

John Deere K Series Air-Cooled Engines

**John Deere Horicon Works
CTM5 (20OCT92)**

LITHO IN U.S.A.
ENGLISH

Introduction

FOREWORD

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the General Information Section of this manual and the cautions presented throughout the text of the manual.



This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

Use this component technical manual in conjunction with the machine technical manual. An application listing in the beginning of each section identifies product-model/component type-model relationship. See the machine technical manual for information on component removal and installation, and gaining access to the components.

Information is organized in groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, other materials needed to do the job, and service parts kits.

Group 00, in the beginning of each section—Repair Specifications, consist of all applicable specifications, wear tolerances and specific torque values for various components on each engine.

Binders, binder labels, and tab sets can be ordered by John Deere dealers direct from the John Deere Distribution Service Center.

This manual is part of a total product support program.

FOS MANUALS—REFERENCE

TECHNICAL MANUALS—MACHINE SERVICE

COMPONENT MANUALS—COMPONENT SERVICE

Fundamentals of Service (FOS) Manuals cover basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic type of failures and their causes. FOS Manuals are for training new personnel and for reference by experienced technicians.

Technical Manuals are concise guides for specific machines. Technical manuals are on-the-job guides containing only the vital information needed for diagnosis, analysis, testing, and repair.

Component Technical Manuals are concise service guides for specific components. Component technical manuals are written as stand-alone manuals covering multiple machine applications.

Dealer Presentation Sheet

JOHN DEERE DEALERS

This is a complete revision to CTM5.

Discard your old CTM5, dated 26 JUN 91.

New information added to this manual includes:

1. The basic engine specifications have been updated to include the new FC400V, 12.5 hp engine.

2. The engine applications charts have been updated to include the new products introduced in 1992:

- 14ST and 14PT 21-Inch Walk-Behind Mowers
- 38-Inch Walk-Behind Commercial Mower
- GX95 Riding Mower
- 245 Lawn and Garden Tractor
- GT242 Lawn and Garden Tractor
- Gator 4 X 2

MX,CTM5,DPS -19-21OCT92

Contents

SECTION 10—GENERAL INFORMATION

- Group 05—Safety
- Group 10—General Specifications
- Group 15—Serial Number Locations
- Group 20—Features

SECTION 20—FA130D and FA210D

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems—FA130D
- Group 06—Fuel and Air Systems—FA210D
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems—FA130D
- Group 31—Starting Systems—FA210D

SECTION 21—FA210V

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 25—FG150G/FG150D

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 30—FC150V

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head and Valves
- Group 20—Cylinder Block and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 35—KF82D/FZ340D

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 40—FC290V/FC400V/FC420V/FC540V

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head and Valves
- Group 20—Cylinder Block and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 45—FE290D and FE290R

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head and Valves
- Group 20—Cylinder Block and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

Continued on next page

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

CTM5-19-20OCT92

COPYRIGHT© 1992
DEERE & COMPANY
Moline, Illinois

All rights reserved

A John Deere ILLUSTRATION™ Manual
Previous Editions

Copyright 1991, 1989, 1988, 1987 Deere & Company

SECTION 50—FB460V

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 100—COMPONENT ANALYSIS AND GENERAL REPAIR

- Group 05—Valves
- Group 10—Piston, Piston Rings, Crankshaft and Connecting Rod
- Group 15—Cylinder Block

Index

Contents

SECTION 10—GENERAL INFORMATION

- Group 05—Safety
- Group 10—General Specifications
- Group 15—Serial Number Locations
- Group 20—Features

SECTION 20—FA130D and FA210D

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems—FA130D
- Group 06—Fuel and Air Systems—FA210D
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems—FA130D
- Group 31—Starting Systems—FA210D

SECTION 21—FA210V

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 25—FG150G/FG150D

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 30—FC150V

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head and Valves
- Group 20—Cylinder Block and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 35—KF82D/FZ340D

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 40—FC290V/FC400V/FC420V/FC540V

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head and Valves
- Group 20—Cylinder Block and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 45—FE290D and FE290R

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head and Valves
- Group 20—Cylinder Block and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

Continued on next page

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

CTM5-19-20OCT92

COPYRIGHT© 1992
DEERE & COMPANY
Moline, Illinois

All rights reserved

A John Deere ILLUSTRATION™ Manual
Previous Editions

Copyright 1991, 1989, 1988, 1987 Deere & Company

SECTION 50—FB460V

- Group 00—Engine Application and Repair Specifications
- Group 05—Fuel and Air Systems
- Group 10—Blower Housing and Flywheel
- Group 15—Cylinder Head
- Group 20—Cylinder Block, Valves and Internal Components
- Group 25—Ignition and Charging System
- Group 30—Starting Systems

SECTION 100—COMPONENT ANALYSIS AND GENERAL REPAIR

- Group 05—Valves
- Group 10—Piston, Piston Rings, Crankshaft and Connecting Rod
- Group 15—Cylinder Block

Index

Section 10 GENERAL INFORMATION

Contents

Page

Group 05—Safety 10-05-1

Group 10—General Specifications

Basic Engine Specifications 10-10-1

Basic Engine Applications Chart 10-10-2

Metric Bolt and Cap Screw Torque
Values 10-10-4

Group 15—Serial Number Locations

Serial Number Location

Engine 10-15-2

Carburetor 10-15-5

Group 20—Features

Engine Features

FA130D 10-20-1

FA210D 10-20-1

FA210V 10-20-2

FG150G/FG150D 10-20-2

FC150V 10-20-3

KF82D/FZ340D 10-20-3

FC290V 10-20-4

FC400V 10-20-4

FC420V 10-20-5

FC540V 10-20-5

FE290D/FE290R 10-20-6

FB460V 10-20-6

RECOGNIZE SAFETY INFORMATION

This is the safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.



DX,ALERT -19-04JUN90

10
05
1
-UN-07DEC88
T81389

UNDERSTAND SIGNAL WORDS

A signal word—DANGER, WARNING, or CAUTION—is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.



DX,SIGNAL -19-09JAN92

-19-30SEP88
TS187

HANDLE FLUIDS SAFELY—AVOID FIRES

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.



DX,FLAME -19-04JUN90

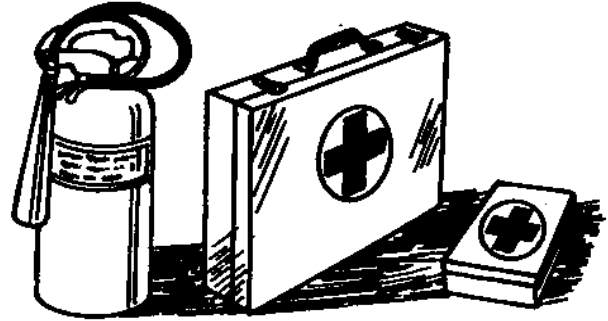
-UN-23AUG88
TS227

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



DX,FIRE2 -19-04JUN90

TS291 -UN-23AUG88

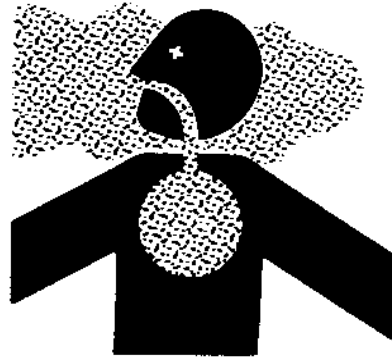
AVOID HARMFUL ASBESTOS DUST

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos.

Keep bystanders away from the area.



DX,DUST -19-15MAR91

TS220 -UN-23AUG88

USE PROPER TOOLS

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.



DX,REPAIR -19-04JUN90

TS779 -UN-08NOV89

DISPOSE OF WASTE PROPERLY

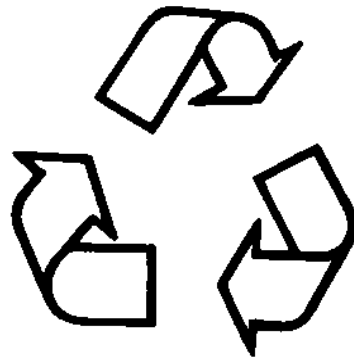
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.



DX,DRAIN -19-09AUG91

TS1133 -UN-26NOV90

10
05
4

BASIC ENGINE SPECIFICATIONS

ENGINE	FA130D	FG150D/ FG150G	FC150V	FA210D	FA210V	KF82D/ FZ340D
CYLINDER	1	1	1	1	1	1
CYCLE	4	4	4	4	4	4
BORE	62 mm (2.44 in.)	64 mm (2.51 in.)	65 mm (2.56 in.)	72 mm (2.83 in.)	72 mm (2.83 in.)	80 mm (3.15 in.)
STROKE	43 mm (1.69 in.)	47 mm (1.85 in.)	46 mm (1.81 in.)	51 mm (2.01 in.)	51 mm (2.01 in.)	68 mm (2.68 in.)
DISPLACE- MENT	129 cm ³ (7.92 cu. in.)	151 cm ³ (9.21 cu. in.)	153 cm ³ (9.30 cu. in.)	207 cm ³ (12.7 cu. in.)	207 cm ³ (12.7 cu. in.)	341 cm ³ (20.9 cu. in.)
HORSE- POWER	2.3 kW (3.1 HP)	2.7 kW (3.6 HP)	3.4 kW (4.5 HP)	3.9 kW (5.2 HP)	4.5 kW (6 HP)	6.3 kW (8.5 HP)
ENGINE	FC290V	FE290D/ FE290R	FB460V	FC400V	FC420V	FC540V
CYLINDER	1	1	1	1	1	1
CYCLE	4	4	4	4	4	4
BORE	78 mm (3.07 in.)	78 mm (3.07 in.)	89 mm (3.50 in.)	87 mm (3.43 in.)	89 mm (3.50 in.)	89 mm (3.50 in.)
STROKE	60 mm (2.36 in.)	60 mm (2.36 in.)	74 mm (2.91 in.)	68 mm (2.68 in.)	68 mm (2.68 in.)	86 mm (3.39 in.)
DISPLACE- MENT	286 cm ³ (17.5 cu. in.)	286 cm ³ (17.5 cu. in.)	460 cm ³ (28.1 cu. in.)	400 cm ³ (24.4 cu. in.)	423 cm ³ (25.8 cu. in.)	535 cm ³ (32.6 cu. in.)
HORSE- POWER	6.7 kW (9 HP)	7.5 kW (10 HP)	9.3 kW (12.5 HP)	9.3 kW (12.5 HP)	10.4 kW (14 HP)	12.7 kW (17 HP)

MX,1010A1,A1 -19-21OCT92

BASIC ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

WALK-BEHIND PRODUCTS

Machine	Engine Model No.
20SR7 Reel Mower	FA130D
3K Lawn Edger	FA130D
E35 Lawn Edger	FA130D
14PB 21-Inch Rear Discharge Mower	FC150V
14SB 21-Inch Rear Discharge Mower	FC150V
14SE 21-Inch Rear Discharge Mower	FC150V
14SC 21-Inch Rear Discharge Mower	FC150V
14ST 21-Inch Rear Discharge Mower	FC150V
14PT 21-Inch Rear Discharge Mower	FC150V
32/36/48/52-Inch Commercial Mower	FB460V
48/52-Inch Commercial Mower	FC540V
48/54-Inch Commercial Mower	FC420V or FC540V
38-Inch Commercial Mower	FC400V

RIDING MOWERS

Machine	Engine Model No.
RX63	FA210V
RX73	FC290V
RX75	FC290V
RX95	FB460V
SX75	FC290V
SX95	FB460V
GX70	FC290V
GX75	FC290V
SRX75	FC290V
SRX95	FB460V
GX95	FB460V

LAWN TRACTORS

Machine	Engine Model No.
112L	FB460V
130	FC290V
160	FB460V
165	FB460V
170	FC420V
175	FC420V
180	FC540V
185	FC540V
LX172	FC420V
LX176	FC420V
LX186	FC540V

MX,1010A1,A2 -19-21OCT92

**BASIC ENGINE APPLICATIONS
CHART—CONTINUED****LAWN AND GARDEN TRACTORS**

Machine	Engine Model No.
240	FC420V
245	FC420V
260	FC540V
265	FC540V
GT262	FC540V
GT242	FC420V

FRONT MOWERS

Machine	Engine Model No.
F710	FC540V

GOLF AND TURF EQUIPMENT

Machine	Engine Model No.
22 Greensmower	FG150G
22R Greensmower	FG150D
519 Walk-Behind Vertical Mower	FA210D
529 Vacuum Blower	FA210D
1200 Bunker and Field Rake	FE290R












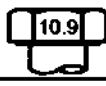


















MISCELLANEOUS

Machine	Engine Model No.
1000 Generator	FA130D
1400 Generator	FA130D
Power Pak Material Collection System	FA210D

UTILITY VEHICLES

Machine	Engine Model No.
AMT600	KF82D/FZ340D
AMT622	FE290D
AMT626	FE290D
Gator 4x2	FE290D

METRIC BOLT AND CAP SCREW TORQUE VALUES

Property Class and Head Markings	4.8	8.8	9.8	10.9	12.9
	  	  	  	  	  
Property Class and Nut Markings	5	10	10	10	12
	  	  	  	  	  

Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a	
	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	225	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

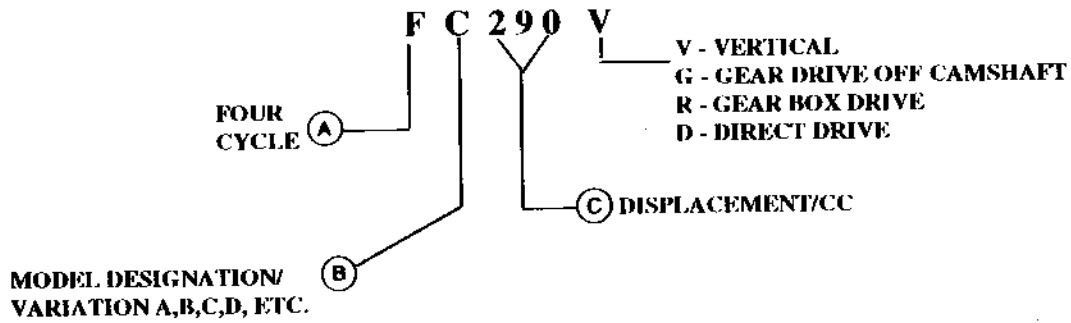
^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

ENGINE DESIGNATION (KAWASAKI)

KAWASAKI ENGINE DESIGNATION



M46856

A—Four Cycle
B—Model Designation

C—Displacement
D—Direct Drive

R—Gear Box Drive
G—Gear Drive Off Camshaft

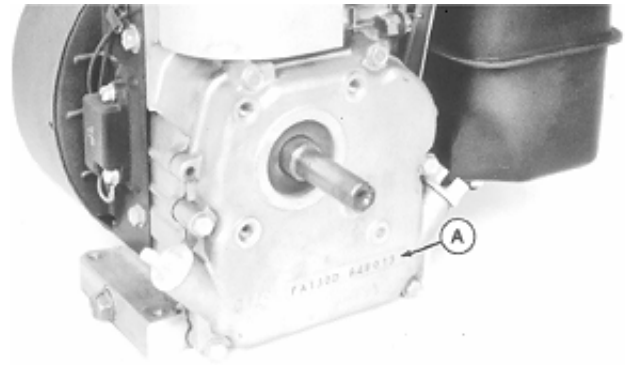
V—Vertical

MX1020A1,A12 -19-21OCT92

M46856 -19-15OCT92

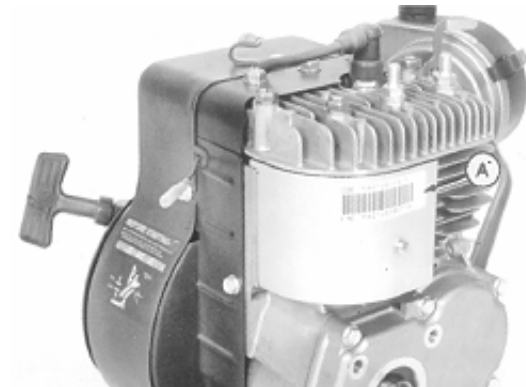
ENGINE SERIAL NUMBER LOCATION

The complete serial number (A) is used to identify the engine model, series, configuration, and serial number range. Have this number available when referring to a particular engine or requesting parts or service information.



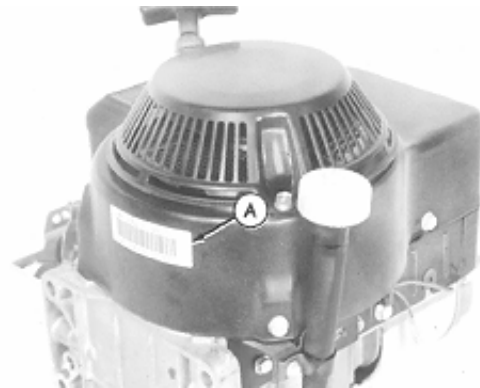
FA130D

M80492 -UN-07JUN91



FA210D

M80493 -UN-07JUN91



FA210V

M80494 -UN-07JUN91



FG150D/FG150G

M80495 -UN-07JUN91

MX,1015A1,A1 -19-21OCT92

SERIAL NUMBER LOCATION—CONTINUED

A—Serial Number Location



FC150V



KF82D/FZ340D



FC290V

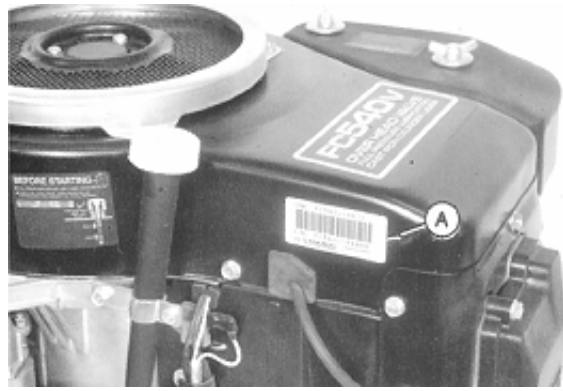


FC400V/FC420V

MX,1015A1,A2 -19-21OCT92

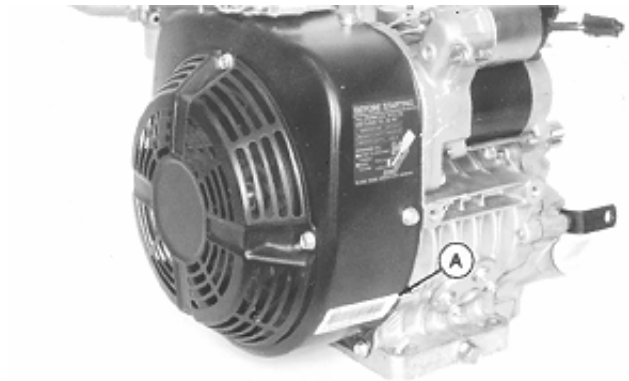
SERIAL NUMBER LOCATION—CONTINUED

A—Serial Number Location



FC540V

M80500 -UN-07JUN91



FE290D/FE290R

M80501 -UN-07JUN91



FB460V

M80502 -UN-07JUN91

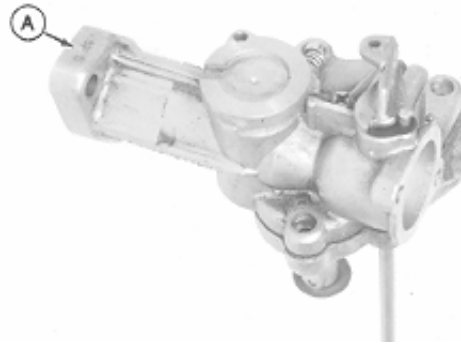
MX,1015A1,A3 -19-21OCT92

CARBURETOR SERIAL NUMBER LOCATION

NOTE: FA130D carburetor shown is used on FA130D-AS16/AS19 and FA210D-AS20 engines. FA130D-AN00 carburetor not shown.

FA210D carburetor shown is used on FA210D-AS17/BS17/CS17 engines. FA210D-AS19-01 carburetor not shown.

The serial number (A) is used to identify the carburetor. Have this number available when requesting parts or service information.



FA130D



FA210D



FA210V



FG150G/FG150D

MX,1015A1,A4 -19-21OCT92

CARBURETOR SERIAL NUMBER LOCATION—CONTINUED

A—Serial Number Location



FC150V



KF82D/FZ340D



FC290V



FC400V/FC420V

M80507 -UN-07JUN91

M80508 -UN-07JUN91

M80509 -UN-07JUN91

M80510 -UN-07JUN91

MX,1015A1,A5 -19-21OCT92

CARBURETOR SERIAL NUMBER LOCATION—CONTINUED

A—Serial Number Location



FC540V



FE290D/FE290R



FB460V

MX,1015A1,A6 -19-21OCT92

10
15
7

-UN-07JUN91

M80511

-UN-07JUN91

M80512

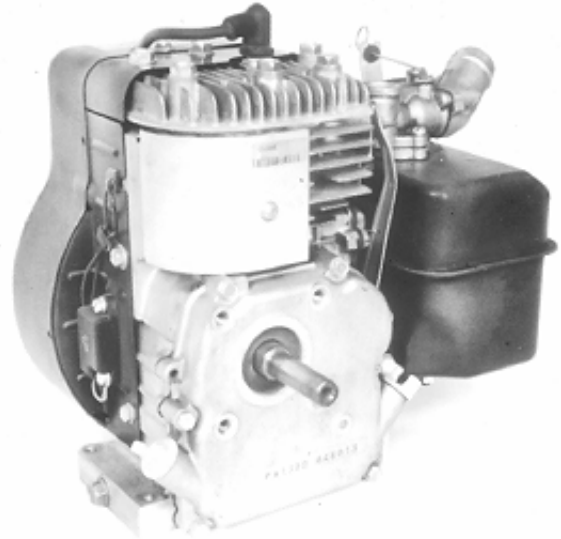
-UN-07JUN91

M80513

10
15
8

FA130D ENGINE FEATURES

- 2.3 kW (3.1 hp)
- Pulse Pump carburetor (FA130D-AS16/AS19)
Float type carburetor (FA130D-AN00)
- Two stage air filter with dry paper filter
and foam precleaner (FA130D-AS16)
Single stage foam air filter (FA130D-AN00)
- Side valves
- Horizontal crankshaft
- Aluminum block
- Splash lubrication
- Low oil level sensor (FA130D-AN00)
- Electronic ignition
- Recoil starter



10
20
1

M80514 -UN-07JUN91

MX,1020A1,A1 -19-21OCT92

FA210D ENGINE FEATURES

- 3.9 kW (5.2 hp)
- Fuel pump (FA210D-AS17/BS17/CS17)
- Pulse pump carburetor (FA210D-AS20)
Float type carburetor
(FA210D-AS17/BS17/CS17 & FA210D-AS19-01)
- Two stage air filter with dry paper
filter and foam precleaner
- Side valves
- Compression release mechanism
(FA210D-AS20)
- Horizontal crankshaft
- Aluminum block
- Splash lubrication
- Electronic ignition
- Recoil starter

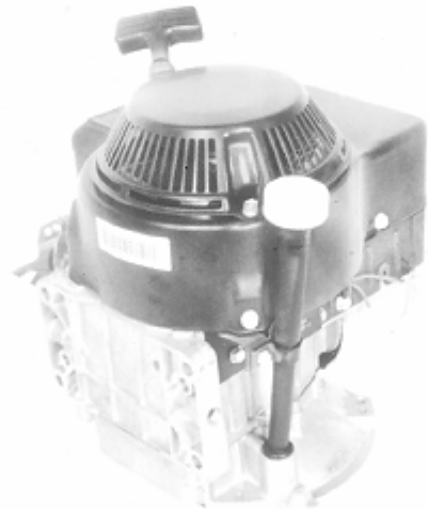


M80515 -UN-07JUN91

MX,1020A1,A2 -19-21OCT92

FA210V ENGINE FEATURES

- 4.5 kW (6 hp)
- Float type carburetor
- Two stage air filter with dry paper filter and foam precleaner
- Side valves
- Compression release mechanism
- Vertical crankshaft
- Aluminum block
- Splash lubrication
- Electronic ignition
- Recoil starter



M80516
-UN-07JUN91

MX,1020A1,A3 -19-21OCT92

FG150G/FG150D ENGINE FEATURES

NOTE: Engines are the same except FG150G engine is camshaft driven and FG150D engine is crankshaft driven.

- 2.7 kW (3.6 hp)
- Float type carburetor
- Two stage air filter with dry paper filter and foam precleaner
- Side valves
- Horizontal crankshaft
- Aluminum block
- Cast-iron cylinder liner
- Electronic ignition
- Recoil starter



FG150G Shown

MX,1020A1,A4 -19-21OCT92

M80517
-UN-07JUN91

FC150V ENGINE FEATURES

- 3.4 kW (4.5 hp)
- 3.7 kW (5.0 hp) (FS01 and ES06)
- Float type carburetor
- Two stage air filter with dry paper filter and foam precleaner
- Flywheel brake (option)
- Overhead valves
- Compression release mechanism
- Vertical crankshaft
- Aluminum block
- Cast-iron cylinder liner
- Splash (AS00 and AS01)
- Full pressure lubrication
- Oil filter (optional)
- Electronic ignition
- Regulated charging system
- Recoil starter
- Electric starter (option)



MX,1020A1,A5 -19-21OCT92

M80518 -UN-07JUN91

10
20
3

KF82D/FZ340D ENGINE FEATURES

- 6.3 kW (8.5 hp)
- Float type carburetor
- Two stage air filter with dry paper filter and foam precleaner
- Side valves
- Horizontal crankshaft
- Dynamic balancer shaft
- Cast-iron cylinder block
- Aluminum crankcase
- Splash lubrication
- CDI ignition
- Regulated charging system
- Electric starter



MX,1020A1,A6 -19-21OCT92

M80519 -UN-07JUN91

FC290V ENGINE FEATURES

- 6.7 kW (9 hp)
- Float type carburetor
- Two stage air filter with dry paper filter and foam precleaner
- Overhead valves
- Compression release mechanism
- Vertical crankshaft with reciprocating balancer
- Aluminum block
- Cast-iron cylinder liner
- Splash lubrication
- Electronic ignition
- Regulated charging system
- Recoil starter
- Electric starter (optional)

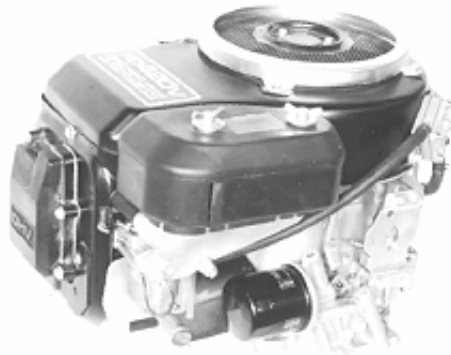


M80213 -UN-19JUN91

MX,1020A1,A7 -19-21OCT92

FC400V ENGINE FEATURES

- 9.3 kW (12.5 hp)
- Float type carburetor
- Two stage air-filter with dry paper filter and foam precleaner
- Overhead valves
- Compression release mechanism
- Vertical crankshaft with reciprocating balancer
- Aluminum block
- Cast-iron cylinder liner
- Full pressure lubrication
- Oil filter
- Solid-state ignition
- Regulated charging system
- Recoil start
- Electric starter (optional)

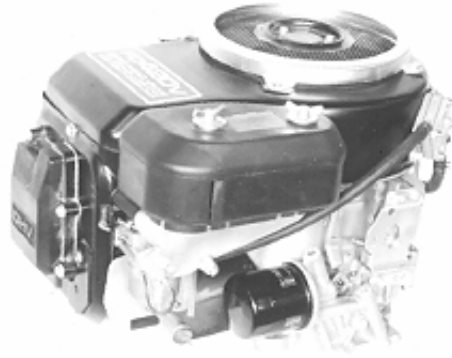


M80214 -UN-19JUN91

MX,1020A1,A8 -19-21OCT92

FC420V ENGINE FEATURES

- 10.4 kW (14 hp)
- Float type carburetor
- Two stage air-filter with dry paper filter and foam precleaner
- Overhead valves
- Compression release mechanism
- Vertical crankshaft with reciprocating balancer
- Aluminum block
- Cast-iron cylinder liner
- Full pressure lubrication
- Oil filter
- Solid-state ignition
- Regulated charging system
- Recoil start
- Electric starter (optional)

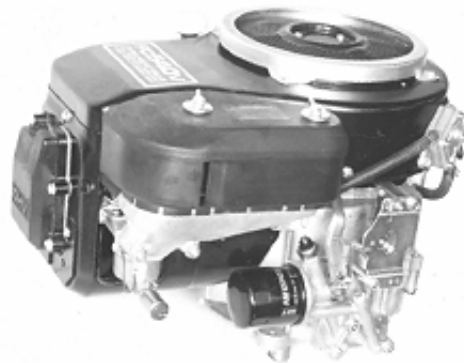


MX,1020A1,A8A -19-21OCT92

10
20
5
-UN-19JUN91
M80214

FC540V ENGINE FEATURES

- 12.6 kW (17 hp)
- 13 kW (17.5 hp) (Engine version AS12)
- Float type carburetor
- Two stage air filter with dry paper filter and foam precleaner
- Overhead valves
- Compression release mechanism
- Vertical crankshaft with reciprocating balancer
- Aluminum block
- Cast-iron cylinder liner
- Full pressure lubrication
- Oil filter
- Solid-state ignition
- Regulated charging system
- Electric starter



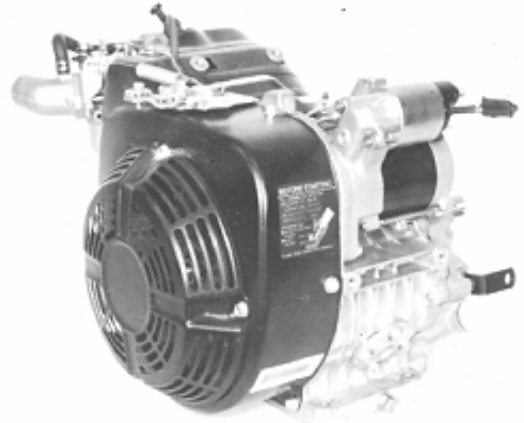
MX,1020A1,A9 -19-21OCT92

-UN-19JUN91
M80215

FE290D/FE290R ENGINE FEATURES

NOTE: Engines are the same except, FE290R can be equipped with a reduction gearbox. Gearbox attaches to crankcase cover.

- 7.5 kW (10 hp)
- Float type carburetor
- Overhead valves
- Compression release mechanism
- Horizontal crankshaft with reciprocating balancer
- Aluminum block
- Cast-iron cylinder liner
- Full pressure lubrication
- Oil filter (optional)
- Solid-state ignition
- Regulated charging system
- Recoil starter (optional)
- Electric starter



-UN-19JUN91

M80216

MX,1020A1,A10 -19-21OCT92

FB460V ENGINE FEATURES

- 9.3 kW (12.5 hp)
- Fuel pump
- Float type carburetor
- Two stage air filter with dry paper filter and foam precleaner
- Side valves
- Compression release mechanism
- Vertical crankshaft with reciprocating balancer
- Aluminum block
- Cast-iron cylinder liner
- Full pressure lubrication
- Oil filter (optional)
- Electronic ignition
- Regulated charging system
- Recoil starter
- Electric starter (optional)

MX,1020A1,A11 -19-21OCT92

Section 20

FA130D and FA210D

Contents

	Page	Page
Group 00—Engine Application and Repair Specifications		
Engine Application Chart	20-00-1	
Repair Specifications		
FA130D	20-00-2	
FA210D	20-00-4	
Group 05—Fuel and Air Systems—FA130D		
Service Parts Kits	20-05-1	
Remove, Inspect and Install Fuel Tank—FA130D-AS16/AS19	20-05-1	
Remove and Install Carburetor		
FA130D-AS16/AS19	20-05-2	
FA130D-AN00	20-05-2	
Disassemble, Clean, Inspect and Assemble Carburetor		
FA130D-AS16/AS19	20-05-3	
FA130D-AN00	20-05-4	
Service Breather		
FA130D-AS16/AS19	20-05-5	
FA130D-AN00	20-05-6	
Service Air Cleaner	20-05-7	
Group 06—Fuel and Air Systems—FA210D		
Service Parts Kits	20-06-1	
Remove, Inspect and Install Fuel Tank—FA210D-AS20	20-06-1	
Remove and Install Fuel Pump—FA210D-AS17/BS17/CS17	20-06-2	
Remove and Install Carburetor		
FA210D-AS20	20-06-2	
FA210D-AS17/BS17/CS17	20-06-3	
FA210D-AS19-01	20-06-4	
Disassemble, Clean, Inspect and Assemble Carburetor		
FA210D-AS20	20-06-5	
FA210D-AS19-01/AS17/BS17/CS17	20-06-6	
R & I Intake Manifold - A210D-AS19-01/AS17/BS17/CS17	20-06-10	
Service Breather		
FA210D-AS20	20-06-10	
FA210D-AS19-01	20-06-11	
FA210D-AS17/BS17/CS17	20-06-11	
Service Air Cleaner	20-06-12	
Group 10—Blower Housing and Flywheel		
Remove and Install Blower Housing		
FA130D and FA210D-AS20	20-10-1	
FA210D-AS19-01/AS17/BS17/CS17	20-10-2	
Flywheel Screen Adjustment	20-10-2	
Remove and Install Flywheel		
FA130D and FA210D-AS20	20-10-3	
FA210D-AS19-01/AS17/BS17/CS17	20-10-3	
Group 15—Cylinder Head		
Other Material	20-15-1	
Remove and Install Cylinder Head	20-15-2	
Inspect Cylinder Head	20-15-3	
Group 20—Cylinder Block, Valves and Internal Components		
Other Materials	20-20-1	
Service Parts Kits	20-20-1	
Remove and Install Valves and Springs	20-20-2	
Inspect Valve Springs	20-20-3	
Inspect Valve Guides	20-20-3	
Recondition Valve Seats	20-20-4	
Check Valve-To-Tappet Clearance	20-20-5	
Remove and Install Crankcase Cover	20-20-6	
Camshaft		
Remove and Install	20-20-6	
Inspect	20-20-7	
Inspect Plain Bearings	20-20-7	
Inspect Automatic Compression Release	20-20-8	
Remove, Inspect and Install Tappets	20-20-8	
Piston and Connecting Rod		
Remove and Install	20-20-9	
Disassemble, Inspect and Assemble	20-20-10	
Inspect Piston	20-20-11	
Inspect Connecting Rod	20-20-13	
Piston Rings		
Remove and Install	20-20-14	
Check End Gap	20-20-14	
Crankshaft		
Remove, Inspect and Install	20-20-15	
Inspect Plain Bearings	20-20-16	

Continued on next page

Page

Crankshaft—Continued

Replace Bearing Shell	20-20-16
Inspect Ball Bearing	20-20-17
Check Alignment (TIR)	20-20-17
Measure End Play	20-20-17

Inspect

Oil Seals	20-20-18
Cylinder Block	20-20-18
Rebore Cylinder Block	20-20-19
Inspect and Replace Oil Splasher	20-20-20
Check Low Oil Level Sensor	20-20-20
Inspect and Replace Governor	20-20-21
Inspect and Replace Governor Shaft	20-20-22
Governor Adjustment	
FA130D-AS16/AS19 & FA210D-AS20	20-20-22
FA210D-AS19-01/AS17/BS17/CS17	20-20-23

Group 25—Ignition and Charging System

Remove and Install Armature with Coil	20-25-1
Adjust Armature Air Gap	20-25-1
Replace Ignitor—FA130D and FA210D-AS20	20-25-2

Group 30—Starting Systems—FA130D

Recoil Starter—FA130D-AS16/AS19

Disassemble	20-30-1
Inspect	20-30-2
Replace Spring	20-30-3
Assemble	20-30-3

Recoil Starter—FA130D-AN00

Disassemble	20-30-4
Inspect	20-30-6
Replace Spring	20-30-7
Assemble	20-30-7

Group 31—Starting Systems—FA210D

Recoil Starter

Disassemble	20-31-1
Inspect	20-31-2
Replace Spring	20-31-4
Assemble	20-31-4

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

Machine	Engine Model No.
3K Lawn Edger	FA130D-AS16
E35 Lawn Edger	FA130D-AS19
1000/1400 Generators	FA130D-AN00
20SR7 Reel Mower	FA130D-AS16
519 Walk-Behind Vertical Mower	FA210D-AS20
529 Vacuum Blower	FA210D-AS19-01
Power Pak Material Collection System	
(Engine S.N. —254693)	FA210D-AS17
(Engine S.N. 254694—289197)	FA210D-BS17
(Engine S.N. 289198—)	FA210D-CS17

MX,2000A1,A1 -19-21OCT92

FA130D REPAIR SPECIFICATIONS**GROUP 10—BLOWER HOUSING AND FLYWHEEL**

Item	Specification
Flywheel Nut Torque	60 N·m (44 lb-ft)

GROUP 15—CYLINDER HEAD

Cylinder Head	
Maximum Cylinder Head Warp	0.25 mm (0.010 in.)
Cap Screw Torque In Sequence	
Initial Torque	10 N·m (89 lb-in.)
Final Torque	21 N·m (186 lb-in.)
Spark Plug Torque	17 N·m (156 lb-in.)

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS

Valve Clearance (cold)	
Intake	0.12—0.18 mm (0.005—0.007 in.)
Exhaust	0.10—0.34 mm (0.004—0.013 in.)

Valves and Springs	
Minimum Spring Free Length	23.50 mm (0.930 in.)
Maximum Valve Guide I.D.	
Intake	6.10 mm (0.2401 in.)
Exhaust	6.09 mm (0.2397 in.)
Minimum Valve Stem Diameter	5.95 mm (0.234 in.)

Valve Clearance (cold)	
Intake	0.12—0.18 mm (0.005—0.007 in.)
Exhaust	0.10—0.34 mm (0.004—0.013 in.)

Valves and Springs	
Minimum Spring Free Length	23.50 mm (0.930 in.)
Maximum Valve Guide I.D.	
Intake	6.10 mm (0.2401 in.)
Exhaust	6.09 mm (0.2397 in.)
Minimum Valve Stem Diameter	5.95 mm (0.234 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seating Surface Angle	45°
Valve Seating Width	1.00—1.60 mm (0.039—0.063 in.)
Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Continued on next page

MX,2000A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Crankcase Cover	
Oil Capacity	0.5 L (1.06 pt)
Cap Screw Torque	6 N·m (53 lb-in.)
Drain Plug Torque	14 N·m (121 lb-in.)
Camshaft	
Minimum End Journals O.D.	11.94 mm (0.469 in.)
Minimum Lobe Height	23.25 mm (0.915 in.)
Maximum Cover and Crankcase Bearing I.D.	12.04 mm (0.474 in.)
Piston	
Maximum Ring Groove Clearance	0.15 mm (0.006 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	1.00 mm (0.039 in.)
Minimum Pin O.D.	12.98 mm (0.511 in.)
Maximum Pin Bore I.D.	13.04 mm (0.513 in.)
Maximum Piston-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Minimum Piston O.D.	61.86—61.89 mm (2.435—2.437 in.)
Piston-to-Cylinder Bore Clearance	
Maximum	0.25 mm (0.0098 in.)
Standard	0.087—0.137 mm (0.0034—0.0054 in.)
Connecting Rod	
Maximum Crankshaft Bearing I.D.	24.05 mm (0.947 in.)
Maximum Piston Pin Bearing I.D.	13.04 mm (0.513 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.10 mm (0.004 in.)
End-Cap Screw Torque	12 N·m (106 lb-in.)
Crankshaft	
Minimum Flywheel Side Journal O.D.	21.97 mm (0.865 in.)
Minimum Connecting Rod Journal O.D.	23.95 mm (0.943 in.)
Maximum Crankcase Plain Bearing I.D.	22.10 mm (0.869 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0—0.30 mm (0—0.012 in.)
PTO Side Oil Seal Depth	4 mm (0.158 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.	61.90—62.00 mm (2.439—2.443 in.)
Maximum Cylinder Bore I.D.	62.07 mm (2.446 in.)
Low Oil Level Sensor Travel	9.50—15.50 mm (0.374—0.610 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.50 mm (0.019 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

FA210D REPAIR SPECIFICATIONS**GROUP 10—BLOWER HOUSING AND FLYWHEEL**

Item	Specification
Flywheel Nut Torque	60 N·m (44 lb-ft)
Flywheel Screen Gap	1—3 mm (0.039—0.118 in.)

GROUP 15—CYLINDER HEAD

Cylinder Head	
Maximum Cylinder Head Warp	0.40 mm (0.015 in.)
Cap Screw Torque In Sequence	
Initial Torque	10 N·m (89 lb-ft)
Final Torque	21 N·m (186 lb-in)
Spark Plug Torque	24 N·m (212 lb-in.)

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS

Valve Clearance (cold)	
Intake	0.12—0.18 mm (0.005—0.007 in.)
Exhaust	0.12—0.34 mm (0.005—0.013 in.)
Valves and Springs	
Minimum Spring Free Length	23.50 mm (0.930 in.)
Maximum Valve Guide I.D.	
Intake	6.10 mm (0.240 in.)
Exhaust	6.13 mm (0.242 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seat and Face Angle	45°
Valve Seating Width	1.30 mm (0.050 in.)
Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Continued on next page

MX,2000A1,A4 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Crankcase Cover	
Oil Capacity	0.6 L (1.27 pt)
Cap Screw Torque	21 N·m (186 lb-in.)
Camshaft	
Minimum End Journals O.D.	12.94 mm (0.509 in.)
Minimum Lobe Height	
Intake	26.45 mm (1.041 in.)
Exhaust	26.35 mm (1.037 in.)
Maximum Bearing I.D.	13.05 mm (0.514 in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.15 mm (0.006 in.)
Second Ring	0.13 mm (0.005 in.)
Oil Ring	0.12 mm (0.004 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	1.00 mm (0.039 in.)
Minimum Pin O.D.	14.98 mm (0.590 in.)
Maximum Pin Bore I.D.	15.04 mm (0.593 in.)
Maximum Piston-to-Piston Pin Clearance	0.06 mm (0.003 in.)
Piston O.D.	71.86—71.89 mm (2.829—2.830 in.)
Piston-to-Cylinder Bore Clearance	
Maximum	0.163 mm (0.0064 in.)
Standard	0.087—0.137 mm (0.0034—0.0054 in.)
Connecting Rod	
Maximum Crankshaft Bearing I.D.	27.06 mm (1.065 in.)
Maximum Piston Pin Bearing I.D.	15.04 mm (0.592 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.06 mm (0.002 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.12 mm (0.005 in.)
End-Cap Screw Torque	19 N·m (168 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	24.96 mm (0.983 in.)
Minimum Flywheel Side Journal O.D.	24.96 mm (0.983 in.)
Minimum Connecting Rod Journal O.D.	26.95 mm (1.061 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0—0.30 mm (0—0.012 in.)
PTO Side Oil Seal Depth	4 mm (0.158 in.)
Crankcase Plain Bearing	25.10 mm (0.988 in.)

MX,2000A1,A5 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Cylinder Bore	
Standard Cylinder Bore I.D.	71.98—72.00 mm (2.834—2.835 in.)
Maximum Cylinder Bore I.D.	72.06 mm (2.837 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

MX,2000A1,A6 -19-21OCT92

20
00
6

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Carburetor Gasket Kit—Engine Number FA130D-AS16

Complete Carburetor

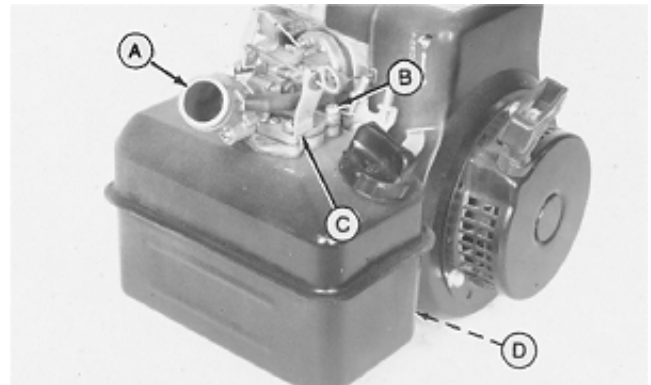
MX,2005A1,A1 -19-21OCT92

REMOVE, INSPECT AND INSTALL FUEL TANK—FA130D-AS16/AS19



CAUTION: Gasoline vapor is explosive. Do not expose to spark or flame. Serious personal injury can result.

1. Remove air cleaner assembly or intake manifold and gasket (A).
2. Remove choke lever and linkage (C).
3. Remove screws (B) and cap screw and washer (D). Remove fuel tank and gasket.
4. Inspect fuel tank for cracks or damage. Repair or replace as necessary.
5. Install fuel tank and gasket.
6. Install choke lever and linkage.
7. Install intake manifold and gasket or air cleaner assembly.



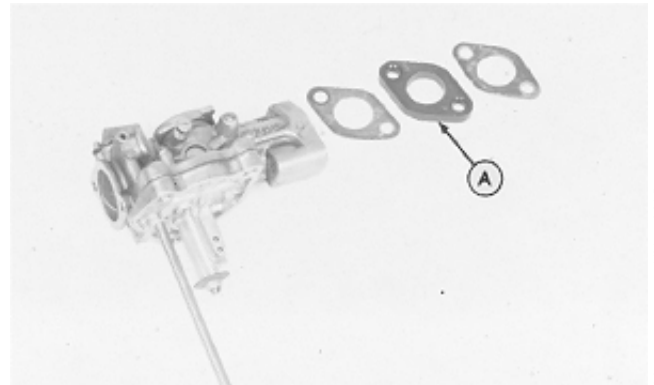
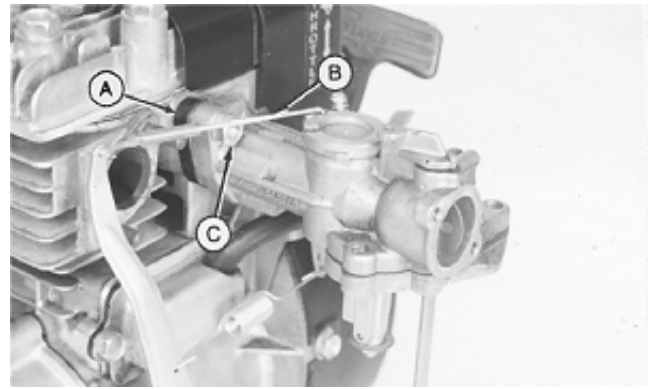
- A—Intake Manifold and Gasket**
B—Screw (3 used)
C—Choke Lever and Linkage
D—Cap Screw and Washer

MX,2005A1,A2 -19-21OCT92

M80231 -JUN-11MAR91

REMOVE AND INSTALL CARBURETOR—FA130D-AS16/AS19

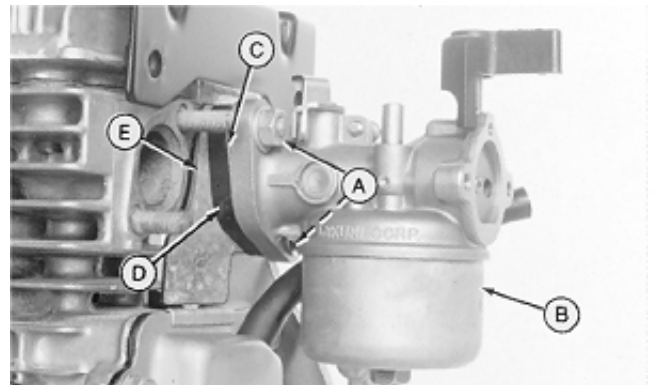
1. Remove fuel tank. (See this group.)
2. Remove two nuts and washers (C).
3. Separate carburetor from spacer (A). Remove carburetor.
4. Disconnect throttle control linkage (B).
5. Remove spacer (A) and gaskets.
6. Make repairs as necessary. (See this group.)
7. Install gaskets and spacer.
8. Connect linkage and install carburetor.
9. Install washers and nuts.
10. Install fuel tank.



MX,2005A1,A3 -19-21OCT92

REMOVE AND INSTALL CARBURETOR—FA130D-AN00

1. Remove air cleaner assembly and gasket.
2. Remove nuts and washers (A).
3. Separate carburetor from spacer (D). Remove carburetor (B).
4. Disconnect throttle control linkage.
5. Remove spacer(D) and gaskets (C and E).
6. Make repairs as necessary. (See this group.)
7. Install gaskets and spacer.
8. Connect linkage and install carburetor.
9. Install washers and nuts.
10. Install air cleaner assembly and gasket.



A—Mounting Nuts and Washers
B—Carburetor
C—Small Gasket
D—Spacer
E—Large Gasket

MX,2005A1,A4 -19-21OCT92

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR—FA130D-AS16/AS19

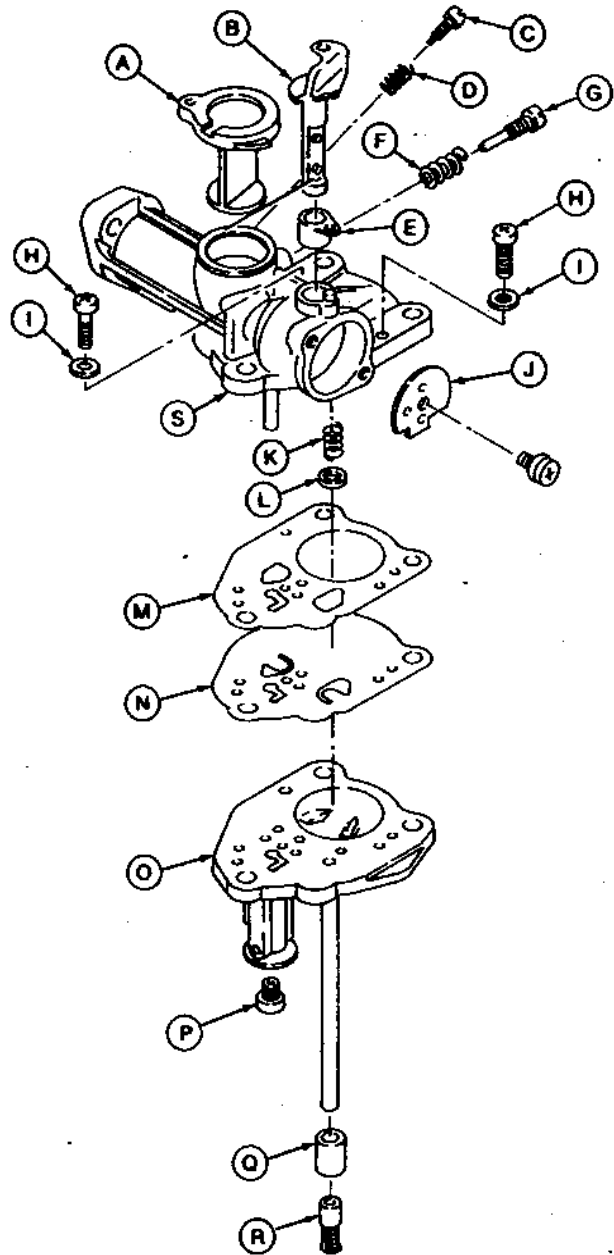
IMPORTANT: Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.
4. Inspect all parts for wear or damage, replace as necessary.

- A—Throttle Shaft
- B—Choke Shaft
- C—Pilot Screw
- D—Spring
- E—Bushing
- F—Spring
- G—Idle Screw
- H—Screw
- I—Gasket
- J—Choke Valve
- K—Spring
- L—Spring Cap
- M—Gasket
- N—Diaphragm
- O—Lower Housing
- P—Main Jet
- Q—Bushing
- R—Strainer
- S—Upper Housing



MX,2005A1,A5 -19-21OCT92

M51767 -UN-07SEP88

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR—FA130D-AN00

IMPORTANT: To remove float, use a long nosed pliers on end of pin (M). Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

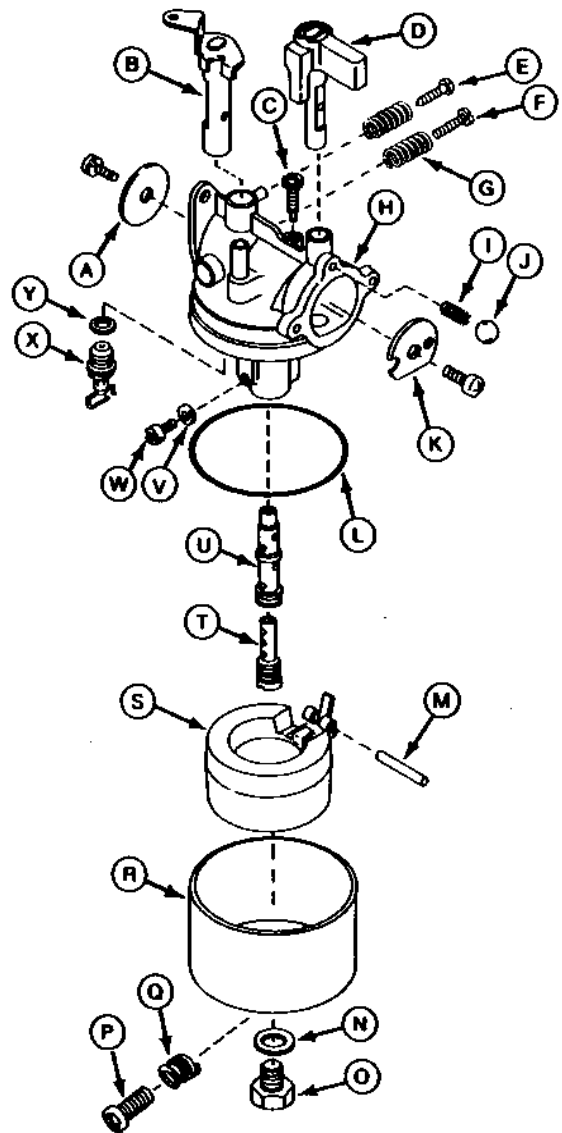
1. Soak carburetor body and all parts, except gaskets and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.

4. Inspect all parts for wear or damage, replace as necessary.

A—Throttle Plate	N—Washer
B—Throttle Shaft	O—Plug
C—Pilot Jet	P—Drain Screw
D—Choke Shaft	Q—Spring
E—Pilot Screw	R—Float Chamber
F—Idle Screw	S—Float
G—Spring (2 used)	T—Bleed Pipe
H—Carburetor Body	U—Main Nozzle
I—Spring	V—Washer
J—Ball	W—Main Jet
K—Choke Plate	X—Needle Valve
L—Gasket	Y—Washer
M—Float Pin	

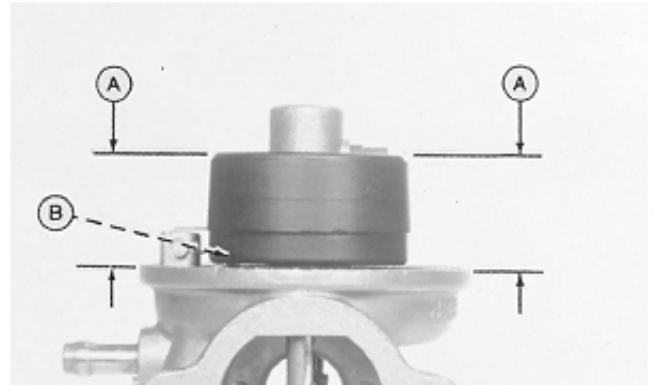


MX,2005A1,A6 -19-21OCT92

-UN-19MAR91
M80236

IMPORTANT: Do not push on float or inlet needle valve when adjusting float level.

5. Adjust float level. With carburetor upside down, float surface must be parallel (A) to carburetor body. Bend tang (B) to adjust float surface angle.



MX,2005A1,A7 -19-21OCT92

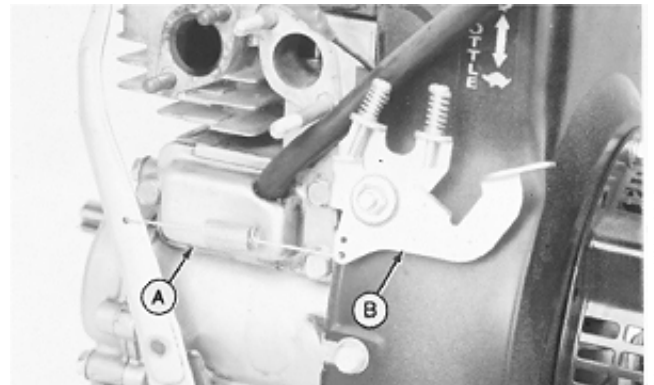
TY15085 -UN-02SEP88

20-05-5

SERVICE BREATHER—FA130D-AS16/AS19

NOTE: The tappet chamber cover is an oil breather.

1. Remove fuel tank. (See this group.)
2. Remove throttle lever assembly (B).
3. Remove tappet chamber cover/breather and gasket (A).
4. Clean cover/breather and tube. Inspect for cracks or damage. Replace if necessary.
5. Install new gasket and cover/breather.
6. Install throttle lever assembly.
7. Install fuel tank.



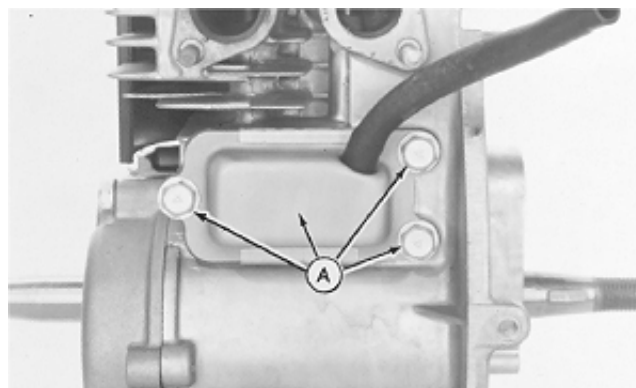
MX,2005A1,A8 -19-21OCT92

M80238 -UN-11MAR91

SERVICE BREATHER—FA130D-AN00

NOTE: The tappet chamber cover is an oil breather.

1. Remove carburetor. (See this group.)
2. Remove tappet chamber cover/breather and gasket (A).
3. Clean cover/breather and tube. Inspect for cracks or damage. Replace if necessary.
4. Install new gasket and cover/breather.
5. Install carburetor.



TY15018 -UN-02SEP88

MX,2005A1,A9 -19-21OCT92

SERVICE AIR CLEANER

NOTE: Replace elements yearly or every 25 hours as required.

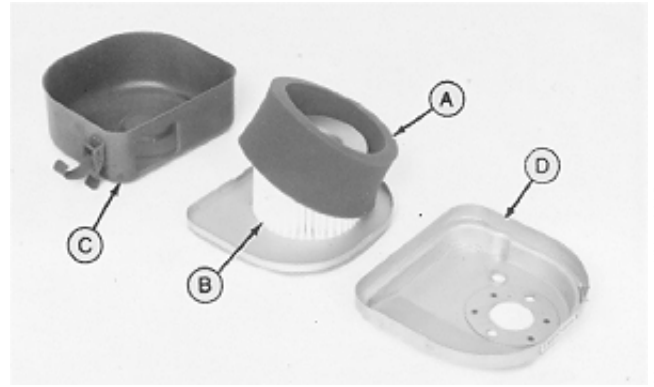
1. Remove and disassemble air cleaner.

IMPORTANT: Do not clean elements with solvent or compressed air.

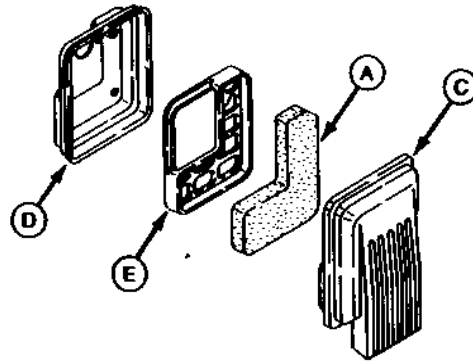
2. Wash foam element (A) in detergent and water. Dry element.
3. Put 12—15 drops of engine oil on foam element (A). Squeeze out excess oil.
4. Gently tap paper element (B) to remove dust:
 - Element is still usable if you can see light through element and paper appears clean.
 - Install new element if element is oily, dirty, bent, torn, crushed, or obstructed in any way.
5. Inspect cover (C), body (E), and base (D) for damage. Replace if necessary.

IMPORTANT: Any time air cleaner base is removed, check for free choke operation during reassembly.

6. Assemble and install air cleaner.



FA130D-AS16



FA130D-AN00

A—Foam Element
B—Paper Element
C—Cover
D—Base
E—Body

MX,2005A1,A10 -19-21OCT92

M80240 -UN-11MAR91

M80241 -UN-06APR91

20
05
8

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Carburetor Gasket Kit:

Engine Number
FA210D-AS19-01
FA210D-AS17
FA210D-BS17
FA210D-CS17

Main Jet High Altitude Kit:

Engine Number
FA210D-AS17
FA210D-BS17
FA210D-CS17

Complete Carburetor

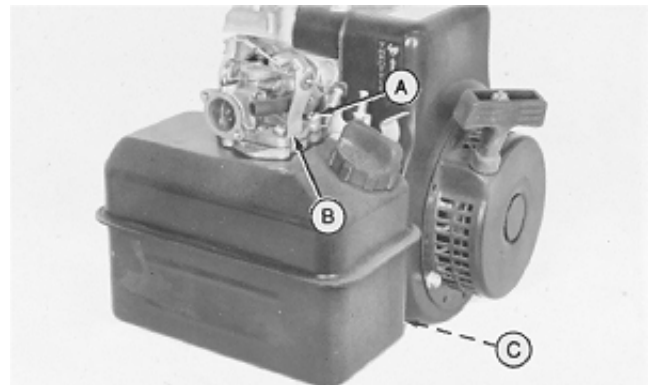
Complete Fuel Pump:
FA210D-AS17
FA210D-BS17
FA210D-CS17

MX,2006A1,A1 -19-21OCT92

REMOVE, INSPECT AND INSTALL FUEL TANK—FA210D-AS20

⚠ CAUTION: Gasoline vapor is explosive. Do not expose to spark or flame. Serious personal injury can result.

1. Remove air cleaner assembly.
2. Remove choke lever and linkage (B).
3. Remove two screws (A) and cap screw and washer (C). Remove fuel tank and gasket.
4. Inspect fuel tank for cracks or damage. Repair or replace as necessary.
5. Install fuel tank and gasket.
6. Install choke lever and linkage.
7. Install air cleaner assembly.

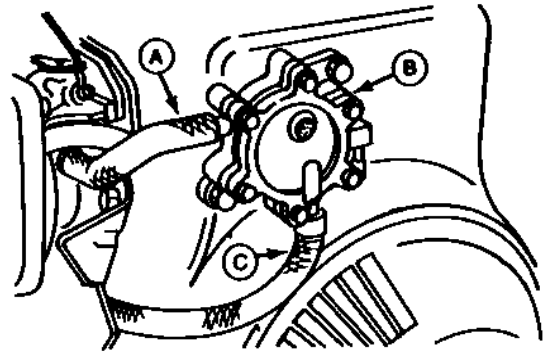


-UN-11MAR91
M80289

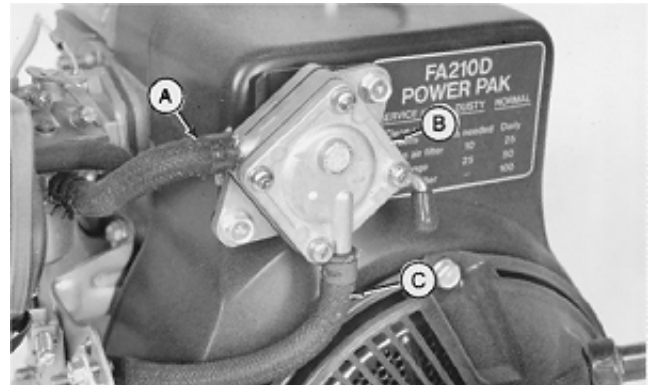
MX,2006A1,A2 -19-21OCT92

REMOVE AND INSTALL FUEL PUMP—FA210D-AS17/BS17/CS17

1. Disconnect fuel hose (A) and vacuum hose (C). Close all openings using caps and plugs.
2. Remove fuel pump (B).
3. Inspect pump for cracks or damage. Replace if necessary.
4. Install fuel pump.
5. Connect hoses.



FA210D-AS17

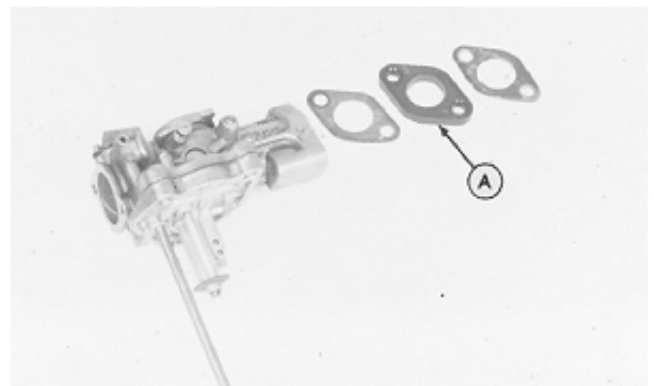
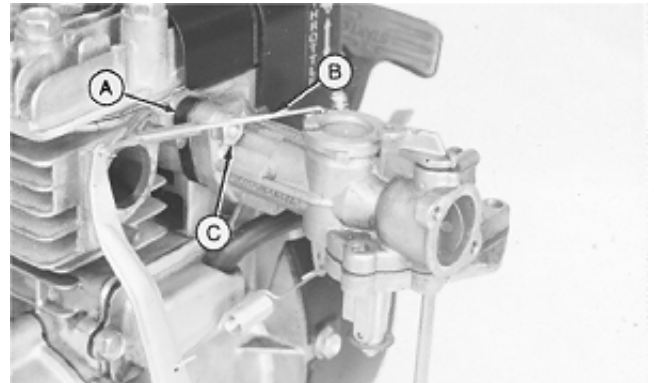


FA210D-BS17/CS17

MX,2006A1,A3 -19-21OCT92

REMOVE AND INSTALL CARBURETOR—FA210D-AS20

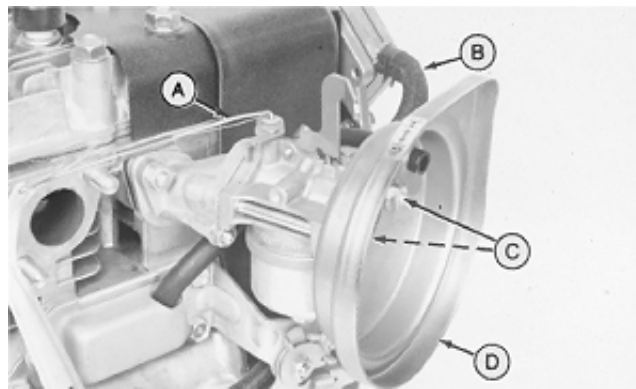
1. Remove fuel tank. (See this group.)
2. Remove two nuts and washers (C).
3. Separate carburetor from spacer (A). Remove carburetor.
4. Disconnect throttle control linkage (B).
5. Remove spacer (A) and gaskets.
6. Make repairs as necessary. (See this group.)
7. Install gaskets and spacer.
8. Connect linkage and install carburetor.
9. Install washers and nuts.
10. Install fuel tank.



MX,2006A1,A4 -19-21OCT92

REMOVE AND INSTALL CARBURETOR—FA210D-AS17/BS17/CS17

1. Remove air cleaner elements.
2. Disconnect hose (B). Close all openings using caps and plugs.
3. Remove cap screws and washers (C), air cleaner base (D) and gasket.
4. Disconnect linkage (A).
5. Remove carburetor and gasket.
6. Make repairs as necessary. (See this group.)
7. Install carburetor and new gasket.
8. Connect throttle linkage.
9. Install new gasket, air cleaner base and cap screws and washers.
10. Connect fuel hose.
11. Install air cleaner elements.



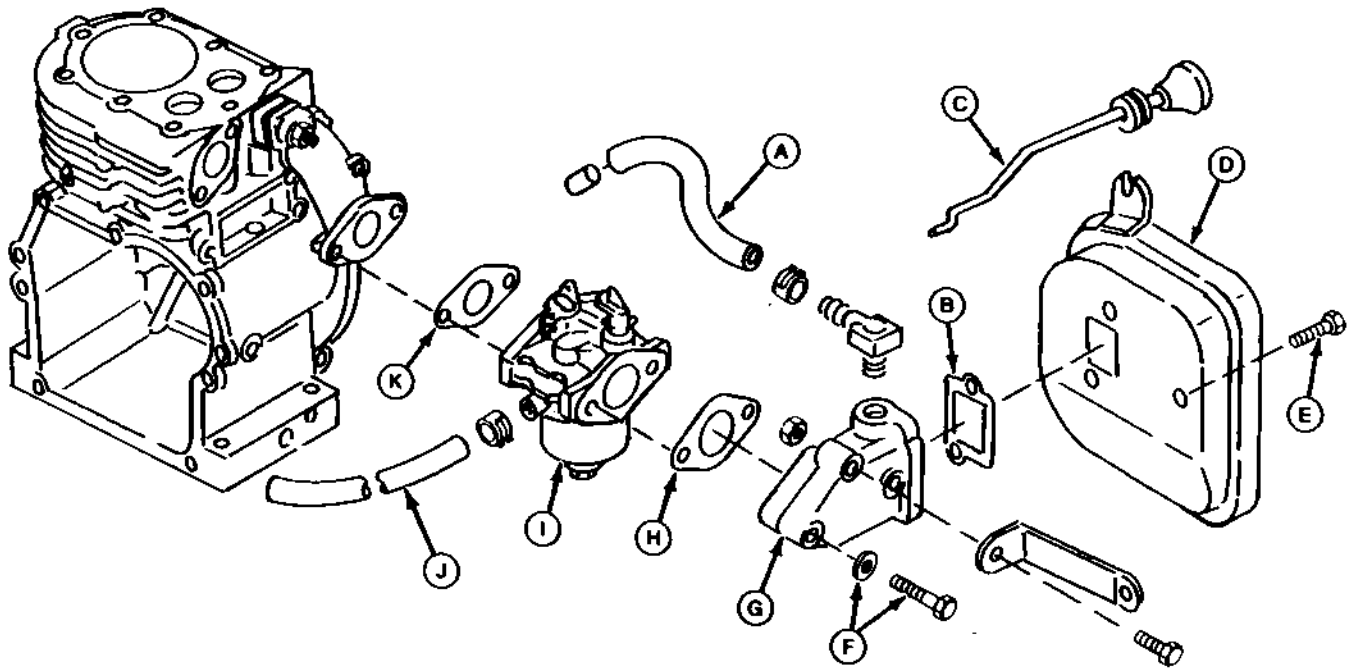
A—Throttle Control Linkage
B—Fuel Hose
C—Cap Screws and Washers
D—Air Cleaner Base

MX,2006A1,A5 -19-21OCT92

M80279 -UN-11MAR91

20
06
3

REMOVE AND INSTALL CARBURETOR—FA210D-AS19-01



A—Crankcase
Breather-to-Intake Pipe
Hose
B—Gasket

C—Choke Control Linkage
D—Air Cleaner Base
E—Cap Screw (3 used)
F—Cap Screw and Washer (2
used)

G—Intake Pipe
H—Gasket
I—Carburetor

J—Fuel Tank-to-Carburetor
Fuel Hose
K—Gasket

1. Remove air cleaner elements.
2. Disconnect linkage (C).
3. Remove cap screws (E), air cleaner base (D) and gasket (B).
4. Disconnect hoses (A and J). Close all openings using caps and plugs.
5. Remove cap screws and washers (F), intake pipe (G) and gasket (H).
6. Remove carburetor (I) and gasket (K).
7. Make repairs as necessary. (See this group.)
8. Install carburetor and new gasket.
9. Install intake pipe and new gasket.
10. Connect hoses.
11. Install air cleaner base and new gasket.
12. Connect linkage.
13. Install air cleaner elements.

M80280 -JUN-06APR91

MX,2006A1,A6 -19-21OCT92

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR—FA210D-AS20

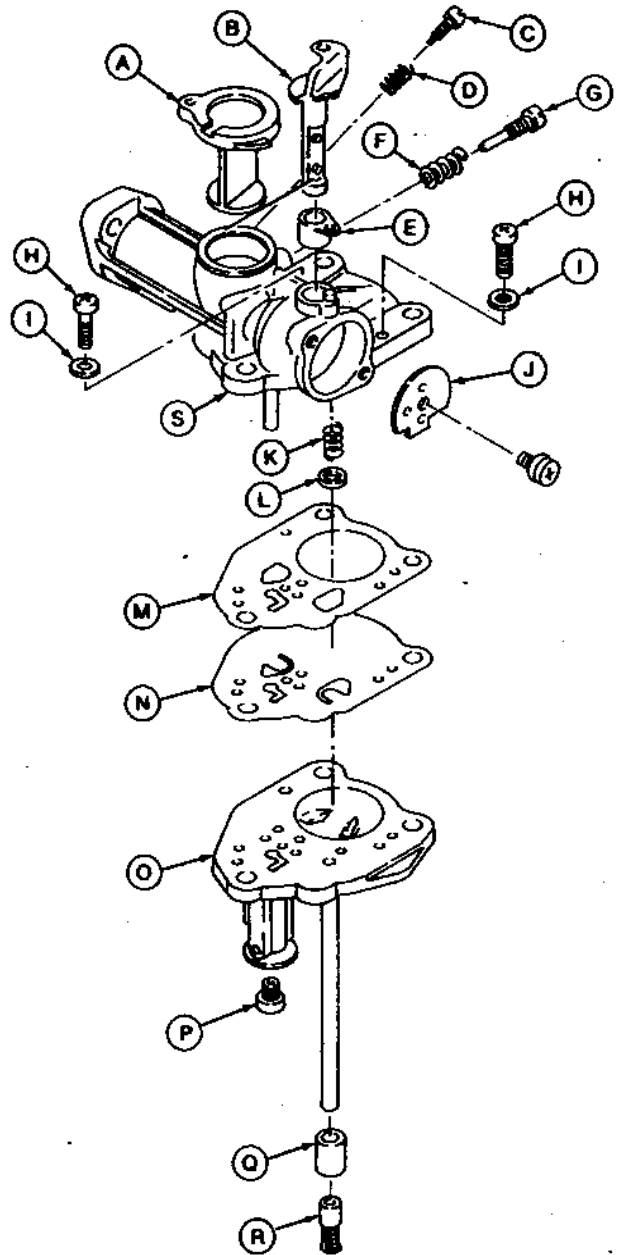
IMPORTANT: Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.
4. Inspect all parts for wear or damage, replace as necessary.

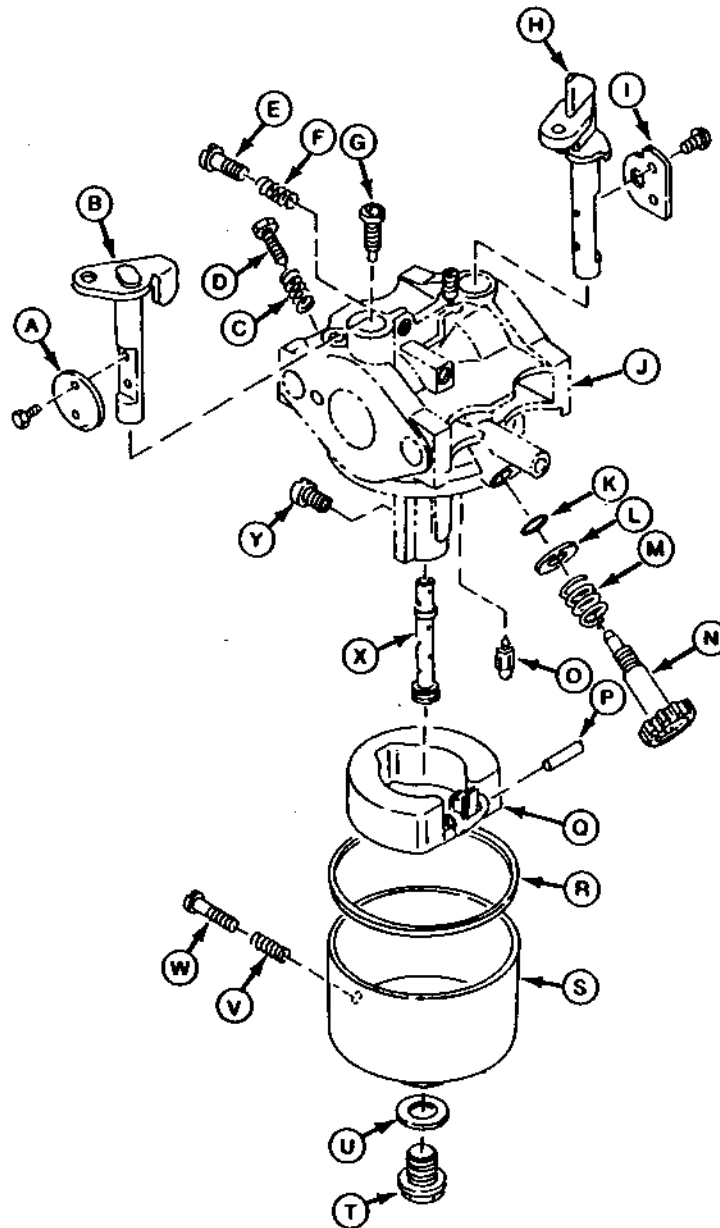
- A—Throttle Shaft
- B—Choke Shaft
- C—Pilot Screw
- D—Spring
- E—Bushing
- F—Spring
- G—Idle Screw
- H—Screw
- I—Gasket
- J—Choke Valve
- K—Spring
- L—Spring Cap
- M—Gasket
- N—Diaphragm
- O—Lower Housing
- P—Main Jet
- Q—Bushing
- R—Strainer
- S—Upper Housing



MX,2006A1,A7 -19-21OCT92

M51767 -UN-07SEP88

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR—FA210D-AS19-01/AS17/BS17/CS17

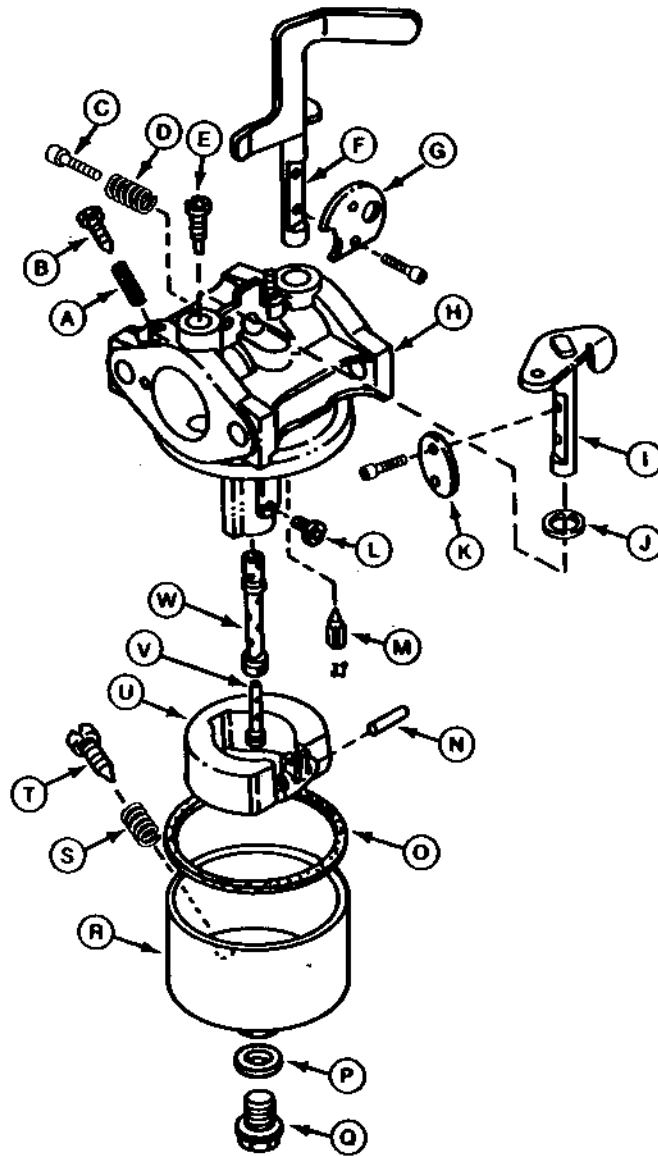


- | | | | |
|------------------|-------------------|-----------------|---------------|
| A—Throttle Plate | H—Choke Shaft | N—Valve | T—Plug |
| B—Throttle Shaft | I—Choke Plate | O—Needle Valve | U—Washer |
| C—Spring | J—Carburetor Body | P—Float Pin | V—Spring |
| D—Screw | K—O-Ring | Q—Float | W—Drain Screw |
| E—Idle Screw | L—Washer | R—Gasket | X—Main Nozzle |
| F—Spring | M—Spring | S—Float Chamber | Y—Main Jet |
| G—Pilot Jet | | | |

FA210D-AS19-01

M80281 -UN-19MAR91

MX,2006A1,A8 -19-21OCT92



A—Spring
B—Screw
C—Idle Screw
D—Spring
E—Pilot Jet
F—Choke Shaft

G—Choke Plate
H—Carburetor Body
I—Throttle Shaft
J—Seal
K—Throttle Plate
L—Main Jet

M—Needle Valve
N—Float Pin
O—Gasket
P—Washer
Q—Plug
R—Float Chamber

S—Spring
T—Drain Screw
U—Float
V—Bleed Pipe
W—Main Nozzle

FA210D-AS17/BS17/CS17

M80282 -JUN-19/MAR91

MX,2006A1,A9 -19-21OCT92

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

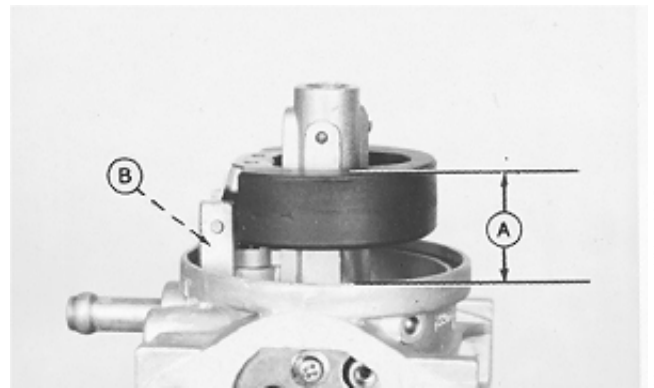
3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or papers to dry parts: lint may plug holes or passages.
4. Inspect all parts for wear or damage, replace as necessary.

NOTE: Main jet high altitude kits are available for FA210D-AS17, BS17 and CS17 engines only.

MX,2006A1,A10 -19-21OCT92

IMPORTANT: Do not push on float or inlet needle valve when adjusting float level.

5. Adjust float level. With carburetor upside down, float surface must be parallel (A) to carburetor body. Bend tang (B) to adjust float surface angle.



MX,2006A1,A11 -19-21OCT92

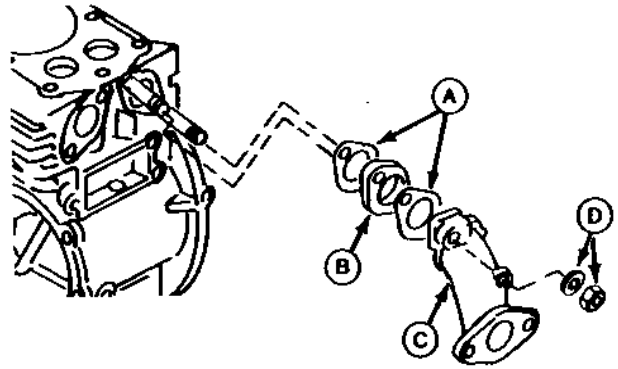
20
06
9

M80283 -UN-11MAR91

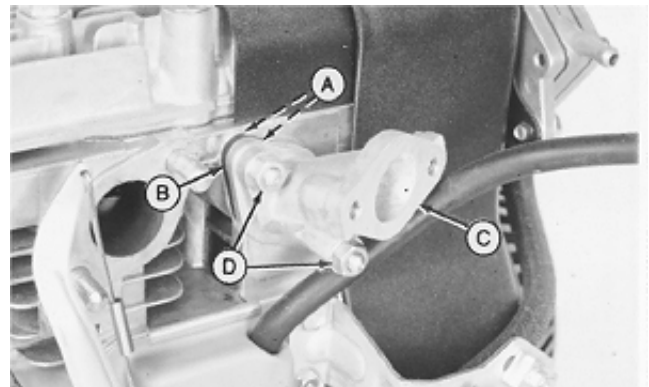
REMOVE AND INSTALL INTAKE MANIFOLD—FA210D-AS19-01/AS17/BS17/CS17

1. Remove carburetor. (See this group.)
2. Remove nuts and washers (D).
3. Separate manifold (C) from spacer (B). Remove intake manifold, spacer and gaskets (A).
4. Inspect parts for cracks or damage. Replace as necessary.
5. Install new gaskets, spacer and manifold.
6. Install carburetor.

