AIRCRAFT TECHNICAL BOOK COMPANY

CAT-A

AVIATION MAINTENANCE TECHNICIAN CERTIFICATION SERIES

PISTON ENGINE

16

COMPLIANT WITH EASA European Aviation Safety Agency EASA PART 66/147

EASA 2023-989 COMPLIANT

The publishers of this Aviation Maintenance Technician Certification Series welcome you to the world of aviation maintenance. For additional educational tools created to prepare candidates for licensure, contact Aircraft Technical Book Company. We wish you good luck and success in your studies and in your aviation career!

Special thanks to our instructors, contributors, and authors
Contributor - Charles L. Rodriguez

Layout and Design by Michael Amrine

VERSION	EFFECTIVE DATE
005	2025.03

To order books or for customer service, please call +1 (970) 726-5111, or visit us online at www.actechbooks.com

ISBN-13: 978-1951275709
9 781951 275709

Update notices for this book will be available online at www.actechbooks.com/revisions.html
If you would like to be notified when changes occur, please join our mailing list at www.actechbooks.com

VERSION	EFFECTIVE DATE	DESCRIPTION OF REVISION(S)
001	2019.04	Module creation and release.
002	2017.02	Format updates and minor type corrections.
003	2020.06	Realignment to Part-66 Appendices. Enhanced figures throughout entire textbook
004	2023.01	Major rewrite and formatting updates. Acronym updates and inclusion of Measurement Standards page.
004.1	2023.04	Minor appearance and format updates.
005	2025.03	Regulatory update for EASA 2023-989 compliance.

Module was reorganized based upon the EASA 2023-989 subject criteria. Enhancements included in this version 004 are:

16.1 *Otto Engine* - topic added.
16.8 *Properties and Specifications of Standard, Alternate, and Drop in Fuel* - topic added.
16.13 *Engine Storage and Preservation* - Submodule removed per 2023-989 requirements.
16.14 *Hybrid and Electric Power Augmentation* - topic added.

TABLE OF CONTENTS

PISTON ENGINE

TABLE OF CONTENTS

TABLE OF CONTENTS

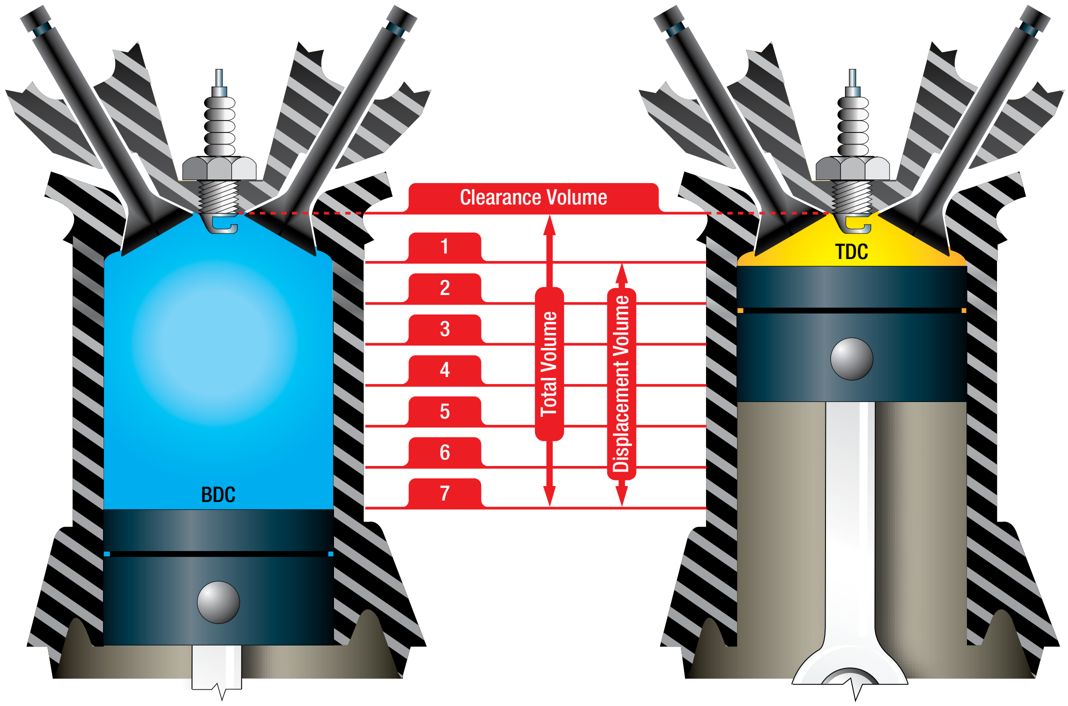

Figure 1-7. Compression ratio.

