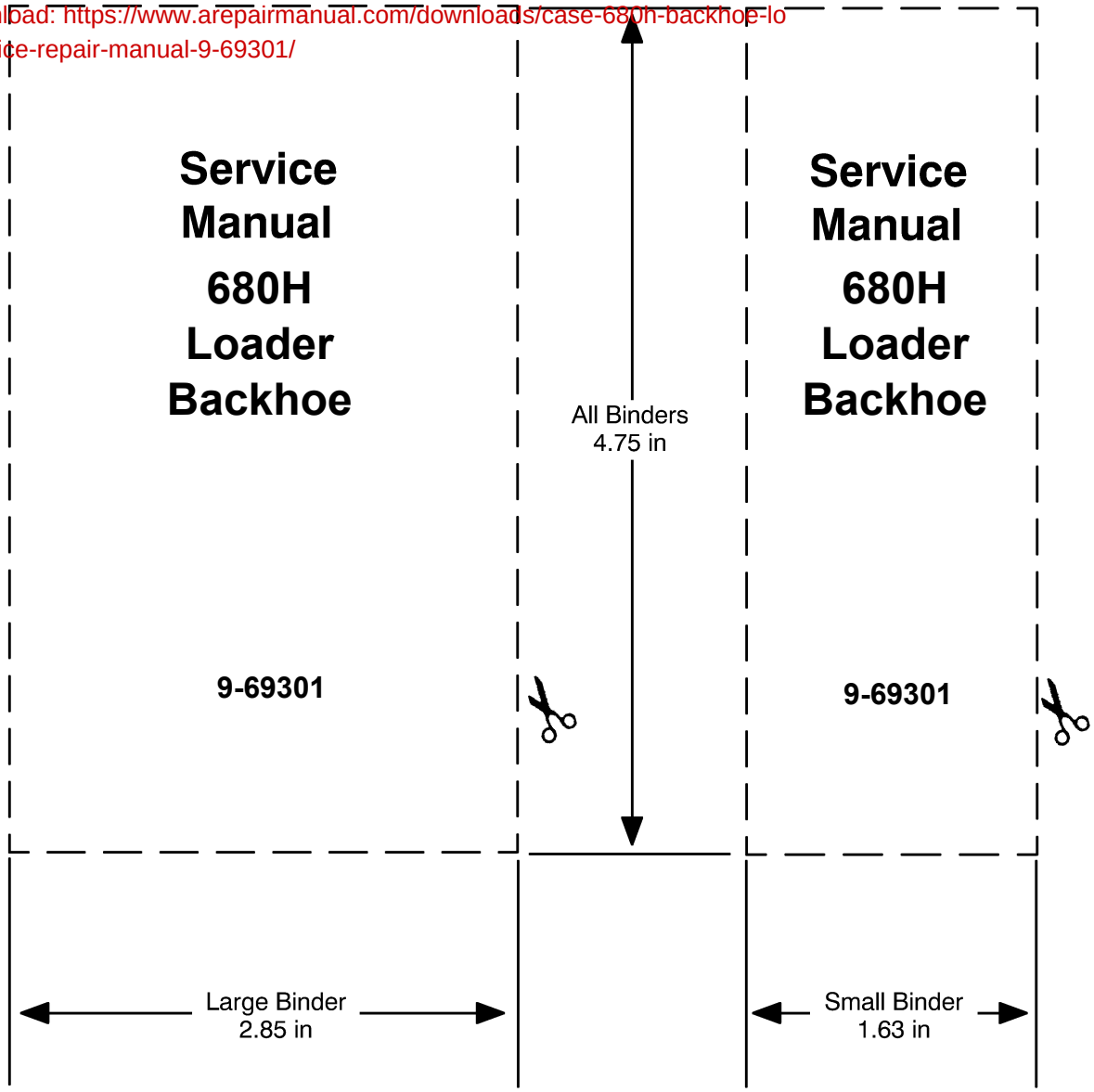

680H LOADER BACKHOE

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Section
1001

SAFETY RULES
SERVICE MANUAL INTRODUCTION
AND
TORQUE SPECIFICATIONS

Written In ***C**lear*
***A**nd*
***S**imple*
***E**nglish*

CASE CORPORATION

9-69300
September 1981

PRINTED IN U.S.A.

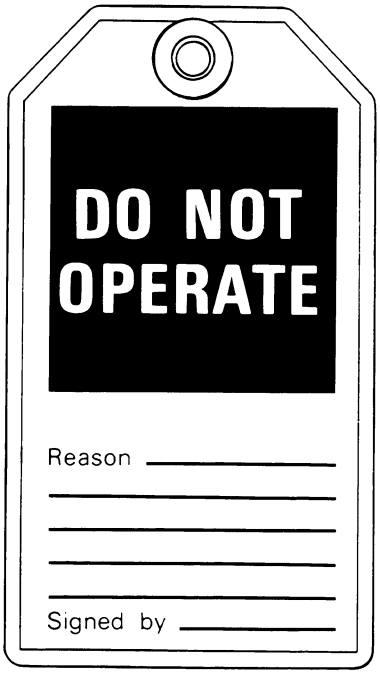
SAFETY RULES

This Symbol Shows Important Information About Safety In This Manual. When You See This Symbol, Carefully Read The Information That Follows and Understand The Possible Causes of Injury Or Death. 1-1-A

IMPORTANT: *To prevent injury on job, follow the Warning, Caution, and Danger notes in this section and other sections throughout this manual. Follow the instructions carefully.*

The procedures recommended and shown in this manual are good, effective service methods. However, all possible procedures and service hazards may not be covered. Therefore, if you use a tool or procedure not recommended, you must make sure that the method you select is a safe method.

Put the warning tag shown below on the key for the key switch when you are servicing or repair- ing this machine. One warning tag is on every new machine. You can buy additional warning tags, part number 331-4614, from Service Parts Supply.