A—Gaskets (2 used)
B—Spacer
C—Intake Manifold
D—Nuts and Washers



FA210D-AS19-01



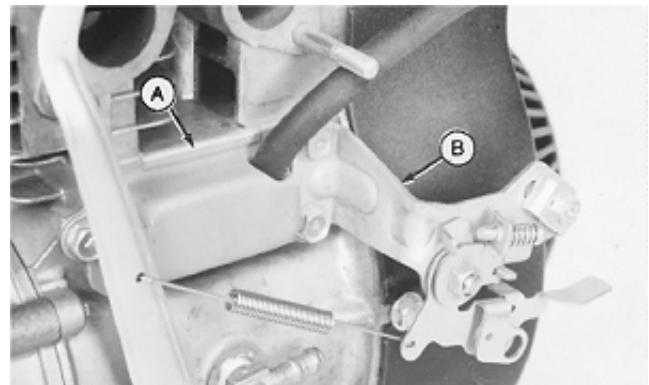
FA210D-AS17/BS17/CS17

MX,2006A1,A12 -19-21OCT92

SERVICE BREATHER—FA210D-AS20

NOTE: The tappet chamber cover is an oil breather.

1. Remove fuel tank. (See this group.)
2. Remove throttle lever assembly (B).
3. Remove tappet chamber cover/breather and gasket (A).
4. Clean cover/breather and tube. Inspect for cracks or damage. Replace if necessary.
5. Install new gasket and cover/breather.
6. Install throttle lever assembly.
7. Install fuel tank.

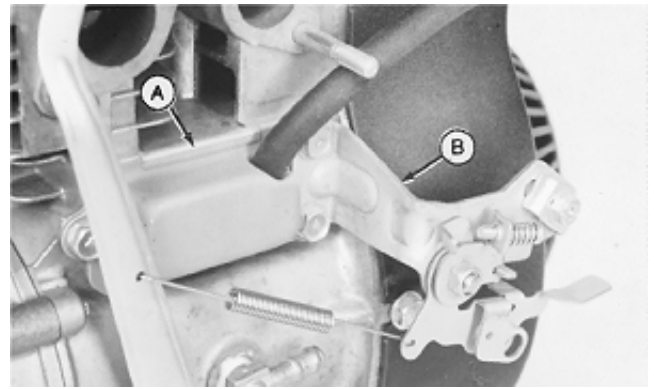


MX,2006A1,A13 -19-21OCT92

SERVICE BREATHER—FA210D-AS19-01

NOTE: Tappet chamber cover is an oil breather.

1. Remove intake manifold (See this group.)
2. Remove throttle lever assembly (B).
3. Remove tappet chamber cover/breather and gasket (A).
4. Clean cover/breather and tube. Inspect for cracks or damage. Replace if necessary.
5. Install new gasket and cover/breather.
6. Install throttle lever assembly.
7. Install intake manifold.



M80286 -UN-11MAR91

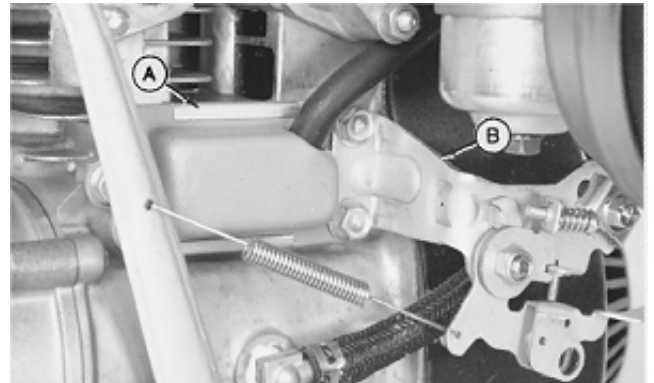
20-06-11

MX,2006A1,A14 -19-21OCT92

SERVICE BREATHER—FA210D-AS17/BS17/CS17

NOTE: Tappet chamber cover is an oil breather.

1. Remove throttle lever assembly (B).
2. Remove tappet chamber cover/breather and gasket (A).
3. Clean cover/breather and tube. Inspect for cracks or damage. Replace if necessary.
4. Install new gasket and breather/cover.
5. Install throttle lever assembly.



M80287 -UN-11MAR91

MX,2006A1,A15 -19-21OCT92

SERVICE AIR CLEANER

NOTE: Replace elements yearly or every 25 hours as required.

1. Remove and disassemble air cleaner.

IMPORTANT: Do not clean elements with solvent or compressed air.

2. Wash foam element (A) in detergent and water. Dry element.

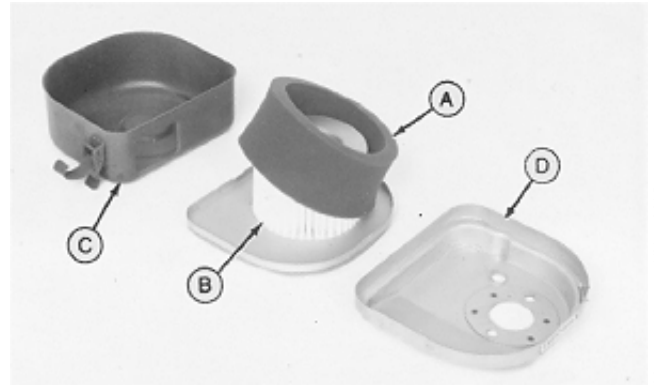
3. Put engine oil on element (A). Squeeze out excess oil.

4. Gently tap paper element (B) to remove dust:
—Element is still usable if you can see light through element and paper appears clean.
—Install new element if element is oily, dirty, bent, torn, crushed, or obstructed in any way.

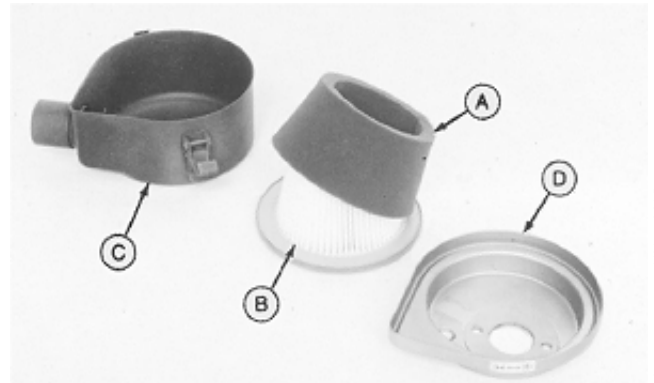
5. Inspect cover (C) and base (D) for damage. Replace if necessary.

IMPORTANT: Any time air cleaner base is removed, check for free choke operation during reassembly.

6. Assemble and install air cleaner.



FA210D-AS20/AS19-01/AS17/BS17



FA210D-CS17

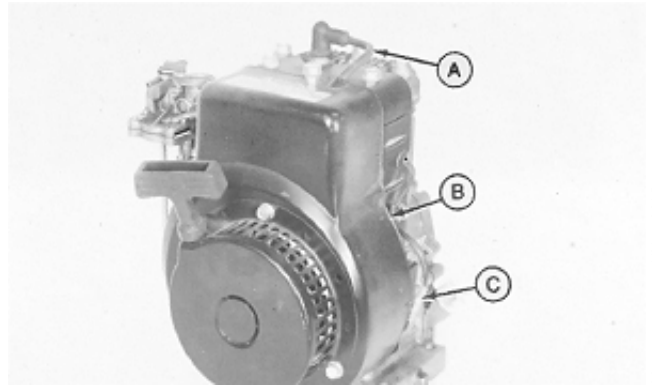
A—Foam Element
B—Paper Element
C—Cover
D—Base

MX,2006A1,A16 -19-21OCT92

REMOVE AND INSTALL BLOWER HOUSING—FA130D AND FA210D-AS20

NOTE: It is not necessary to remove recoil starter from housing.

1. Disconnect spark plug cap (A).
2. Remove fuel tank, if equipped. (See this group.)
3. Disconnect wiring lead (C).
4. Remove blower housing (B).
5. Install blower housing.
6. Connect wiring lead.
7. Install fuel tank, if equipped.
8. Connect spark plug cap.



M80242 -UN-11MAR91

20
10
1

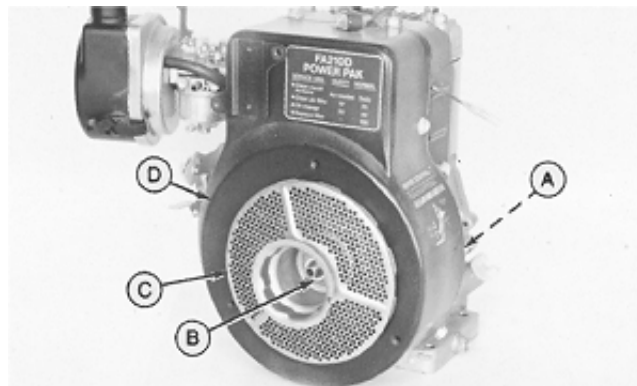
MX,2010A1,A1 -19-21OCT92

REMOVE AND INSTALL BLOWER HOUSING—FA210D-AS19-01/AS17/BS17/CS17

1. Remove recoil starter.
2. Remove fuel pump, if equipped. (See Group 05.)
3. Disconnect wiring lead (A), if equipped.
4. Remove nut and washer (B), starter cup/screen assembly (C), and spacer(s).
5. Remove blower housing (D).
6. Install blower housing.
7. Install spacer(s) and starter cup/screen assembly.
8. Adjust flywheel screen. (See this group.)

NOTE: Install washer with concave side toward flywheel.

9. Install washer and nut. Tighten nut to 60 N·m (44 lb-ft).
10. Connect wiring lead, if equipped.
11. Install fuel pump, if equipped.
12. Install recoil starter.



A—Wiring Lead
B—Nut and Washer
C—Starter Cup/Screen Assembly
D—Blower Housing

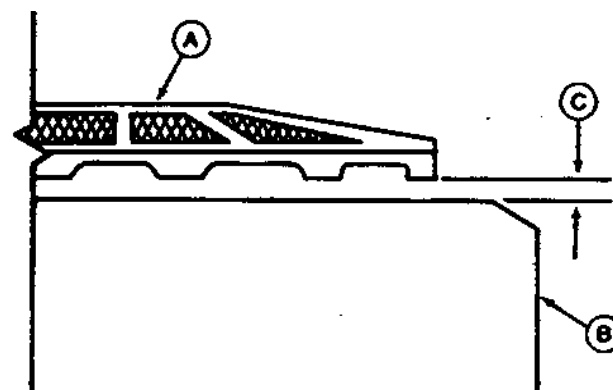
MX,2010A1,A2 -19-21OCT92

FLYWHEEL SCREEN ADJUSTMENT

Adjust gap (C) between the blades under screen (A) and blower housing (B) to specifications using spacers.

FLYWHEEL SCREEN ADJUSTMENT

Gap 1—3 mm (0.039—0.118 in.)



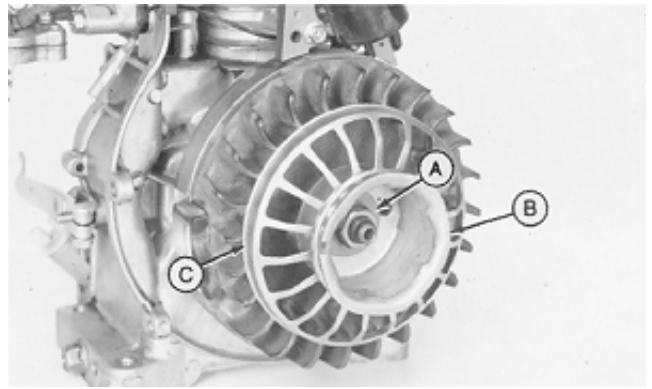
MX,2010A1,A3 -19-21OCT92

REMOVE AND INSTALL FLYWHEEL—FA130D AND FA210D-AS20

1. Remove blower housing. (See this group.)
2. Hold flywheel and remove nut and washer (A).
3. Remove starter cap (B) and bracket (C), if equipped.
4. Remove flywheel using a flywheel puller.
5. Install flywheel.

NOTE: Install washer with concave side toward flywheel.

6. Install bracket, starter cup, washer and nut. Tighten nut to 60 N·m (44 lb-ft).
7. Install blower housing.



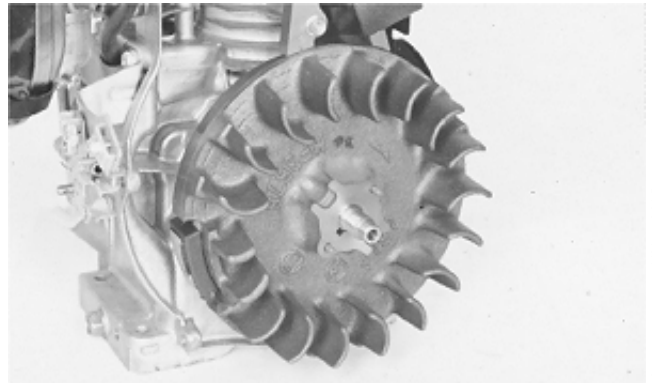
M80243 -UN-11MAR91

20
10
3

MX,2010A1,A4 -19-21OCT92

REMOVE AND INSTALL FLYWHEEL—FA210D-AS19-01/AS17/BS17/CS17

1. Remove blower housing. (See this group.)
2. Remove flywheel using a two-jaw puller.
3. Install flywheel.
4. Install blower housing.



M80291 -UN-11MAR91

MX,2010A1,A5 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean cylinder head

SCOTCH-BRITE is a trade mark of the 3M Company.

MX,5015A1,A1-19-21OCT92

20
15
1

REMOVE AND INSTALL CYLINDER HEAD

1. Remove blower housing. (See Group 10.)
2. Remove cylinder head cover.
3. Remove spark plug.
4. Remove cylinder head and gasket.
5. Make repairs as necessary. (See procedures in this group.)

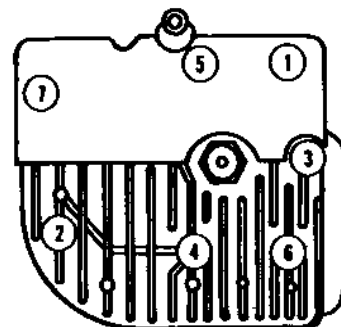
IMPORTANT: Gasket surfaces are coated with sealant. Do not damage surfaces or gasket during installation.

6. Install cylinder head with new gasket.
7. Install cylinder head cover and cap screws. Tighten finger tight.
8. Tighten cap screws in sequence shown. Tighten to initial torque specifications.
9. Continue in sequence, 4 N·m (35 lb-in.) at a time, until final torque is as specified.
10. Install spark plug and tighten to specification.
11. Install blower housing.

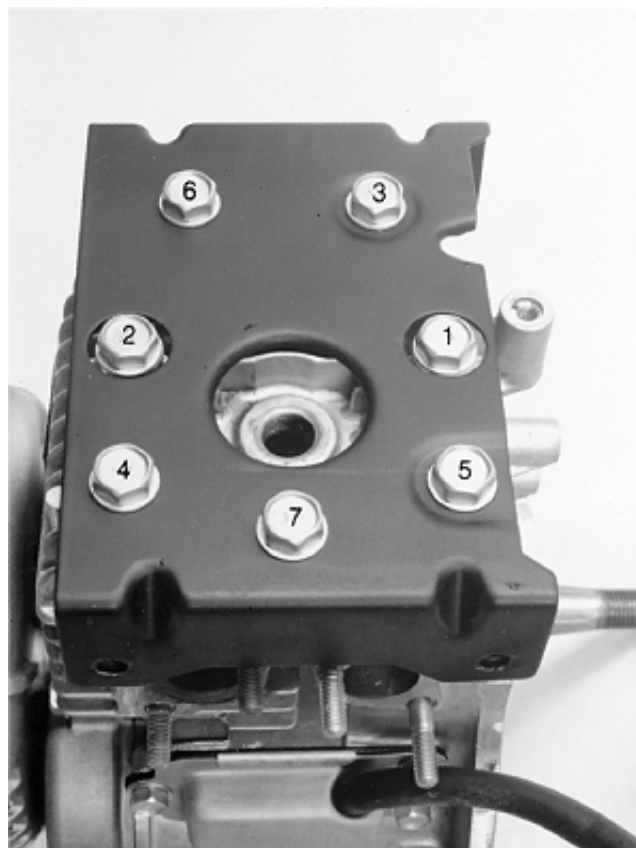
TORQUE SPECIFICATIONS

Cylinder Head Cap Screws

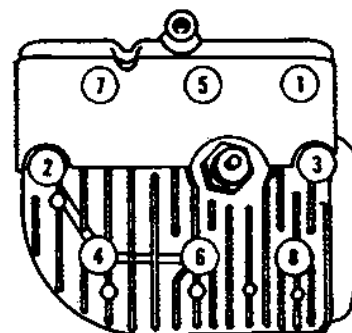
Initial Torque	10 N·m (89 lb-in.)
Final Torque	21 N·m (186 lb-in.)
Spark Plug	
FA130D	17 N·m (156 lb-in.)
FA210D	24 N·m (212 lb-in.)



FA130D-AS16/AS19



FA130D-AN00



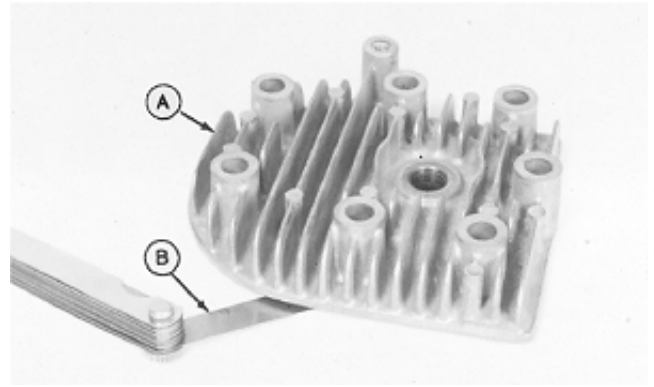
FA210D

INSPECT CYLINDER HEAD

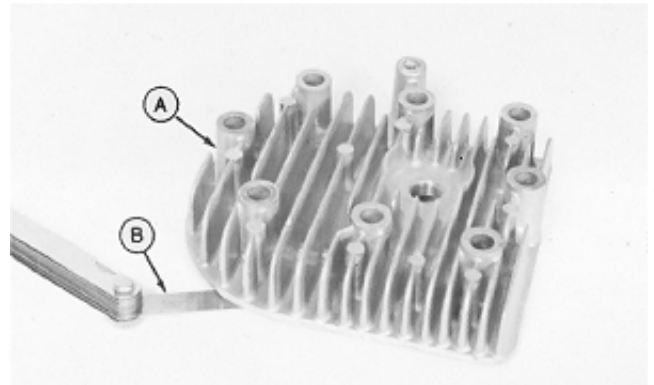
1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Put cylinder head (A) on a surface plate. Check for distortion at several points around the head using a feeler gauge (B). Replace head if distortion is more than specifications.

CYLINDER HEAD DISTORTION SPECIFICATIONS (MAX)

FA130D	0.25 mm (0.010 in.)
FA210D	0.40 mm (0.015 in.)



FA130D



FA210D

MX,2015A1,A2 -19-21OCT92

-UN-11MAR91
M80245-UN-11MAR91
M8029220
15
3

20
15
4

Group 20 Cylinder Block, Valves and Internal Components

OTHER MATERIAL

Number	Name	Use
	Valve Guide Cleaner	Clean valve guides.
	Prussion Blue Compound	Check valve seat contact.
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,2020A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalogue.

Oversized Piston Ring Kit

Oversized Pistons

Cylinder Block

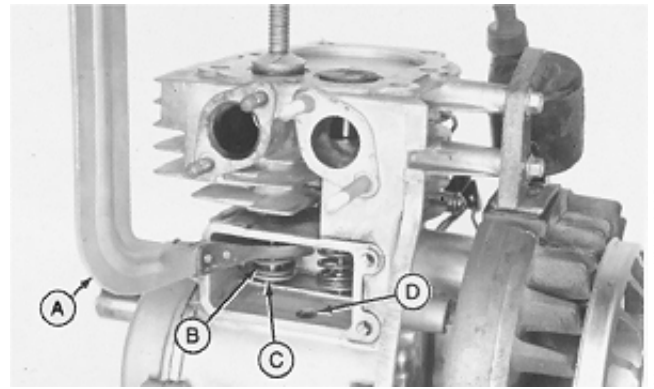
Overhaul Gasket Kit

Short Block Kit

MX,2020A1,A2 -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove carburetor. (See Group 05.)
2. Remove cylinder head. (See Group 15.)
3. Remove tappet chamber cover/breather and gasket.
4. Compress valve spring (B) with a spring compressor (A) and move spring retainer (C) so larger hole is around valve stem.
5. Remove compressor, valves, springs and retainers.
6. Inspect and analyze valves. (See Section 100, Group 05.)
7. Inspect springs, valve guides and seats. (See this group.)
8. Check valve-to-tappet clearance. (See this group.)
9. Check that drainback hole (D) is open.
10. Align valve springs, and retainers in tappet chamber.
11. Coat valve stems with oil and install in cylinder block.
12. Compress each spring and position retainer so smaller hole is around valve stem.
13. Install tappet chamber cover/breather and new gasket.
14. Install cylinder head.
15. Install carburetor.



A—Spring Compressor
B—Valve Spring
C—Spring Retainer
D—Drainback Hole

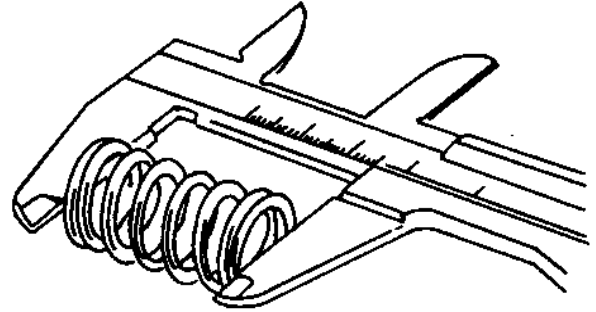
MX,2020A1,A3 -19-21OCT92

INSPECT VALVE SPRINGS

Inspect valve springs. Replace springs if damaged or if free length is less than specification.

SPECIFICATION (MIN)

Valve Spring Free Length 23.50 mm (0.930 in.)



MX,2020A1,A4 -19-21OCT92

M50036 -UN-31AUG88

20
20
3

INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guides. Replace cylinder block if inside diameter is greater than specifications.

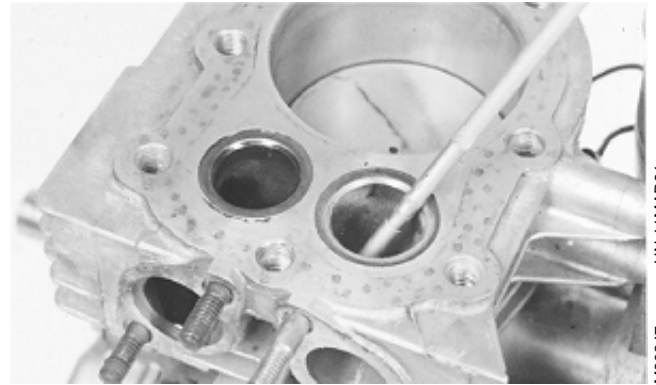
SPECIFICATION (MAX) I.D.

FA130D

Intake 6.10 mm (0.2401 in.)
Exhaust 6.09 mm (0.2397 in.)

FA210D

Intake 6.10 mm (0.240 in.)
Exhaust 6.13 mm (0.242 in.)



MX,2020A1,A5 -19-21OCT92

M80247 -UN-11MAR91

RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.

2. To recondition valve seat, cut at 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).

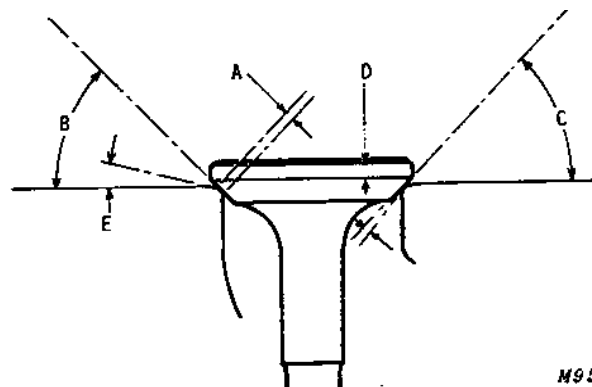
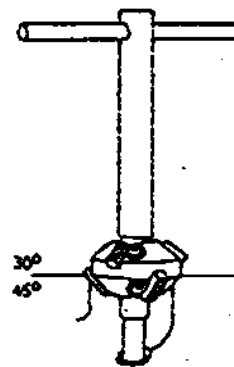
3. Cut valve seating surface (A) as close as possible to specifications.

4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface:

FA130D	1.00—1.60 mm (0.039—0.063 in.)
FA210D	1.30 mm (0.050 in.)
B—Valve Seat Angle	45°
C—Valve Face Angle	45°
D—Valve Margin	0.60 mm (0.020 in.)
E—Valve Narrowing Angle	30°



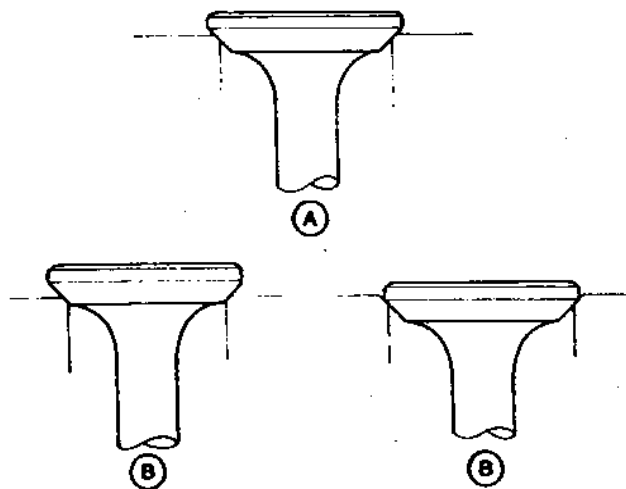
MX,2020A1,A6 -19-21OCT92

5. Center valve seat on the valve face:

—(A) shows correct position.

—(B) shows incorrect.

6. Check seat for good contact using Prussian Blue Compound.

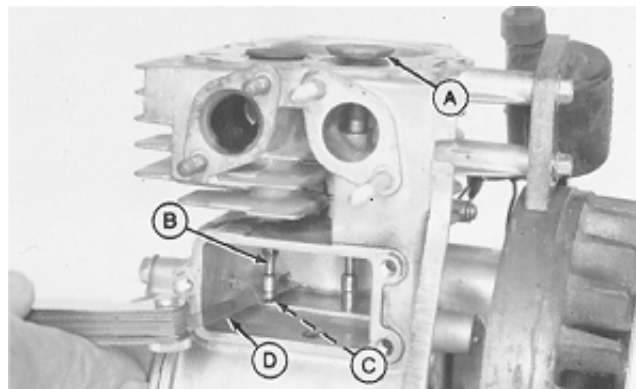


MX,3015A1,A9 -19-21OCT92

CHECK VALVE-TO-TAPPET CLEARANCE

NOTE: Valve grinding changes the valve-to-tappet clearance. Check clearance when engine is cold.

1. Install valves in cylinder block.
2. Turn crankshaft until intake valve (A) is at its highest position. Check clearance between valve (B) and tappet (C), with feeler gauge (D) and compare to specifications.
3. Grind end of valve stem to obtain proper clearance.



M80248 -UN-11MAR91

VALVE CLEARANCE SPECIFICATIONS

FA130D	
Exhaust	0.10—0.34 mm (0.004—0.013 in.)
Intake	0.12—0.18 mm (0.005—0.007 in.)
FA210D	
Exhaust	0.12—0.34 mm (0.005—0.013 in.)
Intake	0.12—0.18 mm (0.005—0.007 in.)

A—Intake Valve
B—Exhaust Valve
C—Tappet
D—Feeler Gauge

MX,2020A1,A7 -19-21OCT92

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is:

FA130D0.5L (1.06 pt)

FA210D0.6L (1.27 pt)

1. Drain crankcase.
2. Remove crankcase cover and gasket.
3. Clean crankcase and crankcase cover gasket surfaces.

NOTE: Do not force cover. Gears must mesh for proper positioning.

4. Install gasket and cover. Tighten cap screws using the sequence shown.

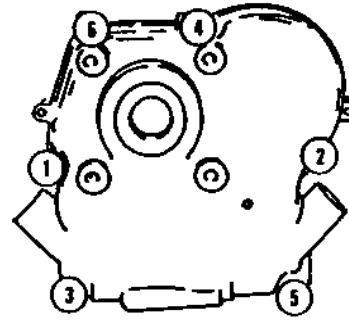
TORQUE SPECIFICATIONS

Mounting Cap Screws

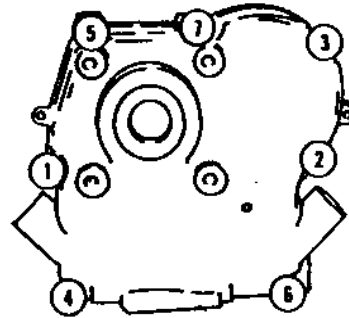
FA130D 6 N·m (53 lb-in.)

FA210D 21 N·m (186 lb-in.)

Oil Drain Plug 14 N·m (121 lb-in.)



FA130D



FA210D

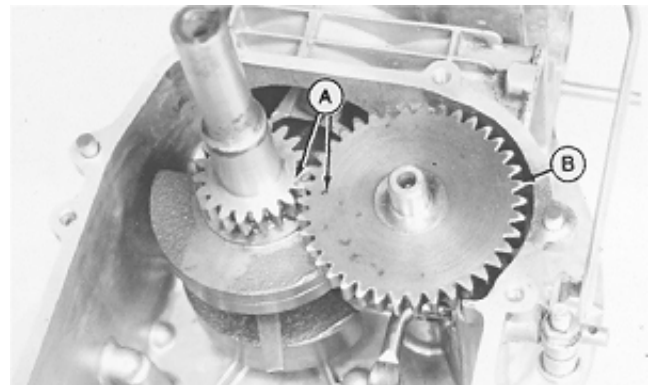
MX,2020A1,A8 -19-21OCT92

REMOVE AND INSTALL CAMSHAFT

1. Remove crankcase cover. (See this group.)

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

2. Rotate crankshaft until timing marks (A) align.
3. Remove camshaft (B).
4. Inspect camshaft. (See this group.)
5. Apply clean engine oil to camshaft lobes and journals.
6. Align timing marks and install camshaft.
7. Install crankcase cover.



MX,2020A1,A9 -19-21OCT92

INSPECT CAMSHAFT

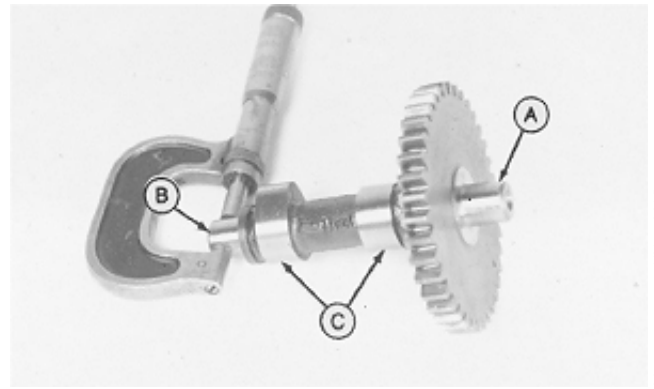
Inspect camshaft for worn or broken teeth.

NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.

Measure PTO side journal (A), flywheel side journal (B), and lobes (C). Replace camshaft and tappets if less than specifications.

SPECIFICATIONS (MIN)

	PTO Side Journal	Flywheel Side Journal	Cam Lobes
FA130D	11.94 mm (0.469 in.)	11.94 mm (0.469 in.)	23.25 mm (0.915 in.)
FA210D	12.94 mm (0.509 in.)	12.94 mm (0.509 in.)	Intake: 26.45 mm (1.041 in.) Exhaust: 26.35 mm (1.037 in.)



M80251 -UN-11MAR91

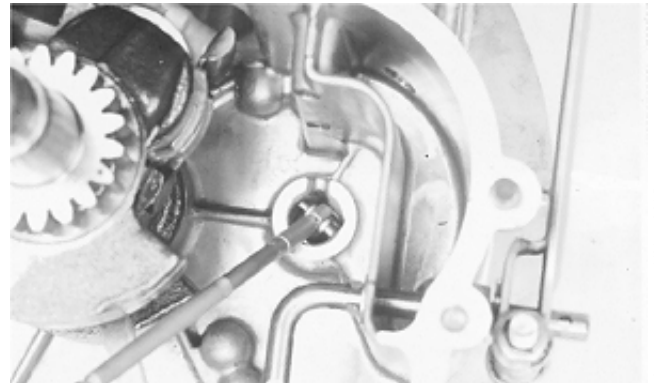
MX,2020A1,A10 -19-21OCT92

INSPECT CAMSHAFT PLAIN BEARINGS

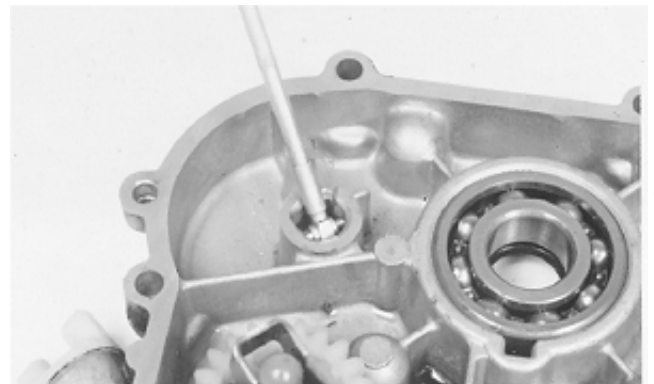
1. Remove camshaft. (See this group.)
2. Measure camshaft bearings in cylinder block and crankcase cover. Replace block or cover if diameter is greater than specification.
3. Install camshaft.

SPECIFICATIONS (MAX)

	Cylinder Block Bearing	Crankcase Cover Bearing
FA130D	12.04 mm (0.474 in.)	12.04 mm (0.474 in.)
FA210D	13.05 mm (0.514 in.)	13.05 mm (0.514 in.)



Cylinder Block



Crankcase Cover

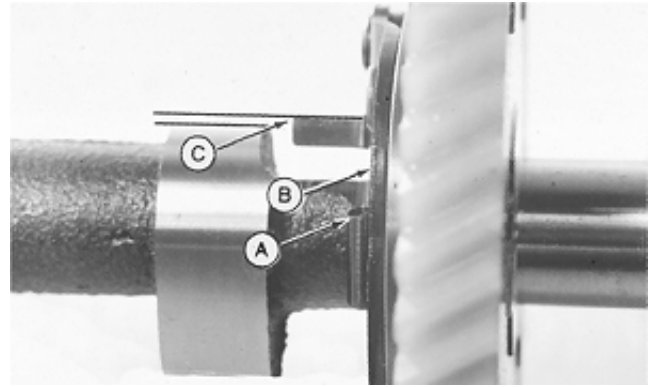
M80252 -UN-11MAR91

M80253 -UN-11MAR91

MX,2020A1,A11 -19-21OCT92

INSPECT AUTOMATIC COMPRESSION RELEASE (A.C.R.)—FA210D-AS20

1. Remove camshaft. (See this group.)
2. Inspect automatic compression release (A.C.R.) for damage.
3. Inspect spring (A). Replace if worn or damaged.
4. Move weight (B) by hand to check for proper operation.
5. Check that tab (C) sits slightly above cam lobe when weight is released. Tab should drop below cam when weight is operated.
6. Replace A.C.R. if it does not operate properly.
7. Install camshaft.

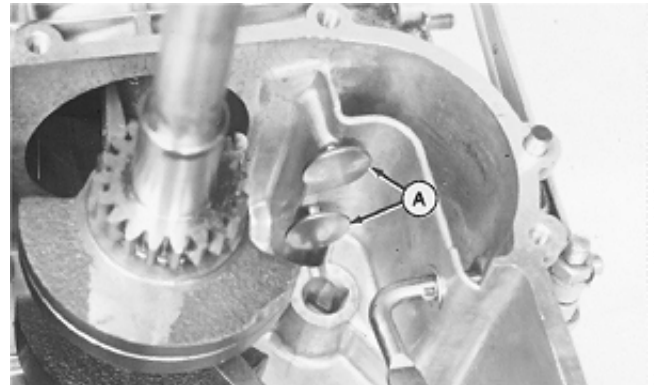


M54493 -UN-09JAN91

MX,2020A1,A12 -19-21OCT92

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)
- NOTE: Mark tappets so they can be installed in their original bores during assembly.*
2. Remove tappets (A).
 3. Inspect tappets for wear or damage. Replace if necessary.
 4. Apply clean engine oil to tappets and bores.
 5. Install tappets in original bores.
 6. Install camshaft.

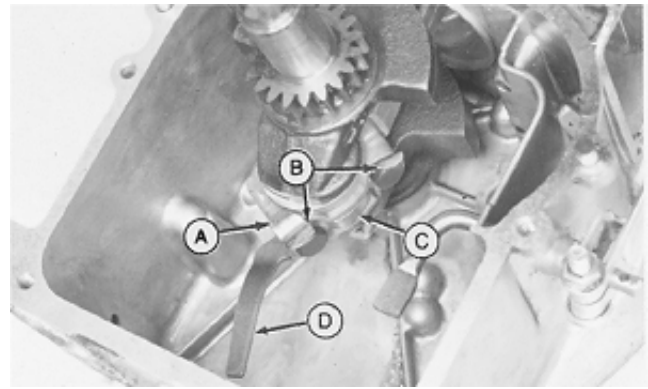


M80254 -UN-11MAR91

MX,2020A1,A13 -19-21OCT92

REMOVE AND INSTALL PISTON AND CONNECTING ROD

1. Remove cylinder head. (See Group 15.)
2. Remove camshaft. (See this group.)
3. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
4. Bend open locking tabs (B).
5. Remove cap screws, lock plate (C), oil splasher (D) and connecting rod cap (A).
6. Push piston and connecting rod from cylinder bore.
7. Make repairs as necessary. (See procedures in this group.)



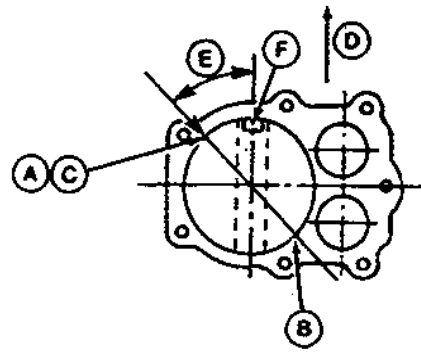
A—Connecting Rod Cap
B—Locking Tabs
C—Lock Plate
D—Oil Splasher

MX,2020A1,A14 -19-21OCT92

M80255 -UN-11MAR91

20
20
9

8. Deglaze cylinder bore. (See Section 100, Group 15.)
9. Align piston assembly to cylinder bore with piston ring end gaps as shown.
10. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
11. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
12. Install piston assembly in cylinder bore with notch on piston head facing flywheel side.
13. Install connecting rod cap, oil splasher and lock plate. Tighten cap screws to specifications.
14. Bend locking tabs over cap screws.
15. Install camshaft.
16. Install cylinder head.



A—First Ring End Gap
B—Second Ring End Gap
C—Oil Ring End Gap
D—Flywheel Side
E—45° Angle
F—Notch

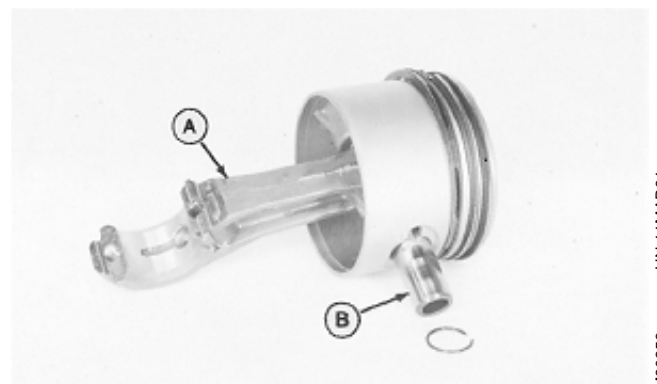
TORQUE SPECIFICATIONS

FA130D	12 N·m (106 lb-in.)
FA210D	19 N·m (168 lb-in.)

MX,2020A1,A15 -19-21OCT92

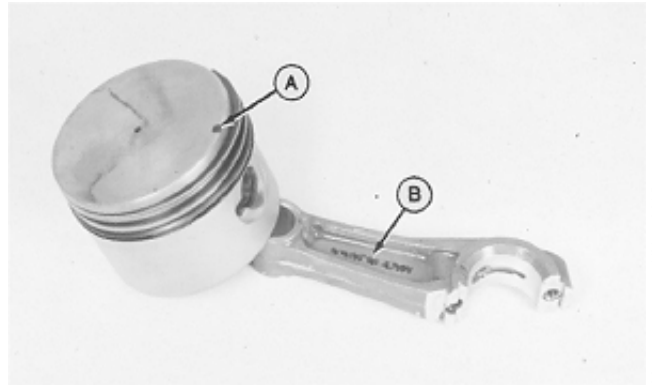
DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

1. Remove circlip, piston pin (B) and connecting rod (A).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.



MX,2020A1,A16 -19-21OCT92

4. Align notch (A) on piston head with MADE IN JAPAN (B) on connecting rod.
5. Install piston pin and circlip.



MX,2020A1,A17 -19-21OCT92

M80257 -UN-11MAR91

20
20
11

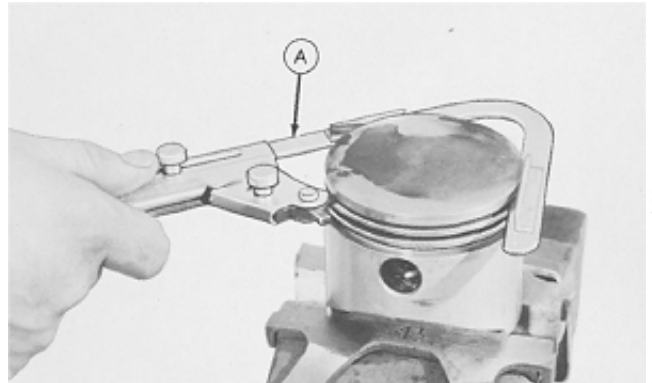
INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)

2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.
4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.
5. Check that oil return passages in grooves are open.



MX,2020A1,A18 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: On FA130D engines, compression rings are tapered and cannot be measured as shown.

Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.



M38102 -UN-29AUG88

CLEARANCE SPECIFICATION (MAX)

	Top Ring	Second Ring	Oil Control Ring
FA130D	—	—	0.15 (0.006 in.)
FA210D	0.15 mm (0.006 in.)	0.13 mm (0.005 in.)	0.12 mm (0.004 in.)

MX,2020A1,A19 -19-21OCT92

8. Measure piston pin outer diameter. Replace if less than specification.

9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

	Piston Pin O.D. (MIN)	Piston Bore I.D. (MAX)
FA130D	12.98 mm (0.511 in.)	13.04 mm (0.513 in.)
FA210D	14.98 mm (0.590 in.)	15.05 mm (0.593 in.)



M50064 -UN-31AUG88



M80258 -UN-11MAR91

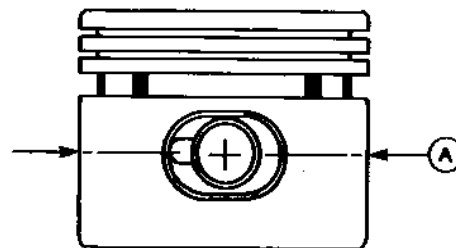
MX,2020A1,A20 -19-21OCT92

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)



SPECIFICATIONS

Piston O.D. (A)

FA130D 61.86—61.89 mm (2.435—2.437 in.)

FA210D 71.86—71.89 mm (2.829—2.830 in.)

Piston-to-Cylinder Bore Clearance

Maximum 0.163 mm (0.0064 in.)

Standard 0.087—0.137 mm (0.0034—0.0054 in.)

MX,2020A1,A20A -19-21OCT92

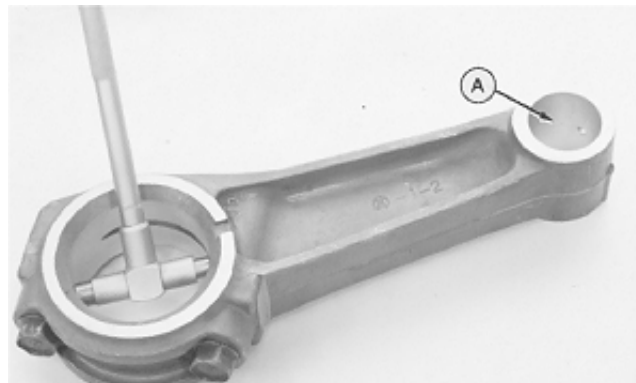
INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.

2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)

3. Install connecting rod cap. Tighten cap screws to specification.

4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



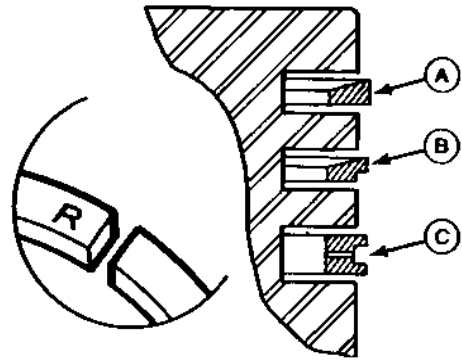
BEARING I.D. SPECIFICATIONS (MAX)

	Crankshaft Bearing	Piston Bearing
FA130D	24.05 mm (0.947 in.)	13.04 mm (0.513 in.)
FA210D	27.06 mm (1.065 in.)	15.04 mm (0.592 in.)

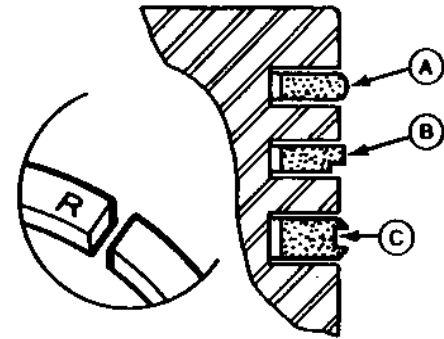
MX,2020A1,A21 -19-21OCT92

REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)
4. Install top ring (A), second ring (B) and oil ring (C) with R or NPR mark facing up. Rings should turn freely in grooves.



FA130D



FA210D

MX,2020A1,A22 -19-21OCT92

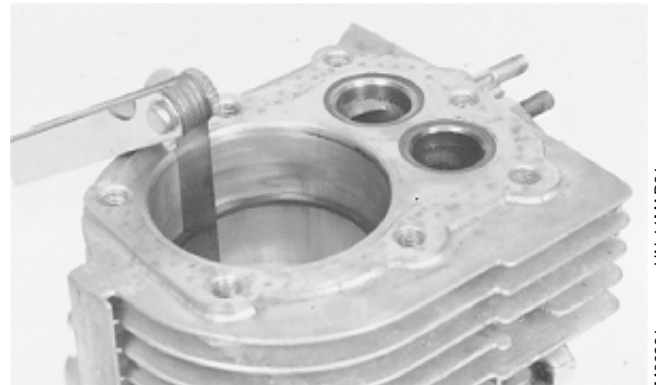
-UN-06APR91
M80234-UN-19MAR91
M80260

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS

Minimum End Gap	0.18 mm (0.007 in.)
Maximum End Gap	1.00 mm (0.039 in.)

-UN-11MAR91
M80261

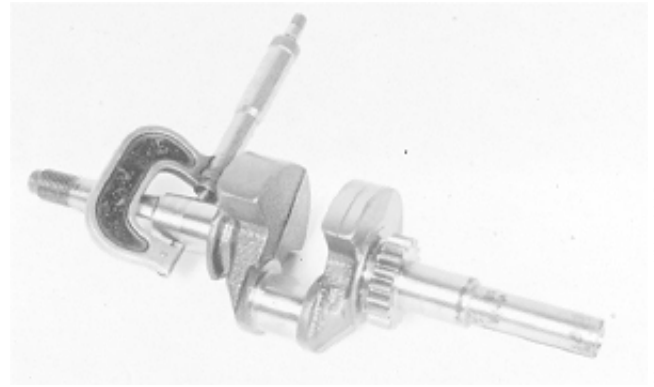
MX,2020A1,A23 -19-21OCT92

REMOVE, INSPECT AND INSTALL CRANKSHAFT

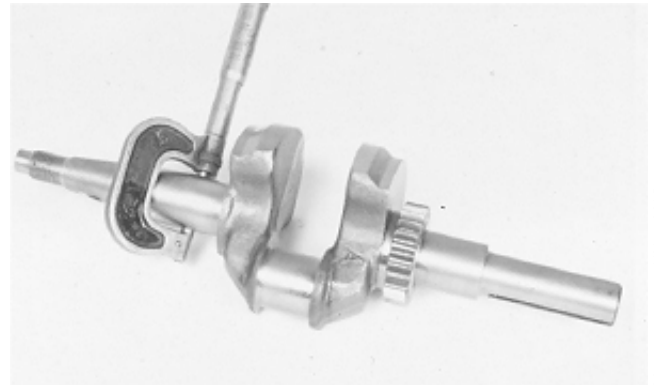
1. Remove piston and connecting rod. (See this group.)
2. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

3. Check crankshaft alignment (T.I.R.). (See this group.)
4. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
5. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
6. Measure crankshaft main bearing journals and connecting rod journal. Replace crankshaft if measurements are less than specifications.
7. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.
8. Apply clean engine oil to crankshaft bearings and journal.
9. Pack lithium based grease in oil seals.
10. Install crankshaft.
11. Install piston and connecting rod.



FA130D



FA210D

JOURNAL SPECIFICATIONS (MIN)

	Main Bearing Journal		Connecting Rod Journal
	PTO Side	Flywheel Side	
FA130D	—	21.97 mm (0.865 in.)	23.95 mm (0.943 in.)
FA210D	—	24.96 mm (0.983 in.)	26.95 mm (1.061 in.)

MX,2020A1,A24 -19-21OCT92

-UN-11MAR91
M80262-UN-11MAR91
M8029520
20
15

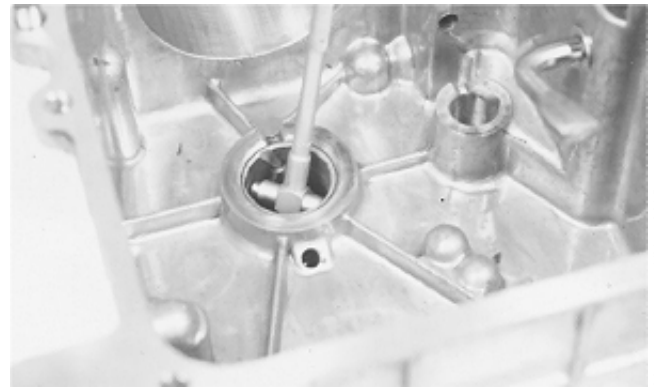
INSPECT CRANKSHAFT PLAIN BEARING

NOTE: Cylinder block is fitted with a replaceable bearing shell.

1. Remove crankshaft. (See this group.)
2. Measure crankshaft bearing in cylinder block. Replace shell, if diameter is greater than specifications. (See this group.)
3. Install crankshaft.

BEARING I.D. SPECIFICATIONS (MAX)

FA130D	22.10 mm (0.869 in.)
FA210D	25.10 mm (0.988 in.)



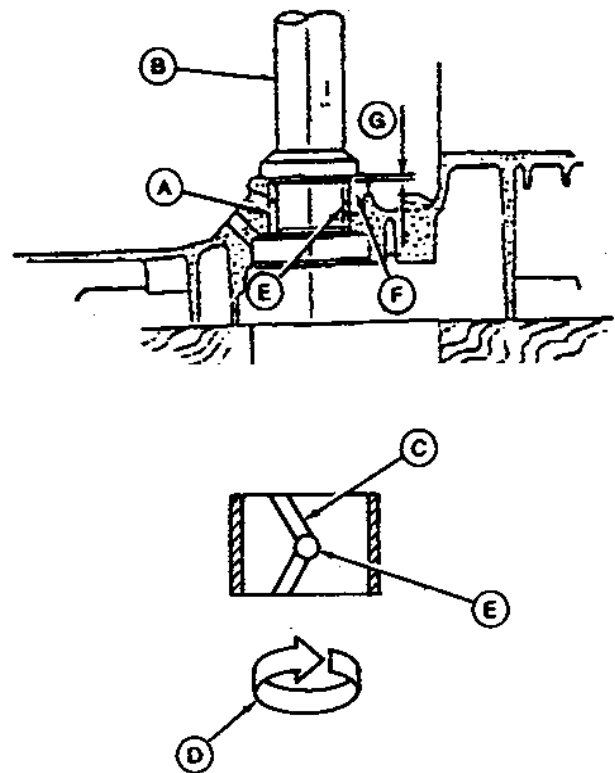
M80263 -UN-11MAR91

MX,2020A1,A25 -19-21OCT92

REPLACE CRANKSHAFT BEARING SHELL

1. Drive old bearing (A) from crankcase using an appropriate bushing tool (B) and an arbor press.
2. Align new bearing so arrow head formed by oil grooves (C) points opposite to engine rotation (D). Align oil hole (E) in bearing with oil passage (F) in crankcase.
3. Install new bearing to depth (G) 1 mm (0.039 in.) below flange surface.

A—Bearing
B—Bushing Tool
C—Oil Grooves
D—Engine Rotation
E—Oil Hole
F—Oil Passage
G—Installation Depth



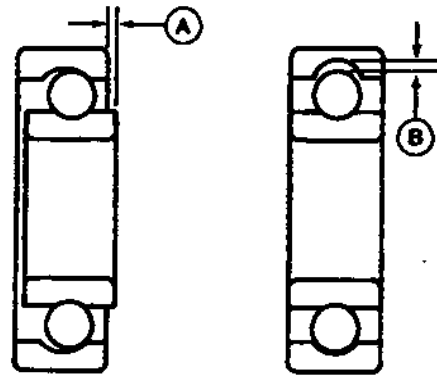
M51527 -UN-31AUG88

M51526 -UN-31AUG88

MX,2020A1,A26 -19-21OCT92

INSPECT CRANKSHAFT BALL BEARING

1. Remove PTO end oil seal. (See Inspect Oil Seals in this group.)
2. Remove crankshaft bearing from crankcase cover using a bearing, bushing and seal driver set.
3. Thoroughly clean bearing in solvent. Dip bearing in light weight oil.
4. Spin the bearing by hand and check for axial (A) and radial (B) free play.
5. Replace the bearing if it is noisy or has too much play.
6. Install bearing flush to inside of crankcase cover using a bearing, bushing and seal driver set.
7. Install oil seal.



MX,2020A1,A27 -19-21OCT92

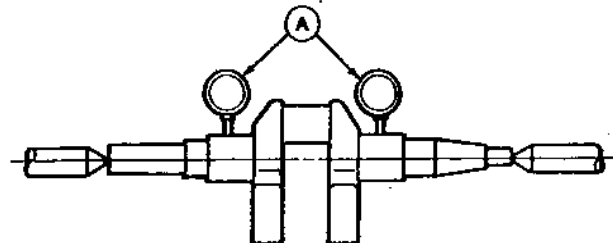
M38073 -UN-29AUG88

20
20
17**CHECK CRANKSHAFT ALIGNMENT (TIR)**

Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

Maximum TIR 0.05 mm (0.002 in.)



MX,2020A1,A28 -19-21OCT92

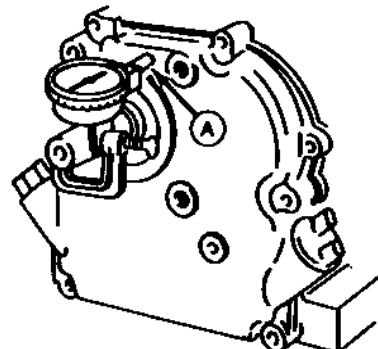
M51761 -UN-07SEP88

MEASURE CRANKSHAFT END PLAY

1. Measure end play using dial indicator (A).
2. Move crankshaft in and out. Record this measurement. Replace block or crankshaft if end play is not within specifications.

SPECIFICATIONS

End Play 0—0.30 mm (0—0.012 in.)



MX,2020A1,A29 -19-21OCT92

M80264 -UN-19MAR91

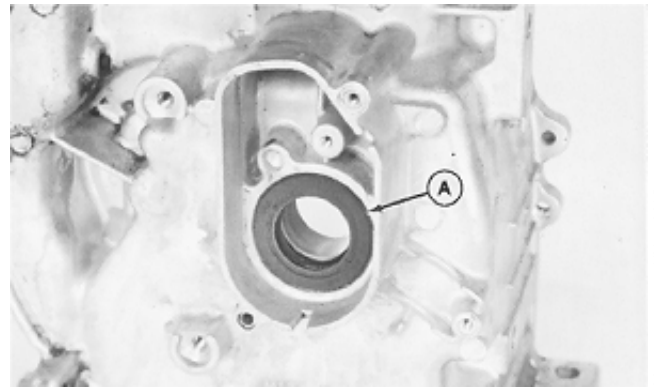
INSPECT OIL SEALS

NOTE: Pack lithium base grease in new or used seals.

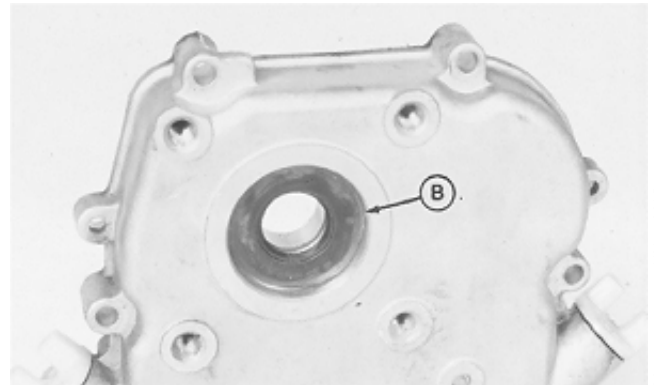
1. Remove flywheel. (See Group 10.)
 2. Inspect oil seals (A and B) at flywheel end and PTO end for wear or damage. Replace if necessary.
 3. Remove crankshaft. (See this group.)
 4. Remove worn or damaged seals with a screwdriver.
 5. Install seals with lip to inside of engine using a bushing, bearing and seal driver set.
- Press in seal on flywheel side until flush with hub.
- Press in PTO side seal below crankcase cover flange surface, to specification.
6. Install crankshaft.
 7. Install flywheel.

SPECIFICATIONS

Seal Depth 4 mm (0.150 in.)



Flywheel Side



PTO Side

MX,2020A1,A30 -19-21OCT92

INSPECT CYLINDER BLOCK

1. Remove crankshaft. (See this group.)
2. Clean and check block for cracks.
3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
4. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,2020A1,A31 -19-21OCT92

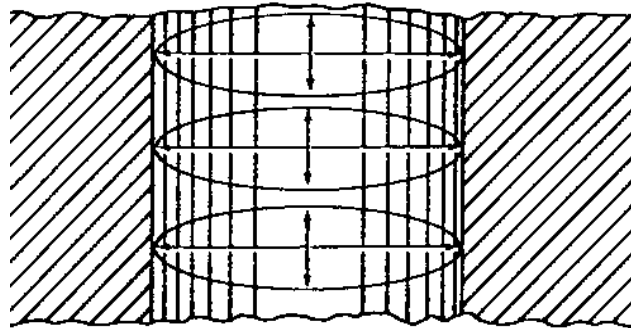
NOTE: A bare block is available for service.

5. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

6. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

NOTE: If cylinder is rebored, oversize piston and rings must be installed.

7. Install crankshaft.

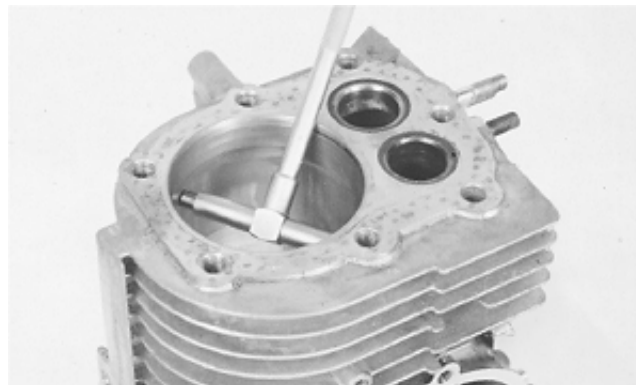


M51745 -UN-23FEB89

20
20
19

CYLINDER BORE SPECIFICATIONS

	Standard	Wear Limit
FA130D	61.98—62.00 mm (2.442—2.443 in.)	62.07 mm (2.446 in.)
FA210D	71.98—72.00 mm (2.834—2.835 in.)	72.06 mm (2.837 in.)



M80267 -UN-11MAR91

MX,2020A1,A32 -19-21OCT92

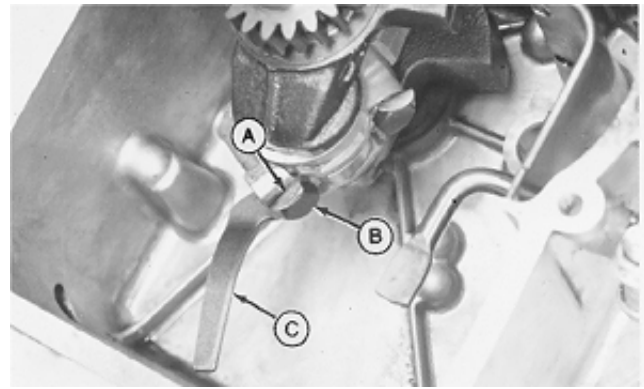
REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use 0.25 or 0.50 mm (0.010 or 0.020 in.) oversize pistons and rings. Have a reliable repair shop rebore the block to initial and final bore specifications. The repair shop must have proper equipment to handle cylinders made of high silicon content aluminum.

MX,2020A1,A33 -19-21OCT92

INSPECT AND REPLACE OIL SPLASHER

1. Remove camshaft. (See this group.)
2. Bend open locking tab (A).
3. Remove cap screw (B).
4. Remove oil splasher (C).
5. Inspect splasher for wear or damage. Replace if necessary.
6. Install splasher and cap screw. Tighten cap screw to specifications.
7. Bend locking tab over cap screw.
8. Install camshaft.



M80268 -UN-11MAR91

TORQUE SPECIFICATIONS

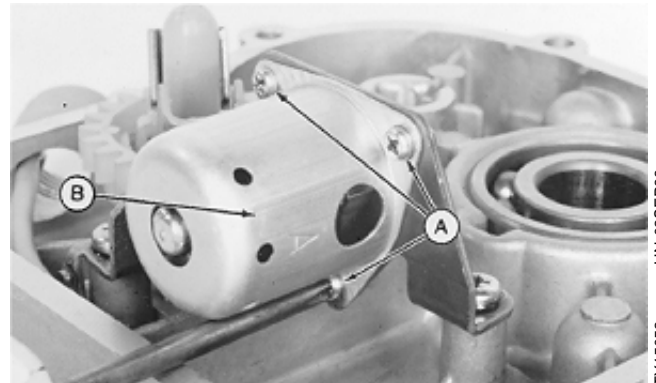
Cap Screws

FA130D	12 N·m (106 lb-in.)
FA210D	19 N·m (168 lb-in.)

MX,2020A1,A34 -19-21OCT92

CHECK LOW OIL LEVEL SENSOR—FA130D-AN00

1. Remove crankcase cover. (See this group.)
2. Remove screws (A) and float cover (B).

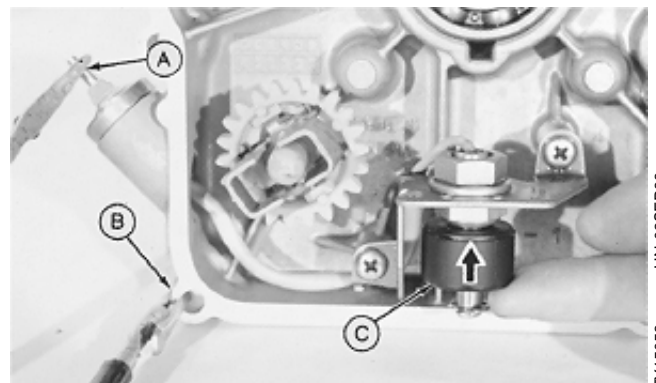


TY15052 -UN-02SEP88

MX,2020A1,A35 -19-21OCT92

3. Connect multimeter test leads to low oil sensor lead (A) and case (B). Set multimeter selector switch to Rx1 ohm position.

Slide float (C) to top of shaft. Multimeter should indicate infinite resistance.



TY15053 -UN-02SEP88

M98,2045A,A11 -19-21OCT92

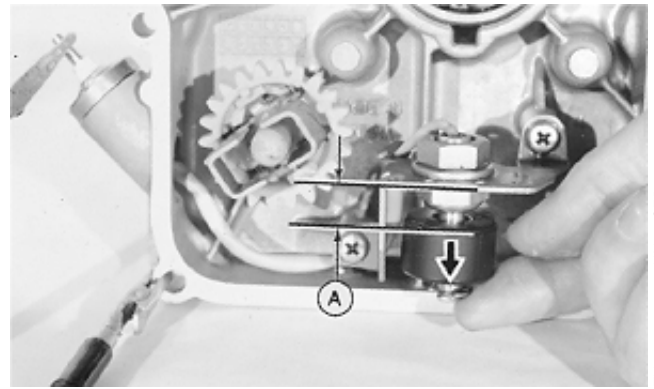
- Slowly slide float down shaft until needle of multimeter swings to 0 ohms.

Measure distance (A) with float at point where needle rapidly moves from infinite resistance to 0 ohms. Replace switch if not according to specification.

- Install cover.

SPECIFICATIONS

Distance (A) 9.5—15.5 mm (0.374—0.610 in.)



M98,2045A,A12 -19-21OCT92

TY15055 -UN-02SEP88

20
20
21

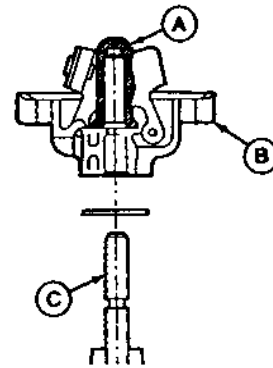
INSPECT AND REPLACE GOVERNOR

IMPORTANT: Removal damages governor. If not damaged, do not remove.

- Remove crankcase cover. (See this group.)
- Inspect governor. If necessary to replace, remove with screwdriver.
- If removed, press shaft (C) back into block until it protrudes 32.2—32.8 mm (1.267—1.291 in.).

NOTE: Assemble sleeve and gear before installing assembly on shaft.

- Install sleeve (A) onto governor gear (B).
- Install governor assembly onto shaft. Push down on assembly until it snaps into place.



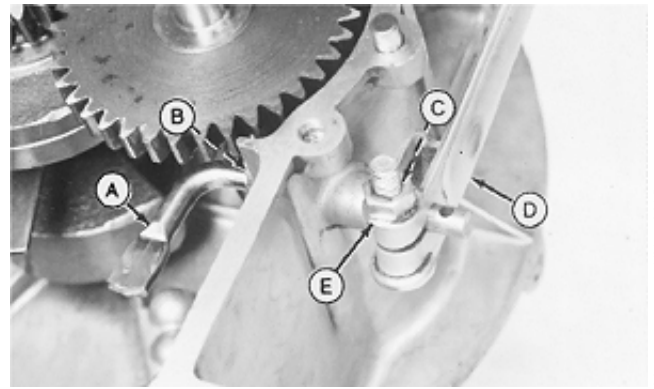
MX,2020A1,A36 -19-21OCT92

M51762 -UN-07SEP88

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (A). Replace if damaged.
3. To replace shaft, loosen nut (E) on lever (D).
4. Remove retaining pin (C), governor shaft and washer (B).
5. Install washer, shaft and retaining pin. Tighten nut.
6. Install crankcase cover.



A—Governor Shaft
B—Washer
C—Retaining Pin
D—Governor Lever
E—Nut

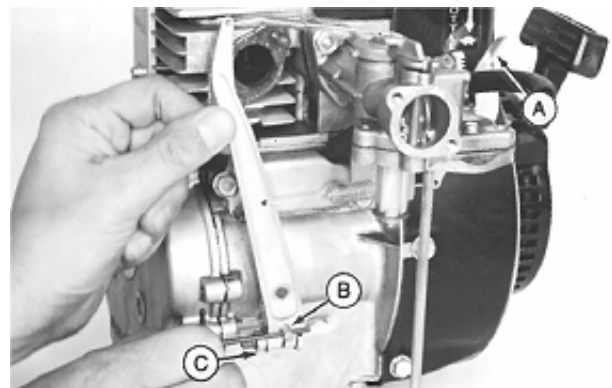
MX,2020A1,A37 -19-21OCT92

M80269 -UN-11MAR91

GOVERNOR ADJUSTMENT—FA130D-AS16/AS19 AND FA210D-AS20

NOTE: Fuel tank is removed for photo clarity only.

1. Move throttle control lever (A) to fast position.
2. Loosen nut (C).
3. Hold governor arm fully clockwise.
4. Using a small pin, rotate shaft (B) clockwise as far as it will go.
5. Tighten nut.

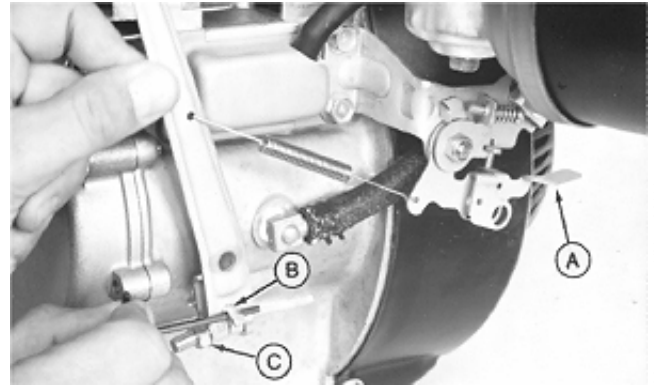


MX,2020A1,A38 -19-21OCT92

M80364 -UN-17MAY91

GOVERNOR ADJUSTMENT—FA130D-AN00 AND FA210D-AS19-01/AS17/BS17/CS17

1. Move throttle control lever (A) to fast position.
2. Loosen nut (C).
3. Hold governor arm fully clockwise.
4. Using a small pin, rotate shaft (B) clockwise as far as it will go.
5. Tighten nut.



M80366 -UN-17MAY91

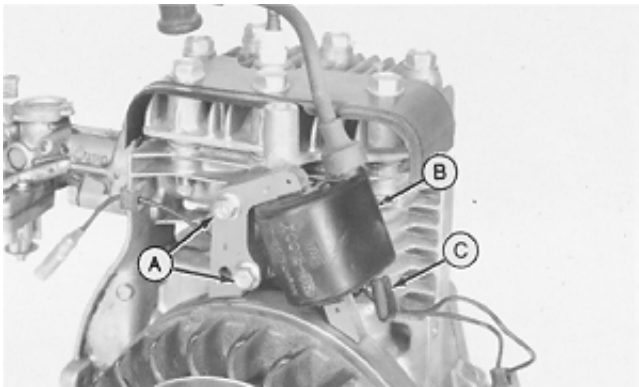
20
20
23

MX,2020A1,A39 -19-21OCT92

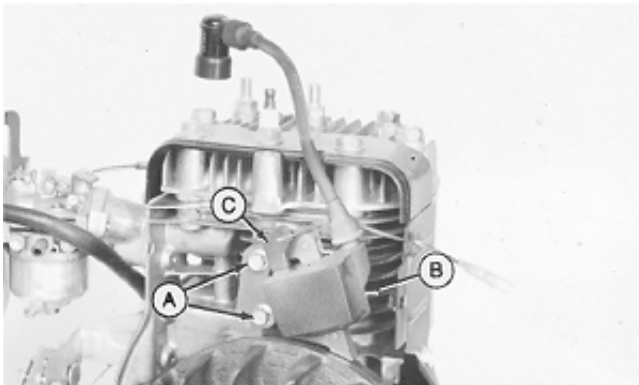
20
20
24

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove blower housing. (See Group 10.)
2. Disconnect wiring lead (C).
3. Remove cap screws (A) and armature with coil (B).
4. Loosely install armature with coil.
5. Connect wiring lead.
6. Adjust armature air gap. (See this group.)
7. Install blower housing.



FA130D and FA210D-AS20



FA210D-AS19-01/AS17/BS17/CS17

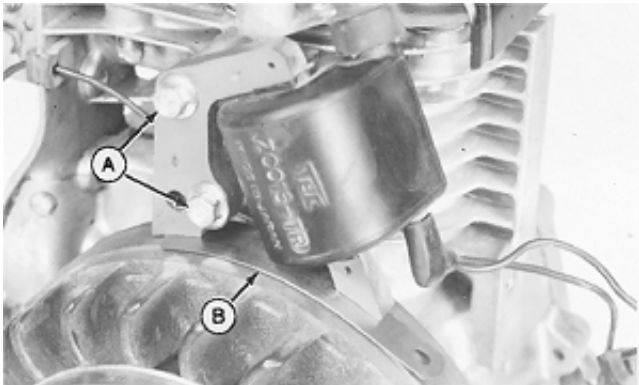
MX,2025A1,A1 -19-21OCT92

ADJUST ARMATURE AIR GAP

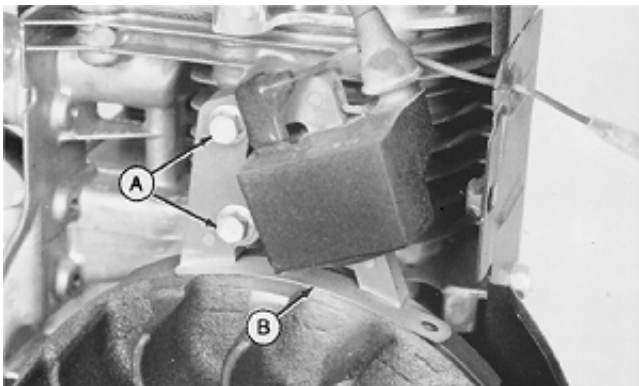
1. Turn flywheel magnet away from armature.
2. Insert feeler gauge blade (B), between flywheel and armature.
3. Push armature against flywheel and tighten screws (A).
4. Turn flywheel to remove gauge.

AIR GAP SPECIFICATIONS

Feeler Gauge Blade		
FA130D	0.50 mm (0.019 in.)
FA210D	0.30 mm (0.012 in.)



FA130D and FA210D-AS20



FA210D-AS19-01/AS17/BS17/CS17

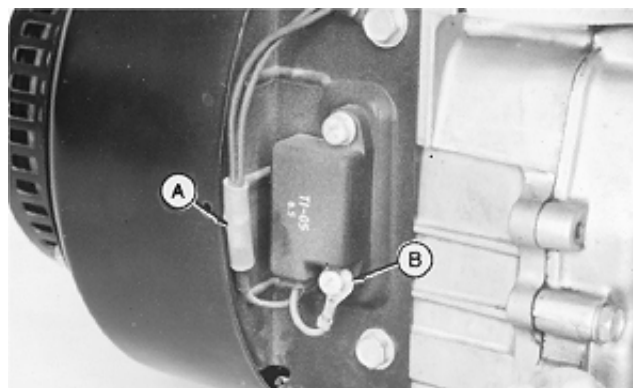
MX,2025A1,A2 -19-21OCT92

REPLACE IGNITOR—FA130D AND FA210D-AS20

1. Disconnect wiring lead (A).
2. Remove ignitor.

NOTE: When installing ignitor, put wiring lead (B) under screw and washer.

3. Install ignitor.
4. Connect wiring lead.



M80299 -UN-11MAR91

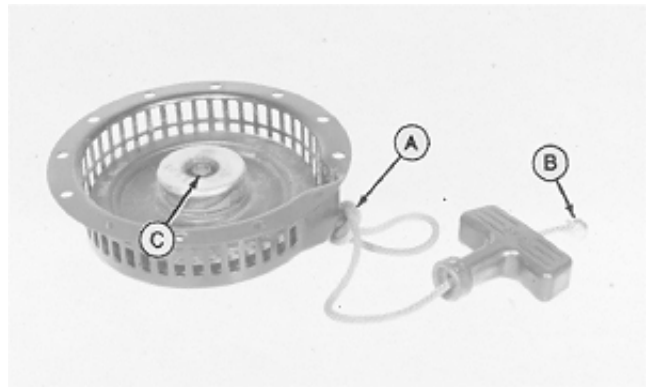
MX,2025A1,A3 -19-21OCT92

DISASSEMBLE RECOIL STARTER—FA130D-AS16/AS19

1. Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (A) to prevent rope from winding back onto reel.
3. Pry knot (B) out of handle and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (A). Slowly release reel tension. Do not let rope get wedged between reel and housing.

CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove cap screw (C) and ratchet cover.
7. Remove pawl and springs.



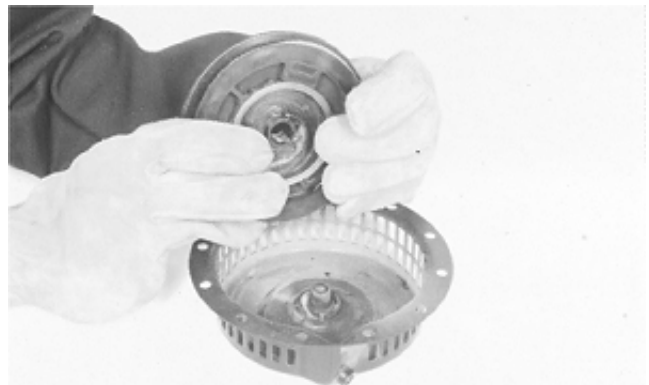
M80272 -UN-11MAR91

20
30
1

MX,2030A1,A1 -19-21OCT92

CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

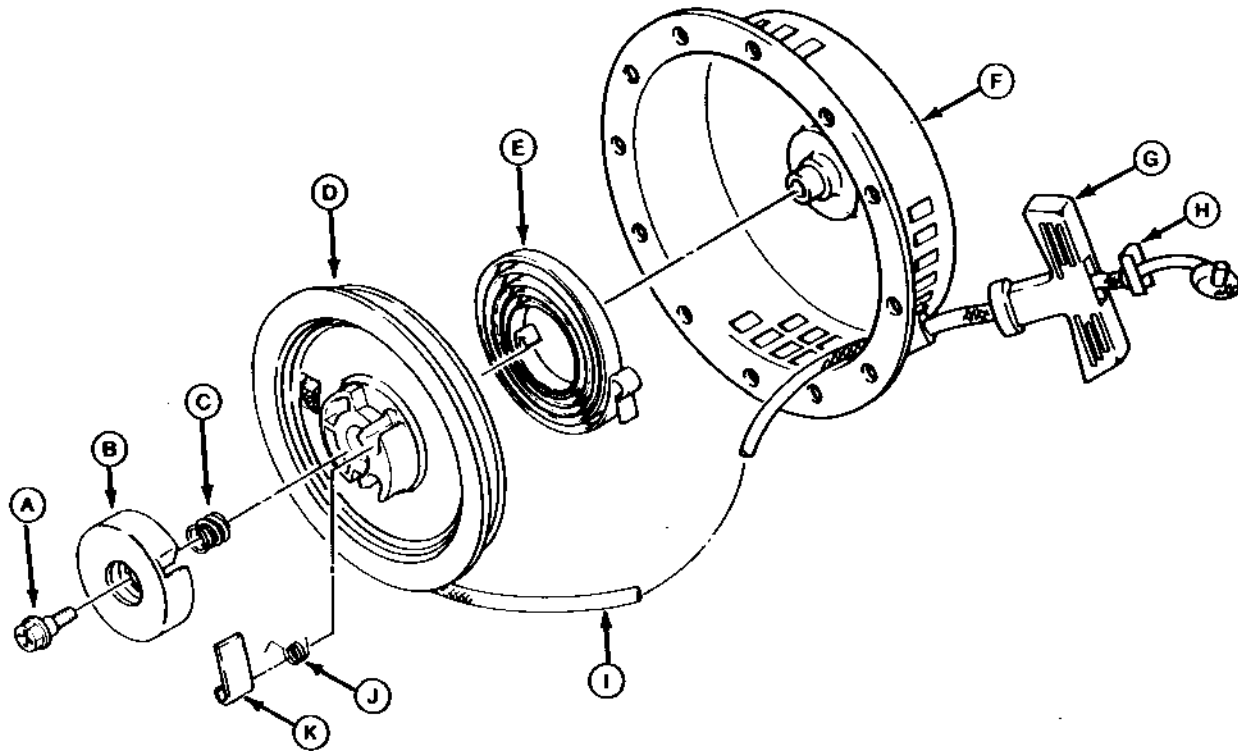
8. Turn the reel one half turn clockwise so no spring tension can be felt.
9. Spring is stored in reel. Carefully remove while holding spring in underside of reel.
10. Inspect starter for wear or damage. (See this group.)



M80273 -UN-11MAR91

MX,2030A1,A2 -19-21OCT92

INSPECT RECOIL STARTER—FA130D-AS16/AS19



A—Screw
B—Retainer
C—Spring

D—Reel
E—Spring
F—Housing

G—Handle
H—Clip
I—Rope

J—Spring
K—Pawl

Inspect all parts for wear or damage. Replace as necessary.

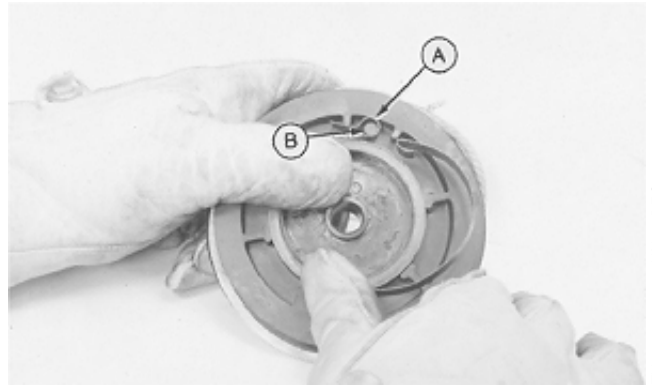
MX,2030A1,A3 -19-21OCT92

M80274 -JUN-19MAR91

REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

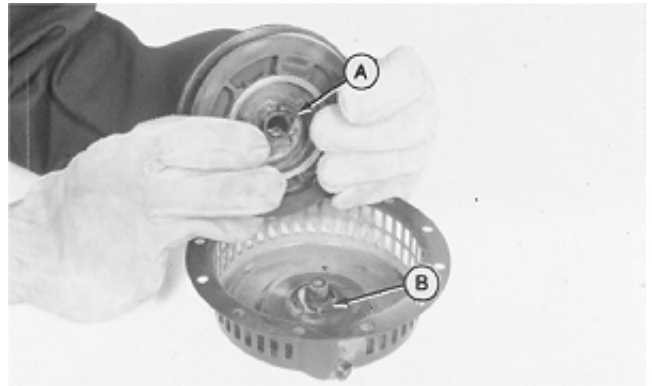
1. Working from the center out, carefully unwind spring from reel.
2. Hook outside loop (A) over peg (B) in reel. Wind spring into reel, working toward center.



MX,2030A1,A4 -19-21OCT92

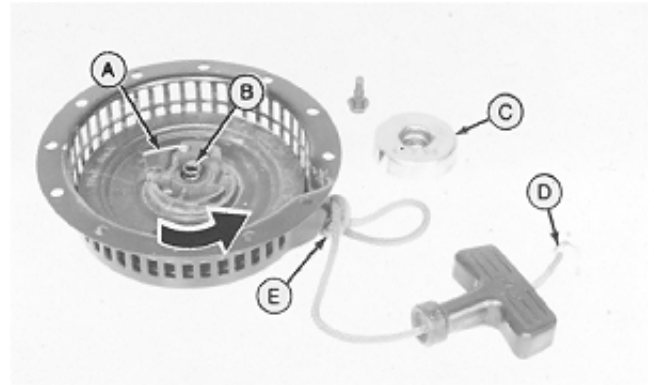
ASSEMBLE RECOIL STARTER—FA130D-AS16/AS19

1. Wind rope counterclockwise onto reel.
2. Apply multipurpose grease to spring.
3. Install reel with spring in housing. Align inner tang (A) with catch (B).
4. Turn reel counterclockwise until you feel tang hook on catch.



MX,2030A1,A5 -19-21OCT92

5. Turn reel two turns counterclockwise to preload spring.
6. While holding reel to keep it from unwinding, feed end of rope through hole. Tie knot (E) to hold rope.
7. Install handle and secure with knot (D).
8. Remove knot (E).
9. Install spring (B), spring and pawl (A) and ratchet cover (C) with opening in cover over pawl. Check for free movement of pawl.
10. Pull rope to check for proper operation.
11. Install recoil starter on engine.

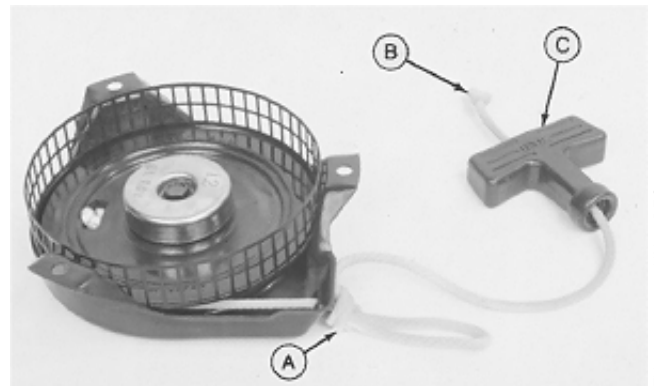


A—Pawl
B—Spring
C—Retainer
D—Knot
E—Knot

MX,2030A1,A6 -19-21OCT92

DISASSEMBLE RECOIL STARTER—FA130D-AN00

- 1 Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (A) to prevent rope from winding back onto reel.
3. Pry knot (B) out of handle (C) and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (A). Slowly release reel tension. Do not let rope get wedged between reel and housing.



