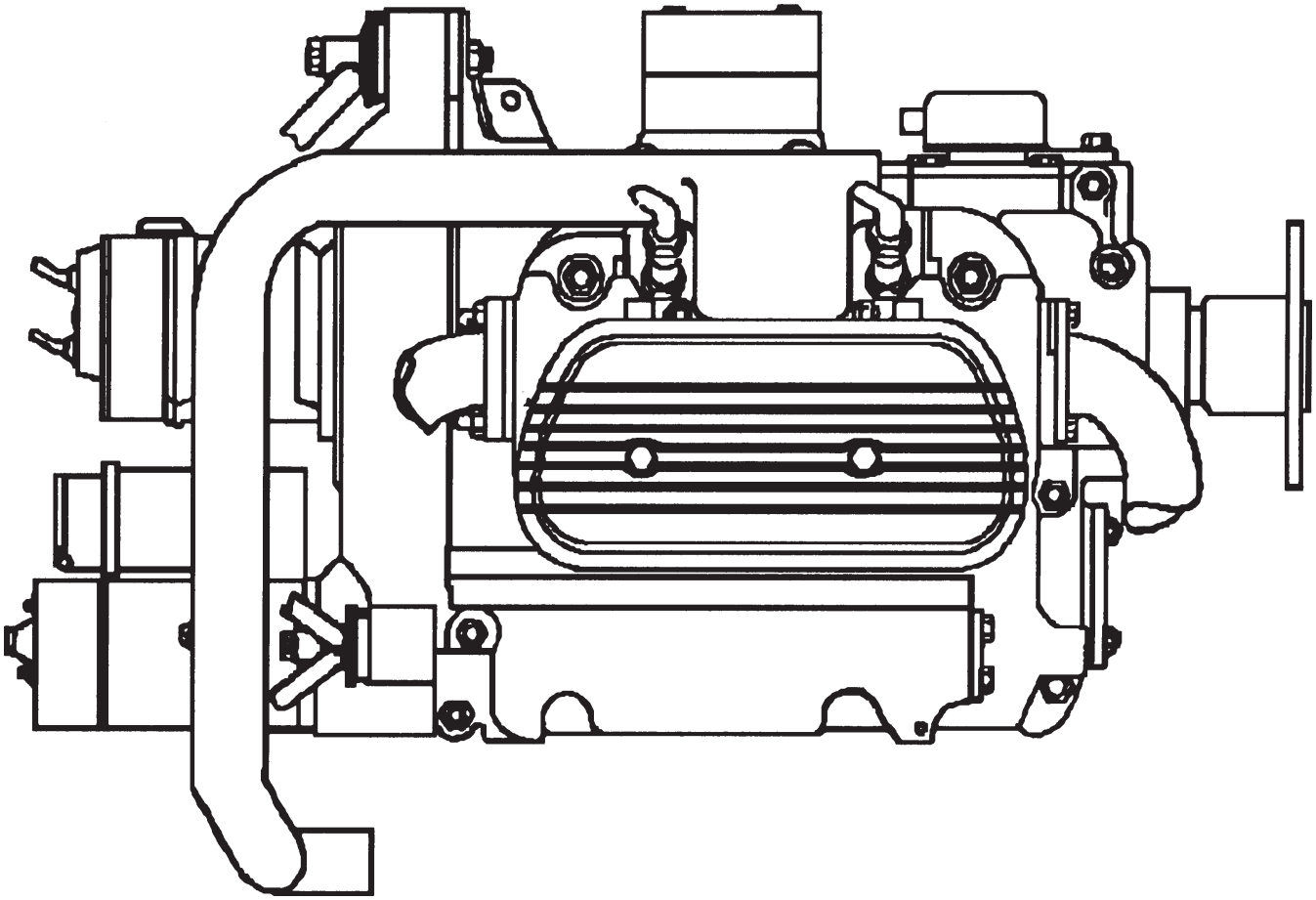
Type 1VW
ENGINE ASSEMBLY MANUAL

For VW Powered Sport Aircraft
1600cc - 2300cc

Revised September, 2008



GREAT PLAINS AIRCRAFT

7011 N 160 Avenue • Bennington, Nebraska 68007

Tel 402 493 6507 • Fax 402 493 3846

Web gpasc.com • Email info@greatplainsas.com

GREAT PLAINS TYPE 1 VW AIRCRAFT ASSEMBLY MANUAL

Great Plains Aircraft Supply Company, Inc. opened for business in November, 1981. Our stated business purpose has always been to provide the very best VW engines, parts and conversion kits available, at a price that is affordable. We pay strict attention to overhead and inventory control. At Great Plains Aircraft, we have been able to maintain a competitive edge by applying sound business practices and customer focus to a very narrow market. Great Plains Aircraft has considerable expertise in the following areas:

1. Assembly of large bore and stroke engines.
2. Valve material makeup.
3. Compression ratio's vs. octane requirements.
4. Alternative ignition systems.
5. Crankshaft material selection.
6. Design and manufacture of propeller hubs and crankshafts.
7. Design and manufacture of fully tuned exhaust systems.
8. Design and manufacture of flywheel drive.
9. Direct Drive, Flywheel Drive and Reduction Drive Engines.

Great Plains Aircraft is committed to the VW powered homebuilt aircraft market. Many other VW Aero supply companies have come and gone, and even reappeared under new names - with the same principals, while we have remained in business focused on our customers. Great Plains is still here, doing what we do best, providing excellent products, parts and kits, at affordable prices - with service and support.

2180cc Long Block Kit

Steve Bennett is the president and founder of Great Plains Aircraft. He received his private pilots license in 1971. To date, Steve has logged more than 2200 hours of flying time behind VW powered aircraft. He is recognized as an authority on VW conversions and presents several seminars at air shows each year on VW Conversions. Steve is a past director of EAA Chapter 135 in Des Moines, Iowa, past president of EAA Chapter 80 in Omaha, Nebraska, and past director and newsletter editor of EAA Chapter 153 in Schaumburg, Illinois.

INTRODUCTION

The VW engine has been used as a power plant in many application's, besides automobiles. Some of these applications are: airboats, dune buggies, water pumps, high volume smoke exhaust fans, air compressors, inboard, portable saw mills, tractor engines, wind machines, and of course, aircraft. In each case, the designer of the finished product looked at the VW engine as a base, upon which to build. Most successful engine conversions which have been built on the VW engine, are a series of compromises. The designer wanted to adapt the engine to their particular need so the engine was modified to suit the requirements of that operating environment.

The VW engine as it is used in aircraft has a series of compromises that must be met. In almost all applications:

- The crankshaft must be modified to fit a prop hub.
- The cylinder bore and stroke may be too small to produce the power required.
- The case and heads must be machined for larger cylinders.
- The stock crankshaft in many cases does not have enough stroke to produce the required power. A longer stroke crankshaft requires careful attention to material selection.
- In addition, modifications to the case, rods, cam and pistons are required.

If we could, we would design an engine so that many of these modifications were built into the raw product. Because of the low volume of VW engines used for the homebuilt aircraft market, this is not economically feasible.

More than anything, we want you to understand that your VW conversion is an automobile engine first and an aircraft engine second. Some companies selling VW products for sport aircraft, claim their engines have very few VW parts, yet they all do. The skeleton of a VW is the engine case that is modified to suit a given application. The same can be said about cylinder heads, bearings, stud kits, gasket sets, lifters, crankshafts and the list goes on. The case used in the buildup of a stock 1600cc engine is essentially the same modified case that is used on a 2300cc engine.

One of the most reoccurring questions we hear is "Just how reliable is the VW engine?' To answer that we usually point out that the VW engine has been produced since the mid 1930's. With production numbers in the millions. The stock VW parts that are used in a conversion have a high degree of reliability. VW powered sport aircraft have accumulated tens of thousands of hours of flight time.

Almost every VW Aero problem that we have seen in our 20+ years of business and 25 years of flying VWs, is with the aftermarket products that are added to complete the conversion. With that said.

The four leading causes of engine failure are:

1. Improper use of crankshafts/prop hubs.
2. Carburetion.
3. Aftermarket performance parts.
4. Improper octane of fuel for the compression ratio of the engine.

This engine assembly manual explains the proper way to set up the crankshaft, the correct way to set the compression ratio for the fuel you want to use, and the correct way to build a reliable engine.