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DANGER: *Engine exhaust fumes can cause death. If it is necessary to start the engine in a closed place, remove the exhaust fumes from the area with an exhaust pipe extension. If you do not have an exhaust pipe extension, open the doors and get outside air into the area.* 48-56

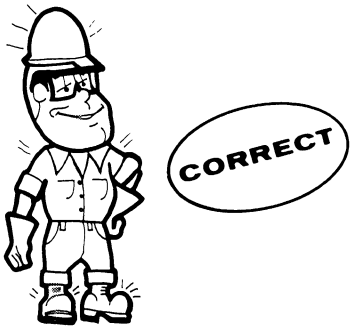
DANGER: *Before you move the backhoe boom to either side, make sure that all persons are out of the way. A swinging boom can crush.* 48-54

WARNING: *Read operator's manual to familiarize yourself with control lever functions.* 46-27

WARNING: *Operate tractor and equipment controls from the seat position only. Any other method could result in serious injury.* 48-55

WARNING: *This is a one man machine, no riders allowed.* 35-8

WARNING: *If you wear clothing that is too loose or do not use the correct safety equipment for your job, you can be injured. Always wear clothing that will not catch on objects. Extra safety equipment that can be required includes hard hat, safety shoes, ear protection, eye or face protection, heavy gloves and reflector clothing.* 45-3-A



WARNING: *When working in the area of the fan belt with the engine running, avoid loose clothing if possible, and use extreme caution.* 35-4

WARNING: *Operate controls from the operator's seat only.* 35-7

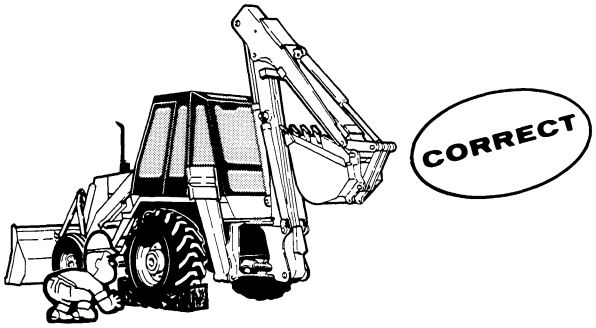
WARNING: *Whenever the bucket must be raised to aid in servicing, block the loader arms in place with lift cylinder safety strut or a suitable safety stand.* 23-7-A

Lift Cylinder Safety Strut

WARNING: *When doing checks and tests on the equipment hydraulics, follow the procedures as they are written. DO NOT change the procedure.* 47-44

WARNING: *When putting the hydraulic cylinders on this machine through the necessary cycles to check operation or to remove air from a circuit, make sure all people are out of the way.* 47-45

WARNING: *Locate the machine on level ground and block the wheels securely before working under the machine. Failure to follow the above procedure can result in personal injury.* 46-77



WARNING: *Use insulated gloves or mittens when working with hot parts.* 47-41A

CAUTION: *Pin sized and smaller streams of hydraulic oil under pressure can penetrate the skin and result in serious infection. If hydraulic oil under pressure does penetrate the skin, seek medical treatment immediately. Maintain all hoses and tubes in good condition. Make sure all connections are tight. Make a replacement of any tube or hose that is damaged or thought to be damaged. DO NOT use your hand to check for leaks; use a piece of cardboard or wood.* 40-6-A

CAUTION: *When removing hardened pins such as a pivot pin, or a hardened shaft, use a soft head (brass or bronze) hammer or use a driver made from brass or bronze and a steel head hammer.* 46-17

CAUTION: *When using a hammer to remove and install pivot pins or separate parts, using compressed air or using a grinder, wear eye protection that completely encloses the eyes (approved goggles or other approved eye protectors).* 46-13

CAUTION: *When servicing or repairing the machine, keep the shop floor and operator's compartment and steps free of oil, water, grease, tools, etc. Use an oil absorbing material and/or shop cloths as required. Use safe practices at all times.* 40-8

CAUTION: *Use suitable floor (service) jacks or chain hoists to raise wheels off the floor. Always block machine in place with suitable safety stands.* 40-7

CAUTION: *Some components of this machine are very heavy. Use suitable lifting equipment or additional help as instructed in this service manual.* 40-10

SERVICE MANUAL INTRODUCTION

This service manual has been prepared with the latest service information available. Troubleshooting, removal, disassembly, inspection and installation procedures, and complete specifications and tightening references can be found in most sections. Some sections have drawings with a written procedure because the job is so easily done. This service manual is one of the most important tools available to the service technician.

Right-Hand and Left-Hand

The terms right-hand and left-hand and front and rear as used in this manual indicate the right and left sides, and front and rear of the machine as seen from the operator's seat for correct operation of the machine or attachment.

Text

If the service manual is for more than one machine or different models of components (planetary axles, gear boxes, control valves, etc.) the procedures have the steps necessary to service each model.

Table of Contents

A Table of Contents is in the front of this manual. The Table of Contents shows the main divisions and the sections that are in each division. The individual sections, where necessary, have a Table of Contents on the second page of that section.

Page Numbers

All page numbers are made of two numbers separated by a dash, such as 4002-9. The number before the dash is the section number. The number following the dash is the page number in that section. Page numbers will be found at the upper right or left of each page.

Illustrations

Illustrations are put as near as possible to the text and are to be used as part of the text.

Torque Specifications

The most common grades of fasteners (bolts, nuts, and screws) used on Case machines are grade 5 and grade 8. See page 1001-6 for torque specifications and identification marks.

The specifications in this section are standard torque values and are to be used on all fasteners during assembly and installation unless special torque values are shown in a section.

P.I.N., Serial and Model Numbers

When replacement parts are needed, it can be necessary to give the parts department one or all of the numbers. The model number is normally found on the Product Identification Number plate or Serial Number plate.

The Product Identification Number (P.I.N.) and serial numbers will be found in the following locations.

Machine - The Product Identification Number plate is above the foot brake pedals.

Engine - A serial number plate is on the right-hand side of the engine above the starter.

Components - A serial number plate is on many components such as starters, alternators, pumps, etc.

Classification of Lubricants

The SAE number is the viscosity of engine oils; for example, SAE 30, a single viscosity oil. SAE 10W30 is a variable viscosity oil.

The API classification (SD, CD, etc.) is the oil performance in terms of engine usage. Only oil specified in Section 1002 can be used. These oils have the needed chemical additives to give maximum engine protection. Both the SAE grade and API classification must be found on the container.

Gear Lubricant and Grease

Gear lubricant and grease for each application is specified in Section 1002.

Special Tools

Special tools are needed to remove and install, disassemble and assemble, check and adjust some component parts of this machine. Some special tools can be easily made locally and the necessary information to make the tool is in this service manual. Other special tools are more difficult to make locally and are available from Service Tools in the U.S. and from Jobborn Manufacturing in Canada. Use these tools according to the instructions in this service manual for your personal safety and to do the job correctly.

Order special tools from either of the following companies:

Service Tools
P.O. Box 314
Owatonna, Minnesota 55060

Jobborn Manufacturing Co.
97 Frid Street
Hamilton, Ontario L8P 4M3
Canada

TORQUE SPECIFICATIONS - U.S. HARDWARE

Use the following torques when special torques are not given.

These torques apply to fasteners as received from suppliers, dry, or when lubricated with engine oil. These torques do not apply if special graphites, moly-disulfide greases or other extreme pressure lubricants are used. These torques apply to both UNC and UNF threads.