INLINE ENGINES

An inline engine generally has an even number of cylinders, although some three-cylinder engines have been constructed. This engine may be either liquid cooled or air cooled and has only one crankshaft, which is located either above or below the cylinders. If the engine is designed to operate with the cylinders below the crankshaft, it is called an inverted inline engine.

The inline engine has a small frontal area and is better adapted to streamlining. When mounted with the cylinders in an inverted position, it offers the added advantages of a shorter landing gear and greater pilot visibility. With increase in engine size, the air cooled, inline type offers additional problems to provide proper cooling; therefore, this type of engine is confined to low and medium horsepower engines used in older light aircraft.

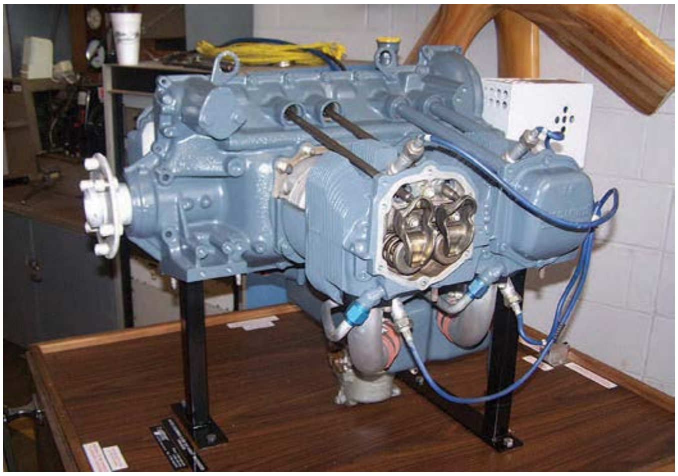
Figure 1-8. Four-cylinder opposed engine.

OPPOSED OR O-TYPE ENGINES

The opposed-type engine has two banks of cylinders directly opposite each other with a crankshaft in the center as shown in **Figure 1-8**. The pistons of both cylinder banks are connected to the single crankshaft. Although the engine can be either liquid cooled or air cooled, the air-cooled version is used predominantly in aviation. It is generally mounted with the cylinders in a horizontal position. The opposed-type engine has a low weight-to-horsepower ratio, and its narrow silhouette makes it ideal for horizontal installation on the aircraft wings (twin engine applications). Another advantage is its low vibration characteristics.

Opposed engines are normally designated with the letter "O" and a dash followed by the piston displacement. For example, an O-360 is an opposed engine with 360 cubic inches of displacement. If there is no prefix before the "O", the engine will likely be mounted with the crankshaft in a horizontal position. If the letter "V" precedes the letter "O", (e.g., VO-360), the engine is mounted with the crankshaft in the vertical position. This is common with early generation reciprocated powered helicopters. When an opposed engine includes the prefix "I", such as IO-360, the engine is fuel injected. The prefix "T" or "TS" indicates the engine has a turbo-supercharging system. The prefix "G" designates a geared engine. A prefix of "L" is used to show that the engine has left-hand rotation as view from the rear of the engine looking forward.

V TYPE ENGINES

In V type engines, the cylinders are arranged in two inline banks generally set 60° apart. Most of the V type engines have 12 cylinders, which are either liquid cooled or air cooled. The engines are designated by a V followed by a dash and the piston displacement in cubic inches. For example, V-1710. This type of engine was used mostly during the second World War and its use is largely limited to older aircraft.