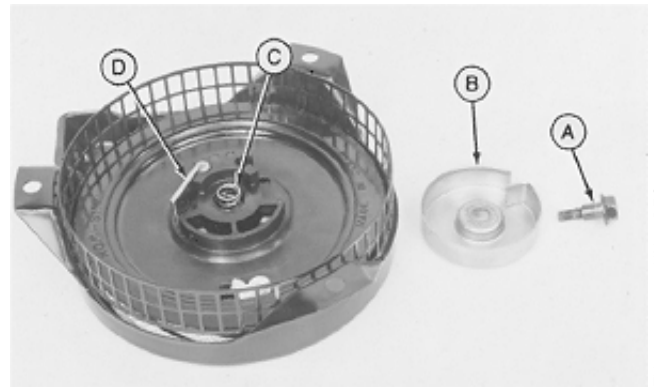
MX,2030A1,A7 -19-21OCT92

CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove cap screw (A) and cover (B).
7. Remove spring (C) and pawl and spring (D).

CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

8. Turn the reel one half turn clockwise so no spring tension can be felt.
9. Spring is stored in reel. Carefully remove while holding spring in underside of reel.
10. Inspect starter for wear or damage. (See this group.)



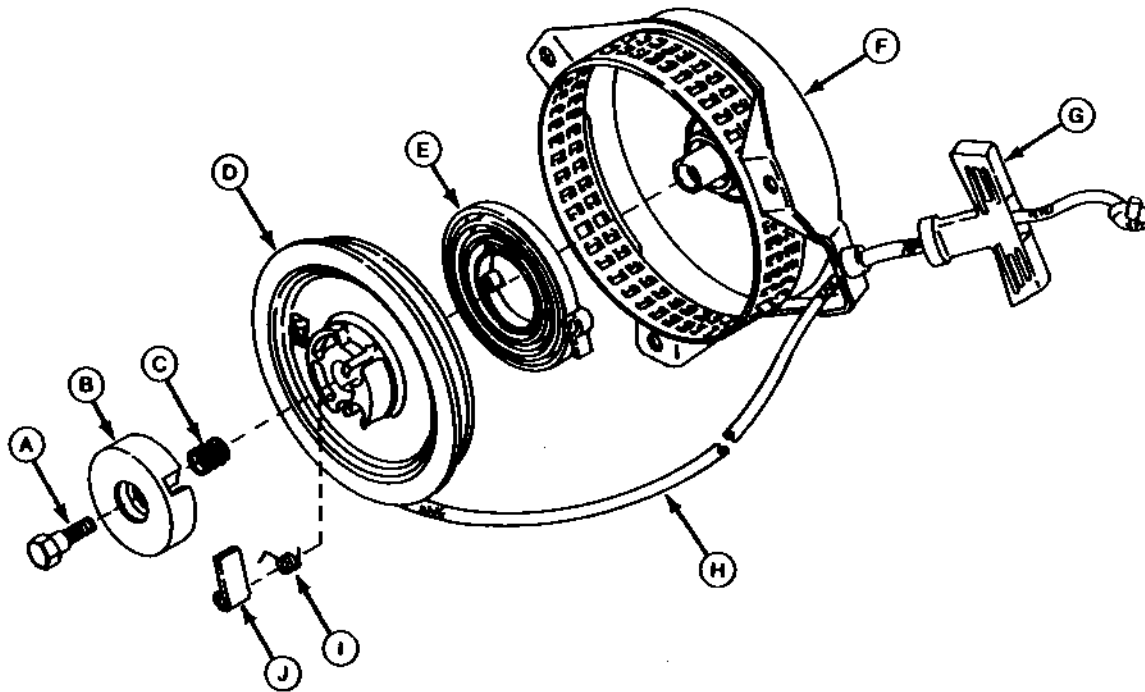
A—Cap Screw
B—Ratchet Cover
C—Spring
D—Pawl and Spring

MX,2030A1,A8 -19-21OCT92

TY15094 -UN-06DEC89

20
30
5

INSPECT RECOIL STARTER—FA130D-AN00



A—Screw
B—Retainer
C—Spring

D—Reel
E—Spring
F—Housing

G—Handle
H—Rope

I—Spring
J—Pawl

Inspect all parts for wear or damage. Replace as necessary.

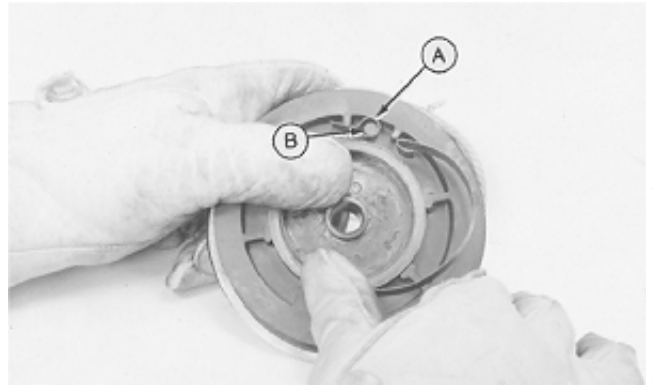
MX,2030A1,A9 -19-21OCT92

M80235 -JUN-06APR91

REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

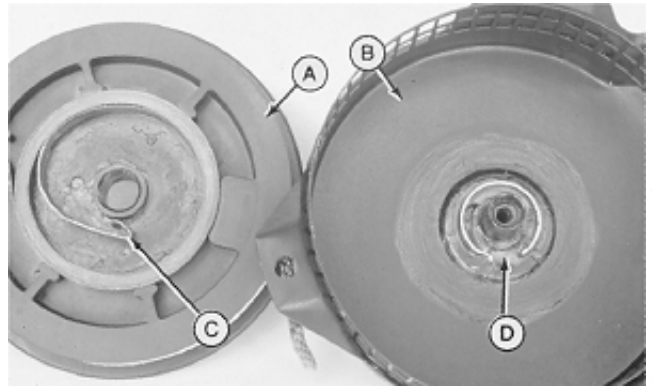
1. Working from the center out, carefully unwind spring from reel.
2. Hook outside loop (A) over peg (B) in reel. Wind spring into reel, working toward center.



MX,2030A1,A4 -19-21OCT92

ASSEMBLE RECOIL STARTER—FA130D-AN00

1. Wind rope counterclockwise onto reel.
2. Apply multipurpose grease to spring.
3. Install reel (A) with spring in housing (B). Align spring hook (C) with slot (D).
4. Turn reel counterclockwise until you feel spring hook on catch.

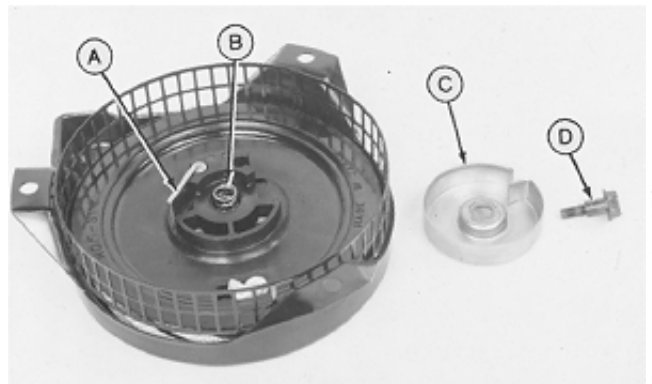


A—Reel
B—Housing
C—Spring Hook
D—Slot

MX,2030A1,A10 -19-21OCT92

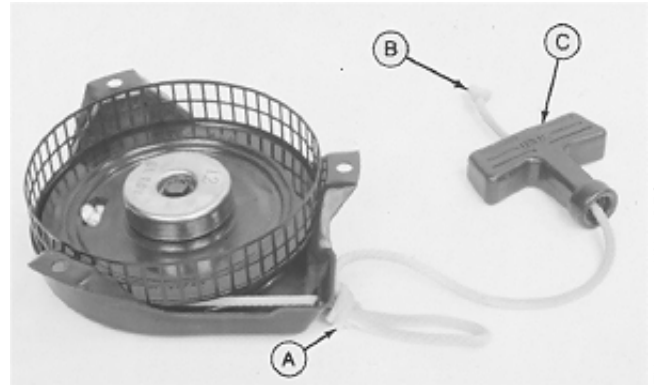
5. Install pawl and spring (A).
6. Install spring (B), cover (C) and cap screw (D).
7. Turn reel two turns counterclockwise to preload spring.

A—Pawl and Spring
B—Spring
C—Ratchet Cover
D—Cap Screw



MX,2030A1,A11 -19-21OCT92

8. While holding reel to keep it from unwinding, feed end of rope through hole. Tie knot (A) to hold rope.
9. Install handle (C) and secure with knot (B).
10. Remove knot (A).
11. Pull rope to check for proper operation.
12. Install recoil starter on engine.



MX,2030A1,A12 -19-21OCT92

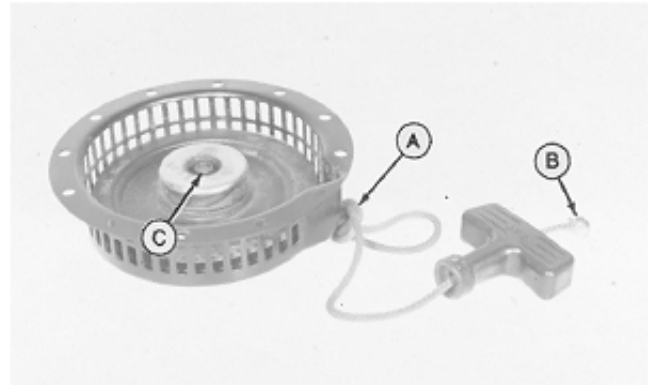
TY15092 -UN-06DEC89

DISASSEMBLE RECOIL STARTER

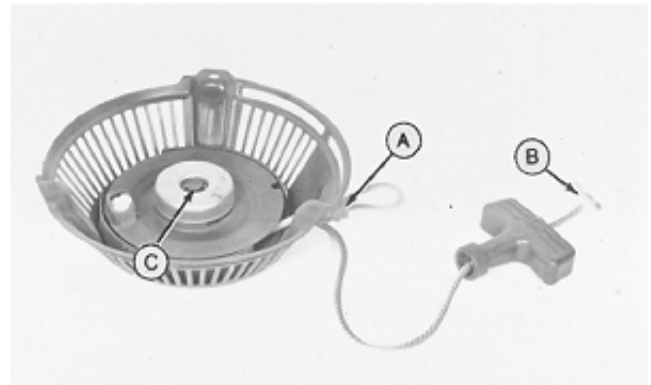
1. Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (A) to prevent rope from winding back onto reel.
3. Pry knot (B) out of handle and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (A). Slowly release reel tension. Do not let rope get wedged between reel and housing.

CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove screw (C) and ratchet cover.
7. Remove pawl and springs.



FA210D-AS20

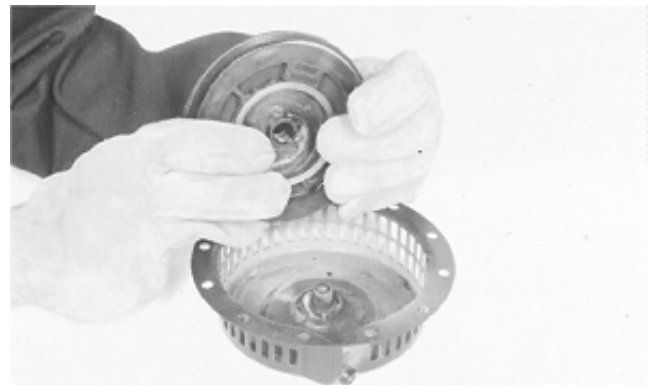


FA210D-AS19-01/AS17/BS17/CS17

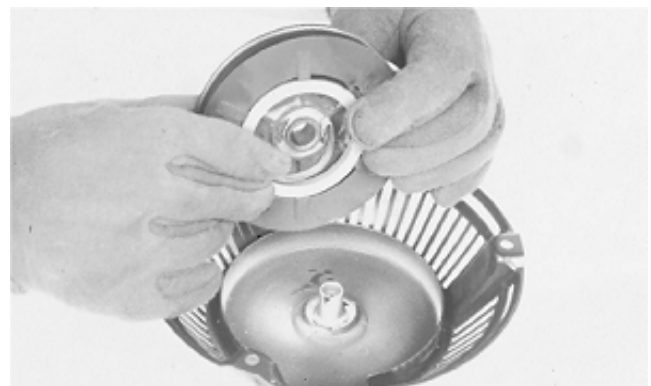
MX,2031A1,A1 -19-21OCT92

CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

8. Turn the reel one half turn clockwise so no spring tension can be felt.
9. FA210D-AS20 and AS19-01: Spring is stored in reel. Carefully remove reel while holding spring in underside of reel.



FA210D-AS20



FA210D-AS19-01

MX,2031A1,A2 -19-21OCT92

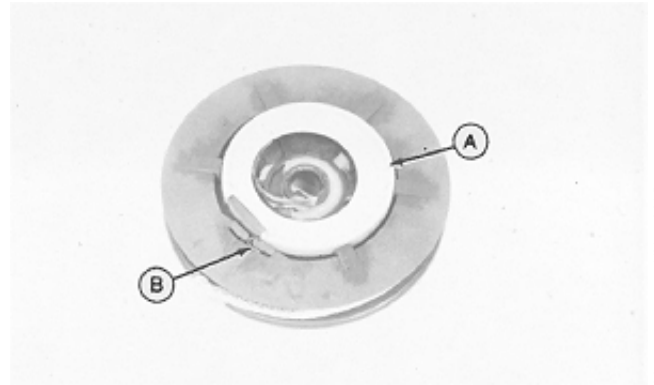
FA210D-AS17/BS17/CS17:

Spring is stored in spring case (A) in reel. Lift reel straight up so spring case remains seated in reel.

—Carefully unhook spring tang (B) from catch.

—Remove spring case from reel.

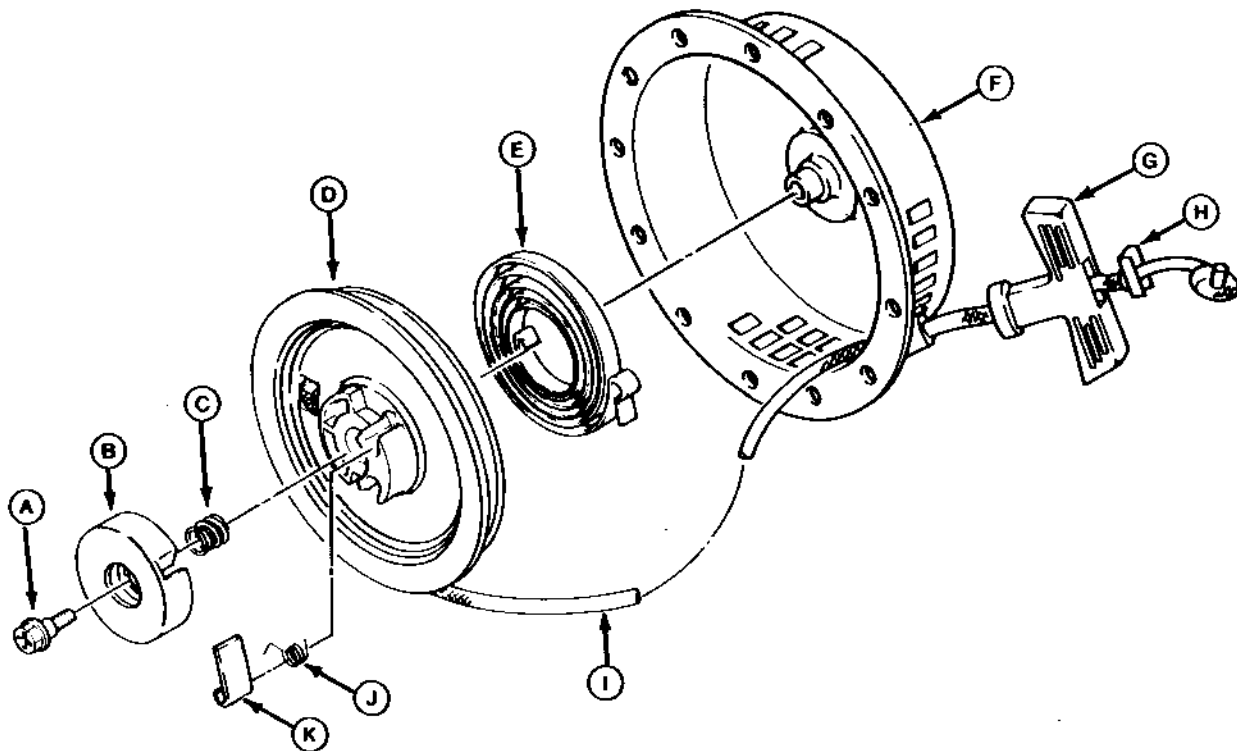
10. Inspect starter for wear or damage. (See this group.)



MX,2031A1,A3 -19-21OCT92

M80301 -UN-11MAR91

INSPECT RECOIL STARTER



A—Screw
B—Retainer
C—Spring

D—Reel
E—Spring
F—Housing

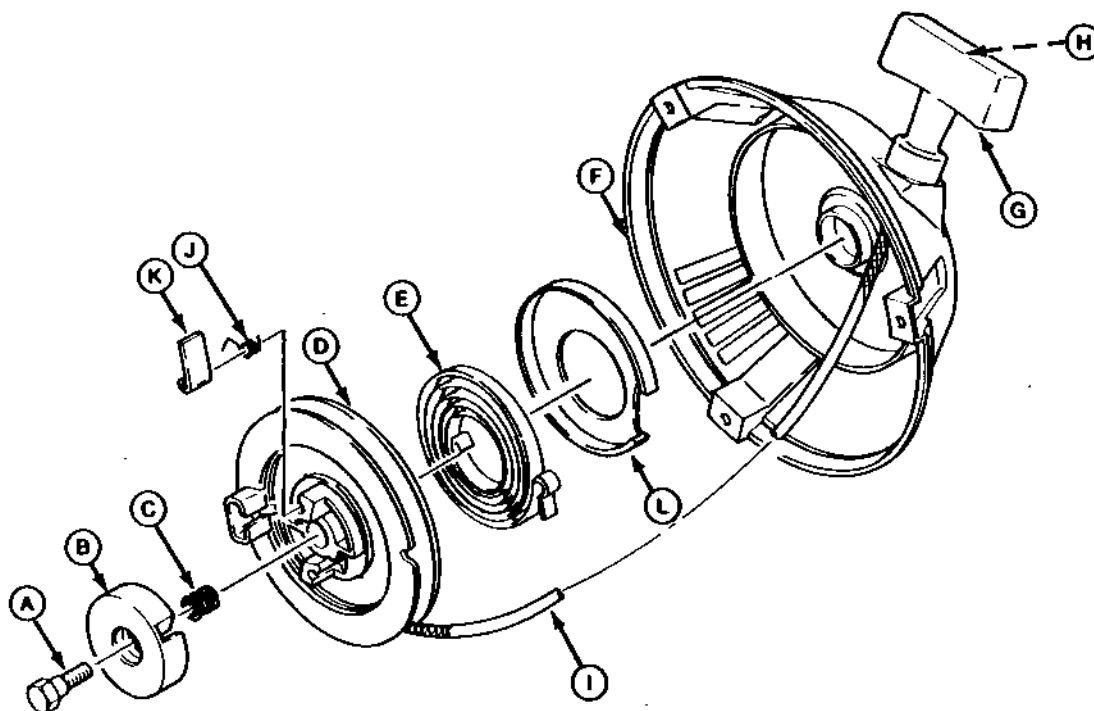
G—Handle
H—Clip
I—Rope

J—Spring
K—Pawl

FA210D-AS20

M80274 -UN-19MAR91

MX,2031A1,A4 -19-21OCT92



A—Screw
B—Retainer
C—Spring

D—Reel
E—Spring
F—Housing

G—Handle
H—Clip
I—Rope

J—Spring
K—Pawl
L—Spring Case*

FA210D-AS19-01/AS17/BS17/CS17

Inspect all parts for wear or damage. Replace as necessary.

*FA210D—AS17, BS17, CS17 only.

MX,2031A1,A4A -19-21OCT92

M80302 -UN-19MAR91

20
31
3

REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

1. Working from the center out, carefully unwind spring from spring case or reel.
2. Hook outside spring tang in reel or case. Wind spring into reel or spring case, working toward center.



FA210D-AS20 and AS19-01

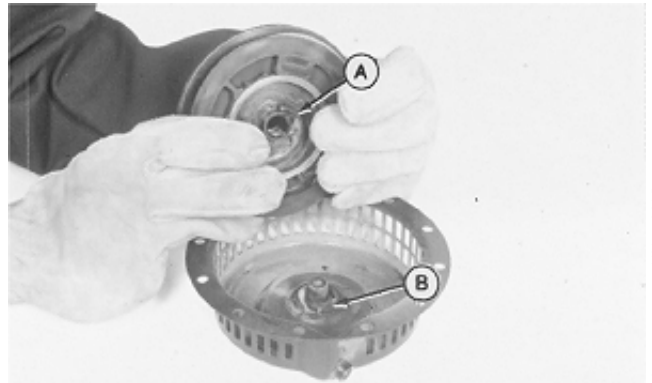


FA210D-AS17/BS17/CS17

MX,2031A1,A5 -19-21OCT92

ASSEMBLE RECOIL STARTER

1. Wind rope counterclockwise onto reel.
2. Apply multipurpose grease to spring.
3. FA210D-AS20 and AS19-01: Install reel with spring in housing. Align inner tang (A) with catch (B).



FA210D-AS19-01

MX,2031A1,A6 -19-21OCT92

FA210D-AS17/BS17/CS17:

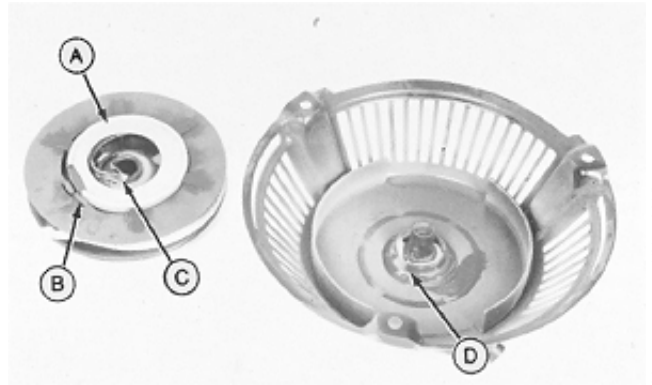
Place spring case (A) into reel with spring tang into catch (B).

—Install reel with spring case into housing, aligning inner tang (C) with catch (D).

4. Turn reel counterclockwise until you feel tang hook on catch.

A—Spring Case
B—Reel Catch

C—Inner Tang
D—Housing Catch



MX,2031A1,A7 -19-21OCT92

M80304 -UN-11MAR91

5. Place rope in notch (F), if equipped. Turn reel two turns counterclockwise to preload spring.

6. While holding reel to keep it from unwinding, feed end of rope through hole. Tie knot (E) to hold rope.

7. Install handle and secure with knot (D).

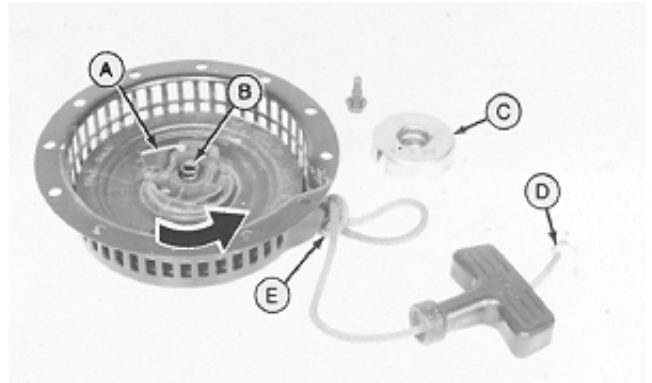
8. Remove knot (E).

9. Install spring (B), spring and pawl (A) and ratchet cover (C) with opening in cover over pawl. Check for free movement of pawl.

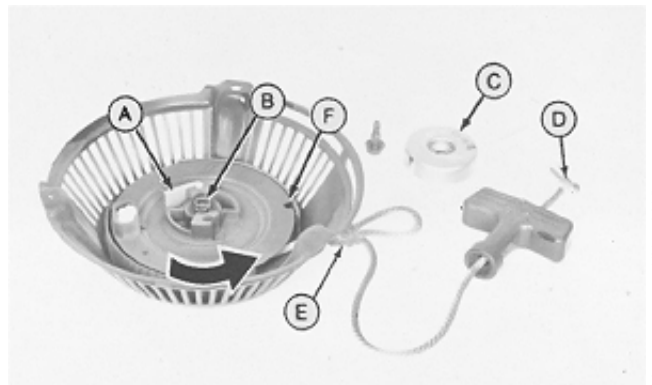
10. Pull rope to check for proper operation.

11. Install recoil starter on engine.

A—Pawl
B—Spring
C—Retainer
D—Knot
E—Knot
F—Notch



FA210D-AS20



FA210D-AS19-01/AS17/BS17/CS17

MX,2031A1,A8 -19-21OCT92

M80276 -UN-11MAR91

M80305 -UN-11MAR91

20
31
6

Section 21

FA210V

Contents

	Page	Page
Group 00—Engine Application and Repair Specifications		
Engine Application Chart	21-00-1	
Repair Specifications	21-00-1	
Group 05—Fuel and Air Systems		
Service Parts Kits	21-05-1	
Carburetor		
Remove and Install	21-05-1	
Disassemble, Clean, Inspect and Assemble	21-05-2	
Remove and Install Intake Manifold	21-05-3	
Service		
Primary Breather	21-05-3	
Secondary Breather	21-05-4	
Air Cleaner	21-05-5	
Group 10—Blower Housing and Flywheel		
Remove and Install		
Blower Housing	21-10-1	
Flywheel Screen Adjustment	21-10-1	
Remove and Install		
Flywheel	21-10-2	
Group 15—Cylinder Head		
Other Material	21-15-1	
Cylinder Head		
Remove and Install	21-15-1	
Inspect	21-15-2	
Group 20—Cylinder Block, Valves and Internal Components		
Other Material	21-20-1	
Service Parts Kits	21-20-1	
Remove and Install Valves and Springs	21-20-2	
Inspect		
Valve Springs	21-20-3	
Valve Guides	21-20-3	
Recondition Valve Seats	21-20-3	
Check Valve-To-Tappet Clearance	21-20-4	
Remove and Install Crankcase Cover	21-20-5	
Camshaft		
Remove and Install	21-20-5	
Inspect	21-20-6	
Inspect Plain Bearings	21-20-6	
Inspect Automatic Compression Release Mechanism	21-20-7	
Remove, Inspect and Install Tappets	21-20-7	
Piston and Connecting Rod		
Remove and Install	21-20-8	
Disassemble, Inspect and Assemble	21-20-9	
Inspect Piston	21-20-10	
Inspect Connecting Rod	21-20-12	
Piston Rings		
Remove and Install	21-20-13	
Check End Gap	21-20-13	
Crankshaft		
Remove, Inspect and Install	21-20-14	
Inspect Plain Bearings	21-20-15	
Replace Bearing Shell	21-20-15	
Check Alignment (TIR)	21-20-16	
Measure End Play	21-20-16	
Inspect		
Oil Seals	21-20-17	
Cylinder Block	21-20-17	
Inspect and Replace		
Oil Slinger	21-20-19	
Governor	21-20-19	
Governor Shaft	21-20-20	
Group 25—Ignition and Charging System		
Armature With Coil		
Remove and Install	21-25-1	
Adjust Air Gap	21-25-1	
Replace Ignitor	21-25-1	
Group 30—Starting Systems		
Recoil Starter		
Disassemble	21-30-1	
Inspect	21-30-2	
Replace Spring	21-30-3	
Assemble	21-30-3	

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

Machine	Engine Model No.
RX63 Riding Mower	FA210V-AS00

MX,2100A1,A1 -19-21OCT92

FA210V REPAIR SPECIFICATIONS

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Item	Specification
Flywheel Nut Torque	60 N·m (44 lb-ft)
Flywheel Screen Gap	1—3 mm (0.039—0.118 in.)

GROUP 15—CYLINDER HEAD

Cylinder Head	
Maximum Cylinder Head Warp	0.40 mm (0.015 in.)
Cap Screw Torque In Sequence	
Initial Torque	10 N·m (89 lb-ft)
Final Torque	21 N·m (186 lb-ft)
Spark Plug Torque	24 N·m (212 lb-in.)

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS

Valve Clearance (cold)	
Intake	0.12—0.18 mm (0.005—0.007 in.)
Exhaust	0.12—0.34 mm (0.005—0.013 in.)
Valves and Springs	
Minimum Spring Free Length	23.50 mm (0.930 in.)
Maximum Valve Guide I.D.	
Intake	6.117 mm (0.248 in.)
Exhaust	6.095 mm (0.240 in.)
Valve Stem Diameter (max.)	
Intake	5.960 mm (.2346 in.)
Exhaust	6.095 mm (.240 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seat and Face Angle	45°
Valve Seating Width	1.30 mm (0.050 in.)
Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Continued on next page

MX,2100A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Crankcase Cover	
Oil Capacity	0.6 L (1.27 pt)
Cap Screw Torque	21 N·m (186 lb-in.)
Camshaft	
Minimum End Journals O.D.	12.94 mm (0.509 in.)
Minimum Lobe Height	
Intake	26.45 mm (1.041 in.)
Exhaust	26.35 mm (1.037 in.)
Maximum Bearing I.D.	13.05 mm (0.514 in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	Not Measured
Second Ring	0.13 mm (0.005 in.)
Oil Ring	0.17 mm (0.007 in.)
Minimum Ring End Gap	0.178 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	1.00 mm (0.039 in.)
Oil Ring Side Rails	1.40 mm (0.055 in.)
Minimum Pin O.D.	14.98 mm (0.590 in.)
Maximum Pin Bore I.D.	15.04 mm (0.593 in.)
Maximum Piston-to-Piston Pin Clearance	0.06 mm (0.003 in.)
Piston O.D.	71.86—71.89 mm (2.829—2.836 in.)
Cylinder-to-Bore Clearance (std.)	0.087—0.137 mm (0.0034—0.0054 in.)
(max.)	0.163 mm (0.0064 in.)
Connecting Rod	
Maximum Crankshaft Bearing I.D.	27.06 mm (1.065 in.)
Maximum Piston Pin Bearing I.D.	15.04 mm (0.592 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.06 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.12 mm (0.005 in.)
End-Cap Screw Torque	19 N·m (168 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	25.37 mm (0.999 in.)
Minimum Flywheel Side Journal O.D.	24.96 mm (0.983 in.)
Minimum Connecting Rod Journal O.D.	26.95 mm (1.061 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0—0.30 mm (0—0.012 in.)
Plain Bearings	
Crankcase Bearing	25.10 mm (0.988 in.)
Crankcase Cover Bearing	24.50 mm (0.965 in.)

Continued on next page

MX,2100A1,A3 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Cylinder Bore	
Standard Cylinder Bore I.D.	71.98—72.00 mm (2.834—2.835 in.)
Maximum Cylinder Bore I.D.	72.06 mm (2.837 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

MX,2000A1,A6 -19-21OCT92

21
00
3

21
00
4

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Carburetor Gasket Kit

Main Jet High Altitude Kit

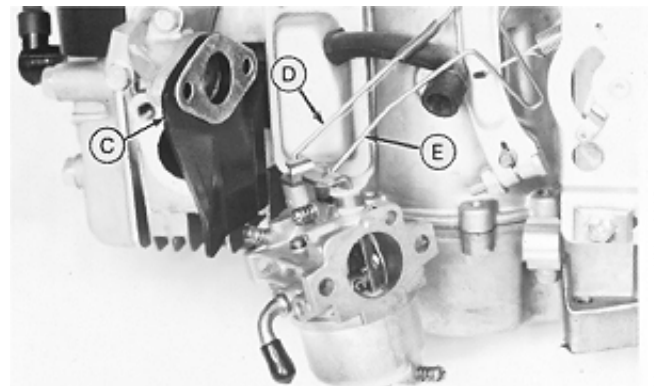
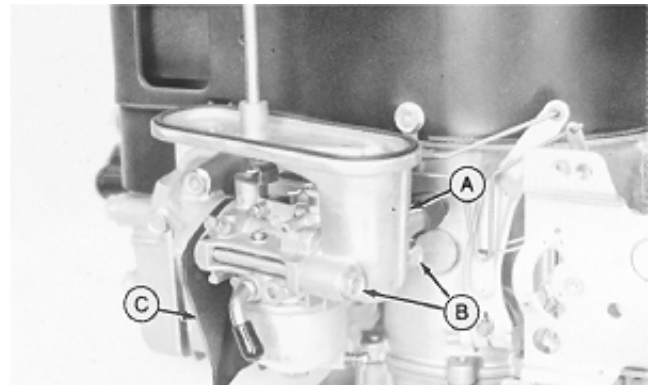
Complete Carburetor

MX,3005A1,A1 -19-21OCT92

REMOVE AND INSTALL CARBURETOR

1. Remove air cleaner assembly.
2. Remove cap screws and washers (B) and duct and gasket (A).
3. Separate carburetor from heat shield (C). Remove carburetor.
4. Disconnect choke linkage (E) and throttle linkage (D).
5. Remove heat shield (C) and gaskets.
6. Make repairs as necessary. (See procedure in this group.)
7. Install gaskets and heat shield.
8. Connect linkage.
9. Install carburetor, gaskets and duct. Tighten cap screws.
10. Install air cleaner assembly.

A—Duct and Gasket
B—Cap Screws and Washers
C—Heat Shield
D—Throttle Linkage
E—Choke Linkage



MX,2105A1,A1 -19-21OCT92

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets, float and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

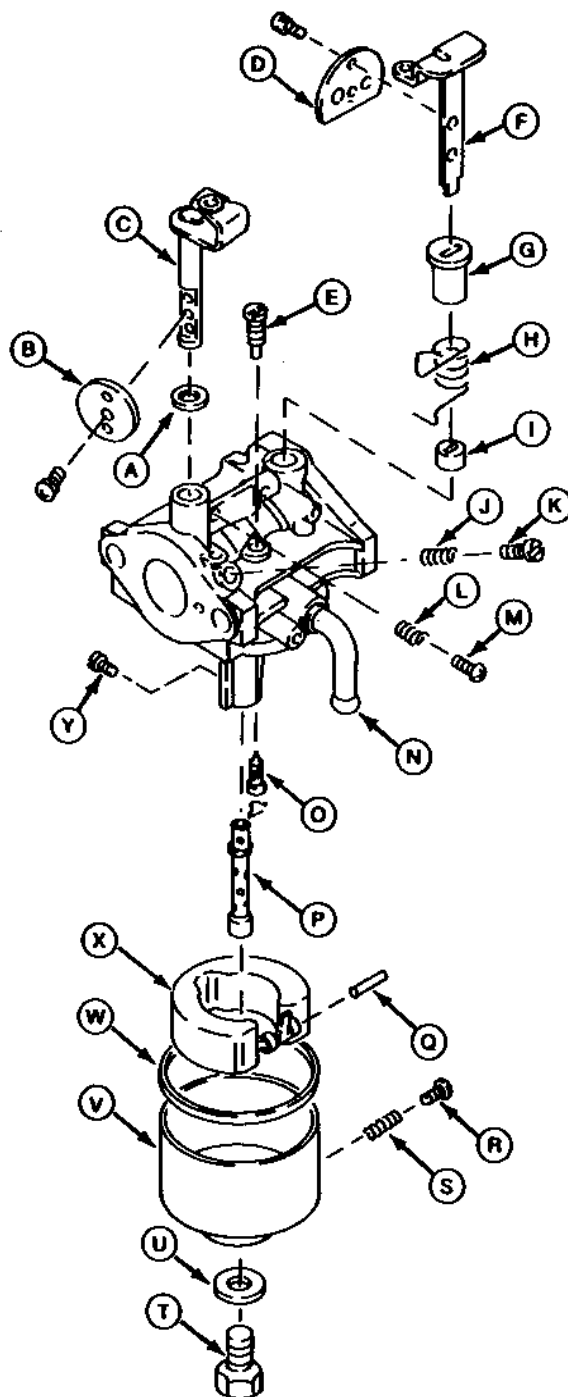
IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.
4. Inspect all parts for wear or damage, replace as necessary.

NOTE: Main jet high altitude kits are available.

Float is plastic. The float cannot be adjusted. Replace if necessary.

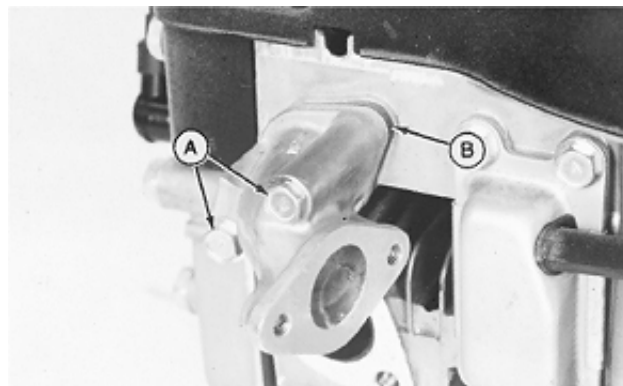
- A—Seal
- B—Throttle Valve
- C—Throttle Shaft
- D—Choke Valve
- E—Pilot Jet
- F—Choke Shaft
- G—Ring
- H—Spring
- I—Ring
- J—Spring
- K—Screw
- L—Spring
- M—Idle Screw
- N—Carburetor Body
- O—Needle Valve
- P—Main Nozzle
- Q—Float Pin
- R—Drain Screw
- S—Spring
- T—Plug
- U—Washer
- V—Float Chamber
- W—Gasket
- X—Float
- Y—Main Jet



MX,2105A1,A2 -19-21OCT92

REMOVE AND INSTALL INTAKE MANIFOLD

1. Remove carburetor. (See this group.)
2. Remove cap screws (A).
3. Separate manifold from spacer (B). Remove intake manifold, spacer and gaskets.
4. Inspect parts for cracks or damage. Replace as necessary.
5. Install new gaskets, spacer and manifold.
6. Install carburetor.



M80309 -UN-11MAR91

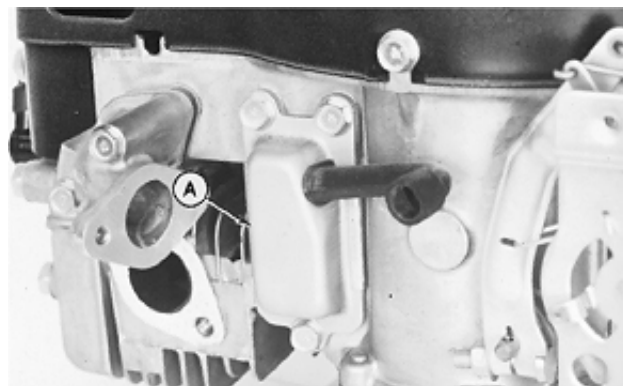
21
05
3

MX,2105A1,A3 -19-21OCT92

SERVICE PRIMARY BREATHER

NOTE: The tappet chamber cover is an oil breather.

1. Remove carburetor. (See this group.)
2. Remove tappet chamber cover/breather and gasket (A).
3. Clean cover/breather and tube. Inspect for cracks or damage. Replace if necessary.
4. Install new gasket and cover/breather.
5. Install carburetor.



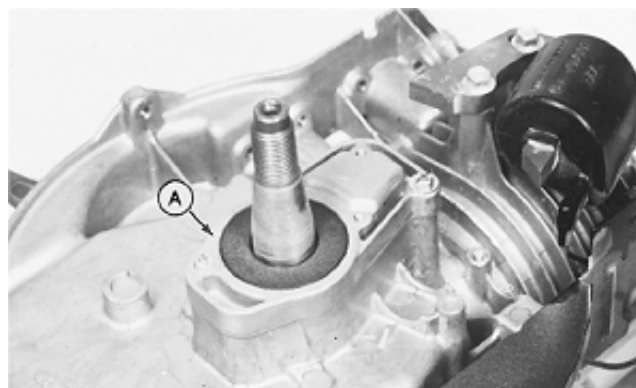
M80310 -UN-11MAR91

MX,2105A1,A4 -19-21OCT92

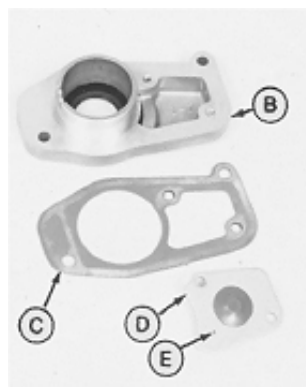
SERVICE SECONDARY BREATHER

1. Remove flywheel. (See Group 10.)
2. Remove breather assembly (A).
3. Remove plate (D).
4. Inspect cover (B), plate and gasket (C) for wear or damage. Replace parts if necessary.
5. Check that drainback holes (E, F and G) are open.
6. Install plate.
7. Install breather assembly.
8. Install flywheel.

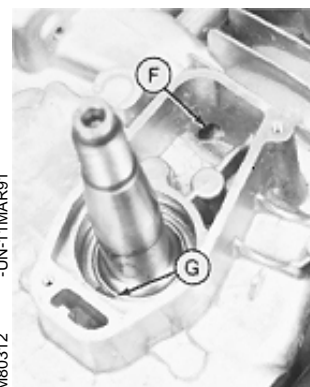
A—Oil Breather Assembly
B—Cover
C—Gasket
D—Plate
E—Small Drainback Hole
F—Secondary Chamber-to-Primary Chamber
G—Large Drainback Hole



M80311 -UN-11MAR91



M80312 -UN-11MAR91



M80313 -UN-11MAR91

MX,2105A1,A5 -19-21OCT92

SERVICE AIR CLEANER

NOTE: Replace elements yearly or every 25 hours as required.

1. Remove and disassemble air cleaner.

IMPORTANT: Do not clean elements with solvent or compressed air.

2. Wash foam element (A) in detergent and water. Dry element.

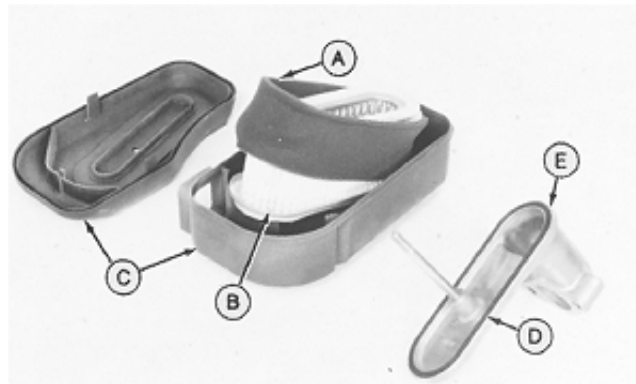
3. Put 12—15 drops of engine oil on foam element (A). Squeeze out excess oil.

4. Replace paper element (B) if:
 - Element is oily, dirty, bent, torn, crushed, or obstructed in any way.
 - Gasket is deformed or damaged in any way.
 - Engine performance is poor.

5. Inspect body (C), gasket (D), and base (E) for damage. Replace if necessary.

IMPORTANT: Any time air cleaner base is removed, check for free choke operation during reassembly.

6. Assemble and install air cleaner.



A—Foam Element
B—Paper Element
C—Body
D—Gasket
E—Base

M80314 -UN-11MAR91

21
05
5

MX,2105A1,A6 -19-21OCT92

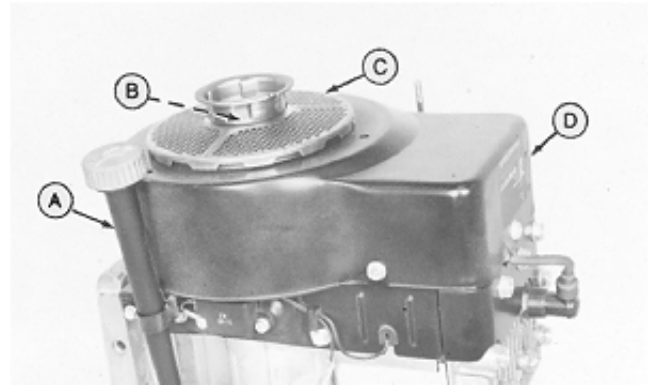
21
05
6

REMOVE AND INSTALL BLOWER HOUSING

1. Remove recoil starter.
2. Remove air cleaner assembly.
3. Remove dipstick tube (A).
4. Remove nut and washer (B), starter cup/screen assembly (C) and spacer(s).
5. Remove blower housing (D).
6. Install blower housing.
7. Install spacer(s) and starter cup/screen assembly.
8. Adjust flywheel screen. (See this group.)

NOTE: Install washer with concave side toward flywheel.

9. Install washer and nut. Tighten nut to 60 N·m (44 lb-ft).
10. Install dipstick tube.
11. Install air cleaner assembly.
12. Install recoil starter.



A—Dipstick Tube
B—Nut and Washer
C—Starter Cup/Screen
D—Blower Housing

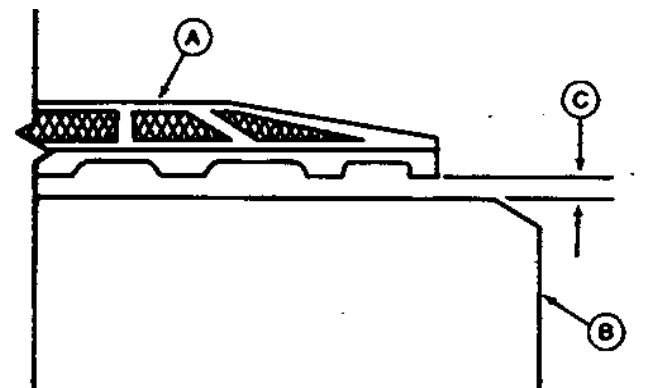
MX,2110A1,A1 -19-21OCT92

FLYWHEEL SCREEN ADJUSTMENT

Adjust gap (C) between the blades under screen (A) and blower housing (B) to specifications using spacers.

SPECIFICATIONS

Gap 1—3 mm (0.039—0.118 in.)



MX,2110A1,A2 -19-21OCT92

REMOVE AND INSTALL FLYWHEEL

1. Remove blower housing. (See this group.)
2. Remove flywheel using a two-jaw puller.
3. Install flywheel.
4. Install blower housing.



MX,2110A1,A3 -19-21OCT92

M80316 -UN-11MAR91

OTHER MATERIAL

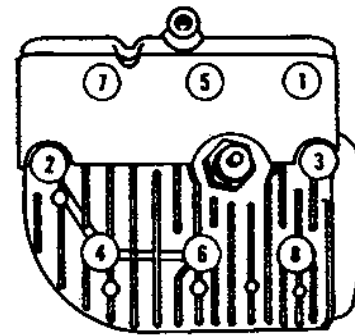
Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean cylinder head

SCOTCH-BRITE is a trade mark of the 3M Company.

MX,5015A1,A1 -19-21OCT92

REMOVE AND INSTALL CYLINDER HEAD

1. Remove blower housing. (See Group 10.)
2. Remove cylinder head cover.
3. Remove spark plug.
4. Remove cylinder head and gasket.
5. Make repairs as necessary. (See procedures in this group.)



IMPORTANT: Gasket surfaces are coated with sealant. Do not damage surfaces or gasket during installation.

6. Install cylinder head with new gasket.
7. Install cylinder head cover and cap screws. Tighten finger tight.
8. Tighten cap screws in sequence shown. Tighten to initial torque specifications.
9. Continue in sequence, 4 N·m (35 lb-in.) at a time, until final torque is as specified.
10. Install spark plug and tighten to specification.
11. Install blower housing.

TORQUE SPECIFICATIONS

Cylinder Head Cap Screws

Initial Torque	10 N·m (89 lb-in.)
Final Torque	21 N·m (186 lb-in.)
Spark Plug	24 N·m (212 lb-in.)

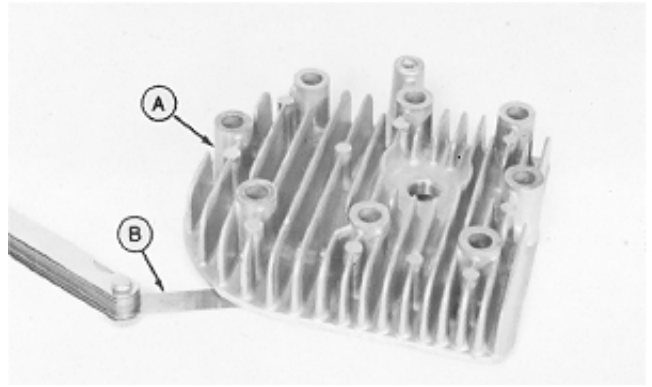
MX,2115A1,A1 -19-21OCT92

INSPECT CYLINDER HEAD

1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Put cylinder head on a surface plate. Check for distortion at several points around the head using a feeler gauge. Replace head if distortion is more than specifications.

SPECIFICATIONS

Cylinder Head Distortion (Max) 0.40 mm (0.015 in.)



M80292 -UN-11MAR91

MX,2115A1,A2 -19-21OCT92

Group 20 Cylinder Block, Valves and Internal Components

OTHER MATERIAL

Number	Name	Use
	Valve Guide Cleaner	Clean valve guides.
	Prussion Blue Compound	Check valve seat contact.
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,2020A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalogue.

Oversized Piston Ring Kit

Oversized Pistons

Cylinder Block

Overhaul Gasket Kit

Short Block Kit

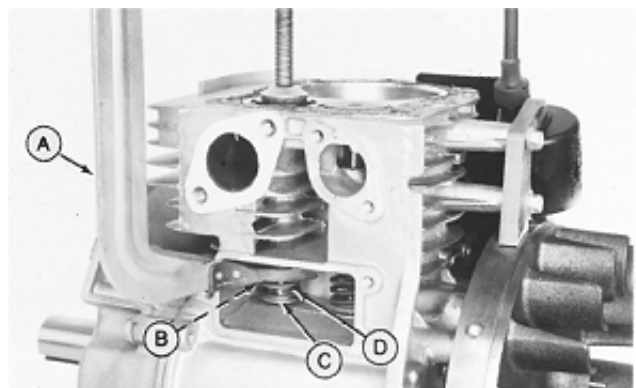
MX,2020A1,A2 -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove carburetor. (See Group 05.)
2. Remove cylinder head. (See Group 15.)
3. Remove tappet chamber cover/breather and gasket.

IMPORTANT: Mark and keep springs and valves together.

4. Compress valve spring (D) with a spring compressor (A) and move spring retainer (C) so larger hole is around valve stem.
5. Remove compressor, valves, spring and retainers.
6. Inspect and analyze valves. (See Section 100, Group 05.)
7. Inspect springs, valve guides and seats. (See this group.)
8. Check valve-to-tappet clearance. (See this group.)
9. Check that drainback hole (B) is open.
10. Align valve springs and retainers in tappet chamber.
11. Coat valve stems with oil and install in cylinder block.
12. Compress each spring and position retainer so smaller hole is around valve stem.
13. Install tappet chamber cover/breather and new gasket.
14. Install cylinder head.
15. Install carburetor.



A—Spring Compressor
B—Drainback Hole
C—Spring Retainer
D—Valve Spring

M80317 -UN-11MAR91

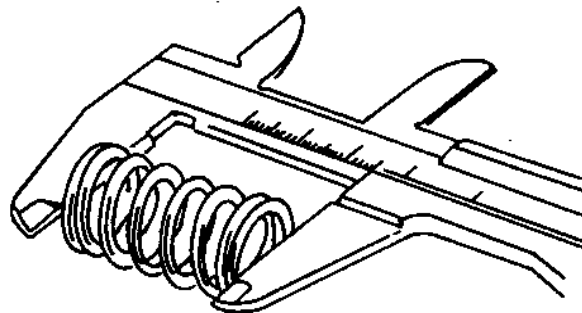
MX,2120A1,A1 -19-21OCT92

INSPECT VALVE SPRINGS

Inspect valve springs. Replace springs if damaged or if free length is less than specification.

SPECIFICATION (MIN)

Valve Spring Free Length 23.50 mm (0.930 in.)



MX,2120A1,A2 -19-21OCT92

M50036 -UN-31AUG88

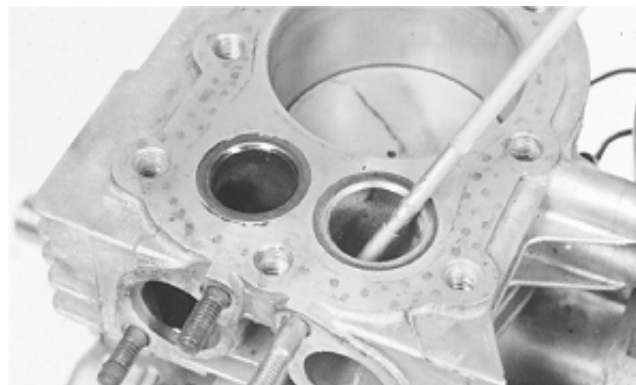
INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guides. Replace cylinder block if inside diameter is greater than specifications.

SPECIFICATIONS (MAX) I.D.

Intake Valve 6.10 mm (0.240 in.)
Exhaust Valve 6.13 mm (0.242 in.)



MX,2120A1,A3 -19-21OCT92

M80247 -UN-11MAR91

RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.

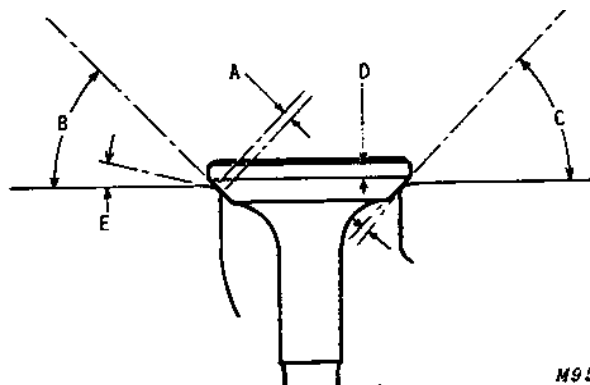
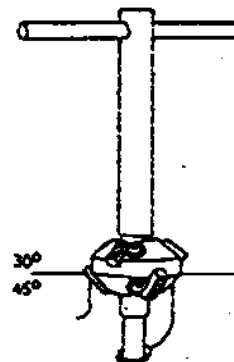
2. To recondition valve seat, cut at 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).

3. Cut valve seating surface (A) as close as possible to specifications.

4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface 1.30 mm (0.050 in.)
B—Valve Seat Angle 45°
C—Valve Face Angle 45°
D—Valve Margin 0.60 mm (0.020 in.)
E—Valve Narrowing Angle 30°



M9552

-UN-31AUG88

M51558

-UN-01SEP88

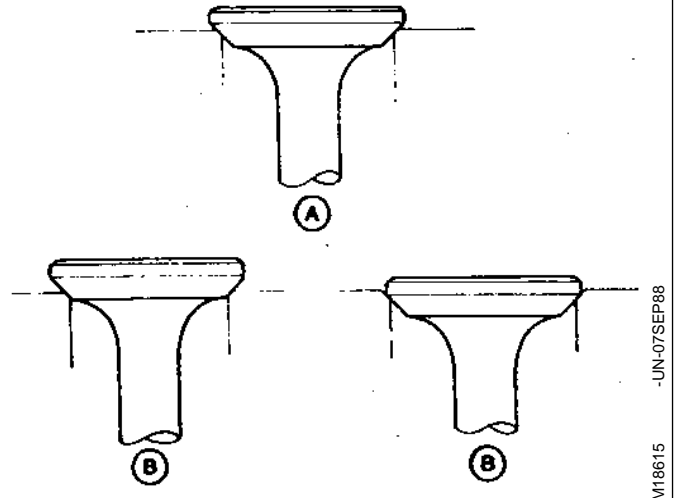
M9552

MX,2120A1,A4 -19-21OCT92

5. Center valve seat on the valve face:

- (A) shows correct position.
- (B) shows incorrect.

6. Check seat for good contact using Prussian Blue Compound.

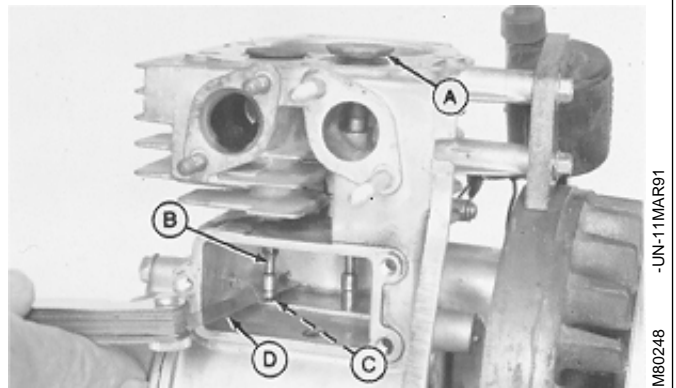


MX,3015A1,A9 -19-21OCT92

CHECK VALVE-TO-TAPPET CLEARANCE

NOTE: Valve grinding changes the valve-to-tappet clearance. Check clearance when engine is cold.

1. Install valves in cylinder block.
2. Turn crankshaft until intake valve (A) is at its highest position. Check clearance between valve (B) and tappet (C), with feeler gauge (D) and compare to specifications.
3. Grind end of valve stem to obtain proper clearance.



VALVE CLEARANCE SPECIFICATIONS

Exhaust Valve	0.12—0.34 mm (0.005—0.013 in.)
Intake Valve	0.12—0.18 mm (0.005—0.007 in.)

A—Intake Valve
B—Exhaust Valve
C—Tappet
D—Feeler Gauge

MX,2120A1,A5 -19-21OCT92

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is 0.6 L (1.27 pt).

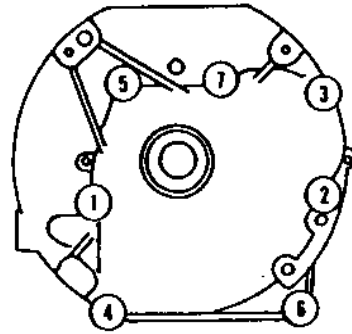
1. Drain crankcase.
2. Remove crankcase cover and gasket.
3. Clean crankcase and crankcase cover gasket surfaces.

NOTE: Do not force cover. Gears must mesh for proper positioning.

4. Install gasket and cover. Tighten cap screws using the sequence shown.

TORQUE SPECIFICATIONS

Mounting Cap Screws	21 N·m (186 lb-in.)
Oil Drain Plug	14 N·m (121 lb-in.)



M80294 -UN-19MAR91

21
20
5

MX,2120A1,A6 -19-21OCT92

REMOVE AND INSTALL CAMSHAFT

1. Remove crankcase cover. (See this group.)

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

2. Remove washer (A).
3. Rotate crankshaft until timing marks (B) align.
4. Remove camshaft (C).
5. Inspect camshaft. (See this group.)
6. Apply clean engine oil to camshaft lobes and journals.
7. Align timing marks and install camshaft.

NOTE: Install washer with beveled ID, toward crankshaft.

8. Install washer.
9. Install crankcase cover.



M80318 -UN-11MAR91

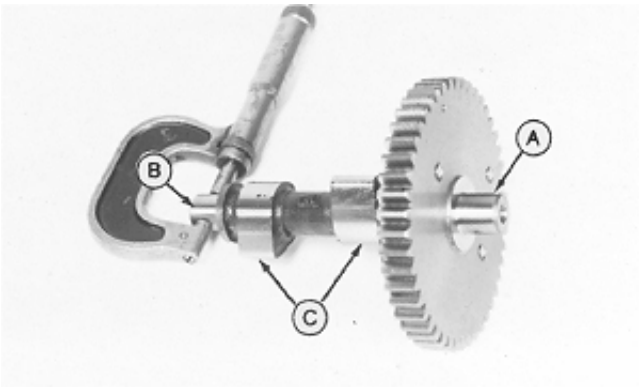
MX,2120A1,A7 -19-21OCT92

INSPECT CAMSHAFT

Inspect camshaft for worn or broken teeth.

*NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.*

Measure PTO side journal (A), flywheel side journal (B), and lobes (C). Replace camshaft and tappets if less than specifications.



M80319 -UN-11MAR91

SPECIFICATIONS (MIN)

PTO Side Journal	Flywheel Side Journal	Cam Lobes
12.94 mm (0.509 in.)	12.94 mm (0.509 in.)	Intake: 26.45 mm (1.041 in.) Exhaust: 26.35 mm (1.037 in.)

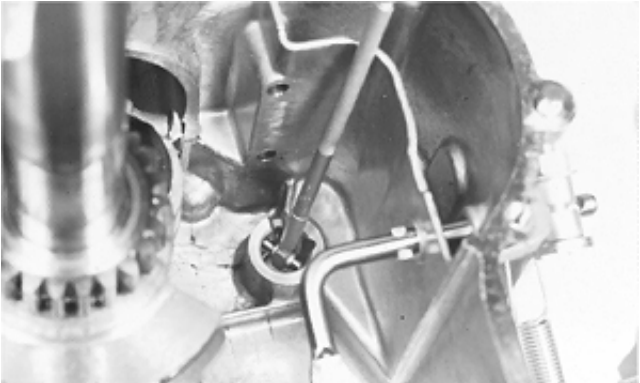
MX,2120A1,A8 -19-21OCT92

INSPECT CAMSHAFT PLAIN BEARINGS

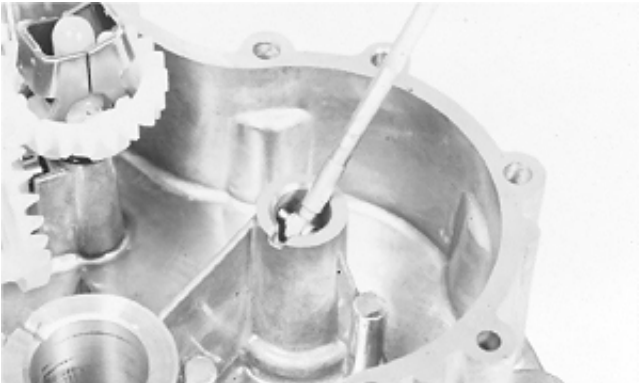
1. Remove camshaft. (See this group.)
2. Measure camshaft bearings in cylinder block and crankcase cover. Replace block or cover if diameter is greater than specification.
3. Install camshaft.

SPECIFICATIONS (MAX)

Cylinder Block Bearing	Crankcase Cover Bearing
13.05 mm (0.514 in.)	13.05 mm (0.514 in.)



Cylinder Block

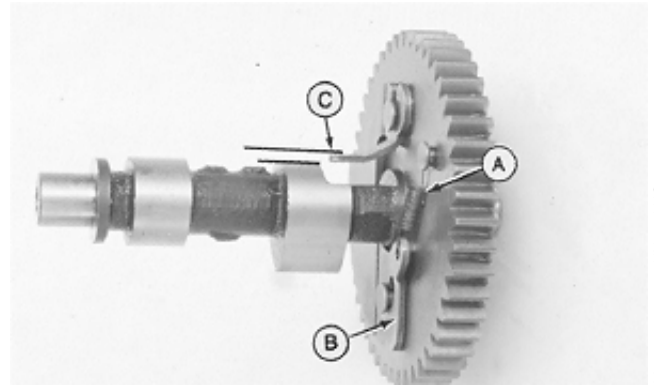


Crankcase Cover

MX,2120A1,A9 -19-21OCT92

INSPECT AUTOMATIC COMPRESSION RELEASE (A.C.R.)

1. Remove camshaft. (See this group.)
2. Inspect automatic compression release (A.C.R.) for damage.
3. Inspect spring (A). Replace if worn or damaged.
4. Move weight(s) (B) by hand to check for proper operation.
5. Check that tab (C) sits slightly above cam lobe when weight is released. Tab should drop below cam when weight is operated.
6. Replace A.C.R. if it does not operate properly.
7. Install camshaft.



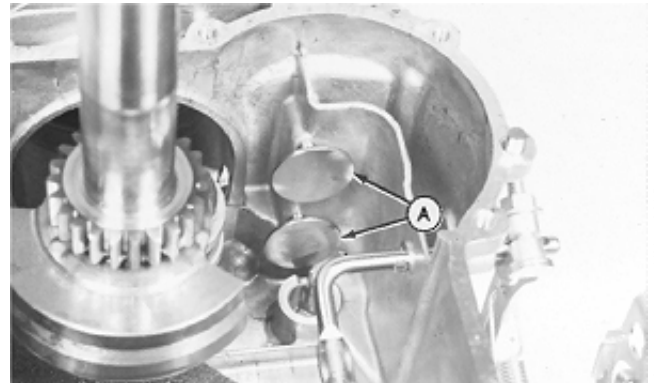
M51489 -UN-31AUG88

21
20
7

MX,2120A1,A10 -19-21OCT92

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)
- NOTE: Mark tappets so they can be installed in their original bores during assembly.*
2. Remove tappets (A).
 3. Inspect tappets for wear or damage. Replace if necessary.
 4. Apply clean engine oil to tappets and bores.
 5. Install tappets in original bores.
 6. Install camshaft.

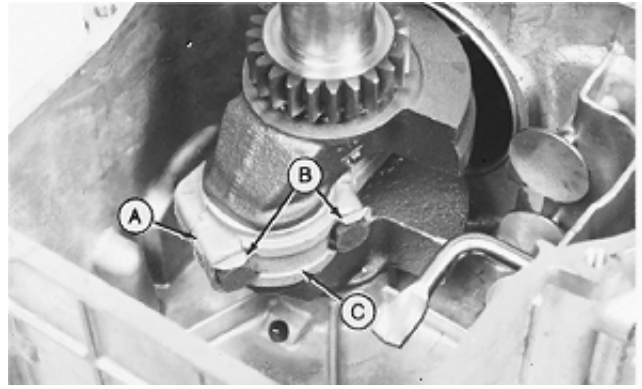


M80322 -UN-11MAR91

MX,2120A1,A11 -19-21OCT92

REMOVE AND INSTALL PISTON AND CONNECTING ROD

1. Remove cylinder head. (See Group 15.)
2. Remove camshaft. (See this group.)
3. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
4. Bend open locking tabs (B).
5. Remove cap screws, lock plate (C), and connecting rod cap (A).
6. Push piston and connecting rod from cylinder bore.
7. Make repairs as necessary. (See procedures in this group.)



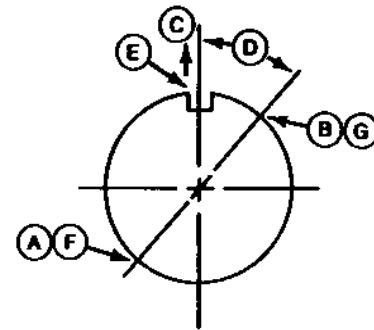
M80323 -UN-11MAR91

MX,2120A1,A12 -19-21OCT92

8. Deglaze cylinder bore. (See Section 100, Group 15.)
9. Align piston assembly to cylinder bore with piston ring end gaps as shown.
10. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
11. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
12. Install piston assembly in cylinder bore with notch on piston head facing flywheel side.
13. Install connecting rod cap and lock plate. Tighten cap screws to specifications.
14. Bend locking tabs over cap screws.
15. Install camshaft.
16. Install cylinder head.

TORQUE SPECIFICATIONS

Connecting Rod Cap Screws 19 N·m (168 lb-in.)

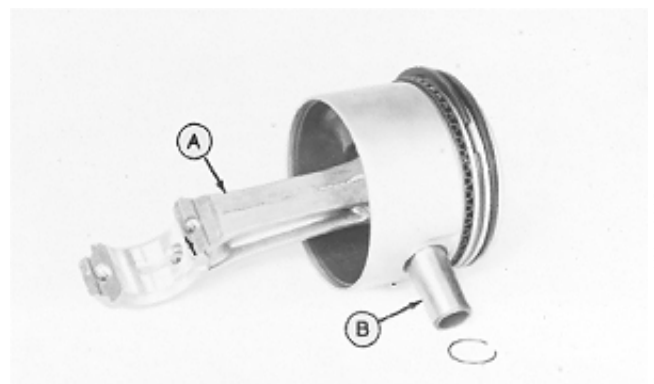


- A—First Ring End Gap
 B—Second Ring End Gap
 C—Oil Ring End Gap
 D—Flywheel Side
 E—45° Angle
 F—Notch
 G—Upper Side Rail End Gap
 H—Lower Side Rail End Gap

MX,2120A1,A13 -19-21OCT92

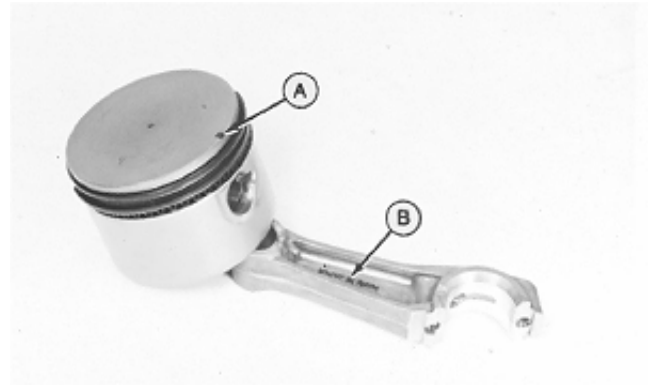
DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

1. Remove circlip, piston pin (B) and connecting rod (A).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.



MX,2120A1,A14 -19-21OCT92

4. Align notch (A) on piston head with MADE IN JAPAN (B) on connecting rod.
5. Install piston pin and circlip.



MX,2120A1,A15 -19-21OCT92

M80326 -UN-11MAR91

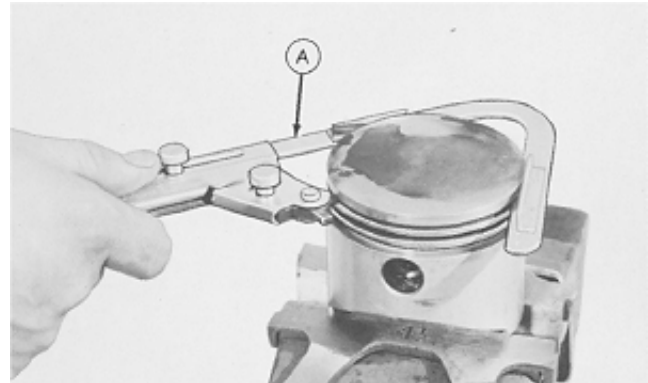
21
20
10

INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)
2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.
4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.
5. Check that oil return passages in grooves are open.



MX,2120A1,A16 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Top ring is tapered and cannot be measured as shown.

Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.



M38102 -UN-29AUG88

CLEARANCE SPECIFICATION (MAX)

Top Ring	Second Ring	Oil Control Ring
—	0.13 mm (0.005 in.)	0.17 mm (0.007 in.)

MX,2120A1,A17 -19-21OCT92

21
20
11

8. Measure piston pin outer diameter. Replace if less than specification.

9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

**Piston Pin O.D.
(MIN)**

14.98 mm
(0.590 in.)

**Piston Bore I.D.
(MAX)**

15.05 mm
(0.593 in.)



M50064 -UN-31AUG88



M80327 -UN-11MAR91

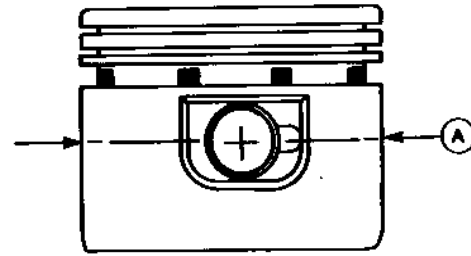
MX,2120A1,A18 -19-21OCT92

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)



SPECIFICATIONS

Piston O.D. (A)	71.86—71.89 mm (2.829—2.830 in.)
Piston-to-Cylinder	
Bore Clearance (std.)	0.087—0.137 mm (0.0034—0.00
(max.)	0.163 mm (0.0064 in.)

MX,2120A1,A18A -19-21OCT92

M80328 -UN-19MAR91

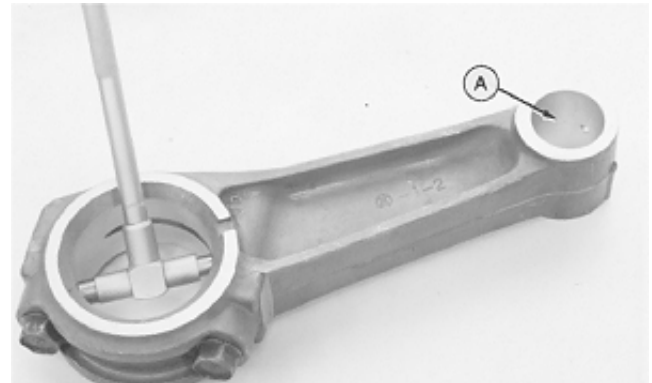
INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.

2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)

3. Install connecting rod cap. Tighten cap screws to 19 N-m (168 lb-in.).

4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



BEARING I.D. SPECIFICATIONS (MAX)

Crankshaft Bearing

27.06 mm
(1.065 in.)

Piston Bearing

15.04 mm
(0.592 in.)

MX,2120A1,A19 -19-21OCT92

M50066 -UN-31AUG88

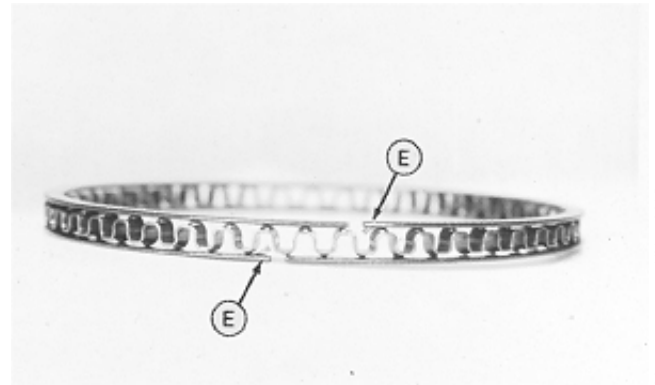
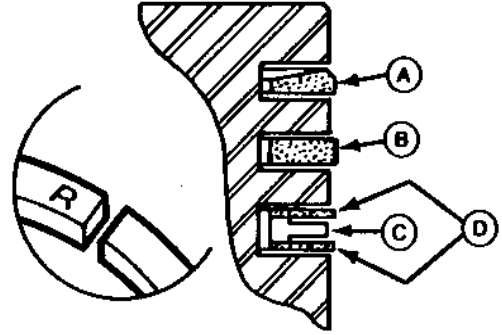
REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)
4. Install top ring (A) and second ring (B) with R or NPR mark facing up. Rings should turn freely in grooves.

NOTE: Install side rails with prongs (E) facing toward spacer.

5. Oil ring is an assembly. Install spacer (C), then side rails (D). Put side rail end gaps 180° apart.

A—Top Ring
B—Second Ring
C—Spacer
D—Side Rails
E—Prongs



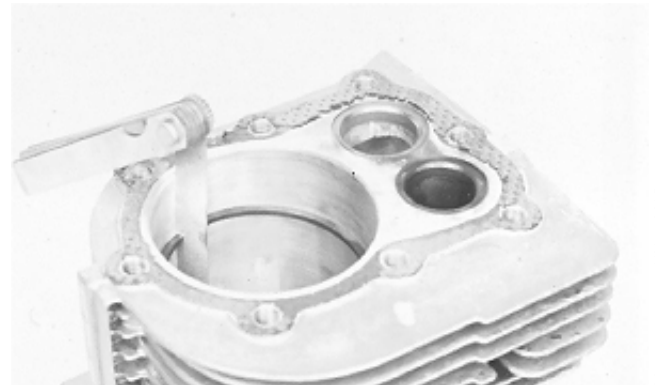
MX,2120A1,A20 -19-21OCT92

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS

Minimum End Gap	0.18 mm (0.007 in.)
Maximum End Gap	
Compression Rings	1.00 mm (0.039 in.)
Oil Ring Side Rails	1.40 mm (0.055 in.)



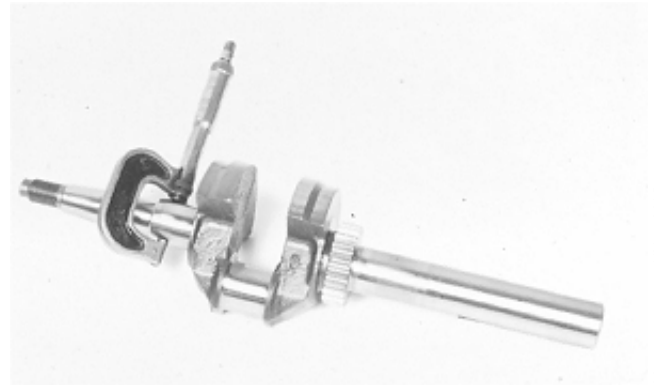
MX,2120A1,A21 -19-21OCT92

REMOVE, INSPECT AND INSTALL CRANKSHAFT

1. Remove piston and connecting rod. (See this group.)
2. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

3. Check crankshaft alignment (T.I.R.). (See this group.)
4. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
5. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
6. Measure crankshaft main bearing journals and connecting rod journal. Replace crankshaft if measurements are less than specifications.
7. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.
8. Apply clean engine oil to crankshaft bearings and journal.
9. Pack lithium based grease in oil seals.
10. Install crankshaft.
11. Install piston and connecting rod.



M80332 -UN-11MAR91

JOURNAL SPECIFICATIONS (MIN)

Main Bearing Journal		Connecting Rod Journal
PTO Side	Flywheel Side	
25.37 mm (0.999 in.)	24.96 mm (0.983 in.)	26.95 mm (1.061 in.)

MX,2120A1,A22 -19-21OCT92

INSPECT CRANKSHAFT PLAIN BEARINGS

NOTE: Cylinder block is fitted with a replaceable shell.

1. Remove crankshaft. (See this group.)
2. Measure crankshaft bearings in cylinder block and crankcase cover. Replace cover or shell, if equipped, if diameter is greater than specifications. (See this group.)
3. Install crankshaft.

BEARING I.D. SPECIFICATIONS (MAX)

Cylinder Block Bearing

25.10 mm
(0.988 in.)

Crankcase Cover Bearing

24.50 mm
(0.965 in.)



Cylinder Block



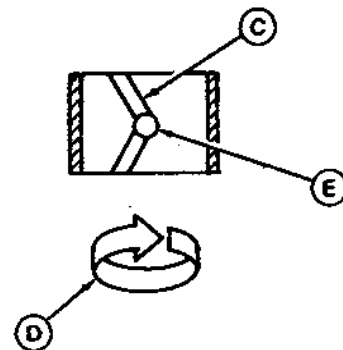
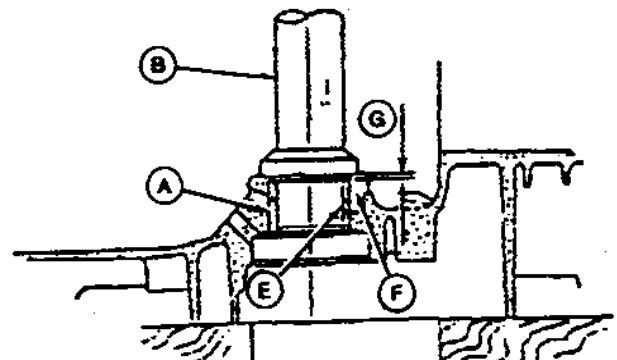
Crankcase Cover

MX,2120A1,A23 -19-21OCT92

REPLACE CRANKSHAFT BEARING SHELL

1. Drive old bearing (A) from crankcase using an appropriate bushing tool (B) and an arbor press.
2. Align new bearing so arrow head formed by oil grooves (C) points opposite to engine rotation (D). Align oil hole (E) in bearing with oil passage (F) in crankcase.
3. Install new bearing to depth (G) 1 mm (0.039 in.) below flange surface.

- A—Bearing
B—Bushing Tool
C—Oil Grooves
D—Engine Rotation
E—Oil Hole
F—Oil Passage
G—Installation Depth



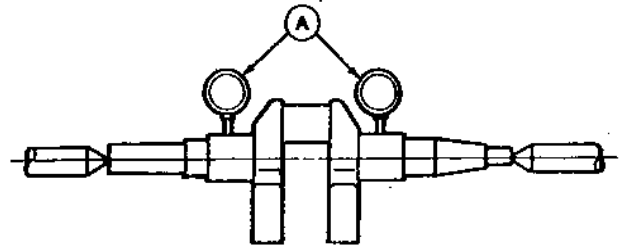
MX,2120A1,A24 -19-21OCT92

CHECK CRANKSHAFT ALIGNMENT (TIR)

Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

Maximum TIR 0.05 mm (0.002 in.)



MX,2120A1,A25 -19-21OCT92

M51761 -UN-07SEP88

MEASURE CRANKSHAFT END PLAY

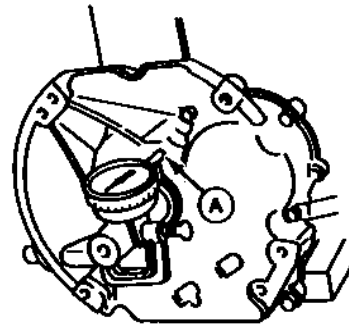
1. Measure end play using dial indicator (A).

2. Move crankshaft in and out. Record this measurement.

Replace block or crankshaft if end play is not within specifications.

SPECIFICATIONS

End Play 0—0.30 mm (0—0.012 in.)



MX,2120A1,A26 -19-21OCT92

M80296 -UN-19MAR91

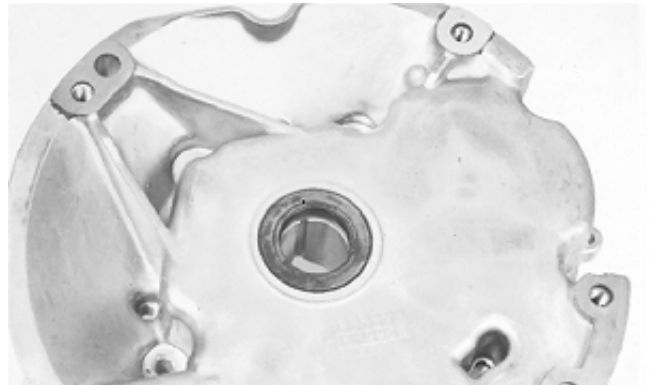
INSPECT OIL SEALS

NOTE: Pack lithium base grease in new or used seals.
Flywheel side seal is located in secondary breather assembly.

1. Remove flywheel. (See Group 10.)
2. Inspect oil seals (A and B) at flywheel end and PTO end for wear or damage. Replace if necessary.
3. Remove secondary breather assembly. (See Group 05.)
4. Remove crankcase cover. (See this group.)
5. Remove worn or damaged seals with a screwdriver.
6. Install seals with lip toward inside of engine using a bearing, bushing and seal driver set. Press seals in until flush with hub.
7. Install crankcase cover.
8. Install secondary breather.



Flywheel Side/Breather Assembly



PTO Side

MX,2120A1,A27 -19-21OCT92

INSPECT CYLINDER BLOCK

1. Remove crankshaft. (See this group.)
2. Clean and check block for cracks.
3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
4. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,2120A1,A28 -19-21OCT92

NOTE: A bare block is available for service.

5. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

6. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

7. Install crankshaft.

NOTE: If cylinder is rebored, oversize piston and rings must be installed.

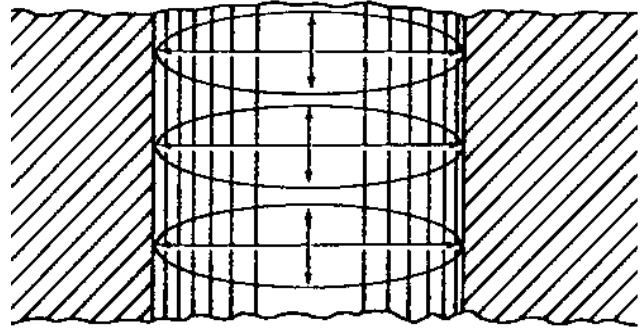
CYLINDER BORE SPECIFICATIONS

Standard

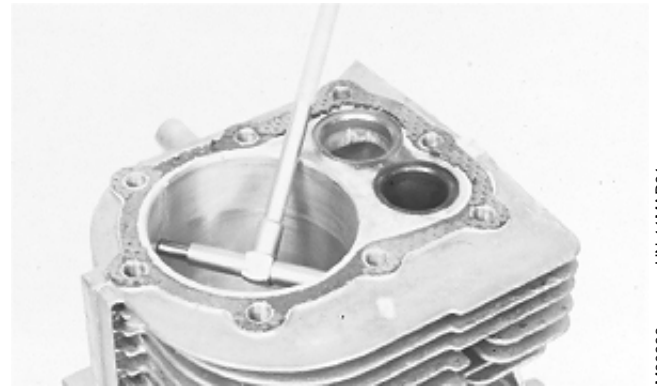
71.98—72.00 mm
(2.834—2.835 in.)

Wear Limit

72.06 mm
(2.837 in.)



