SERVICE MANUAL
LOADER
W24
Articulated
9-99737

1. Trim along dashed line.
2. Slide into pocket on Binder Spine.

TYPE 1-4

SERVICE MANUAL
LOADER
W24
Articulated
9-99737

1. Trim along dashed line.
2. Slide into pocket on Binder Spine.

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SERVICE MANUAL
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2. Slide into pocket on Binder Spine.

TYPE 1-4

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CASE CORPORATION
CE-DN: 9-99737
June 1978
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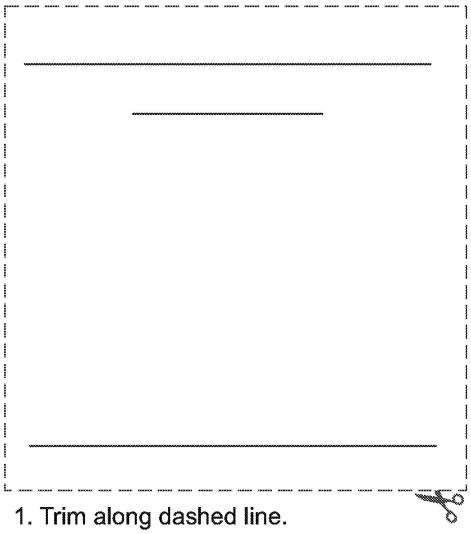

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2. Slide into pocket on Binder Spine.

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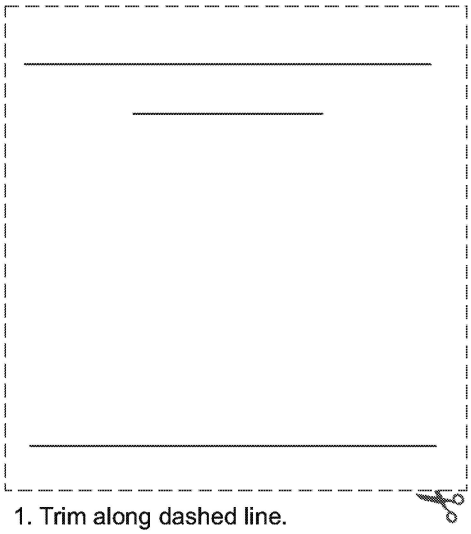

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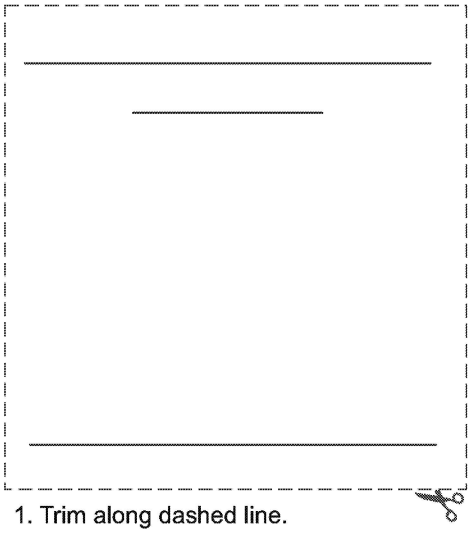

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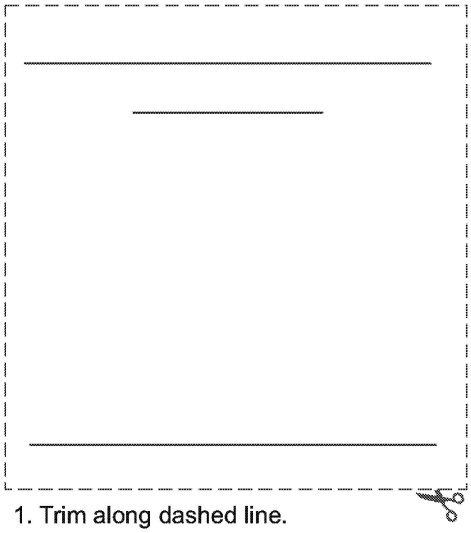