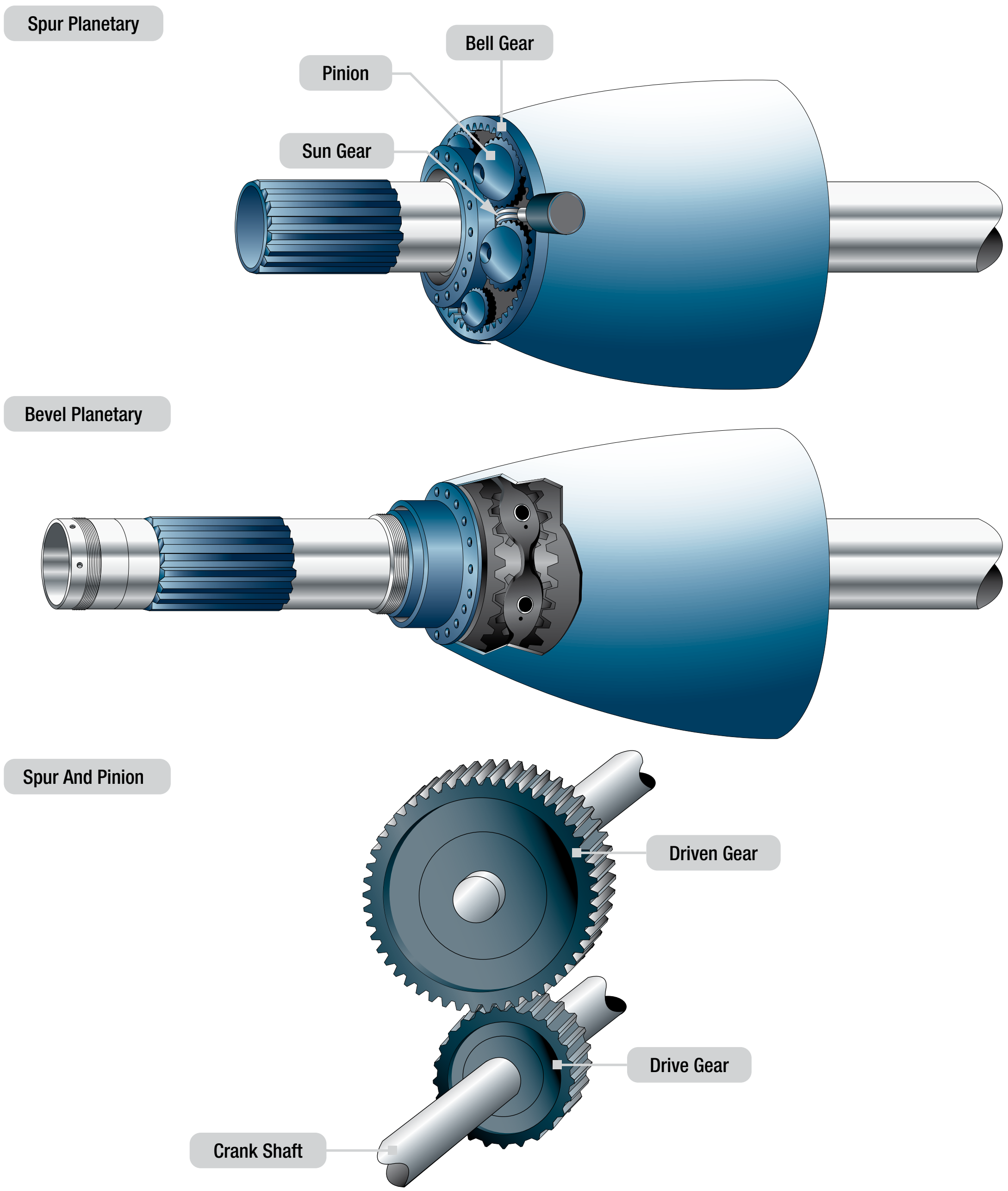

Figure 3-30. Reduction gears.

Figure 3-31. Spur-Type propeller gear reduction system.