M51745 -UN-23FEB89



M80336 -UN-11MAR91

MX,2120A1,A29 -19-21OCT92

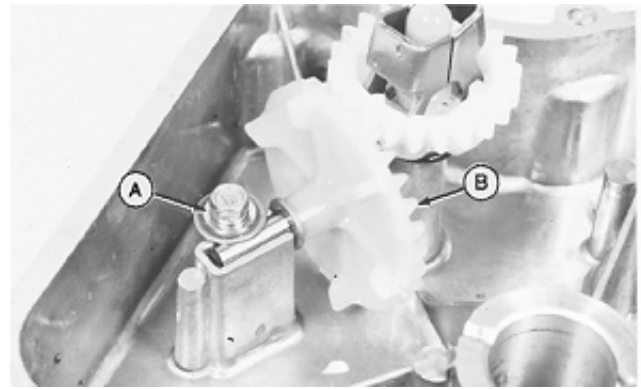
REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use 0.25 or 0.50 mm (0.010 or 0.020 in.) oversize pistons and rings. Have a reliable repair shop rebore the block to initial and final bore specifications. The repair shop must have proper equipment to handle cylinders made of high silicon content aluminum.

MX,2120A1,A30 -19-21OCT92

INSPECT AND REPLACE OIL SLINGER

1. Remove crankcase cover. (See this group.)
2. Remove cap screw and washer (A).
3. Remove oil slinger (B).
4. Inspect for wear or damage. Replace if necessary.
5. Install oil slinger, washer and cap screw.
6. Install crankcase cover.



M80337 -UN-11MAR91

21
20
19

MX,2120A1,A31 -19-21OCT92

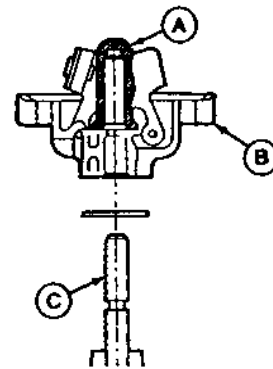
INSPECT AND REPLACE GOVERNOR

IMPORTANT: Removal damages governor. If not damaged, do not remove.

1. Remove crankcase cover. (See this group.)
2. Inspect governor. If necessary to replace, remove with screwdriver.
3. If removed, press shaft (C) back into block until it protrudes 32.2—32.8 mm (1.267—1.291 in.).

NOTE: Assemble sleeve and gear before installing assembly on shaft.

4. Install sleeve (A) into governor gear (B).
5. Install governor assembly onto shaft. Push down on assembly until it snaps into place.



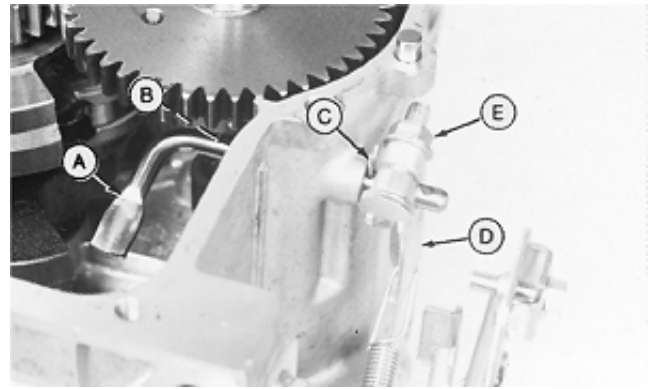
M51762 -UN-07SEP88

MX,2120A1,A32 -19-21OCT92

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (A). Replace if damaged.
3. To replace shaft, loosen nut (E) on lever (D).
4. Remove retaining pin (C), governor shaft and washer (B).
5. Install washer, shaft and retaining pin. Tighten nut.
6. Install crankcase cover.



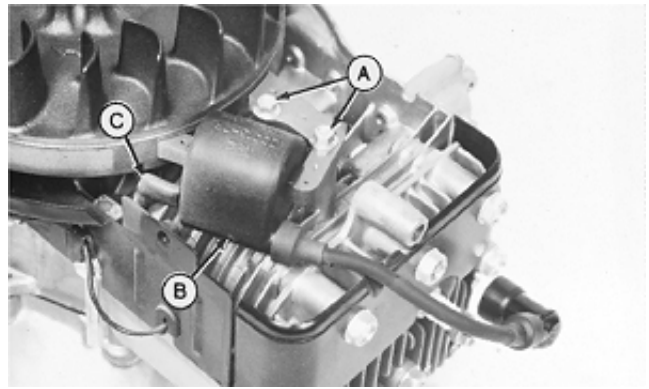
A—Governor Shaft
B—Washer
C—Retaining Pin
D—Governor Lever
E—Nut

MX,2120A1,A33 -19-21OCT92

M80338 -UN-11MAR91

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove blower housing. (See Group 10.)
2. Disconnect wiring lead (C).
3. Remove cap screws (A) and armature with coil (B).
4. Loosely install armature with coil.
5. Connect wiring lead.
6. Adjust armature air gap. (See this group.)
7. Install blower housing.

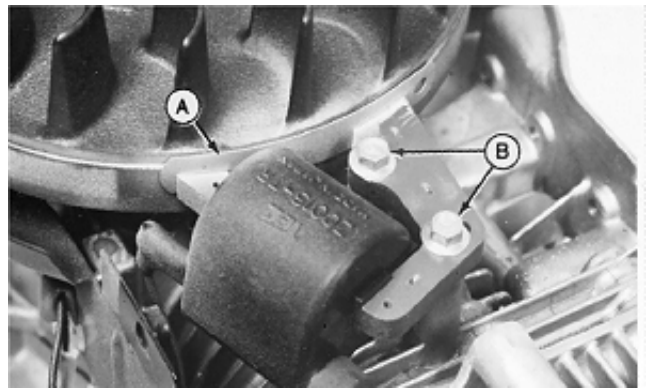


M80339 -UN-11MAR91

MX,2125A1,A1 -19-21OCT92

ADJUST ARMATURE AIR GAP

1. Turn flywheel magnet away from armature.
2. Insert feeler gauge blade (A) between flywheel and armature.
3. Push armature against flywheel and tighten screws (B).
4. Turn flywheel to remove feeler gauge.



M80340 -UN-11MAR91

AIR GAP SPECIFICATIONS

Feeler Gauge Blade 0.30 mm (0.012 in.)

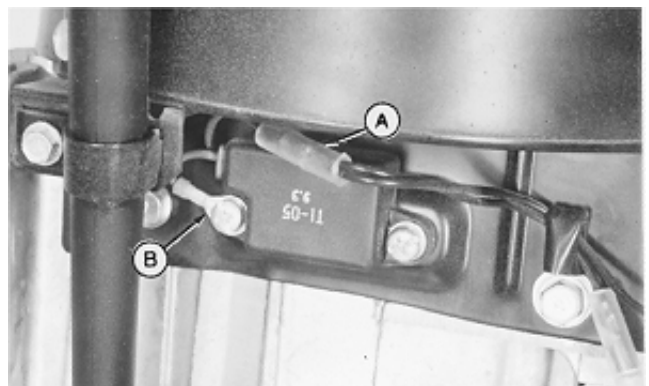
MX,2125A1,A2 -19-21OCT92

REPLACE IGNITOR

1. Disconnect wiring lead (A).
2. Remove ignitor.

NOTE: When installing ignitor, put wiring lead (B) under screw and washer.

3. Install ignitor.
4. Connect wiring lead.



M80341 -UN-11MAR91

MX,2125A1,A3 -19-21OCT92

21
25
2

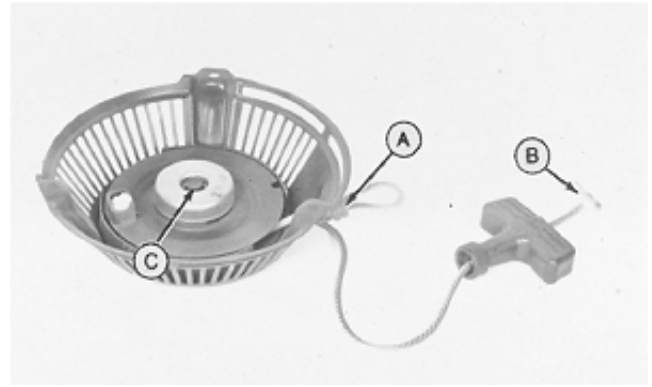
DISASSEMBLE RECOIL STARTER

1. Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (A) to prevent rope from winding back onto reel.
3. Pry knot (B) out of handle and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (A). Slowly release reel tension. Do not let rope get wedged between reel and housing.



CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove screw (C) and ratchet cover.
7. Remove pawl and springs.



M80300 -UN-11MAR91

21
30
1

MX,2130A1,A1 -19-21OCT92



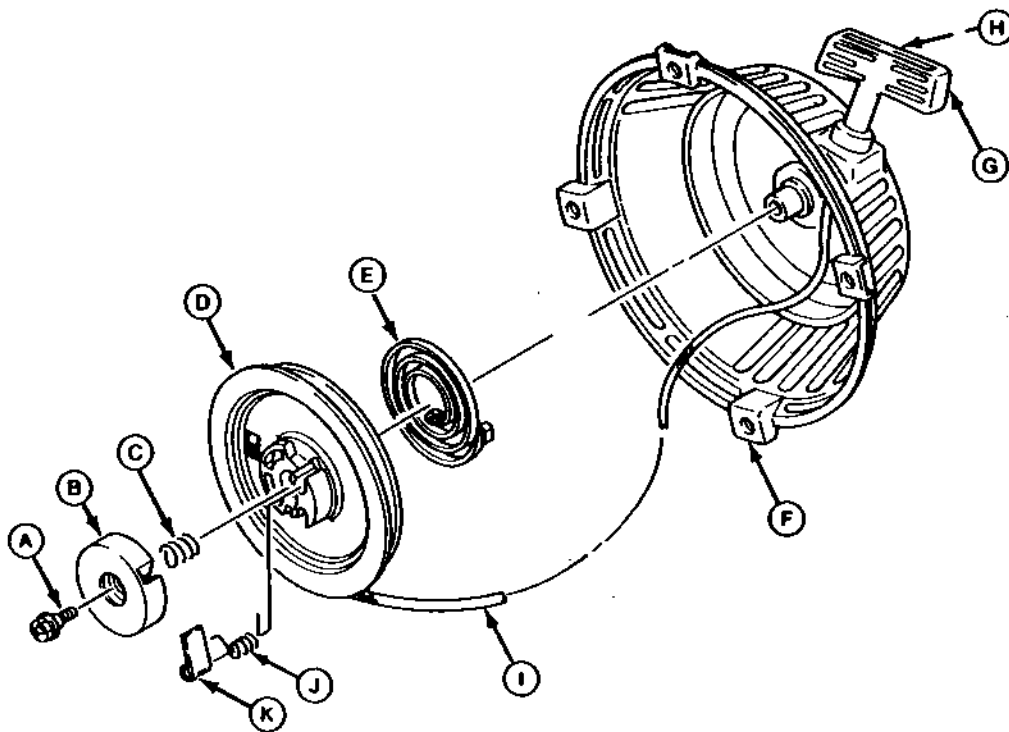
CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

8. Turn the reel one half turn clockwise so no spring tension can be felt.
9. Spring is stored in reel. Carefully remove reel while holding spring in underside of reel.



M51551 -UN-31AUG88

MX,2130A1,A2 -19-21OCT92

INSPECT RECOIL STARTER

A—Screw
B—Retainer
C—Spring

D—Reel
E—Spring
F—Housing

G—Handle
H—Clip
I—Rope

J—Spring
K—Pawl

Inspect all parts for wear or damage. Replace as necessary.

MX,2130A1,A3 -19-21OCT92

M80342 -JUN-19/MAR91

REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

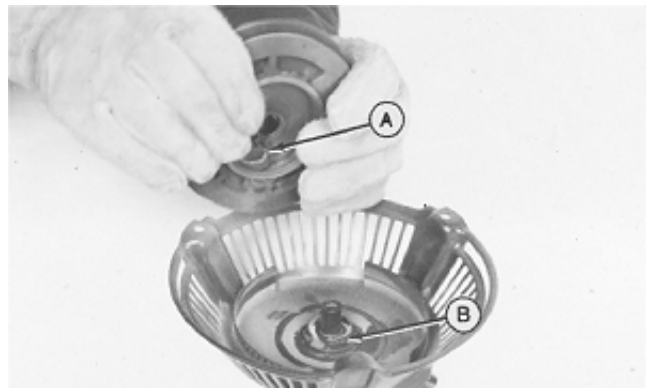
1. Working from the center out, carefully unwind spring from reel.
2. Hook outside spring tang in reel. Wind spring into reel, working toward center.



MX,2130A1,A4 -19-21OCT92

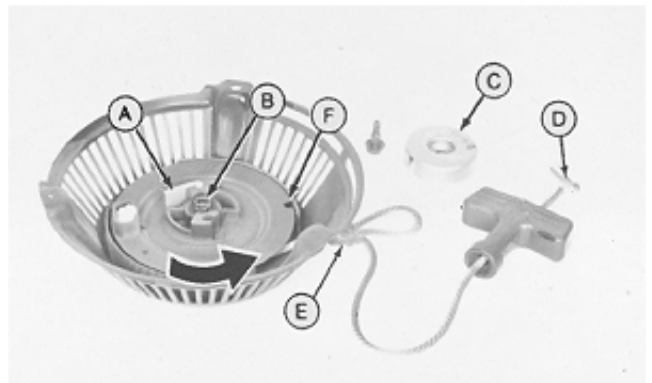
ASSEMBLE RECOIL STARTER

1. Wind rope counterclockwise onto reel.
2. Apply multipurpose grease to spring.
3. Install reel with spring in housing. Align inner tang (A) with catch (B).
4. Turn reel counterclockwise until you feel tang hook on catch.



MX,2130A1,A5 -19-21OCT92

5. Place rope in notch (F) and turn reel two turns counterclockwise to preload spring.
6. While holding reel to keep it from unwinding, feed end of rope through hole. Tie knot (E) to hold rope.
7. Install handle and secure with knot (D).
8. Remove knot (E).
9. Install spring (B) spring and pawl (A) and ratchet cover (C) with opening in cover over pawl. Check for free movement of pawls.
10. Pull rope to check for proper operation.
11. Install recoil starter on engine.



A—Pawl
B—Spring
C—Retainer
D—Knot
E—Knot

MX,2130A1,A6 -19-21OCT92

21
30
4

Section 25

FG150G/FG150D

Contents

	Page	Page
Group 00—Engine Application and Repair Specifications		
Engine Application Chart	25-00-1	
Repair Specifications	25-00-1	
Group 05—Fuel and Air Systems		
Service Parts Kits	25-05-1	
Remove, Inspect and Install Fuel Tank . .	25-05-1	
Replace Fuel Filter/Shutoff Valve	25-05-2	
Carburetor		
Remove and Install	25-05-3	
Disassemble, Clean, Inspect and Assemble	25-05-4	
Service		
Breather	25-05-6	
Air Cleaner	25-05-6	
Group 10—Blower Housing and Flywheel		
Remove and Install		
Blower Housing	25-10-1	
Flywheel	25-10-1	
Group 15—Cylinder Head		
Essential Tools	25-15-1	
Other Material	25-15-1	
Cylinder Head		
Remove and Install	25-15-2	
Inspect	25-15-3	
Group 20—Cylinder Block, Valves and Internal Components		
Other Material	25-20-1	
Service Parts Kits	25-20-1	
Remove and Install Valves and Springs . .	25-20-2	
Inspect		
Valve Springs	25-20-3	
Valve Guides	25-20-3	
Replace Valve Guide Bushing	25-20-3	
Recondition Valve Seats	25-20-4	
Check Valve-To-Tappet Clearance	25-20-5	
Remove and Install Crankcase Cover . . .	25-20-6	
Camshaft		
Remove and Install	25-20-6	
Inspect	25-20-7	
Inspect Plain Bearings	25-20-8	
Inspect Ball Bearing—FG150G	25-20-8	
Remove, Inspect and Install Tappets	25-20-9	
Piston and Connecting Rod		
Remove and Install	25-20-10	
Disassemble, Inspect and Assemble . . .	25-20-11	
Inspect Piston	25-20-11	
Inspect Connecting Rod	25-20-13	
Piston Rings		
Remove and Install	25-20-14	
Check End Gap	25-20-14	
Crankshaft		
Remove, Inspect and Install	25-20-15	
Inspect Ball Bearings—FG150G	25-20-16	
Inspect Ball Bearings—FG150D	25-20-17	
Check Alignment (TIR)	25-20-17	
Inspect Oil Seals	25-20-18	
Cylinder Block		
Inspect	25-20-18	
Rebore	25-20-20	
Inspect and Replace		
Governor	25-20-21	
Governor Shaft	25-20-22	
Group 25—Ignition and Charging System		
Remove and Install Armature with Coil . .	25-25-1	
Adjust Armature Air Gap	25-25-1	
Replace Ignitor	25-25-2	
Group 30—Starting Systems		
Recoil Starter		
Disassemble	25-30-1	
Inspect	25-30-2	
Replace Spring	25-30-3	
Assemble	25-30-3	

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

Machine	Engine Model No.
22 Greensmower	FG150G-BH90 or FG150G-BH90-01
22R Greensmower	FG150D-BH90

MX,2500A1,A1 -19-21OCT92

FG150G/FG150D REPAIR SPECIFICATIONS

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Item	Specification
Flywheel Nut Torque	60 N·m (44 lb-ft)

GROUP 15—CYLINDER HEAD

Cylinder Head	
Maximum Cylinder Head Warp	0.30 mm (0.012 in.)
Cap Screw Torque In Sequence	
Initial Torque	10 N·m (89 lb-in.)
Final Torque	24 N·m (212 lb-in.)
Spark Plug Torque	27 N·m (20 lb-ft)

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS

Valve Clearance (cold)	
Intake	0.12—0.18 mm (0.005—0.007 in.)
Exhaust	0.21—0.23 mm (0.008—0.009 in.)
Valves and Springs	
Minimum Spring Free Length	32 mm (1.260 in.)
Maximum Valve Guide I.D.	6.08 mm (0.239 in.)
Minimum Valve Stem Diameter	5.95 mm (0.234 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Seat and Face Angle	45°
Valve Seating Width	1.00—1.60 mm (0.039—0.063 in.)
Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Continued on next page

MX,2500A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Crankcase Cover	
Oil Capacity	0.5 L (1.06 pt)
Cap Screw Torque	9 N·m (84 lb-in.)
Drain Plug Torque	14 N·m (121 lb-in.)
Camshaft	
Minimum End Journal O.D.	14.94 mm (0.588 in.)
Minimum Lobe Height	
Intake	27.30 mm (1.070 in.)
Exhaust	27.10 mm (1.060 in.)
Maximum Crankcase Bearing I.D.	15.04 mm (0.592 in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.17 mm (0.007 in.)
Second Ring	0.16 mm (0.006 in.)
Oil Ring Assembly	Not Measured
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	0.80 mm (0.032 in.)
Minimum Pin O.D.	12.99 mm (0.511 in.)
Maximum Pin Bore I.D.	13.04 mm (0.513 in.)
Maximum Piston-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Piston O.D.	63.86—63.88 mm (2.516—2.5168 in.)
Piston-to-Cylinder Bore Clearance (std.)	0.12 mm (0.005 in.)
(max.)	0.1375 mm (0.0054 in.)
Connecting Rod	
Maximum Crankshaft Bearing I.D.	24.55 mm (0.967 in.)
Maximum Piston Pin Bearing I.D.	13.04 mm (0.514 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.10 mm (0.004 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	19.96 mm (0.786 in.)
Minimum Flywheel Side Journal O.D.	19.96 mm (0.786 in.)
Minimum Connecting Rod Journal O.D.	24.45 mm (0.963 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.	63.98—64.00 mm (2.521—2.522 in.)
Maximum Cylinder Bore I.D.	64.05 mm (2.524 in.)
Maximum Out-of-Round	0.045 mm (0.0018 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	64.21—64.23 mm (2.530—2.531 in.)
0.50 mm	64.46—64.48 mm (2.540—2.541 in.)

Continued on next page

MX,2500A1,A3 -19-21OCT92

GROUP 25—IGNITION AND CHARGING SYSTEM

Item	Specification
Ignition Coil Air Gap	0.30 mm (0.012 in.)
See Ignition Tests in this Group.	

GROUP 30—STARTING SYSTEMS

Electric Starter
See Starter Specifications in this Group.

MX,2500A1,A3A -19-21OCT92

25
00
3

25
00
4

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Carburetor Gasket Kit—FG150D (Carburetor S.N. 840001—)

Complete Carburetor

Complete Fuel Filter/Shutoff Valve

MX,2505A1,A1 -19-21OCT92

REMOVE, INSPECT AND INSTALL FUEL TANK

NOTE: The approximate fuel tank capacity is 3 L (3.16 U.S. qt).

⚠ CAUTION: Gasoline vapor is explosive. Do not expose to spark or flame. Serious personal injury can result.

1. Disconnect hose (A). Close all openings using caps and plugs.
2. Remove nuts and washers (B) from both sides of fuel tank.
3. Remove fuel tank.
4. Inspect tank for cracks or damage. Repair or replace as necessary.
5. Install fuel tank.
6. Install washers and nuts.
7. Connect fuel hose.



25-05-1
M80343 -UN-02APR91

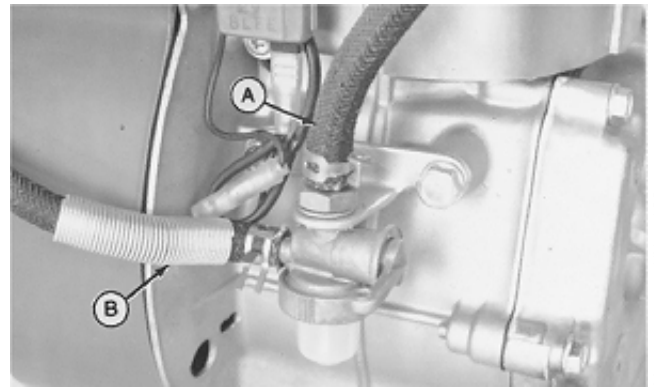
MX,2505A1,A2 -19-21OCT92

REPLACE FUEL FILTER/SHUTOFF VALVE



CAUTION: Gasoline vapor is explosive. Do not expose to spark or flame. Serious personal injury can result.

1. Disconnect hoses (A and B). Close all openings using caps and plugs.
2. Remove fuel filter/shutoff assembly.
3. Install fuel filter/shutoff assembly.
4. Connect hoses.

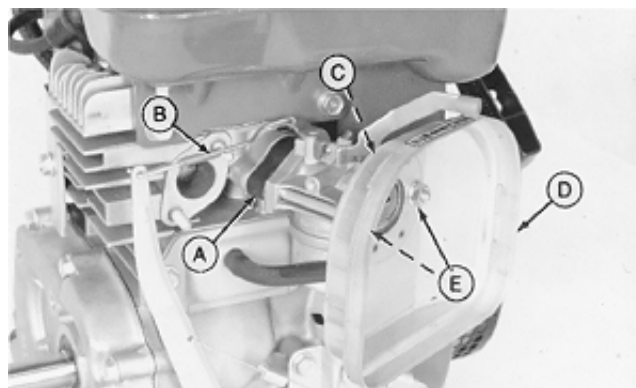


M80344 -UN-02APR91

MX,2505A1,A3 -19-21OCT92

REMOVE AND INSTALL CARBURETOR

1. Remove air cleaner elements.
 2. Close fuel shutoff.
 3. Remove two nuts (E).
 4. Remove air cleaner base (D) and gasket.
 5. Disconnect hose (C). Close all openings using caps and plugs.
 6. Separate carburetor from spacer (A). Remove carburetor.
 7. Disconnect throttle control linkage (B).
 8. Remove spacer (A) and gaskets.
 9. Make repairs as necessary. (See this group.)
- NOTE: Install spacer (A) with flat side toward carburetor.*
10. Install spacer and gaskets.
 11. Connect throttle control linkage.
 12. Install carburetor.
 13. Connect fuel hose.
 14. Install new gasket, air cleaner base and nuts.
 15. Install air cleaner elements.



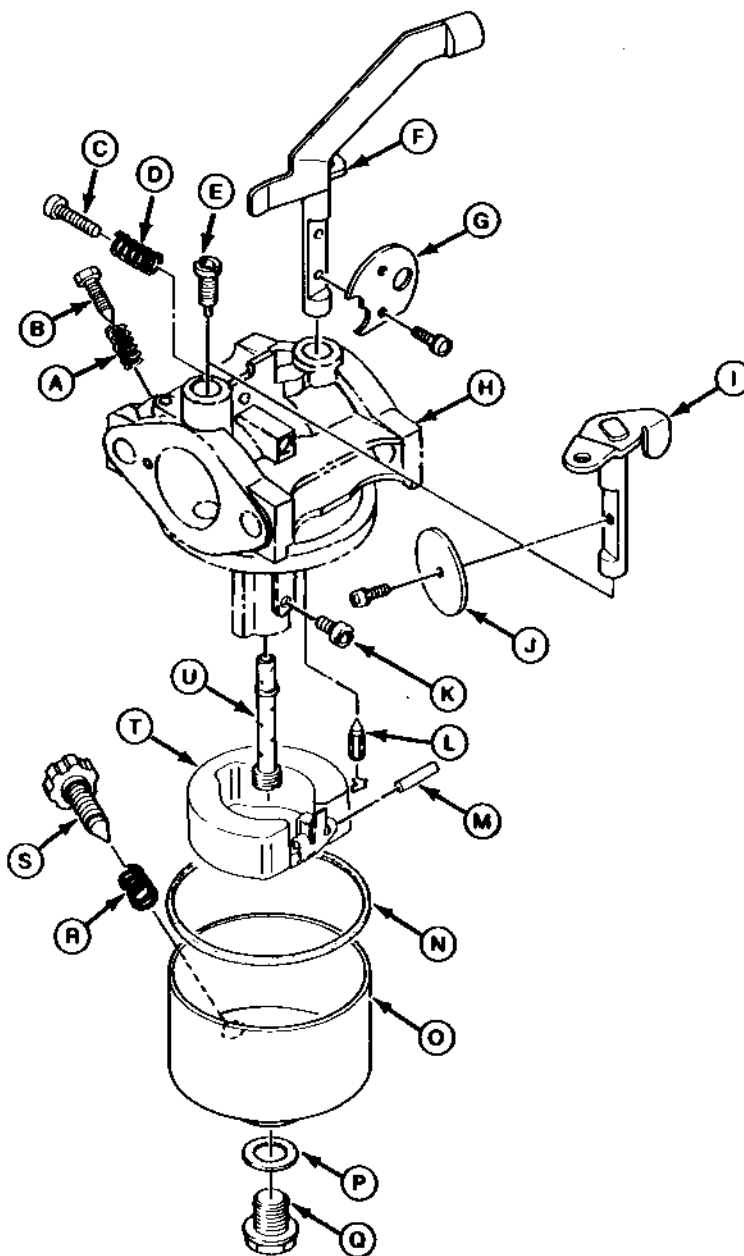
A—Spacer
B—Throttle Control Linkage
C—Fuel Hose
D—Air Cleaner Base
E—Nuts

M80345 -UN-02APR91

25
05
3

MX,2505A1,A4 -19-21OCT92

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR



A—Spring
B—Pilot Screw
C—Idle Screw
D—Spring
E—Pilot Jet
F—Choke Shaft

G—Choke Plate
H—Carburetor Body
I—Throttle Shaft
J—Throttle Plate
K—Main Jet

L—Needle Valve
M—Float Pin
N—Gasket
O—Float Chamber
P—Washer

Q—Plug
R—Spring
S—Drain Screw
T—Float
U—Main Nozzle

FG150D (Carb S.N. 840001—)

M80347 -JUN-06APR91

MX,2505A1,A5 -19-21OCT92

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets, float and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

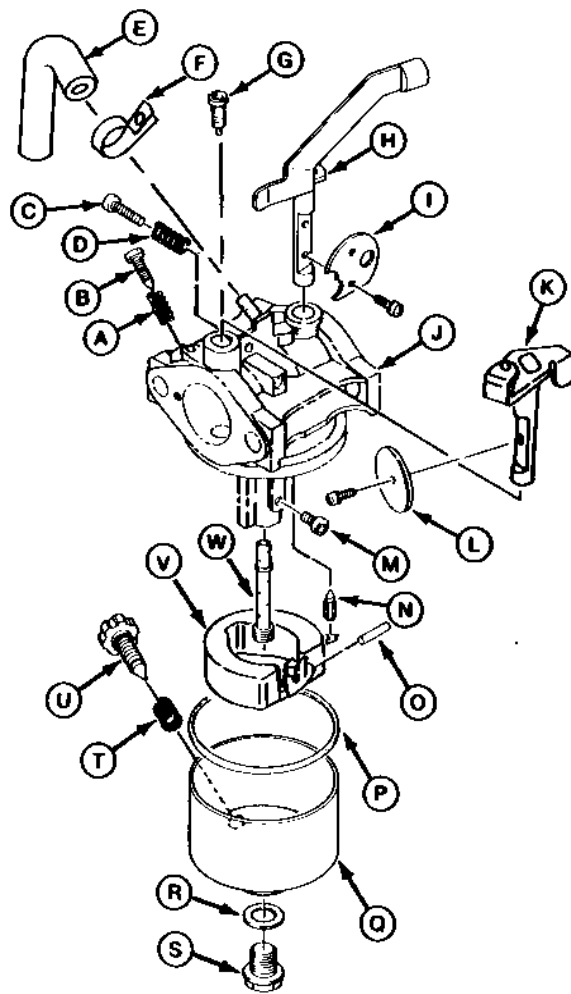
3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.

4. Inspect all parts for wear or damage, replace as necessary.

NOTE: Float is plastic. The float cannot be adjusted. Replace if necessary.

FG150D (Carb S.N. —840000) and FG150G shown.

- | | |
|-------------------|-----------------|
| A—Spring | M—Main Jet |
| B—Pilot Screw | N—Needle Valve |
| C—Idle Screw | O—Float Pin |
| D—Spring | P—Gasket |
| E—Hose | Q—Float Chamber |
| F—Clamp | R—Washer |
| G—Pilot Jet | S—Plug |
| H—Choke Shaft | T—Spring |
| I—Choke Plate | U—Drain Screw |
| J—Carburetor Body | V—Float |
| K—Throttle Shaft | W—Main Nozzle |
| L—Throttle Plate | |



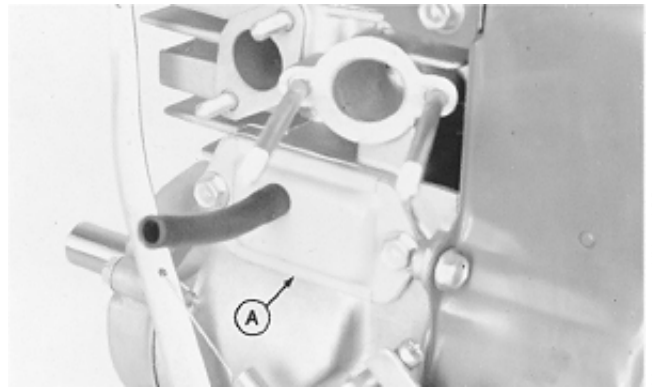
MX,2505A1,A6 -19-21OCT92

M80348 -UN-06APR91

SERVICE BREATHER

NOTE: Tappet chamber cover is an oil breather.

1. Remove carburetor. (See this group.)
2. Remove tappet chamber cover/breather and gasket (A).
3. Clean cover/breather and tube. Inspect for cracks or damage. Replace if necessary.
4. Install new gasket and cover/breather.
5. Install carburetor.



M80349 -UN-02APR91

MX,2505A1,A7 -19-21OCT92

SERVICE AIR CLEANER

NOTE: Replace elements yearly or every 25 hours as required.

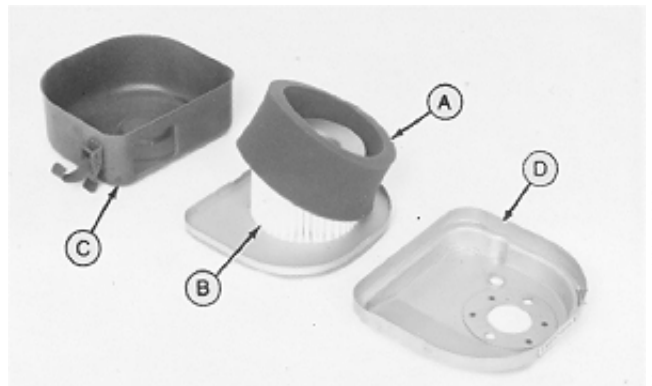
1. Remove and disassemble air cleaner.

IMPORTANT: Do not clean elements with solvent or compressed air.

2. Wash foam element (A) in detergent and water. Dry element.
3. Put 12—15 drops of engine oil on foam element (A). Squeeze out excess oil.
4. Replace paper element (B) if:
 - Element is oily, dirty, bent, torn, crushed, or obstructed in any way.
 - Seal is damaged.
 - Engine performance is poor.
5. Inspect cover (C) and base (D) for damage. Replace if necessary.

IMPORTANT: Any time air cleaner base is removed, check for free choke operation during reassembly.

6. Assemble and install air cleaner.



A—Foam Element
B—Paper Element
C—Cover
D—Base

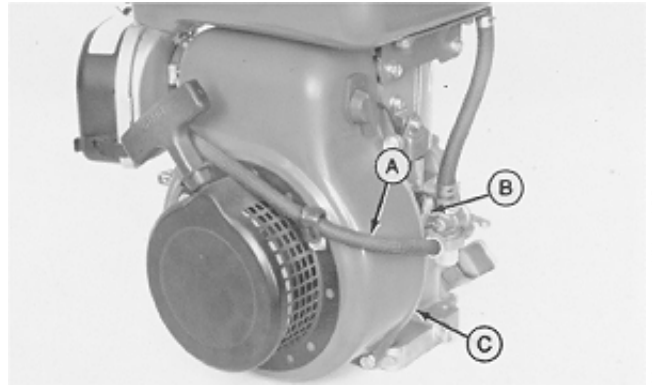
M80240 -UN-11MAR91

MX,2505A1,A8 -19-21OCT92

REMOVE AND INSTALL BLOWER HOUSING

NOTE: It is not necessary to remove recoil starter from blower housing.

1. Close fuel shutoff valve.
2. Disconnect hose (A).
3. Cut wire tie and disconnect wiring lead (B).
4. Remove blower housing (C).
5. Install blower housing.
6. Connect wiring lead.
7. Install wire tie.
8. Connect fuel hose.



M80350 -UN-02APR91

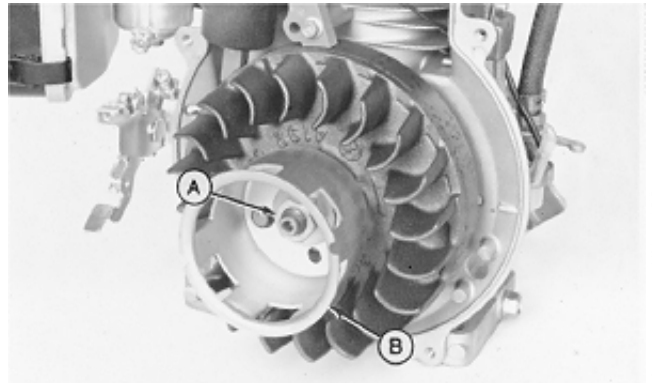
MX,2510A1,A1 -19-21OCT92

REMOVE AND INSTALL FLYWHEEL

1. Remove blower housing. (See this group.)
2. Hold flywheel and remove nut and washer (A).
3. Remove starter cup (B).
4. Remove flywheel using a two-jaw puller.
5. Install flywheel.

NOTE: Install washer with concave side toward flywheel.

6. Install starter cup, washer and nut. Tighten nut to 60 N·m (44 lb-ft).
7. Install blower housing.



M80351 -UN-02APR91

MX,2510A1,A2 -19-21OCT92

25
10
2

SPECIAL OR ESSENTIAL TOOLS

NOTE: Order tools according to information given in the
U.S. SERVICE-GARD™ Catalog or in the
European Microfiche Tool Catalog (MTC).

DX,TOOLS -19-05JUN91

Valve Guide Driver Tool JDG504

Replace valve guide bushings.

MX,JDG504 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean cylinder head

SCOTCH-BRITE is a trade mark of the 3M Company.

MX,5015A1,A1 -19-21OCT92

REMOVE AND INSTALL CYLINDER HEAD

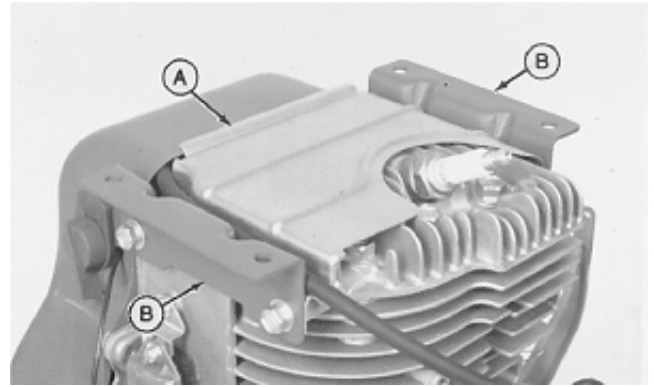
1. Disconnect spark plug wiring lead.
2. Remove fuel tank. (See Group 05.)
3. Remove brackets (B).
4. Remove shield (A).
5. Remove spark plug.
6. Remove cylinder head and gasket.
7. Make repairs as necessary. (See procedures in this group.)

IMPORTANT: Gasket surfaces are coated with sealant. Do not damage surfaces or gasket during installation.

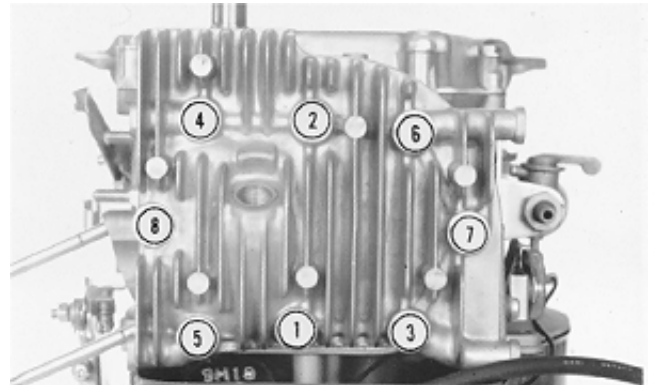
8. Install cylinder head with new gasket. Install cap screws and tighten finger tight.
9. Tighten cap screws in sequence shown. Tighten to initial torque specifications.
10. Continue in sequence, 4 N·m (35 lb-in.) at a time, until final torque is as specified.
11. Install spark plug and tighten to specification.
12. Install heat shield.
13. Install fuel tank brackets.
14. Install fuel tank.

TORQUE SPECIFICATIONS

Initial Torque	10 N·m (89 lb-in.)
Final Torque	24 N·m (212 lb-in.)
Spark Plug	27 N·m (20 lb-ft)



M80352 -UN-02APR91



M80353 -UN-02APR91

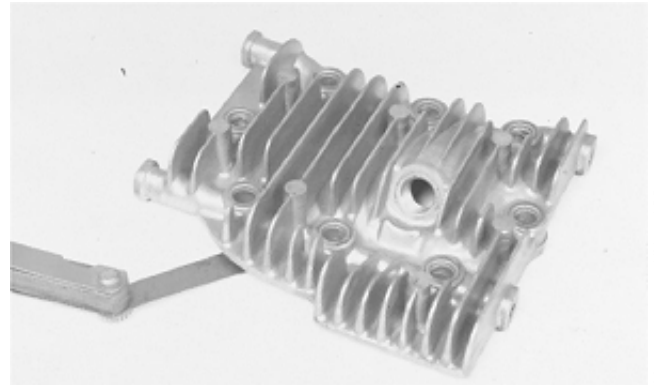
MX,2515A1,A1 -19-21OCT92

INSPECT CYLINDER HEAD

1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Put cylinder head on a surface plate. Check for distortion at several points around the head using a feeler gauge. Replace head if distortion is more than specifications.

SPECIFICATIONS

Cylinder Head Distortion (Max) 0.30 mm (0.012 in.)



M80354 -UN-02APR91

25
15
3

MX,2515A1,A2 -19-21OCT92

25
15
4

Group 20 Cylinder Block, Valves and Internal Components

OTHER MATERIAL

Number	Name	Use
	Valve Guide Cleaner	Clean valve guides
	Stanisol (or Kerosene)	Finish ream valve guide
	Prussian Blue Compound	Check valve seat contact
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,5020A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalogue.

Oversized Piston Ring Kit

Oversized Pistons

Cylinder Block

Overhaul Gasket Kit

Short Block Kit

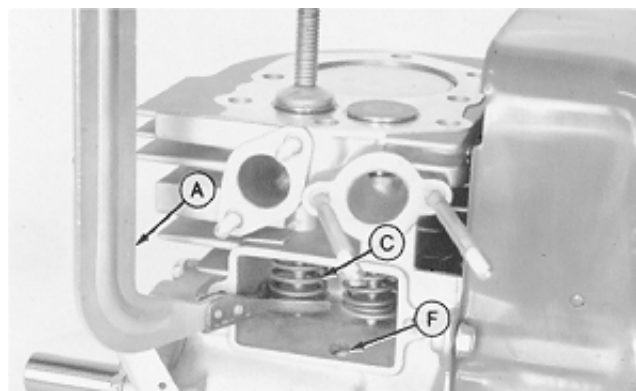
MX,2020A1,A2 -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove carburetor. (See Group 05.)
2. Remove cylinder head. (See Group 15.)
3. Remove tappet chamber cover/breather.

IMPORTANT: Mark and keep springs and valves together.

4. Compress valve spring (C) with a spring compressor (A) and remove valve sleeve (E).
5. Remove compressor, valves, springs and retainers.
6. Inspect and analyze valves. (See Section 100, Group 05.)
7. Inspect springs, valve guides and seats. (See this group.)
8. Check valve-to-tappet clearance. (See this group.)
9. Check that drainback hole (F) is open.
10. Align valve springs and retainers in tappet chamber.
11. Coat valve stems with oil and install in cylinder block.
12. Compress each spring and install valve sleeves.
13. Install tappet chamber cover/breather and new gasket.
14. Install cylinder head.
15. Install carburetor.



A—Spring Compressor
B—Valve
C—Spring
D—Spring Retainer
E—Valve Sleeve
F—Drainback Hole

M80355 -UN-02APR91

25
20
2

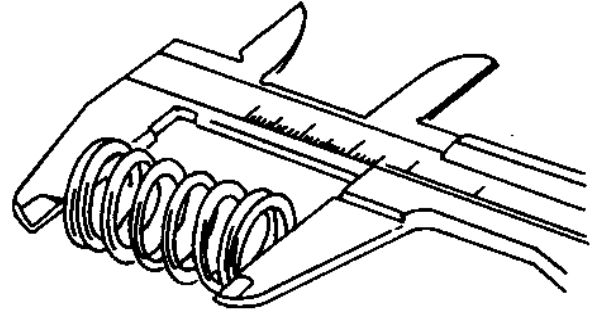
MX,2520A1,A1 -19-21OCT92

INSPECT VALVE SPRINGS

Inspect valve springs. Replace springs if damaged or if free length is less than specification.

SPECIFICATION (MIN)

Valve Spring Free Length 32.00 mm (1.260 in.)



MX,2520A1,A2 -19-21OCT92

M50036 -UN-31AUG88

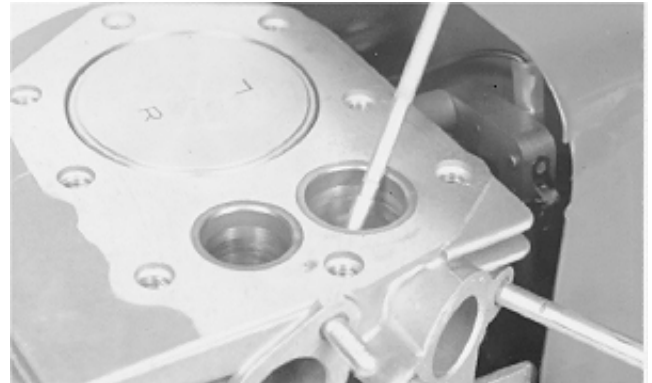
INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guide bushings. Replace bushings if inside diameter is greater than specifications. (See this group.)

SPECIFICATIONS (MAX) I.D.

Intake and Exhaust 6.08 mm (0.239 in.)

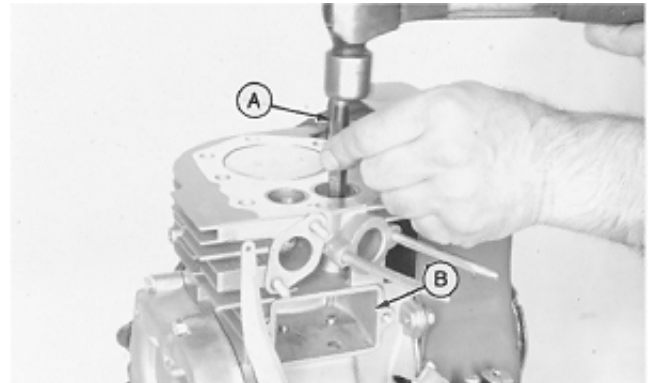


MX,2515A1,A3 -19-21OCT92

M80356 -UN-02APR91

REPLACE VALVE GUIDE BUSHING

1. Use JDG-504 Valve Guide Driver (A) to drive bushing into tappet chamber (B). Use locking pliers to crush end of bushing in chamber. Drive remaining portion of bushing into chamber and remove.



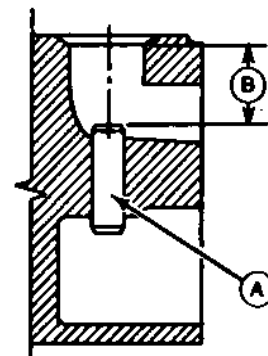
MX,2520A1,A4 -19-21OCT92

M80357 -UN-02APR91

2. Use valve guide driver to install new bushing (A). Drive bushing into cylinder body until distance from valve seat counterbore to top of bushing (B) is according to specifications.

SPECIFICATIONS

Distance (B) 23 mm (0.910 in.)



MX,2520A1,A5 -19-21OCT92

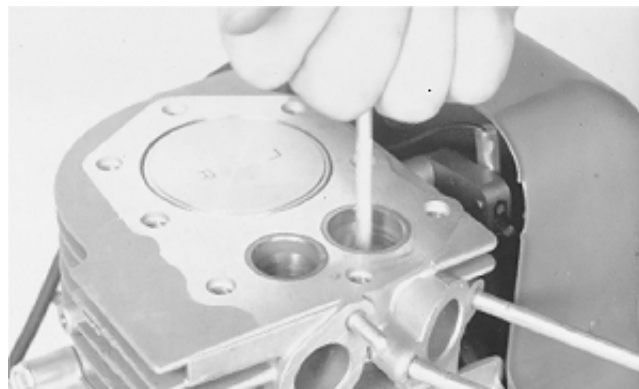
M80358 -UN-06APR91

3. Finish reaming valve guide according to specifications, with stanisol or kerosene lubricant and a 6 mm valve guide reamer. Turn reamer clockwise.

4. Thoroughly clean valve area before assembly.

SPECIFICATIONS

Bushing Finished I.D. 6—6.02 mm (0.236—0.237 in.)



M80359 -UN-02APR91

MX,2520A1,A6 -19-21OCT92

RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder block. Pitted or worn seats can be refaced using a seat cutter.

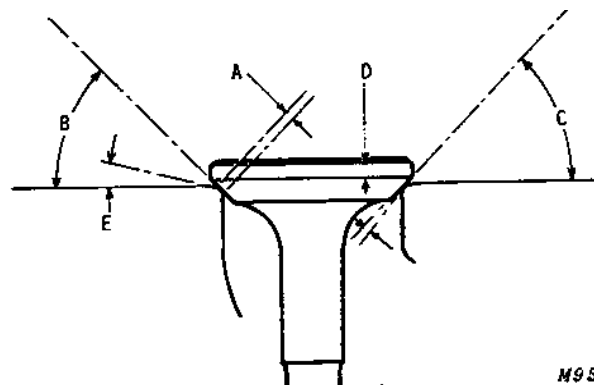
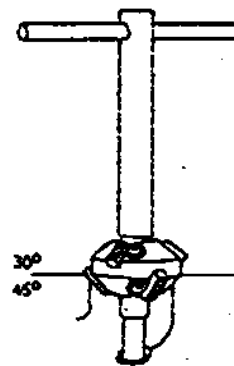
2. To recondition valve seat, cut at 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).

3. Cut valve seating surface (A) as close as possible to specifications.

4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface 1.00—1.60 mm (0.039—0.063 in.)
 B—Valve Seat Angle 45°
 C—Valve Face Angle 45°
 D—Valve Margin 0.60 mm (0.020 in.)
 E—Valve Narrowing Angle 30°



M955

-UN-31AUG88

M51558

-UN-01SEP88

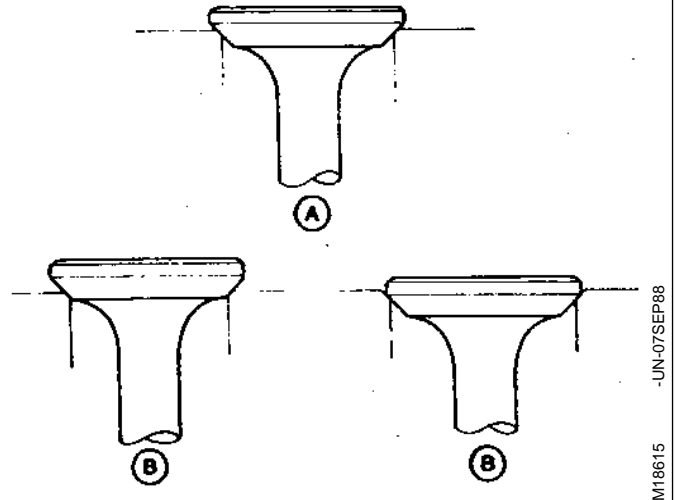
M9552

MX,2520A1,A7 -19-21OCT92

5. Center valve seat on the valve face:

- (A) shows correct position.
- (B) shows incorrect.

6. Check seat for good contact using Prussian Blue Compound.

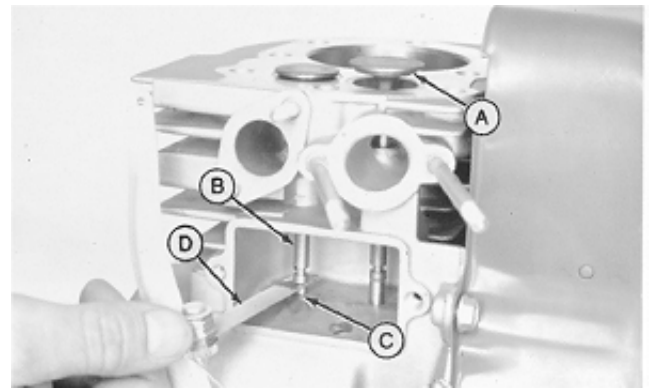


MX,3015A1,A9 -19-21OCT92

CHECK VALVE-TO-TAPPET CLEARANCE

NOTE: Valve grinding changes the valve-to-tappet clearance. Check clearance when engine is cold.

1. Install valves in cylinder block.
2. Turn flywheel until intake valve (A) is at its highest position. Check clearance between valve (B) and tappet (C), with feeler gauge (D) and compare to specification.
3. Perform same procedure for exhaust valve (B).
4. Grind end of valve stem to obtain proper clearance.



- A—Intake Valve
- B—Exhaust Valve
- C—Tappet
- D—Feeler Gauge

VALVE CLEARANCE SPECIFICATIONS

Exhaust	0.21—0.23 mm (0.008—0.009 in.)
Intake	0.12—0.18 mm (0.005—0.007 in.)

MX,2520A1,A8 -19-21OCT92

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is 0.5 L (1.06 pt).

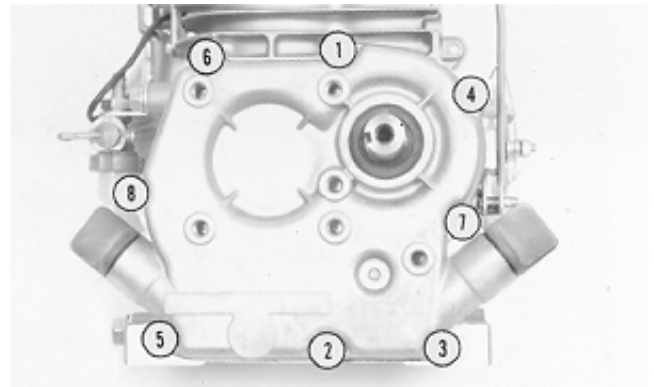
1. Drain crankcase.
2. Remove crankcase cover and gasket.
3. Clean crankcase and crankcase cover gasket surfaces.

NOTE: Do not force cover. Gears must mesh for proper positioning.

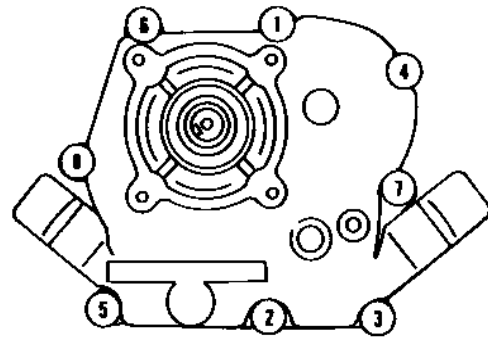
4. Install gasket and cover. Tighten cap screws using the sequence shown.

TORQUE SPECIFICATIONS

Mounting Cap Screws	9 N·m (84 lb-in.)
Oil Drain Plug	14 N·m (121 lb-in.)



FG150G



FG150D

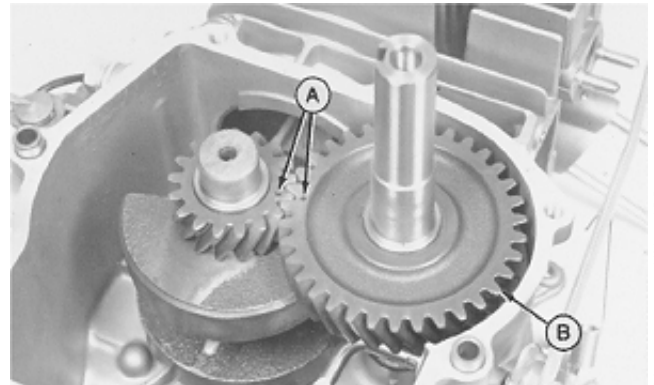
MX,2520A1,A9 -19-21OCT92

REMOVE AND INSTALL CAMSHAFT

1. Remove crankcase cover. (See this group.)

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

2. Rotate crankshaft until timing marks (A) align.
3. Remove camshaft (B).
4. Inspect camshaft. (See this group.)
5. Apply clean engine oil to camshaft lobes and journals.
6. Align timing marks and install camshaft.
7. Install crankcase cover.



FG150G Shown

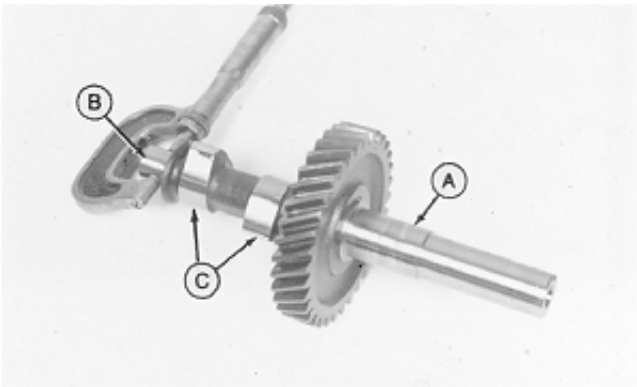
MX,2520A1,A10 -19-21OCT92

INSPECT CAMSHAFT

Inspect camshaft for worn or broken teeth.

*NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.*

Measure PTO side journal (A), flywheel side journal (B), and lobes (C). Replace camshaft and tappets if less than specifications.



FG150G Shown

SPECIFICATIONS (MIN)

	PTO Side Journal	Flywheel Side Journal	Cam Lobes
FG150G	—	14.94 mm (0.588 in.)	Intake: 27.30 mm (1.070 in.) Exhaust: 27.10 mm (1.060 in.)
FG150D	14.94 mm (0.588 in.)	14.94 mm (0.588 in.)	Intake: 27.30 mm (1.070 in.) Exhaust: 27.10 mm (1.060 in.)

MX,2520A1,A11 -19-21OCT92

M80365 -UN-02APR91

25
20
7

INSPECT CAMSHAFT PLAIN BEARINGS

NOTE: FG150G crankcase cover is equipped with a ball bearing.

1. Remove camshaft. (See this group.)
2. Measure camshaft bearings in cylinder block and crankcase cover, if equipped. Replace block or cover if diameter is greater than specification.
3. Install camshaft.



Cylinder Block

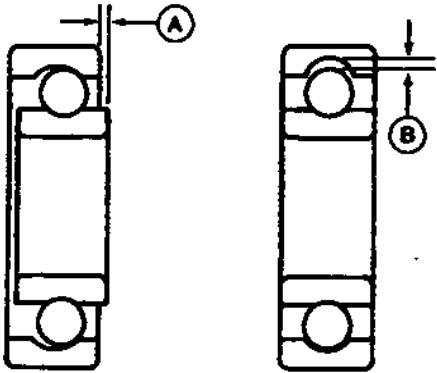
SPECIFICATIONS (MAX)

	Cylinder Block Bearing	Crankcase Cover Bearing
FG150G	15.04 mm (0.592 in.)	—
FG150D	15.04 mm (0.592 in.)	15.04 mm (0.592 in.)

MX,2520A1,A12 -19-21OCT92

INSPECT CAMSHAFT BALL BEARING—FG150G

1. Remove PTO end oil seal. (See Inspect Oil Seals in this group.)
2. Remove camshaft bearing from crankcase cover using a bearing, bushing and seal driver set.
3. Thoroughly clean bearing in solvent. Dip bearing in light weight oil.
4. Spin the bearing by hand and check for axial (A) and radial (B) free play.
5. Replace bearing if it is noisy or has too much play.
6. Install bearing flush to inside of crankcase cover using a bearing, bushing and seal driver set.
7. Install oil seal.



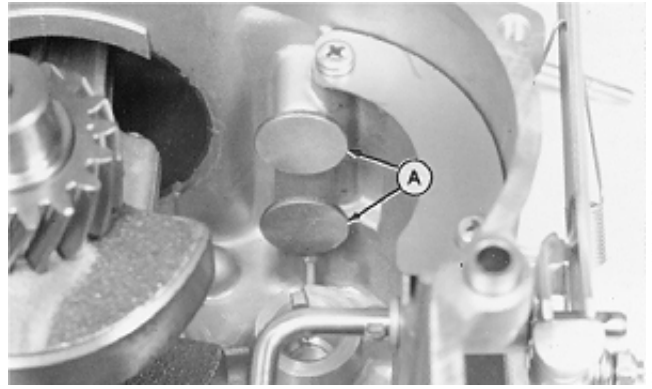
MX,2520A1,A13 -19-21OCT92

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)

NOTE: Mark tappets so they can be installed in their original bores during assembly.

2. Remove tappets (A).
3. Inspect tappets for wear or damage. Replace if necessary.
4. Apply clean engine oil to tappets and bores.
5. Install tappets in original bores.
6. Install camshaft.



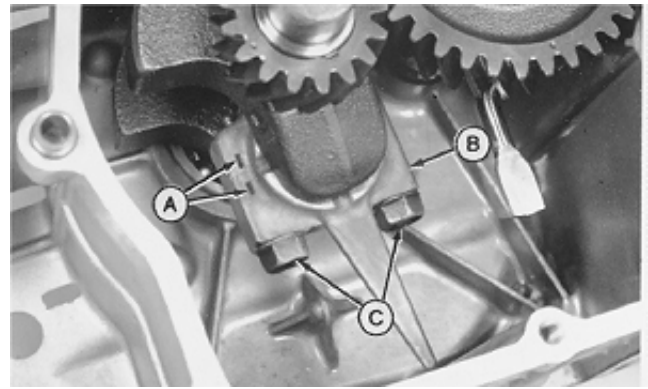
M80369 -UN-02APR91

MX,2520A1,A14 -19-21OCT92

25
20
9

REMOVE AND INSTALL PISTON AND CONNECTING ROD

1. Remove cylinder head. (See Group 15.)
2. Remove crankcase cover. (See this group.)
3. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
4. Remove cap screws (C) and connecting rod cap (B).
5. Push piston and connecting rod from cylinder bore.
6. Make repairs as necessary. (See procedures in this group.)
7. Deglaze cylinder bore. (See Section 100, Group 15.)
8. Stagger piston ring end gaps 180° apart, but do not align with oil ring side rail end gaps.
9. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
10. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
11. Install piston assembly in cylinder bore with engraved "L" on piston head facing flywheel side of engine.
12. Align marks (A) on connecting rod and cap. Install connecting rod cap and cap screws. Tighten cap screws to specifications.



M80370 -UN-02APR91

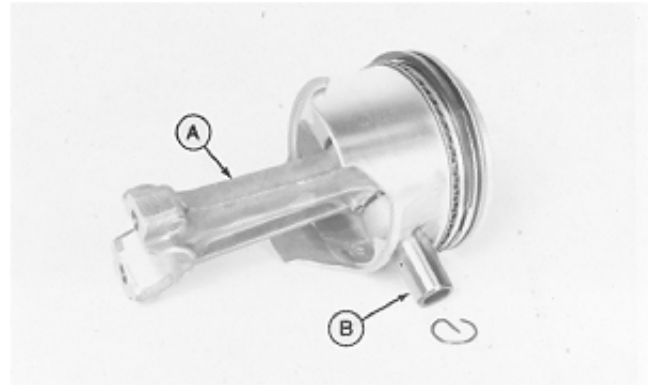
TORQUE SPECIFICATIONS

Connecting Rod Cap Screws 20 N·m (177 lb-in.)

MX,2520A1,A15 -19-21OCT92

DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

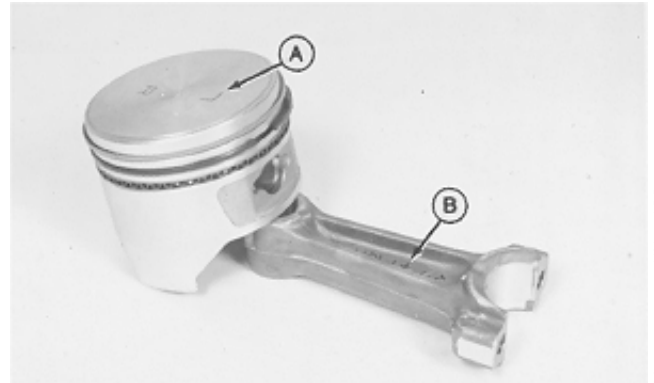
1. Remove circlip, piston pin (B) and connecting rod (A).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.



MX,2520A1,A16 -19-21OCT92

M80371 -UN-02APR91

4. Align "L" mark (A) on piston head with the Japanese characters (B) on the connecting rod.
5. Install piston pin and circlip.



MX,2520A1,A17 -19-21OCT92

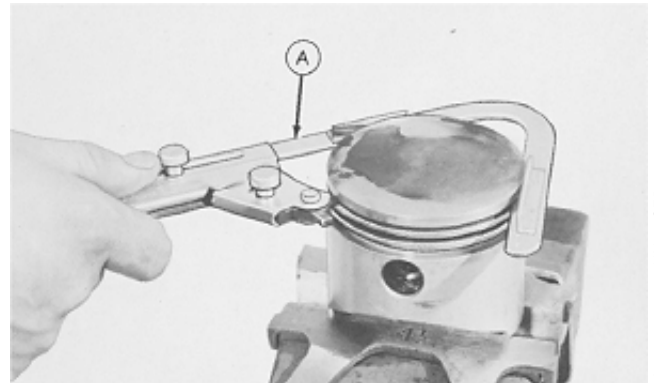
M80372 -UN-02APR91

INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)
2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.
4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.
5. Check that oil return passages in grooves are open.



MX,2520A1,A18 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.

CLEARANCE SPECIFICATION (MAX)

Top Ring	Second Ring	Oil Control Ring
0.17 mm (0.007 in.)	0.16 mm (0.006 in.)	—



M38102 -UN-29AUG88

MX,2520A1,A19 -19-21OCT92

8. Measure piston pin outer diameter. Replace if less than specification.

9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

Piston Pin O.D. (MIN)	Piston Bore I.D. (MAX)
12.99 mm (0.511 in.)	13.04 mm (0.513 in.)



M50064 -UN-31AUG88



M80373 -UN-02APR91

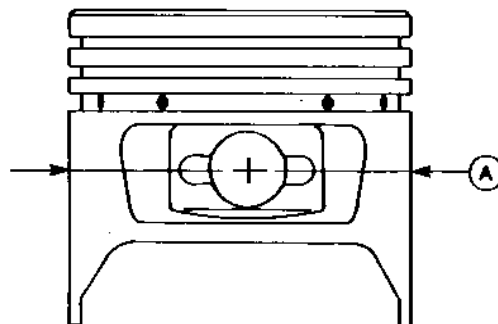
MX,2520A1,A20 -19-21OCT92

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)



M80374 -UN-06APR91

SPECIFICATIONS

Piston O.D. (A)	63.86—63.88 mm (2.516—2.5168 in.)
Piston-to-Cylinder Bore Clearance (std.)	0.12 mm (0.005 in.)
(max.)	0.1375 mm (0.0054 in.)

25
20
13

MX,2520A1,A20A -19-21OCT92

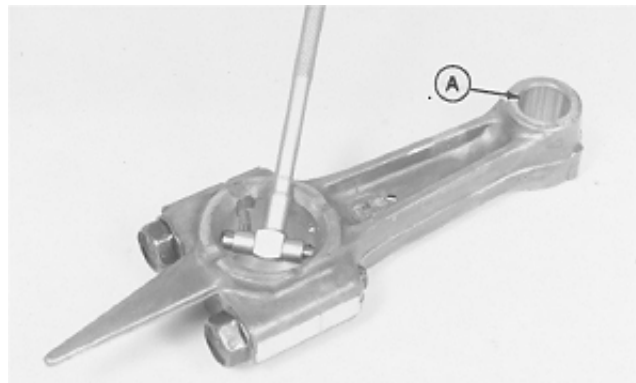
INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.

2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)

3. Install connecting rod cap. Tighten to 20 N·m (177 lb-in.).

4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



M80375 -UN-02APR91

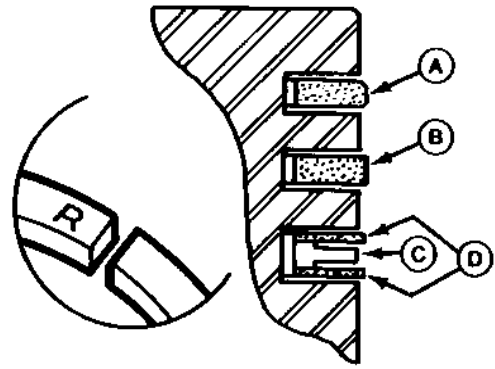
BEARING I.D. SPECIFICATIONS (MAX)

Crankshaft Bearing	Piston Bearing
24.55 mm (0.967 in.)	13.04 mm (0.514 in.)

MX,2520A1,A21 -19-21OCT92

REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)
4. Install top ring (A) and second ring (B) with R or NPR mark facing up. Rings should turn freely in grooves.
5. Oil ring is an assembly. Install spacer (C), then side rails (D). Put side rail end gaps 180° apart.



A—Top Ring
B—Second Ring
C—Spacer
D—Side Rails

MX,2520A1,A22 -19-21OCT92

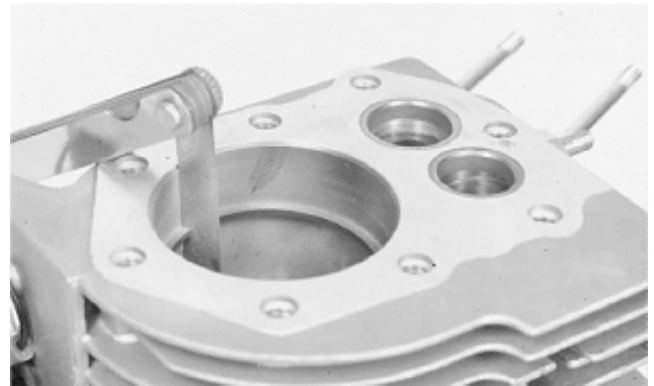
M80376 -UN-06APR91

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS

Minimum End Gap	0.18 mm (0.007 in.)
Maximum End Gap	0.80 mm (0.032 in.)



MX,2520A1,A23 -19-21OCT92

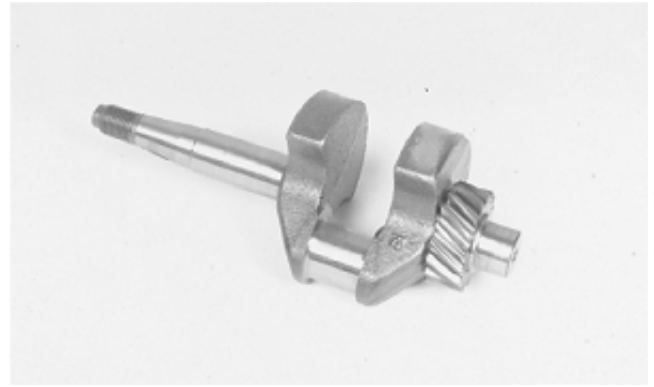
M80377 -UN-02APR91

REMOVE, INSPECT AND INSTALL CRANKSHAFT

1. Remove flywheel. (See Group 10.)
2. Remove camshaft. (See this group.)
3. Remove piston and connecting rod. (See this group.)
4. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

5. Check crankshaft alignment (T.I.R.). (See this group.)
6. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
7. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
8. Measure crankshaft connecting rod journal. Replace crankshaft if measurement is less than specifications.
9. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.
10. Apply clean engine oil to crankshaft bearings and journal.
11. Pack lithium based grease in oil seals.
12. Install crankshaft.
13. Install piston and connecting rod.
14. Install crankshaft.
15. Install flywheel.



FG150G Shown

M80378 -UN-02APR91

25
20
15

JOURNAL SPECIFICATIONS (MIN)

Main Bearing Journal		Connecting Rod Journal
PTO Side	Flywheel Side	
19.963 mm (0.786 in.)	19.963 mm (0.786 in.)	24.45 mm (0.963 in.)

MX,2520A1,A24 -19-21OCT92

INSPECT CRANKSHAFT BALL BEARINGS—FG150G

1. Remove flywheel end oil seal. (See Inspect Oil Seals in this group.)

2. Remove crankshaft bearing from cylinder block using a bearing, bushing and seal driver set.

Remove bearing from crankcase cover using a blind hole puller set.

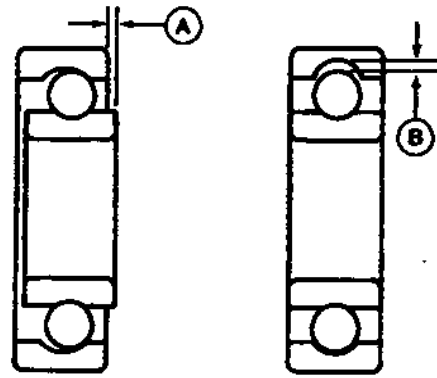
3. Thoroughly clean bearings in solvent. Dip bearings in light weight oil.

4. Spin each bearing by hand and check for axial (A) and radial (B) free play.

5. Replace bearings if noisy or too much play.

6. Install bearings flush to inside of crankcase cover or cylinder block using a bearing, bushing and seal driver set.

7. Install oil seal.

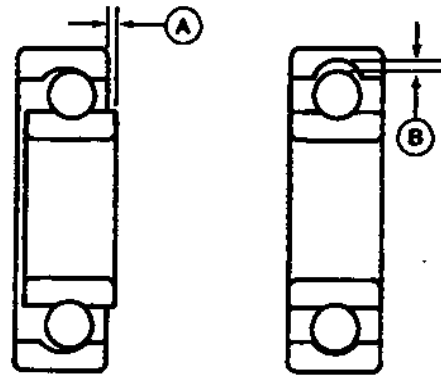


M38073 -UN-29AUG88

MX,2520A1,A25 -19-21OCT92

INSPECT CRANKSHAFT BALL BEARINGS—FG150D

1. Remove oil seals. (See Inspect Oil Seals in this group.)
2. Remove crankshaft bearings using a bearing, bushing and seal driver set.
3. Thoroughly clean bearings in solvent. Dip bearings in light weight oil.
4. Spin each bearing by hand and check for axial (A) and radial (B) free play.
5. Replace bearings if noisy or too much play.
6. Install bearings flush to inside of crankcase cover or cylinder block using a bearing, bushing and seal driver set.
7. Install oil seals.



M38073 -UN-29AUG88

25
20
17

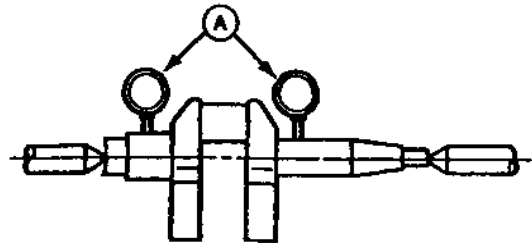
MX,2520A1,A26 -19-21OCT92

CHECK CRANKSHAFT ALIGNMENT (TIR)

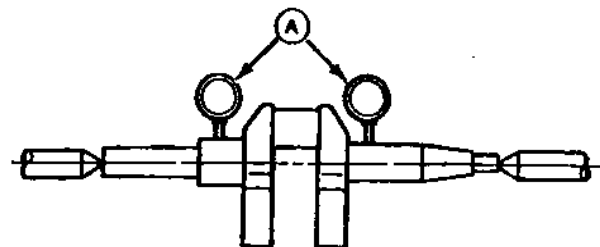
Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

Maximum TIR 0.05 mm (0.002 in.)



FG150G



FG150D

MX,2520A1,A27 -19-21OCT92

-UN-06APR91

M80380

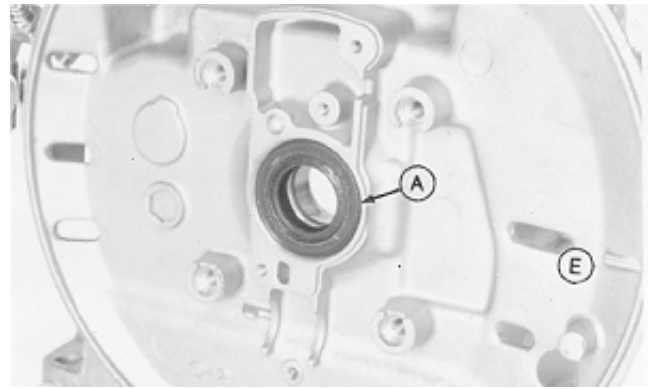
-UN-06APR91

M80381

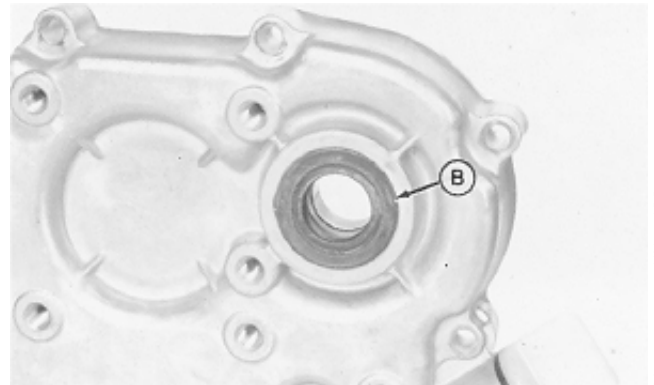
INSPECT OIL SEALS

NOTE: FG150G PTO is driven by the camshaft, FG150D PTO is driven by the crankshaft.

1. Remove flywheel. (See Group 10.)
2. Inspect oil seals (A and B) at flywheel end and PTO end for wear or damage. Replace if necessary.
3. Remove crankshaft. (See this group.)
4. Remove worn or damaged seals with a screwdriver.
5. Install seals with lip to inside of engine using bearing, bushing and seal driver set. Press seals in until flush with hub.
6. Install crankshaft.
7. Install flywheel.



Flywheel Side



PTO Side—FG150G Shown

MX,2520A1,A28 -19-21OCT92

INSPECT CYLINDER BLOCK

1. Remove crankshaft. (See this group.)
2. Clean and check block for cracks.
3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
4. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,2520A1,A29 -19-21OCT92

NOTE: A bare block is available for service.

5. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

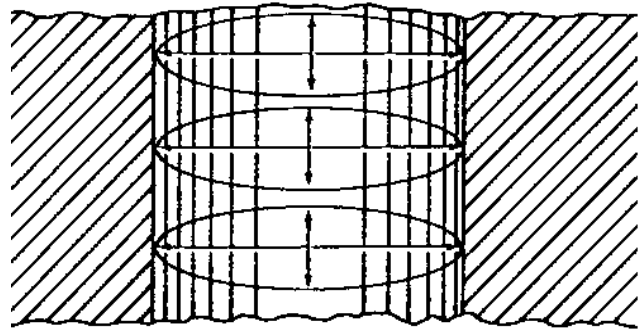
6. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

NOTE: If cylinder is rebored, oversize piston and rings must be installed.

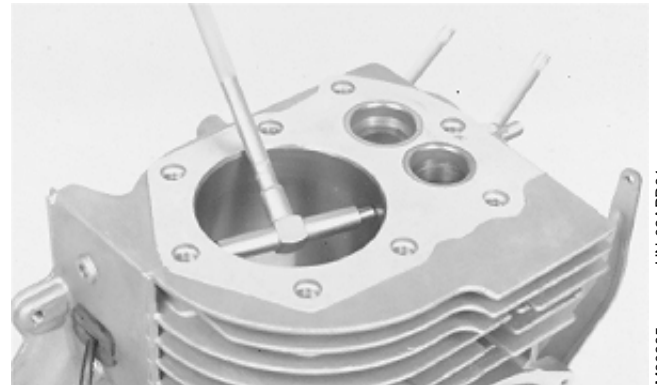
7. Install crankshaft.

CYLINDER BORE SPECIFICATIONS

Standard	63.98—64.00 mm (2.521—2.522 in.)
Wear Limit	64.05 mm (2.524 in.)
Out-of-Round (Max)	0.045 mm (0.0018 in.)



M51745 -UN-23FEB89



M80385 -UN-02APR91

25
20
19

MX,2520A1,A30 -19-21OCT92

REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use 0.25, or 0.50 mm (0.010 or 0.020 in.) oversize pistons and rings. Have a reliable repair shop rebore the block, or use the drill press and honing tool.

1. Rebore cylinder with a honing tool to initial and final bore specifications.
2. Align center of bore to press center. Set the press to operate from 200—250 rpm.
3. Lower and raise hone until ends extend 20—25 mm (0.75—1.0 in.) past ends of cylinder.
4. Turn adjusting nut on one hone until stones contact cylinder wall at narrowest point.
5. Coat inside of cylinder with honing oil. Turn hone by hand. If you cannot turn it, hone is too tight.
6. Start drill press. Move hone up and down in cylinder approximately 20 times per minute.
7. Check cylinder diameter regularly during honing. Stop press before measuring. Remove hone from cylinder.

NOTE: Finish should not be smooth, but have a 40—60° cross-hatch pattern.

IMPORTANT: Check stone for wear or damage. Use correct stone for the job.

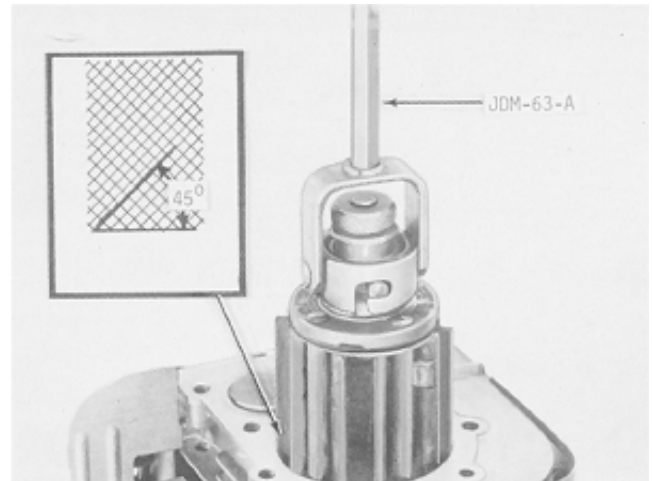
CYLINDER INITIAL BORE SPECIFICATIONS

Piston Oversize:
0.25 mm
(0.010 in.)

64.21—64.23 mm
(2.530—2.531 in.)

Piston Oversize:
0.50 mm
(0.020 in.)

64.46—64.48 mm
(2.540—2.541 in.)



M24711 -UN-25AUG88

MX,2520A1,A31 -19-21OCT92

8. Hone the cylinder an additional 0.028—0.030 mm (0.0011—0.0012 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

IMPORTANT: DO NOT use gasoline or commercial solvents to clean cylinder bores. Solvents will not remove metal particles produced during honing.

9. Clean the cylinder thoroughly using soap, warm water and clean rags. Continue to clean cylinder until white rags show no discoloration.

10. Dry the cylinder. Apply engine oil to cylinder wall.

M98,2040A,A9 -19-21OCT92

25
20
21

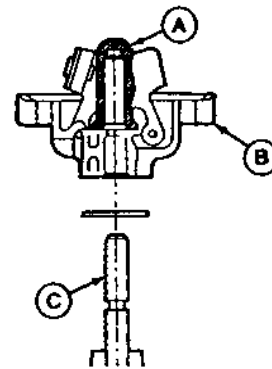
INSPECT AND REPLACE GOVERNOR

IMPORTANT: Removal damages governor. If not damaged, do not remove.

1. Remove crankcase cover. (See this group.)
2. Remove governor cover.
3. Inspect governor. If necessary to replace, remove with screwdriver.
4. If removed, press shaft (C) back into block until it protrudes 32.2—32.8 mm (1.267—1.291 in.).

NOTE: Assemble sleeve and gear before installing assembly on shaft.

5. Install sleeve (A) onto governor gear (B).
6. Install governor assembly onto shaft. Push down on assembly until it snaps into place.
7. Install governor cover.
8. Install crankcase cover.



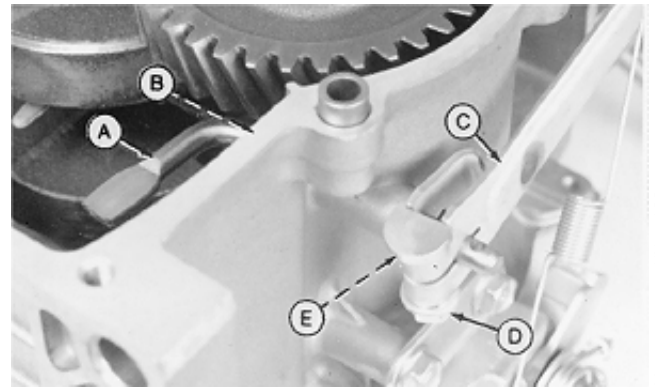
M51762 -UN-07SEP88

MX,2520A1,A32 -19-21OCT92

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (A). Replace if damaged.
3. To replace shaft, loosen nut (D) on lever (C).
4. Remove retaining pin (E), governor shaft and washer (B).
5. Install washer, shaft and retaining pin. Tighten nut.
6. Install crankcase cover.



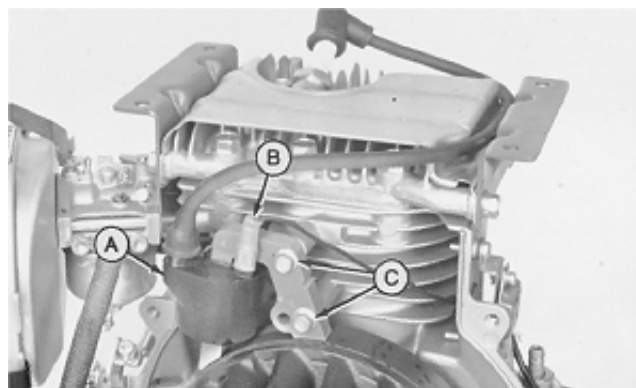
A—Governor Shaft
B—Washer
C—Governor Lever
D—Nut
E—Retaining Pin

M80386 -UN-02APR91

MX,2520A1,A33 -19-21OCT92

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove blower housing. (See Group 10.)
2. Remove fuel tank. (See Group 05.)
3. Disconnect wiring lead (B).
4. Remove cap screws (C) and armature with coil (A).
5. Loosely install armature with coil.
6. Connect wiring lead.
7. Adjust armature air gap. (See this group.)
8. Install fuel tank.
9. Install blower housing.

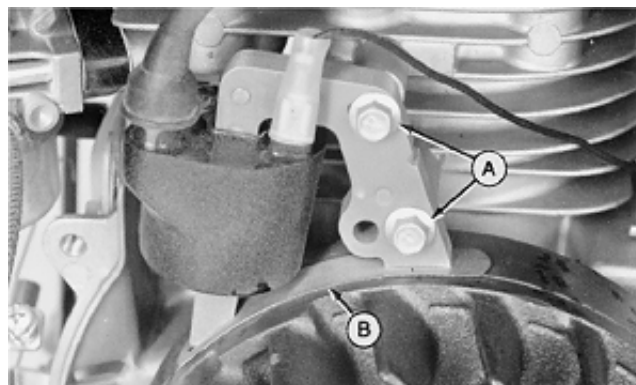


M80387 -UN-02APR91

MX,2525A1,A1 -19-21OCT92

ADJUST ARMATURE AIR GAP

1. Turn flywheel magnet away from armature.
2. Insert feeler gauge blade (B) between flywheel and armature.
3. Push armature against flywheel and tighten screws (A).
4. Turn flywheel to remove feeler gauge.