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TYPE 1-4

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SERIAL NUMBER LOCATIONS

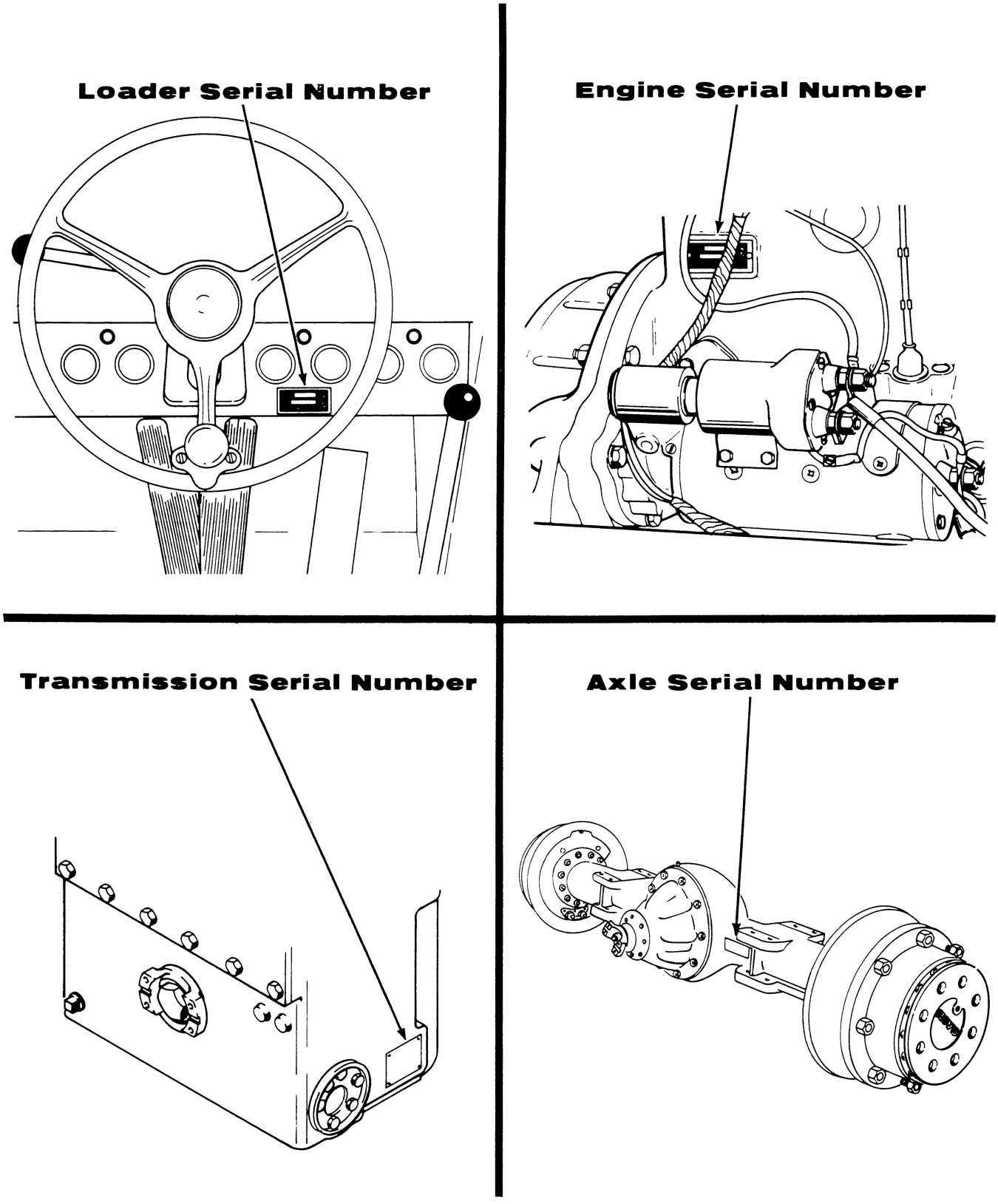

Figure 1

MAINTENANCE CHART

INTERVAL	TYPE OF SERVICE	FLUIDS & LUBRICANTS
Run-In Every 2 Hours	Check wheel bolt torque until stabilized. Torque 380 to 420 foot pounds. (Dry threads).	
Run-In After First 20 Hours	Change engine oil. Replace engine oil filter	See page 6.
Every 10 Hours Or Daily	Grease the loader pivot points. Check engine oil level. Drain water from main air reservoir. Drain water from auxiliary air reservoir. Check radiator coolant level.	See page 7.
Every 60 Hours Or Weekly	Grease rear axle trunnion pivots. Grease upper and lower hinge pins. Grease steering cylinders. Check hydraulic oil level. Check transmission oil level. Check battery electrolyte level. Lubricate brake pedal. Drain water from 1st stage fuel filter.	See page 7. See page 7. See page 7. Distilled water. Few drops engine oil.
Every 150 Hours	Change engine oil. Grease all drive line grease fittings and plugs. Grease pitman arm link. Check brake master cylinders fluid level.	See page 6. See page 7. See page 7. SAE J1703 fluid
Every 300 Hours	Replace engine oil filter.	

INTERVAL	TYPE OF SERVICE	FLUIDS & LUBRICANTS
Every 500 Hours	Check front and rear axle oil level.	See page 7.
	Check steering gear box oil level.	
	Check fan belts and air compressor drive belt tensions.	
	Change hydraulic oil.	See page 7.
	Replace hydraulic oil outlet filters (3).	
	Clean air baffle screen.	
	Clean hydraulic oil inlet screen.	
	Drain water from fuel tank.	
	Change fuel filters. (Late production only.)	
Every 1000 Hours	Clean transmission breather.	
	Clean transmission oil screen.	
	Replace transmission oil filter.	
	Change transmission and converter oil.	See page 7.
	Change front and rear axle oil.	See page 7.
	Remove air compressor cylinder head and clean (by Case dealer only).	
Every 3000 Hours	Rebuild or replace air compressor (by Case Dealer only).	
As required	Clean air cleaner filter element when indicator red band is showing.	
	Replace fuel filters when gauge (if so equipped) is in red zone.	
	Remove and clean fuel tank filler screen.	

Loader Pivot Points

The following pivot points are to be lubricated once every 10 hours of operation or daily. In severe or abnormal working conditions lubrication should be more often. Clean grease fittings before applying grease gun. See Figure 2.

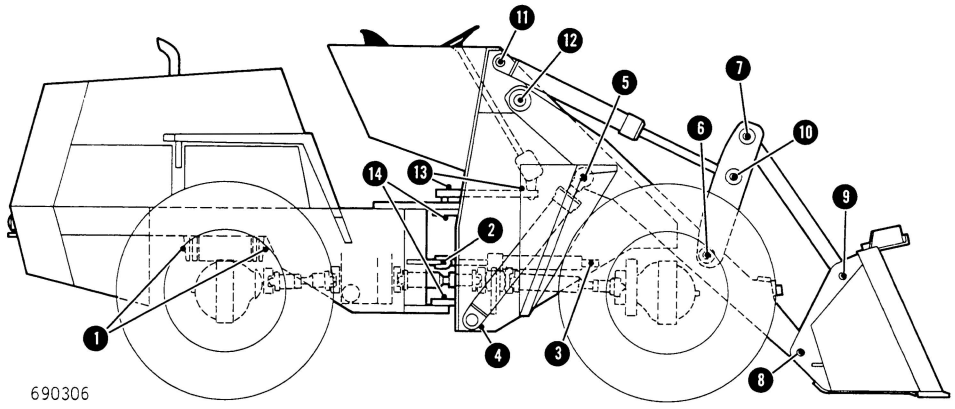

Figure 2

(1.) Rear Axle Mounting Pivot Pins ..... (2) Front and Rear
(2.) Steering Cylinder Rear Pivot ..... (2) 1 Each Side
(3.) Steering Cylinder Front Pivot ..... (2) 1 Each Side
(4.) Lift Cylinder Lower Pivot ..... (2) 1 Each Side
(5.) Lift Cylinder Upper Pivot ..... (2) 1 Each Side
(6.) Bellcrank to Lift Arm ..... (2) 1 Each Side
(7.) Bellcrank to Bucket Control Link ..... (2) 1 Each Side
(8.) Lift Arm to Bucket ..... (2) 1 Each Side
(9.) Bucket Control Link to Bucket ..... (2) 1 Each Side
(10.) Tilt Cylinder to Bellcrank ..... (2) 1 Each Side
(11.) Tilt Cylinder Rear Pivot ..... (4) 2 Each Side
(12.) Lift Arm Upper Pivot ..... (4) 2 Each Arm
2 Inside Operators Compartment
(13.) Pitman Arm Link ..... (2) Front and Rear
(14.) Chassis Center Pivot ..... (2) Upper and Lower

LUBRICANTS

Engine Lubricating Oil

SAE 30 (Service DS, Series 3 and Mil - L - 45199 .....32 and above
SAE 20W (Service DS, Series 3 and Mil - L - 45199..... 10 - 50
SAE 10W (Service DS, Series 3 and Mil - L - 45199..... below 32

NOTE: If the loader is operated during extremely cold weather, it may then be necessary to drain the oil while it is still hot and preheat it to approximately 100° F before pouring it back into the crankcase, just prior to starting.

Transmission and Converter Oil

Use Case Hi-Lo TCH oil.