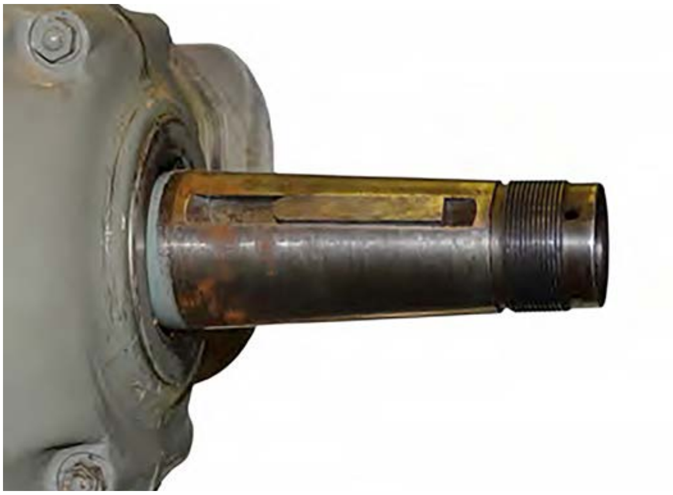

Figure 3-32. Tapered propeller shaft.

lapped seat in the body, the fuel lines to the cylinders are closed off. The valve is drilled for passage of fuel from the diaphragm chamber to its base, and a ball valve is installed within the valve. All incoming fuel must pass through a fine screen installed in the diaphragm chamber.

From the fuel injection control valve, fuel is delivered to the fuel manifold valve, which provides a central point for dividing fuel flow to the individual cylinders. In the fuel manifold valve, a diaphragm raises or lowers a plunger valve to open or close the individual cylinder fuel supply ports simultaneously.

FUEL DISCHARGE NOZZLE

The fuel discharge nozzle is located in the cylinder head with its outlet directed into the intake port. The nozzle body contains a drilled central passage with a counterbore at each end. [**Figure 4-34**] The lower end is used as a chamber for fuel/air mixing before the spray leaves the nozzle. The upper bore contains a removable orifice for calibrating the nozzles. Nozzles are calibrated in several ranges, and all nozzles furnished for one engine are of the same range and are identified by a letter stamped on the hex of the nozzle body.

Drilled radial holes connect the upper counterbore with the outside of the nozzle body. These holes enter the counterbore above the orifice and draw air through a cylindrical screen fitted

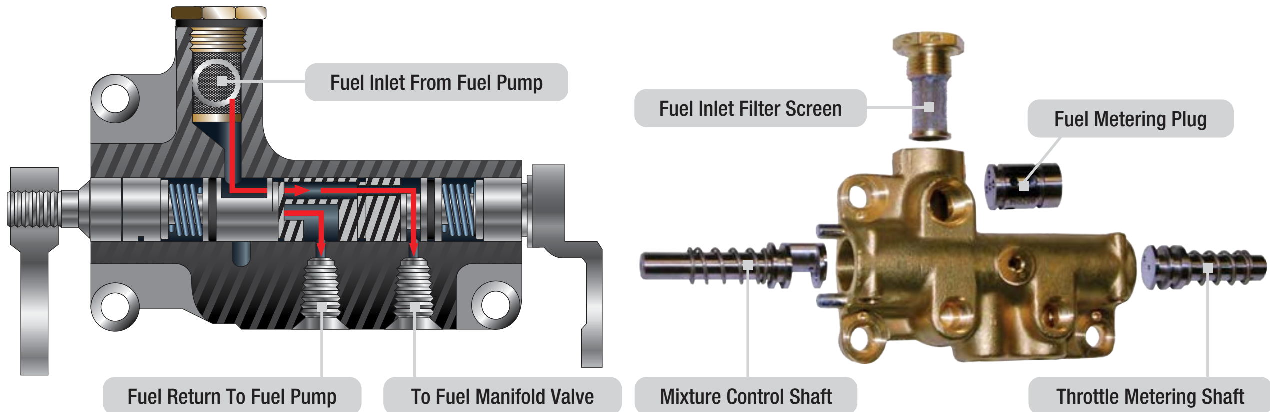

Figure 4-32. Dual fuel control assembly.