M80388 -UN-02APR91

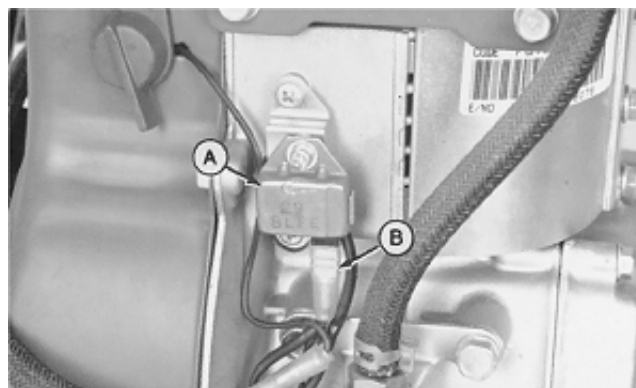
AIR GAP SPECIFICATIONS

Feeler Gauge Blade 0.30 mm (0.012 in.)

MX,2525A1,A2 -19-21OCT92

REPLACE IGNITOR

1. Disconnect wiring lead (B).
2. Remove ignitor (A).
3. Install ignitor.
4. Connect wiring lead (B).



M80389 -UN-02APR91

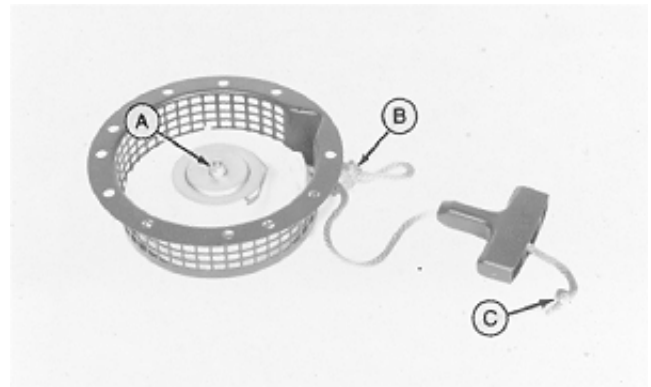
MX,2525A1,A3 -19-21OCT92

DISASSEMBLE RECOIL STARTER

1. Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (B) to prevent rope from winding back onto reel.
3. Pry knot (C) out of handle and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (B). Slowly release reel tension. Do not let rope get wedged between reel and housing.

CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove nut (A) and ratchet cover.



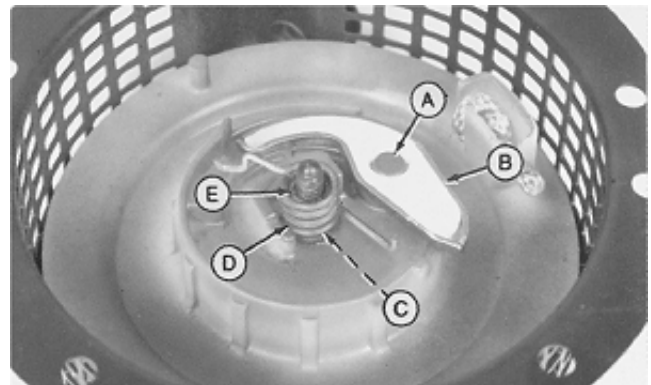
M80390 -UN-02APR91

MX,2530A1,A1 -19-21OCT92

CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

7. Turn the reel one half turn counterclockwise so no spring tension can be felt.
8. Remove spring (D), collar (E), and nylon washer (C).
9. Remove pawl assembly (B) and pivot pin (A).

A—Pivot Pin
B—Pawl Assembly
C—Nylon Washer
D—Spring
E—Collar

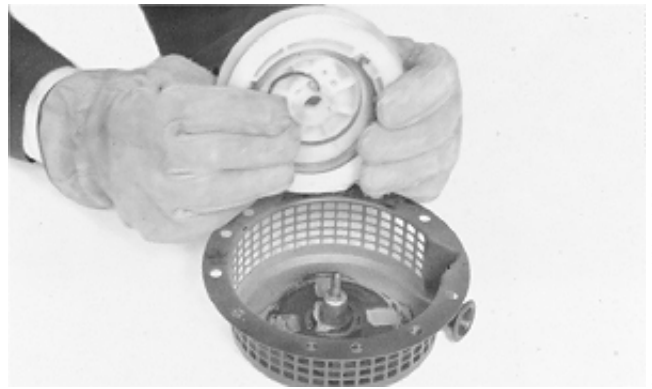


M80391 -UN-02APR91

MX,2530A1,A1A -19-21OCT92

10. Spring is stored in reel. Carefully remove while holding spring in underside of reel.

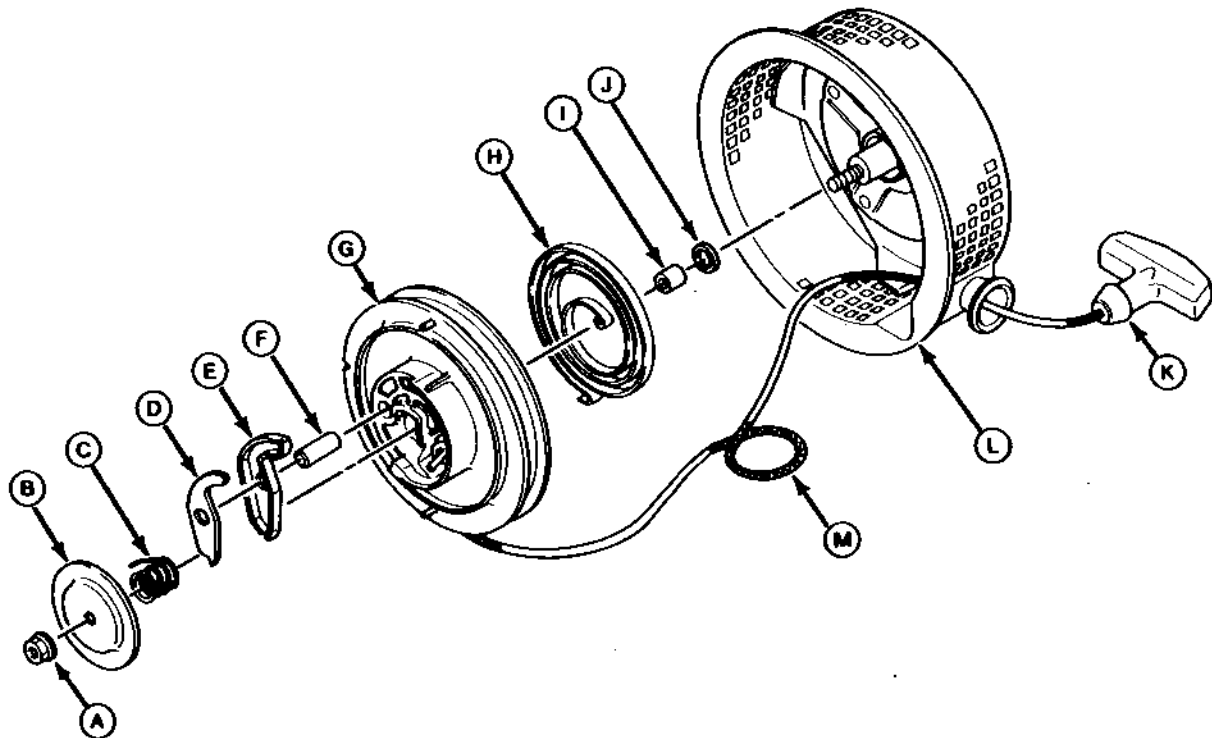
11. Inspect starter for wear or damage. (See this group.)



MX,2530A1,A2 -19-21OCT92

M80392 -UN-02APR91

INSPECT RECOIL STARTER



A—Nut
B—Ratchet Cover
C—Spring
D—Nylon Pawl

E—Pawl
F—Pivot Pin
G—Reel

H—Spring
I—Collar
J—Nylon Washer

K—Handle
L—Housing
M—Rope

Inspect all parts for wear or damage. Replace as necessary.

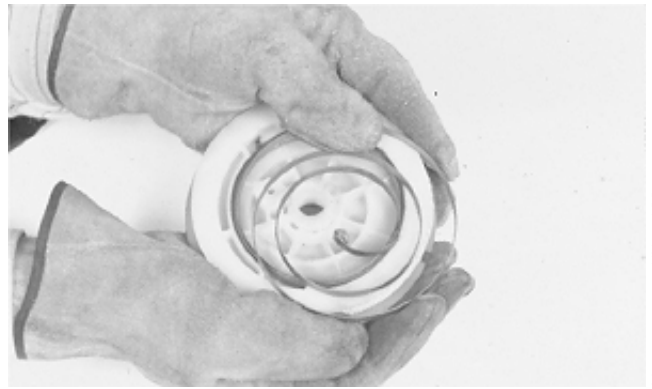
MX,2530A1,A3 -19-21OCT92

M80393 -UN-06APR91

REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

1. Working from the center out, carefully unwind spring from reel.
2. Hook outside spring tang in reel. Wind spring into reel, working toward center.

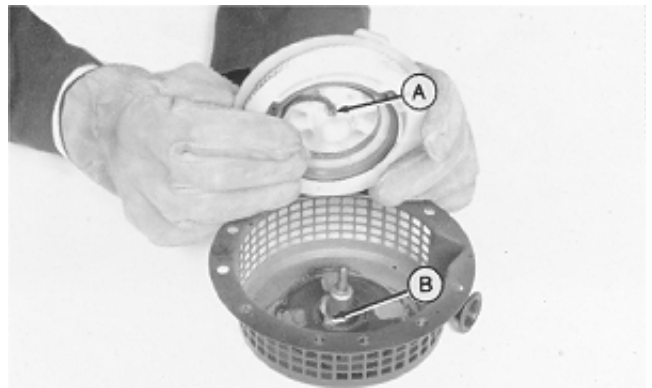


M80394 -UN-02APR91

MX,2530A1,A4 -19-21OCT92

ASSEMBLE RECOIL STARTER

1. Wind rope clockwise onto reel.
2. Apply multipurpose grease to spring.
3. Install reel with spring in housing. Align inner tang (A) with catch (B).
4. Turn reel clockwise until you feel tang hook on catch.

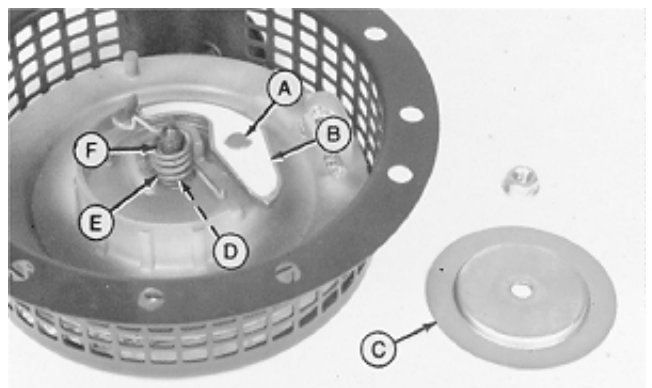


M80395 -UN-02APR91

MX,2530A1,A5 -19-21OCT92

5. Install pivot pin (A) and pawl assembly (B).
6. Install nylon washer (D), collar (F) and spring (E).
7. Install ratchet cover (C) and nut.

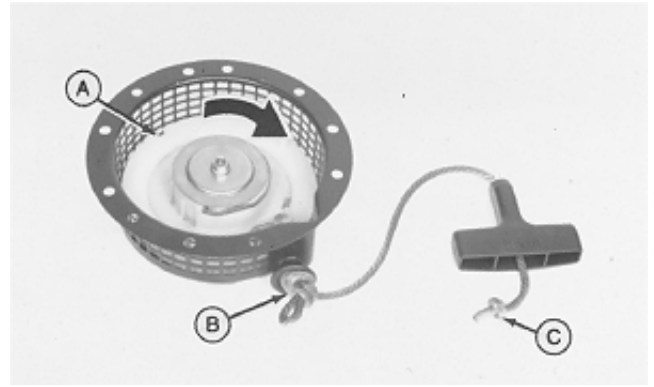
A—Pivot Pin
B—Pawl Assembly
C—Ratchet Cover
D—Nylon Washer
E—Spring
F—Collar



M80397 -UN-02APR91

MX,2530A1,A6 -19-21OCT92

8. Place rope in notch (A). Turn reel two turns clockwise to preload spring.
9. While holding reel to keep it from unwinding, feed end of rope through hole. Tie knot (B) to hold rope.
10. Install handle and secure with knot (C).
11. Remove knot (B).
12. Pull rope to check for proper operation.
13. Install recoil starter on engine.



A—Knot
B—Knot
C—Spring
D—Pawls
E—Retainer

MX,2530A1,A7 -19-21OCT92

M80396 -UN-02APR91

Section 30

FC150V

Contents

	Page		Page
Group 00—Engine Application and Repair Specifications			
Engine Application Chart	30-00-1	Camshaft	
Repair Specifications	30-00-2	Remove and Install	30-20-2
		Inspect	30-20-3
Group 05—Fuel and Air Systems		Inspect Plain Bearings	30-20-3
Service Parts Kits	30-05-1	Inspect Automatic Compression	
Carburetor		Release Mechanism	30-20-4
Remove and Install	30-05-1	Remove, Inspect and Install Tappets	30-20-4
Disassemble, Clean, Inspect and		Piston and Connecting Rod	
Assemble	30-05-2	Remove and Install	30-20-5
Service		Disassemble, Inspect and Assemble . . .	30-20-5
Breather	30-05-3	Inspect	
Air Cleaner	30-05-4	Piston	30-20-6
		Connecting Rod	30-20-8
Group 10—Blower Housing and Flywheel		Piston Rings	
Other Material	30-10-1	Remove and Install	30-20-8
Remove and Install Engine Cover	30-10-2	Check End Gap	30-20-9
Flywheel Screen Adjustment	30-10-3	Crankshaft	
Remove and Install Brake Band—If		Remove, Inspect and Install	30-20-9
Equipped	30-10-3	Inspect Plain Bearings	30-20-10
Remove and Install Flywheel	30-10-4	Inspect Ball Bearing	30-20-11
		Check Alignment (TIR)	30-20-11
Group 15—Cylinder Head and Valves		Measure End Play	30-20-11
Other Material	30-15-1	Inspect	
Service Parts Kits	30-15-1	Oil Seals	30-20-12
Rocker Arm Assembly		Cylinder Block	30-20-12
Remove, Inspect and Install	30-15-2	Rebore Cylinder Block	30-20-14
Remove and Install		Oil Pump	
Cylinder Head Assembly	30-15-3	Disassemble and Assemble	30-20-16
Valves and Springs	30-15-5	Inspect	30-20-16
Inspect		Remove, Inspect and Install Oil Filter	
Valve Springs	30-15-5	Manifold, if Equipped	30-20-18
Cylinder Head	30-15-6	Inspect and Replace	
Valve Guides	30-15-6	Governor	30-20-18
Recondition Valve Seats	30-15-7	Governor Shaft	30-20-19
Check Valve Clearance	30-15-7		
Group 20—Cylinder Block and Internal Components		Group 25—Ignition and Charging System	
Other Material	30-20-1	Remove and Install	
Service Parts Kits	30-20-1	Stator	30-25-1
Remove and Install Crankcase Cover . . .	30-20-2	Armature with Coil	30-25-1
		Adjust Armature Air Gap	30-25-2

Continued on next page

Page

Group 30—Starting Systems

Recoil Starter

Disassemble	30-30-1
Inspect	30-30-2
Replace Spring	30-30-3
Assemble	30-30-3

Electric Starter

Analyze Condition	30-30-4
Check Armature Rotation	30-30-5
Inspect	30-30-6

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

21-INCH REAR DISCHARGE WALK-BEHIND MOWERS (S.N. 450001—) (S.N. 050001-)

Machine	Engine Model No.
14PB	FC150V-AS02
14SB	FC150V-AS00
14SE	FC150V-AS01

21-INCH REAR DISCHARGE WALK-BEHIND MOWERS (S.N. GXXXXX010001—)

Machine	Engine Model No.
14PB (Engine S.N. —103663)	FC150V-BS00
14SB (Engine S.N. 103664—225603)	FC150V-CS00
(Engine S.N. A00002—)	FC150V-ES00
14SE (Engine S.N. 047346—221774)	FC150V-BS01
(Engine S.N. A05501—)	FC150V-ES01
14SE (Engine S.N. 221775—) (5 HP)	FC150V-FS01
14SC (5 HP)	FC150V-ES06
14ST (5 HP)	FC150V-ES09

NOTE: 1992 MODELS, both Push or Self-Propelled, start with SN 050001-.

NOTE: SERIAL NUMBER PREFIX FOR PUSH MOWER IS GX14PTA (1992-)

NOTE: SERIAL NUMBER PREFIX FOR SELF-PROPELLED IS GX14STA (1992-)

MX,3000A1,A1 -19-21OCT92

FC150V REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Breather	
Maximum Air Gap	0.20 mm (0.008 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	45 N·m (33 lb-ft)
Minimum Flywheel Screen Gap	1.50 mm (0.059 in.)

GROUP 15—CYLINDER HEAD AND VALVES

Valve Clearance	0.12 mm (0.005 in.)
---------------------------	---------------------

Rocker Arm	
Stud and Nut Torque	7 N·m (62 lb-in.)

Push Rod	
Maximum Bend	0.60 mm (0.024 in.)

Valves and Springs	
Minimum Spring Free Length	31.50 mm (1.240 in.)
Maximum Valve Guide I.D.	
Intake	5.55 mm (0.218 in.)
Exhaust	5.56 mm (0.219 in.)
Minimum Valve Stem O.D.	
Intake	5.44 mm (0.214 in.)
Exhaust	5.42 mm (0.213 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Minimum Valve Stem End Length	3.80 mm (0.150 in.)
Valve Seating Surface	0.50—1.10 mm (0.020—0.043 in.)
Valve Seat and Face Angle	45°
Minimum Valve Margin	0.50 mm (0.020 in.)
Valve Narrowing Angle	30°

Cylinder Head	
Cylinder Head Flatness	0.07 mm (0.003 in.)
Cap Screw Torque In Sequence	
Initial Torque	18 N·m (159 lb-in.)
Final Torque	24 N·m (212 lb-in.)

Spark Plug Torque	20 N·m (177 lb-in.)
-----------------------------	---------------------

Continued on next page

MX,3000A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS

Item	Specification
Crankcase Cover	
Oil Capacity	0.6 L (1.27 pt)
Cap Screw Torque	7 N·m (62 lb-in.)
Drain Plug Torque	21 N·m (186 lb-in.)
Camshaft	
Minimum End Journals O.D.	13.92 mm (0.548 in.)
Minimum Lobe Height	22.80 mm (0.898 in.)
Maximum Cover and Crankcase Bearing I.D.	14.07 mm (0.554 in.)
Piston	
Maximum Ring Groove Clearance	0.10 mm (0.004 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	1.00 mm (0.039 in.)
Oil Ring Side Rails	1.50 mm (0.059 in.)
Minimum Pin O.D.	14.98 mm (0.590 in.)
Maximum Pin Bore I.D.	15.05 mm (0.593 in.)
Maximum Piston-to-Piston Pin Clearance	0.07 mm (0.003 in.)
Piston O.D.	64.90 mm (2.555 in.)
Piston-to-Cylinder Bore Clearance	
Standard Clearance	0.06—0.10 mm (0.0024—0.0039 in.)
Wear Limit	0.1375 mm (0.0054 in.)
Connecting Rod	
Maximum Crankshaft Bearing I.D.	28.07 mm (1.105 in.)
Maximum Piston Pin Bearing I.D.	15.05 mm (0.593 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.07 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.15 mm (0.006 in.)
End-Cap Screw Torque	12 N·m (106 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	24.92 mm (0.981 in.)
Minimum Connecting Rod Journal O.D.	27.92 mm (1.099 in.)
Maximum Crankcase Cover Plain Bearing I.D.	25.10 mm (0.988 in.)
Maximum T.I.R.	0.20 mm (0.008 in.)
End Play	0—0.050 mm (0—0.020 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.	64.90—65.00 mm (2.557—2.561 in.)
Maximum Cylinder Bore I.D.	65.06 mm (2.563 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	65.21—65.23 mm (2.567—2.568 in.)
0.50 mm	65.46—65.48 mm (2.577—2.578 in.)
0.75 mm	65.71—65.73 mm (2.587—2.588 in.)

Continued on next page

MX,3000A1,A3 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Oil Pump	
Minimum Rotor Shaft O.D.	9.01 mm (0.355 in.)
Maximum Rotor Shaft Bearing I.D.	9.14 mm (0.360 in.)
Minimum Outer Rotor Thickness	11.95 mm (0.471 in.)
Maximum Outer Rotor Bore Depth	12.10 mm (0.476 in.)
Minimum Outer Rotor O.D.	22.93 mm (0.903 in.)
Maximum Outer Rotor Bearing I.D.	23.17 mm (0.912 in.)
Minimum Valve Spring Free Length	
(Engine S.N. 047346—072217)	17.00 mm (0.669 in.)
(Engine S.N. 072218—)	19 mm (0.748 in.)
Governor Arm Nut Torque	7 N·m (62 lb-in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS

Recoil and Electric Starter

See Starter Specifications in this Group.

MX,3000A1,A4 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Carburetor Gasket Kit

Main Jet High Altitude Kit

Complete Carburetor

MX,3005A1,A1 -19-21OCT92

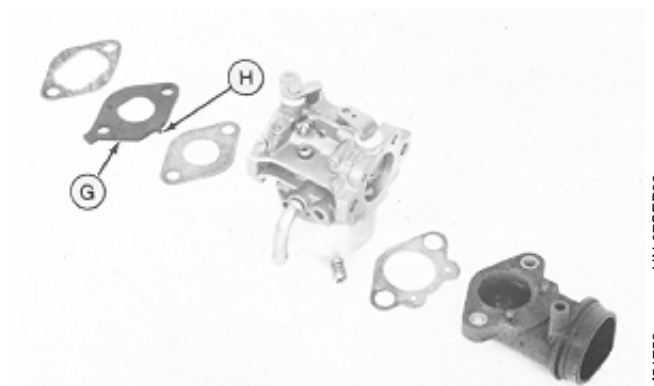
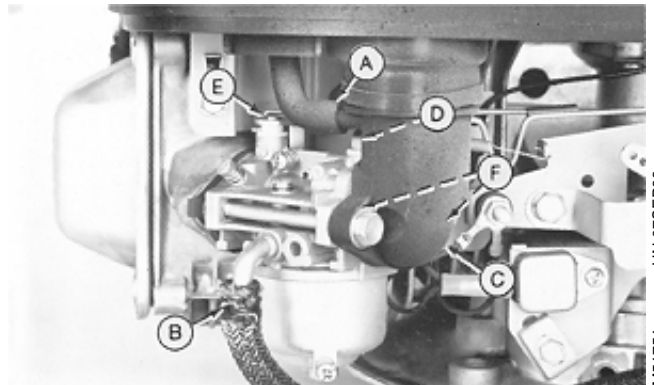
REMOVE AND INSTALL CARBURETOR

1. Close fuel shut off valve on fuel tank.
2. Drain fuel from carburetor.
3. Disconnect hoses (A and B).
4. Remove duct (C) and collars (F).
5. Disconnect linkage (D and E) and remove carburetor, gaskets and insulator (G).

6. Make repairs as necessary. (See procedure in this group.)

NOTE: Install carburetor and gaskets with convex side of insulator (G) toward cylinder head and tab (H) pointing down.

7. Install gaskets, insulator and carburetor. Connect linkage.
8. Install collars, duct and cap screws.
9. Connect hoses.

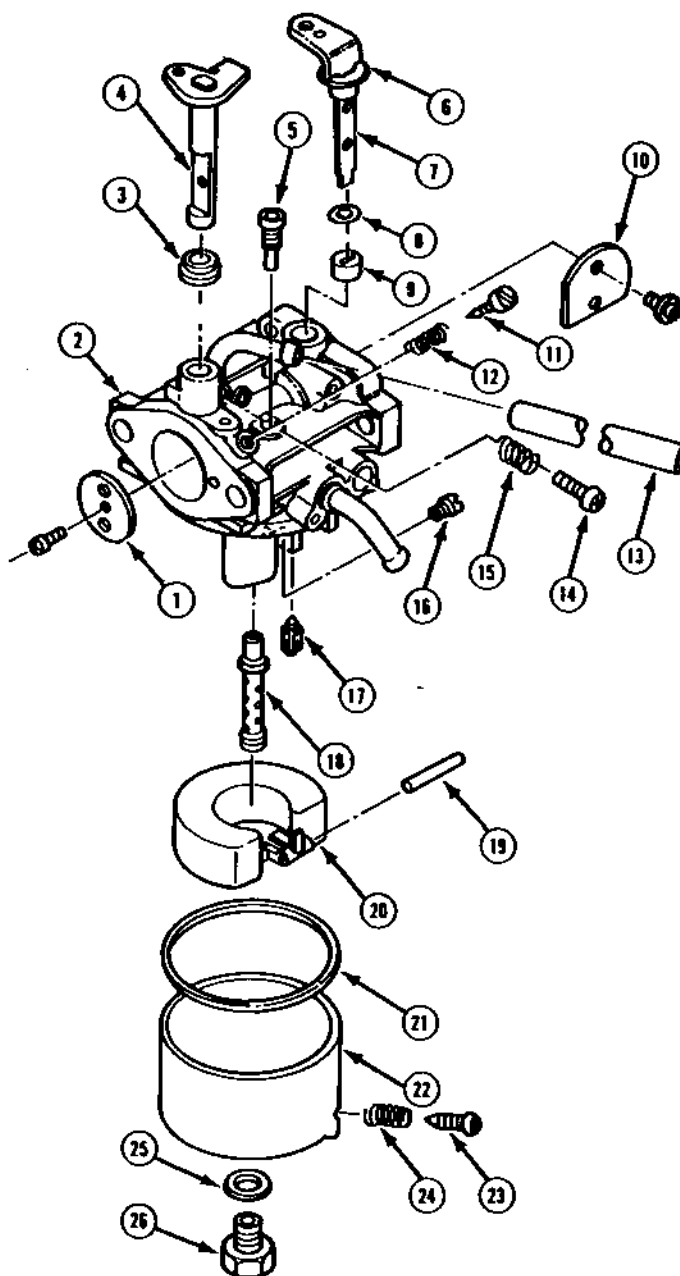


A—Oil Breather Hose
B—Fuel Hose
C—Air Intake Duct
D—Choke Linkage

E—Throttle Linkage
F—Collar
G—Insulator
H—Tab

MX,3005A1,A2 -19-21OCT92

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR



- 1—Throttle Plate
- 2—Carburetor Body
- 3—Bushing
- 4—Throttle Shaft
- 5—Pilot Jet
- 6—Bushing
- 7—Choke Shaft

- 8—Washer
- 9—Collar
- 10—Choke Plate
- 11—Pilot Screw
- 12—Spring
- 13—Hose
- 14—Idle Screw

- 15—Spring
- 16—Main Jet
- 17—Needle Valve
- 18—Main Nozzle
- 19—Float Pin
- 20—Float

- 21—Gasket
- 22—Float Chamber
- 23—Drain Screw
- 24—Spring
- 25—Washer
- 26—Plug

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets, float and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.
4. Inspect all parts for wear or damage, replace as necessary.

NOTE: Main jet high altitude kits are available.

Float is plastic. The float cannot be adjusted. Replace if necessary.

MX,3005A1,A4 -19-21OCT92

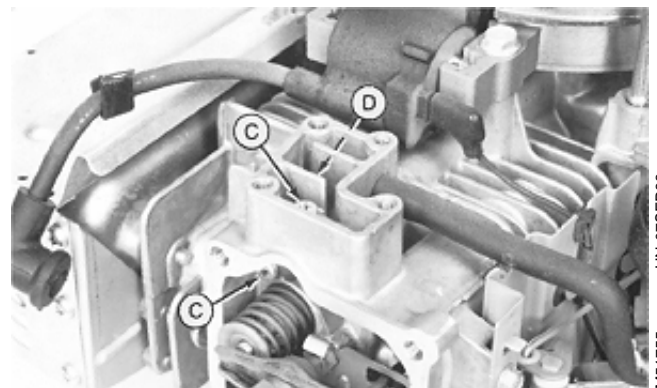
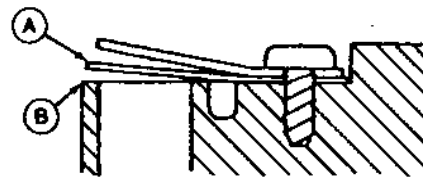
SERVICE BREATHER

NOTE: Breather is located in cylinder head.

1. Remove engine cover. (See Group 10.)
2. Remove breather cover and gasket.
3. Remove rocker arm cover.
4. Measure air gap between reed valve (A) and valve seat (B) at valve tip. Replace reed valve if gap exceeds specification.
5. Remove breather valve (C).
6. Inspect breather for sticking, binding, cracks or distortion. Replace breather if worn or damaged.
7. Inspect valve seating surface. Surface must be free of nicks or burrs.
8. Check that drain back hole (D) in breather chamber is open.
9. Install breather assembly, gasket and cover.

SPECIFICATIONS

Air Gap (MAX) 0.20 mm (0.008 in.)



- A—Reed Valve
- B—Valve Seat
- C—Breather Valve (2 used)
- D—Drain Back Hole

MX,3005A1,A5 -19-21OCT92

SERVICE AIR CLEANER

1. Remove cover (D) and disassemble the filter elements.

IMPORTANT: Do not clean paper element.

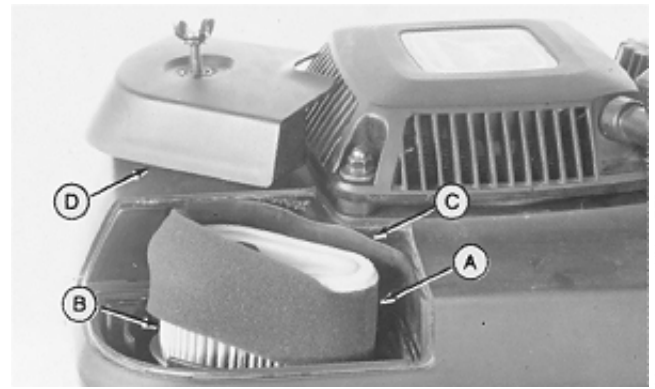
2. Wash foam element (A) in detergent and water. Dry element.

3. Put 12—15 drops of engine oil on foam element (A). Squeeze out excess oil.

4. Replace paper element (B) if:
 —Element is oily, dirty, bent, torn, crushed, or obstructed in any way.
 —Seal is damaged.
 —Engine performance is poor.

5. Inspect housing (C), and cover (D) for damage. Replace if necessary.

6. Assemble and install air cleaner elements.



A—Foam Element
 B—Paper Element
 C—Housing
 D—Cover

M80165 -UN-11FEB91

30
05
4

MX,3005A1,A6 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
T43512	Thread Lock and Sealer (Medium Strength)	Engine cover mounting stud.

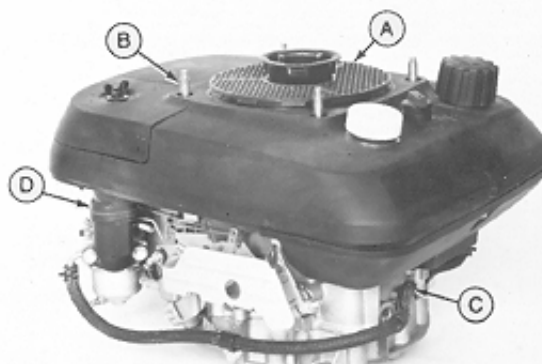
MX,3010A1,A1 -19-21OCT92

30
10
1

REMOVE AND INSTALL ENGINE COVER

NOTE: Fuel tank assembly is removed with engine cover.

1. Close fuel shut-off valve.
2. Disconnect fuel hose (C). Close all openings using caps and plugs.
3. Remove recoil starter.
4. Remove flywheel nut, cup and screen assembly (A) and spacers, if equipped.
5. Remove oil filler cap and collars (B).
6. Disconnect adapter (D).
7. Remove engine cover.
8. Inspect cover for wear or damage. Replace if necessary.
9. Install engine cover and cup and screen assembly.
10. Adjust flywheel screen. (See this group.)
11. Connect adapter.
12. Install collars and filler cap.
13. Install spacers, if equipped, cup and screen assembly and flywheel nut. Tighten nut to 45 N·m (33 lb·ft).
14. Install recoil starter.
15. Connect fuel hose and open shut-off valve.



A—Cup and Screen Assembly
 B—Collar (4 used)
 C—Fuel Hose
 D—Adapter

M51746 -UN-07SEP88

30
10
2

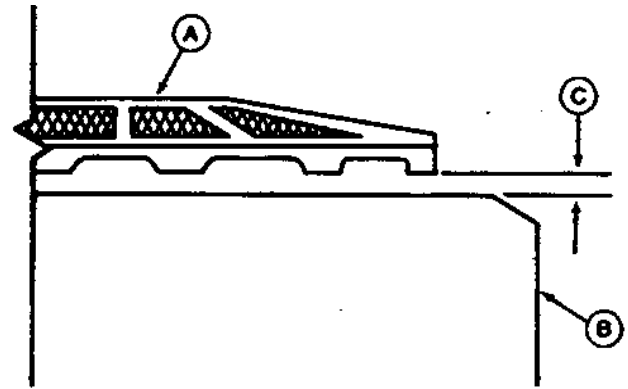
MX,3010A1,A2 -19-21OCT92

FLYWHEEL SCREEN ADJUSTMENT

Adjust gap (C) between the blades under screen (A) and engine cover (B) to specifications using spacers.

SPECIFICATIONS

Gap (Min) 1.5 mm (0.059 in.)



MX,3010A1,A3 -19-21OCT92

M38037 -UN-29AUG88

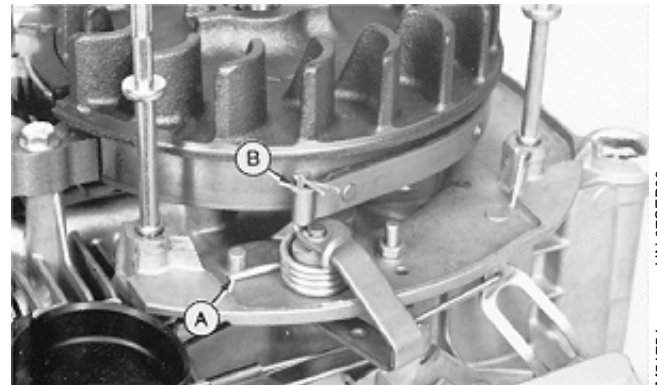
REMOVE AND INSTALL BRAKE BAND—ZONE START MODELS

1. Remove engine cover. (See this group.)
2. Remove oil fill tube.
3. Pry spring arm (A) over stop.
4. Remove pin and washer (B).

NOTE: Remove engine cover mount stud when replacing brake band only.

5. Inspect band for wear or damage. Replace if necessary.
 - Remove engine cover mount stud on end of band.
 - Replace brake band.
 - Apply thread lock and sealer (medium strength) on threads of engine cover mount stud.
 - Install brake band and stud.

6. Install brake band, washer and pin.
7. Install spring arm in front of stop.
8. Install oil fill tube.
9. Install engine cover.

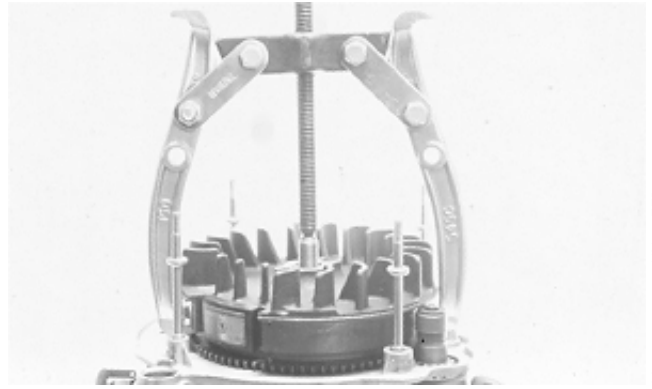


MX,3010A1,A4 -19-21OCT92

M51754 -UN-07SEP88

REMOVE AND INSTALL FLYWHEEL

1. Remove engine cover. (See this group.)
2. Remove armature with coil. (See Group 25.)
3. Remove brake band, if equipped. (See this group.)
4. Remove flywheel using a two-jaw puller.
5. Inspect flywheel for wear or damage. Replace if necessary.
6. Install flywheel.
7. Install brake band, if equipped.
8. Install armature with coil.
9. Install engine cover.



M80166 -UN-11FEB91

OTHER MATERIAL

Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean Cylinder Head
	Valve Guide Cleaner	Clean Valve Guides
	Stanisol (or Kerosene)	Finish Ream Valve Guide
	Prussian Blue Compound	Check Valve Seat Contact

SCOTCH-BRITE is a trade mark of the 3M Company.

MX,4015A1,A1-19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

- Overhaul Gasket Kit
- Intake & Exhaust Valve Kit
- Rocker Arm Kit

MX,3015A1,A0-19-21OCT92

REMOVE, INSPECT AND INSTALL ROCKER ARM ASSEMBLY

1. Remove rocker arm cover.
2. Turn crankshaft until piston is at highest position in compression stroke.
3. Remove nut (C) and pivot (D) to remove arm (A).

IMPORTANT: Mark push rods for reassembly in original locations.

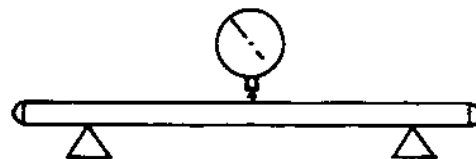
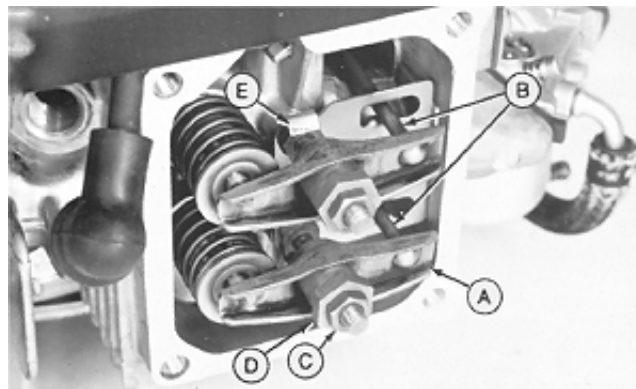
4. Remove push rods (B).
5. Bend open lock tabs (E). Remove rocker arm studs and support plate.
6. Inspect parts for wear or damage. Replace as necessary.
7. Inspect push rods for bends using V-blocks and a dial indicator. Turn rod slowly and read variation on indicator. Replace if variation is greater than specifications.
8. Install support plate and studs. Tighten studs to specifications. Bend over lock tabs.

IMPORTANT: Align rocker arms over push rods during assembly.

9. Install push rods, rocker arms, pivots and nuts.
10. Check valve clearance. (See this group.)
11. Install rocker arm cover.

SPECIFICATIONS

Push Rod Bend (Max) 0.30 mm (0.012 in.)
Rocker Arm Stud Torque 7 N·m (62 lb-in.)

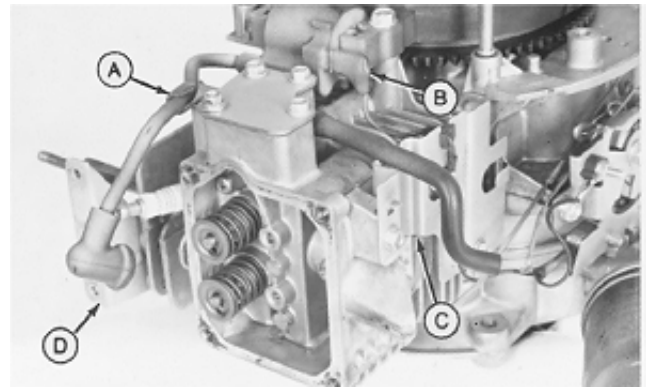


A—Rocker Arm (2 used)
B—Push Rods
C—Nut (2 used)
D—Pivot (2 used)
E—Lock Tab

MX,3015A1,A1 -19-21OCT92

REMOVE AND INSTALL CYLINDER HEAD ASSEMBLY

1. Remove engine cover. (See Group 10.)
2. Remove carburetor. (See Group 05.)
3. Remove rocker arm assembly. (See this group.)
4. Remove muffler shield, muffler and gasket.
5. Disconnect wiring lead (B).
6. Remove heat shields (C and D).
7. Disconnect spark plug wiring lead and remove from clamp (A).
8. Remove spark plug.
9. Remove cylinder head assembly.
10. Make repairs as necessary. (See procedures in this group.)



A—Clamp
B—Wiring Lead
C—Heat Shield
D—Heat Shield

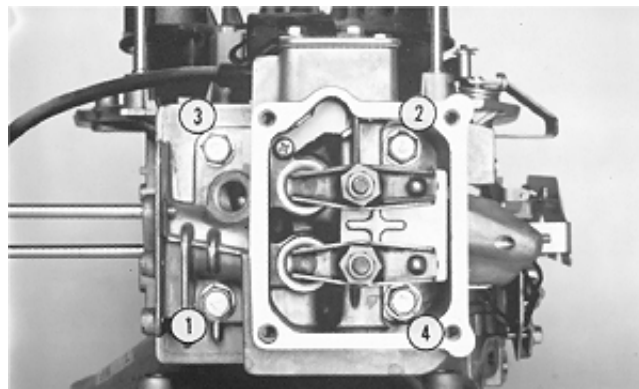
M80167 -UN-11FEB91

MX,3015A1,A2 -19-21OCT92

30
15
3

IMPORTANT: Gasket surfaces are coated with sealant. Do not damage surfaces or gasket during installation.

11. Install cylinder head assembly with new gasket. Install cap screws and tighten finger tight.
12. Tighten cap screws in sequence shown. Tighten to initial torque specifications.
13. Continue in sequence, 3 N·m (27 lb-in.) at a time, until final torque is as specified.
14. Install spark plug and tighten to specification.
15. Connect spark plug wiring lead.
16. Install heat shields.
17. Connect armature wiring lead.
18. Install new gasket, muffler and muffler shield.
19. Install rocker arm assembly.
20. Install carburetor.
21. Install engine cover.



M51748 -UN-07SEP88

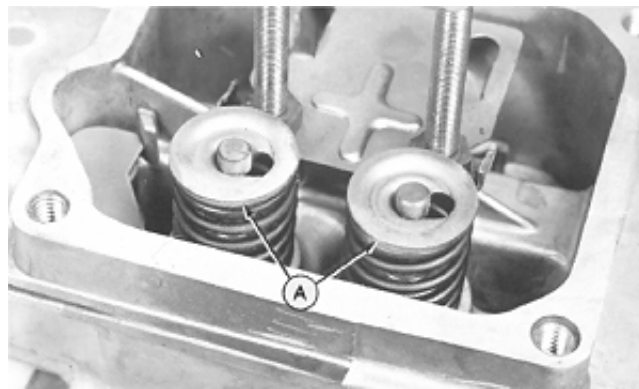
TORQUE SPECIFICATIONS

Initial Torque	18 N·m (159 lb-in.)
Final Torque	24 N·m (212 lb-in.)
Spark Plug	20 N·m (177 lb-in.)

MX,3015A1,A3 -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove cylinder head. (See this group.)
2. Support valves from below and press down on spring retainers (A).
3. Remove retainers, springs and valves.
4. Inspect and analyze valves. (See Section 100, Group 05.)
5. Inspect springs, valves, guides and seats. (See procedures in this group.)
6. Install valves, springs, and retainers.
7. Install cylinder head.



M51749 -UN-07SEP88

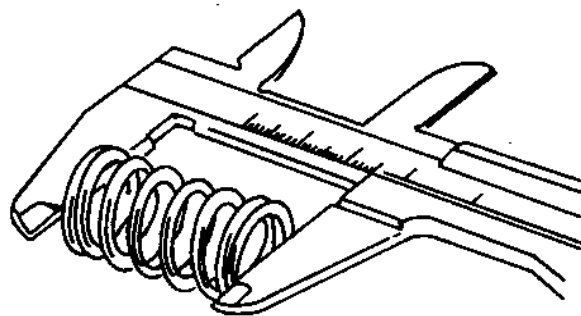
MX,3015A1,A4 -19-21OCT92

INSPECT SPRINGS

Inspect spring free length. Replace if damaged or if less than specifications.

SPECIFICATIONS

Free Length (Min) 31.50 mm (1.240 in.)



M50036 -UN-31AUG88

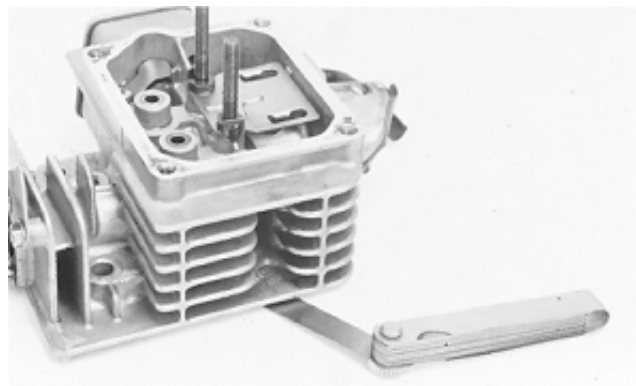
MX,3015A1,A5 -19-21OCT92

INSPECT CYLINDER HEAD

1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Check that oil drainback passages are not plugged.
7. Put cylinder head on a surface plate. Check for distortion at several points around the head using a feeler gauge. Replace head if distortion is more than specifications.

SPECIFICATIONS

Cylinder Head Distortion (Max) 0.07 mm (0.003 in.)



M80168 -UN-11FEB91

MX,3015A1,A6 -19-21OCT92

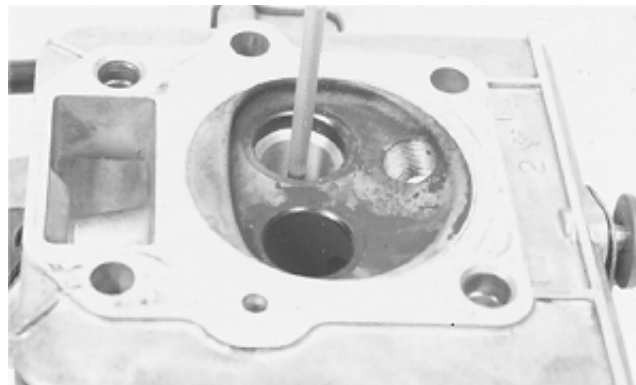
INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guides. Replace cylinder head if inside diameter is greater than specifications. (See this group.)

SPECIFICATIONS (MAX) I.D.

Intake 5.55 mm (0.218 in.)
Exhaust 5.56 mm (0.219 in.)



M80169 -UN-11FEB91

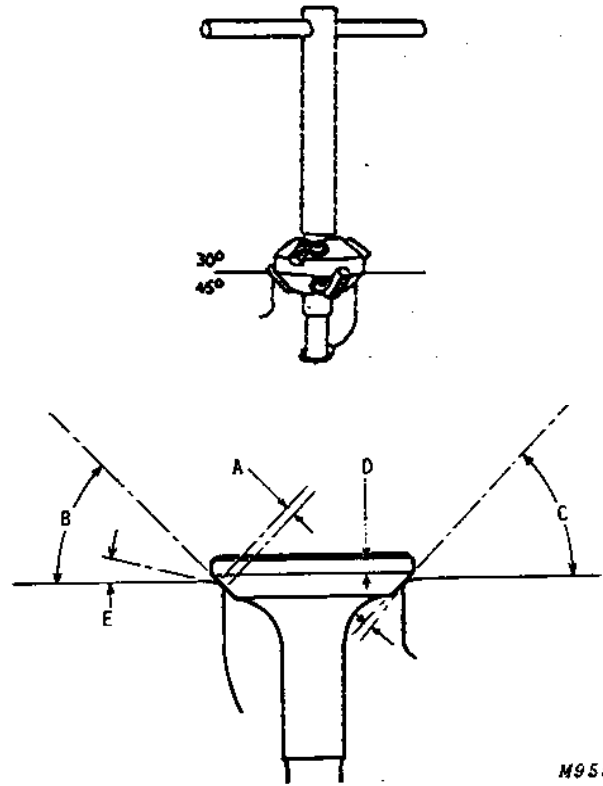
MX,3015A1,A7 -19-21OCT92

RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.
2. To recondition valve seat, cut at 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).
3. Cut valve seating surface (A) as close as possible to specifications.
4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface	0.80 mm (0.031 in.)
B—Valve Seat Angle	45°
C—Valve Face Angle	45°
D—Valve Margin	0.60 mm (0.020 in.)
E—Valve Narrowing Angle	30°



M955

MX,3015A1,A8 -19-21OCT92

-UN-31AUG88
M51558

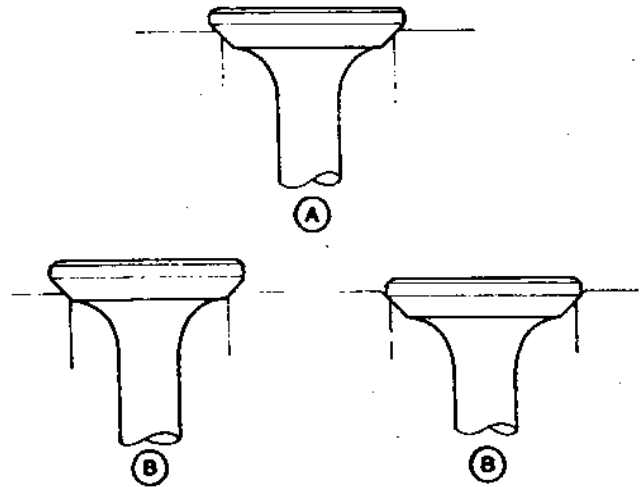
-UN-01SEP88

M9552

30
15
7

5. Center valve seat on the valve face:
—(A) shows correct position.
—(B) shows incorrect.

6. Check seat for good contact using Prussian Blue Compound.



MX,3015A1,A9 -19-21OCT92

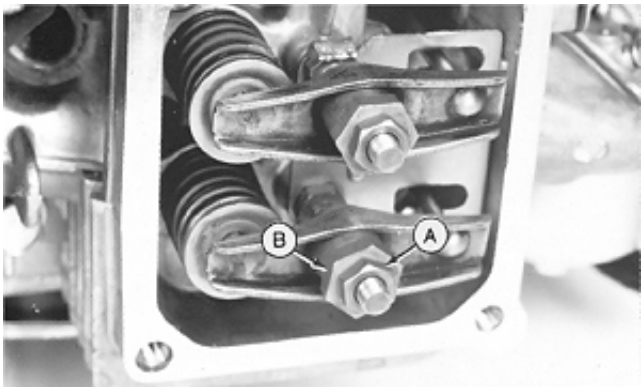
-UN-07SEP88

M118615

CHECK VALVE CLEARANCE

NOTE: Valve repair changes valve clearance. Check valve clearance. Adjust if needed.

- 1. Turn crankshaft until piston is at highest position in compression stroke.
- 2. Measure clearance.
- 3. If necessary, adjust clearance to specifications. Loosen nut (A) and turn pivot (B) in or out to adjust clearance. Tighten nut to specifications.



M51750 -UN-07SEP88

SPECIFICATIONS

Valve Clearance	0.12 mm (0.005 in.)
Nut Torque	7 N·m (62 lb-in.)

MX,3015A1,A10 -19-21OCT92

Group 20 Cylinder Block and Internal Components

OTHER MATERIAL

Number	Name	Use
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,4020A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalogue.

Piston Ring Kit
Oversized Pistons
Oversized Piston Rings
Undersized Connecting Rod
Cylinder Block
Overhaul Gasket Kit
Short Block Kit

MX,3020A1,A1 -19-21OCT92

30
20
1

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is 0.6 L (1.27 pt).

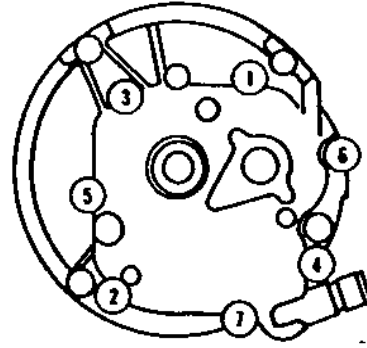
1. Drain crankcase.
2. Remove crankcase cover and gasket.
3. Clean crankcase and crankcase cover gasket surfaces.

NOTE: Do not force cover. Gears must mesh for proper positioning.

4. Install gasket and cover. Tighten cap screws using the sequence shown.

TORQUE SPECIFICATIONS

Mounting Cap Screws	7 N·m (62 lb-in.)
Oil Drain Plug	21 N·m (186 lb-in.)



M80170 -UN-11FEB91

MX,3020A1,A1A -19-21OCT92

REMOVE AND INSTALL CAMSHAFT

1. Remove crankcase cover. (See this group.)

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

2. Rotate crankshaft until timing marks (A) align.
3. Remove camshaft (B).
4. Inspect camshaft. (See this group.)
5. Apply clean engine oil to camshaft lobes and journals.
6. Align timing marks and install camshaft.
7. Install crankcase cover.



M80171 -UN-11FEB91

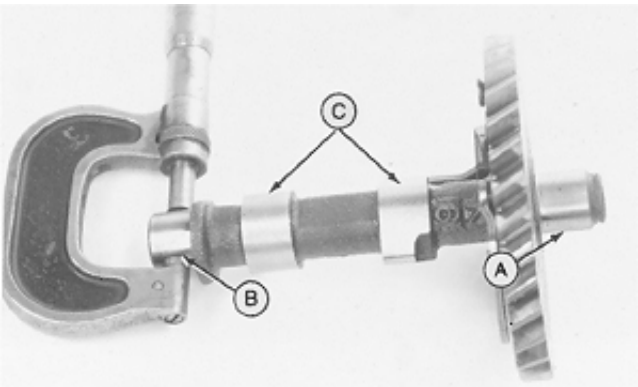
MX,3020A1,A2 -19-21OCT92

INSPECT CAMSHAFT

Inspect camshaft for worn or broken teeth.

NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.

Measure PTO side journal (A), flywheel side journal (B), and lobes (C). Replace camshaft and tappets if less than specifications.



M80172 -UN-11FEB91

SPECIFICATIONS (MIN)

PTO Side Journal	Flywheel Side Journal	Cam Lobes
13.92 mm (0.548 in.)	13.92 mm (0.548 in.)	22.80 mm (0.898 in.)

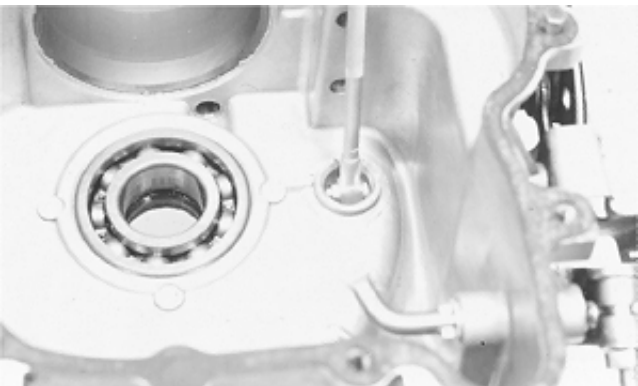
MX,3020A1,A3 -19-21OCT92

INSPECT CAMSHAFT PLAIN BEARINGS

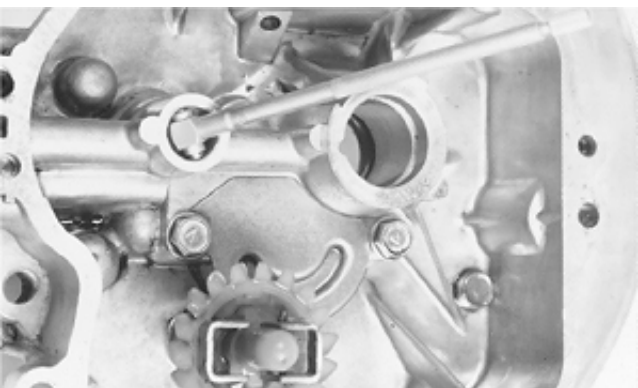
1. Remove camshaft. (See this group.)
2. Measure camshaft bearings in cylinder block and crankcase cover. Replace block or cover if diameter is greater than specification.
3. Install camshaft.

SPECIFICATIONS (MIN)

Cylinder Block Bearing	Crankcase Cover Bearing
14.07 mm (0.554 in.)	14.07 mm (0.554 in.)



Cylinder Block

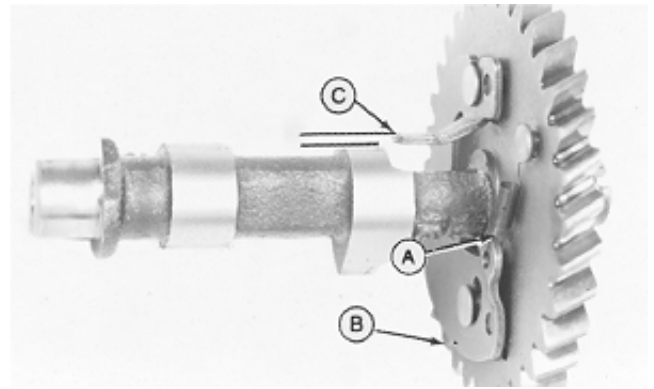


Crankcase Cover

MX,3020A1,A4 -19-21OCT92

INSPECT AUTOMATIC COMPRESSION RELEASE (A.C.R.)

1. Remove camshaft. (See this group.)
2. Inspect automatic compression release mechanism (A.C.R.) for damage.
3. Inspect spring (A). Replace if worn or damaged.
4. Move weight (B) by hand to check for proper operation.
5. Check that tab (C) sits slightly above cam lobe when weight is released. Tab should drop below cam when weight is operated.
6. Replace A.C.R. if it does not operate properly.
7. Install camshaft.

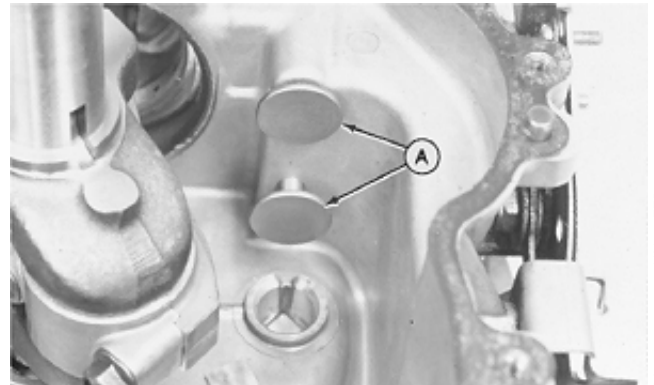


M80175 -UN-11FEB91

MX,3020A1,A5 -19-21OCT92

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)
- NOTE: Mark tappets so they can be installed in their original bores during assembly.*
2. Remove tappets (A).
 3. Inspect tappets for wear or damage. Replace if necessary.
 4. Apply clean engine oil to tappets and bores.
 5. Install tappets in original bores.
 6. Install camshaft.

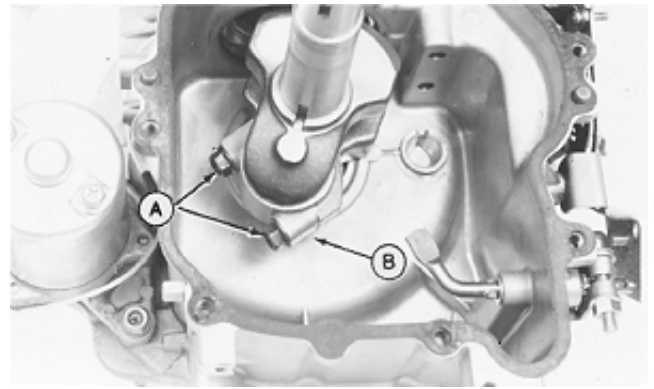


M80176 -UN-11FEB91

MX,3020A1,A6 -19-21OCT92

REMOVE AND INSTALL PISTON AND CONNECTING ROD

1. Remove cylinder head. (See Group 15.)
2. Remove crankcase cover. (See this group.)
3. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
4. Remove cap screws (A) and connecting rod cap (B).
5. Push piston and connecting rod from cylinder bore.
6. Make repairs as necessary. (See procedures in this group.)



M80177 -UN-11FEB91

MX,3020A1,A7 -19-21OCT92

7. Deglaze cylinder bore. (See Section 100, Group 15.)
8. Stagger piston ring end gaps 180° apart, but do not align with oil ring side rail end gaps.
9. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
10. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
11. Install piston assembly in cylinder bore with engraved match mark/arrow on piston head facing flywheel side of engine.
12. Install connecting rod cap and cap screws. Tighten cap screws to 12 N·m (106 lb-in.).

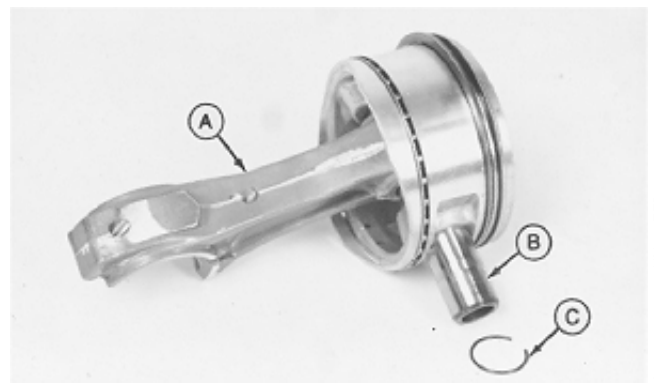


M50074 -UN-31AUG88

MX,3020A1,A8 -19-21OCT92

DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

1. Remove circlip (C), piston pin (B) and connecting rod (A).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.

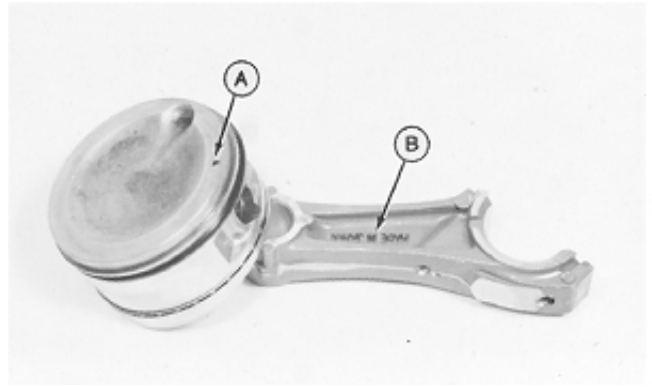


M80178 -UN-11FEB91

MX,3020A1,A9 -19-21OCT92

4. Align arrow match mark (A) on piston head with MADE IN JAPAN (B) on connecting rod.

5. Install piston pin and circlip.



MX,3020A1,A10 -19-21OCT92

M80179 -UN-11FEB91

INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)

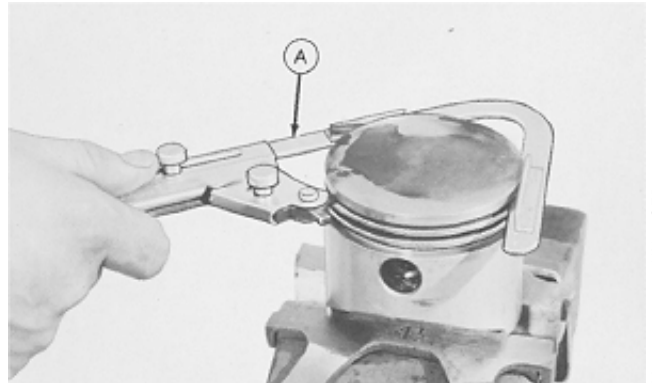
2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.

4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.

5. Check that oil return passages in grooves are open.



MX,3020A1,A11 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.

CLEARANCE SPECIFICATION (MAX)

Top Ring	Second Ring	Oil Control Ring
0.10 mm (0.004 in.)	0.10 mm (0.004 in.)	0.10 mm (0.004 in.)



MX,3020A1,A12 -19-21OCT92

M38102 -UN-29AUG88

8. Measure piston pin outer diameter. Replace if less than specification.

9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

Piston Pin O.D. (MIN)

14.98 mm
(0.590 in.)

Piston Bore I.D. (MAX)

15.05 mm
(0.593 in.)



MX,3020A1,A13 -19-21OCT92

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)

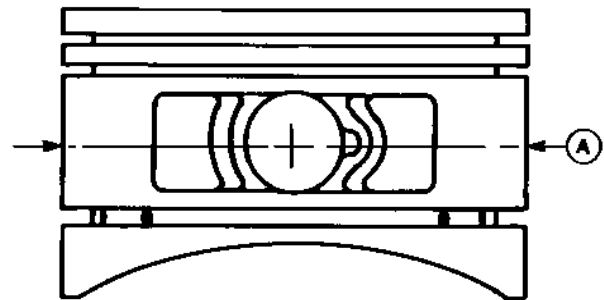
SPECIFICATIONS

Piston O.D. (A) 64.90 mm (2.555 in.)

Piston-to-Cylinder Bore Clearance

Standard 0.06—0.10 mm (0.0024—0.0039 in.)

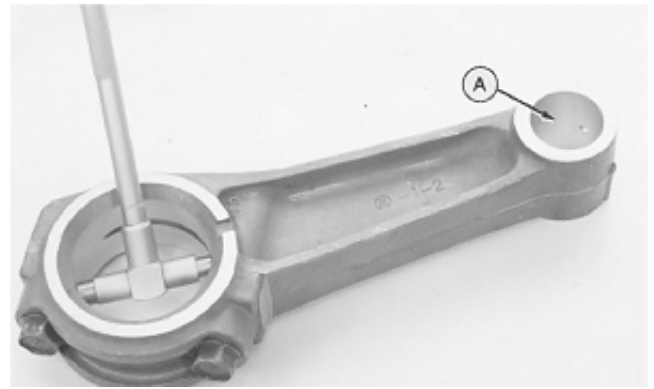
Wear Limit 0.1375 mm (0.0054 in.)



MX,3020A1,A14 -19-21OCT92

INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.
2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
3. Install connecting rod cap. Tighten to 12 N·m (106 lb-in.).
4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



M50066 -UN-31AUG88

BEARING I.D. SPECIFICATIONS (MAX)

Crankshaft Bearing

28.07 mm
(1.105 in.)

Piston Bearing

15.05 mm
(0.593 in.)

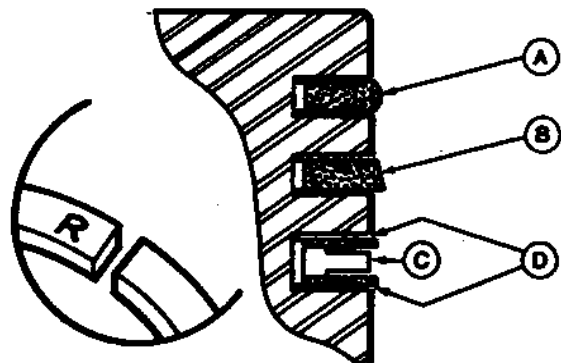
MX,3020A1,A15 -19-21OCT92

REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)
4. Install top ring (A) and second ring (B) with R or NPR mark facing up. Rings should turn freely in grooves.

NOTE: Oil ring assembly is located near bottom of piston.

5. Oil ring is an assembly. Install spacer (C), then side rails (D). Put side rail end gaps 180° apart.



A—Top Ring
B—Second Ring
C—Spacer
D—Side Rails

M38074 -UN-29AUG88

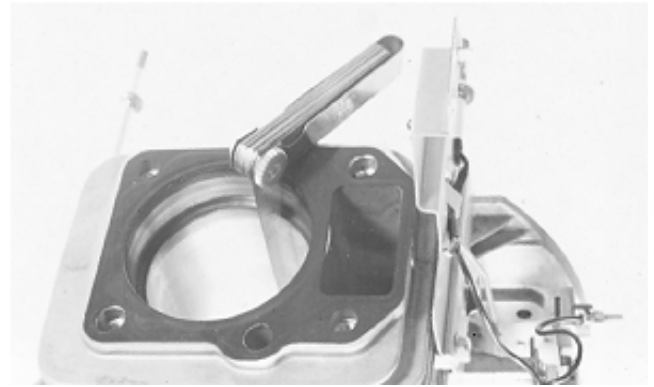
MX,3020A1,A16 -19-21OCT92

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS

Minimum End Gap	0.18 mm (0.007 in.)
Maximum End Gap	
Compression Rings	1.00 mm (0.039 in.)
Oil Ring Side Rails	1.50 mm (0.059 in.)



M80182 -UN-11FEB91

MX,3020A1,A17 -19-21OCT92

REMOVE, INSPECT AND INSTALL CRANKSHAFT

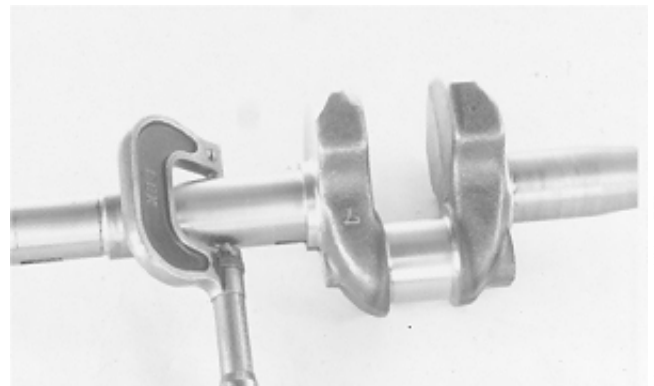
1. Remove camshaft. (See this group.)
2. Remove piston and connecting rod. (See this group.)
3. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

4. Check crankshaft alignment (T.I.R.). (See this group.)
5. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
6. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
7. Measure crankshaft main bearing journals and connecting rod journal. Replace crankshaft if measurements are less than specifications.

JOURNAL SPECIFICATIONS (MIN)

Main Bearing PTO Side	Journal Flywheel Side	Connecting Rod Journal
24.92 mm (0.981 in.)	24.92 mm (0.981 in.)	27.92 mm (1.099 in.)

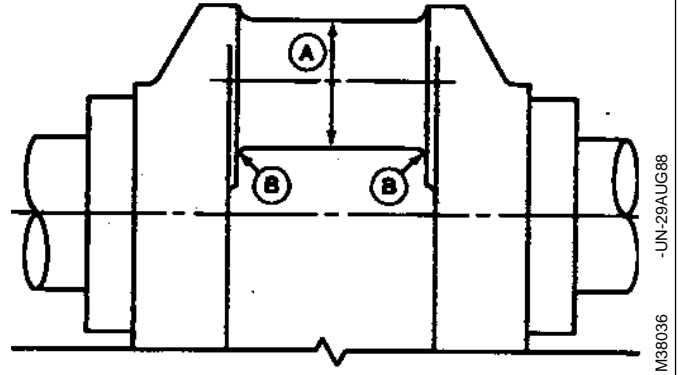


M80183 -UN-11FEB91

MX,3020A1,A18 -19-21OCT92

NOTE: An undersized connecting rod is available through the parts catalog, if necessary.

8. Connecting rod journal (A) can be resized to accept under-sized rod. Have grinding done by a reliable repair shop. Before sending crankshaft for grinding, inspect journal radii (B) for cracks.
9. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.
10. Put a light film of oil on crankshaft bearing surfaces.
11. Pack grease in oil seals and install crankshaft.
12. Install piston and connecting rod.
13. Install camshaft.



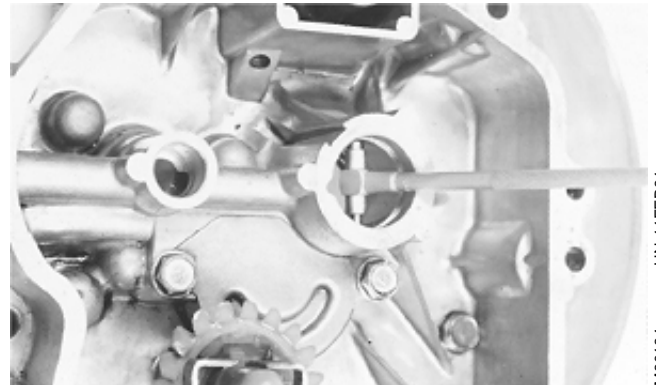
MX,3020A1,A19 -19-21OCT92

INSPECT CRANKSHAFT PLAIN BEARING

1. Remove crankshaft. (See this group.)
2. Measure crankshaft bearing in crankcase cover. Replace cover if diameter is greater than specifications. (See this group.)
3. Install crankshaft.

SPECIFICATIONS

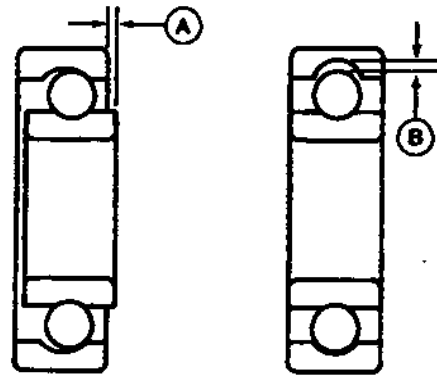
Bearing I.D. (Max) 25.10 mm (0.988 in.)



MX,3020A1,A19A -19-21OCT92

INSPECT CRANKSHAFT BALL BEARING

1. Remove flywheel end oil seal. (See Inspect Oil Seals in this group.)
2. Remove crankshaft bearing using a bearing, bushing and seal driver set.
3. Thoroughly clean bearing in solvent. Dip bearing in light weight oil.
4. Spin the bearing by hand and check for axial (A) and radial (B) free play.
5. Replace the bearing if it is noisy or has too much play.
6. Install bearing flush to inside of crankcase using a bearing, bushing and seal driver set.
7. Install oil seal.



M38073 -UN-29AUG88

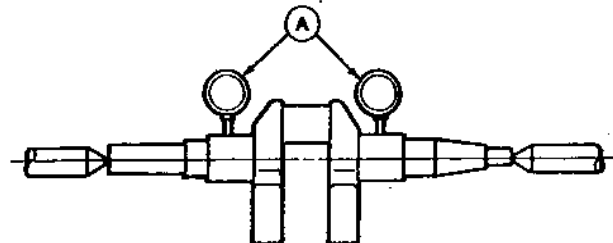
MX,3020A1,A20 -19-21OCT92

CHECK CRANKSHAFT ALIGNMENT (TIR)

Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

TIR (Max) 0.20 mm (0.008 in.)



M51761 -UN-07SEP88

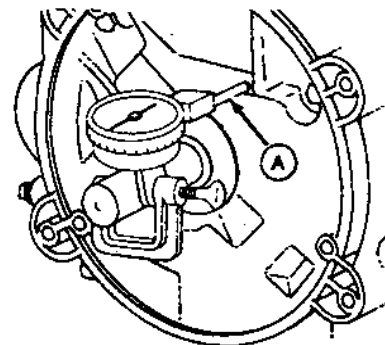
MX,3020A1,A21 -19-21OCT92

MEASURE CRANKSHAFT END PLAY

1. Measure end play using dial indicator (A). Record this measurement.
2. Move crankshaft in and out. Replace block or crankshaft if end play is not within specifications.

SPECIFICATIONS

End Play 0—0.50 mm (0—0.020 in.)

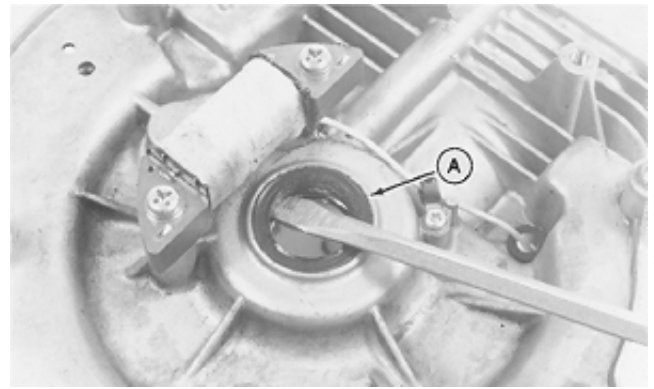


M30048 -UN-06SEP88

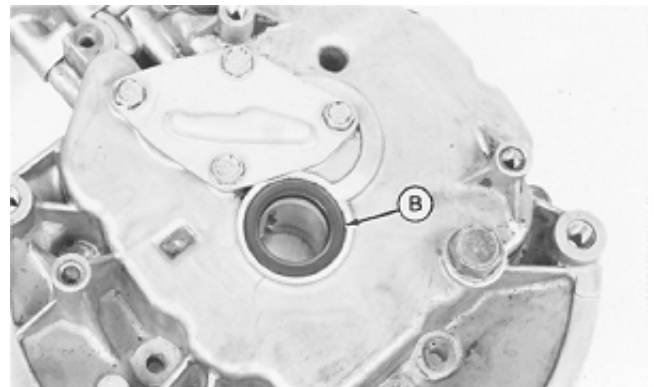
MX,3020A1,A22 -19-21OCT92

INSPECT OIL SEALS

1. Remove flywheel. (See Group 10.)
2. Inspect oil seals (A and B) at flywheel end and PTO end for wear or damage. Replace if necessary.
3. Remove crankshaft. (See this group.)
4. Remove worn or damaged seals with a screwdriver.
5. Install seals with lip to inside of engine using a bearing, bushing and seal driver set. Press seals in until flush with hub.
6. Install crankshaft.
7. Install flywheel.



Flywheel End



PTO End

MX,3020A1,A23 -19-21OCT92

M80185 -UN-11FEB91

M80186 -UN-11FEB91

30
20
12

INSPECT CYLINDER BLOCK

1. Remove crankshaft. (See this group.)
2. Clean and check block for cracks.
3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
4. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,3020A1,A24 -19-21OCT92

NOTE: A bare block is available for service.

5. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

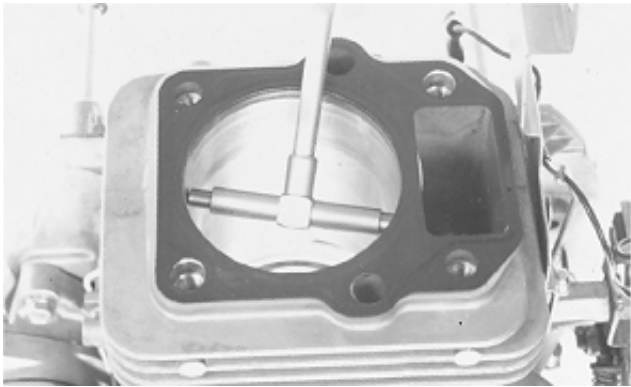
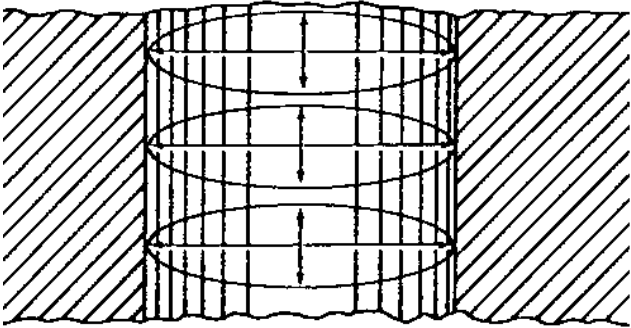
6. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

NOTE: If cylinder is rebored, oversize piston and rings must be installed.

7. Install crankshaft.

CYLINDER BORE SPECIFICATIONS

Standard	Wear Limit
64.90—65.00 mm (2.557—2.561 in.)	65.06 mm (2.563 in.)



MX,3020A1,A25 -19-21OCT92

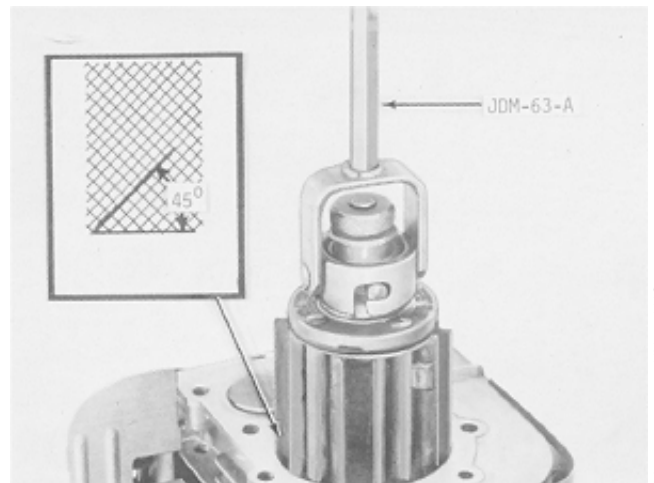
REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use 0.25, 0.50 or 0.75 mm (0.010, 0.020 or 0.030 in.) oversize pistons and rings. Have a reliable repair shop rebore the block, or use the drill press and honing tool.

1. Rebore cylinder with a honing tool to initial and final bore specifications.
2. Align center of bore to press center. Set the press to operate from 200—250 rpm.
3. Lower and raise hone until ends extend 20—25 mm (0.75—1.0 in.) past ends of cylinder.
4. Turn adjusting nut on one hone until stones contact cylinder wall at narrowest point.
5. Coat inside of cylinder with honing oil. Turn hone by hand. If you cannot turn it, hone is too tight.
6. Start drill press. Move hone up and down in cylinder approximately 20 times per minute.
7. Check cylinder diameter regularly during honing. Stop press before measuring. Remove hone from cylinder.

NOTE: Finish should not be smooth, but have a 40—60° cross-hatch pattern.

IMPORTANT: Check stone for wear or damage. Use correct stone for the job.



M24711 -UN-25AUG88

CYLINDER INITIAL BORE SPECIFICATIONS

Piston Oversize:
0.25 mm
(0.010 in.)

65.21—65.23 mm
(2.567—2.568 in.)

Piston Oversize:
0.50 mm
(0.020 in.)

65.46—65.48 mm
(2.577—2.578 in.)

Piston Oversize:
0.75 mm
(0.030 in.)

65.71—65.73 mm
(2.587—2.588 in.)

MX,3020A1,A26 -19-21OCT92

8. Hone the cylinder an additional 0.028—0.030 mm (0.0011—0.0012 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

IMPORTANT: DO NOT use gasoline or commercial solvents to clean cylinder bores. Solvents will not remove metal particles produced during honing.

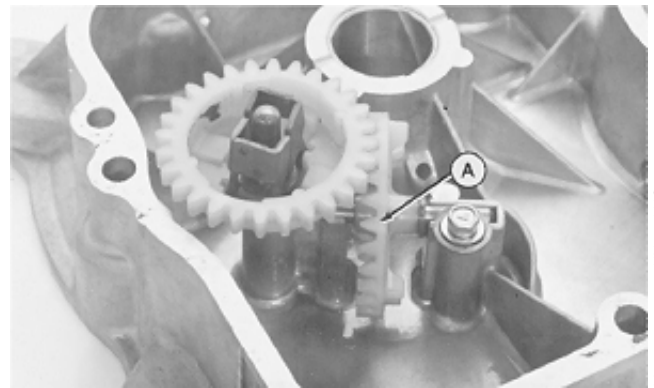
9. Clean the cylinder thoroughly using soap, warm water and clean rags. Continue to clean cylinder until white rags show no discoloration.

10. Dry the cylinder. Apply engine oil to cylinder wall.

M98,2040A,A9 -19-21OCT92

INSPECT AND REPLACE OIL SLINGER—IF EQUIPPED

1. Remove crankcase cover. (See this group.)
2. Remove oil slinger (A).
3. Inspect oil slinger. Replace if worn or damaged.
4. Install oil slinger.

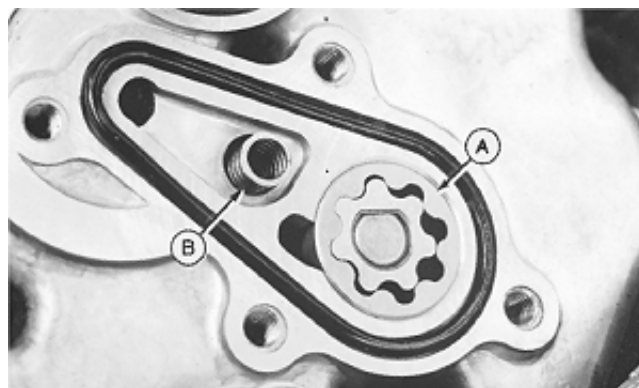


MX,3020A1,A28 -19-21OCT92

30
20
15
-UN-31AUG88
M50078

DISASSEMBLE AND ASSEMBLE OIL PUMP—IF EQUIPPED

1. Remove cover and gasket.
2. Remove oil pump assembly (A), relief spring and ball (B).
3. Inspect all parts. (See this group.)
4. Install oil pump assembly, gasket and cover. Tighten the cap screws using the sequence shown.