Grade 2 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres	Kilogram metres
1/4 in 6.4 mm	5-6	7-8	0.7-0.8
5/16 in 7.9 mm	10-12	14-16	1.4-1.7
3/8 in 9.5 mm	20-23	27-31	2.8-3.2
7/16 in 11.1 mm	30-35	41-47	4.1-4.8
1/2 in 12.7 mm	45-52	61-71	6.2-7.2
9/16 in 14.3 mm	65-75	88-102	9.0-10.4
5/8 in 15.9 mm	95-105	129-142	13.1-14.5
3/4 in 19.0 mm	150-185	203-251	20.7-25.6
7/8 in 22.2 mm	160-200	217-271	22.1-27.7
1.0 in 25.4 mm	250-300	339-407	34.6-41.5

Grade 5 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres	Kilogram metres
1/4 in 6.4 mm	9-11	12-15	1.2-1.5
5/16 in 7.9 mm	17-21	23-28	2.4-2.9
3/8 in 9.5 mm	35-42	48-57	4.8-5.8
7/16 in 11.1 mm	54-64	73-87	7.5-8.8
1/2 in 12.7 mm	80-96	109-130	11.1-13.3
9/16 in 14.3 mm	110-132	149-179	15.2-18.2
5/8 in 15.9 mm	150-180	203-244	20.8-24.9
3/4 in 19.0 mm	270-324	366-439	37.3-44.8
7/8 in 22.2 mm	400-480	542-651	55.3-66.4
1.0 in 25.4 mm	580-696	787-944	80.2-96.2
1-1/8 in 28.6 mm	800-880	1085-1193	111-122
1-1/4 in 31.8 mm	1120-1240	1519-1681	155-171
1-3/8 in 34.9 mm	1460-1680	1980-2278	202-232
1-1/2 in 38.1 mm	1940-2200	2631-2983	268-304

811360

Grade 8 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres	Kilogram metres
1/4 in 6.4 mm	12-15	16-20	1.7-2.1
5/16 in 7.9 mm	24-29	33-39	3.3-4.0
3/8 in 9.5 mm	45-54	61-73	6.2-7.5
7/16 in 11.1 mm	70-84	95-114	9.7-11.6
1/2 in 12.7 mm	110-132	149-179	15.2-18.2
9/16 in 14.3 mm	160-192	217-260	22.1-26.5
5/8 in 15.9 mm	220-264	298-358	30.4-36.5
3/4 in 19.0 mm	380-456	515-618	52.5-63.0
7/8 in 22.2 mm	600-720	814-976	83.0-99.5
1.0 in 25.4 mm	900-1080	1220-1465	124-149
1-1/8 in 28.6 mm	1280-1440	1736-1953	177-199
1-1/4 in 31.8 mm	1820-2000	2468-2712	252-277
1-3/8 in 34.9 mm	2380-2720	3227-3688	329-376
1-1/2 in 38.1 mm	3160-3560	4285-4827	437-492

NOTE: Use thick nuts with Grade 8 bolts.

Split Flange Mounting Bolts

Size	Pound-Feet	Newton metres	Kilogram metres
5/16-18	15-20	20-27	2.1-2.8
3/8-16	20-25	26-33	2.8-3.5
7/16-14	34-45	47-61	4.7-6.2
1/2-13	55-65	74-88	7.6-9.0
5/8-11	140-150	190-203	19.4-20.7

Steel Hydraulic Fittings

Tube OD Hose ID	Thread Size	Pound-Feet	Newton metres	Kilogram metres
37 Degree Flare Fittings				
1/4 in 6.4 mm	7/16-20	6-12	8-16	0.8-1.7
5/16 in 7.9 mm	1/2-20	8-16	11-21	1.1-2.2
3/8 in 9.5 mm	9/16-18	10-25	14-33	1.4-3.5
1/2 in 12.7 mm	3/4-16	15-42	20-56	2.1-5.8
5/8 in 15.9 mm	7/8-14	25-58	34-78	3.5-8.0
3/4 in 19.0 mm	1-1/16-12	40-80	54-108	5.5-11.1
7/8 in 22.2 mm	1-3/16-12	60-100	81-135	8.3-13.9
1.0 in 25.4 mm	1-5/16-12	75-117	102-158	10.4-16.2
1-1/4 in 31.8 mm	1-5/8-12	125-165	169-223	17.3-22.8
1-1/2 in 38.1 mm	1-7/8-12	210-250	285-338	29.0-34.6
Straight Threads with O-ring				
1/4 in 6.4 mm	7/16-20	12-19	16-25	1.7-2.6
5/16 in 7.9 mm	1/2-20	16-25	22-33	2.2-3.5
3/8 in 9.5 mm	9/16-18	25-40	34-54	3.5-5.5
1/2 in 12.7 mm	3/4-16	42-67	57-90	5.8-9.3
5/8 in 15.9 mm	7/8-14	58-92	79-124	8.0-12.7
3/4 in 19.0 mm	1-1/16-12	80-128	108-174	11.1-17.8
7/8 in 22.2 mm	1-3/16-12	100-160	136-216	13.8-22.1
1.0 in 25.4 mm	1-5/16-12	117-187	159-253	16.2-25.9
1-1/4 in 31.8 mm	1-5/8-12	165-264	224-357	22.8-36.5
1-1/2 in 38.1 mm	1-7/8-12	250-400	339-542	34.6-55.3

Section 1002

MAINTENANCE AND LUBRICATION

Written In *Clear And Simple English*

CASE CORPORATION

9-69300
September 1981

PRINTED IN U.S.A.

FLUIDS AND LUBRICANTS

Component	Capacity		Specifications
	U.S.	Metric	
Fuel tank	33 gallons	125 litres	Diesel Fuel, See Operators Manual
Engine crankcase Without filter change With filter change	15 quarts 16 quarts	14 litres 15 litres	Case HDM Oil Alternate engine oil: CD-Commercial class D Above 32° F (0° C) .....SAE 30 -10 - 50° F (-12 - 10° C) .....SAE 20 Below 32° F (0° C) .....SAE 10W
Hydraulic reservoir Total system Refill capacity With filter change Without filter change	40.8 gallons 14.2 gallons 13.6 gallons	154 litres 54 litres 52 litres	Case TCH Fluid Alternate oils: Automatic transmission fluid (ATF) such as Dexron II
Transmission oil	16 quarts	15.1 litres	Case TCH Fluid
Axle Center Bowl Planetary (each)	8 quarts 2 quarts	7.5 litres 1.9 litres	Case FDL multipurpose gear lubricant (API-GL-4) Above 40° F (4° C) .....SAE 140 -15 to 70° F (-26 to 21° C) .....SAE 80W -40 to 35° F (-40 to 2° C) .....SAE 75W
Engine cooling system With heater Without heater	37 quarts 36 quarts	35 litres 34 litres	Mix an ethylene glycol coolant with water for the lowest outside temperature that is expected. The mixture must be at least 50/50.
Batteries	As needed		Add drinking water or distilled water
Alcohol evaporator	1 pint	0.5 litres	Clean methyl alcohol
Grease fittings	As needed		Number 2 molydisulfide grease
Wheel bearings	As needed		Number 2 wheel bearing grease

MAINTENANCE CHART

This chart shows maximum service intervals for the correct maintenance of the machine. Some operating conditions will make it necessary to increase the service intervals.