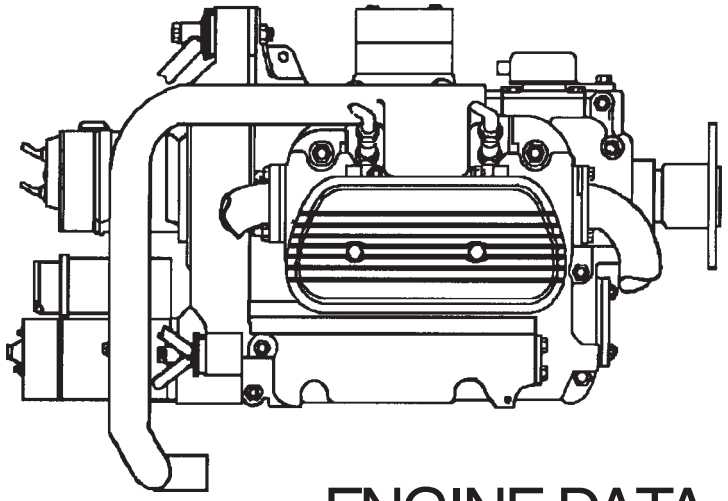
Building a successful VW Conversion is no accident. Careful attention must be paid to the smallest details. It is usually the lack of attention to these small details that turn into big problems. By taking the time to read this manual, asking the questions that you have, and thoroughly preparing your engine kit and yourself for engine assembly, you will be able to complete the engine of your choice "successfully" and maintain a high degree of reliability and confidence.

Assembling an engine is not for everyone, however. If you have the basic skills to build an aircraft, you can obtain the skills required to assemble your engine. It is very q rewarding, personally, not only to build your aircraft, but to also complete the assembly of your power plant.

Great Plains Aircraft engine kits are to be assembled following the instructions in this manual. The assembly procedures in this manual applies to all Type 1 VW engine conversions from 1600cc through 2300cc's.

This manual details the assembly of a Great Plains Type 1, 2180/2276cc long block kit using a Force One Prop Hub and Accessory Packages #1 and #6 - with a magnetion and electronic secondary ignition - which is described in the Great Plains Catalog.

GREAT PLAINS AIRCRAFT



Affordable, Quality Parts,
With Tested Reliability and
Outstanding Service & Support
"When only the best will do" -
Choose Great Plains Aircraft!

ENGINE DATA - FRONT DRIVE

	1600cc	1700cc	1835cc	1915cc	2180cc	2300cc
Take off HP: 3600 RPM	59	62	66	69	75	80
Continuous HP: 3200 RPM	55	58	62	65	70	75
Manifold Pressure @ Cruise	23-25"	23-25"	23-25"	23-25"	23-25"	23-25"
Vacuum @ Cruise	5-7" sea level	5-7" sea level	5-7" sea level	5-7" sea level	5-7" sea level	5-7" sea level
Bore	85.5	88	92	94	92	94
Stroke	69	69	69	69	82	82
Displacement (cc)	1600	1700	1835	1915	2180	2300
Compression ratio	6.6:1	6.6:1	8.0:1	8.0:1	8.0:1	8.0:1
Minimum fuel octane	87	87	92	92	92	92
Firing order	1-2-3-4	1-2-3-4	1-2-3-4	1-2-3-4	1-2-3-4	1-2-3-4
Spark plugs (mag) w/adapters	W8AC	W8AC	W8AC	W8AC	W8AC	W8AC
Spark plugs (distributor)	BOSCH W8AC	BOSCH W8AC	BOSCH W8AC	BOSCH W8AC	BOSCH W8AC	BOSCH W8AC
Spark plugs-GPAS Secondary	NGK C7HSA	NGK C7HSA	NGK C7HSA	NGK C7HSA	NGK C7HSA	NGK C7HSA
Harness (Slick 4316 magneto)	Slick M2266	Slick M2266	Slick M2266	Slick M2266	Slick M2266	Slick M2266
Harness (distributor)	stock	stock	stock	stock	stock	stock
Propeller drive	1:1	1:1	1:1	1:1	1:1	1:1
Carburetor	n/a	n/a	n/a	n/a	n/a	n/a
Fuel pump	n/a	n/a	n/a	n/a	n/a	n/a
Starter	geared	geared	geared	geared	geared	geared
Alternator	20 amp	20 amp	20 amp	20 amp	20 amp	20 amp
Dry weight	159.2 lbs	160 lbs	163 lbs	164 lbs	164 lbs	164 lbs
Propeller Flange Diameter	5"	5"	5"	5"	5"	5"
Propeller Flange Bolt Pattern	4"o/c	4"o/c	4"o/c	4"o/c	4"o/c	4"o/c
Prop Flange Pilot Depth	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"
Prop Flange Pilot Diameter	2"	2"	2"	2"	2"	2"
Propeller Bolt Diameter	AN5 (5/16")	AN5 (5/16")	AN5 (5/16")	AN5 (5/16")	AN5 (5/16")	AN5 (5/16")