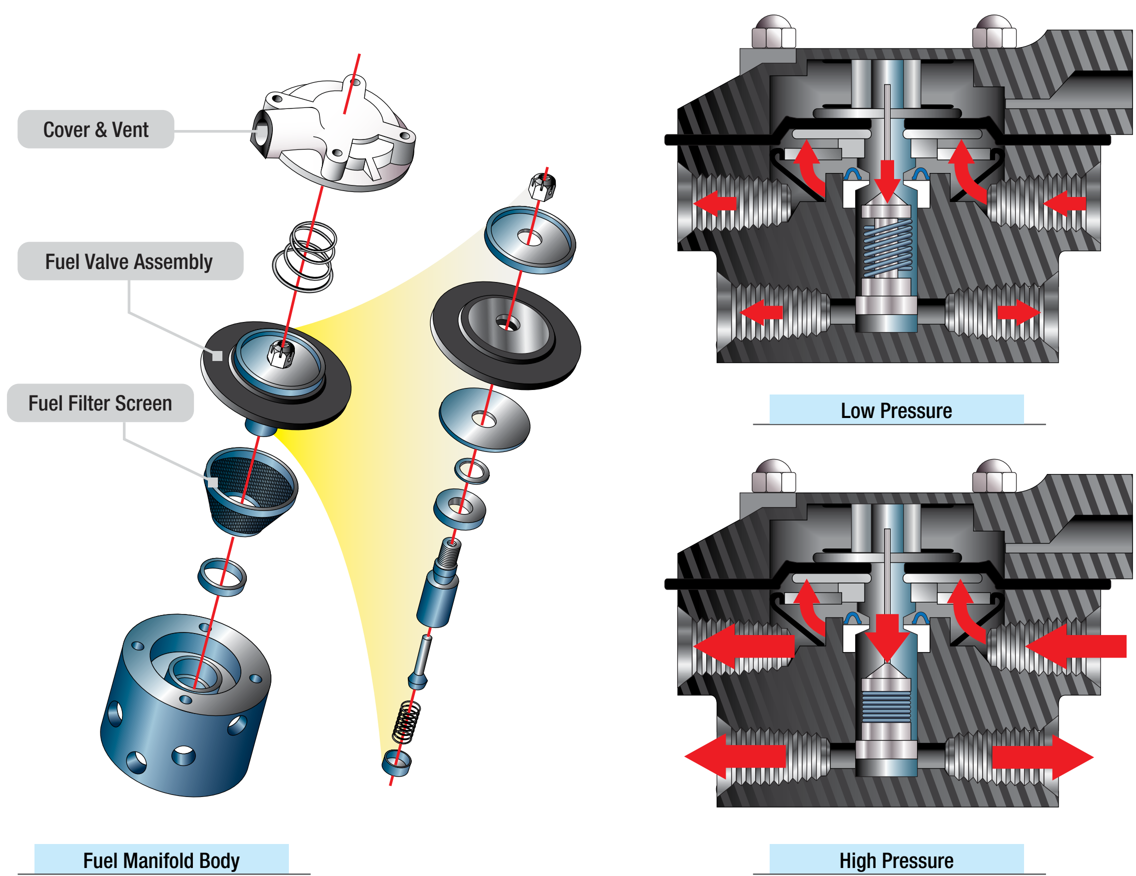

Figure 4-33. Fuel manifold valve assembly.