INTERVAL	SERVICE	INSTRUCTIONS
After the first 2 hours of operation, new machine only	Tighten the wheel nuts and bolts.	See Section 6229.
	Tighten the mounting bolts for the rear axle.	See Section 6226.
	Tighten the mounting bolts for the swing cylinders.	See Section 9100.
	Tighten the nut on the upper pivot pin for the swing tower.	See Section 9100.
After the first 20 hours of operation, new machine only	Do the After Delivery Check.	See the Operators Manual.
Every 10 hours of operation or each day, whichever comes first	Lubricate the loader and backhoe pivot points.	
	Lubricate the front axle pivot points.	
	Check the level of the engine oil.	
	Check the level of the coolant in the radiator.	
	Check the level of the hydraulic oil.	See Section 8002.
	Clean the dust cup for the air cleaner, if equipped.	
	Clean or replace all safety and instruction decals that cannot be read.	See Section 9201.
	Remove water from the air reservoir.	
	Check the sediment bowl of the fuel transfer pump. If you see water or sediment, clean the sediment bowl.	
After every 50 hours of operation or each week, whichever comes first	Lubricate the front axle king pins.	
	Lubricate the three grease fittings of the driveshaft	See Section 6222.
	Lubricate the four grease fittings of the brake shafts and brake adjusters	See Section 7123.
	Check the transmission oil level	
	Lubricate the anti-rollback pivots	
Every 100 Hours of Operation	Lubricate the seat post	
	Change the engine oil	
	Lubricate the boom release pivot.	

INTERVAL	SERVICE	INSTRUCTIONS
Every 125 Hours of Operation	If equipped, clean the spark arresting muffler	See Section 2005
Every 200 Hours of Operation	Replace the engine oil filter	
After Every 250 Hours of Operation or Each Month, Whichever Comes First	Lubricate the 4-in-1 loader control pivot, (if equipped)	
	Lubricate the backhoe control pivots	
	Check the oil level in the rear axle planetaries	
	Check the oil level in the rear axle center bowl	
	Replace the transmission oil filter	See Section 6202.
	Clean the screen in the alcohol evaporator	See Section 7111.
Every 500 Hours of Operation	Lubricate the drive coupling for the hydraulic pump	See Section 8005.
	Replace the fuel filters	See Section 3010.
	Lubricate the front wheel bearings	See Section 5021.
	Inspect the ROPS cab or ROPS canopy	See Section 9021.
	Replace the hydraulic filter	See Section 8002.
	Check the engine valve adjustment	See Section 2015.
	Check the drive belt(s) tension	See Section 4007.
	Change the transmission oil	See Section 6202.
	Clean the transmission screen	See Section 6202.
After every 1000 hours of operation or two times a year, whichever comes first	Change the hydraulic oil	See Section 8002.
	Clean the hydraulic oil suction screen.	See Section 8002.
	Change the oil for the rear axle - center bowl	See Section 6226.
	Change the oil for the rear axle - planetaries.	See Section 6226.
	Check the battery fluid level.	See Section 4005.
	Clean the cab air filter (if equipped).	See Section 9061.

INTERVAL	SERVICE	INSTRUCTIONS
After every 2000 hours of operation or each year, whichever comes first	Change the coolant in the radiator. Clean the cooling system.	See Fluids and Lubricants Chart.
	Drain water and sediment from fuel tank.	See Section 3052.
	Replace filter in the air cleaner	See Section 2005
	Disassemble, clean, and replace gaskets in the alcohol evaporator	See Section 7111.
As necessary	Service the air cleaner filters when the air filter warning lamp is illuminated	See Section 2007.
	Replace the hydraulic filter when the warning lamp for the hydraulic filter is illuminated during operation	See Section 8002.
	When a wheel is removed and installed, tighten the bolts for the wheel every two hours until the torque does not change.	See Section 6229.
	Replace the ether can for the ether injection system.	
	Adjust the parking brake	See Section 7106.

Section

1010

GENERAL ENGINE SPECIFICATIONS

680 CK Series H Loader

Written In *Clear And Simple English*

CASE CORPORATION

Rac 8-23130

Printed in U.S.A.
March, 1981

DIESEL ENGINES

General

Type	4 Cylinder, 4 Stroke Cycle, Valve-In-Head
Firing Order	1-3-4-2
Bore	4-5/8 Inches (117.5mm)
Stroke	5 Inches (127mm)
Piston Displacement	336 Cubic Inches (8 259cm³)
Compression Ratio	16.0 to 1
No Load Governed Speed	2300 to 2400 RPM
Rated Engine Speed	2200 RPM
Engine Idling Speed	725 to 775 RPM
Valve Tappet Clearance (Exhaust)	(Cold) 0.025 Inch (0.635mm)
(Intake)	(Cold) 0.015 Inch (0.381mm)
Thermostat Operating Range	175°F to 202°F (79°C to 94°C)

Piston and Connecting Rods

Rings per Piston	3
Number of Compression Rings	2
Number of Oil Rings	1
Type Pins	Full Floating Type
Type Bearing	Steel Back With Copper-Lead or Aluminum Alloy Liners. Replacement Bearings Available.

Main Bearings

Number of Bearings	5
Type Bearings	Steel Back With Copper-Lead or Aluminum Alloy Liners. Replacement Bearings Available.