Hydraulic and Steering System Oil

It is recommended that Case Hi-Lo TCH oil be used. NOTE: An alternate oil may be used. It must be a heavy duty oil that meets American Petroleum Institute Service Designation MS or DG. For temperatures above 32° F. use SAE 10-W. For temperatures below 32° F. use SAE 5-W. If SAE 5-W is not available, Conoco Dexron may be used.

Differentials and Planetaries

For temperatures of 0° F. and above use a Multipurpose Gear Lubricant meeting API service designation API - GL-4, SAE 90 EP.

For temperatures below 0° F. use a Multipurpose Gear Lubricant meeting API service designation API GL-4, SAE 80 EP.

The above lubricants are suitable for use in the steering gear housing.

Grease Fittings

Use a lithium "soap-base" grease of the following grades:

Below 32° F.	#1
32° F. to 90° F.	#2
Above 90° F.	#3

FUEL

Number 2 Diesel Fuel

Case diesel engines are designed to operate most efficiently when using a number 2 Diesel Fuel.

Do not confuse Number 2 Diesel Fuel (ASTM DESIGNATION D975-60T) with Number 2 Furnace Oil (ASTM DESIGNATION D396-60T).

These are specifications for suitable number 2 Diesel fuel.

API Gravity	32 - 39
Pour Point	A Rating 10 Degrees Lower than the Lowest Expected Temperature
Volatility	
Initial Boiling Point (Minimum)	320° F.
50% Condensed	475° - 550° F.
Final Boiling Point (Maximum)	675° F.
Distillation Recovery (Minimum)	97%
Flash Point	Legal Minimum Limit or Higher
SUS Viscosity at 100° Fahrenheit	34 - 39 Seconds
Cetance (Minimum)	45 (45-55 for Winter Use)
Diesel Index	43
Water and Sediment (Maximum)	.05%
Ash (Maximum)	.02%
Total Sulphur (Maximum)	.5%
Conradson Carbon	.2%
Copper Strip Corrosion	Pass
Alkali and Mineral Acid	Neutral

The use of number 1 Diesel Fuel, which is a lighter fuel, may result in a loss of engine power and increased fuel consumption because it has less heat content and a lower viscosity than number 2 Diesel Fuel.

The life of the injection pump may also be affected because of the lack of lubricant in the light number 1 Diesel Fuel.

Approximate Capacities

U. S. MEASURE

Fuel Tank	58 Gallons
Engine Crankcase	
Without Filter Change	12 Quarts
With Filter Change	13 Quarts
Differential Housing	
Front	21 Pints
Rear	22 Pints
Planetary Housings	
Front (Each)	5 Pints
Rear (Each)	3-1/2 Pints
Transmission and Torque Converter	9 Gallons
Cooling System	27 Quarts
Hydraulic Reservoir, Refill	20.8 Gallons
Steering Gear Housing	2.5 Pints

SERVICING AIR CLEANER ELEMENTS

The air cleaner must be serviced when the red band is in full view on the air cleaner service indicator.

PRIMARY FILTER ELEMENT: Washing is the preferred method of cleaning the element as it removes more dust and soot, thus restoring the element to an almost new condition.

Wash the filter in Case Filter Element Cleaner, Part No. A40910. Mix according to instructions on container. Do not use water pressure over 40 PSI at the nozzle. Let the element dry completely before installing. Do not use air pressure to dry the element.

The element can be cleaned with compressed air although it is not recommended because it will not remove carbon and soot. Do not use air pressure in excess of 100 PSI at the nozzle. Place the element on a clean flat surface, then place a cover (wood or metal) with a small opening over the top of the element. Place nozzle in opening in cover. Blow element clean, starting with low air pressure and gradually increasing it.

Inspect the element after it is clean and dry as shown in Figure 3.

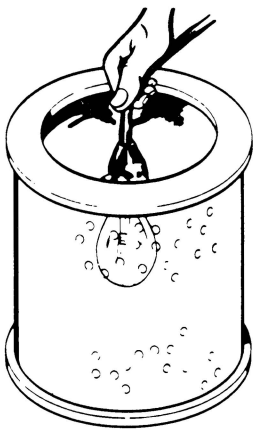

Figure 3

Rotate the filter around the light and check for damage and pin holes. Check the gasket for defects. Inspect the metal covering for dents. Any dent in the covering is a potential puncture, in that the paper element will rub the dent and a hole will result. Elements with holes or indications of fuzz must be replaced. Replace gasket if it is found to be defective. Do not accept a new filter or in-

stall a new or used filter if the metal covering is dented.

The filter should be replaced after it has been cleaned six times or once a year (1000 hours), whichever occurs first. When servicing the air cleaner, make sure all connections are air tight. Air cleaner efficiency is directly dependent upon air tight connections.

SECONDARY FILTER ELEMENT: Cleaning the secondary element is not recommended except in an emergency. If the element is cleaned it should be replaced as soon as possible. Check the secondary element for replacement as follows: Install cleaned or new primary filter element and start engine. Observe air cleaner service indicator. If the red signal is still in full view on the service indicator the secondary filter element must be replaced immediately.

Fuel Shut-Off Adjustment

Refer to Figure 4.

1. Loosen set screw on fuel shut-off arm pivot. The shut-off arm will position itself in the run position when free to move.

2. Push the fuel shut-off handle in until seated against the mounting ferrule. If necessary loosen cable mounting clamps to position cable in shut-off arm pivot.

3. Tighten cable pivot set screw and the cable clamps if loosened.

4. With the engine running, pull the fuel shut-off handle all the way out. The engine should stop if the adjustment is correct.