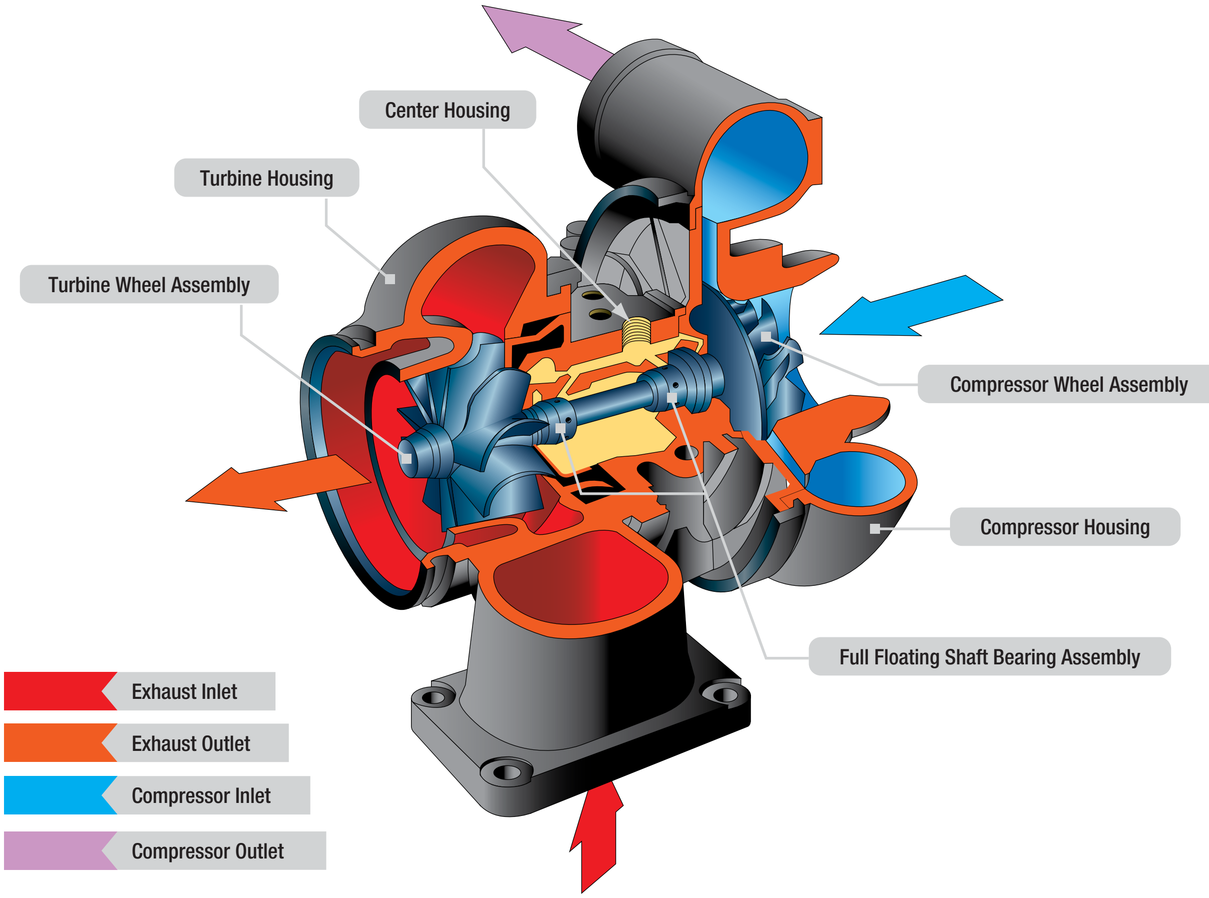

Figure 7-3. A typical turbosupercharger and its main parts.