Engine Lubricating System

Oil Pressure	45 to 60 PSI (310 to 414 kPa) With Engine Warm and Operating at Rated Engine Speed
Type System	Pressure and Spray Circulation
Oil Pump	Gear Type
Oil Filter	Full Flow Turn on Type
Oil Capacity With Filter	15 U.S. Quarts (14.2 litre)
Without Filter	14 U.S. Quarts (13.2 litre)

Fuel System

Fuel Injection Pump	Robert Bosch, Type PES Multiple Plunger
Pump Timing	27 Degrees Before Top Center (Port Closing)
Fuel Injectors	17 mm, Opening Pressure 3950 to 4100 PSI (27 234 to 28 268 kPa)
Fuel Transfer Pump	Plunger Type, Part of Injection Pump
Governor	Variable Speed, Fly-Weight Centrifugal Type, Part of Injection Pump
1st Stage Fuel Filter	Full Flow Turn on Type
2nd Stage Fuel Filter	Full Flow Turn on Type
Hand Primer Pump	Located Top of Fuel Transfer Pump
Primary Fuel Filter	Located Bottom of Fuel Transfer Pump

Section

1023

SPECIFICATION DETAILS

336BD AND 336BDT ENGINE

Written In *Clear And Simple English*

CASE CORPORATION

Rac 9-78647

Printed in U.S.A.
March, 1981

FRACTION to DECIMAL to MILLIMETER CONVERSION TABLE

Fraction	Decimal	MM	Fraction	Decimal	MM	Fraction	Decimal	MM
1/64	.0156	0.397	23/64	.3593	9.128	45/64	.7031	17.859
1/32	.0312	0.794	**3/8**	**.3750**	**9.525**	23/32	.7187	18.256
3/64	.0468	1.191	25/64	.3906	9.922	47/64	.7343	18.653
1/16	.0625	1.587	13/32	.4062	10.319	**3/4**	**.7500**	**19.050**
5/64	.0781	1.984	27/64	.4218	10.716	49/64	.7656	19.447
3/32	.0937	2.381	7/16	.4375	11.113	25/32	.7812	19.844
7/64	.1093	2.778	29/64	.4531	11.509	51/64	.7968	20.240
1/8	**.1250**	**3.175**	15/32	.4687	11.906	13/16	.8125	20.637
9/64	.1406	3.572	31/64	.4843	12.303	53/64	.8281	21.034
5/32	.1562	3.969	**1/2**	**.5000**	**12.700**	27/32	.8437	21.431
11/64	.1718	4.366	33/64	.5156	13.097	55/64	.8593	21.828
3/16	.1875	4.762	17/32	.5312	13.494	**7/8**	**.8750**	**22.225**
13/64	.2031	5.159	35/64	.5468	13.890	57/64	.8906	22.622
7/32	.2187	5.556	9/16	.5625	14.287	29/32	.9062	23.019
15/64	.2343	5.953	37/64	.5781	14.684	59/64	.9218	23.415
1/4	**.2500**	**6.350**	19/32	.5937	15.081	15/16	.9375	23.812
17/64	.2656	6.747	39/64	.6093	15.478	61/64	.9531	24.209
9/32	.2812	7.144	**5/8**	**.6250**	**15.875**	31/32	.9687	24.606
19/64	.2968	7.541	41/64	.6406	16.272	63/64	.9843	25.003
5/16	.3125	7.937	21/32	.6562	16.669	**1**	**1.0000**	**25.400**
21/64	.3281	8.334	43/64	.6718	17.065			
11/32	.3437	8.731	11/16	.6875	17.462			

INCH to MILLIMETER CONVERSION TABLE

Inch	MM	Inch	MM	Inch	MM	Inch	MM
1	25.400	6	152.000	10	254.000	60	1,524.000
2	50.800	7	177.800	20	508.000	70	1,778.000
3	76.200	8	203.200	30	762.000	80	2,032.000
4	101.600	9	228.600	40	1,016.000	90	2,286.000
5	127.000	10	254.000	50	1,270.000	100	2,540.000

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GENERAL TORQUE SPECIFICATION TABLE 15

RUN-IN INSTRUCTIONS

Engine Lubrication

Fill the engine crankcase with CASE HDM oil and install new engine oil filters, after an engine has been rebuilt.

NOTE: *Use a SERIES 3 DS or CD SERVICE CLASSIFICATION oil that has the correct viscosity rating for ambient air temperature, if CASE HDM oil is not used.*

Change the engine oil while the engine is hot and replace the engine oil filters, after the first 20 hours of operation.

Change the engine oil and filters at the given intervals, after the 20 hours, as found in the Operator's Manual.

Run-In Procedure For Rebuilt Engines (With A Dynamometer)

The following procedure must be followed when using a PTO dynamometer to run-in the engine. The dynamometer will make sure of the control of the engine load at each speed and will remove stress on new parts during run-in.

During the run-in, continue to check the oil pressure, coolant level and coolant temperature.

STEP	TIME	ENGINE SPEED	DYNAMOMETER SCALE LOAD*
1	**10 Minutes	1000 RPM	Not Any
2	**10 Minutes	1800 RPM	Not Any
3	20 Minutes	1800 RPM	1/3
4	20 Minutes	1800 RPM	1/2
5	***30 Minutes	100 RPM below rated speed	3/4
6	Tighten the cylinder head bolts to the torque that is found in Section 2015 of the service manual.		

* According to normal dynamometer scale load at rated speed for the specific vehicle model. Decrease this scale load as shown.

** The best run-in procedure will constantly change the throttle between 750 to 1000 RPM, for the first 10 minutes and from 1000 to 1800 RPM, for the next 10 minutes. The purpose of this changing RPM is to change the lubrication and coolant flow.

*** 30 minutes at 3/4 load is a minimum amount of time the engine can be run. It is best that when possible, the engine (especially a turbocharged diesel) must be run for four (4) hours or more, at the above speed and load before checking the full engine horsepower or before using the engine for heavy field work.

Run-In Procedure For Rebuilt Engines (Without A Dynamometer)

STEP	TIME	ENGINE SPEED	LOAD
1	*10 Minutes	1000 RPM	Not Any
2	* 10 Minutes	1800 RPM	Not Any
3	30 Minutes	2/3 Rated RPM	Light Load
4	1 Hour	Full RPM (not over 2000 RPM)	80 to 90%
5	Tighten the cylinder head bolts to the torque that is found in Section 2015 of the service manual.		

* If engine must then run at or near full load to operate the machine, remove the load for the first hour and run at high idle for several minutes at 15 minute intervals.

Run-In Procedure

Keep in one gear lower than normal for the first 8 hours of field operation. DO NOT "lug" the engine for the next 12 hours. Prevent "lugging" by moving the shift lever to a lower gear. The engine must not be "lugged" below the Rated Engine RPM during the early hours of life.