M52443
-UN-06DEC88



M52444
-UN-06DEC88

MX,3020A1,A29 -19-21OCT92

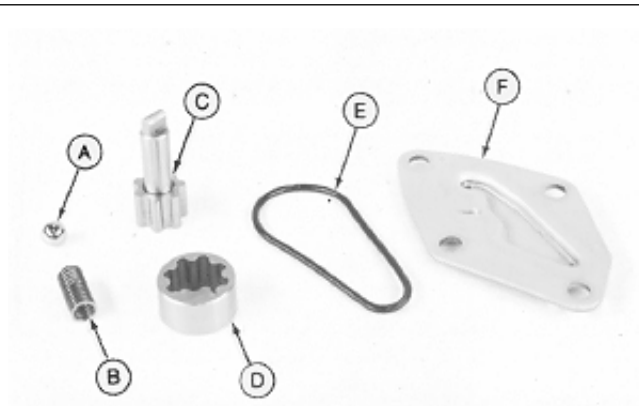
INSPECT OIL PUMP

NOTE: Oil screen not shown. To inspect or clean screen, remove crankcase cover. (See this group.)

1. Inspect all parts for wear or damage. Replace as necessary.

A—Check Ball
B—Relief Spring
C—Rotor Shaft

D—Outer Rotor
E—Gasket
F—Cover



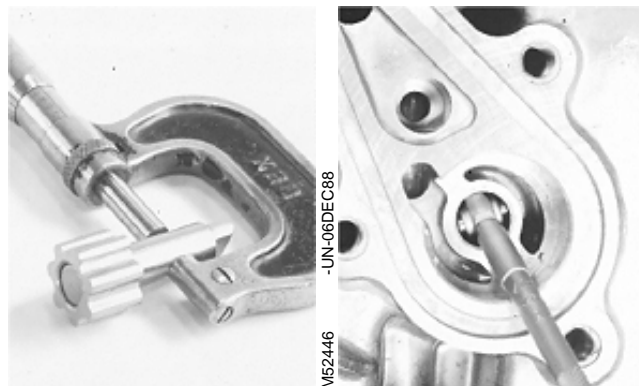
M52445
-UN-06DEC88

MX,3020A1,A30 -19-21OCT92

2. Measure outside diameter of shaft. Replace both shaft and outer rotor if less than specifications.
3. Measure rotor shaft bearing. Replace crankcase cover if greater than specifications.

ROTOR SHAFT SPECIFICATIONS

Shaft O.D. (Min)	9.01 mm (0.335 in.)
Bearing I.D. (Mix)	9.14 mm (0.360 in.)



M52446
-UN-06DEC88

M52447
-UN-06DEC88

MX,3020A1,A31 -19-21OCT92

4. Measure thickness of outer rotor. Replace both outer rotor and shaft if less than specification.

5. Measure outer rotor bearing depth. Replace crankcase cover if greater than specification.

OUTER ROTOR SPECIFICATIONS

Rotor Thickness (Min)	11.95 mm (0.471 in.)
Bearing Depth (Max)	12.10 mm (0.476 in.)



M52448
-UN-06DEC88



M52449
-UN-06DEC88

MX,3020A1,A32 -19-21OCT92

6. Measure outside diameter of outer rotor. Replace both outer rotor and shaft if less than specification.

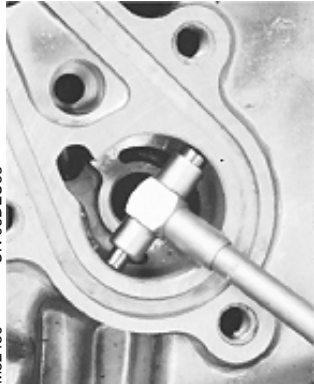
7. Measure inside diameter of rotor bearing. Replace crankcase cover if greater than specification.

OUTER ROTOR SPECIFICATIONS

Rotor O.D. (Min)	22.93 mm (0.903 in.)
Bearing I.D. (Max)	23.17 mm (0.912 in.)



M52450
-UN-06DEC88



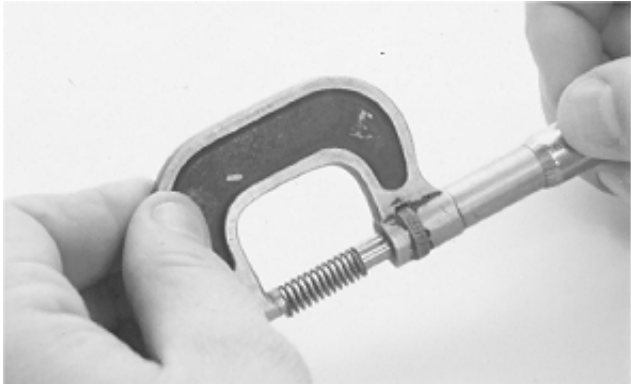
M52451
-UN-06DEC88

MX,3020A1,A33 -19-21OCT92

8. Measure relief valve spring. Replace if free length is less than 18 mm (0.700 in.).

SPRING FREE LENGTH SPECIFICATIONS (MIN)

Relief Valve Spring	
(Engine S.N. 047346—072217)	17 mm (0.669 in.)
(Engine S.N. 072218—)	19 mm (0.748 in.)

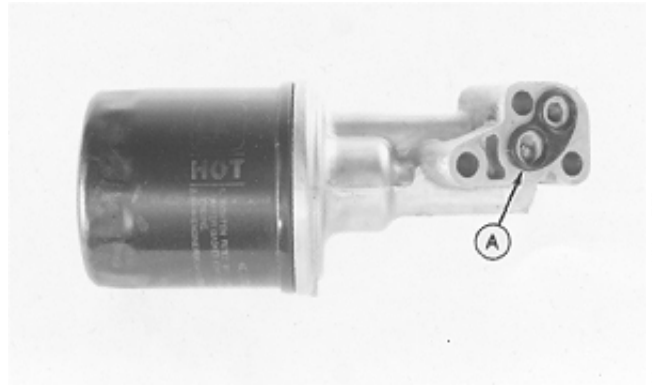


M50083
-UN-31AUG88

MX,3020A1,A34 -19-21OCT92

REMOVE, INSPECT AND INSTALL OIL FILTER MANIFOLD—IF EQUIPPED

1. Remove oil filter and manifold.
2. Inspect oil filter. Replace if excessively contaminated or damaged.
3. Inspect oil passages for clogs. Clean if needed.
4. Inspect gasket (A) for wear or damage. Replace if necessary.
5. Install filter and manifold.



M80188 -UN-11FEB91

MX,3020A1,A35 -19-21OCT92

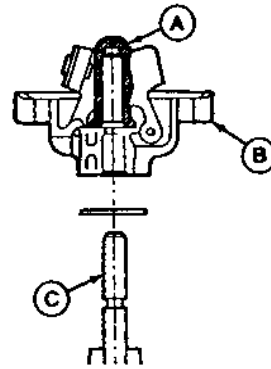
INSPECT AND REPLACE GOVERNOR

IMPORTANT: Removal damages governor. If not damaged, do not remove.

1. Remove crankcase cover. (See this group.)
2. Inspect governor. If necessary to replace, remove with screwdriver.
3. If removed, press shaft (C) back into block until it protrudes 32.2—32.8 mm (1.267—1.291 in.).

NOTE: Assemble sleeve and gear before installing assembly on shaft.

4. Install sleeve (A) onto governor gear (B).
5. Install governor assembly onto shaft. Push down on assembly until it snaps into place.



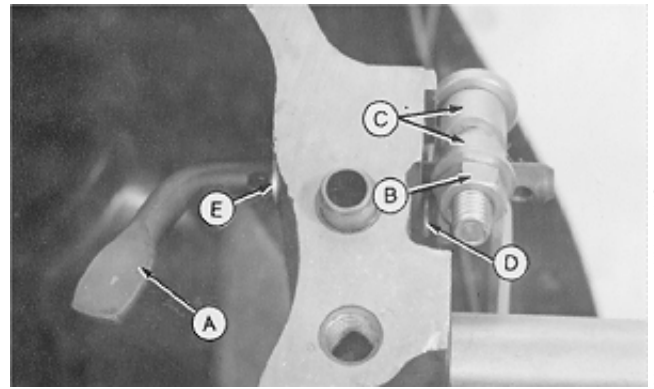
M51762 -UN-07SEP88

MX,3020A1,A36 -19-21OCT92

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (A). Replace if damaged.
3. To replace shaft, loosen nut (B) on lever (C).
4. Remove retaining pin (D), governor shaft and washer (E).
5. Install washer, shaft and retaining pin. Tighten nut to 7 N·m (62 lb-in.).



A—Governor Shaft
B—Nut
C—Governor Lever
D—Retaining Pin
E—Washer

MX,3020A1,A37 -19-21OCT92

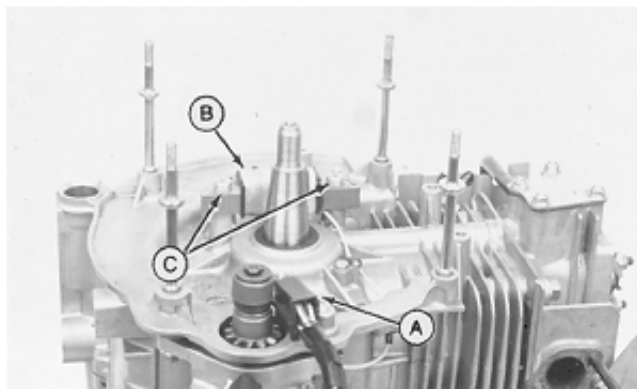
M50094 -UN-31AUG88

30
20
19

30
20
20

REMOVE AND INSTALL STATOR

1. Remove flywheel. (See Group 10.)
2. Disconnect stator lead from wiring connector (A).
3. Remove screws (C) and stator (B).
4. Install stator.
5. Connect stator lead.
6. Install flywheel.

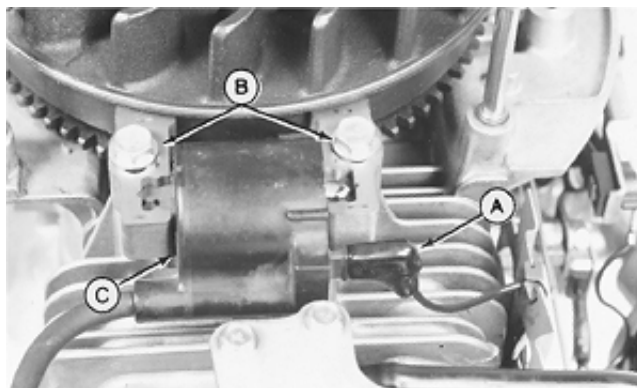


M80189 -UN-11FEB91

MX,3025A1,A1 -19-21OCT92

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove engine cover. (See Group 10.)
2. Disconnect wiring lead (A).
3. Remove cap screws (B) and armature with coil (C).
4. Loosely install armature with coil.
5. Connect wiring lead.
6. Adjust armature air gap. (See this group.)
7. Install engine cover.



M80190 -UN-11FEB91

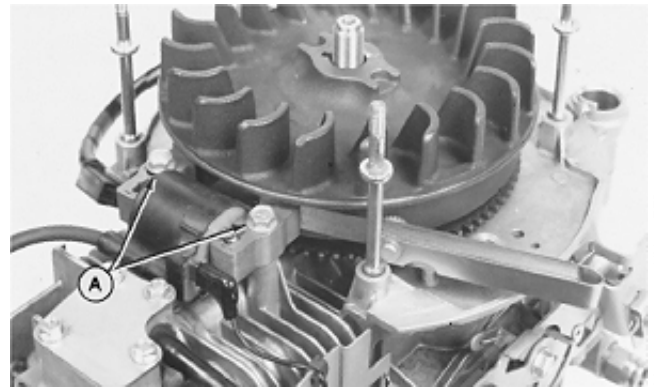
MX,3025A1,A2 -19-21OCT92

ADJUST ARMATURE AIR GAP

1. Turn flywheel magnet away from armature.
2. Insert feeler gauge, between flywheel and armature.
3. Push armature against flywheel and tighten screws (A).
4. Turn flywheel to remove feeler gauge.

AIR GAP SPECIFICATIONS

Feeler Gauge Blade 0.30 mm (0.012 in.)



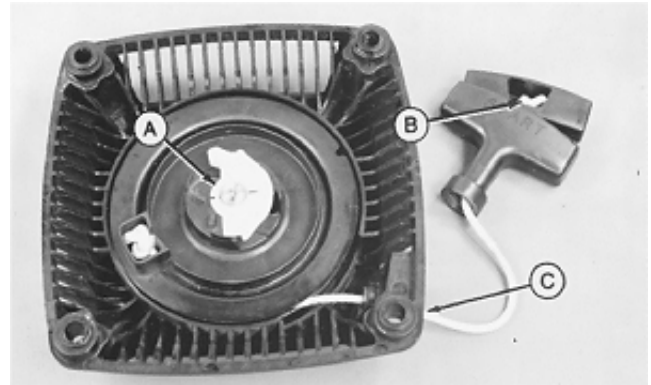
MX,3025A1,A3 -19-21OCT92

DISASSEMBLE RECOIL STARTER

1. Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (C) to prevent rope from winding back onto reel.
3. Pry knot (B) out of handle and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (C). Slowly release reel tension. Do not let rope get wedged between reel and housing.

CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove screw, washer and retainer (A).
7. Remove pawl and spring.

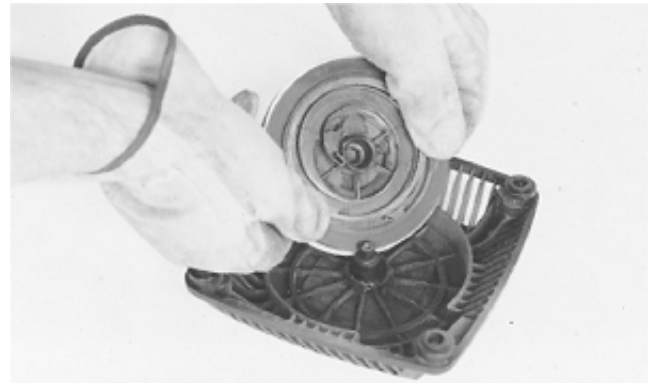


M80192 -UN-11FEB91

MX,3030A1,A1 -19-21OCT92

CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

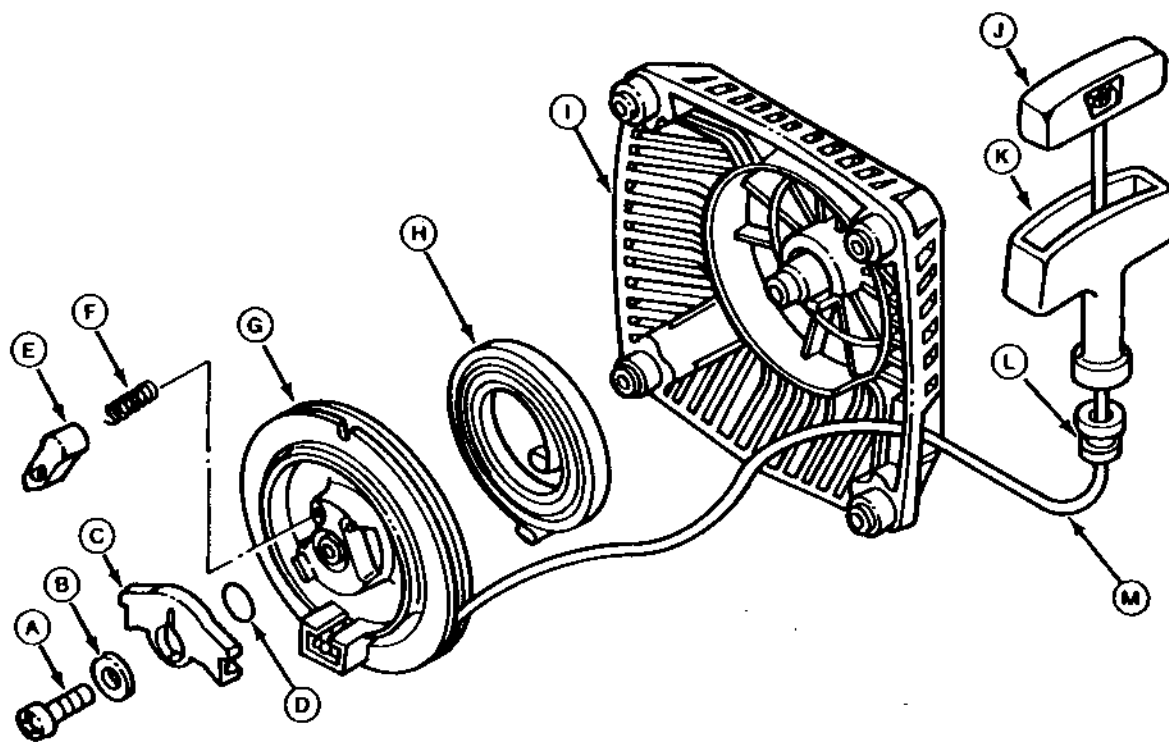
8. Turn the reel one half turn clockwise so no spring tension can be felt.
9. Spring is stored in reel. Carefully remove while holding spring in underside of reel.
10. Inspect starter for wear or damage. (See this group.)



M80193 -UN-11FEB91

MX,3030A1,A2 -19-21OCT92

INSPECT RECOIL STARTER



A—Screw
B—Washer
C—Retainer

D—Spring
E—Pawl
F—Spring

G—Reel
H—Torsion Spring
I—Housing

J—Cap
K—Handle
L—Guide

Inspect all parts for wear or damage. Replace as necessary.

MX,3030A1,A3 -19-21OCT92

M80194 -JUN-11FEB91

REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

1. Working from the center out, carefully unwind spring from reel.
2. Hook outside spring tang in reel. Wind spring into reel, working toward center.

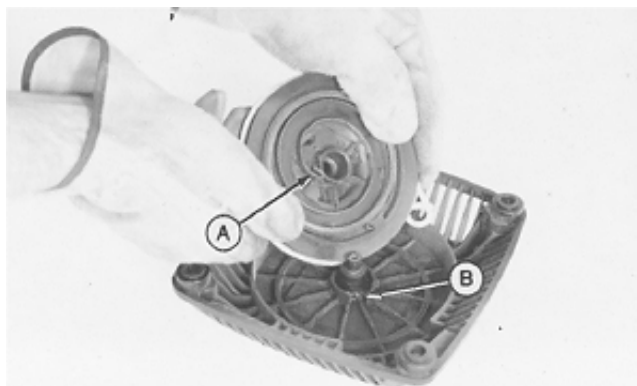


M80195 -UN-11FEB91

MX,3030A1,A4 -19-21OCT92

ASSEMBLE RECOIL STARTER

1. Wind rope counterclockwise onto reel.
2. Apply multipurpose grease to spring.
3. Install reel with spring in housing. Align inner tang (A) with catch (B).

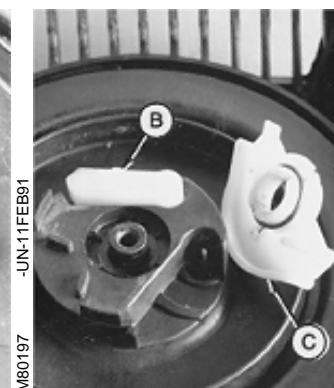


M80196 -UN-11FEB91

MX,3030A1,A5 -19-21OCT92

NOTE: Install spring and pawl on side of retainer marked "R".

4. Install spring (A), pawl (B) and retainer (C).
5. Install washer and screw.

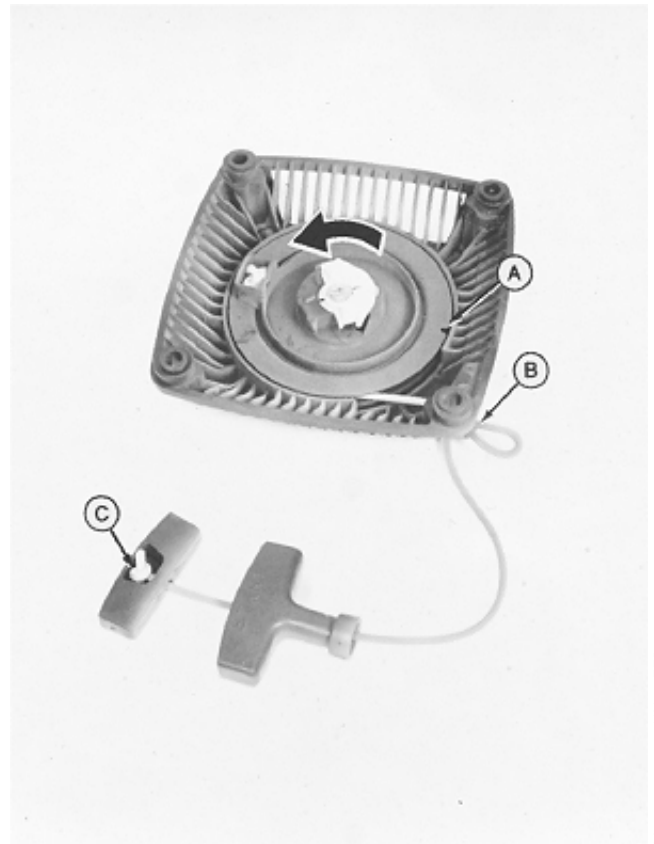


M80197 -UN-11FEB91

M80198 -UN-11FEB91

MX,3030A1,A6 -19-21OCT92

6. Place rope in notch (A). Turn reel counterclockwise until you feel tang hook on catch.
7. Turn reel two turns counterclockwise to preload spring.
8. While holding reel to keep it from unwinding, feed end of rope through guide. Tie knot (B) to hold rope.
9. Install handle and secure with knot (C).
10. Remove knot (B).
11. Pull rope to check for proper operation.
12. Install recoil starter on engine.



M80199 -JUN-11/FEB91

MX,3030A1,A7 -19-21OCT92

ANALYZE ELECTRIC STARTER CONDITION

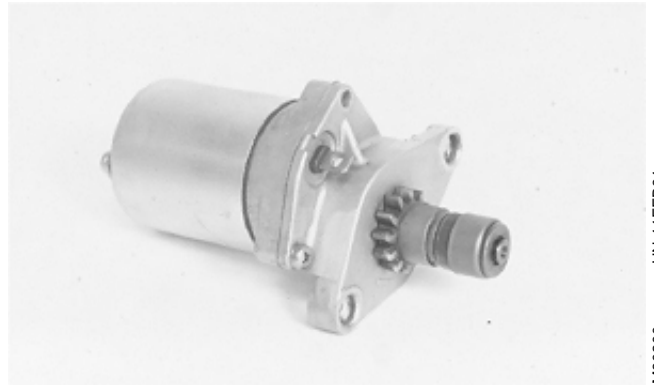
1. The starter overheats because of:
 - Long cranking.
 - Armature binding.
2. The starter operates poorly because of:
 - Armature binding.
 - Dirty or damaged starter drive.
 - Badly worn brushes or weak brush springs.
 - Excessive voltage drop in cranking system.
 - Battery or wiring defective.
 - Shorts, opens, or grounds in armature.

NOTE: Starter repair is limited to brushes, end caps, and starter drive. Fields in starter are permanent magnets and are not serviceable. If housing or armature is damaged, replace starter.

MX,3030A1,A8 -19-21OCT92

CHECK STARTER ARMATURE ROTATION

1. Remove starter.
2. Rotate armature (A).
3. If armature does not rotate freely, armature may be bent or bearings may be worn. Disassemble, inspect and clean starter. (See this group.)

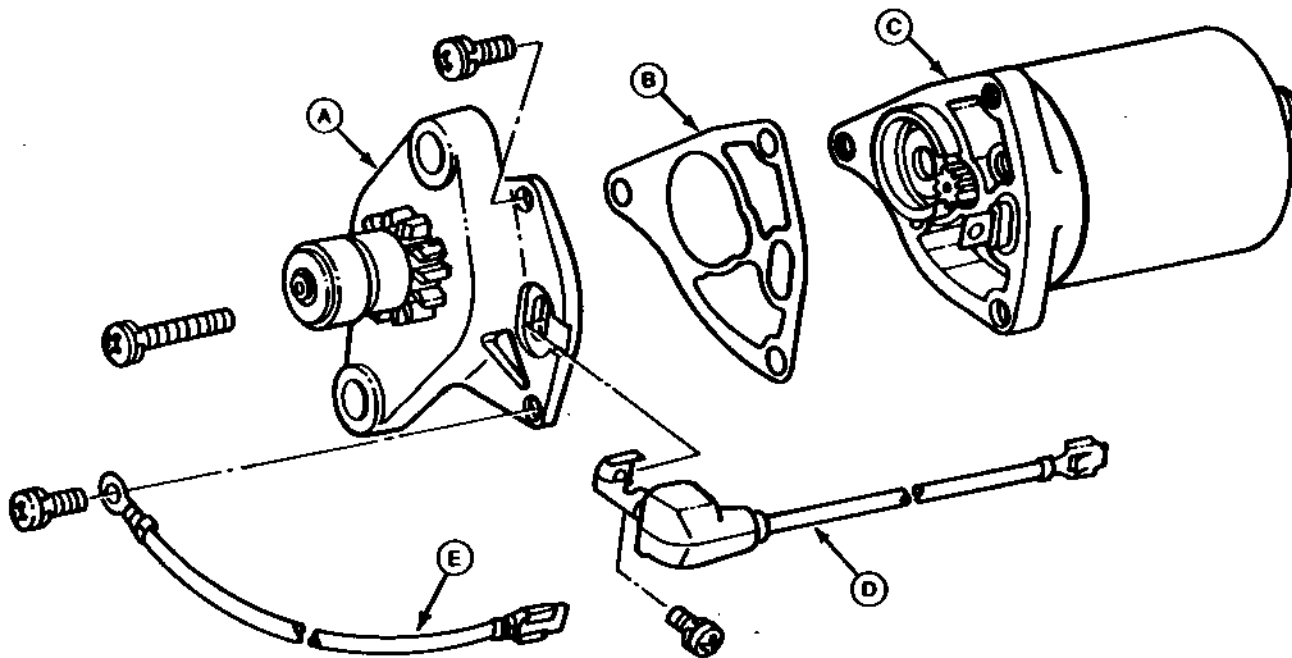


M80200 -UN-11FEB91

MX,3030A1,A9 -19-21OCT92

30
30
5

INSPECT ELECTRIC STARTER



A—End Cover Assembly
B—Gasket

C—Electric Motor Assembly

D—Wiring Lead

E—Wiring Lead

NOTE: Wiring leads (D and E) are removed when starter is removed from engine.

1. Mark body and cover for correct alignment during reassembly.
2. Remove end cover assembly (A).
3. Inspect all parts for wear or damage. Replace as necessary.

4. Apply a thin coat of multipurpose grease to:
 - sliding surfaces of armature.
 - armature shaft spline.
 - points where shaft contacts cover.
5. Assemble starter.

MX,3030A1,A10 -19-21OCT92

Section 35

KF82D/FZ340D

Contents

	Page	Page
Group 00—Engine Application and Repair Specifications		
Engine Application Chart	35-00-1	
Repair Specifications	35-00-2	
Group 05—Fuel and Air Systems		
Service Parts Kits	35-05-1	
Carburetor		
Remove and Install	35-05-1	
Disassemble, Clean, Inspect and Assemble	35-05-2	
Service		
Breather	35-05-3	
Air Cleaner	35-05-4	
Group 10—Blower Housing and Flywheel		
Remove and Install Blower Housing	35-10-1	
Remove and Install Flywheel	35-10-1	
Group 15—Cylinder Head		
Other Materials	35-15-1	
Cylinder Head		
Remove and Install	35-15-1	
Inspect	35-15-2	
Group 20—Cylinder Block, Valves and Internal Components		
Other Material	35-20-1	
Service Parts Kits	35-20-1	
Remove and Install Valves and Springs	35-20-2	
Inspect Valve Springs	35-20-2	
Inspect Valve Guides	35-20-3	
Recondition Valve Seats	35-20-3	
Check Valve-To-Tappet Clearance	35-20-4	
Change Tappet Caps	35-20-5	
Remove and Install Crankcase Cover	35-20-6	
Camshaft		
Remove and Install	35-20-6	
Inspect	35-20-7	
Inspect Ball Bearings	35-20-7	
Remove, Inspect and Install Tappets	35-20-8	
Adjust Camshaft End Play	35-20-8	
Dynamic Balancer		
Remove, Inspect and Install	35-20-9	
Inspect Ball Bearings	35-20-9	
Piston and Connecting Rod		
Remove and Install	35-20-10	
Disassemble, Inspect and Assemble	35-20-11	
Inspect Piston	35-20-12	
Inspect Connecting Rod	35-20-14	
Remove and Install Piston Rings	35-20-14	
Check Piston Ring End Gap	35-20-15	
Crankshaft		
Remove, Inspect and Install	35-20-16	
Inspect Ball Bearings	35-20-17	
Check Alignment (TIR)	35-20-17	
Measure and Adjust End Play	35-20-18	
Inspect Oil Seals	35-20-18	
Remove and Install Cylinder Block	35-20-19	
Replace Crankcase/Block Studs	35-20-19	
Cylinder Block		
Inspect	35-20-20	
Rebore	35-20-21	
Inspect and Replace		
Oil Splasher	35-20-22	
Governor	35-20-23	
Governor Shaft	35-20-23	
Group 25—Ignition and Charging System		
Remove and Install		
Stator and Pulser Coil	35-25-1	
Armature with Coil	35-25-2	
Group 30—Starting Systems		
Other Material	35-30-1	
Service Parts Kits	35-30-1	
Analyze Electric Starter Condition	35-30-1	
Bench Test Solenoid Drive Starter	35-30-2	
Test Solenoid	35-30-3	
Check Starter Armature Rotation	35-30-3	
Inspect Starter	35-30-4	
Test Starter Armature	35-30-5	
Test Field Coil	35-30-6	
Replace Brushes	35-30-6	

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

Machine	Engine Model No.
AMT600	
(Engine S.N. —118372)	KF82D
(Engine S.N.118373—)	FZ340D-BS10

MX,3500A1,A1 -19-21OCT92

35
00
1

KF82D/FZ340D REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Float-to-Carburetor Body Adjustment	5—8 mm (0.200—0.310 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	83 N·m (61 lb-ft)
-------------------------------	-------------------

GROUP 15—CYLINDER HEAD

Maximum Cylinder Head Warp	0.40 mm (0.015 in.)
Cap Screw Torque In Sequence	
Initial Torque	10 N·m (89 lb-in.)
Final Torque	24 N·m (212 lb-in.)
Spark Plug Torque	24 N·m (212 lb-in.)

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS

Valve Clearance (cold)	0.17—0.27 mm (0.007—0.011 in.)
----------------------------------	--------------------------------

Valves and Springs

Minimum Spring Free Length	40 mm (1.570 in.)
Maximum Valve Guide I.D.	
Exhaust	8.08 mm (0.318 in.)
Intake	8.00 mm (0.315 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seat and Face Angle	45°
Valve Seating Width	1.30 mm (0.050 in.)
Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Crankcase Cover

Oil Capacity	1.0 L (2.11 pt)
Cap Screw Torque	21 N·m (186 lb-in.)

Camshaft

Minimum Lobe Height	36.72 mm (1.447 in.)
-------------------------------	----------------------

Continued on next page

MX,3500A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Piston	
Maximum Ring Groove Clearance	0.15 mm (0.006 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	1.00 mm (0.039 in.)
Minimum Pin O.D.	17.98 mm (0.708 in.)
Maximum Pin Bore I.D.	18.03 mm (0.710 in.)
Maximum Piston-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Piston O.D.	79.77—79.79 mm (3.140—3.141 in.)
Piston-to-Cylinder Bore Clearance	0.195—0.235 mm (0.0077—0.009 in.)
Connecting Rod	
Maximum Crankshaft Bearing I.D.	32.06 mm (1.262 in.)
Maximum Piston Pin Bearing I.D.	18.04 mm (0.710 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.06 mm (0.002 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.11 mm (0.004 in.)
End-Cap Screw Torque	21 N·m (186 lb-in.)
Crankshaft	
Minimum Connecting Rod Journal O.D.	31.95 mm (1.259 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.05—0.20 mm (0.002—0.008 in.)
Cylinder Block	
Crankcase/Block Stud Torque	36 N·m (27 lb-ft)
Cylinder Bore	
Standard Cylinder Bore I.D.	79.91—79.98 mm (3.146—3.149 in.)
Maximum Cylinder Bore I.D.	80.09 mm (3.155 in.)
Maximum Out-of-Round	0.063 mm (0.0025 in.)
Rebore Cylinder	
Oversize Diameter	
0.50 mm	80.46—80.48 mm (3.168—3.169 in.)

GROUP 30—STARTING SYSTEMS**Electric Starter**

See Starter Specifications in this Group.

MX,3500A1,A3 -19-21OCT92

35
00
4

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Main Jet High Altitude Kit—Standard Air Cleaner

Main Jet High Altitude Kit—Heavy Duty Air Cleaner

Complete Carburetor

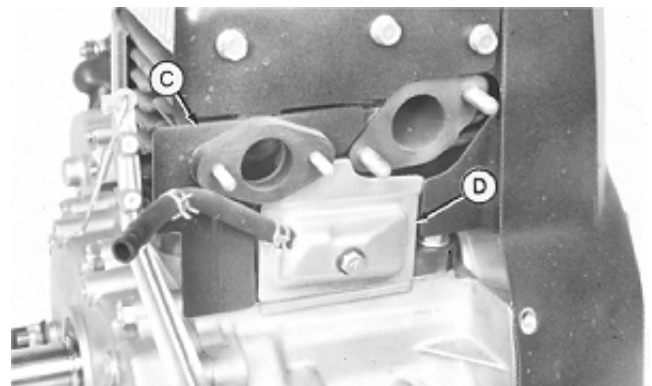
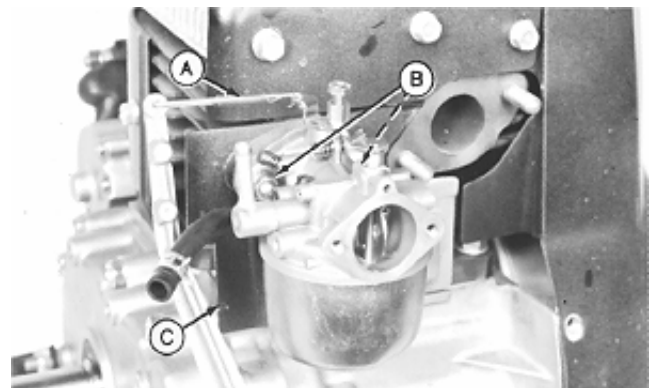
Gasket Kit

Air Cleaner Assembly

MX,3505A1,A1 -19-21OCT92

REMOVE AND INSTALL CARBURETOR

1. Remove air cleaner base and gasket.
 2. Remove nuts and washers (B).
 3. Separate carburetor from spacer (C).
 4. Disconnect linkage (A) and remove carburetor.
 5. Remove tappet chamber cover and gasket (D).
 6. Remove spacer and gaskets.
 7. Make repairs as necessary. (See procedures in this group.)
 8. Install spacer and gaskets.
- NOTE: Install tappet chamber cover gasket with large slot facing down.*
9. Install tappet chamber cover and gasket.
 10. Install carburetor and connect linkage.
 11. Install nuts and washers. Tighten nuts.
 12. Install air cleaner base and gasket.



A—Throttle Control Linkage
B—Nuts and Washers
C—Spacer
D—Tappet Chamber Cover and Gasket

MX,3505A1,A2 -19-21OCT92

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets, float and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

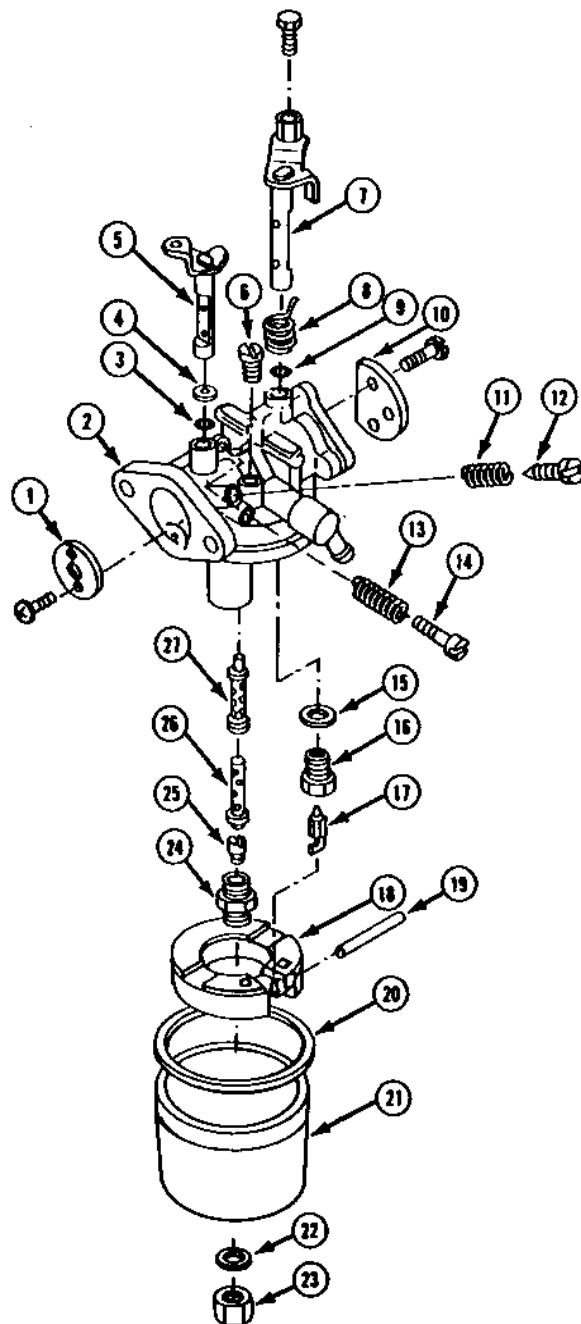
3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.
4. Inspect all parts for wear or damage, replace as necessary.

NOTE: Main jet high altitude kits are available.

- 1—Throttle Plate
- 2—Carburetor Body
- 3—Seal*
- 4—Felt Washer**
- 5—Throttle Shaft
- 6—Pilot Jet
- 7—Choke Shaft
- 8—Spring
- 9—Seal*
- 10—Choke Plate
- 11—Spring
- 12—Idle Adjustment Screw
- 13—Spring
- 14—Speed Adjustment Screw
- 15—Washer
- 16—Needle Valve Seat
- 17—Needle Valve
- 18—Float
- 19—Float Pin
- 20—Gasket
- 21—Float Chamber
- 22—Washer
- 23—Nut
- 24—Nozzle Holder
- 25—Main Jet
- 26—Bleed Pipe
- 27—Nozzle

*Equipped on newer models only.

**Equipped on older models only.



M80452 -UN-17MAY91

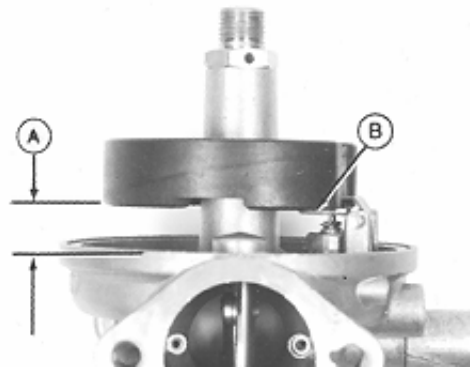
MX,3505A1,A3 -19-21OCT92

IMPORTANT: Do not push on float or inlet needle valve when adjusting float level.

5. Adjust float level. With carburetor upside down, support float so surface touches the needle valve. Do not compress the needle valve spring. Measure the distance from carburetor body to bottom of float surface (A). If not according to specifications, bend tang (B) to adjust float surface angle.

FLOAT SPECIFICATIONS

Distance (A) 5—8 mm (0.200—0.310 in.)

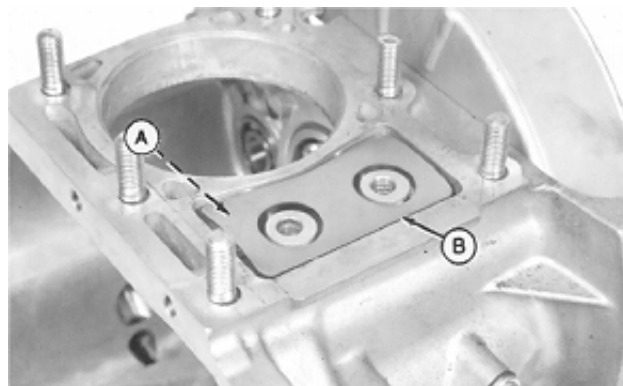


MX,3505A1,A4 -19-21OCT92

M80453 -UN-17MAY91

SERVICE BREATHER

1. Remove cylinder block. (See Group 20.)
2. Remove breather plate (B).
3. Inspect plate for cracks or damage. Replace if necessary.
4. Make sure oil drain back hole (A) is open.
5. Install breather plate.
6. Install cylinder block.



MX,3505A1,A5 -19-21OCT92

M80454 -UN-17MAY91

SERVICE AIR CLEANER

NOTE: Replace elements yearly or every 25 hours as required.

1. Remove and disassemble air cleaner.

IMPORTANT: Do not clean elements with solvent or compressed air.

2. Wash foam element (A) in detergent and water. Dry element.

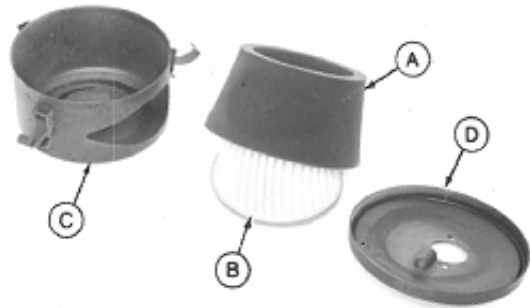
3. Put 12—15 drops of engine oil on foam element (A). Squeeze out excess oil.

4. Replace paper element (B) if:
 - Element is oily, dirty, bent, torn, crushed, or obstructed in any way.
 - Engine performance is poor.
 - Seal is damaged in any way.

5. Inspect cover (C), and base (D) for damage. Replace if necessary.

IMPORTANT: Any time air cleaner base is removed, check for free choke operation during reassembly.

6. Assemble and install air cleaner.



A—Foam Element
B—Paper Element
C—Cover
D—Base

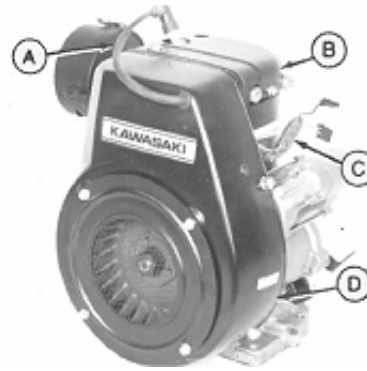
M80455 -UN-17MAY91

35
05
4

MX,3505A1,A6 -19-21OCT92

REMOVE AND INSTALL BLOWER HOUSING

1. Disconnect spark plug wiring lead (A).
2. Remove cover (B).
3. Disconnect wiring connector (C).
4. Remove blower housing (D).
5. Install blower housing.
6. Connect wiring connector.
7. Install cylinder head cover.
8. Connect spark plug wiring lead.



A—Spark Plug Wiring Lead
B—Cylinder Head Cover
C—Wiring Connector
D—Blower Housing

MX,3510A1,A1 -19-21OCT92

M80456 -UN-17MAY91

REMOVE AND INSTALL FLYWHEEL

1. Remove blower housing. (See this group.)
- NOTE: Flywheel nut has left-hand thread.*
2. Hold flywheel and remove nut and washer (A).
3. Remove flywheel using a flywheel puller.
4. Install flywheel.

NOTE: Install washer with concave side toward flywheel.

5. Install washer and nut. Tighten nut to 83 N·m (61 lb-ft).
6. Install blower housing.



MX,3510A1,A2 -19-21OCT92

M80457 -UN-17MAY91

35
10
1

OTHER MATERIAL

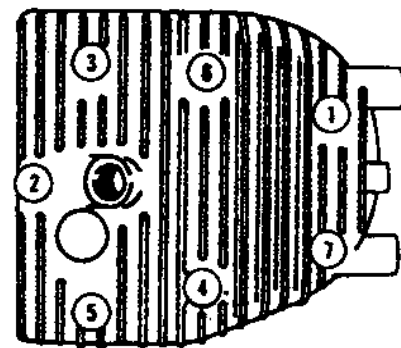
Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean cylinder head

SCOTCH-BRITE is a trade mark of the 3M Company.

MX,5015A1,A1 -19-21OCT92

REMOVE AND INSTALL CYLINDER HEAD

1. Remove blower housing. (See Group 10.)
2. Remove spark plug.
3. Remove cylinder head and gasket.
4. Make repairs as necessary. (See procedures in this group.)
5. Install cylinder head with new gasket. Install cap screws and tighten finger tight.
6. Tighten cap screws in sequence shown. Tighten to initial torque specifications.
7. Continue in sequence, 4 N·m (35 lb-in.) at a time, until final torque is as specified.
8. Install spark plug and tighten to specification.
9. Install blower housing.



M51536 -UN-31AUG88

35
15
1

TORQUE SPECIFICATIONS

Initial Torque	10 N·m (89 lb-in.)
Final Torque	24 N·m (212 lb-in.)
Spark Plug	24 N·m (212 lb-in.)

MX,3515A1,A1 -19-21OCT92

INSPECT CYLINDER HEAD

1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Put cylinder head (A) on a surface plate. Check for distortion at several points around the head using a feeler gauge (B). Replace head if distortion is more than specifications.



M80458 -UN-17MAY91

SPECIFICATIONS

Cylinder Head Distortion (Max) 0.40 mm (0.015 in.)

MX,3515A1,A2 -19-21OCT92

Group 20 Cylinder Block, Valves and Internal Components

OTHER MATERIAL

Number	Name	Use
	Valve Guide Cleaner	Clean valve guides
	Prussian Blue Compound	Check valve seat contact
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,3520A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog.

Tappet Cap Kit

Camshaft Axial Play Shim Kit

Oversized Pistons

Oversized Piston Rings

Undersized Connecting Rod

Cylinder Block

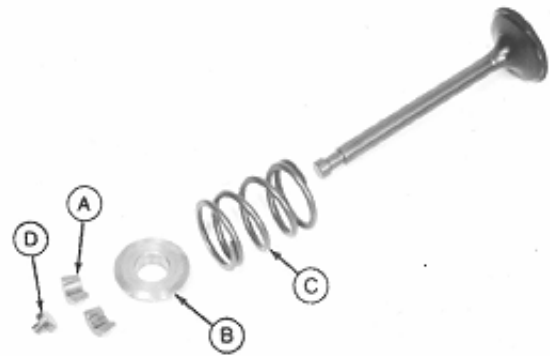
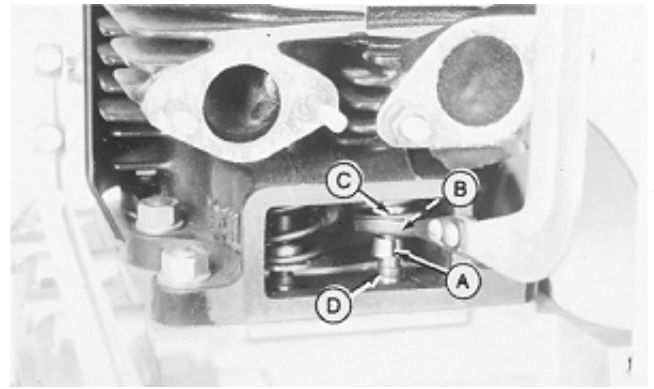
Short Block Kit

Crankshaft End Play Shim Kit

MX,3520A1,A2 -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove carburetor. (See Group 05.)
2. Remove cylinder head. (See Group 15.)
3. Compress valve spring (C) with a valve spring compressor.
4. Remove collet halves (A).
5. Slowly release compressor and remove valve.
6. Remove spring, retainer (B) and tappet cap (D).
7. Inspect and analyze valves. (See Section 100, Group 05.)
8. Inspect springs, valve guides and seats. (See this group.)
9. Check valve-to-tappet clearance. (See this group.)
10. Install tappet caps.
11. Align valve springs and retainers in tappet chamber.
12. Coat valve stems with oil and install in cylinder block.
13. Compress each spring and install collet halves.
14. Install cylinder head.
15. Install carburetor.



A—Collet Halves
B—Spring Retainer
C—Spring
D—Tappet Cap

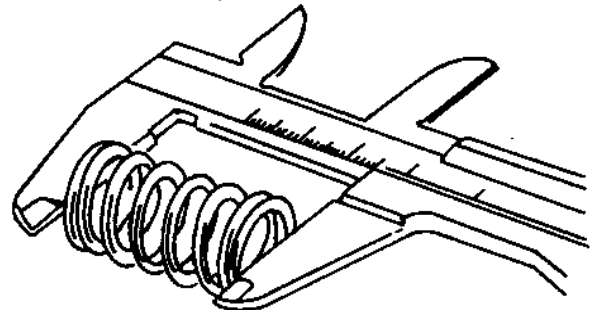
MX,3520A1,A3 -19-21OCT92

INSPECT VALVE SPRINGS

Inspect valve springs. Replace springs if damaged or if free length is less than specification.

SPECIFICATION

Spring Free Length (MIN) 40.00 mm (1.570 in.)



MX,3520A1,A4 -19-21OCT92

INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guides. Replace cylinder block if inside diameters are greater than specifications. (See this group.)

SPECIFICATIONS (MAX) I.D.

Intake Valve Guide	8.00 mm (0.315 in.)
Exhaust Valve Guide	8.08 mm (0.318 in.)



MX,3520A1,A5 -19-21OCT92

M80460 -UN-17MAY91

RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.

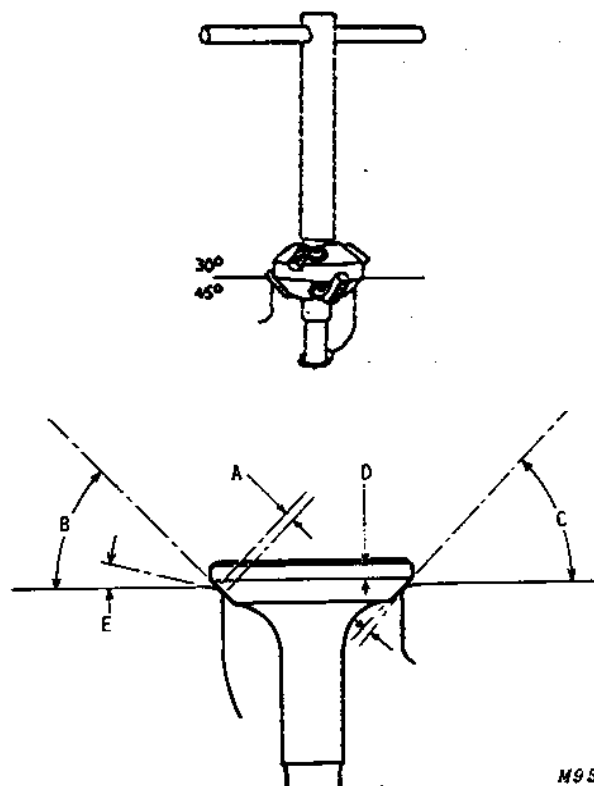
2. To recondition valve seat, cut a 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).

3. Cut valve seating surface (A) as close as possible to specifications.

4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface	1.30 mm (0.050 in.)
B—Valve Seat Angle	45°
C—Valve Face Angle	45°
D—Valve Margin	0.60 mm (0.020 in.)
E—Valve Narrowing Angle	30°



M955

MX,3520A1,A6 -19-21OCT92

M51558 -UN-31AUG88

M9552 -UN-01SEP88

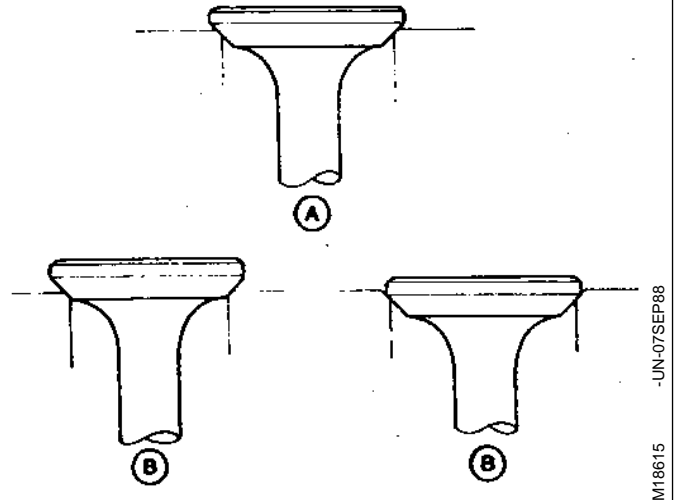
35
20
3

5. Center valve seat on the valve face:

—(A) shows correct position.

—(B) shows incorrect.

6. Check seat for good contact using Prussian Blue Compound.



MX,3015A1,A9 -19-21OCT92

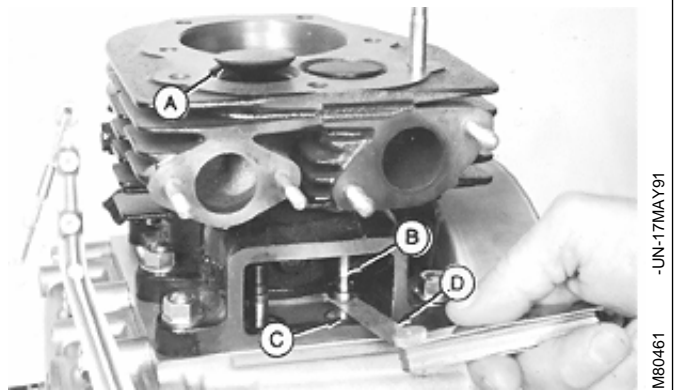
CHECK VALVE-TO-TAPPET CLEARANCE

1. Install tappet caps on tappets.

2. Install valves in cylinder block.

3. Turn crankshaft until intake valve (A) is at its highest position. Check clearance between valve (B) and tappet cap (C), with feeler gauge (D) and compare to specifications.

4. Change tappet caps to obtain proper clearance. (See this group.)



SPECIFICATIONS

Valve Clearance 0.17—0.27 mm (0.007—0.011 in.)

A—Intake Valve
B—Exhaust Valve
C—Tappet Cap
D—Feeler Gauge

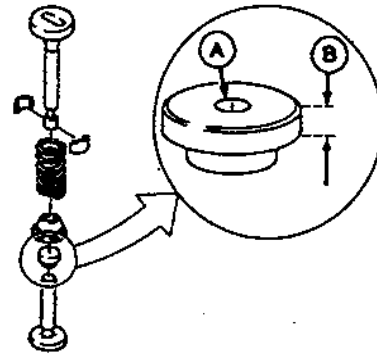
MX,3520A1,A7 -19-21OCT92

CHANGE TAPPET CAPS

Determine thickness (B) of old cap by finding its stamp (A) in the table.

Install a thicker or thinner cap as needed for proper valve clearance.

Stamp	Thickness
1	2.70 mm (0.106 in.)
2	2.75 mm (0.108 in.)
3	2.80 mm (0.110 in.)
4	2.85 mm (0.112 in.)
5	2.90 mm (0.114 in.)
6	2.95 mm (0.116 in.)
7	3.00 mm (0.118 in.)
8	3.05 mm (0.120 in.)
9	3.10 mm (0.122 in.)
10	3.15 mm (0.124 in.)
11	3.20 mm (0.125 in.)
12	3.25 mm (0.128 in.)
13	3.30 mm (0.130 in.)
14	3.35 mm (0.132 in.)
15	3.40 mm (0.134 in.)
16	3.45 mm (0.136 in.)
17	3.50 mm (0.138 in.)
18	3.55 mm (0.140 in.)
19	3.60 mm (0.142 in.)
20	3.65 mm (0.144 in.)



M51539 -UN-31AUG88

MX,3520A1,A8 -19-21OCT92

35
20
5

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is 1.0 L (2.11 pt).

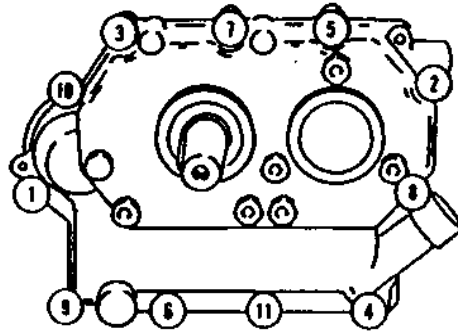
1. Drain crankcase.
2. Disconnect governor arm return spring.
3. Remove crankcase cover and gasket.
4. Clean crankcase and crankcase cover gasket surfaces.

NOTE: Install stud & bracket at position (1).

5. Install gasket and cover. Tighten cap screws using the sequence shown.
6. Connect governor arm return spring.

TORQUE SPECIFICATIONS

Mounting Cap Screws 21 N·m (186 lb-in.)



M80462 -UN-17MAY91

MX,3520A1,A9 -19-21OCT92

REMOVE AND INSTALL CAMSHAFT

NOTE: Governor is attached to camshaft.

1. Remove crankcase cover. (See this group.)

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

2. Rotate crankshaft until timing marks (A) align.
3. Remove camshaft (B).
4. Inspect camshaft. (See this group.)
5. Apply clean engine oil to camshaft lobes and journals.
6. Align timing marks and install camshaft.
7. Install crankcase cover.



M80463 -UN-17MAY91

MX,3520A1,A10 -19-21OCT92

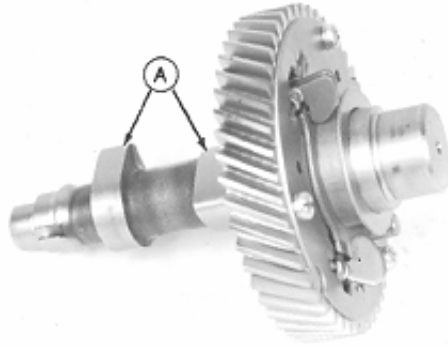
INSPECT CAMSHAFT

Inspect camshaft for worn or broken teeth.

NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.

*Camshaft side journals rotate in ball bearings.
Side journals are not measured.*

Measure lobes (A). Replace camshaft and tappets if less than specifications.



SPECIFICATIONS (MIN)

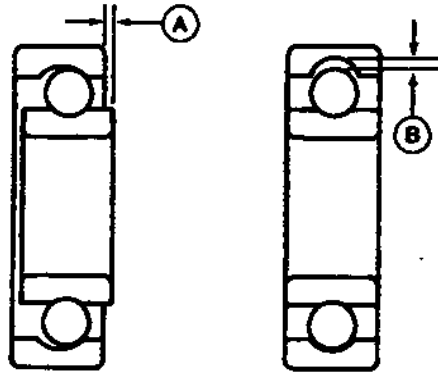
PTO Side Journal	Flywheel Side Journal	Cam Lobes
—	—	36.72 mm (1.447 in.)

MX,3520A1,A11 -19-21OCT92

M80464 -UN-17MAY91

INSPECT CAMSHAFT BALL BEARINGS

1. Remove camshaft. (See this group.)
2. Remove bearings using a blind hole puller set.
3. Thoroughly clean bearings in solvent. Dip bearings in light weight oil.
4. Spin the bearings by hand and check for axial (A) and radial (B) free play.
5. Replace bearings if noisy or too much play.
6. Install bearings flush to inside of crankcase or crankcase cover using a bearing, bushing and seal driver set.
7. Install camshaft.



MX,3520A1,A12 -19-21OCT92

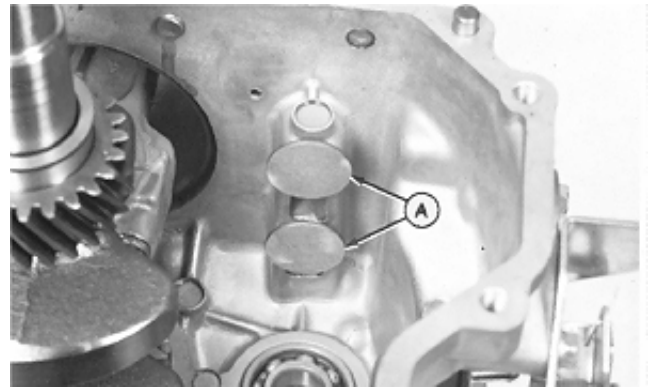
M38073 -UN-29AUG88

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)

NOTE: Mark tappets so they can be installed in their original bores during assembly.

2. Remove tappets (A).
3. Inspect tappets for wear or damage. Replace if necessary.
4. Apply clean engine oil to tappets and bores.
5. Install tappets in original bores.
6. Install camshaft.



M80465 -UN-17MAY91

MX,3520A1,A13 -19-21OCT92

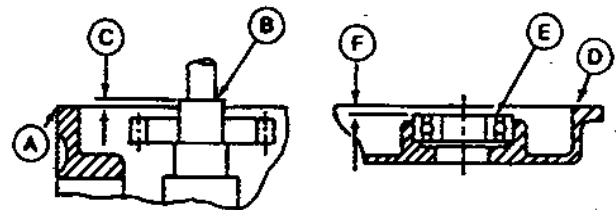
ADJUST CAMSHAFT END PLAY

NOTE: Measure camshaft end play without crankcase cover gasket installed.

1. Measure from crankcase machined surface (A) to cam gear timing flange (B). Record this measurement (C).
2. Measure from crankcase cover mounting face (D) to camshaft bearing inner race surface (E). Record this measurement (F).
3. Subtract measurement (C) from measurement (F).

Install shims having total thickness indicated on chart.

A—Crankcase Machined Surface
B—Camshaft Timing Flange
C—Measurement
D—Crankcase Cover Machined Surface
E—Bearing Inner Race
F—Measurement



M51556 -UN-31AUG88

Difference (F-C) in mm	Total Thickness of Shims
1.90-1.94 mm	2.10 mm
1.95-1.99 mm	2.15 mm
2.00-2.04 mm	2.20 mm
2.05-2.09 mm	2.25 mm
2.10-2.14 mm	2.30 mm
2.15-2.19 mm	2.35 mm
2.20-2.24 mm	2.40 mm
2.25-2.29 mm	2.45 mm
2.30-2.34 mm	2.50 mm
2.35-2.39 mm	2.55 mm
2.40-2.44 mm	2.60 mm

M51557 -19-14MAR89

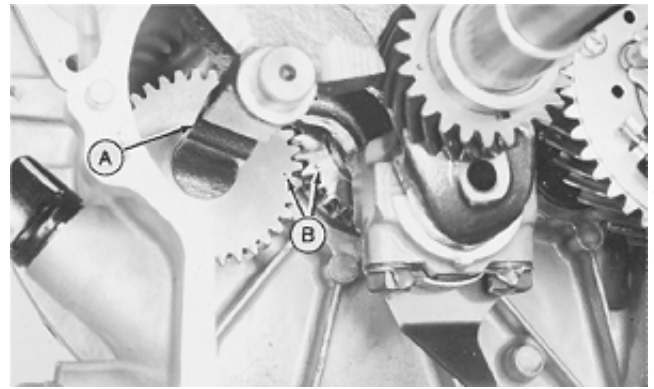
MX,3520A1,A14 -19-21OCT92

REMOVE, INSPECT AND INSTALL DYNAMIC BALANCER

1. Remove crankcase cover. (See this group.)
2. Rotate crankshaft until match marks (B) align.
3. Remove dynamic balancer (A).
4. Inspect balancer for wear or damage. Replace if necessary.

IMPORTANT: Align match marks exactly or balancer will not function correctly.

5. Install balancer with match marks aligned.
6. Install crankcase cover.

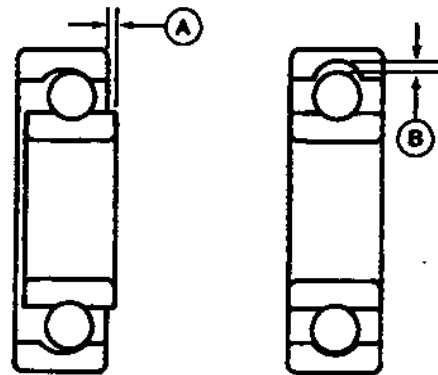


M51534
-UN-31AUG88

MX,3520A1,A15 -19-21OCT92

INSPECT BALANCER BALL BEARINGS

1. Remove balancer. (See this group.)
2. Remove bearings using a blind hole puller set.
3. Thoroughly clean bearings in solvent. Dip bearing in light weight oil.
4. Spin the bearings by hand and check for axial (A) and radial (B) free play.
5. Replace the bearings if it is noisy or has too much play.
6. Install bearings flush to inside of crankcase or crankcase cover using a bearing, bushing and seal driver set.
7. Install oil seal.

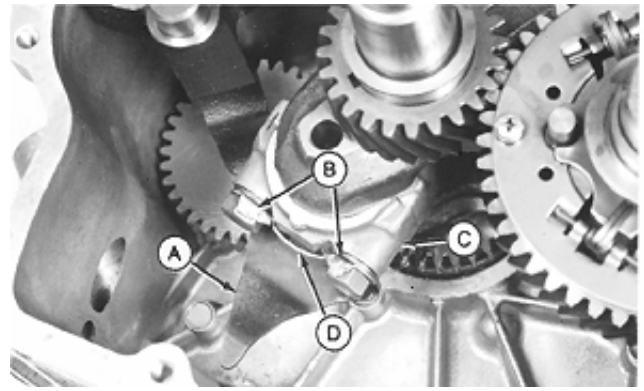


M38073
-UN-29AUG88

MX,3520A1,A16 -19-21OCT92

REMOVE AND INSTALL PISTON AND CONNECTING ROD

1. Remove cylinder head. (See Group 15.)
2. Remove crankcase cover. (See this group.)
3. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
4. Bend open locking tabs (B).
5. Remove cap screws, lock plate (D), oil splasher (A) and connecting rod cap (C).
6. Push piston and connecting rod from cylinder bore.
7. Make repairs as necessary. (See procedures in this group.)



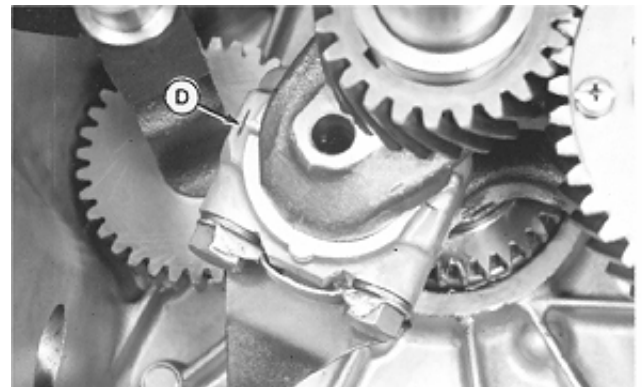
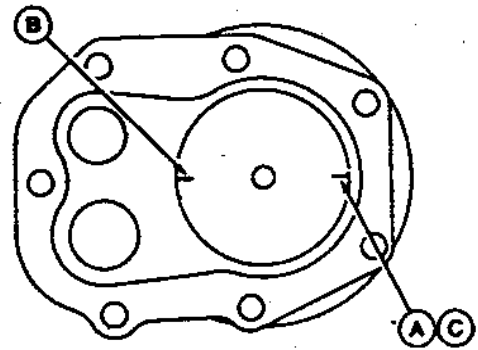
A—Oil Splasher
B—Locking Tabs
C—Connecting Rod Cap
D—Lock Plate

MX,3520A1,A17 -19-21OCT92

8. Deglaze cylinder bore. (See Section 100, Group 15.)
9. Align piston assembly to cylinder bore with piston ring end gaps as shown.
10. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
11. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
12. Install piston assembly in cylinder bore with "R" on piston head facing flywheel side.
13. Align marks (D) on connecting rod and cap. Install connecting rod cap, oil splasher and lock plate. Tighten cap screws to specifications.
14. Bend locking tabs over cap screws.
15. Install crankcase cover.
16. Install cylinder head.

SPECIFICATIONS.

Cap Screw Torque 21 N·m (186 lb-in.)



A—First Ring End Gap
B—Second Ring End Gap
C—Oil Ring End Gap
D—Alignment Marks

MX,3520A1,A18 -19-21OCT92

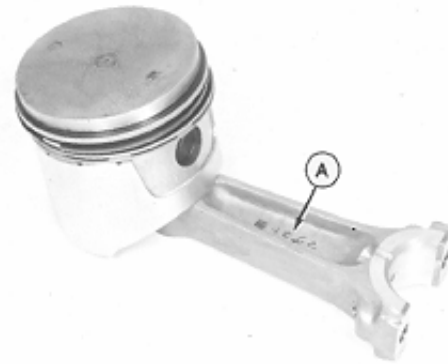
DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

1. Remove circlip, piston pin (B) and connecting rod (A).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.



MX,3520A1,A19 -19-21OCT92

4. Align the R on the piston head with the Japanese characters (A) on the connecting rod.
5. Install piston pin and circlip.



MX,3520A1,A20 -19-21OCT92

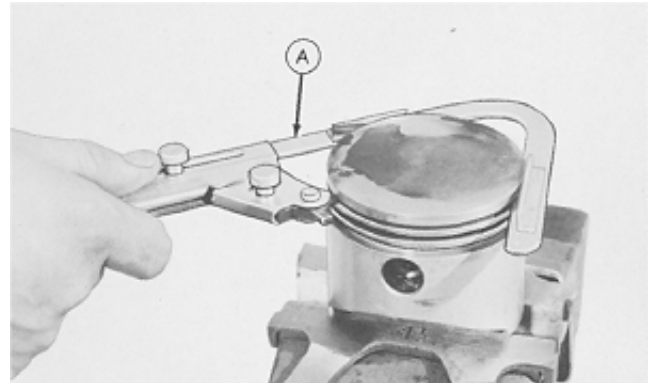
M80469 -UN-17MAY91

INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)
2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.
4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.
5. Check that oil return passages in grooves are open.



MX,3520A1,A21 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.

CLEARANCE SPECIFICATION (MAX)

Top Ring	Second Ring	Oil Control Ring
0.15 mm (0.006 in.)	0.15 mm (0.006 in.)	0.15 mm (0.006 in.)



MX,3520A1,A22 -19-21OCT92

M38102 -UN-29AUG88

8. Measure piston pin outer diameter. Replace if less than specification.

9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

Piston Pin O.D. (MIN)	Piston Bore I.D. (MAX)
20.98 mm (0.827 in.)	21.03 mm (0.829 in.)



M50064 -UN-31AUG88



M80470 -UN-17MAY91

MX,3520A1,A23 -19-21OCT92

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)

SPECIFICATIONS

Piston O.D. (A) 79.77—79.79 mm (3.140—3.141 in.)

Piston-to-Cylinder
Bore Clearance 0.195—0.235 mm (0.0077—0.009 in.)



M80471 -UN-17MAY91

MX,3520A1,A24 -19-21OCT92

INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.
2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
3. Install connecting rod cap. Tighten to 20 N·m (177 lb-in.)
4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



BEARING I.D. SPECIFICATIONS (MAX)

Crankshaft Bearing

32.06 mm
(1.262 in.)

Piston Bearing

18.04 mm
(0.710 in.)

MX,3520A1,A25 -19-21OCT92

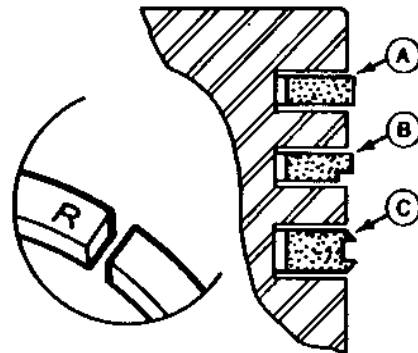
M80472 -UN-17MAY91

REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)

NOTE: Service rings may not be marked. If not marked, compression rings have no top side and can be installed in either direction.

4. Install top ring (A), second ring (B) and oil ring (C) with NPR mark facing up. Rings should turn freely in grooves.



MX,3520A1,A26 -19-21OCT92

M80473 -UN-17MAY91

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS

Minimum End Gap 0.18 mm (0.007 in.)
Maximum End Gap 1.00 mm (0.039 in.)



M80474 -UN-17MAY91

MX,3520A1,A27 -19-21OCT92

35
20
15

REMOVE, INSPECT AND INSTALL CRANKSHAFT

1. Remove camshaft. (See this group.)
2. Remove piston and connecting rod. (See this group.)
3. Remove balancer. (See this group.)
4. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

5. Check crankshaft alignment (T.I.R.). (See this group.)
6. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
7. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)

NOTE: Crankshaft rotates on ball bearings. Crankshaft main bearing journals are not measured.

8. Measure connecting rod journal. Replace crankshaft if measurement is less than specifications.
9. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.
10. Apply clean engine oil to crankshaft bearings and journal.
11. Pack lithium based grease in oil seals.
12. Install crankshaft.
13. Install balancer.
14. Install piston and connecting rod.
15. Install camshaft.

JOURNAL SPECIFICATIONS (MIN)

Main Bearing Journal		Connecting Rod Journal
PTO Side	Flywheel Side	
—	—	31.95 mm (1.259 in.)



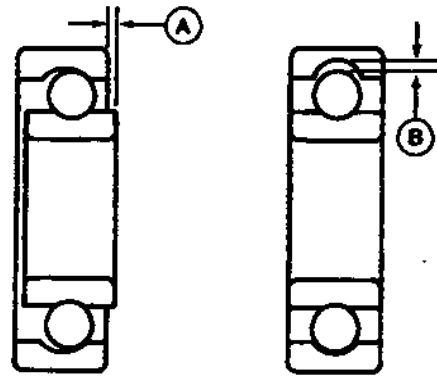
M80475 -UN-17MAY91

35
20
16

MX,3520A1,A28 -19-21OCT92

INSPECT CRANKSHAFT BALL BEARINGS

1. Remove oil seals. (See Inspect Oil Seals in this group.)
2. Remove bearings using a bearing, bushing and seal driver set.
3. Thoroughly clean bearings in solvent. Dip bearings in light weight oil.
4. Spin bearings by hand and check for axial (A) and radial (B) free play.
5. Replace bearings if noisy or too much play.
6. Install bearings flush to inside of crankcase or crankcase cover using a bearing, bushing and seal driver set.
7. Install oil seals.



M38073 -UN-29AUG88

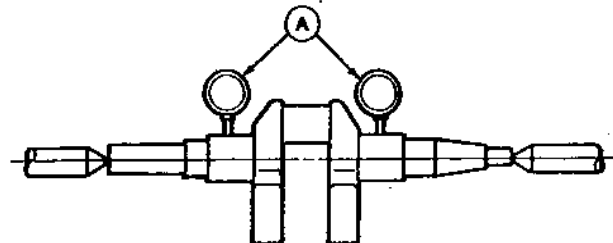
MX,3520A1,A29 -19-21OCT92

CHECK CRANKSHAFT ALIGNMENT (TIR)

Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

Maximum TIR 0.05 mm (0.002 in.)



M51761 -UN-07SEP88

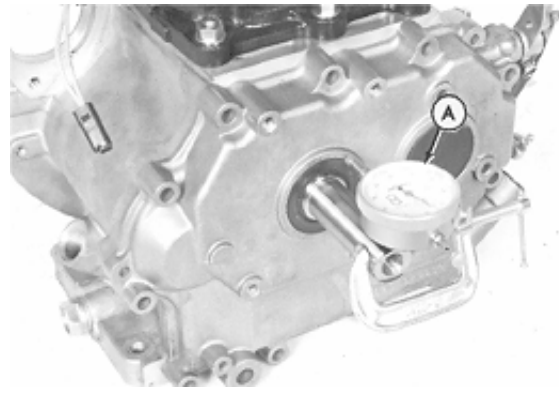
MX,3520A1,A30 -19-21OCT92

MEASURE AND ADJUST CRANKSHAFT END PLAY

1. Measure end play using dial indicator (A).
2. Move crankshaft in and out. Record this measurement. If end play is not within specifications, remove crankcase cover and add or subtract shims as necessary.

SPECIFICATIONS

End Play 0.05—0.20 mm (0.002—0.008 in.)



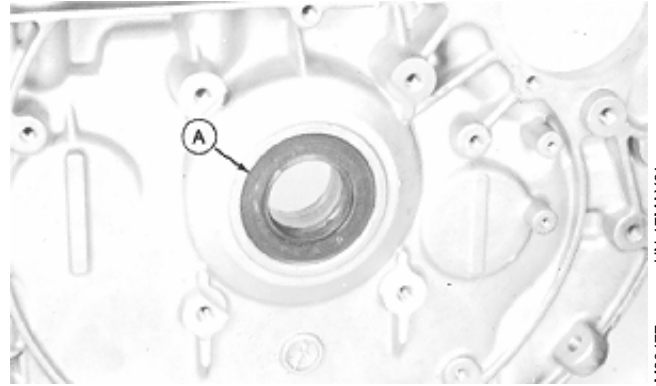
M80476 -UN-17MAY91

MX,3520A1,A31 -19-21OCT92

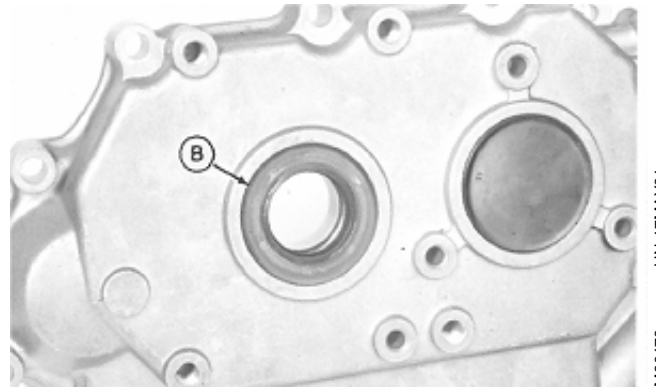
INSPECT OIL SEALS

NOTE: Pack lithium base grease in new or used seals.

1. Remove flywheel. (See Group 10.)
2. Inspect oil seals (A and B) at flywheel end and PTO end for wear or damage. Replace if necessary.
3. Remove stator. (See Group 25.)
4. Remove crankshaft. (See this group.)
5. Remove worn or damaged seals with a screwdriver.
6. Install seals with lip to inside of engine using a bushing, bearing and seal driver set. Press in seals until flush with hub.
7. Install crankshaft.
8. Install stator.
9. Install flywheel.



Flywheel Side



PTO Side

MX,3520A1,A32 -19-21OCT92

M80477 -UN-17MAY91

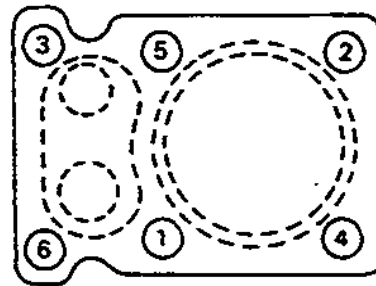
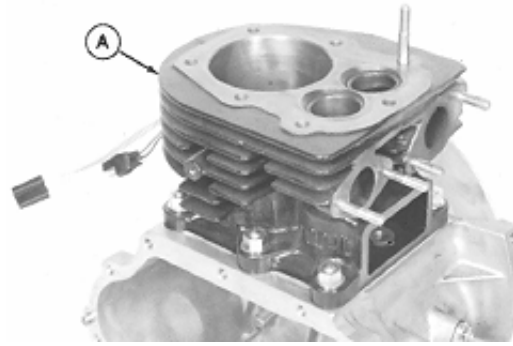
M80478 -UN-17MAY91

REMOVE AND INSTALL CYLINDER BLOCK

1. Remove crankshaft. (See this group.)
2. Remove cylinder block and gasket (A).
3. Remove breather plate. (See Group 05.)
4. Inspect block. (See this group.)
5. Replace crankcase/block studs, if necessary. (See this group.)
6. Install breather plate.
7. Install new gasket and cylinder block. Tighten nuts in sequence shown to specification.
8. Install crankshaft.

TORQUE SPECIFICATIONS

Cylinder Block Nuts 36 N·m (27 lb-ft)



MX,3520A1,A33 -19-21OCT92

-UN-17MAY91

M80479

-UN-31AUG88

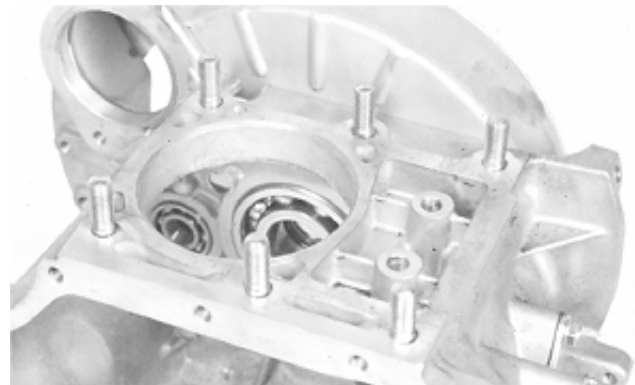
M51528

REPLACE CRANKCASE/BLOCK STUDS

1. Remove cylinder block. (See this group.)
2. Inspect studs for cracks or wear. Replace if necessary.
3. Install two nuts on stud and tighten together. Remove stud.
4. Put thread lock and sealer (medium strength) on threads of stud and install in block. Tighten to specification.
5. Install cylinder block.

TORQUE SPECIFICATIONS

Crankcase-to-Block Studs 36 N·m (27 lb-ft)



MX,3520A1,A34 -19-21OCT92

-UN-17MAY91

M80480

INSPECT CYLINDER BLOCK

1. Clean and check block for cracks.
2. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
3. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,3520A1,A35 -19-21OCT92

NOTE: A bare block is available for service.

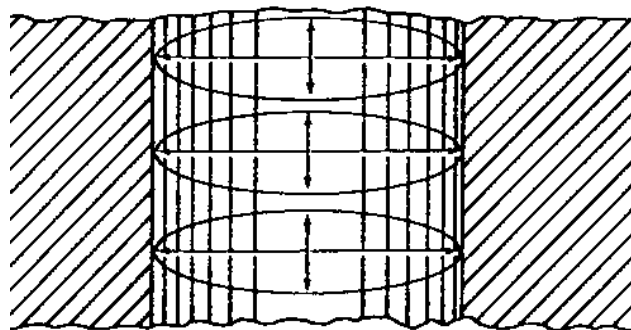
4. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

5. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

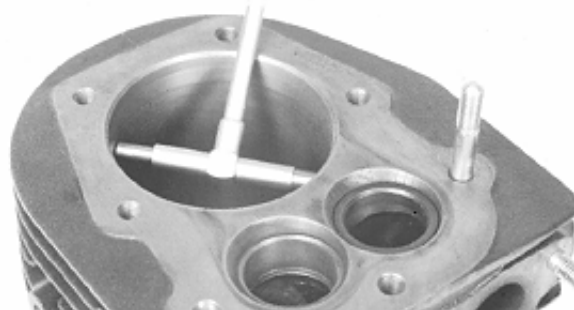
NOTE: If cylinder is rebored, oversize piston and rings must be installed.

CYLINDER BORE SPECIFICATIONS

Standard	79.91—79.98 mm (3.146—3.149 in.)
Wear Limit	80.09 mm (3.155 in.)
Out-of-Round (Max)	0.063 mm (0.0025 in.)



M51745 -UN-23FEB89



M80481 -UN-17MAY91

MX,3520A1,A36 -19-21OCT92

REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use a 0.50 mm (0.020 in.) oversize pistons and rings. Have a reliable repair shop rebores the block, or use the drill press and honing tool.

1. Rebores cylinder with a honing tool to initial and final bore specifications.
2. Align center of bore to press center. Set the press to operate from 200—250 rpm.
3. Lower and raise hone until ends extend 20—25 mm (0.75—1.0 in.) past ends of cylinder.
4. Turn adjusting nut on one hone until stones contact cylinder wall at narrowest point.
5. Coat inside of cylinder with honing oil. Turn hone by hand. If you cannot turn it, hone is too tight.
6. Start drill press. Move hone up and down in cylinder approximately 20 times per minute.
7. Check cylinder diameter regularly during honing. Stop press before measuring. Remove hone from cylinder.

NOTE: Finish should not be smooth, but have a 40—60° cross-hatch pattern.

IMPORTANT: Check stone for wear or damage. Use correct stone for the job.

CYLINDER INITIAL BORE SPECIFICATIONS

Piston Oversize:
0.50 mm (0.020 in.)

80.46—80.48 mm (3.168—3.169 in.)

MX,3520A1,A37 -19-21OCT92

35
20
21

8. Hone the cylinder an additional 0.028—0.030 mm (0.0011—0.0012 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

IMPORTANT: DO NOT use gasoline or commercial solvents to clean cylinder bores. Solvents will not remove metal particles produced during honing.

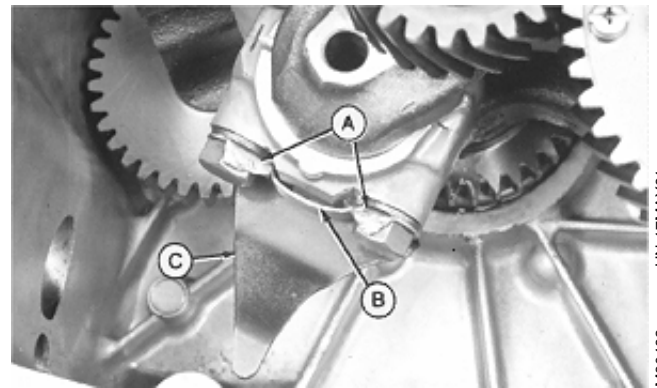
9. Clean the cylinder thoroughly using soap, warm water and clean rags. Continue to clean cylinder until white rags show no discoloration.

