordance with the terms set forth below.

c. If Buyer has requested the Installment Plan (Variable Rate) in Part II of the order form, and Seller agrees to sell pursuant to such Plan, then Buyer shall pay the Total Cash Price and any interest thereon in accordance with the Loan and Security Agreement to be executed by Buyer and Seller.

2. Title. Title to Equipment purchased by Buyer from Seller shall pass to Buyer upon Seller's receipt of all amounts owing by Buyer to Seller hereunder.

3. Risk of Loss. Seller shall be responsible for risk of loss until Equipment is delivered to the location set forth herein, at which time risk of loss shall be the responsibility of Buyer.

4. Acceptance and Inspection. Buyer shall be deemed to have accepted Equipment upon Seller's delivery. Equipment shall be deemed to have been delivered in good condition unless Buyer gives Seller notice to the contrary within 10 days after Seller's delivery.

5. Delays. Seller shall not be liable for any failure or delay in delivering Equipment, or for any failure to perform any provision hereof, resulting from fire, flood or other casualty, riot, strike or other labor difficulty, governmental regulation or other restriction, or any other cause beyond Seller's control.

6. Unconditional Obligation. Buyer's obligation to make payments to Seller or its assignee shall be absolute and unconditional and shall continue unmodified despite any loss, damage or other interruption in the use of Equipment. The obligation of Buyer to pay in full any amounts due under this contract shall not be subject to dispute, claim, counterclaim, defense or other right which Buyer may have to assert against Seller or the manufacturer of Equipment. Buyer acknowledges that: (a) Buyer has selected Equipment and Manufacturer, and Buyer has determined Equipment's suitability and fitness for the Buyer's purpose, (b) Seller is not the manufacturer of Equipment, and (c) Manufacturer issues its own warranty and performs the obligations under such warranty.

7. Warranty. THE MANUFACTURER'S WARRANTY SHALL BE BUYER'S EXCLUSIVE REMEDY, RECOURSE OR DAMAGE FOR ANY DEFECT IN WORKMANSHIP OR MATERIAL OR ANY FAILURE OF THE EQUIPMENT. SELLER MAKES NO WARRANTIES, REPRESENTATIONS, INDEMNITIES OR GUARANTEES WHATSOEVER WITH RESPECT TO EQUIPMENT EITHER EXPRESS OR IMPLIED, ARISING BY LAW OR CUSTOM, INCLUDING ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THE LIABILITY OF THE SELLER SHALL BE LIMITED TO EXPRESS OBLIGATION TO DELIVER THE EQUIPMENT. UNDER NO CIRCUMSTANCES SHALL SELLER BE LIABLE OR RESPONSIBLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, WHETHER FORESEEABLE OR UNFORESEEABLE, WHICH BUYER MAY INCUR, EXPERIENCE OR CLAIM, INCLUDING, BUT NOT LIMITED TO, CLAIMS FOR LOSS OF PROFITS, INTERRUPTION IN BUSINESS, LOST OPPORTUNITY, WORK STOPPAGE OR OTHER IMPAIRMENT OF ASSETS, ARISING OUT OF MISREPRESENTATION, NEGLIGENCE, STRICT LIABILITY, IN TORT OR OTHERWISE, ON ACCOUNT OF ENTERING INTO OR RELYING ON THIS AGREEMENT, EVEN IF SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

8. Freight and Taxes. Freight costs and applicable taxes will be added to the final invoice and will be borne by Buyer.

9. Security Interest. Buyer hereby grants to Seller a continuing security interest in the Equipment, including all products and proceeds thereof, until all amounts due hereunder are paid. Buyer agrees to execute, and pay filing fees for, any financing statement or other documents deemed necessary by Seller to maintain a valid security interest in the Equipment.

10. Maintenance. Buyer shall use the Equipment carefully and properly. Buyer, at Buyer's own expense, shall maintain and repair all items of the Equipment in order to keep them in good order and condition and, in particular, shall comply fully with the maintenance, operating, usage or other instructions provided by the manufacturer. Buyer authorizes Seller, or any third party appointed by Seller, to inspect the Equipment when necessary. Buyer shall at all times keep the Equipment free and clear of all liens, charges or encumbrances.

11. Personal Property. Ford proprietary diagnostic equipment (including the software, if applicable) shall be kept at Buyer's premises as listed on the reverse side and shall remain personal property regardless of how and to what degree it may be affixed or attached to any building or structure or what may be the consequence of its removal from such building or structure. Buyer shall not encumber the Equipment (including software, if applicable) until all amounts owing to Seller hereunder are paid. In addition, Seller grants to Buyer, and Buyer accepts, a non-exclusive license to use the Equipment (including the software, if applicable) in accordance with the terms and conditions set forth herein. The license (and Equipment) shall not be leased, sold, assigned or otherwise transferred, in whole or in part. In the event, Buyer proposes to lease, sell assign or otherwise transfer the Equipment (and/or its software, if applicable), in whole or in part, to any person or entity, Ford Motor Company shall have a Right of First Refusal to purchase the Equipment (including all software, if applicable) for Ten and 00/100 Dollars ($10.00) in U.S. currency.