ENGINE SPECIFICATION DETAILS

Cylinder Sleeves

	U.S. Value	Metric Value
Type	Wet, Can Be Replaced	
Material	Cast Iron	
ID of Sleeve	4.6250 to 4.6263"	117.475 to 117.508 mm
Maximum Service Limit	4.6283"	117.5588 mm
Sleeve Out of Round (Installed in Block)	0.002"	0.0508 mm
Maximum Service Limit	0.002"	0.0508 mm
Taper (Installed in Block)	0.001"	0.0254 mm
Maximum Service Limit	0.002"	0.051 mm
Clearance at Bottom of Piston, 90 Degrees to Piston Pin	0.0052 to 0.0075"	0.1321 to 0.1905 mm
Maximum Service Limit	0.0100"	0.2540 mm

Piston with 1.62" (41.15 mm) Pin Bore

Type	Cam Ground	
Material	Aluminum Alloy	
OD At Bottom, 90 Degrees to Piston Pin	4.6188 to 4.6198"	117.3175 to 117.3429 mm
Minimum Service Limit	4.6178"	117.2921 mm
ID of Piston Pin Bore	1.6251 to 1.6253"	41.2775 to 41.2826 mm
Maximum Service Limit	1.6258"	41.2953 mm
Width of 1st Ring Groove	0.097 to 0.098"	2.464 to 2.489 mm
Maximum Service Limit	0.0985"	2.5019 mm
Width of 2nd Ring Groove	0.097 to 0.098"	2.464 to 2.489 mm
Maximum Service Limit	0.0985"	2.5019 mm
Width of 3rd Ring Groove	0.188 to 0.189"	4.775 to 4.801 mm
Maximum Service Limit	0.190"	4.826 mm

Piston with 1.80" (45.72 mm) Pin Bore

Type	Cam Ground	
Material	Aluminum Alloy	
OD at Bottom, 90 Degree to Piston Pin	4.6188 to 4.6198"	117.3175 to 117.3429 mm
Minimum Service Limit	4.6178"	117.2921 mm
ID of Piston Pin Bore	1.8001 to 1.8005"	45.7225 to 45.7327 mm
Maximum Service Limit	1.8010"	45.7454 mm
Width of 1st Ring Groove	Not Measureable	
Width of 2nd Ring Groove	Not Measureable	
Width of 3rd Ring Groove	0.188 to 0.189"	4.775 to 4.801 mm
Maximum Service Limit	0.190"	4.826 mm

Piston Pin for Piston with 1.62" (41.15 mm) Pin Bore

Type	Floats	
OD of Pin	1.6244 to 1.6246"	41.2598 to 41.2648 mm

Piston Pin for Piston with 1.80" (45.72 mm) Pin Bore

Type	Floats	
OD of Pin	1.7994 to 1.7996"	45.7048 to 45.7098 mm

Piston Rings

	U.S. Value	Metric Value
Number One Compression (Top)	Square Type with Chrome Face	
End Gap in 4.625" (117.475 mm) ID Sleeve	0.015 to 0.025"	0.381 to 0.635 mm
Maximum Service Limit	0.030"	0.762 mm
Side Clearance	0.0035 to 0.0050"	0.0889 to 0.127 mm
Maximum Service Limit	0.006"	0.152 mm
Number One Compression (Top)	Keystone Type	
End Gap in 4.625" (117.475 mm) ID Sleeve	0.015 to 0.025"	0.381 to 0.635 mm
Maximum Service Limit	0.030"	0.762 mm
Side Clearance	Not Measureable	
Number Two Compression (Intermediate)	Square Type with Tapered Face	
End Gap in 4.625" (117.475 mm) ID Sleeve	0.013 to 0.023"	0.330 to 0.584 mm
Maximum Service Limit	0.028"	0.711 mm
Side Clearance	0.003 to 0.005"	0.076 to 0.127 mm
Maximum Service Limit	0.006"	0.152 mm
Number Two Compression (Intermediate)	Keystone Type	
End Gap in 4.625" (117.475 mm) ID Sleeve	0.015 to 0.025"	0.381 to 0.635 mm
Maximum Service Limit	0.030"	0.762 mm
Side Clearance	Not Measureable	
Number Three Oil Control Ring (Bottom)	Two Piece	
Width	0.1860 to 0.1865"	4.7244 to 4.7371 mm
End Gap in 4.625" (117.475 mm) ID Sleeve	0.016 to 0.026"	0.406 to 0.660 mm
Maximum Service Limit	0.031"	0.787 mm
Side Clearance	0.0015 to 0.003"	0.0381 to 0.0762 mm
Maximum Service Limit	0.0035"	0.0889 mm

Connecting Rod for Piston with 1.62" (41.15 mm) Pin Bore

Bushing	Replaceable	
Bushing ID, Installed (Ream to Size)	1.6254 to 1.6258"	41.2852 to 41.2953 mm
Maximum Service Limit	1.6265"	41.3131 mm
Bearing Liners	Replaceable	
Bearing Liner Width	1.586 to 1.596"	40.284 to 40.538 mm
Bore ID without Bearing Liners	2.9003 to 2.9013"	73.6676 to 73.6930 mm
Bearing Oil Clearance	0.0013 to 0.0038"	0.0330 to 0.0965 mm
Maximum Service Limit	0.0043"	0.1092 mm
Undersize Bearings for Service	0.002, 0.010, 0.020, 0.030"	0.051, 0.254, 0.508, 0.762 mm
Side Clearance	0.007 to 0.016"	0.178 to 0.406 mm

Connecting Rod for Piston with 1.80" (45.72 mm) Pin Bore

Bushing	Replaceable	
Bushing ID, Installed (Ream to Size)	1.8004 to 1.8008"	45.7302 to 45.7403 mm
Maximum Service Limit	1.8015"	45.7581 mm
Bearing Liners	Replaceable	
Bearing Liner Width	1.586 to 1.596"	40.284 to 40.538 mm
Bore ID without Bearing Liners	3.1503 to 3.1513"	80.0176 to 80.043 mm
Bearing Oil Clearance	0.0013 to 0.0038"	0.0330 to 0.0965 mm
Maximum Service Limit	0.0043"	0.1092 mm
Undersize Bearings for Service	0.002, 0.010, 0.020, 0.030"	0.051, 0.254, 0.508, 0.762 mm
Side Clearance	0.007 to 0.016"	0.178 to 0.406 mm