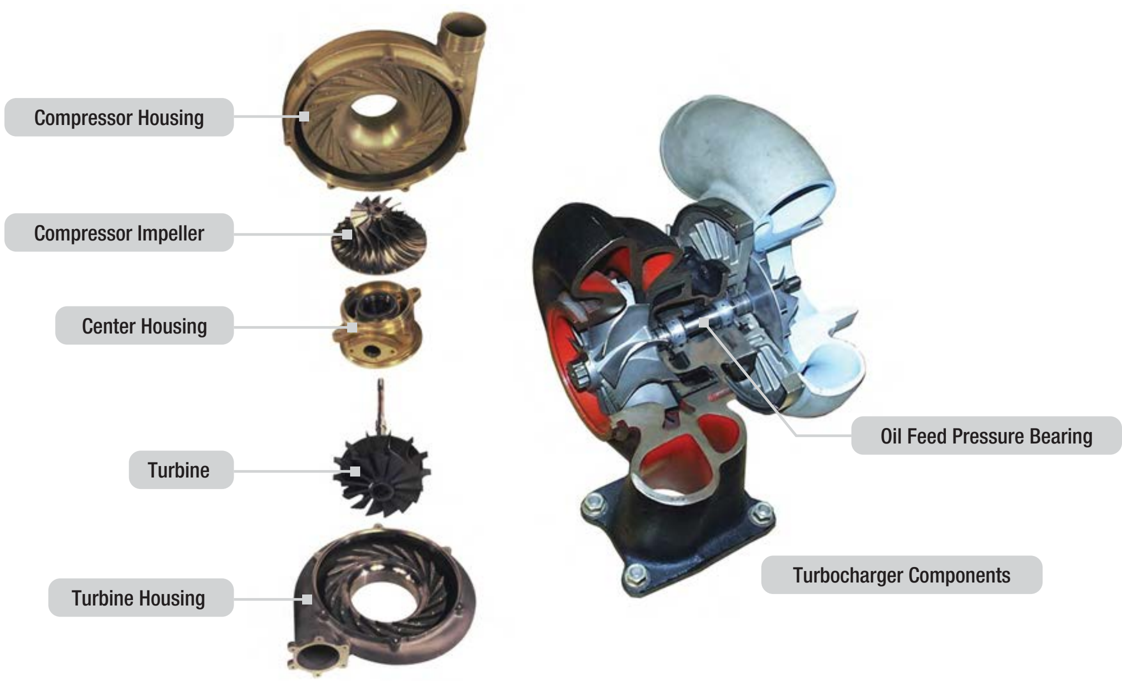

Figure 7-4. Detail examples of the main components of a turbocharger.

exhaust gases directed to the turbine. The waste gate controls the volume of the exhaust gas that is directed onto the turbine and thereby regulates the speed of the rotor (turbine and impeller). [**Figure 7-6**]

If the waste gate is completely closed, all the exhaust gases are "backed up" and forced through the turbine wheel. If the waste gate is partially closed, a corresponding amount of exhaust gas is directed to the turbine. The exhaust gasses, thus directed, strike the turbine blades, arranged radially around the outer edge of the

LUBRICATION SYSTEM MAINTENANCE PRACTICES

OIL TANK

The oil tank, constructed of welded aluminum, is serviced (filled) through a filler neck located on the tank and equipped with a spring-loaded locking cap. Inside the tank, a weighted, flexible rubber oil hose is mounted so that it is repositioned automatically to ensure oil pickup during all maneuvers. A dipstick guard is welded inside the tank for the protection of the flexible oil hose assembly. During normal flight, the oil tank is vented to the engine crankcase by a flexible line at the top of the tank. The location of the oil system components in relation to each other and to the engine is shown in **Figure 9-14**.

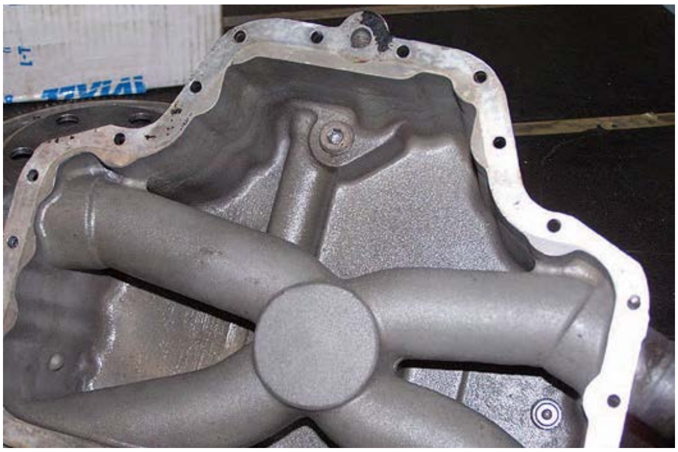

Figure 9-13. Wet-sump system's sump with intake tube running through it.

Repair of an oil tank usually requires that the tank be removed. The removal and installation procedures normally remain the same regardless of whether the engine is removed or not. First, the oil must be drained. Most light aircraft provide an oil drain similar to that shown in **Figure 9-15**. On some aircraft, the normal ground attitude of the aircraft may prevent the oil tank from draining completely. If the amount of undrained oil is excessive, the aft portion of the tank can be raised slightly after the tank straps have been loosened to complete the drainage.