10. Dry the cylinder. Apply engine oil to cylinder wall.

M98,2040A,A9 -19-21OCT92

INSPECT AND REPLACE OIL SPLASHER

1. Remove crankcase cover. (See this group.)
2. Bend open locking tabs (A).
3. Remove cap screws, lock plate (B), and oil splasher (C).
4. Inspect splasher for wear or damage. Replace if necessary.
5. Install splasher, lock plate and cap screws. Tighten cap screws to specifications.
6. Bend locking tabs over cap screws.
7. Install crankcase cover.



-UN-17MAY91
M80482

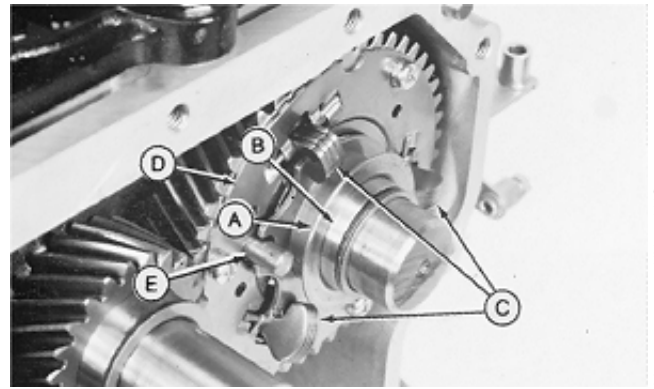
SPECIFICATIONS

Cap Screw Torque 21 N·m (186 lb-in.)

MX,3520A1,A38 -19-21OCT92

INSPECT AND REPLACE GOVERNOR

1. Remove crankcase cover. (See this group.)
2. Remove sleeve (A).
3. Inspect bearing surfaces inside sleeve and on camshaft (B) for damage or wear. Replace parts as necessary.
4. Check that weights (C) move freely. Replace entire weight assembly plate (D) if damaged.
5. Install plate (D), if removed, and governor sleeve. Align lower flange of governor sleeve with locator pin (E) and insert into notches in weights.
6. Install crankcase cover.



A—Governor Sleeve
 B—Camshaft
 C—Weights
 D—Weight Assembly Plate
 E—Locator Pin

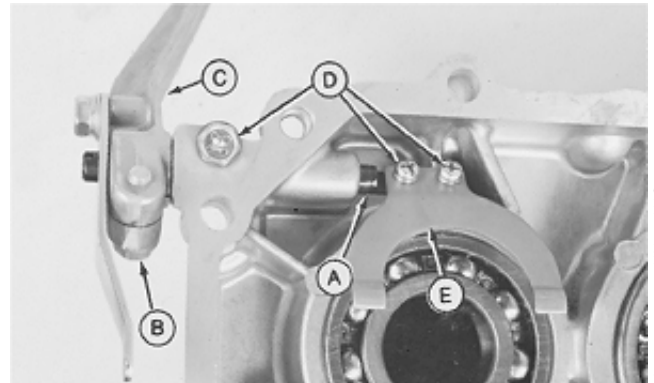
MX,3520A1,A39 -19-21OCT92

M51523 -UN-31AUG88

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (A). Replace if damaged.
3. To replace shaft, loosen cap screw (B) on lever (C).
4. Remove screws (D), clevis (E) and shaft.
5. Install shaft, clevis and screws.
6. Tighten cap screw on governor lever.
7. Install crankcase cover.



A—Governor Shaft
 B—Cap Screw
 C—Governor Lever
 D—Screws
 E—Clevis

MX,3520A1,A40 -19-21OCT92

M51522 -UN-31AUG88

35
20
23

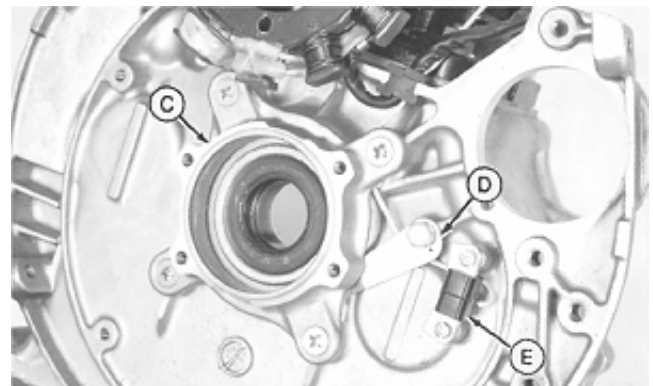
35
20
24

REMOVE AND INSTALL STATOR AND PULSER COIL

NOTE: Stator and pulser coil must be replaced as an assembly.

1. Remove flywheel. (See Group 10.)
2. Remove housing (B).
3. Remove screws and stator (A).
4. Remove base plate (C).
5. Remove bracket (D).
6. Remove screws and pulser coil (E).
7. Remove stator and pulser coil assembly.
8. Install stator and pulser coil assembly.
9. Install pulser coil and bracket.
10. Install base plate.
11. Install stator.
12. Install cover.
13. Install flywheel.

A—Stator
B—Housing
C—Base Plate
D—Bracket
E—Pulser Coil



MX,3525A1,A1 -19-21OCT92

-JUN-17MAY91

M80483

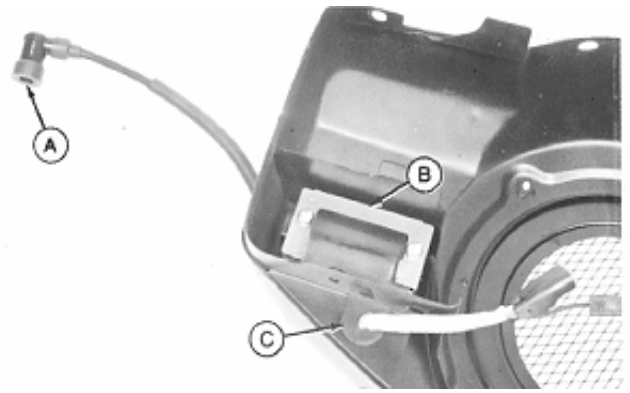
-JUN-17MAY91

M80484

35
25
1

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove blower housing. (See Group 10.)
2. Remove rubber grommet (C).
3. Remove spark plug cap (A).
4. Remove cap screws and armature with coil (B).
5. Install armature with coil.
6. Install spark plug cap.
7. Install rubber grommet.
8. Install blower housing.



M80485
-UN-17MAY91

MX,3525A1,A2 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	Mineral Spirits	Clean armature.
	Multipurpose Grease	Grease starter parts.

MX,3530A1,A1-19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

- Electric Starter
- Complete Starter

Brush Kit

Complete Solenoid

MX,3530A1,A2-19-21OCT92

ANALYZE ELECTRIC STARTER CONDITION

1. The starter overheats because of:
- Long cranking.

• Armature binding.
2. The starter operates poorly because of:
- Armature binding.

• Dirty or damaged starter drive.

• Badly worn brushes or weak brush springs.

• Excessive voltage drop in cranking system.

• Battery or wiring defective.

• Shorts, opens, or grounds in armature.

NOTE: Starter repair is limited to brushes, end caps, and starter drive. Fields in starter are permanent magnets and are not serviceable. If housing or armature is damaged, replace starter.

MX,3530A1,A3-19-21OCT92

BENCH TEST SOLENOID DRIVE STARTER

NOTE: Perform bench test before disassembling starter motor to determine cause of problem.

IMPORTANT: Never operate motor longer than 20 seconds. Allow at least two minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starting motor.

1. Disconnect battery leads from battery.
2. Remove starter from engine.
3. Connect 12-volt battery (A) to starter battery terminal (B) and starter frame (C) using heavy duty cables.
4. Connect remote start switch (D) between switch terminal (E) and battery terminal (B).

NOTE: A short piece of wire with a small clip on the end will allow a more positive connection at the switch terminal.

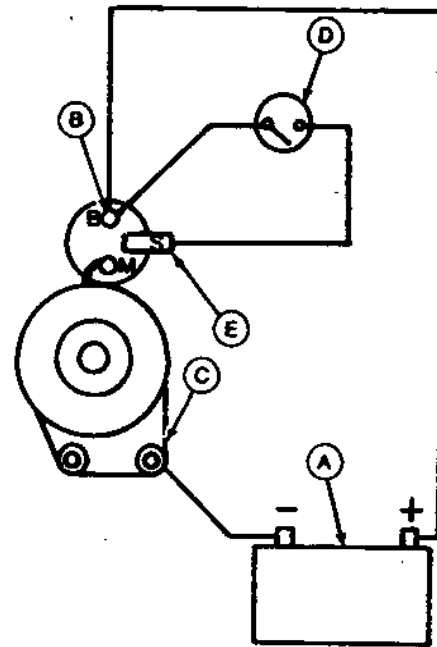
When switch is activated, starter should engage and run.

IF SOLENOID CHATTERS; hold-in winding is open-circuited.

IF NOTHING HAPPENS; either the solenoid pull-in winding is open-circuited or mechanical parts are sticking.

IF SOLENOID ENGAGES, BUT MOTOR DOES NOT RUN; check solenoid switch continuity, brushes, armature and field windings.

Solenoid cannot be repaired, replace it.



A—12-Volt Battery
B—Battery Terminal
C—Starter Frame
D—Remote Start Switch
E—Switch Terminal

MX,3530A1,A4 -19-21OCT92

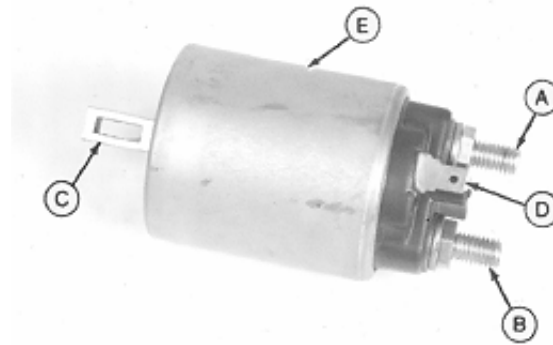
M37149 -JUN-29AUG88

TEST SOLENOID

NOTE: If bench test indicated solenoid problems, use an ohmmeter or test light to check solenoid.

1. Test solenoid terminals (A and B) for continuity. There should be no continuity.
2. Depress switch arm (C). There should be continuity when arm is fully depressed.
3. Test for open circuits between terminal (B) and tang (D). There should be continuity.
4. Test for open circuits between tang (D) and body (E). There should be continuity.

If solenoid fails any test, it is defective and must be replaced.



A—Terminal
B—Terminal
C—Switch Arm
D—Tang
E—Solenoid Body

MX,3530A1,A5 -19-21OCT92

M80486 -UN-17MAY91

CHECK STARTER ARMATURE ROTATION

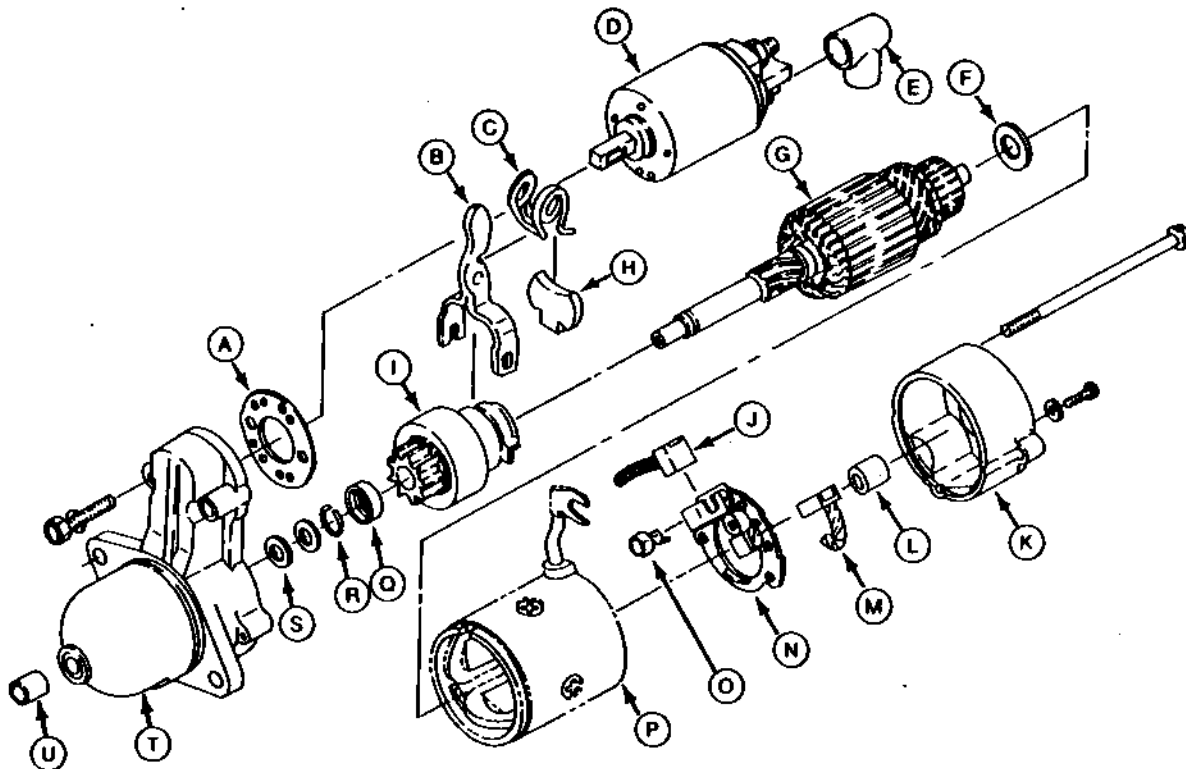
1. Remove starter.
2. Rotate armature (A).
3. If armature does not rotate freely, armature may be bent or bearings may be worn. Disassemble and inspect starter. (See this group.)
4. Install starter.



MX,3530A1,A6 -19-21OCT92

M80487 -UN-17MAY91

INSPECT STARTER



A—Cover
B—Shift Lever
C—Spring
D—Solenoid
E—Cap
F—Washer

G—Armature
H—Cover
I—Pinion
J—Brush
K—End Cover

L—Bushing
M—Brush
N—Brush Holder
O—Spring (2 used)
P—Body

Q—Pinion Stopper
R—Retaining Clip
S—Washer (2 used)
T—Front Cover
U—Bushing

1. Mark body and covers for correct alignment during reassembly.

2. Push pinion stopper (Q) toward pinion (I) to remove retaining clip (R).

3. Inspect parts for wear or damage.

IMPORTANT: If front or rear armature bushings (U,L) must be replaced, ream new bushings to an inside diameter of 9.5 mm (+0.015, -0.00 mm).

4. Measure brushes. Replace brushes as a set if length of any one is less than 10 mm (0.394 in.).

5. Test starter armature and brushes. (See this group.)

6. Apply a thin coat of multipurpose grease to:
—sliding surfaces of armature and solenoid shift lever.
—armature shaft spline.
—points where shaft contacts cover.

7. Assemble starter.

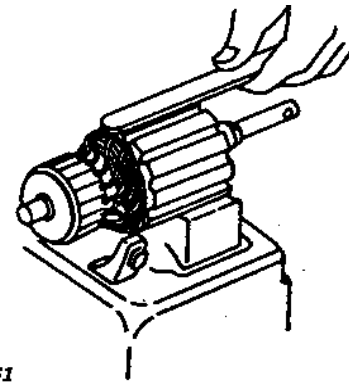
M80488 -JUN-17MAY91

TEST STARTER ARMATURE

IMPORTANT: Do not clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.

1. Locate short circuits by rotating armature on a growler while holding a hacksaw blade or steel strip on armature. The hacksaw blade will vibrate in area of short circuit.
2. Shorts between bars are sometimes caused by dirt or copper between bars. Inspect for this condition.
3. If test indicates short circuited windings, clean the commutator of dust and fillings. Check armature again. If test still indicates short circuit, replace armature.

M24861

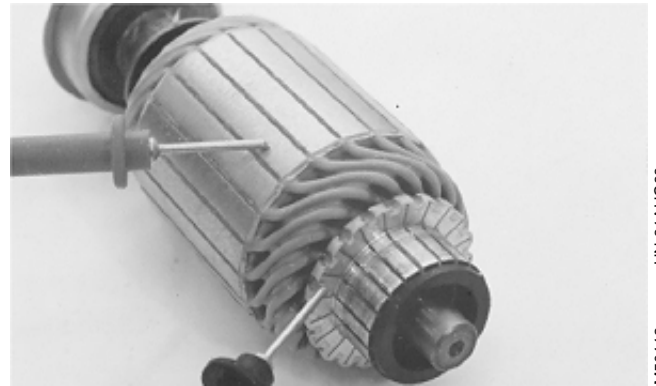


MX,3530A1,A8 -19-21OCT92

4. Test for grounded windings using an ohmmeter or test light.

Armature windings are connected in parallel, so each commutator bar needs to be checked.

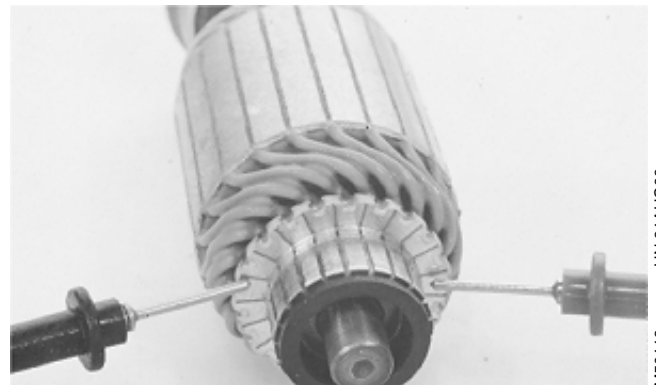
If test shows continuity, a winding is grounded and the armature must be replaced.



M98,2030A,AH -19-21OCT92

5. Test for open circuited windings using an ohmmeter or test light.

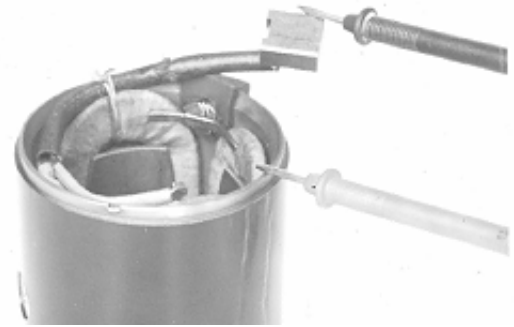
If test shows no continuity, there is an open circuit and armature must be replaced.



M98,2030A,M -19-21OCT92

TEST FIELD COIL

1. Test for continuity between brush to housing. Replace field coil if there is no continuity.

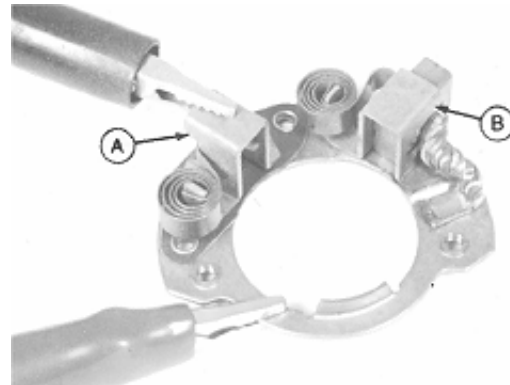


M80489 -UN-17MAY91

MX,3530A1,A9 -19-21OCT92

2. Test for continuity between negative brush holder (A) and brush plate. Replace brush holder assembly if there is continuity.

3. Test for continuity between positive brush holder (B) and brush plate. Replace brush holder assembly if there is no continuity.



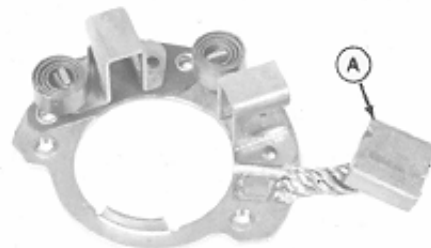
M80490 -UN-17MAY91

MX,3530A1,A10 -19-21OCT92

REPLACE BRUSHES

1. Melt solder from brush lead connection to replace field coil brush. Cut off old brush to replace brush (A) on brush plate assembly.

2. Install new brushes using only 60—40 rosin core solder. Newly installed wire should be approximately same length as original.



M80491 -UN-17MAY91

MX,3530A1,A11 -19-21OCT92

Section 40

FC290V/FC400V/FC420V/FC540V

Contents

	Page	Page
Group 00—Engine Application and Repair Specifications		
Engine Application Chart	40-00-1	
Repair Specifications		
FC290V	40-00-2	
FC400V/FC420V	40-00-5	
FC540V	40-00-8	
Group 05—Fuel and Air Systems		
Service Parts Kits	40-05-1	
Remove and Install Fuel Pump	40-05-1	
Remove and Install Carburetor		
FC290V	40-05-1	
FC400V/FC420V	40-05-2	
FC540V	40-05-4	
Disassemble, Clean, Inspect and Assemble Carburetor	40-05-6	
Service		
Breather	40-05-9	
Air Cleaner	40-05-10	
Group 10—Blower Housing and Flywheel		
Remove and Install Blower Housing		
Service Parts Kits	40-10-1	
Recoil Start	40-10-1	
Electric Start	40-10-2	
Flywheel Screen Adjustment	40-10-2	
Remove and Install Flywheel		
FC290V	40-10-3	
FC400V/FC420V/FC540V	40-10-3	
Group 15—Cylinder Head and Valves		
Essential Tools	40-15-1	
Other Materials	40-15-1	
Service Parts Kits	40-15-1	
Rocker Arm		
Assembly—FC290V/FC400V/FC420V		
Remove and Install	40-15-2	
Inspect	40-15-2	
Remove and Install		
Cylinder Head Assembly	40-15-3	
Valves and Springs	40-15-5	
Inspect and Replace Stem Seals	40-15-5	
Inspect		
Valve Springs	40-15-6	
Cylinder Head	40-15-6	
Valve Guides	40-15-6	
Replace Valve Guide Bushings	40-15-7	
Recondition Valve Seats	40-15-8	
Check Valve Clearance	40-15-9	
Group 20—Cylinder Block and Internal Components		
Other Materials	40-20-1	
Service Parts Kits	40-20-1	
Remove and Install Crankcase Cover	40-20-2	
Camshaft		
Remove and Install	40-20-3	
Inspect	40-20-3	
Inspect Plain Bearings	40-20-4	
Inspect Automatic Compression Release	40-20-4	
Remove, Inspect and Install Tappets	40-20-5	
Adjust Camshaft Axial Play—FC290V/FC540V	40-20-6	
Reciprocating Balancer		
Remove and Install	40-20-7	
Disassemble and Assemble	40-20-8	
Inspect	40-20-9	
Replace Bushings	40-20-10	
Piston and Connecting Rod		
Remove and Install	40-20-11	
Disassemble, Inspect and Assemble	40-20-12	
Inspect		
Piston	40-20-12	
Connecting Rod	40-20-14	
Piston Rings		
Remove and Install	40-20-15	
Check End Gap	40-20-15	
Crankshaft		
Remove, Inspect and Install	40-20-16	
Inspect Plain Bearings	40-20-17	
Replace Bearing Shell—FC290V	40-20-18	
Inspect Ball Bearings	40-20-18	
Check Alignment (TIR)	40-20-19	
Measure End Play	40-20-19	

Continued on next page

Page

Crankshaft—Continued

Adjust End Play	40-20-19
Inspect	
Oil Seals	40-20-21
Cylinder Block	40-20-21
Rebore Cylinder Block	40-20-23
Inspect and Replace Oil Slinger—FC290V .	40-20-25
Oil Pump—FC400V/FC420V	
Disassemble and Assemble	40-20-25
Inspect	40-20-26
Oil Pump—FC540V	
Disassemble and Assemble	40-20-28
Inspect	40-20-29
Remove, Inspect and Install Oil Filter	
Manifold	40-20-32
Inspect and Replace	
Governor	40-20-32
Governor Shaft	40-20-33

Group 25—Ignition and Charging System

Remove and Install	
Stator	40-25-1
Armature with Coil	40-25-1
Adjust Armature Air Gap	40-25-2

Group 30—Starting Systems

Other Materials	40-30-1
Service Parts Kits	40-30-1
Recoil Starter—FC290V/FC400V/FC420V	
Disassemble	40-30-2
Inspect	40-30-3
Replace Spring	40-30-4
Assemble	40-30-4
Analyze Electric Starter Condition	40-30-6
Bench Test	
Solenoid Drive	
Starter—FC400V/FC420V/FC540V . .	40-30-7
Solenoid—FC400V/FC420V/FC540V . .	40-30-8
Test Electric Starter Armature Rotation . .	40-30-8
Inspect Electric Starter	
FC290V	40-30-9
FC400V/FC420V	40-30-10
FC540V	40-30-11
Test Armature	40-30-12
Test Field Coil	40-30-13

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

LAWN TRACTORS

Machine	Engine Model No.
130 (Engine S.N. —060824)	FC290V-AS00
(Engine S.N. 060825—)	FC290V-BS00
170/175 (Engine S.N. —006515)	FC420V-AS00
(Engine S.N. 006516—009053)	FC420V-BS00
(Engine S.N. 009054—028504)	FC420V-CS00
(Engine S.N. 028505—)	FC420V-DS00
180/185 (Engine S.N. —058710)	FC540V-AS00
(Engine S.N. 058711—105580)	FC540V-BS00
(Engine S.N. 105581—)	FC540V-CS00
LX172/176	FC420V-AS10
LX186	FC540V-AS10

LAWN AND GARDEN TRACTORS

GT242	FC420V-AS10
240 (Engine S.N. —028504)	FC420V-CS00
(Engine S.N. 028505—124169)	FC420V-DS00
(Engine S.N. 124170—)	FC420V-ES00
245	FC420V-FS00
260/265 (Engine S.N. —105580)	FC540V-BS00
(Engine S.N. 105581—163399)	FC540V-CS00
(Engine S.N. 163400—)	FC540V-DS00
GT262	FC540V-AS10

RIDING MOWERS

RX73 (Engine S.N. —061534)	FC290V-AS01
(Engine S.N. 061535—106800)	FC290V-BS01
(Engine S.N. 106801—)	FC290V-CS01
RX75 (Engine S.N. —060604)	FC290V-AS02
(Engine S.N. 080518—113843)	FC290V-AS10
(Engine S.N. 113944—)	FC290V-BS10
SX75 (Engine S.N. —060604)	FC290V-AS02
(Engine S.N. 060605—113943)	FC290V-BS02 or FC290V-BS02-01
(Engine S.N. 113944—)	FC290V-BS10
GX70/75	FC290V-BS10
SRX75	FC290V-CS10

COMMERCIAL WALK-BEHIND MOWERS

38/48-Inch	FC400V-AS05
48/52-Inch (Engine S.N. —067591)	FC540V-AS01
(Engine S.N. 067592—)	FC540V-BS01
48/54-Inch	FC420V-AS11 or FC540V-AS11

FRONT MOUNT MOWERS

F710	FC540V-AS12
----------------	-------------

FC290V REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Breather	
Maximum Air Gap	0.20 mm (0.008 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	85 N·m (63 lb·ft)
Minimum Flywheel Screen Gap	1.50 mm (0.059 in.)

GROUP 15—CYLINDER HEAD AND VALVES

Valve Clearance	0.15 mm (0.006 in.)
---------------------------	---------------------

Rocker Arm	
Minimum Shaft O.D.	12.94 mm (0.509 in.)
Maximum Bearing I.D.	13.07 mm (0.515 in.)

Push Rod	
Maximum Bend	0.30 mm (0.012 in.)
Intake Pushrod Lift	5.313 mm (0.2092 in.)
(wear min.)	5.048 mm (0.1987 in.)
Exhaust Pushrod Lift	5.388 mm (0.2121 in.)
(wear min.)	5.118 mm (0.2015 in.)

Valves and Springs	
Minimum Spring Free Length	31.00 mm (1.220 in.)
Valve Guide I.D.	(min.) 7.000 mm (0.2756 in.)
	(max.) 7.015 mm (0.2762 in.)
Intake Valve Stem O.D.	(min.) 6.960 mm (0.2740 in.)
	(max.) 6.975 mm (0.2746 in.)
Intake Valve-To-Guide Clearance	(min.) 0.025 mm (0.0010 in.)
	(max.) 0.055 mm (0.0022 in.)
Exhaust Valve Stem O.D.	(min.) 6.950 mm (0.2736 in.)
	(max.) 6.965 mm (0.2742 in.)
Exhaust Valve-To-Guide Clearance	(min.) 0.035 mm (0.0014 in.)
	(max.) 0.065 mm (0.0026 in.)
Intake Valve Lift (W/Clearance set at 0.00)	6.923 mm (0.2726 in.)
(wear min.)	6.578 mm (0.2590 in.)
Exhaust Valve Lift (W/Clearance set at 0.00)	7.021 mm (0.2764 in.)
(wear min.)	6.670 mm (0.2626 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seating Surface	0.50—1.10 mm (0.020—0.043 in.)
Valve Seat and Face Angle	45°
Minimum Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Continued on next page

MX,4000A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS

Item	Specification
Cylinder Head	
Cylinder Head Flatness	0.05 mm (0.002 in.)
Cap Screw Torque In Sequence (Lubricated)	
Initial Torque	18 N·m (159 lb-in.)
Final Torque	24 N·m (212 lb-in.)
Spark Plug Torque	20 N·m (177 lb-in.)
Crankcase Cover	
Oil Capacity	1.0 L (2.11 pt)
Cap Screw Torque	20 N·m (177 lb-in.)
Camshaft	
Minimum End Journal O.D.	
PTO Side	13.92 mm (0.548 in.)
Flywheel Side	15.92 mm (0.627 in.)
Minimum Lobe Height	27.08 mm (1.066 in.)
Maximum Bearing I.D.	
Crankcase	16.06 mm (0.632 in.)
Crankcase Cover	14.05 mm (0.553 in.)
Reciprocating Balancer	
Link Rod	
Minimum Journal O.D.	46.86 mm (1.845 in.)
Maximum Small End I.D.	12.06 mm (0.475 in.)
Maximum Large End I.D.	47.12 mm (1.855 in.)
Bushing Depth	1 mm (0.040 in.)
Balancer Weight	
Maximum Bearing I.D.	26.10 mm (1.027 in.)
Support Shaft	
Minimum Shaft O.D.	25.93 mm (1.021 in.)
Balancer Bushing Assembly Torque	7.3 N·m (65 lb-in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.16 mm (0.006 in.)
Second Ring	0.14 mm (0.005 in.)
Oil Control Ring	0.19 mm (0.007 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	0.71 mm (0.028 in.)
Oil Ring Side Rails	1.20 mm (0.047 in.)
Minimum Pin O.D.	18.98 mm (0.747 in.)
Maximum Pin Bore I.D.	19.03 mm (0.749 in.)
Maximum Piston-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Piston O.D.	77.85—77.87 mm (3.0649—3.0657 in.)
Piston-to-Cylinder Bore Clearance	0.110—0.142 mm (0.0043—0.0056 in.)

Continued on next page

MX,4000A1,A3 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Connecting Rod	
Maximum Crankshaft Bearing I.D.	35.57 mm (1.400 in.)
Maximum Piston Pin Bearing I.D.	19.06 mm (0.750 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.08 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.14 mm (0.006 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	29.92 mm (1.178 in.)
Minimum Connecting Rod Journal O.D.	35.43 mm (1.395 in.)
Maximum Crankcase Cover Plain Bearing I.D.	30.13 mm (1.186 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.09—0.22 mm (0.004—0.009 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.	77.98—78.00 mm (3.070—3.071 in.)
Maximum Cylinder Bore I.D.	78.07 mm (3.074 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	78.21—78.23 mm (3.079—3.080 in.)
0.50 mm	78.46—78.48 mm (3.089—3.090 in.)
0.75 mm	78.71—78.73 mm (3.099—3.100 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS

Electric Starter	
See Starter Specifications in this Group.	

MX,4000A1,A4 -19-21OCT92

FC400V/FC420V REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Breather	
Air Gap	1—2 mm (0.040—0.080 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	137 N·m (101 lb-ft)
Minimum Flywheel Screen Gap	1.50 mm (0.059 in.)

GROUP 15—CYLINDER HEAD AND VALVES

Valve Clearance	0.15 mm (0.006 in.)
---------------------------	---------------------

Rocker Arm	
Minimum Shaft O.D.	12.94 mm (0.509 in.)
Maximum Bearing I.D.	13.07 mm (0.515 in.)

Push Rod	
Intake Pushrod Lift	6.903 mm (0.2718 in.) (wear min.) 6.558 mm (0.2582 in.)
Exhaust Pushrod Lift	6.903 mm (0.2718 in.) (wear min.) 6.558 mm (0.2582 in.)
Maximum Bend	0.30 mm (0.012 in.)

Valves and Springs	
Minimum Spring Free Length	37.50 mm (1.476 in.)
Valve Guide I.D.	(min.) 7.000 mm (0.2756 in.) (max.) 7.015 mm (0.2762 in.)

Intake Valve Stem O.D.	(min.) 6.972 mm (0.2745 in.) (max.) 6.987 mm (0.2751 in.)
--------------------------------	--

Intake Valve-To-Guide Clearance	(min.) 0.013 mm (0.0005 in.) (max.) 0.043 mm (0.0017 in.)
---	--

Exhaust Valve Stem O.D.	(min.) 6.965 mm (0.2742 in.) (max.) 6.980 mm (0.2748 in.)
---------------------------------	--

Exhaust Valve-To-Guide Clearance	(min.) 0.020 mm (0.0008 in.) (max.) 0.050 mm (0.0020 in.)
--	--

Intake Valve Lift (W/Clearance set at 0.00)	8.995 mm (0.3541 in.) (wear min.) 8.545 mm (0.3365 in.)
---	--

Exhaust Valve lift (W/Clearance set at 0.00)	8.995 mm (0.3541 in.) (wear min.) 8.545 mm (0.3365 in.)
--	--

Maximum Valve Stem Bend	0.03 mm (0.001 in.)
-----------------------------------	---------------------

Valve Seating Surface	1.10—1.46 mm (0.043—0.057 in.)
---------------------------------	--------------------------------

Valve Seat and Face Angle	45°
-------------------------------------	-----

Minimum Valve Margin	0.60 mm (0.020 in.)
--------------------------------	---------------------

Valve Narrowing Angle	30°
---------------------------------	-----

Continued on next page

MX,4000A1,A5 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS

Item	Specification
Cylinder Head	
Cylinder Head Flatness	0.05 mm (0.002 in.)
Cap Screw Torque In Sequence (Lubricated)	
Initial Torque	32 N·m (24 lb-ft)
Final Torque	52 N·m (38 lb-ft)
Spark Plug Torque	20 N·m (177 lb-in.)
Crankcase Cover	
Oil Capacity	
With Filter	1.5 L (3.17 pt)
Without Filter	1.3 L (2.75 pt)
Cap Screw Torque	26 N·m (230 lb-in.)
Camshaft	
Minimum End Journal O.D.	
PTO Side	20.91 mm (0.823 in.)
Flywheel Side	19.91 mm (0.784 in.)
Minimum Lobe Height	36.75 mm (1.447 in.)
Maximum Bearing I.D.	
Crankcase	20.08 mm (0.790 in.)
Crankcase Cover	21.08 mm (0.830 in.)
Reciprocating Balancer	
Link Rod	
Minimum Journal O.D.	53.95 mm (2.124 in.)
Maximum Small End I.D.	12.60 mm (0.475 in.)
Maximum Large End I.D.	54.12 mm (2.131 in.)
Bushing Depth	0.50 mm (0.020 in.)
Balancer Weight	
Maximum Bearing I.D.	26.10 mm (1.027 in.)
Support Shaft	
Minimum Shaft O.D.	25.93 mm (1.021 in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.17 mm (0.007 in.)
Second Ring	0.15 mm (0.006 in.)
Oil Ring	0.20 mm (0.008 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	0.90 mm (0.035 in.)
Oil Ring Side Rails	1.30 mm (0.051 in.)
Minimum Pin O.D.	21.98 mm (0.865 in.)
Maximum Pin Bore I.D.	22.04 mm (0.868 in.)
Maximum Piston-to-Piston Pin Clearance	0.06 mm (0.002 in.)
Piston O.D.—FC400V	86.83—86.85 mm (3.4185—3.4192 in.)
Piston O.D.—FC420V	88.83—88.85 mm (3.4885—3.498 in.)
Piston-to-Cylinder Bore Clearance	0.13—0.17 mm (0.005—0.0067 in.)

Continued on next page

MX,4000A1,A6 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Connecting Rod	
Maximum Crankshaft Bearing I.D.	41.07 mm (1.617 in.)
Maximum Piston Pin Bearing I.D.	22.06 mm (0.868 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.08 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.14 mm (0.006 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	34.92 mm (1.376 in.)
Minimum Connecting Rod Journal O.D.	40.93 mm (1.611 in.)
Maximum Crankcase Cover Plain Bearing I.D.	35.06 mm (1.380 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.09—0.22 mm (0.004—0.009 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.—FC400V	86.98—87.00 mm (3.424—3.425 in.)
Standard Cylinder Bore I.D.—FC420V	88.98—89.00 mm (3.503—3.504 in.)
Maximum Cylinder Bore I.D.—FC400V	87.08 mm (3.428 in.)
Maximum Cylinder Bore I.D.—FC420V	89.08 mm (3.507 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	89.23—89.25 mm (3.513—3.514 in.)
0.50 mm	89.48—89.50 mm (3.523—3.524 in.)
0.75 mm	89.73—89.75 mm (3.533—3.534 in.)
Oil Pump	
Minimum Rotor Shaft O.D.	
Large O.D.	12.63 mm (0.497 in.)
Small O.D.	7.94 mm (0.313 in.)
Maximum Rotor Shaft Bearing I.D.	
Oil Pump Cover	12.76 mm (0.502 in.)
Crankcase Cover	8.07 mm (0.318 in.)
Outer Rotor	
Minimum Thickness	11.92 mm (0.470 in.)
Minimum O.D.	28.95 mm (1.140 in.)
Outer Rotor Bearing	
Maximum Depth	12.14 mm (0.478 in.)
Maximum I.D.	29.20 mm (1.149 in.)
Minimum Valve Spring Free Length	19.00 mm (0.750 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap 0.30 mm (0.012 in.)

See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS

Electric Starter

See Starter Specifications in this Group.

MX,4000A1,A7 -19-21OCT92

FC540V REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Breather	
Air Gap	1—2 mm (0.040—0.080 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	172 N·m (127 lb-ft)
Minimum Flywheel Screen Gap	1.5 mm (0.059 in.)

GROUP 15—CYLINDER HEAD AND VALVES

Valve Clearance	0.15 mm (0.006 in.)
---------------------------	---------------------

Rocker Arm	
Minimum Shaft O.D.	12.94 mm (0.509 in.)
Maximum Bearing I.D.	13.07 mm (0.515 in.)

Push Rod	
Intake Pushrod Lift	7.240 mm (0.2850 in.) (wear min.) 6.878 mm (0.2708 in.)
Exhaust Pushrod Lift	7.240 mm (0.2850 in.) (wear min.) 6.878 mm (0.2708 in.)
Maximum Bend	0.30 mm (0.012 in.)

Valves and Springs	
Intake Valve Lift (W/Clearance set at 0.00)	9.343 mm (0.3714 in.) (wear min.) 8.962 mm (0.3528 in.)
Exhaust Valve Lift (W/Clearance set at 0.00)	9.343 mm (0.3714 in.) (wear min.) 8.962 mm (0.3528 in.)
Minimum Spring Free Length	37.50 mm (1.476 in.)
Maximum Valve Guide I.D.	7.07 mm (0.278 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seating Surface	1.10—1.46 mm (0.043—0.057 in.)
Valve Seat and Face Angle	45°
Minimum Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Continued on next page

MX,4000A1,A8 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS

Item	Specification
Cylinder Head	
Cylinder Head Flatness	0.05 mm (0.002 in.)
Cap Screw Torque In Sequence (Lubricated)	
Initial Torque	32 N·m (24 lb-ft)
Final Torque	52 N·m (38 lb-ft)
Spark Plug Torque	20 N·m (177 lb-in.)
Crankcase Cover	
Oil Capacity	
With Filter	1.8 L (3.80 pt)
Without Filter	1.6 L (3.40 pt)
Cap Screw Torque	20 N·m (177 lb-in.)
Camshaft	
Minimum End Journal O.D.	20.91 mm (0.823 in.)
Minimum Lobe Height	37.10 mm (1.461 in.)
Maximum Bearing I.D.	21.08 mm (0.830 in.)
Reciprocating Balancer	
Link Rod	
Minimum Journal O.D.	57.94 mm (2.281 in.)
Maximum Small End I.D.	12.60 mm (0.475 in.)
Maximum Large End I.D.	58.15 mm (2.289 in.)
Bushing Depth	1.00 mm (0.040 in.)
Balancer Weight	
Maximum Bearing I.D.	26.10 mm (1.027 in.)
Bushing Depth	0.50 mm (0.02 in.)
Support Shaft	
Minimum Shaft O.D.	25.93 mm (1.021 in.)
Balancer Bushing Assy. Torque	7.3 N·m (65 lb-in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.17 mm (0.007 in.)
Second Ring	0.15 mm (0.006 in.)
Oil Ring	1.30 mm (0.051 in.)
Minimum Ring End Gap	0.8 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	0.90 mm (0.035 in.)
Oil Ring Side Rails	0.20 mm (0.008 in.)
Minimum Pin O.D.	21.98 mm (0.865 in.)
Maximum Pin Bore I.D.	22.04 mm (0.868 in.)
Maximum Piston-to-Piston Pin Clearance	0.06 mm (0.003 in.)
Piston O.D.	88.83—88.864 mm (3.4885—3.4984 in.)
Piston-to-Cylinder Bore Clearance	0.110—0.151 mm (0.0043—0.0059 in.)

Continued on next page

MX,4000A1,A9 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Connecting Rod	
Maximum Crankshaft Bearing I.D.	41.07 mm (1.617 in.)
Maximum Piston Pin Bearing I.D.	22.06 mm (0.868 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.08 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.14 mm (0.006 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	37.90 mm (1.492 in.)
Minimum Connecting Rod Journal O.D.	40.93 mm (1.611 in.)
Maximum Crankcase Cover Plain Bearing I.D.	38.06 mm (1.498 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.09—0.22 mm (0.004—0.009 in.)
PTO Side Oil Seal Depth	0.50 mm (0.020 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.	89.98—89.00 mm (3.503—3.504 in.)
Maximum Cylinder Bore I.D.	89.08 mm (3.507 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	89.21—89.23 mm (3.512—3.513 in.)
0.50 mm	89.46—89.48 mm (3.522—3.523 in.)
0.75 mm	89.71—89.73 mm (3.532—3.533 in.)
Oil Pump	
Minimum Rotor Shaft O.D.	12.63 mm (0.497 in.)
Maximum Rotor Shaft Bearing I.D.	12.76 mm (0.502 in.)
Outer Rotor	
Minimum Thickness	9.92 mm (0.391 in.)
Minimum O.D.	40.47 mm (1.596 in.)
Outer Rotor Bearing	
Minimum Depth	10.17 mm (0.401 in.)
Maximum I.D.	40.77 mm (1.605 in.)
Minimum Valve Spring Free Length	19.00 mm (0.750 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS

Electric Starter

See Starter Specifications in this Group.

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Fuel Pump Gasket Kit—FC400V/FC420V/FC540V

Carburetor

Gasket Kit

Needle Valve

Float Kit

Choke Shaft Kit

Throttle Shaft Kit

Breather Valve Kit

Air Cleaner Assembly

Main Jet High Altitude Kit

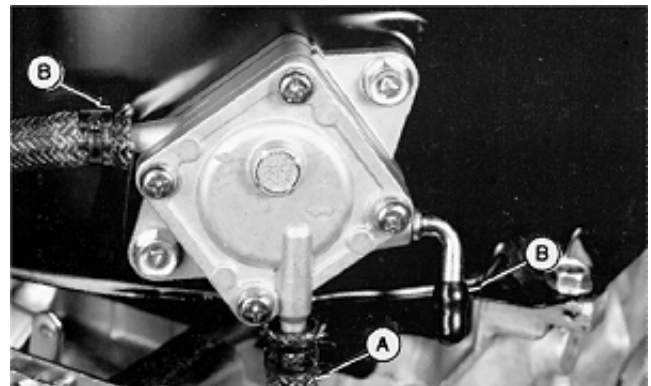
MX,4005A1,A1 -19-21OCT92

REMOVE AND INSTALL FUEL PUMP



CAUTION: Gasoline is dangerous. Avoid fires due to smoking or careless maintenance practices.

1. Disconnect vacuum line (A) and fuel lines (B). Close all openings using caps and plugs.
2. Remove fuel pump.
3. Inspect pump for wear or damage. Repair or replace as necessary.
4. Install fuel pump.
5. Connect vacuum and fuel lines.

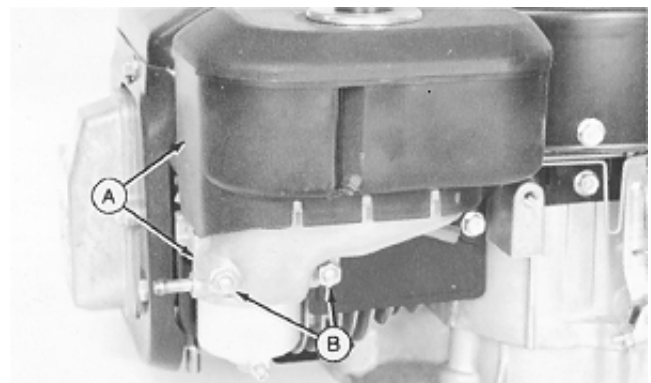


M54481 -UN-25SEP90

MX,4005A1,A2 -19-21OCT92

REMOVE AND INSTALL CARBURETOR—FC290V

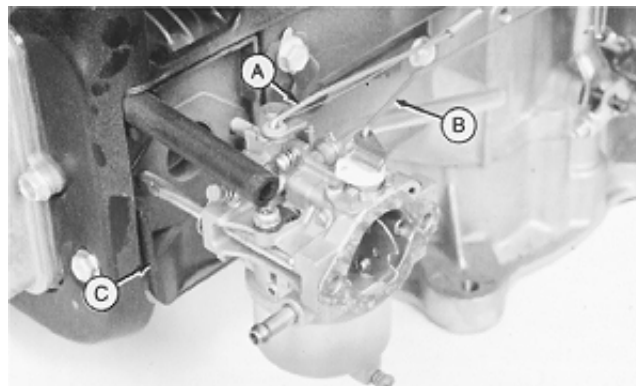
1. Remove two nuts (B) and air cleaner assembly (A).



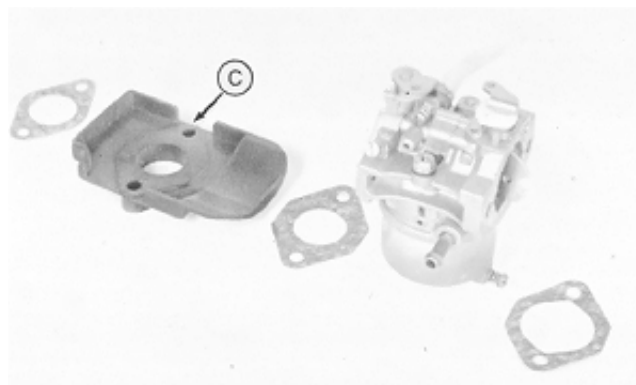
M80000 -UN-09JAN91

MX,4005A1,A3 -19-21OCT92

2. Separate carburetor from heat shield (C). Remove carburetor.
3. Disconnect choke linkage (B) and throttle linkage (A).
4. Remove heat shield (C) and gaskets.
5. Make repairs as necessary. (See procedure in this group.)
6. Install gaskets and heat shield.
7. Connect linkage and install carburetor.
8. Install air cleaner assembly.



M80001
-UN-09JAN91



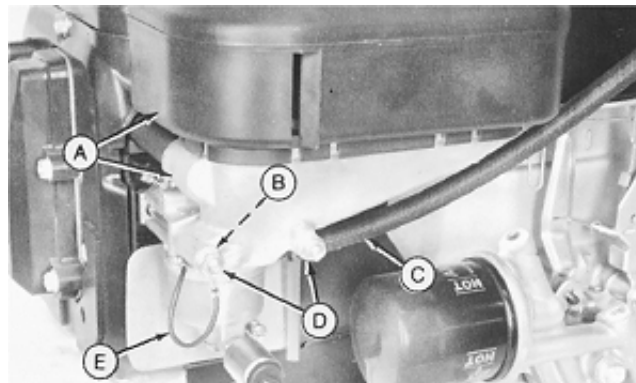
M80002
-UN-09JAN91

MX,4005A1,A4 -19-21OCT92

REMOVE AND INSTALL CARBURETOR—FC400V/FC420V

1. Disconnect fuel hose (C).
2. Remove two nuts (D) and washer (B).
3. Disconnect wiring lead (E).
4. Remove air cleaner assembly (A).

A—Air Cleaner Assembly
B—Washer
C—Fuel Hose
D—Nuts
E—Ground Wiring Lead



M80003
-UN-09JAN91

MX,4005A1,A5 -19-21OCT92

5. Separate carburetor from heat shield (C). Remove carburetor.

6. Disconnect choke linkage (B) and throttle control linkage (A).

7. Remove heat shield (C) and gaskets.

8. Make repairs as necessary. (See procedure in this group.)

9. Install gaskets and heat shield.

10. Connect linkage and install carburetor.

NOTE: Install gasket (D) with hole (E) pointing toward fuel inlet side of carburetor and tab (F) pointing up.

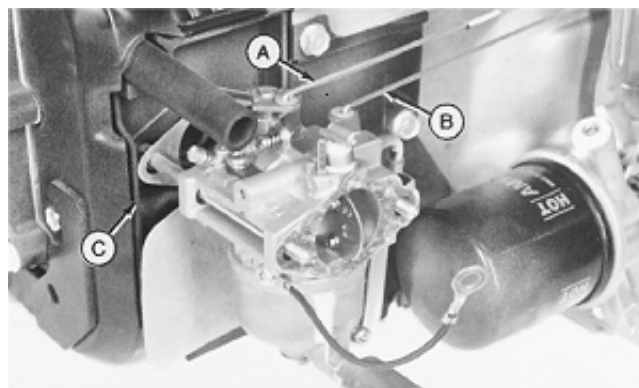
11. Install gasket (D) and air cleaner assembly.

12. Connect wiring lead.

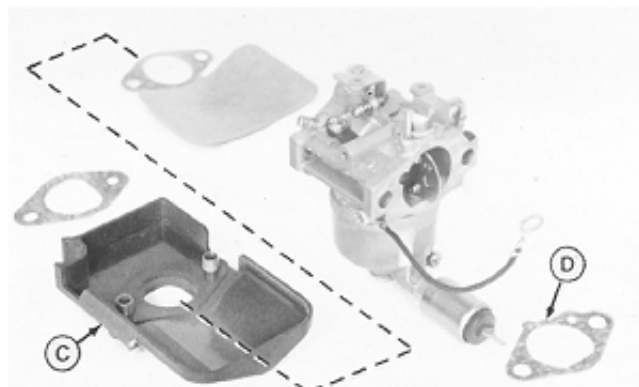
13. Install washer and two nuts.

14. Connect fuel hose.

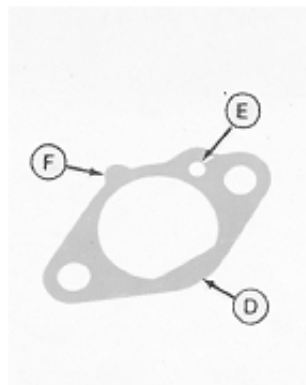
A—Throttle Control Linkage
B—Choke Linkage
C—Heat Shield
D—Gasket
E—Hole
F—Tab



M80004 -UN-09JAN91



M80005 -UN-09JAN91



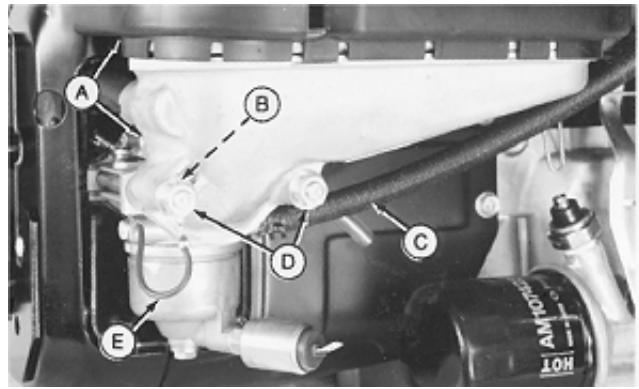
M80006 -UN-09JAN91

MX,4005A1,A6 -19-21OCT92

REMOVE AND INSTALL CARBURETOR—FC540V

1. Disconnect fuel hose (C).
2. Remove two nuts (D) and washer (B).
3. Disconnect wiring lead (E).
4. Remove air cleaner assembly (A).

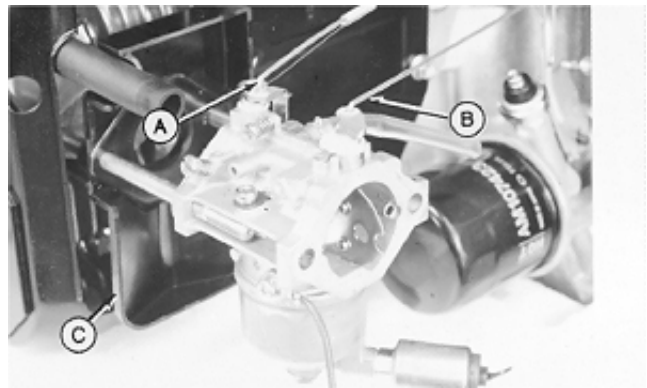
A—Air Cleaner Assembly
B—Washer
C—Fuel Hose
D—Nuts
E—Ground Wiring Lead



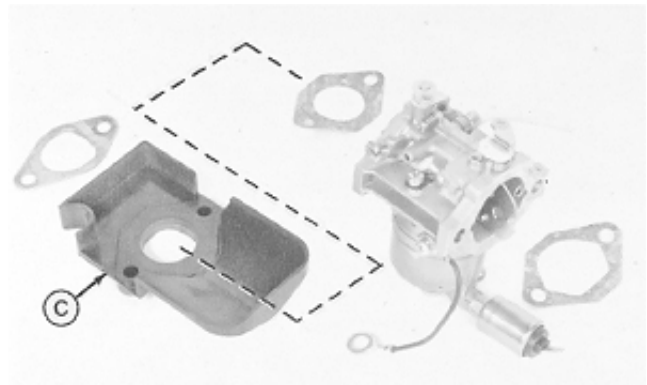
M54484
-UN-09JAN91

MX,4005A1,A7 -19-21OCT92

5. Separate carburetor from heat shield (C). Remove carburetor.
6. Disconnect choke linkage (B) and throttle control linkage (A).
7. Remove heat shield (C) and gaskets.
8. Make repairs as necessary. (See procedure in this group.)
9. Install gaskets and heat shield.
10. Connect linkage and install carburetor.
11. Install air cleaner assembly.
12. Connect wiring lead.
13. Install washer and two nuts.
14. Connect fuel hose.



M54485
-UN-09JAN91



M80007
-UN-20DEC90

MX,4005A1,A8 -19-21OCT92

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR

NOTE: FC400V, FC420V and FC540V engines are equipped with a fuel control solenoid.

FC540V engines with engine tag number BS00, pilot jet is pressed in.

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets, float and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.

2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.

4. Inspect all parts for wear or damage, replace as necessary.

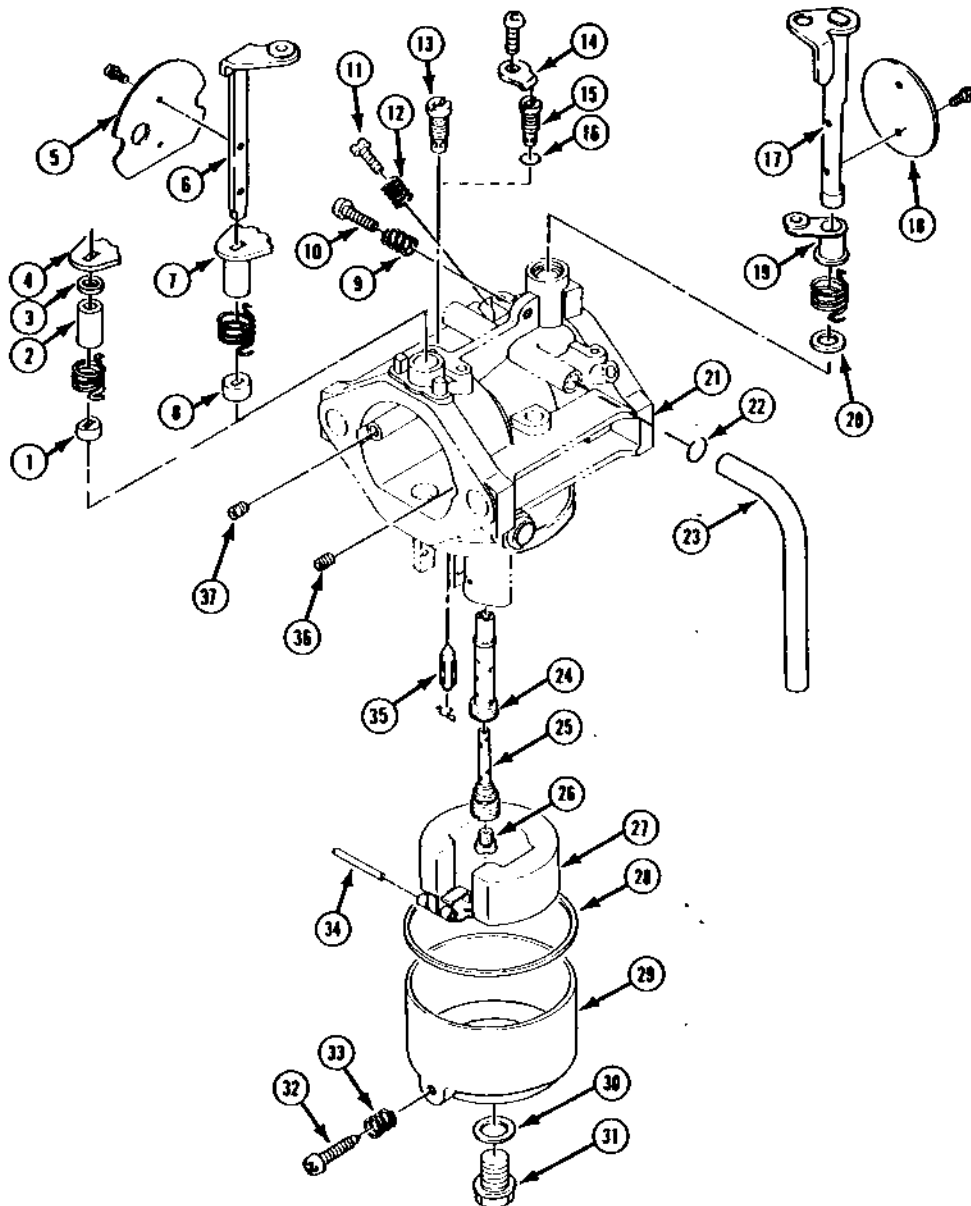
NOTE: Main jet high altitude kits are available.

Float is plastic. The float cannot be adjusted. Replace if necessary.

Use this procedure when referring to the following three exploded views.

MX,4005A1,A12 -19-21OCT92

40
05
5



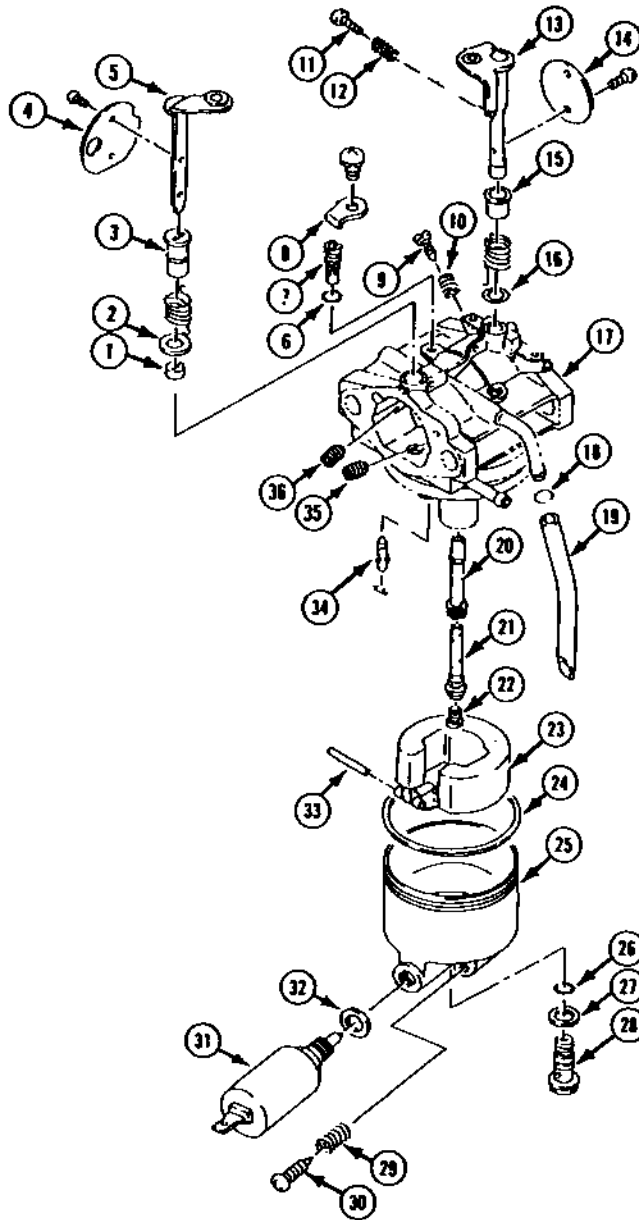
- | | | | |
|---------------|----------------------|--------------------|------------------|
| 1—Collar* | 11—Pilot Screw | 20—Seal | 29—Float Chamber |
| 2—Collar | 12—Spring | 21—Carburetor Body | 30—Washer |
| 3—Seal | 13—Pilot Jet* | 22—Clamp | 31—Plug |
| 4—Plate* | 14—Plate | 23—Hose | 32—Drain Screw |
| 5—Choke Plate | 15—Fixed Pilot Jet** | 24—Main Nozzle | 33—Spring |
| 6—Choke Shaft | 16—O-Ring | 25—Bleed Pipe | 34—Float Pin |
| 7—Plate** | 17—Throttle Shaft | 26—Main Jet | 35—Needle Valve |
| 8—Collar** | 18—Throttle Plate | 27—Float | 36—Air Jet |
| 9—Spring | 19—Ring | 28—Gasket | 37—Pilot Air Jet |
| 10—Idle Screw | | | |

FC290V

* Used without fixed pilot jet

** Used with fixed pilot jet

M80008 -UN-09/JAN91

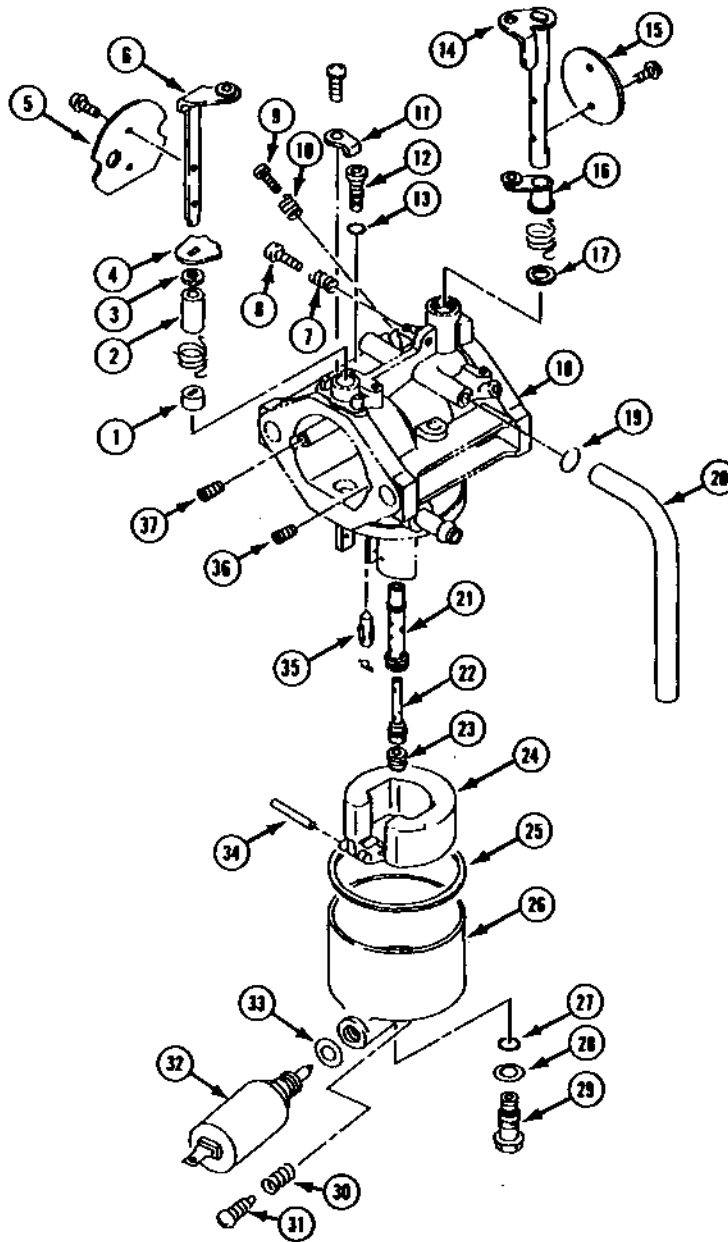


- | | | | |
|---------------|--------------------|------------------|--------------------------|
| 1—Collar | 10—Spring | 19—Hose | 28—Plug |
| 2—Seal | 11—Idle Screw | 20—Main Nozzle | 29—Spring |
| 3—Collar | 12—Spring | 21—Bleed Pipe | 30—Drain Screw |
| 4—Choke Plate | 13—Throttle Shaft | 22—Main Jet | 31—Fuel Shutoff Solenoid |
| 5—Choke Shaft | 14—Throttle Plate | 23—Float | 32—Washer |
| 6—O-Ring | 15—Ring | 24—Gasket | 33—Float Pin |
| 7—Pilot Jet | 16—Seal | 25—Float Chamber | 34—Needle Valve |
| 8—Plate | 17—Carburetor Body | 26—O-Ring | 35—Air Jet |
| 9—Pilot Screw | 18—Clamp | 27—Washer | 36—Pilot Air Jet |

FC400V/FC420V

JUN-09/JAN-91
40-05-7
M80009

MX,4005A1,A10 -19-21OCT92



- | | | | |
|---------------|--------------------|------------------|--------------------------|
| 1—Collar | 11—Plate | 20—Hose | 29—Plug |
| 2—Collar | 12—Pilot Jet | 21—Main Nozzle | 30—Spring |
| 3—Seal | 13—O-Ring | 22—Bleed Pipe | 31—Drain Screw |
| 4—Plate | 14—Throttle Shaft | 23—Main Jet | 32—Fuel Shutoff Solenoid |
| 5—Choke Plate | 15—Throttle Plate | 24—Float | 33—Washer |
| 6—Choke Shaft | 16—Ring | 25—Gasket | 34—Float Pin |
| 7—Spring | 17—Seal | 26—Float Chamber | 35—Needle Valve |
| 8—Idle Screw | 18—Carburetor Body | 27—O-Ring | 36—Air Jet |
| 9—Pilot Screw | 19—Clamp | 28—Washer | 37—Pilot Air Jet |
| 10—Spring | | | |

FC540V

MX,4005A1,A11 -19-21OCT92

SERVICE BREATHER

NOTE: Breather is located in cylinder block of FC290V engine, and in cylinder heads of FC400V, FC420V and FC540V engines.

1. FC290V: Remove blower housing. (See Group 10.)

Remove breather cover.

FC400V/FC420V/FC540V: Remove rocker arm cover.

2. Measure air gap between reed valve (A) and valve seat (B) at valve tip. Replace reed valve if gap exceeds specification.

3. Remove breather valve (C).

4. Inspect breather for sticking, binding, cracks or distortion. Replace breather if worn or damaged.

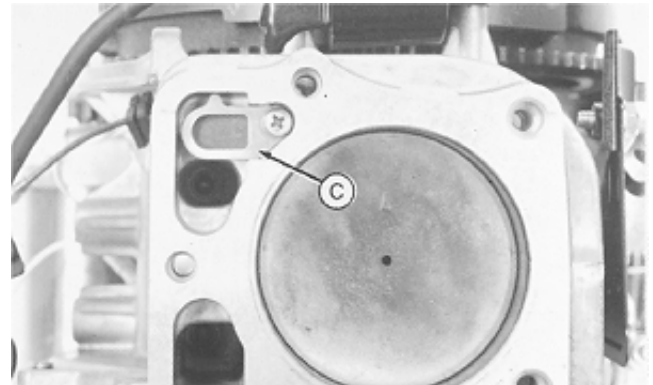
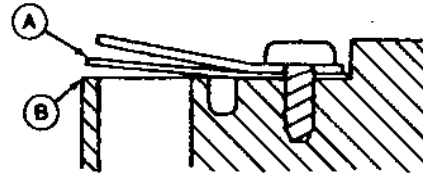
5. Inspect valve seating surface. Surface must be free of nicks or burrs.

NOTE: On FC290V engine, check that drain back slot in breather chamber is open.

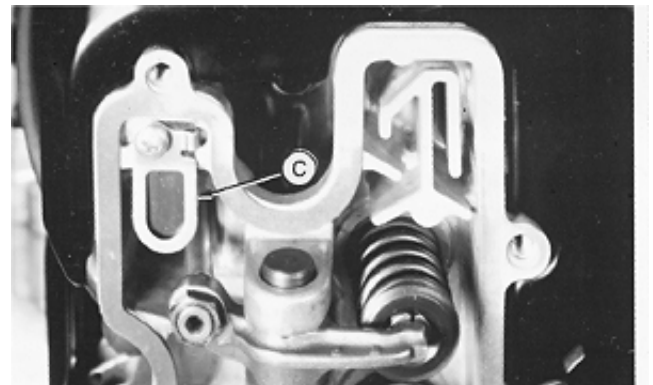
6. Install breather assembly.

AIR GAP SPECIFICATIONS (MAX)

FC290V	0.20 mm (0.008 in.)
FC400V/FC420V/FC540V	1—2 mm (0.040—0.080 in.)



FC290V



FC400V/FC420V/FC540V

MX,4005A1,A13 -19-21OCT92

-UN-07SEP88

M51757

-UN-09JAN91

M54498

-UN-09JAN91

M54486

40-05-9

SERVICE AIR CLEANER

NOTE: Replace elements yearly or every 25 hours as required.

1. Remove and disassemble air cleaner.

IMPORTANT: Do not clean elements with solvent or compressed air.

2. Wash foam element (A) in detergent and water. Dry element.

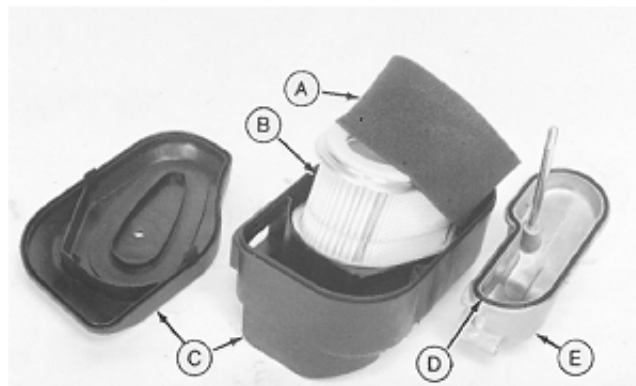
3. Put 12—15 drops of engine oil on foam element (A). Squeeze out excess oil.

4. Gently tap paper element (B) to remove dust:
 - Element is still usable if you can see light through element and paper appears clean.
 - Install new element if element is oily, dirty, bent, torn, crushed, or obstructed in any way.

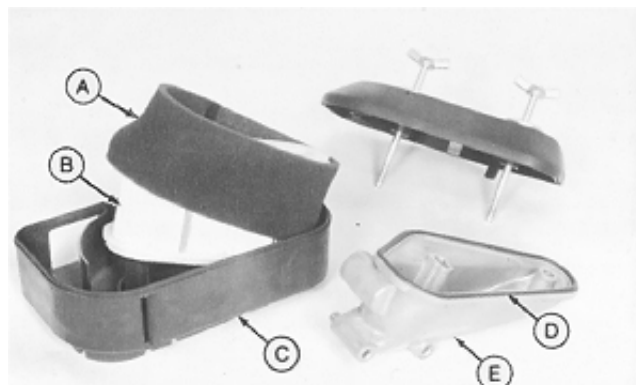
5. Inspect body (C), gasket (D), and base (E) for damage. Replace if necessary.

IMPORTANT: Any time air cleaner base is removed, check for free choke operation during reassembly.

6. Assemble and install air cleaner.



FC290V



FC400V/FC420V/FC540V

A—Foam Element
B—Paper Element
C—Body
D—Gasket
E—Base

-UN-09JAN91

M54487

-UN-09JAN91

M80157

MX,4005A1,A14 -19-21OCT92

40
05
10

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Blower Housing Engine Cover Kit

Decal Kit

Flywheel Screen and Spacer Kit

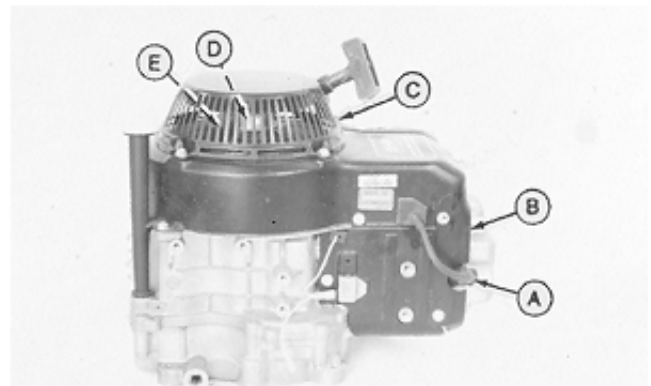
Dipstick Tube Kit

MX,4010A1,A0 -19-21OCT92

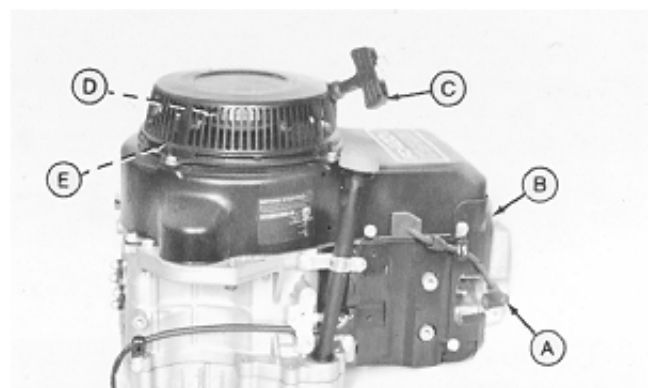
REMOVE AND INSTALL BLOWER HOUSING—RECOIL START

1. Disconnect spark plug cap (A).
2. Remove air cleaner assembly.
3. FC400V/FC420V: Remove fuel pump. (See Group 05.)
4. Remove cover (B).
5. Remove recoil starter (C), cup (D), screen (E) and spacer(s).
6. Remove blower housing and dipstick tube.
7. Install dipstick tube, blower housing, spacer(s) screen and cup.
8. Adjust flywheel screen. (See this group.)
9. Install recoil starter and cylinder head cover.
10. FC400V/FC420V: Install fuel pump.
11. Install air cleaner assembly.

A—Spark Plug Cap
B—Cover
C—Recoil Starter
D—Starter Cup
E—Screen



FC290V



FC400V/FC420V

M51481 -UN-31AUG88

M80158 -UN-09JAN91

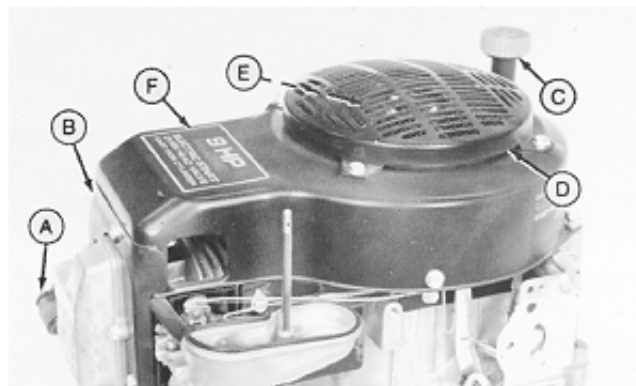
MX,4010A1,A1 -19-21OCT92

REMOVE AND INSTALL BLOWER HOUSING—ELECTRIC START

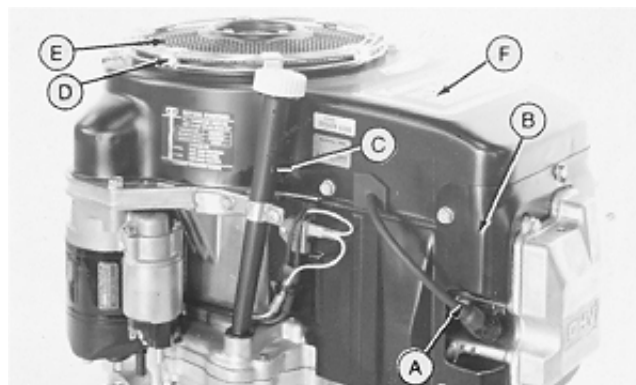
1. Disconnect spark plug cap (A).
2. Remove air cleaner assembly.
3. Remove fuel pump. (See Group 05.)
4. Remove cover (B).

NOTE: On FC290V, remove dipstick tube after blower housing removal.

5. Remove dipstick tube (C).
6. Remove protector (D) and screen (E).
7. Remove blower housing (F).
8. Install blower housing, screen and protector.
9. Adjust flywheel screen. (See this group.)
10. Install cylinder head cover and dipstick tube.
11. Install fuel pump.
12. Install air cleaner assembly.



FC290V



FC400V/FC420V/FC540V

A—Spark Plug Cap
B—Cylinder Head Cover
C—Dipstick Tube
D—Protector
E—Screen
F—Blower Housing

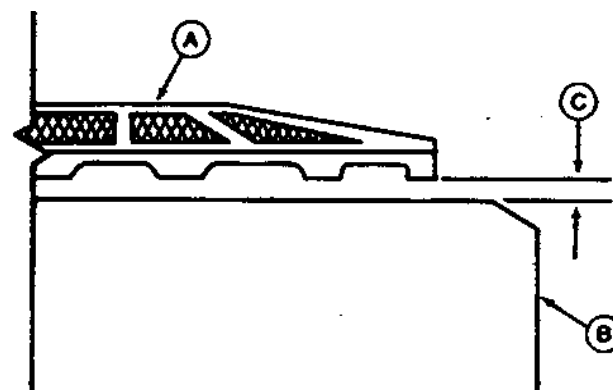
MX,4010A1,A2 -19-21OCT92

FLYWHEEL SCREEN ADJUSTMENT

Adjust gap (C) between the blades under screen (A) and blower housing (B) to specifications using spacers.

SPECIFICATIONS

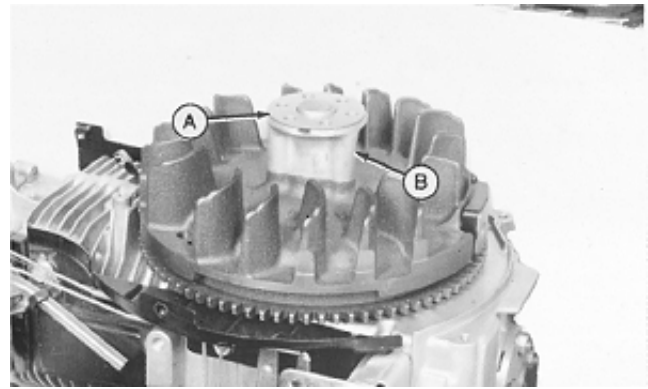
Minimum Gap 1.5 mm (0.059 in.)



MX,4010A1,A2A -19-21OCT92

REMOVE AND INSTALL FLYWHEEL—FC290V

1. Remove armature with coil. (See Group 25.)
2. Remove shims (A) and bracket (B).
3. Hold flywheel and remove nut and washer.
4. Remove flywheel using a flywheel puller.
5. Install flywheel, washer and nut. Tighten nut to 85 N·m (63 lb-ft).
6. Install bracket and shims.
7. Install armature with coil.

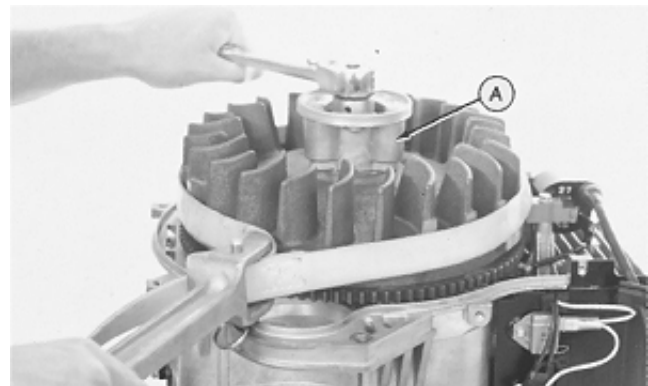


M80160 -UN-09JAN91

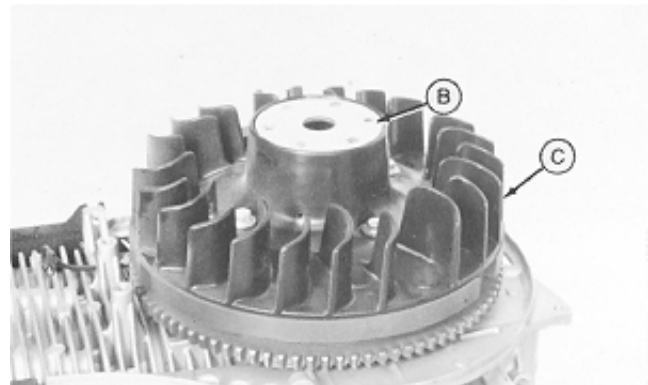
MX,4010A1,A3 -19-21OCT92

REMOVE AND INSTALL FLYWHEEL—FC400V/FC420V/FC540V

1. Remove armature with coil. (See Group 25.)
2. Remove shims (B).
3. Hold flywheel and remove nut.
4. Remove bracket (A) or fan (C), if equipped.
5. Remove flywheel using a flywheel puller.
6. Install flywheel and bracket, if equipped.
7. Install nut. Tighten nut to specifications.
8. Install fan, if equipped.
9. Install shims.
10. Install armature with coil.



M50051 -UN-31AUG88



M80161 -UN-09JAN91

TORQUE SPECIFICATIONS

FC400V/FC420V	137 N·m (101 lb-ft)
FC540V	172 N·m (127 lb-ft)

MX,4010A1,A3A -19-21OCT92

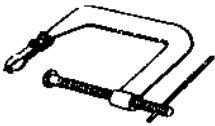
SPECIAL OR ESSENTIAL TOOLS

NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

DX,TOOLS -19-05JUN91

Valve Spring Compressor JDM70

Remove and install valve springs.



MX,JDM70 -19-21OCT92

Valve Guide Driver Tool JDG504

Replace valve guide bushings.

MX,JDG504 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean Cylinder Head
	Valve Guide Cleaner	Clean Valve Guides
	Stanisol (or Kerosene)	Finish Ream Valve Guide
	Prussian Blue Compound	Check Valve Seat Contact

SCOTCH-BRITE is a trade mark of the 3M Company. MX,4015A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Rocker Arm and Shaft Kit

Intake Valve Kit

Exhaust Valve Kit

MX,4015A1,A1 -19-21OCT92

REMOVE AND INSTALL ROCKER ARM ASSEMBLY

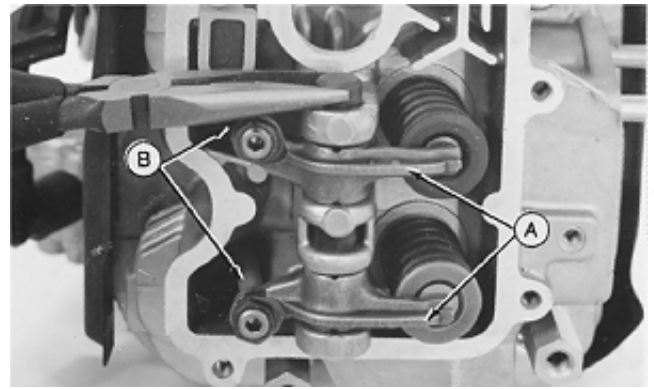
1. Remove rocker arm cover.
2. Turn crankshaft until piston is at highest position in compression stroke.
3. Remove rocker shaft and arms (A).

IMPORTANT: Mark push rods for reassembly in original locations.

4. Remove push rods (B).

IMPORTANT: Align rocker arms over push rods during assembly.

5. Install push rods and rocker arm assemblies.
6. Check valve clearance. (See this group.)



M50027 -UN-31AUG88

MX,4015A1,A2 -19-21OCT92

INSPECT ROCKER ARM ASSEMBLY

Measure outside diameter of rocker shaft and inside diameter of rocker arm bearing. Replace if not according to specifications.