Crankshaft with 3″ (76.2 mm) Main Bearing Journals

	U.S. Value	Metric Value
Type	Forged, Heat Treated and Balanced	
End Play, Number Five Main Bearing Cap	0.003 to 0.015″	0.076 to 0.381 mm
Thrust Bearing, Standard Thickness	0.184 to 0.186″	4.674 to 4.724 mm
Thrust Bearing, Oversize Thickness for Service	0.190 to 0.192″	4.826 to 4.877 mm
Connecting Rod Journal Width	1.9975 to 2.0025″	50.7365 to 50.8635 mm
Connecting Rod Journal, Standard OD	2.748 to 2.749″	69.799 to 69.825 mm
0.010″ (0.254 mm) OD Undersize, Grind to	2.738 to 2.739″	69.545 to 69.571 mm
0.020″ (0.508 mm) OD Undersize, Grind to	2.728 to 2.729″	69.291 to 69.317 mm
0.030″ (0.762 mm) OD Undersize, Grind to	2.718 to 2.719″	69.037 to 69.063 mm
Connecting Rod Journal Maximum Taper	0.0005″	0.0127 mm
Connecting Rod Journals Out of Round	0.0005″	0.0127 mm
Main Bearing Liners	Replaceable	
Main Bearing Liner Width, 1st, 3rd and 5th	2.1515 to 2.1615″	54.6481 to 54.9021 mm
Main Bearing Liner Width, 2nd and 4th	1.151 to 1.161″	29.235 to 29.489 mm
Main Bearing Oil Clearance	0.0016 to 0.0046″	0.0406 to 0.1168 mm
Maximum Service Limit	0.005″	0.127 mm
Undersize Main Bearing Liners for Service	0.002, 0.010, 0.020, 0.030″	0.051, 0.254, 0.508, 0.762 mm
Main Bearing Journal, Standard OD	2.998 to 2.999″	76.149 to 76.175 mm
0.010″ (0.254 mm) OD Undersize, Grind to	2.988 to 2.989″	75.895 to 75.921 mm
0.020″ (0.508 mm) OD Undersize, Grind to	2.978 to 2.979″	75.641 to 75.667 mm
0.030″ (0.762 mm) OD Undersize, Grind to	2.968 to 2.969″	75.387 to 75.413 mm
Main Bearing Journal Bore ID without Liners	3.191 to 3.192″	81.051 to 81.077 mm
Main Bearing Journal Width		
2nd and 4th	1.555 to 1.570″	39.497 to 39.878 mm
3rd	2.623 to 2.627″	66.624 to 66.726 mm
5th	2.6175 to 2.6325″	66.4845 to 66.8655 mm

Crankshaft with 3.5″ (88.9 mm) Main Bearing Journals

Type	Forged, Heat Treated and Balanced	
End Play, Number Three Main Bearing Cap	0.003 to 0.015″	0.076 to 0.381 mm
Thrust Bearing, Standard Thickness	0.155 to 0.157″	3.937 to 3.988 mm
Thrust Bearing, Oversize Thickness for Service	0.161 to 0.163″	4.089 to 4.140 mm
Connecting Rod Journal Width	1.9775 to 2.0025″	50.2285 to 50.8635 mm
Connecting Rod Journal, Standard OD	2.998 to 2.999″	76.149 to 76.175 mm
0.010″ (0.254 mm) OD Undersize, Grind to	2.988 to 2.989″	75.895 to 75.921 mm
0.020″ (0.508 mm) OD Undersize, Grind to	2.978 to 2.979″	75.641 to 75.667 mm
0.030″ (0.762 mm) OD Undersize, Grind to	2.968 to 2.969″	75.387 to 75.413 mm
Connecting Rod Journal Maximum Taper	0.0005″	0.0127 mm
Connecting Rod Journals Out of Round	0.0005″	0.0127 mm
Main Bearing Liners	Replaceable	
Main Bearing Liner Width, 1st, 3rd and 5th	2.1515 to 2.1615″	54.6481 to 54.9021 mm
Main Bearing Liner Width, 2nd and 4th	1.214 to 1.224″	30.836 to 31.089 mm
Main Bearing Oil Clearance	0.0016 to 0.0046″	0.0406 to 0.1168 mm
Maximum Service Limit	0.005″	0.127 mm
Undersize Main Bearing Liners for Service	0.002, 0.010, 0.020, 0.030″	0.051, 0.254, 0.508, 0.762 mm

Crankshaft With 3.5" (88.9 mm) Main Bearing Journals (Continued)

	U.S. Value	Metric Value
Main Bearing Journal, Standard OD	3.498 to 3.499"	88.849 to 88.875 mm
0.010" (0.254 mm) OD Undersize, Grind to	3.488 to 3.489"	88.595 to 88.621 mm
0.020" (0.508 mm) OD Undersize, Grind to	3.478 to 3.479"	88.341 to 88.367 mm
0.030" (0.762 mm) OD Undersize, Grind to	3.468 to 3.469"	88.087 to 88.113 mm
Main Bearing Journal Bore ID without Liners	3.691 to 3.692"	93.751 to 93.777 mm
Main Bearing Journal Width		
2nd and 4th	1.618 to 1.633"	41.097 to 41.478 mm
3rd	2.561 to 2.565"	65.049 to 65.151 mm
5th	2.5855 to 2.6005"	65.6717 to 66.0527 mm

Camshaft

Type	Parabolic	
Bushing	Four, Replaceable	
Bushing Lubrication	Under Pressure	
ID of Bushing	2.2484 to 2.2514"	57.1094 to 57.1856 mm
Maximum Service Limit	2.2524"	57.2110 mm
Bushing Width		
1st (Front)	1.646 to 1.666"	41.808 to 42.316 mm
2nd and 3rd	1.4275 to 1.4475"	36.2585 to 36.7665 mm
4th	1.1462 to 1.1662"	29.1135 to 29.6215 mm
OD of Each Bearing Surface	2.2460 to 2.2470"	57.0484 to 57.0738 mm
Minimum Service Limit	2.2455"	57.0357 mm
Thrust Washer Thickness	0.1225 to 0.1275"	3.1115 to 3.2385 mm
Minimum Service Limit	0.1215"	3.0861 mm
Thrust Plunger Spring		
Free Length	3.625"	92.075 mm
OD of Spring	0.3912 to 0.4062"	9.9365 to 10.3175 mm
Compress to 2.750" (69.85 mm)	45 to 55 lbs.	200 to 245 N

Valve Push Rod Lifters

OD of Lifter Stem, Standard	0.8097 to 0.8102"	20.5664 to 20.5791 mm
OD of Lifter Stem, Oversize for Service	0.8190 to 0.8195"	20.8026 to 20.8153 mm
ID of Block Bore, Standard	0.8118 to 0.8130"	20.6197 to 20.6502 mm
Maximum Service Limit	0.8135"	20.6629 mm
ID of Block Bore, Oversize for Service	0.8215 to 0.8225"	20.8661 to 20.8915 mm