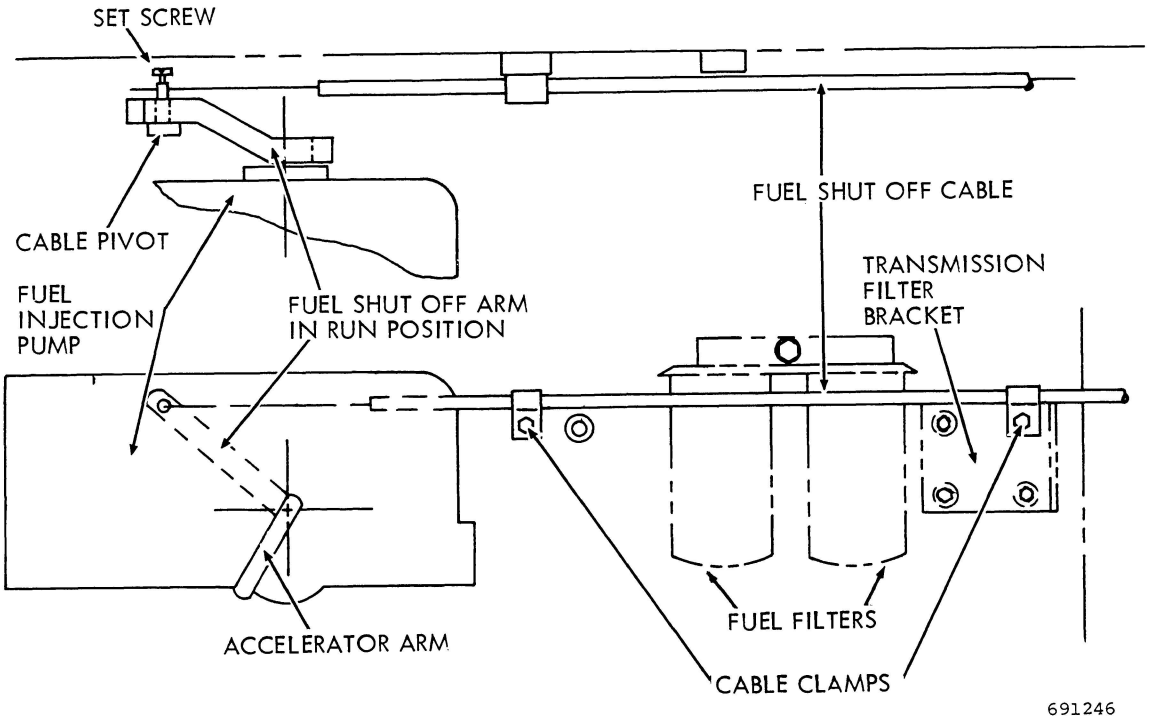

Figure 4

Shift Linkage Routing and Adjustment

Prior to adjusting the linkage make sure the cable is routed as shown in Figure 5. Also make sure clutch cut-out actuating collar at the bottom of the shift lever permits movement to "H" position on the selector and engage the stop.

To adjust the shift linkage proceed as follows:

1. Disconnect shift cable at transmission end and position direction selector on transmission in reverse.

2. Place the shift lever in reverse.

3. Turn the cable eye as necessary to align the hole in the eye with the hole in the cross arm.

4. Start engine and check for proper shifting operation. Readjust as required.

5. Tighten cable eye locknut after final adjustment.

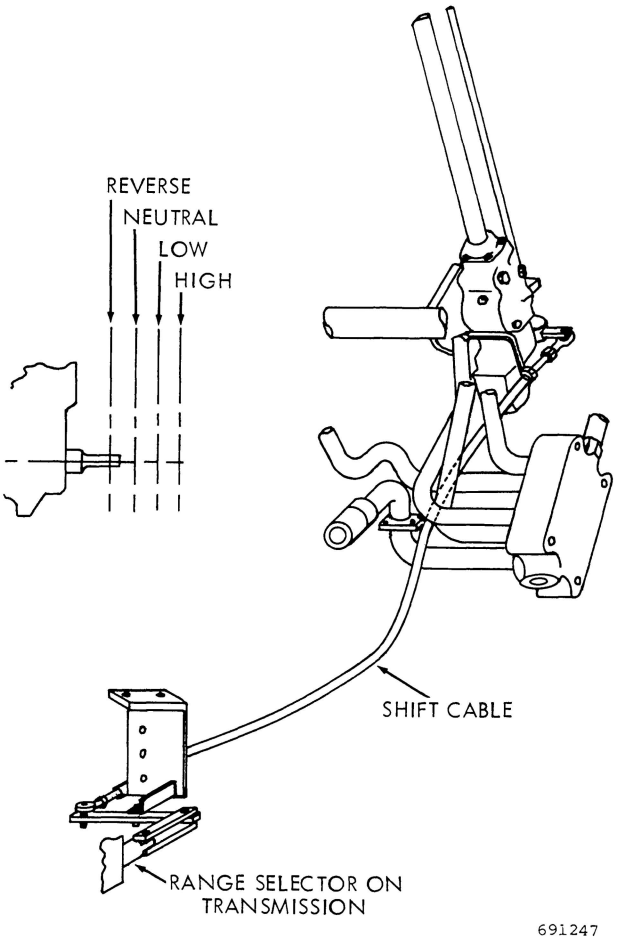

Figure 5

HYDRAULIC AND STEERING SYSTEM

The hydraulic and steering system must be serviced after every 500 hours of operation.

WARNING: This is a pressurized system. Before performing any service on the hydraulic and steering system, close the air valve and loosen dipstick/filler cap slowly to release air pressure. Figure 6.

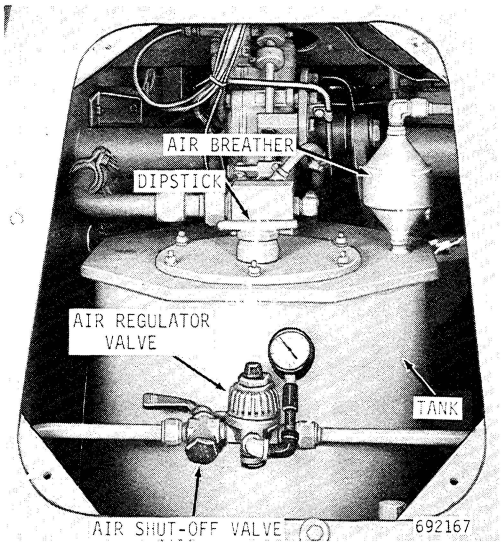

Figure 6

Servicing the Hydraulic Reservoir

AIR BREATHER - To service air breather, disconnect air line from breather and remove breather. Clean breather in cleaning solvent. After the air breather is dry, reinstall breather and connect the air line.

FILTERS - See Figure 7. Make sure air valve to reservoir is closed and air pressure in the reservoir has been released. Remove reservoir top cover and gasket. Discard gasket. Remove the two drain plugs on the bottom of the reservoir. Remove the inlet filter screen and clean in a cleaning solvent. Remove the relief valves that hold the three outlet filter elements. Remove and discard filter elements. Clean inside of reservoir with a lint free cloth.

Install three new outlet filter elements and the relief valves that retain them. Reinstall the cleaned inlet filter screen. Reinstall the two drain plugs. Install new top cover gasket and the top cover, torque nuts to 35-40 foot pounds. Refill reservoir with 20.8 gallons of new Case TCH Oil. Replace "O" ring on dipstick/filler cap and replace dipstick/filler cap to reservoir.