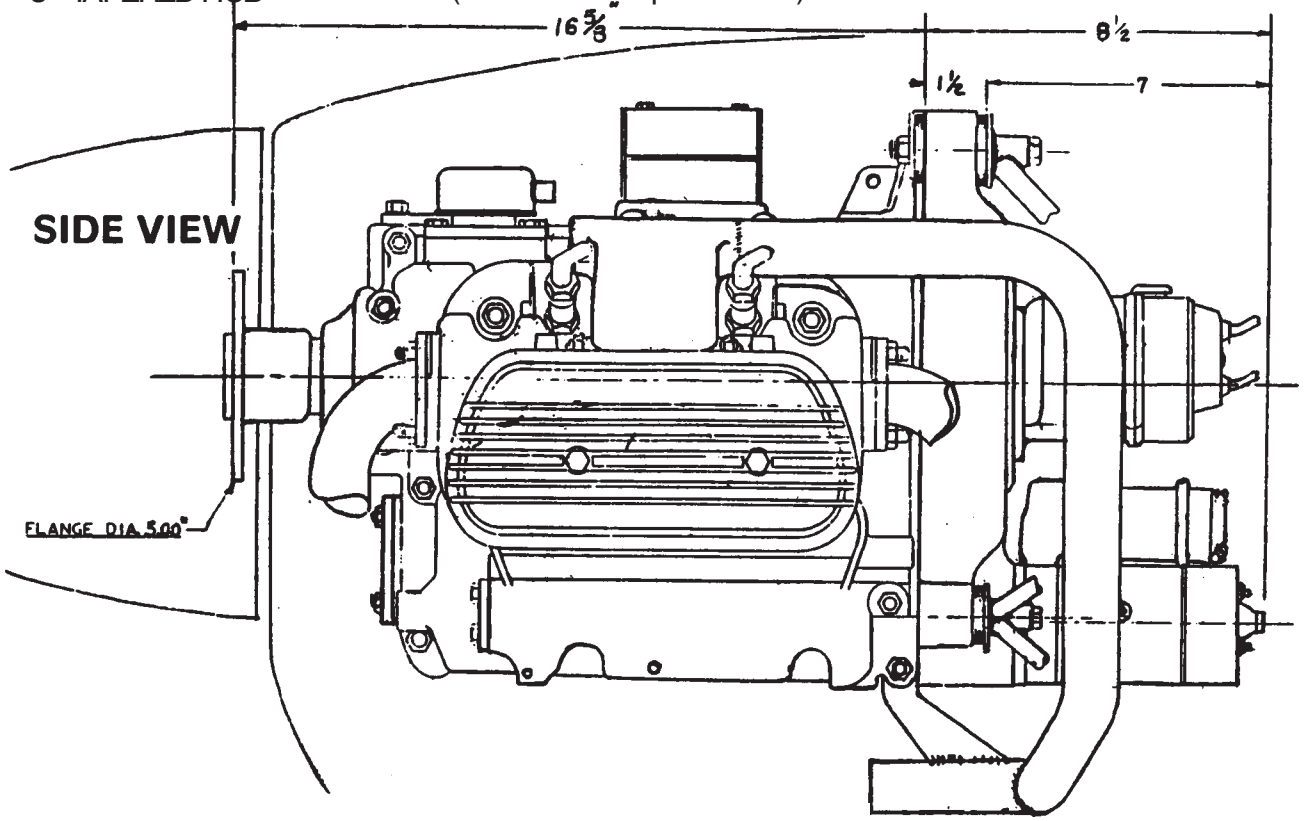
For use with wood propellers only.