Gear Train

	U.S. Value	Metric Value
Backlash		
Crankshaft Gear to Camshaft Gear	0.004 to 0.011"	0.102 to 0.279 mm
Idler Drive Gear to Idler Gear	0.003 to 0.010"	0.076 to 0.254 mm
Idler Gear to Fuel Pump Gear	0.004 to 0.012"	0.102 to 0.305 mm
Crankshaft Gear to Oil Pump Gear	0.006 to 0.011"	0.152 to 0.279 mm
Crankshaft Gear to Fuel Pump Gear	0.027" Max.	0.686 mm Max.
OD of Idler Gear Shaft	1.7325 to 1.7330"	44.0055 to 44.0182 mm
ID of Idler Gear Bushing	1.7345 to 1.7355"	44.0563 to 44.0817 mm
Maximum Service Limit	1.7375"	44.1325 mm
Idler Gear Thrust Washer Thickness	0.061 to 0.063"	1.5494 to 1.6002 mm
Idler Gear Lateral Movement	0.002 to 0.012"	0.051 to 0.305 mm

Oil Pump and Two Gear Balancer

Positive Displacement Pump	Gear Type	
Pump Gears to Cover Clearance	0.005 max.	0.127 mm max.
Pump Gear to Housing - Radial Clearance	0.006" max.	0.152 mm max.
Backlash		
Crankshaft Gear to Counterweight Gear	0.008 to 0.013"	0.203 to 0.330 mm
Counterweight Gear to Counterweight Gear	0.003 to 0.024"	0.076 to 0.610 mm
Relief Valve Spring		
Free Length	2.000"	50.800 mm
Wire Diameter	0.080"	2.032 mm
Maximum OD of Spring	0.673"	17.094 mm
Number of Coils	11	11
Compress to 1.234" (31.344 mm)	24.4 to 26.2 lbs.	108 to 116 N

Oil Pump and Three Gear Balancer

Positive Displacement Pump	Gear Type	
Pump Gears to Cover Clearance	0.005" max.	0127 mm max.
Backlash		
Crankshaft Gear to Counterweight Gear	0.008 to 0.013"	0.203 to 0.330 mm
Counterweight Gear to Counterweight Gear	0.005 to 0.013"	0.127 to 0.330 mm
Counterweight Gear and Drive Gear Bushing Wear	0.007 max.	0.178 mm max.
Relief Valve Spring		
Free Length	3.00"	76.20 mm
Wire Diameter	0.062"	1.575 mm
OD of Spring	0.515"	13.081 mm
Number of Coils	25	25
Compress to 1.68" (42.67 mm)	13.5 to 15.5 lbs.	60 to 69 N

Oil Pump, Front Mount

	U.S. Value	Metric Value
Positive Displacement Pump	Gear Type	
Backlash		
Pump Gear To Crankshaft Gear	0.006 to 0.011"	0.152 to 0.279 mm
Pump Gears to Body Radial Clearance	0.006" max.	0.152 mm max.
Pump Gears to Pump Cover Clearance	0.005" max.	0.127 mm max.
Oil Pressure at Rated Speed, Hot Oil	45 to 60 PSI	310 to 413 kPa
Relief Valve Spring - Inner		
Number of Coils	14.5	14.5
Direction of Coils	L.H.	L.H.
Wire Diameter	0.063"	1.600 mm
Maximum OD	0.454"	11.532 mm
Free Length	1.750"	44.450 mm
Compress to 1.234 (31.344)	16.4 to 17.6 lbs.	73 to 78 N
Relief Valve Spring - Outer (Also For Pumps With One Spring)		
Number of Coils	11	11
Direction of Coils	RH	RH
Wire Diameter	0.080"	2.032 mm
Minimum ID	0.493"	12.522 mm
Maximum OD	0.673"	17.094 mm
Free Length	2.000"	50.800 mm
Compress to 1.234 (31.344)	24.4 to 26.2 lbs.	108 to 116 N
Relief Valve Cup Plug Depth	0.375"	9.525 mm

Cylinder Head	U.S. Value	Metric Value
Warpage	0.005″	0.127 mm

Exhaust Valve

Tappet Clearance	0.025″	0.635 mm
Face Angle	44 Degrees	44 Degrees
Face Run-Out	0.002″ max.	0.051 mm
OD of Head	1.745 to 1.755″	44.323 to 44.577 mm
OD of Stem	0.402 to 0.403″	10.211 to 10.236 mm
Minimum Service Limit	0.4018″	10.2057 mm
OD of Taper at 4.2675″ (108.3945 mm)	0.401 to 0.402″	10.185 to 10.211 mm
Minimum Service Limit	0.4008″	10.1803 mm
Length	6.4195 to 6.4405″	163.0553 to 163.5887 mm
Insert Seat Angle	45 Degrees	45 Degrees
Seat Contact Width	0.0800 to 0.1000″	2.0320 to 2.5400 mm
Seat Run-Out	0.002″	0.051 mm
Insert Height	0.3115 to 0.3175″	7.9121 to 8.0645 mm
OD of Insert	1.9455 to 1.9465″	49.4157 to 49.4411 mm
ID of Insert	1.569 to 1.579″	39.853 to 40.107 mm

Intake Valve - 45 Degree

Tappet Clearance	0.015″	0.381 mm
Face Angle	44 Degrees	44 Degrees
Face Run-Out	0.002″ max.	0.051 mm
OD of Stem	0.402 to 0.403″	10.211 to 10.236 mm
Minimum Service Limit	0.4018″	10.2057 mm
OD of Head	1.995 to 2.005″	50.673 to 50.927 mm
Length	6.4195 to 6.4405″	163.0553 to 163.5887 mm
Seat Angle	45 Degrees	45 Degrees
Seat Contact Width	0.0775 to 0.0975″	1.9685 to 2.4765 mm
Seat Run-Out	0.002″ max.	0.051 mm

Intake Valve - 30 Degree

Tappet Clearance	0.015″	0.381 mm
Face Angle	29 Degrees	29 Degrees
Face Run-Out	0.002″ max.	0.051 mm
OD of Stem	0.402 to 0.403″	10.211 to 10.236 mm
Minimum Service Limit	0.4018″	10.2057 mm
OD of Head	1.995 to 2.005″	50.673 to 50.927 mm
Length	6.4195 to 6.4405″	163.0553 to 163.5887 mm
Seat Angle	30 Degrees	30 Degrees
Seat Contact Width	0.075 to 0.1.000″	1.905 to 2.540 mm
Seat Run-Out	0.002″ max.	0.051 mm max.
Insert Height (If Equipped)	0.2660 to 0.2670	6.7564 to 6.7818 mm
OD of Insert (If Equipped)	2.099 to 2.100″	53.315 to 53.340 mm
ID of Insert (If Equipped)	1.777 to 1.787″	45.136 to 45.390 mm