After disconnecting the oil inlet and vent lines, the scupper drain hose and bonding wire can be removed. [**Figure 9-16**] The securing straps fitted around the tank can now be removed. [**Figure 9-17**] Any safety wire securing the clamp must be removed before the clamp can be loosened and the strap disconnected. The tank can now be lifted out of the aircraft. The tank is reinstalled by reversing the sequence used in the tank removal. After installation, the oil tank should be filled to capacity. [**Figure 9-18**]

After the oil tank has been filled, the engine should be run for at least two minutes. Then, the oil level should be checked and, if necessary, sufficient oil should be added to bring the oil up to the proper level on the dipstick. [**Figure 9-19**]

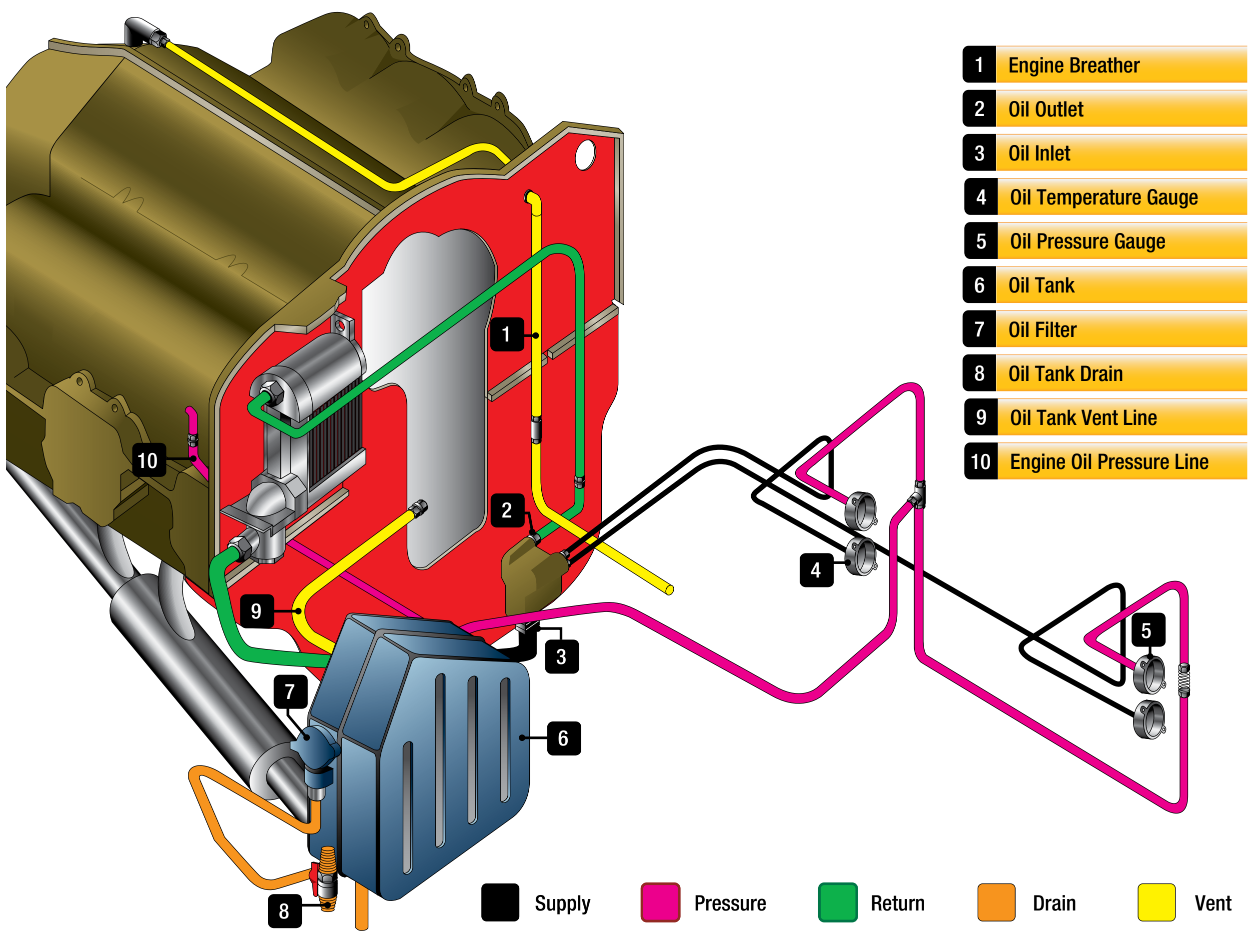

Figure 9-13. Oil system perspective.