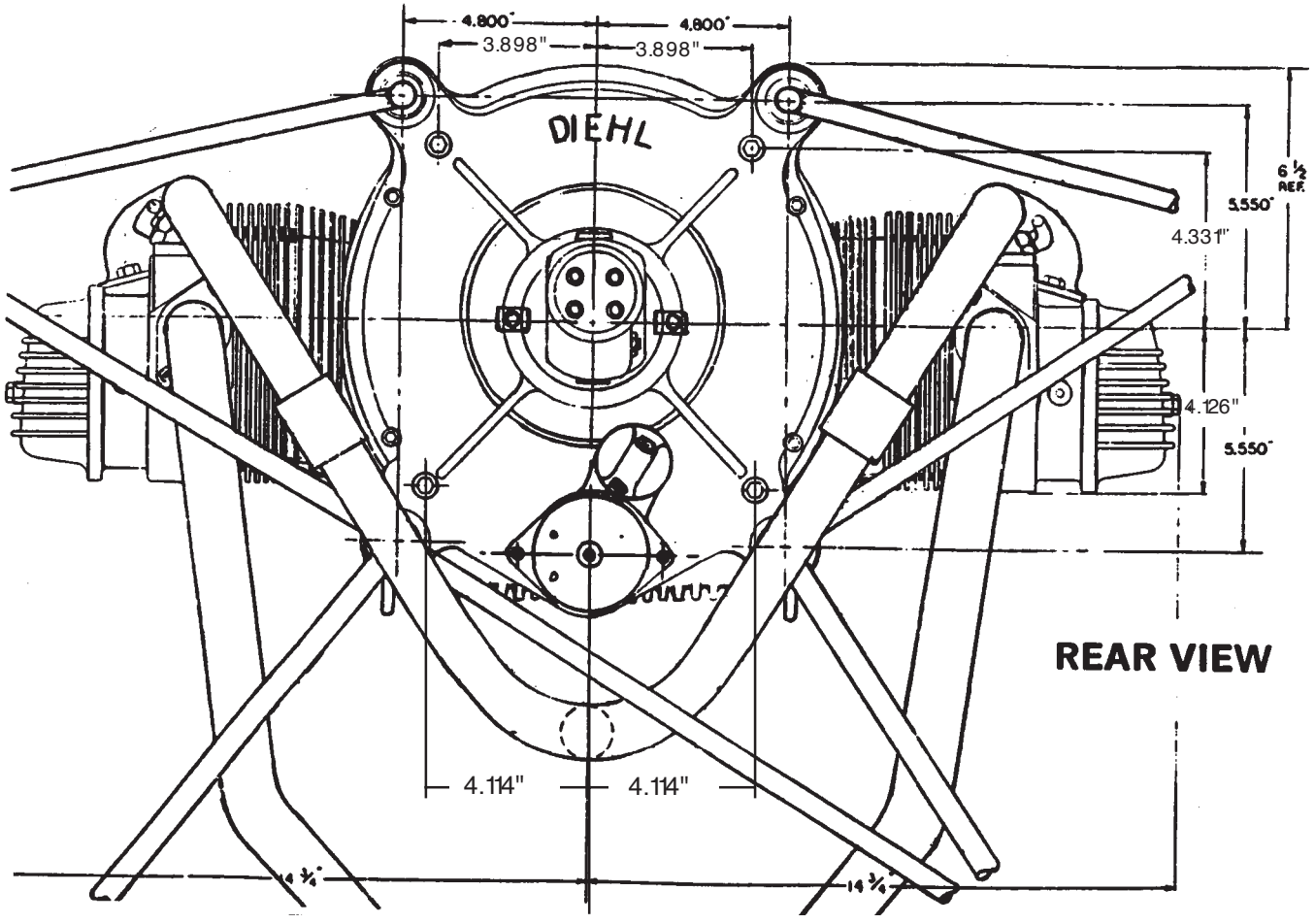
Great Plains engine configued as the above drawing depicts (front drive off the pulley end), can not be used with a metal or composite propeller when driven off the pulley end. Octane requirements will vary with compression ratio. The engine compression ratio is set to match the needs of the owner/operator. Great Plains Aircraft's engines are NOT for use in certified aircraft. No warranty is implied or intended.