After servicing is completed, open air valve to reservoir and start engine. Do not operate engine over low idle speed until air

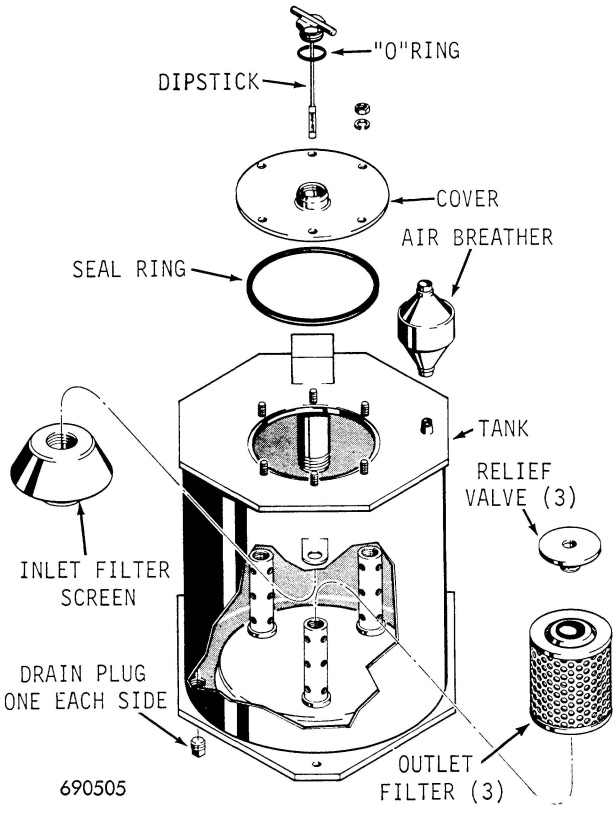

Figure 7

pressure gauge on reservoir registers between 13 and 19 PSI. Operate hydraulic system through complete cycle (raise, dump, retract and lower) and turn steering wheel to extreme right and left. Shut engine off and close air valve. Check oil level with dipstick. Add oil if needed and repeat cycle until oil is at the proper level. Check reservoir oil level after every 60 hours of operation. Do not overfill. The reservoir air pressure gauge should read between 13 and 19 PSI.

TRANSMISSION AND CONVERTER OIL AND FILTER CHANGE

The transmission must be serviced after every 1000 hours of operation or yearly.

TRANSMISSION OIL STRAINER - Figure 8. Remove drain plug and strainer and gasket. Discard gasket. Clean the strainer in cleaning solvent. NOTE: Do not install drain plug and strainer until the oil filter and breather have been serviced. This procedure is recommended to allow maximum oil drainage.

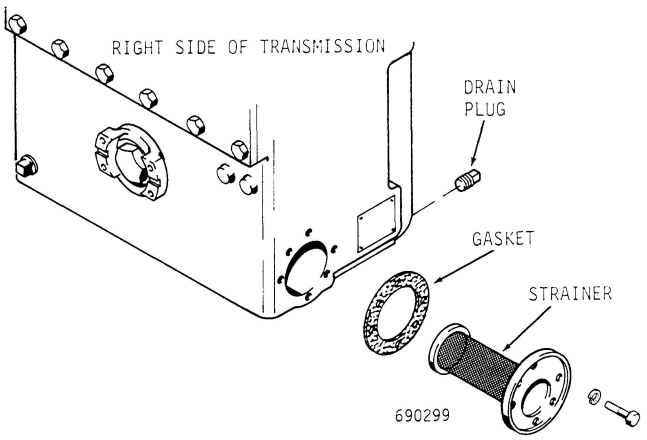

Figure 8

TRANSMISSION BREATHER - Figure 9. Remove breather and clean in cleaning solvent. Reinstall breather. If the breather appears to be damaged it must be replaced.

TRANSMISSION OIL FILTER - Figure 9. To remove the filter element, loosen the cover retaining clamp bolts and remove clamp, cover with relief valve, gasket and filter

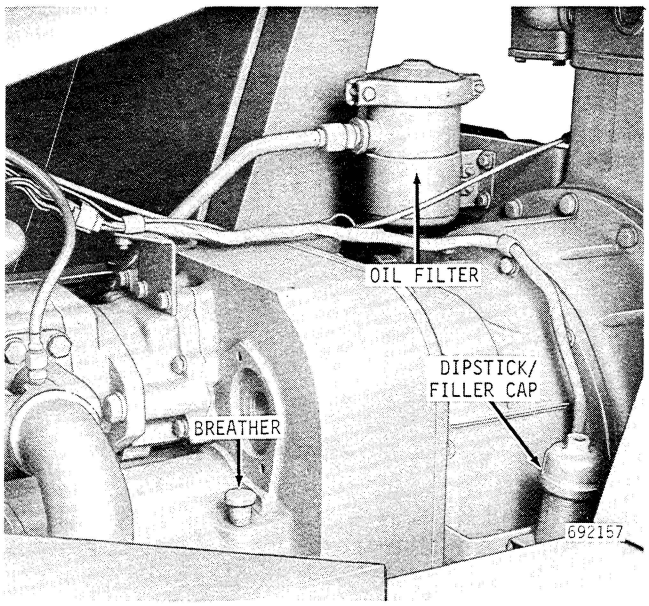

Figure 9

element. Discard gasket and filter element. Remove the remaining oil from the filter case with a hand suction gun. Clean the inside of the filter case with a lint free cloth. Install a new filter element and gasket. Reinstall cover and retaining clamp and tighten.

After servicing the oil filter, reinstall the drain plug and strainer with a new gasket. Fill transmission with 9 gallons of new Case TCH Oil. Start engine and run at idling speed for a few minutes to fully charge the transmission and converter. Check oil level as instructed on page 35 in Transmission Section. Check for oil leaks.

TORQUE SPECIFICATIONS

Grade 5 Capscrews, Nuts, Studs

S.A.E. Grade 5 Bolts (A.S.T.M. A325 and A.S.T.M. A449) are made from quenched and tempered medium carbon steel - Grade 5 bolts are identified by three (3) equally spaced radial lines embossed on the head of the bolt.

Coarse Thread (N.C.) Fine Thread (N.F.)

	Torque (ft. lbs.)		Torque (ft. lbs.)
1/4" - 20 N.C.	5-10	9/16" - 12 N.C.	100-120
1/4" - 28 N.F.	10-15	9/16" - 18 N.F.	110-130
5/16" - 18 N.C.	15-20	5/8" - 11 N.C.	135-165
5/16" - 24 N.F.	15-20	5/8" - 18 N.F.	160-200
3/8" - 16 N.C.	25-35	3/4" - 10 N.C.	235-285
3/8" - 24 N.F.	30-40	3/4" - 16 N.F.	270-330
7/16" - 14 N.C.	45-55	7/8" - 9 N.C.	360-440
7/16" - 20 N.F.	50-60	7/8" - 14 N.F.	395-490
1/2" - 13 N.C.	65-85	1" - 8 N.C.	520-640
1/2" - 20 N.F.	80-100	1" - 12 N.F.	575-705

Grade 8 Capscrews, Nuts, Studs

S.A.E. Grade 8 Bolts (A.S.T.M. A354, Grade BD), are made from quenched and tempered medium carbon alloy steel. Grade 8 Bolts are identified by six (6) equally spaced radial lines embossed on the head of the bolt.