12. Insurance and Indemnification. Buyer shall defend, indemnify and hold harmless Seller from and against, and at Buyer's own expense provide insurance satisfactory to Seller covering any and all losses, damages, claims, expenses and other liabilities (including attorney's fees,) relating to or arising out of: (i) damage, loss, theft, or destruction of the Equipment, or (ii) death, injury or property damage connected with the use, operation or condition (including without limitation, defects whether or not discoverable by any party) of the Equipment. Buyer shall promptly notify Seller of any such claim. Seller shall have the right to participate, at its own expense, in any proceeding for which Buyer has undertaken the defense of Seller, and in no event shall Buyer settle any claim against Seller without Seller's prior written consent, Buyer shall provide evidence of such insurance to Seller upon demand. Seller is under no obligation to examine any insurance certificate or advise Buyer that its insurance does not comply with the requirements set forth herein. The losses covered by insurance shall in all cases be payable to Seller and Buyer as their interests may appear. If Buyer fails to insure the Equipment as herein provided, Seller may, but is not obligated to, place such insurance upon the Equipment and the Buyer agrees to pay to Seller on demand the premiums for such insurance placed by Seller. In no event shall any insurance coverage be deemed to limit or replace Buyer's obligation to indemnify Seller as provided herein.

13. Default. In the event that Buyer: (a) fails to pay any amount due hereunder within ten (10) days of the due date, (b) fails to comply with any other provision hereof, (c) files, or if there is filed against Buyer, any petition under any bankruptcy or insolvency laws or suffers the appointment of any trustee or receiver for all or any part of Buyer's business or assets, or (d) has any assignment (voluntarily or involuntarily), lien, attachment or levy issued against the Equipment (unless such petition, assignment or appointment, lien, attachment or levy is withdrawn or nullified within twenty (20) days) then Buyer shall be in default hereunder and all of Buyer's indebtedness and obligations to Seller shall, at Seller's option, become immediately due and payable, and Seller may, at its option, terminate this contract and repossess any and all items of Equipment with or without legal process and sell the same at private or public sale without prior notice to Buyer to the extent permitted by law. Upon request, Buyer shall deliver the Equipment to Seller at a place designated by Seller. Repossession and/or sales of the Equipment upon such default shall not affect the Seller's right to retain all payments made prior to repossession or to recover the balance due hereunder for any deficiency. Buyer shall reimburse Seller all costs of collection, repossession and resale (including reasonable attorneys' fees, court costs and other expenses incurred by Seller.) Buyer hereby releases Seller from any liability for damages resulting from repossession hereunder. The rights and remedies of Seller, in the event of default herein mentioned shall not be deemed exclusive but shall be cumulative and in addition to all other rights and remedies existing under law, and may be enforced successively or concurrently. Waiver by Seller of any default shall not be deemed a waiver of any other default.

14. General. The waiver by either party of, or failure to claim, a breach of any provision of this contract shall not be deemed to be a waiver of any provision of this contract, shall not be deemed to be a waiver of any subsequent breach or to affect in any way the effectiveness of such provision. This contract constitutes the entire agreement between the parties and may not be changed except by an instrument in writing signed by the party to be charged. This contract may not be assigned by Buyer without the Seller's prior written consent. Seller may assign this contract at any time but shall not thereby be relieved from any liability hereunder. In the event that one or more clauses of this contract are found to be unenforceable, illegal or contrary to public policy by court of competent jurisdiction, the remainder of this contract shall remain in full force and effect except for the unenforceable, illegal or other provisions. This agreement is a Michigan agreement and shall be interpreted, construed and enforced in accordance with the laws of the State of Michigan, United States of America. Each of the parties here to agrees that any legal or equitable action or proceeding with respect to this agreement shall be brought only in any court of the State of Michigan, or in any court of the United States of America sitting in Michigan, and each of the parties hereto submits to and accepts generally and unconditionally the jurisdiction of those courts with respect to such party's person and property. Each party hereby irrevocably waives any objection to the laying of venue of any such action or proceeding in the above described courts.

15. Finance Charge. Monthly portion of Finance Charge (Part III, Item 3) due is calculated each month by multiplying 1/12 of the annual finance charge rate times the remaining portion of the Unpaid Balance of Cash Price, and is added to the portion of the Unpaid Balance of Cash Price due each month.

PART III

Installment Plan Agreement

1. Cash Price $ _____

2. Down Payment (if any) $ _____

3. Unpaid Balance of Cash Price $ _____
(Difference between 1 and 2)

4. Finance Charge $ _____
(Finance charge will reduce each month)
Call 1-800-768-8632 for the current finance charge rate.

5. Time Balance (3 + 4) $ _____

6. Number of Installments
❑ 12 ❑ 24 ❑ 36 ❑ 48 ❑ 60
equal monthly installments. Taxes and transportation (if any) will be billed separately.

7. Installment Payment Price (1 + 4) $ _____

I agree to pay the time Balance set forth in accordance with the above schedule and the terms and conditions of this order form.

Dealer Signature: _____ **Date:** _____

MAIL COMPLETED ORDER FORM TO:
ROTUNDA EQUIPMENT PROGRAM
P.O. Box 1450
Kenosha, WI 53141

FCSD

Technical Training

Questions/Comments/Suggestions FAX Form

Please use this form to contact us regarding Technical Training Courses on FORDSTAR.
Fax this form to the Technical Training FAX-Line at 313-317-7194

Dealership _____ Your Name _____

Phone Number _____ Course _____

Dealer P&A Code _____ Date You Took Course _____

Dealer FAX Phone _____ Your I.D. Number _____

Please write your questions, comments, or suggestions:

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If you have a concern, how would you like it resolved?

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Thanks for your Feedback!