DIMENSIONAL DATA

17 3/4" - FORCE ONE PROP HUB
16 5/8" - SHRINK FIT HUB
16 5/8" - 3° TAPERED HUB

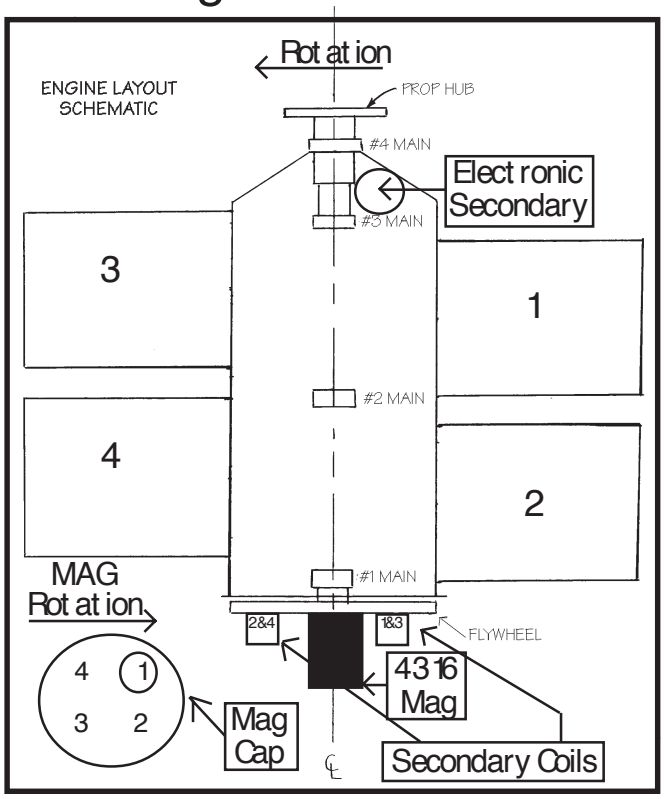
(Shrink Fit & Tapered Hubs)



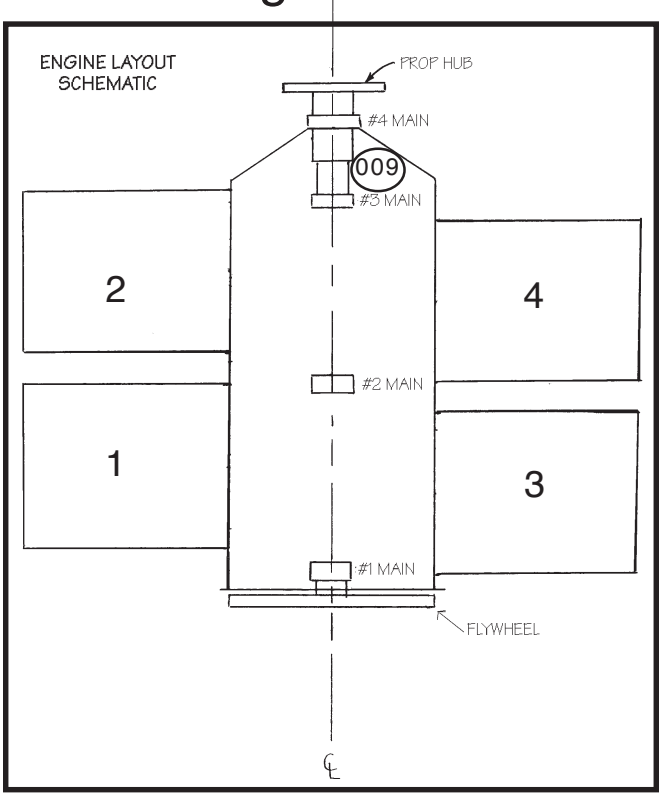


FIRING ORDER - Note: This Manual uses Firing Order #1

#1 - 4316 Slick MAGNETO
Firing Order: 1234



#2 - BOSCH 009 - (When used alone)
Firing Order: 1432

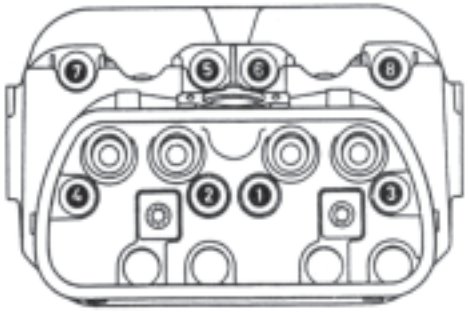


TORQUE VALUES

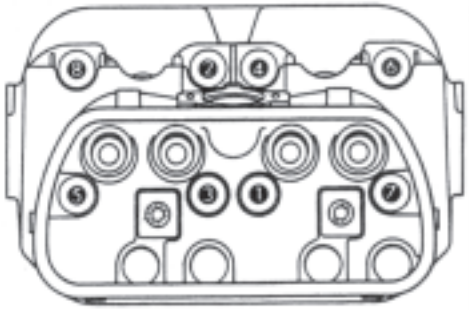
Note: To convert foot pounds to inch pounds, multiply by 12.