Coarse Thread (N.C.) Fine Thread (N.F.)

	Torque (ft. lbs.)		Torque (ft. lbs.)
1/4" - 20 N.C.	10-15	9/16" - 12 N.C.	135-165
1/4" - 28 N.F.	15-20	9/16" - 18 N.F.	155-190
5/16" - 18 N.C.	20-30	5/8" - 11 N.C.	200-240
5/16" - 24 N.F.	25-30	5/8" - 18 N.F.	215-265
3/8" - 16 N.C.	40-50	3/4" - 10 N.C.	340-420
3/8" - 24 N.F.	45-55	3/4" - 16 N.F.	380-460
7/16" - 14 N.C.	60-80	7/8" - 9 N.C.	540-660
7/16" - 20 N.F.	70-90	7/8" - 14 N.F.	595-725
1/2" - 13 N.C.	100-120	1" - 8 N.C.	810-990
1/2" - 20 N.F.	110-130	1" - 12 N.F.	900-1100

TORQUES FOR HYDRAULIC FITTINGS

The following are torque specifications for installation of 37° flare female swivel fittings, straight thread "O" ring boss fittings, and the locking nut on adjustable style "O" ring fittings. These torque values apply to steel fittings only.

Dash Size	Tube O.D. (Ref.)	Thread Size	37° Flare Female Swivel Ft. Lbs. Torque	Straight Thd. "O" Ring Ft. Lbs. Torque
4	1/4	7/16-20	6-12	12-19
5	5/16	1/2-20	8-16	16-25
6	3/8	9/16-18	10-25	25-40
8	1/2	3/4-16	15-42	42-67
10	5/8	7/8-14	25-58	58-92
12	3/4	1-1/16-12	40-80	80-128
14	7/8	1-3/16-12	60-100	100-160
16	1	1-5/16-12	75-117	117-187

Section
1020

DETAILED SPECIFICATIONS

504BD ENGINE

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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CASE CORPORATION

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RUN-IN-INSTRUCTIONS

Engine Lubrication

When the engine rebuild is complete, fill the engine crankcase with Case HDM oil and install new engine oil filters. **NOTE:** If Case HDM oil is not used, use only a Series 3 DS or CD Service Classification oil that has the proper viscosity rating for prevailing air temperature. Refer to vehicle Operators Manual.

After the first 20 hours of operation, change the engine oil while the engine is hot and replace the the engine oil filter/s. DO NOT DRAIN OIL UNTIL THE ENGINE HAS BEEN OPERATED 20 HOURS.

Change the engine oil and filter/s at the recommended intervals thereafter as outlined in the Operator's Manual.

Break-In Procedure for Rebuilt Engines (With a Dynamometer)

The following procedure must be implemented when using a PTO dynamometer to break-in the engine. The dynamometer will insure control of the engine load at each speed and will eliminate over stressing new parts during break-in.

During the break-in, continually check the oil pressure, coolant level, and coolant temperature.

STEP	TIME	ENGINE SPEED	DYNAMOMETER SCALE LOAD*
1	**10 Minutes	1000 RPM	None
2	**10 Minutes	1800 RPM	None
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	Retorque the cylinder head bolts using the procedure described in Section 2015 of this service manual.		

*Based upon normal dynamometer scale load at rated speed for the particular vehicle model. Reduce this scale load as indicated.

**The most ideal break-in procedure would be to constantly vary the throttle between 750 to 1000 RPM for the first 10 minutes and from 1000 RPM to 1800 RPM for the next 10 minutes. The purpose of this changing RPM is to vary the lubrication and coolant flow.

***30 minutes at 3/4 load is a minimum amount of time the engine should be run. It is recommended that whenever possible the engine (especially turbocharged diesels) should 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.

Break-In Procedure for Rebuilt Engines (Without a Dynamometer)

STEP	TIME	ENGINE SPEED	LOAD
1	*10 Minutes	1000 RPM	None
2	*10 Minutes	1800 RPM	None
3	30 Minutes	2/3 Rated RPM	Light Load
4	1 Hour	Full RPM (not over 2000 RPM)	80 to 90%
5	Retorque the cylinder head bolts using the procedure described in Section 2015 of this service manual.		

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

Run-In Procedure (Agricultural Tractors)

For the first 8 hours of field operation stay one gear lower than normal. For the next 12 hours DO NOT "lug" the engine. Prevent "lugging" by shifting to a lower gear. The engine must not be "lugged" below its Rated Engine RPM during the early hours of life.

Run-In Procedure (Construction Equipment)

For the first 8 hours, operate the engine at full throttle maintaining a normal load. DO NOT baby the engine, but avoid prolonged converter or hydraulic stall. Engine must not be "lugged" below its Rated Engine RPM (Do not exceed 10 seconds of stall).

Run-In Procedure (Power Units)

For the first 1/2 hour, operate engine at 2/3 rated RPM with a light load or no load. For the next (1) hour, run engine at 80 to 90% load at rated RPM (but not over 2000 RPM). Then full load and rated RPM as required in application.

DETAILED ENGINE SPECIFICATIONS

Cylinder Sleeves

	Decimal System	Metric System
I.D. of sleeve including wear	4.6250 to 4.6333″	117.475 to 117.7163mm
Sleeve out of round (installed in block)	.001″	.025mm
Maximum Limit including wear	.002″	.0508mm
Taper (installed in block)	.001″	.0254mm
Maximum limit including wear	.007″	.1778mm
Clearance to bottom of piston skirt, 90° to piston pin including wear	.0052 to .0175″	.1321 to .445mm

Piston

Type	Cam ground	
Material	Aluminum Alloy	
O.D. at bottom of skirt, 90° to piston pin including wear	4.6178 to 4.6198″	117.2921 to 117.3429mm
I.D. of piston pin bore including wear	1.8001 to 1.8015″	45.7225 to 45.7581mm
Width of 3rd ring groove including wear	.2505 to .2535″	6.3627 to 6.4389mm

Piston Rings

No. 1 Compression (chrome)	Keystone	
End gap in 4.625 I.D. (117.475 I.D.) sleeve including wear	.017 to .036″	.432 to .914mm
No. 2 Compression	Square Section	
End gap in 4.625 I.D. (117.475mm I.D.) sleeve including wear	.013 to .033″	.330 to .838mm

Oil Ring

Width	.2485 to .2490″	6.3119 to 6.3246mm
End gap in 4.625 I.D. (117.475mm I.D.) sleeve	.013 to .038″	.330 to .838mm
Side clearance including wear	.001 to .005″	.025 to .127mm

Piston Pin

Type	Full Floating	
O.D. of pin	1.7994 to 1.7996″	45.7052 to 45.7102mm
Fit in piston	.0005 to .0011″	.0127 to .0279mm
Fit in rod bushing	.0008 to .0014″	.0203 to .0356mm

Connecting Rod

	Decimal System	Metric System
Bushing	Replaceable	
Bushing I.D. installed (ream to size)	1.8004 to 1.8008″	45.7302 to 45.7403mm
Maximum limit including wear	1.8018″	45.7657mm
Bushing out of round including wear	.0015″	.0377mm
Bearing liners	Replaceable	
Bearing liner width	1.586 to 1.596″	40.284 to 40.538mm
Journal I.D. without bearing liners	3.1503 to 3.1513″	80.0176 to 80.0426mm
Bearing oil clearance including wear	.0013 to .005″	.0326 to .127mm
Undersize bearings for service	.002,.010,.020,.030″	.051,.254,.508,.762mm
Side clearance	.007 to .016″	.178 to .406mm
Cap bolts	12 point flange head	

Crankshaft

Type	Balanced	
Main bearing liners	Replaceable	
End play, No. 5 main bearing cap including wear	.003 to .020″	.076 to .508mm
Thrust bearings std. thickness including wear	.147 to .157″	3.734 to 3.988mm
Thrust bearings oversize thickness for service including wear	.153 to .163″	3.886 to 4.140mm
Connecting rod journal std. O.D.	2.998 to 2.999″	76.149 to 76.175mm
.010″ (.254mm) O.D. undersize, grind to	2.988 to 2.989″	75.895 to 75.921mm
.020″ (.508mm) O.D. undersize, grind to	2.978 to 2.979″	75.641 to 75.667mm
.030″ (.762mm) O.D. undersize, grind to	2.968 to 2.969″	75.387 to 75.413mm
Connecting rod journal maximum taper including wear	.0015″	.0377mm
Journals out of round	.0005″	.0127mm
Main bearing liner width 1st, 3rd, 5th and 7th	2.1515 to 2.1615″	54.6477 to 54.9017mm
Main bearing liner width 2nd, 4th and 6th	1.214 to 1.224″	30.836 to 31.09mm
Undersize main bearing liners for service	.002,.010,.020,.030″	.051,.254,.508,.762mm
Main bearing oil clearance including wear	.0016 to .006″	.0402 to .152mm
Main bearing journal std. O.D.	3.498 to 3.499″	88.849 to 88.875mm
.010″ (.254mm) O.D. undersize, grind to	3.488 to 3.489″	88.595 to 88.621mm
.020″ (.508mm) O.D. undersize, grind to	3.478 to 3.479″	88.341 to 88.367mm
.030″ (.762mm) O.D. undersize, grind to	3.468 to 3.469″	88.087 to 88.113mm
Main journal bore I.D. without liners	3.691 to 3.692″	93.751 to 93.777mm

Crankshaft (Cont'd)

	Decimal System	Metric System
Main journal width between cheeks:		
2nd, 4th and 6th	1.618 to 1.633″	41.097 to 41.478mm
3rd	2.555 to 2.570″	64.897 to 65.278mm
5th	2.561 to 2.565″	65.049 to 65.151mm
7th	2.585 to 2.600″	65.659 to 66.040mm
Connecting rod journals width between cheeks	1.9775 to 2.0025″	50.2287 to 50.8637mm

Camshaft

Type	Parabolic	
Bushings	5, Replaceable	
Bushing Lubrication	Pressurized	
Oil clearance including wear	.0014 to .0124″	.0352 to .3150mm
I.D. of bushing including wear	2.2484 to 2.2554″	57.1092 to 57.2872mm
Bushing width:		
1st (front)	1.646 to 1.666″	41.808 to 42.316mm
2nd, 3rd and 4th	1.4275 to 1.4475″	36.2587 to 36.7667mm
5th	1.1462 to 1.1662″	29.1131 to 29.6211mm
O.D. of each bearing surface including wear	2.242 to 2.247″	56.947 to 57.074mm
Thrust washer thickness including wear	.1105 to .1275″	2.8067 to 3.2385mm
Thrust plunger spring:		
Free length	3.625″	92.075mm
O.D. of spring	.3912 to .4062″	9.9361 to 10.317mm
Compressed 2.750″ (69.85mm)	45 to 55 lbs.	20.37 kg. to 24.97 kg.

Valve Push Rod Lifters

Type	Mushroom	
O.D. of lifter stem, standard	.8097 to .8102″	20.5668 to 20.5791mm
O.D. of lifter stem, oversize for service	.8190 to .8195″	20.803 to 20.8157mm
I.D. of block bore, std. including wear	.8115 to .8145″	20.6117 to 20.6883mm
I.D. of block bore, oversize for service	.8215 to .8225″	20.8657 to 20.8917mm

Gear Train

	Decimal System	Metric System
Backlash:		
Crankshaft gear to camshaft gear	.004 to .011″	.102 to .279mm
Idler drive gear to idler gear	.003 to .010″	.076 to .254mm
Idler gear to fuel pump gear	.004 to .012″	.102 to .305mm
Crankshaft gear to oil pump gear	.006 to .011″	.152 to .279mm
Crankshaft gear to fuel pump gear	Maximum .027″	Maximum .686mm
O.D. of idler gear shaft including wear	1.732 to 1.733″	43.993 to 44.019mm
I.D. of idler gear with bushing including wear	1.7345 to 1.740″	44.0567 to 44.196mm
Idler gear thrust washer thickness	.057 to .063″	1.448 to 1.600mm
Idler gear end play (maximum limit including wear)	.010″	.254mm

Oil Pump

Postive displacement	Gear Type	
Backlash, pump gear to crankshaft gear	.006 to .011″	.152 to .279mm
Drive gear to pump body clearance	.0035 to .0065″	.0889 to .1651mm
Pump gears to body radial clearance including wear	.003 to .009″	.0760 to .229mm
Pump gears to pump cover clearance including wear	.0015 to .008″	.0377 to .203mm
Oil pressure	45 to 60 PSI	3.164 to 4.218 kg/cm^2
Relief valve spring:		
No. coils	12	
Wire thickness	.071″	1.803mm
Minimum I.D.	.469″	11.913mm
Free length	2.06″	52.32mm
Compressed 1.252″ (31.801mm)	17.25 to 19 lbs.	7.84 to 8.62 kg

Cylinder Head

Warpage	(Max. Limit Incl. wear) .005″	0.127mm

Intake Valve

Tappet clearance (COLD and HOT)	.015″	3.81mm
Face angle	44^0	44^0
Face run-out (max. limit Incl. wear)	.002″	.051mm
Length	6.4195 to 6.4405″	163.0557 to 163.5887mm
O.D. of stem including wear	.400 to .403″	10.160 to 10.236mm
O.D. of head	1.995 to 2.005″	50.673 to 50.927mm
Seat angle	45^0	45^0