LOCATION	FT. LBS.	SOCKET SIZE
Engine Case nuts - large	25	19mm
Engine Case Nuts - small	14	13mm
Cylinder Head Nuts (8mm studs)	18	15mm
Rocker Arm Nuts	14	13mm
Prop Hub Bolt - 20mm	70	30mm
Prop Hub Bolt - 1/2" Fine Thread	60	3/4"
Flywheel Gland Nut	217	36mm
Connecting Rod Nuts	25	14mm
Oil Cover Plate Nuts	5	10mm
Oil Pump Cover Plate Bolts/Nuts	14	13mm

CYLINDER HEAD TORQUE SEQUENCE



1ST PASS



2ND PASS

TERMS

CCW	Counter Clock Wise
CW	Clock Wise
TDC	Top Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
BBDC	Before Bottom Dead Center
LHSIS	Low Height Secondary Ignition System
NPT	National Pipe Thread

TOOLS FOR ENGINE ASSEMBLY

This is a representation of tools and supplies you will need to assemble your engine. You may require additional items that are not pictured.

To assemble your engine, you will need the following tools:

1. 3/8" METRIC SOCKET SET
2. METRIC WRENCH SET
3. 1/2" BREAKING BAR
4. 30 MM SOCKET
5. 36 MM SOCKET
6. ENGINE STAND
7. FEELER GAUGES
8. SCREWDRIVERS
9. FLYWHEEL LOCK
10. TORQUE WRENCH
11. 3/8" TO 1/2" ADAPTOR
12. MICROMETER
13. RING COMPRESSOR
14. SMALL HAMMER
15. INSPECTION LIGHT AND MIRROR
16. DREMEL TOOL & SANDING DRUMS
17. FILES
18. 1/8" PIPE TAP AND 21/64" DRILL
19. 1/4" PIPE TAP AND 7/16" DRILL
20. 3/8" PIPE TAP AND 37/64" DRILL
21. MAG TIMING LIGHT
22. 12 V DC TEST LIGHT

In addition to the tools, you will also need some assembly supplies. The following are suggested:

1. PAPER TOWELS
2. A GOOD DEGREASER
3. VALVE GRINDING COMPOUND
4. NEVER-SEIZE COMPOUND
5. PERMETEX 3H
6. LOCTITE 518 (OR GASGACINCH GASKET SEALER
6. GRAPHITE ASSEMBLY LUBE
7. COMET CLEANSER
8. DAWN DISHWASHER SOAP
9. SPRAY ADHESIVE
10. LOCTITE BLUE

When prepping your engine case, pressurize the case by using water pressure to verify that you have water flowing from all the main bearing oil holes on the stud side of the case. For added safety, you can drill out and tap all of the oil gallery plugs that are pressed into the case. You will need 1/8", 1/4" and 3/8" pipe taps and corresponding drills to complete this.

If you want to paint your case and cylinders, we recommend using Rustoleum Hammered Enamel. Or, use a mixture of enamel oil based paint and gasoline - a 50/50 mix. It's more like staining than painting, and it will adhere. (Do not apply near open flame or furnace!)

Use Loctite 518 or Gasgacinch Gasket Sealer on the case halves, cylinders and shims, and oil pump. Loctite 518 gap fills up to .020" and will leave you with a very dry engine (no leaks!). NOTE: Gasgacinch Gasket Sealer may be used as a substitute for Loctite 518. Use Permetex 3H on the oil sump gaskets and oil pump cover gasket. Spray the valve covers and gaskets with spray adhesive and give them a few minutes to "tack up" before installing. Clip on valve covers are the most maintenance free and leak free valve covers to use.

When installing the prop hub, regardless of type, it is imperative that you size the bolt. If the bolt is too long, it will bottom out in the crankshaft and two things will happen. 1. You will strip the threads when removing it after you torque it. 2. The hub will never be tight on the taper and will eventually break the crankshaft. Also, never, never use anything but a wood propeller on the pulley end of the engine. You will break the crankshaft if you do not heed this warning about props.