Intake Valve (Cont'd)

	Decimal System	Metric System
Seat contact width	.0775 to .0975″	1.9685 to 2.4511mm
Seat run-out (max. limit Incl. wear)	.002″	.051mm
Insert height	.2775 to .2825″	7.0485 to 7.1755
O.D. of insert	2.0990 to 2.1000″	53.315 to 53.34mm
I.D. of insert	1.805 to 1.815″	45.847 to 46.101mm

Exhaust Valve

Tappet clearance (COLD)	.025″	.635mm
Tappet clearance (HOT)	.020″	.508mm
Face angle	44°	44°
Fan run-out	(Max. Limit Incl. wear) .002″	.051mm
O.D. of head	1.745 to 1.755″	44.323 to 44.577mm
O.D. of stem end including wear	.400 to .403″	10.160 to 10.236mm
O.D. of taper 4.2675″ (108.3947mm) including wear	.399 to .402″	10.135 to 10.211mm
Length	6.4195 to 6.4405″	163.0557 to 163.5887mm
Insert seat angle	45°	45°
Seat contact width	.0800 to .1000″	2.032 to 2.540mm
Seat run-out (max. limit Incl. wear)	.002″	.051mm
Insert height	.313 to .316″	7.95 to 8.026mm
O.D. of insert	1.9455 to 1.9465″	49.4157 to 49.4407mm
I.D. of insert	1.571 to 1.577″	39.903 to 40.056mm

Intake and Exhaust Valve Guides

Length	3.219″	81.763mm
O.D.	.7510 to .7515″	19.075 to 19.202mm
I.D. (installed and reamed)	.4045 to .4055″	10.2747 to 10.2997mm
Maximum limit including wear	.4065″	10.3251mm
Protrusion above cylinder head	.953″	24.206mm

Valve Spring

Free length	2.28″	57.912mm
Total coils	7.75	
Wire diameter	.171″	4.343mm
Compressed to 1.48″ (30.480mm) (valve open)	135 to 145 lbs.	61.24 to 65.78 kg.
Compressed to 1.94″ (49.276mm) (valve closed)	40 to 50 lbs.	18.14 to 22.68 kg.

Rocker Arm Assembly

	Decimal System	Metric System
O.D. of shaft	.872 to .873"	22.149 to 22.174mm
I.D. of arm bore	.8745 to .8755"	22.2127 to 22.2377mm
Shaft assembly end play (both ends)	.010 to .030"	.254 to .762mm
Shaft spring:		
Total coils (working coils)	4	
Wire diameter	.080"	2.033mm
Compressed to 1.562" (39.675mm)	8.5 to 11.5 lbs.	3.86 to 5.22 kg.
Lubrication	Engine oil, camshaft metering	
Shaft oil holes	Toward valve side of engine. Shaft cannot be rotated.	

SPECIAL TORQUES

	Decimal System	Metric System
Camshaft nut	95 to 105 ft. lbs.	13.134 to 14.517m-kg.
Connecting rod bolts	95 to 105 ft. lbs.	13.134 to 14.517m-kg.
Crankshaft nut	125 to 135 ft. lbs.	17.3 to 18.7 m-kg.
Crankshaft pulley bolt	100 to 110 ft. lbs.	13.825 to 15.208m-kg.
Cylinder block oil cooler outlet cover screw	35 to 42 ft. lbs.	4.8 to 5.8m-kg.
Cylinder head bolts	200 to 210 ft. lbs.	27.660 to 29.043m-kg.
Cylinder head cover stud nut	60 to 70 in. lbs.	691.3 to 806.5mm-kg.
Engine oil filter	Install until gasket contacts filter head then hand tighten 1/2 turn. Loosen filter approximately 1 full turn and retighten until gasket contact is made, then hand tighten an additional 1/2 to 3/4 turn.	
Flywheel to crankshaft bolts	180 to 190 ft. lbs.	24.886 to 26.268m-kg.
Intake and Exhaust manifold stud nut	25 to 30 ft. lbs.	3.4 to 4.2m-kg.
Oil pan capscrews	13 to 17 ft. lbs.	1.797 to 2.350m-kg.
Oil pan drain plug (copper or nylon)	18 to 20 ft. lbs.	2.5 to 2.9m-kg.
Oil pump idler gear shaft bolt	40 to 45 ft. lbs.	5.5 to 6.2m-kg.
Oil pump suction tube nut	95 to 105 ft. lbs.	13.134 to 14.517m-kg.
Rocker arm adjusting screw locknut	20 to 25 ft. lbs.	2.8 to 3.5m-kg.
Rocker arm bracket stud nut and bolt	40 to 45 ft. lbs.	5.5 to 6.2m-kg.
Water pump and fan shaft nut	60 to 70 ft. lbs.	8.3 to 9.7m-kg.
Crankshaft main bearing bolts	145 to 155 ft. lbs.	20 to 21.4m-kg.

GENERAL TORQUE SPECIFICATION TABLE (Revised 7-72)

USE THE FOLLOWING TORQUES WHEN SPECIAL TORQUES ARE NOT GIVEN

NOTE: These values apply to fasteners as received from supplier, dry, or when lubricated with normal engine oil. They do not apply if special graphited or moly-disulphide greases or other extreme pressure lubricants are used. This applies to both UNF and UNC threads.

SAE Grade No.		5				8 ★			
Bolt head identification marks as per grade NOTE: Manufacturing Marks Will Vary									
Bolt Size		Torque				Torque			
		Foot Pounds		Meter Kilograms		Foot Pounds		Meter Kilograms	
Inches	Millimeters	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1/4	6.35	9	11	1.2	1.5	12	15	1.7	2.1
5/16	7.94	17	20.5	2.4	2.8	24	29	2.3	4.0
3/8	9.53	35	42	4.8	5.8	45	54	6.2	7.5
7/16	11.11	54	64	7.5	8.9	70	84	9.7	11.6
1/2	12.70	80	96	11.1	13.3	110	132	15.2	18.3
9/16	14.29	110	132	15.2	18.3	160	192	22.1	26.6
5/8	15.88	150	180	20.7	24.9	220	264	30.4	36.5
3/4	19.05	270	324	37.3	44.8	380	456	52.6	63.1
7/8	22.23	400	480	55.3	66.4	600	720	83.0	99.6
1	25.40	580	696	80.2	96.3	900	1080	124.5	149.4
1-1/8	25.58	800	880	110.6	121.7	1280	1440	177.0	199.2
1-1/4	31.75	1120	1240	154.9	171.5	1820	2000	251.7	276.6
1-3/8	34.93	1460	1680	201.9	232.3	2380	2720	329.2	376.2
1-1/2	38.10	1940	2200	268.3	304.3	3160	3560	437.0	492.3

★ Thick nuts must be used with Grade 8 bolts