SPECIFICATIONS

Minimum Shaft O.D.	12.94 mm (0.509 in.)
Maximum Arm I.D.	13.07 mm (0.515 in.)



M50028 -UN-31AUG88



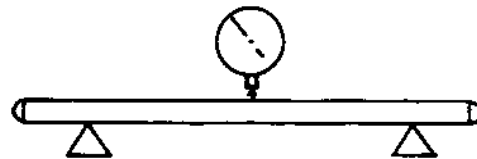
M50029 -UN-31AUG88

MX,4015A1,A3 -19-21OCT92

Inspect push rod for bend using V-blocks and a dial indicator. Turn rod slowly and read variation on indicator. Replace if variation is greater than specification.

SPECIFICATION

Push Rod Bend (MAX) 0.30 mm (0.012 in.)



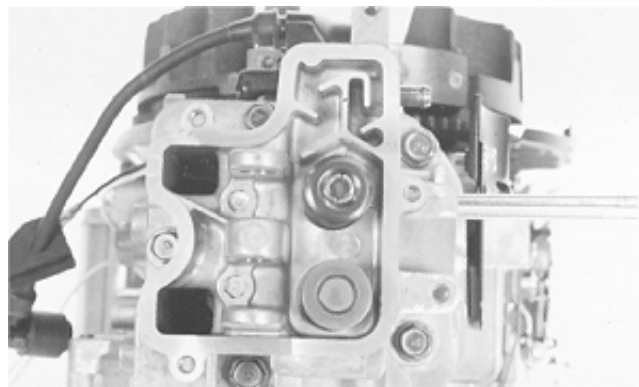
MX,4015A1,A3A -19-21OCT92

-UN-31AUG88

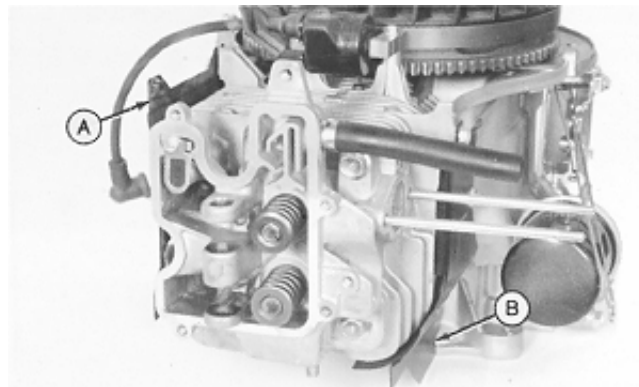
M50044

REMOVE AND INSTALL CYLINDER HEAD ASSEMBLY

1. Remove blower housing. (See Group 10.)
2. Remove carburetor. (See Group 05.)
3. Remove rocker arm assembly. (See this group.)
4. Remove shields (A and B).
5. Remove spark plug.
6. Remove cylinder head assembly.
7. Make repairs as necessary. (See procedures in this group.)



FC290V



FC400V/FC420V/FC540V

MX,4015A1,A4 -19-21OCT92

-UN-09JAN91

M54488

-UN-09JAN91

M80162

40
15
3

IMPORTANT: Gasket surfaces are coated with sealant. Do not damage surfaces or gasket during installation.

8. Install cylinder head assembly with new gasket. Install cap screws and tighten finger tight.

9. Tighten cap screws in sequence shown. Tighten to initial torque specifications.

10. On FC290V continue in sequence, 3 N·m (27 lb-in.) at a time, until final torque is as specified.

On FC400V, FC420V and FC540V, continue in sequence, 7 N·m (62 lb-in.) at a time, until final torque is as specified.

11. Install spark plug and tighten to specification.

12. Install shields.

13. Check valve clearance. (See this group.)

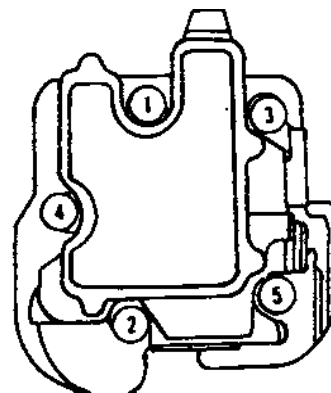
TORQUE SPECIFICATIONS

Initial Torque

FC290V	18 N·m (159 lb-in.)
FC400V/FC420V/FC540V	32 N·m (24 lb-ft)

Final Torque

FC290V	24 N·m (212 lb-in.)
FC400V/FC420V/FC540V	52 N·m (38 lb-ft)
Spark Plug	20 N·m (177 lb-in.)

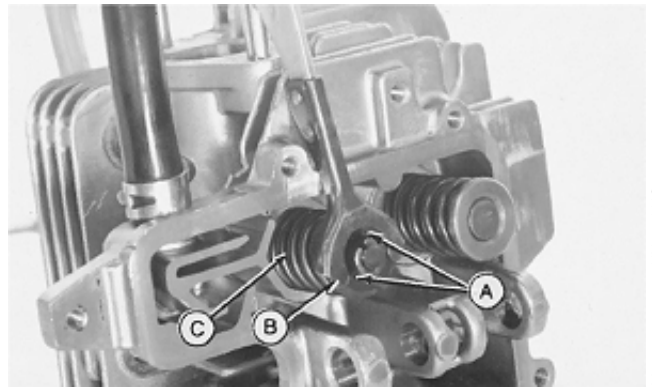


M50046 -UN-31AUG88

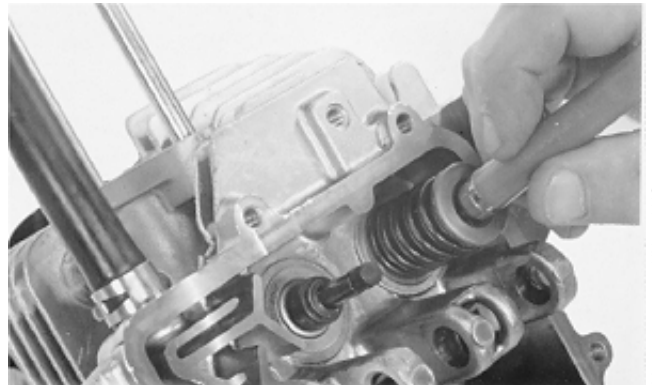
MX,4015A1,A5 -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove cylinder head. (See this group.)
2. Compress intake valve spring with JDM70 Valve Spring Compressor and remove collet halves (A).
3. Remove spring retainer (B) and spring (C).
4. Remove exhaust valve rotator with a magnet.
5. Support exhaust valve from below and press down on spring retainer.
6. Remove retainer, spring and valves.
7. Inspect and replace stem seals as necessary. (See this group.)
8. Inspect and analyze valves. (See Section 100, Group 05.)
9. Inspect springs, valves, guides and seats. (See procedures in this group.)
10. Install valves, springs, and retainers.



M50033 -UN-31AUG88



M50034 -UN-31AUG88

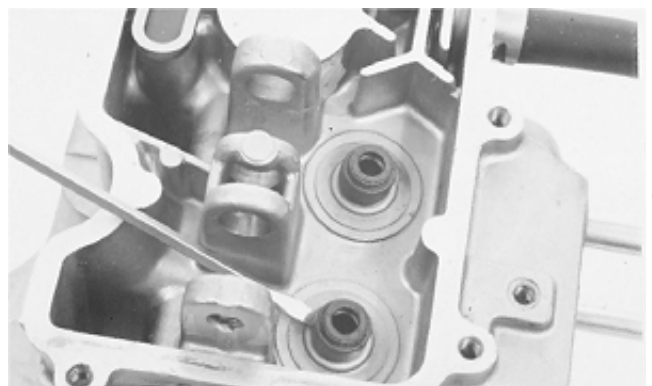
MX,4015A1,A6 -19-21OCT92

INSPECT AND REPLACE STEM SEALS

Remove valves and springs. (See this group.)

IMPORTANT: Bottom spring retainer can only be removed with valve stem seal. Removal of retainer or seal damages stem seal. Inspect seal. If seal is not damaged, do not remove it.

If necessary to replace stem seal, remove with screwdriver.



M50111 -UN-31AUG88

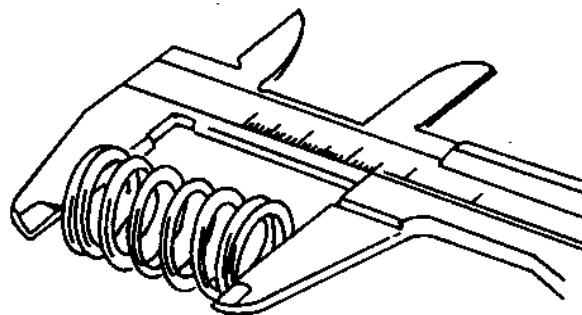
MX,4015A1,A7 -19-21OCT92

INSPECT SPRINGS

Inspect spring free length. Replace if damaged or if less than specifications.

FREE LENGTH SPECIFICATIONS (MIN)

FC290V	31.00 mm (1.220 in.)
FC400V/FC420V/FC540V	37.50 mm (1.476 in.)

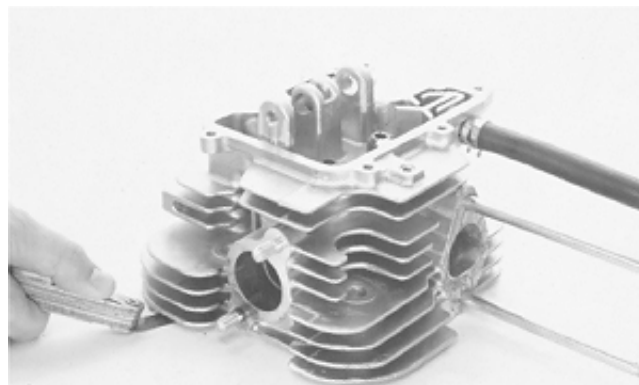


MX,4015A1,A8 -19-21OCT92

M50036 -UN-31AUG88

INSPECT CYLINDER HEAD

1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Check that oil drainback passages are not plugged.
7. Put cylinder head on a surface plate. Check for distortion at several points around the head using a feeler gauge. Replace head if distortion is more than specifications.



M50032 -UN-31AUG88

SPECIFICATIONS

Cylinder Head Distortion (Max)	0.05 mm (0.002 in.)
--------------------------------------	---------------------

MX,4015A1,A9 -19-21OCT92

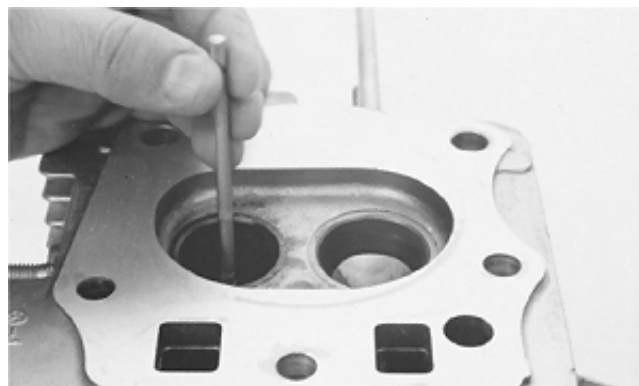
INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guides or bushings. Replace bushing if inside diameter is greater than specifications. (See this group.)

SPECIFICATIONS (MAX) I.D.

Intake and Exhaust	7.07 mm (0.278 in.)
--------------------------	---------------------

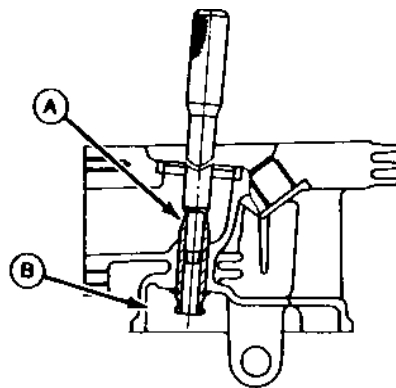


MX,4015A1,A10 -19-21OCT92

M50037 -UN-31AUG88

REPLACE VALVE GUIDE BUSHINGS

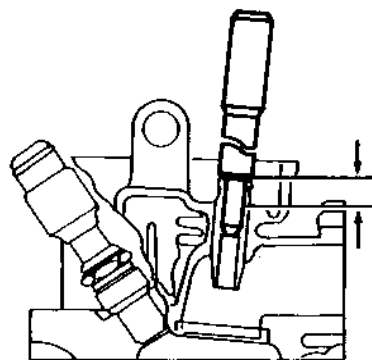
1. Drive valve guide bushing (A) into valve chamber (B) using JDG-504 Valve Guide Driver.



MX,4015A1,A10A -19-21OCT92

M50038
-UN-06APR91

2. Clean carbon deposits from valve guide port.
3. Install new bushing with valve guide driver. Drive in from valve chamber side to an installation depth of 12 mm (0.472 in.) for the FC400V/FC420V and 9.5 mm (0.37 in.) for the FC540V.



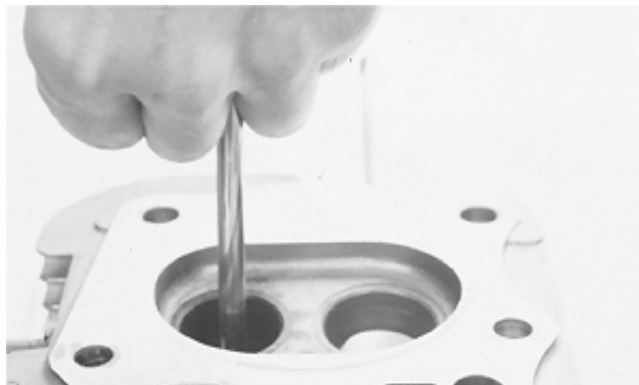
MX,4515A1,A9A -19-21OCT92

M50039
-UN-15OCT92

4. Finish reaming valve guide bushings with stanisol or kerosene lubricant and a 7 mm valve guide reamer. Turn reamer clockwise.
5. Thoroughly clean valve area before assembly.

BUSHING FINISHED I.D. SPECIFICATIONS

Valve Guide 7—7.02 mm (0.275—0.276 in.)



M98,2015A,A21 -19-21OCT92

M50040
-UN-31AUG88

40
15
7

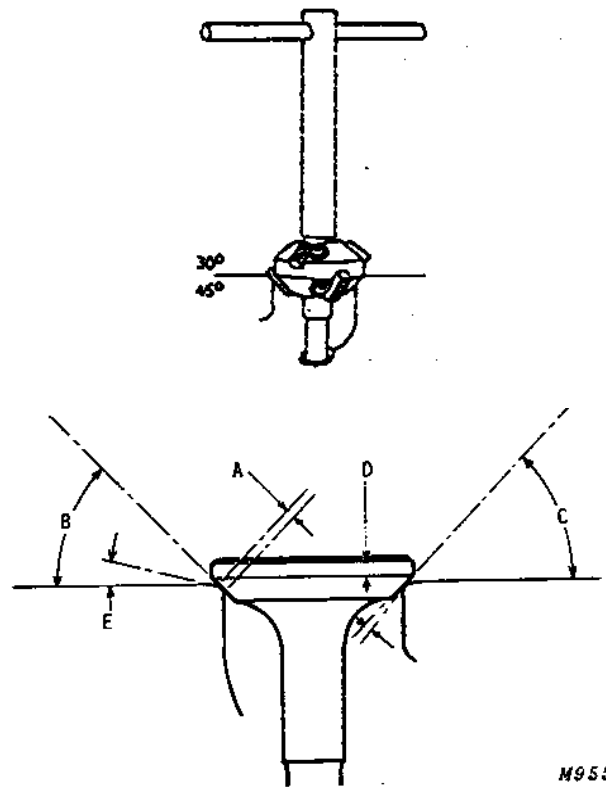
RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.
2. To recondition valve seat, cut at 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).
3. Cut valve seating surface (A) as close as possible to specifications.
4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface:

FC290V	0.50—1.10 mm (0.020—0.043 in.)
FC400V/FC420V	1.10—1.46 mm (0.043—0.057 in.)
FC540V	1.10—1.46 mm (0.043—0.057 in.)
B—Valve Seat Angle	45°
C—Valve Face Angle	45°
D—Valve Margin	0.60 mm (0.020 in.)
E—Valve Narrowing Angle	30°

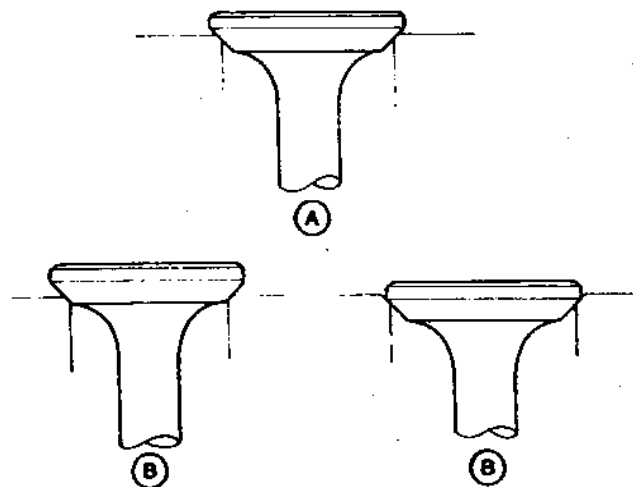


M955

MX,4015A1,A11 -19-21OCT92

5. Center valve seat on the valve face:
—(A) shows correct position.
—(B) shows incorrect.

6. Check seat for good contact using Prussion Blue Compound.



M18615

-UN-07SEP88

M9552

-UN-01SEP88

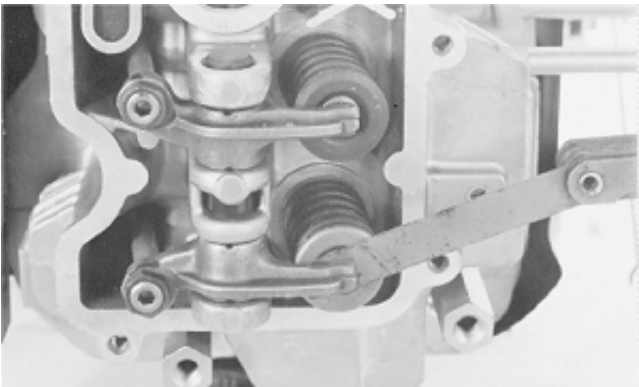
M51558

-UN-31AUG88

CHECK VALVE CLEARANCE

NOTE: Valve repair changes valve clearance. Check valve clearance. Adjust if needed.

- 1. Turn crankshaft until piston is at highest position in compression stroke.
- 2. Measure clearance.



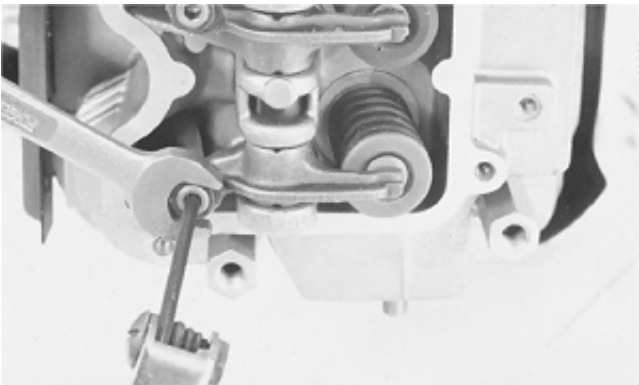
M50048 -UN-31AUG88

M98,2015A,AJ -19-26MAR86

- 3. If necessary, adjust clearance to specifications.

SPECIFICATIONS

Valve Clearance 0.15 mm (0.006 in.)



M50049 -UN-31AUG88

MX,4015A1,A12 -19-21OCT92

40
15
10

OTHER MATERIAL

Number	Name	Use
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,4020A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalogue.

Camshaft and Tappet Kt

Camshaft Axial Play Shim Kit—FC290V and FC540V

Piston Ring Kit

Oversized Pistons

Oversized Piston Rings

Undersized Connecting Rod

Crankshaft End Play Shim Kit

Cylinder Block

Overhaul Gasket Kit

Short Block Kit

Oil Slinger Kit—FC290V

Oil Pump Kit—FC400V, FC420V and FC540V

Governor and Shaft Kit

MX,4020A1,A2 -19-21OCT92

40
20
1

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is:

FC290V1.0L (2.11 pt)

FC400V/FC420V

Without Filter1.3L (2.74 pt)

With Filter1.5L (3.17 pt)

FC540V

Without Filter1.6L (3.38 pt)

With Filter1.8L (3.80 pt)

1. Drain crankcase.
 2. Remove crankcase cover and gasket.
 3. Clean crankcase and crankcase cover gasket surfaces.
- NOTE:** Do not force cover. Gears must mesh for proper positioning.
4. Install gasket and cover. Tighten cap screws using the sequence shown.

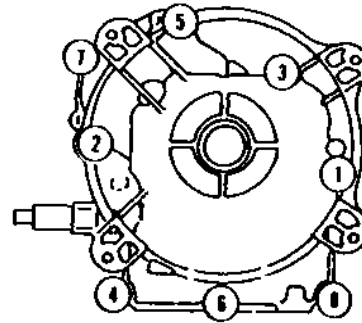
TORQUE SPECIFICATIONS

Mounting Cap Screws

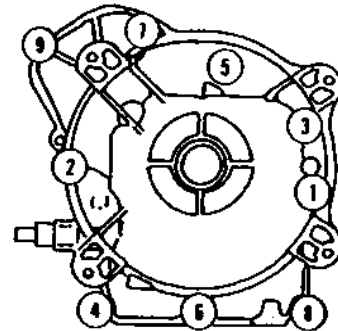
FC290V 20 N·m (177 lb-in.)

FC400V/FC420V/FC540V 26 N·m (230 lb-in.)

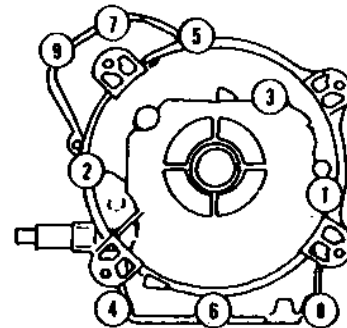
Oil Drain Plug 23 N·m (200 lb-in.)



FC290V



FC400V/FC420V



FC540V

MX,4020A1,A3 -19-21OCT92

-UN-09JAN91

M54489

-UN-09JAN91

M54490

-UN-06APR91

M80237

REMOVE AND INSTALL CAMSHAFT

1. Remove crankcase cover. (See this group.)

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

2. Rotate crankshaft until timing marks (A) align.

3. Remove camshaft (B).

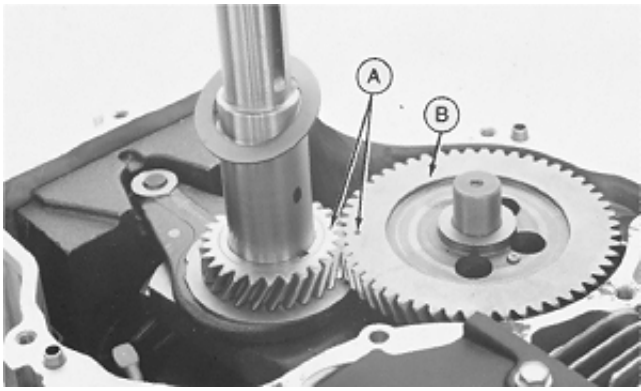
4. Inspect camshaft. (See this group.)

5. Apply clean engine oil to camshaft lobes and journals.

6. Align timing marks and install camshaft.

7. On FC540V (S/N —014454) and FC290V engines, adjust camshaft axial play. (See this group.)

8. Install crankcase cover.



M50056
-UN-31AUG88

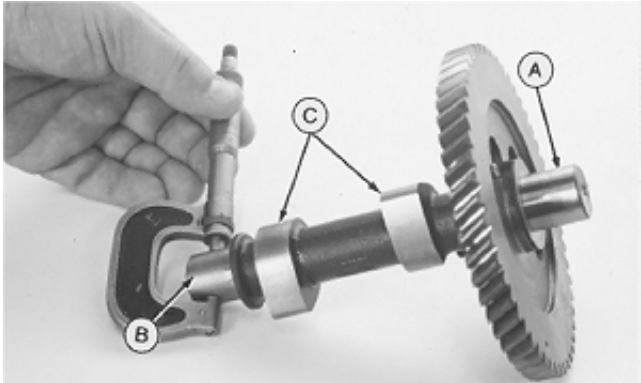
MX,4020A1,A4 -19-21OCT92

INSPECT CAMSHAFT

Inspect camshaft for worn or broken teeth.

*NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.*

Measure PTO side journal (A), flywheel side journal (B), and lobes (C). Replace camshaft and tappets if less than specifications.



M50057
-UN-31AUG88
40
20
3

SPECIFICATIONS (MIN)

	PTO Side Journal	Flywheel Side Journal	Cam Lobes
FC290V	13.92 mm (0.548 in.)	15.92 mm (0.627 in.)	27.08 mm (1.066 in.)
FC400V/ FC420V	20.91 mm (0.823 in.)	19.91 mm (0.784 in.)	36.75 mm (1.447 in.)
FC540V	20.91 mm (0.823 in.)	20.91 mm (0.823 in.)	37.10 mm (1.461 in.)

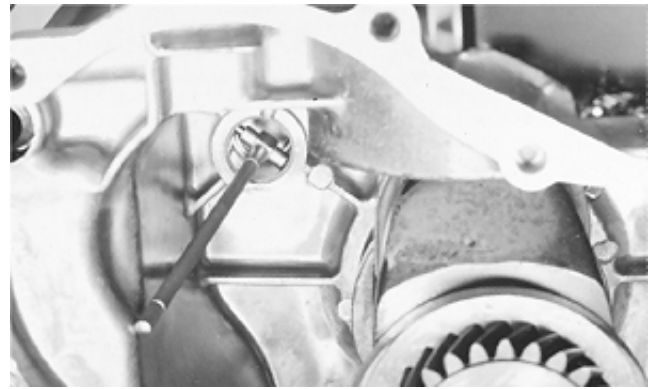
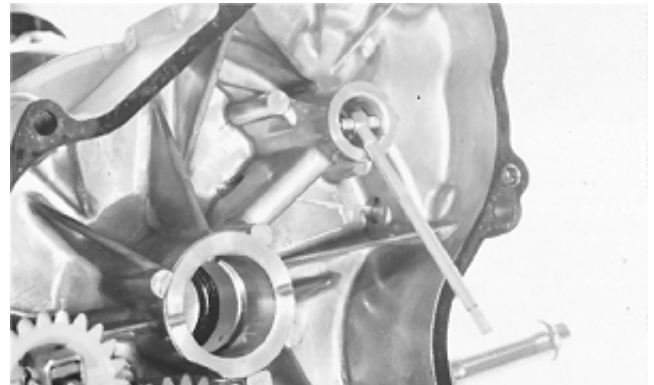
MX,4020A1,A5 -19-21OCT92

INSPECT CAMSHAFT PLAIN BEARINGS

1. Remove camshaft. (See this group.)
2. Measure camshaft bearings in cylinder block and crankcase cover. Replace block or cover if diameter is greater than specification.
3. Install camshaft.

SPECIFICATIONS (MAX)

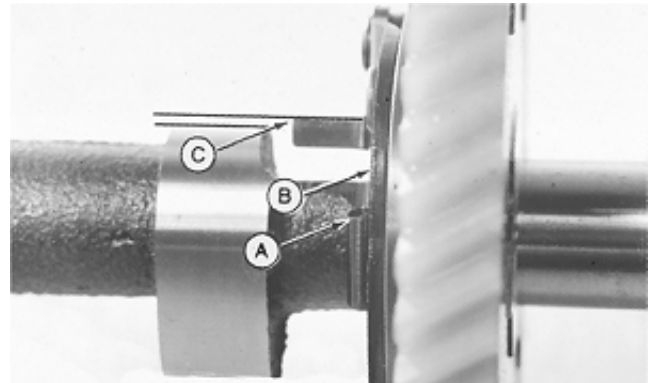
	Cylinder Block Bearing	Crankcase Cover Bearing
FC290V	16.06 mm (0.632 in.)	14.05 mm (0.553 in.)
FC400V/ FC420V	20.08 mm (0.790 in.)	21.08 mm (0.830 in.)
FC540V	21.08 mm (0.830 in.)	21.08 mm (0.830 in.)

*Cylinder Block**Crankcase Cover*

MX,4020A1,A6 -19-21OCT92

-UN-09JAN91
M54492-UN-09JAN91
M54491**INSPECT AUTOMATIC COMPRESSION RELEASE (A.C.R.)**

1. Remove camshaft. (See this group.)
2. Inspect automatic compression release (A.C.R.) for damage.
3. Inspect spring (A). Replace if worn or damaged.
4. Move weight(s) (B) by hand to check for proper operation.
5. On FC400V, FC420V and FC540V engines, check that tab (C) sits slightly above cam lobe when weights are released. Tab should drop below cam when weights are operated.

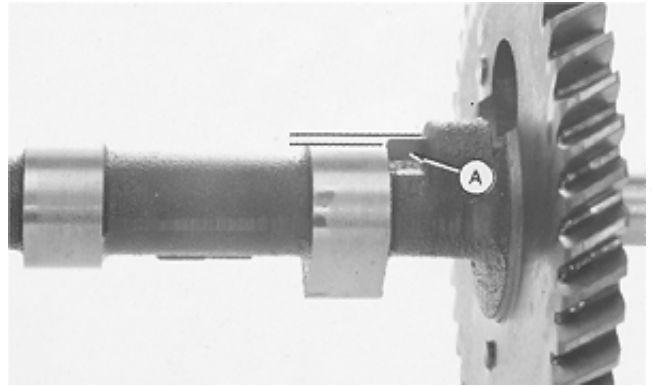
-UN-09JAN91
M54493

MX,4020A1,A7 -19-21OCT92

6. On FC290V engines, check that tab (A) sits just above cam lobe when weight is released. Tab should rotate 90° and drop below cam lobe when weight is operated.

7. Replace camshaft if it does not operate properly.

8. Install camshaft.



MX,4020A1,A8 -19-21OCT92

M50058
-UN-31AUG88

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)

NOTE: Mark tappets so they can be installed in their original bores during assembly.

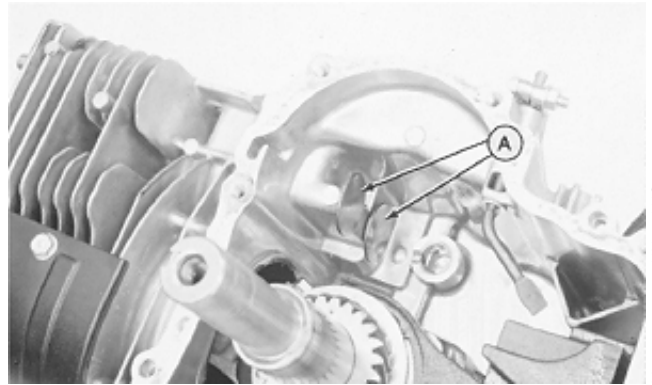
2. Remove tappets (A).

3. Inspect tappets for wear or damage. Replace if necessary.

4. Apply clean engine oil to tappets and bores.

5. Install tappets in original bores.

6. Install camshaft.



MX,4020A1,A9 -19-21OCT92

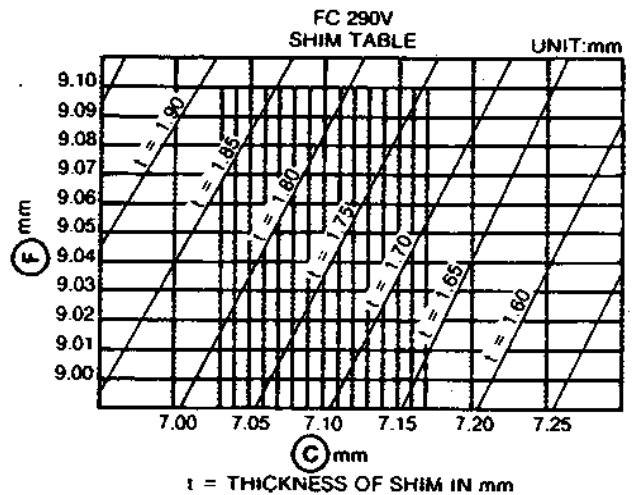
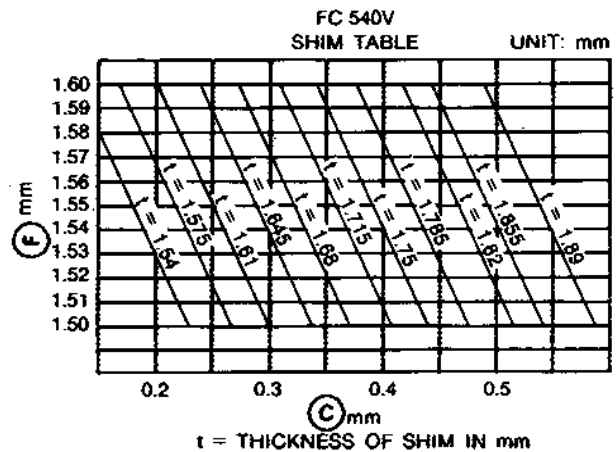
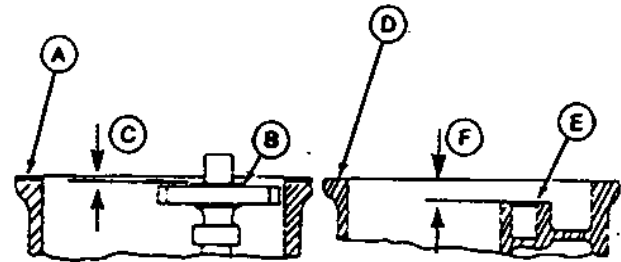
M38092
-UN-29AUG88

ADJUST CAMSHAFT AXIAL PLAY—FC290V AND FC540V

1. With gasket (A) installed on crankcase, measure from gasket surface to cam gear timing flange (B). Record this measurement (C).
2. Measure from crankcase cover mounting face (D) to camshaft bearing end (E). Record this measurement (F).
3. Locate measurements on appropriate table. Follow lines to where recorded measurements intersect. Choose the next smaller shim from the table.

Install shim to cam gear timing flange (B).

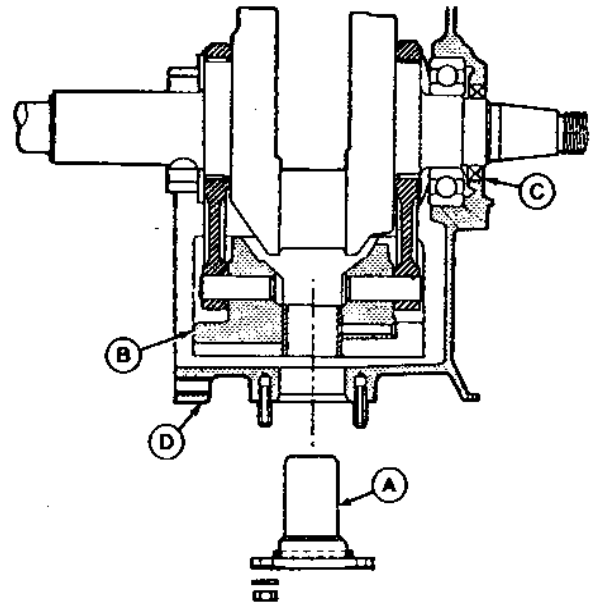
- A—Gasket
B—Timing Flange
C—Measurement
D—Cover Mounting Face
E—Bearing End
F—Measurement



MX,4020A1,A10 -19-21OCT92

REMOVE AND INSTALL RECIPROCATING BALANCER

1. Remove flywheel. (See Group 10.)
2. Remove camshaft. (See this group.)
3. Remove piston. (See this group.)
4. Remove support shaft (A).
5. Remove crankshaft with balancer assembly (B).
6. Make repairs as necessary. (See procedures in this group.)
7. Inspect oil seals. (See this group.)
8. Cover keyway on flywheel end of crankshaft with tape to prevent damage to seal (C) when installing assembly.
9. Put light film of oil on crankshaft bearing surfaces.
10. Install balancer assembly with crankshaft into crankcase (D).
11. Tighten balancer nut to 7 N·m (65 lb-in.).
12. Align balancer weight in crankcase and install support shaft.
13. Adjust crankshaft end play. (See this group.)



A—Support Shaft
 B—Balancer Assembly
 C—Seal
 D—Crankcase

M51758 -UN-07SEP88

40
20
7

MX,4020A1,A11 -19-21OCT92

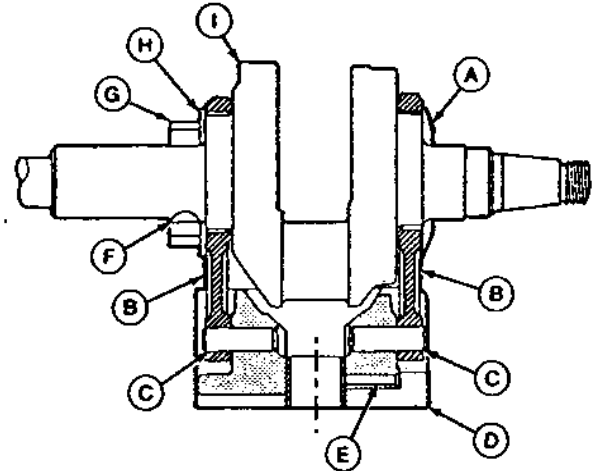
DISASSEMBLE AND ASSEMBLE RECIPROCATING BALANCER

NOTE: On FC290V engine, spacer (H) is governor drive gear.

1. Remove collar (A), gear (G) key (F) and gear or spacer (H).
2. Remove rods (B) and crankshaft (I).
3. Inspect crankshaft. (See this group.)
4. Inspect balancer assembly. (See this group.)
5. Put a light film of oil on bearing surfaces.

NOTE: Oil grooves of link rods (B) must face away from crankwebs.

6. Install balance weight to crankshaft with oil hole (E), if equipped, facing flywheel side.
7. Install collar (A).
8. Install gear or spacer (H) with chamfered face toward link rod.
9. Install key and crank gear.



- A—Collar
- B—Link Rod
- C—Wrist Pin
- D—Balance Weight
- E—Oil Hole
- F—Woodruff Key
- G—Crank Gear
- H—Spacer or Gear
- I—Crankshaft

M51759 -UN-07SEP88

40
20
8

MX,4020A1,A12 -19-21OCT92

INSPECT BALANCER ASSEMBLY

1. Clean and inspect all parts for wear or damage. Replace parts, if necessary.
2. Measure crankshaft journals (A). Replace crankshaft if diameter is less than specifications.

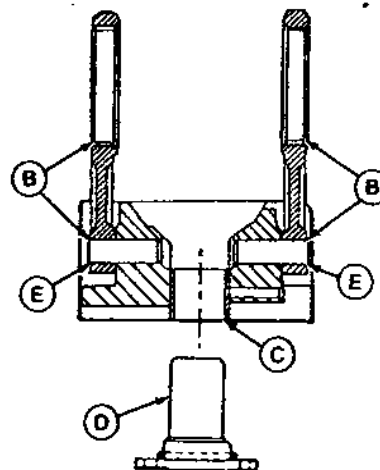
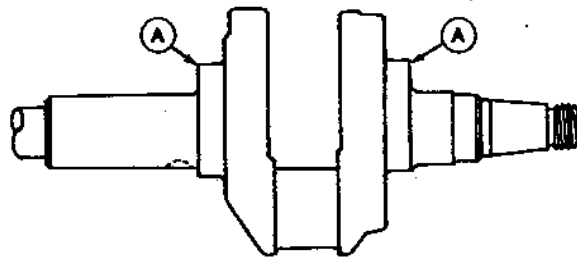
3. Measure inside diameter of bearings (B). Replace link rod if small end is greater than specifications. Replace bushing if large end is greater than specifications. (See this group.)

NOTE: FC290V engine is not equipped with a replaceable support shaft bushing. If bearing is worn, replace weight.

4. Measure inside diameter of support shaft bearing (C). If bearing is greater than specifications, replace bushing, if equipped. (See this group.)

5. Measure support shaft diameter (D). Replace shaft if diameter is less than specification.

6. Inspect wrist pins (E) for any damage. If necessary, replace weight.



DIAMETER SPECIFICATIONS

Link Rod Journal O.D. (MIN)	
FC290V	46.86 mm (1.845 in.)
FC400V/FC420V	53.95 mm (2.124 in.)
FC540V	57.94 mm (2.281 in.)
Link Rod Small End I.D. (MAX)	
All	12.06 mm (0.475 in.)
Link Rod Large End I.D. (MAX)	
FC290V	47.12 mm (1.855 in.)
FC400V/FC420V	54.12 mm (2.131 in.)
FC540V	58.15 mm (2.289 in.)
Support Shaft O.D. (MIN)	
All	25.93 mm (1.021 in.)
Support Shaft Bearing I.D. (MAX)	
All	26.10 mm (1.027 in.)

A—Link Rod Journals
 B—Link Rod Bearings
 C—Shaft Bearing
 D—Support Shaft
 E—Wrist Pins

MX,4020A1,A13 -19-21OCT92

M51760 -JUN-07SEP88

40
20
9

REPLACE BALANCER BUSHINGS

NOTE: Remove bushings with a bearing driver or a press.

Remove link rod bushings with oil groove side facing up.

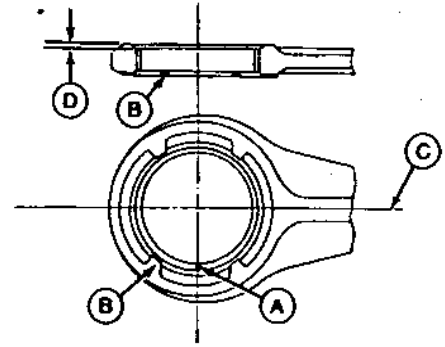
1. Remove bushings.
2. Install link rod bushings with seam (A) at a 90° angle to centerline (C).

NOTE: On FC400V, FC420V and FC540V engines, install bushing from opposite side of oil grooves (B).

3. Install bushing below surface to specifications.

SPECIFICATIONS

Bushing Depth (D) 1.00 mm (0.040 in.)



A—Bushing Seam
B—Oil Grooves
C—Link Rod Centerline
D—Measurement

MX,4020A1,A14 -19-21OCT92

M51681 -UN-31AUG88

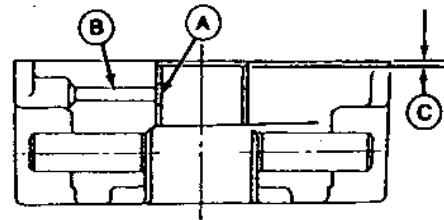
FC400V, FC420V and FC540V:

4. Align oil hole (A) in bushing and oil passage (B) in weight. Install bushing.

5. Install bushing below surface to specifications.

SPECIFICATIONS

Bushing Depth (C) 0.50 mm (0.020 in.)

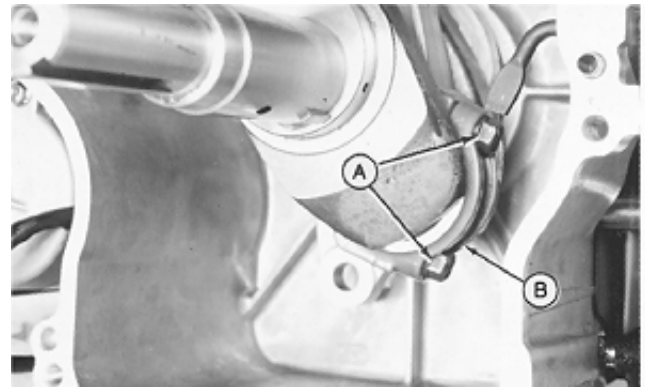


M98,2030A,A7 -19-21OCT92

M51725 -UN-07SEP88

REMOVE AND INSTALL PISTON AND CONNECTING ROD

1. Remove cylinder head. (See Group 15.)
2. Remove crankcase cover. (See this group.)
3. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
4. Remove cap screws (A) and connecting rod cap (B).
5. Push piston and connecting rod from cylinder bore.
6. Make repairs as necessary. (See procedures in this group.)



M54494 -UN-09JAN91

MX,4020A1,A15 -19-21OCT92

7. Deglaze cylinder bore. (See Section 100, Group 15.)
8. Stagger piston ring end gaps 180° apart, but do not align with oil ring side rail end gaps.
9. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
10. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
11. Install piston assembly in cylinder bore with engraved match mark/arrow on piston head facing flywheel side of engine.
12. Install connecting rod cap and cap screws. Tighten cap screws to specifications.



M50074 -UN-31AUG88

TORQUE SPECIFICATIONS

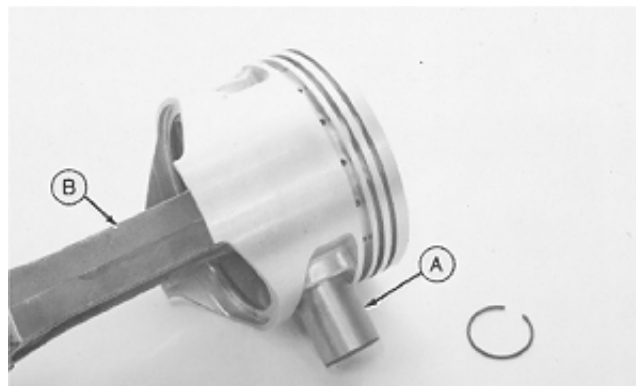
All 20 N·m (177 lb-in.)

MX,4020A1,A16 -19-21OCT92

40
20
11

DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

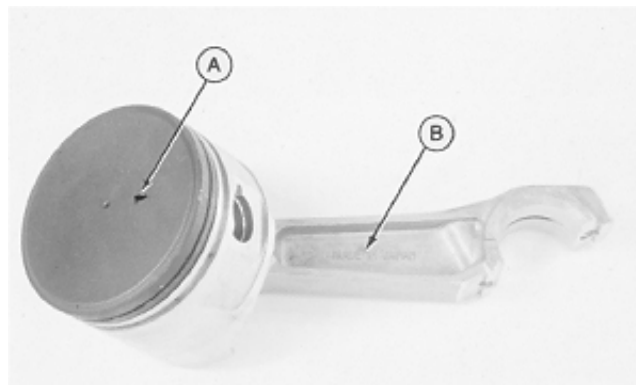
1. Remove circlip, piston pin (A) and connecting rod (B).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.



MX,4020A1,A17 -19-21OCT92

M50063 -UN-31AUG88

4. Align arrow match mark (A) on piston head with MADE IN JAPAN (B) on connecting rod, or if piston is marked with R and L align the R on the piston with the Japanese characters on the connecting rod.
5. Install piston pin and circlip.



MX,4020A1,A18 -19-21OCT92

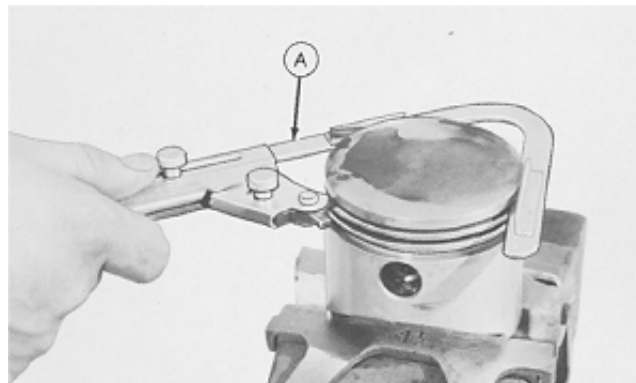
M38111 -UN-29AUG88

INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)
2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.
4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.
5. Check that oil return passages in grooves are open.



MX,4020A1,A19 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.

CLEARANCE SPECIFICATION (MAX)

	Top Ring	Second Ring	Oil Control Ring
FC290V	0.16 mm (0.006 in.)	0.14 mm (0.005 in.)	0.19 mm (0.007 in.)
FC400V/ FC420V/ FC540V	0.17 mm (0.007 in.)	0.15 mm (0.006 in.)	0.20 mm (0.008 in.)



M38102 -UN-29AUG88

MX,4020A1,A20 -19-21OCT92

8. Measure piston pin outer diameter. Replace if less than specification.

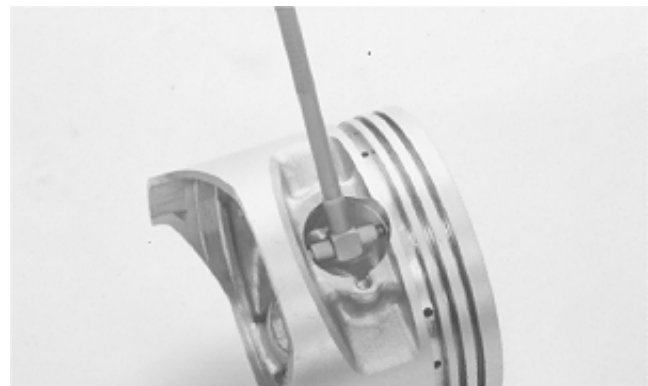
9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

	Piston Pin O.D. (MIN)	Piston Bore I.D. (MAX)
FC290V	18.98 mm (0.747 in.)	19.03 mm (0.749 in.)
FC400V/ FC420V/ FC540V	21.98 mm (0.865 in.)	22.04 mm (0.868 in.)



M50064 -UN-31AUG88



M50065 -UN-31AUG88

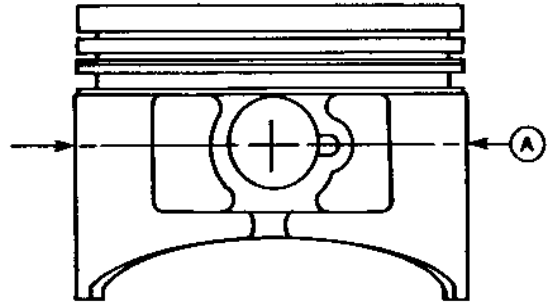
MX,4020A1,A21 -19-21OCT92

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)



SPECIFICATIONS

Piston O.D. (A)

FC290V	77.85—77.87 mm (3.0649—3.0657 in.)
FC400V	86.83—86.864 mm (3.4185—3.4192 in.)
FC420V	88.83—88.85 mm (3.4885—3.498 in.)
FC540V	88.83—88.864 mm (3.4885—3.4984 in.)

Piston-to-Cylinder Bore Clearance

FC290V	0.142 mm (0.0056 in.)
FC400V	0.13—0.151 mm (0.005—0.0059 in.)
FC420V	0.13—0.151 mm (0.005—0.0059 in.)
FC540V	0.110—0.151 mm (0.0043—0.0059 in.)

MX,4020A1,A21A -19-21OCT92

-UN-06APR91
M80398

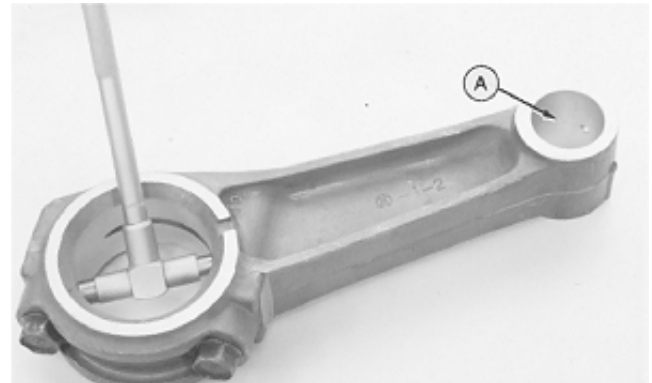
INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.

2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)

3. Install connecting rod cap. Tighten to 20 N·m (177 lb-in.).

4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



BEARING I.D. SPECIFICATIONS (MAX)

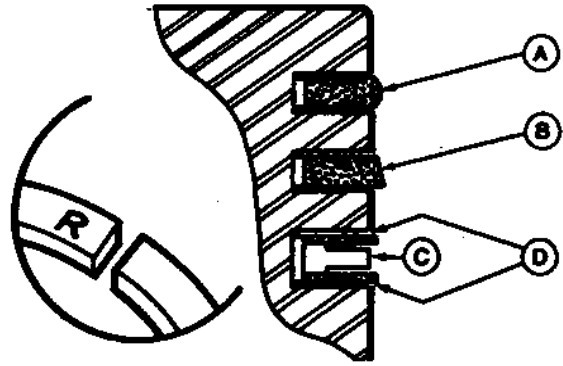
	Crankshaft Bearing	Piston Bearing
FC290V	35.57 mm (1.400 in.)	19.06 mm (0.750 in.)
FC400V/ FC420V/ FC540V	41.07 mm (1.617 in.)	22.06 mm (0.868 in.)

MX,4020A1,A22 -19-21OCT92

-UN-31AUG88
M50066

REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)
4. Install top ring (A) and second ring (B) with R or NPR mark facing up. Rings should turn freely in grooves.
5. Oil ring is an assembly. Install spacer (C), then side rails (D). Put side rail end gaps 180° apart.



A—Top Ring
B—Second Ring
C—Spacer
D—Side Rails

MX,4020A1,A23 -19-21OCT92

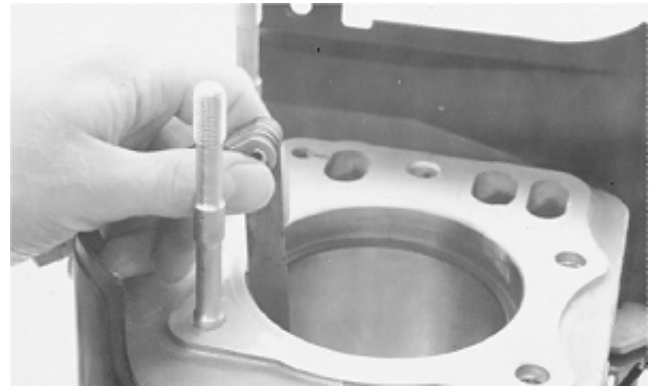
M38074 -UN-29AUG88

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS

Minimum End Gap	0.18 mm (0.007 in.)
Maximum End Gap	
Compression Rings	
FC290V	0.71 mm (0.028 in.)
FC400V/FC420V/FC540V	0.90 mm (0.035 in.)
Oil Ring Side Rails	
FC290V	1.20 mm (0.047 in.)
FC400V/FC420V/FC540V	1.30 mm (0.051 in.)



M50073 -UN-31AUG88

MX,4020A1,A24 -19-21OCT92

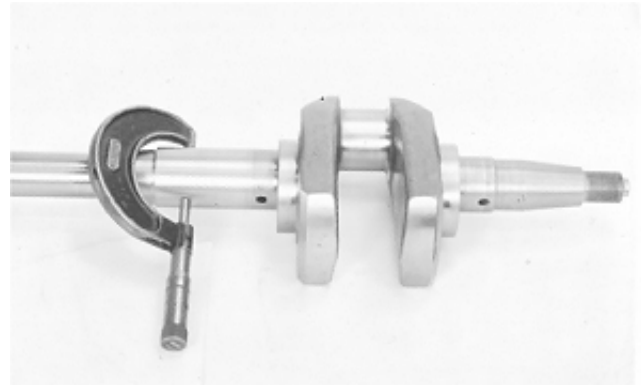
40
20
15

REMOVE, INSPECT AND INSTALL CRANKSHAFT

1. Remove camshaft. (See this group.)
2. Remove piston and connecting rod. (See this group.)
3. Remove balancer. (See this group.)
4. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

5. Check crankshaft alignment (T.I.R.). (See this group.)
6. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
7. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
8. Measure crankshaft main bearing journals and connecting rod journal. Replace crankshaft if measurements are less than specifications.



M54495 -UN-09JAN91

JOURNAL SPECIFICATIONS (MIN)

	Main Bearing Journal PTO Side	Journal Flywheel Side	Connecting Rod Journal
FC290V	29.92 mm (1.178 in.)	—	35.43 mm (1.395 in.)
FC400V/ FC420V	34.92 mm (1.376 in.)	—	40.93 mm (1.611 in.)
FC540V	37.90 mm (1.492 in.)	—	40.93 mm (1.611 in.)

MX,4020A1,A25 -19-21OCT92

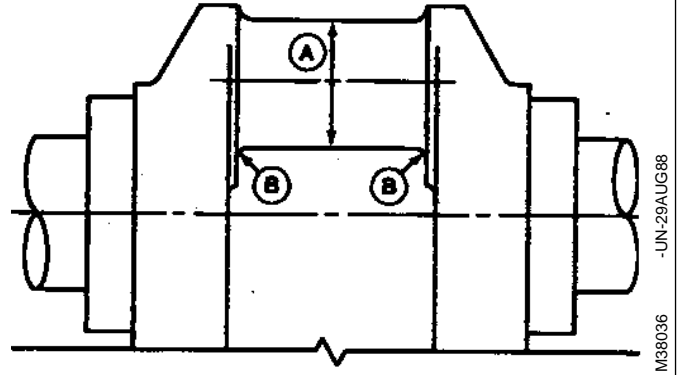
NOTE: An under-sized connecting rod is available through the parts catalog, if necessary.

9. Connecting rod journal (A) can be resized to accept under-sized rod. Have grinding done by a reliable repair shop. Before sending crankshaft for grinding, inspect journal radii (B) for cracks.

10. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.

11. Put a light film of oil on crankshaft bearing surfaces.

12. Pack grease in oil seals and install crankshaft.

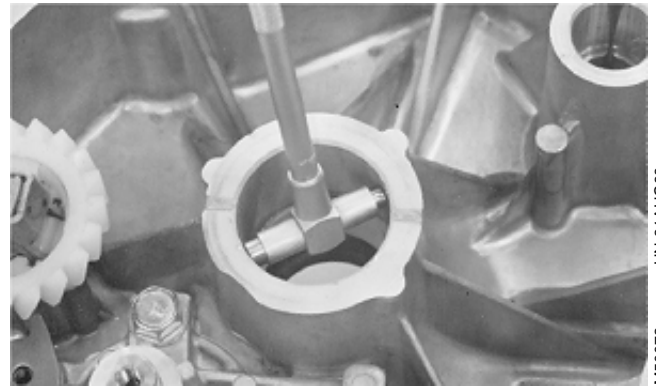


MX,4020A1,A25A -19-21OCT92

INSPECT CRANKSHAFT PLAIN BEARING

NOTE: FC290V crankcase cover is fitted with a replaceable shell.

1. Remove crankshaft. (See this group.)
2. Measure crankshaft bearing in crankcase cover. Replace cover or shell, if equipped, if diameter is greater than specifications. (See this group.)
3. Install crankshaft.



BEARING I.D. SPECIFICATIONS (MAX)

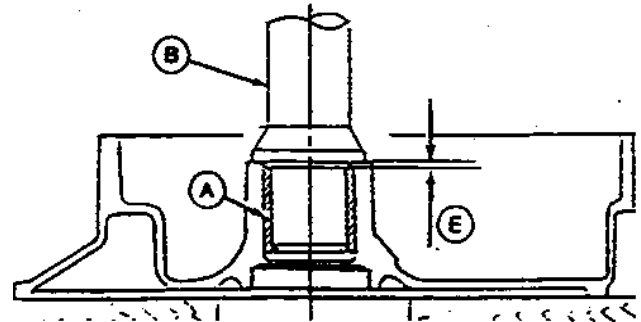
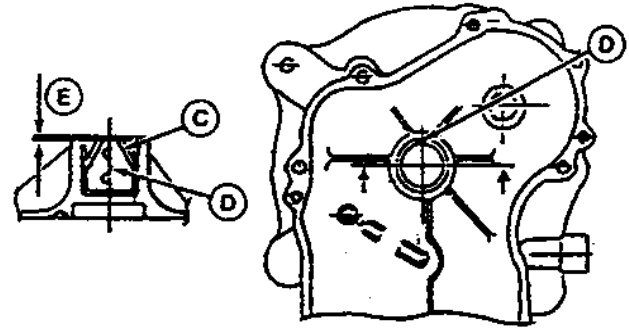
FC290V	30.13 mm (1.186 in.)
FC400V/FC420V	35.07 mm (1.381 in.)
FC540V	38.06 mm (1.498 in.)

MX,4020A1,A26 -19-21OCT92

REPLACE CRANKSHAFT BEARING SHELL—FC290V

1. Remove oil seal. (See Inspect Oil Seals in this group.)
2. Drive old bearing (A) from cover using an appropriate bushing tool (B) and an arbor press.
3. Align new bearing with oil grooves (C) facing out of cover and with seam (D) facing top of cover
4. Install new bearing to depth (E) 1 mm (0.039 in.) below flange surface.
5. Install new oil seal.

A—Bearing Shell
B—Bushing Tool
C—Oil Grooves
D—Seam
E—Installation Depth



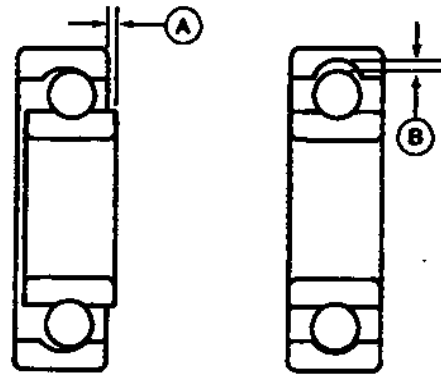
MX,4020A1,A27 -19-21OCT92

M51524 -UN-31AUG88

M51525 -UN-31AUG88

INSPECT CRANKSHAFT BALL BEARING

1. Remove flywheel and oil seal. (See Inspect Oil Seals in this group.)
2. Remove crankshaft bearing using a bearing, bushing and seal driver set.
3. Thoroughly clean bearing in solvent. Dip bearing in light weight oil.
4. Spin the bearing by hand and check for axial (A) and radial (B) free play.
5. Replace the bearing if it is noisy or has too much play.
6. Install bearing flush to inside of crankcase using a bearing, bushing and seal driver set.
7. Install oil seal.



MX,4020A1,A28 -19-21OCT92

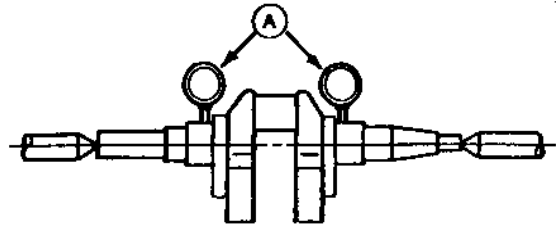
M38073 -UN-29AUG88

CHECK CRANKSHAFT ALIGNMENT (TIR)

Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

Maximum TIR 0.05 mm (0.002 in.)



MX,4020A1,A29 -19-21OCT92

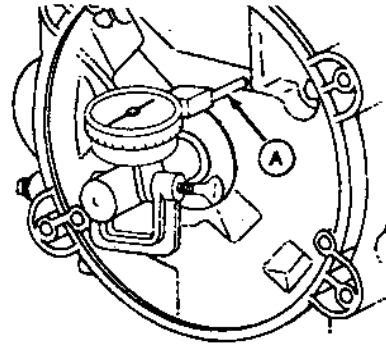
M80432 -UN-08MAY91

MEASURE CRANKSHAFT END PLAY

1. Measure end play using dial indicator (A). Record this measurement.
2. Move crankshaft in and out. Remove crankcase cover and adjust end play if not within specifications. (See this group.)

SPECIFICATIONS

End Play 0.09—0.22 mm (0.004—0.009 in.)



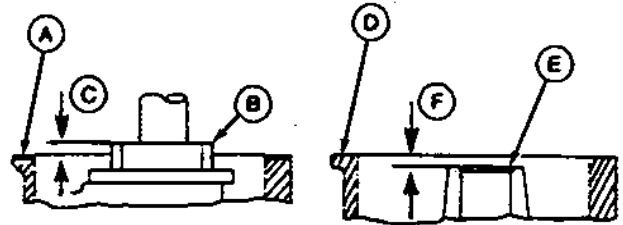
MX,4020A1,A30 -19-21OCT92

M30048 -UN-06SEP88

ADJUST CRANKSHAFT END PLAY

1. With gasket (A) installed on crankcase, measure from gasket surface to crankshaft gear surface (B). Record measurement (C).
2. Measure from crankcase cover mounting face (D) to PTO bearing end (E). Record measurement (F).

- A—Gasket
- B—Crank Gear Surface
- C—Measurement
- D—Crankcase Cover Mounting Face
- E—PTO Bearing End
- F—Measurement



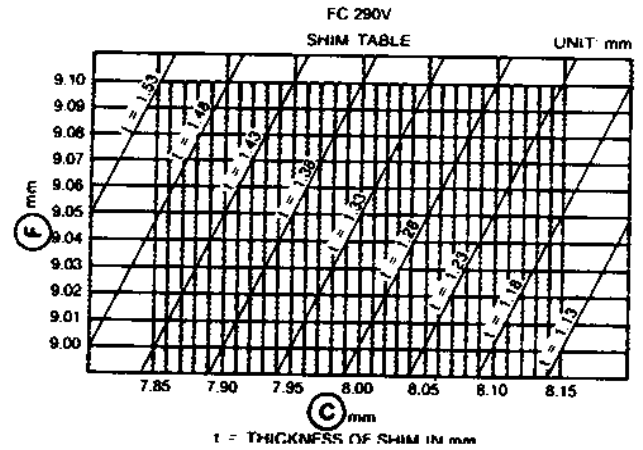
MX,4020A1,A31 -19-21OCT92

M51545 -UN-31AUG88

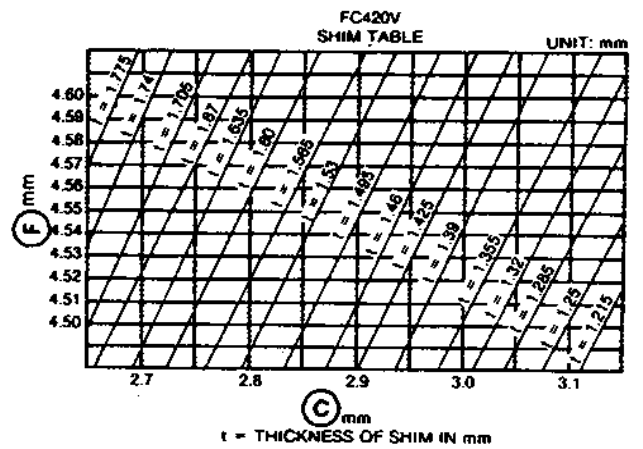
3. Locate measurements on appropriate table. Follow lines to where recorded measurements intersect. Choose the next smaller shim from the table.

4. Install shim on PTO shaft.

5. Install crankcase cover. (See this group.)

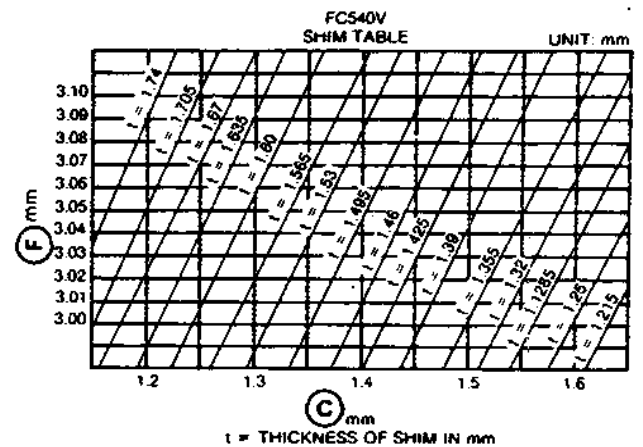


M51548
-19-14MAR89



M51547
-19-14MAR89

Also FC400V



M51546
-19-14MAR89

MX.4020A1,A31A -19-21OCT92

INSPECT OIL SEALS

NOTE: Pack lithium base grease in new or used seals.

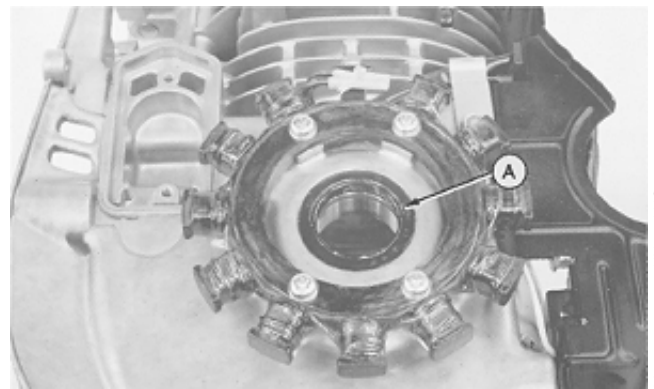
1. Remove flywheel. (See Group 10.)
2. Inspect oil seals (A and B) at flywheel end and PTO end. Replace if necessary.
3. Remove crankshaft. (See this group.)
4. Remove worn or damaged seals with a screwdriver.
5. Install seals with lip to inside of engine using a bearing, bushing and seal driver set. Press seals in until flush with hub.

On FC540V engine, press in seal on PTO side to specification, below crankcase cover flange surface.

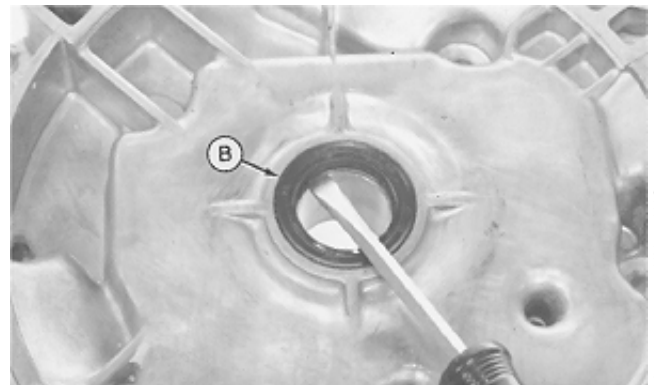
6. Install crankshaft.

SPECIFICATIONS

FC540V Seal Depth 0.50 mm (0.020 in.)



Flywheel End



PTO End

MX,4020A1,A32 -19-21OCT92

INSPECT CYLINDER BLOCK

1. Remove crankshaft.
2. Clean and check block for cracks.
3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
4. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,4020A1,A33 -19-21OCT92

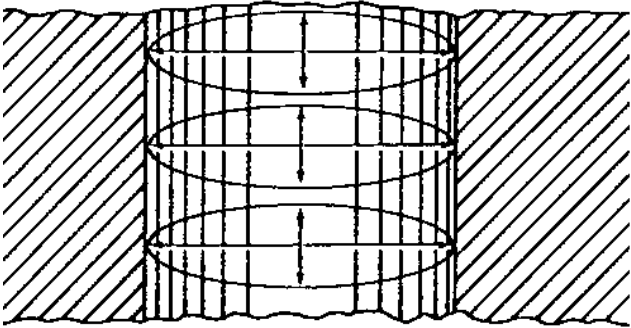
NOTE: A bare block is available for service.

5. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

6. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

NOTE: If cylinder is rebored, oversize piston and rings must be installed.

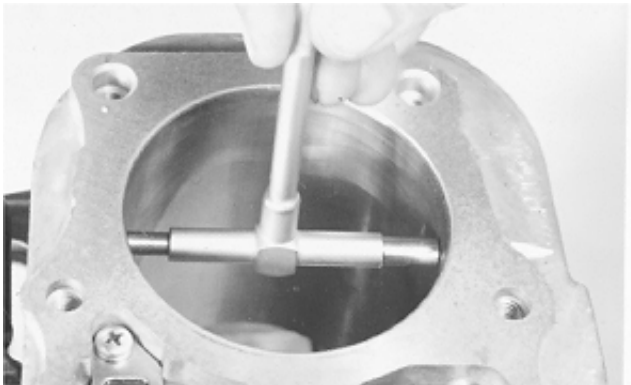
7. Install crankshaft.



M51745 -UN-23FEB89

CYLINDER BORE SPECIFICATIONS

	Standard	Wear Limit
FC290V	77.98—78.00 mm (3.070—3.071 in.)	78.07 mm (3.074 in.)
FC400V	86.98—87.00 mm (3.424—3.425 in.)	87.08 mm (3.428 in.)
FC420V	88.98—89.00 mm (3.503—3.504 in.)	89.08 mm (3.507 in.)
FC540V	88.98—89.00 mm (3.503—3.504 in.)	89.08 mm (3.507 in.)



M54496 -UN-09JAN91

MX,4020A1,A34 -19-21OCT92

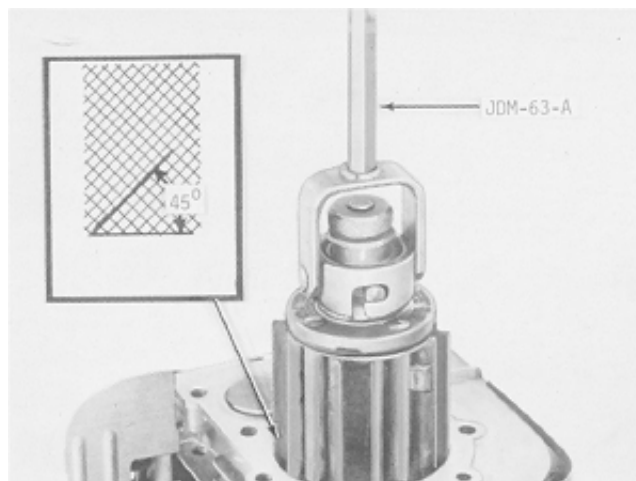
REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use 0.25, 0.50 or 0.75 mm (0.010, 0.020 or 0.030 in.) oversize pistons and rings. Have a reliable repair shop rebore the block, or use the drill press and honing tool.

1. Rebore cylinder with a honing tool to initial and final bore specifications.
2. Align center of bore to press center. Set the press to operate from 200—250 rpm.
3. Lower and raise hone until ends extend 20—25 mm (0.75—1.0 in.) past ends of cylinder.
4. Turn adjusting nut on one hone until stones contact cylinder wall at narrowest point.
5. Coat inside of cylinder with honing oil. Turn hone by hand. If you cannot turn it, hone is too tight.
6. Start drill press. Move hone up and down in cylinder approximately 20 times per minute.
7. Check cylinder diameter regularly during honing. Stop press before measuring. Remove hone from cylinder.

NOTE: Finish should not be smooth, but have a 40—60° cross-hatch pattern.

IMPORTANT: Check stone for wear or damage. Use correct stone for the job.



M24711 -UN-25AUG88

40
20
23

MX,4020A1,A35 -19-21OCT92

CYLINDER INITIAL BORE SPECIFICATIONS

Piston Oversize:
0.25 mm
(0.010 in.)

FC290V
 78.21—78.23 mm
 (3.079—3.080 in.)

FC400V
 87.23—87.25 mm
 (3.434—3.435 in.)

FC420V
 89.23—89.25 mm
 (3.513—3.514 in.)

FC540V
 89.21—89.23 mm
 (3.512—3.513 in.)

Piston Oversize:
0.50 mm
(0.020 in.)

78.46—78.48 mm
 (3.089—3.090 in.)

87.48—87.50 mm
 (3.444—3.4448 in.)

89.48—89.50 mm
 (3.523—3.524 in.)

89.46—89.48 mm
 (3.522—3.523 in.)

Piston Oversize:
0.75 mm
(0.030 in.)

78.71—78.73 mm
 (3.099—3.100 in.)

87.73—87.75 mm
 (3.453—3.454 in.)

89.73—89.75 mm
 (3.533—3.534 in.)

89.72—89.73 mm
 (3.532—3.533 in.)

MX,4020A1,A36 -19-21OCT92

8. Hone the cylinder an additional 0.028—0.030 mm (0.0011—0.0012 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

IMPORTANT: DO NOT use gasoline or commercial solvents to clean cylinder bores. Solvents will not remove metal particles produced during honing.

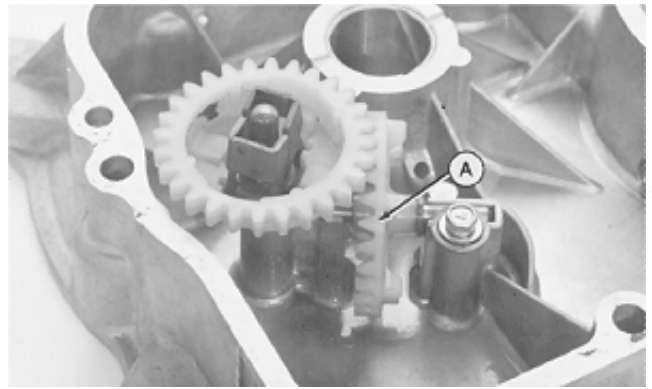
9. Clean the cylinder thoroughly using soap, warm water and clean rags. Continue to clean cylinder until white rags show no discoloration.

10. Dry the cylinder. Apply engine oil to cylinder wall.

M98,2040A,A9 -19-21OCT92

INSPECT AND REPLACE OIL SLINGER—FC290V

1. Remove crankcase cover. (See this group.)
2. Remove oil slinger (A).
3. Inspect oil slinger. Replace if worn or damaged.
4. Install oil slinger.



MX,4020A1,A37 -19-21OCT92

M50078 -UN-31AUG88

DISASSEMBLE AND ASSEMBLE OIL PUMP—FC400V/FC420V

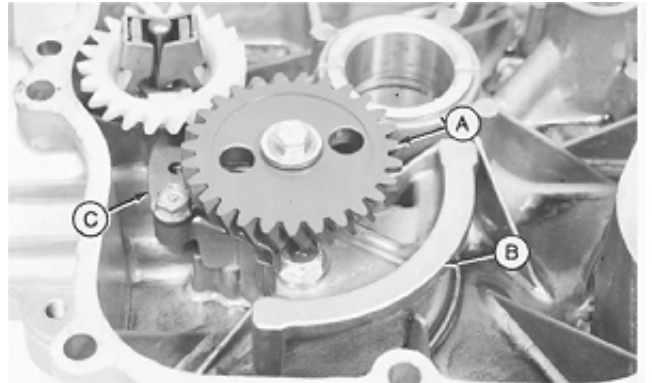
1. Remove crankcase cover. (See this group.)
2. Remove oil pump gear (A).

IMPORTANT: Remove rotor shaft and oil pump cover together to avoid damaging governor.

3. Remove oil pump assembly (B).
4. Remove relief spring and ball (C).
5. Inspect all parts. (See this group.)

NOTE: Install gear (A) with recess facing away from crankcase cover.

6. Install oil pump assembly.



MX,4020A1,A38 -19-21OCT92

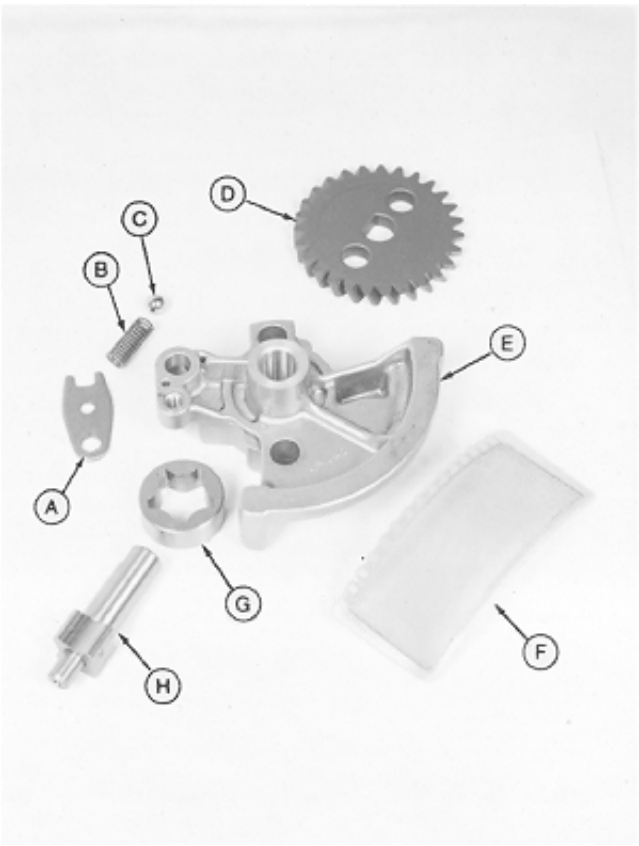
M80018 -UN-09JAN91

40
20
25

INSPECT OIL PUMP—FC400V/FC420V

1. Inspect all parts for wear or damage. Replace as necessary.

- A—Plate
- B—Spring
- C—Ball
- D—Gear
- E—Cover
- F—Screen
- G—Outer Rotor
- H—Rotor Shaft



MX,4020A1,A39 -19-21OCT92

2. Measure outside diameters of shaft. Replace both shaft and outer rotor if less than specification.

SPECIFICATIONS

Minimum Shaft O.D.	
Large O.D.	12.63 mm (0.497 in.)
Small O.D.	7.94 mm (0.313 in.)

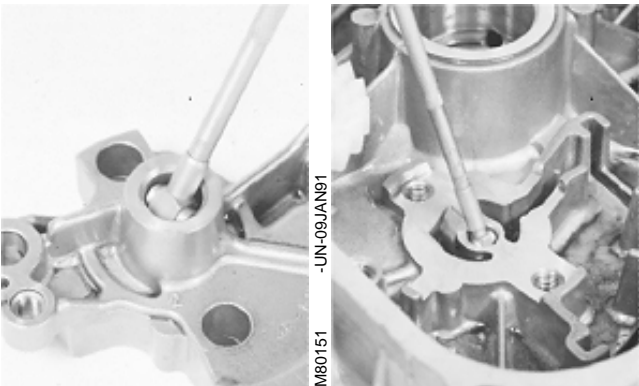


MX,4020A1,A40 -19-21OCT92

3. Measure rotor shaft bearings. Replace oil pump cover or crankcase cover if greater than specifications.

SPECIFICATIONS

Maximum Rotor Shaft Bearing I.D.	
Oil Pump Cover	12.76 mm (0.502 in.)
Crankcase Cover	8.07 mm (0.318 in.)

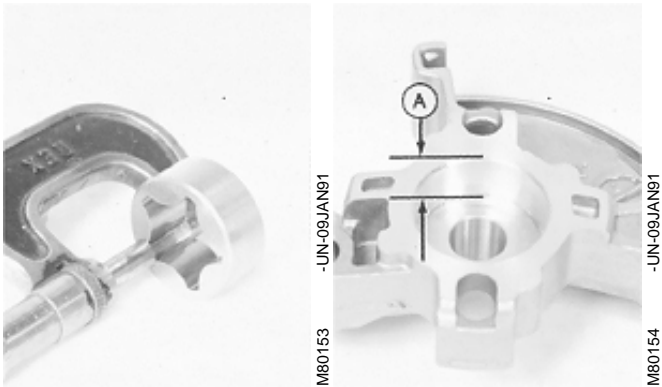


MX,4020A1,A41 -19-21OCT92

4. Measure thickness of outer rotor. Replace both outer rotor and shaft if less than specifications.
5. Measure out rotor bearing depth (A). Replace oil pump cover if greater than specifications.

OUTER ROTOR SPECIFICATIONS

Minimum Rotor Thickness	11.92 mm (0.470 in.)
Maximum Bearing Depth	12.14 mm (0.478 in.)

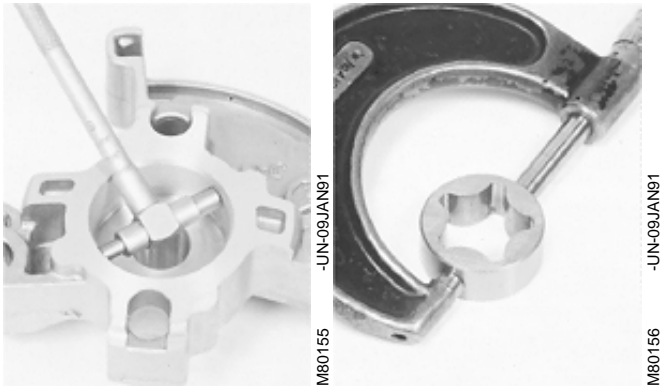


MX,4020A1,A42 -19-21OCT92

6. Measure inside diameter of rotor bearing. Replace oil pump cover if greater than specifications.
7. Measure outside diameter of rotor. Replace both rotor and shaft if less than specifications.

OUTER ROTOR SPECIFICATIONS

Maximum Bearing I.D.	29.20 mm (1.149 in.)
Minimum Rotor O.D.	28.95 mm (1.140 in.)



MX,4020A1,A43 -19-21OCT92

8. Measure relief valve spring. Replace if free length is less than specification.

SPECIFICATIONS

Minimum Spring Length	19.00 mm (0.750 in.)
-----------------------	----------------------



MX,4020A1,A44 -19-21OCT92

DISASSEMBLE AND ASSEMBLE OIL PUMP—FC540V

1. Remove crankcase cover. (See this group.)
2. Remove oil pump gear (A).

IMPORTANT: Remove rotor shaft and oil pump cover together to avoid damaging governor.

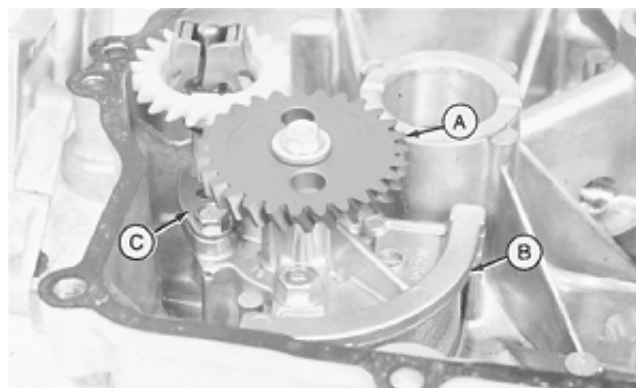
3. Remove oil pump assembly (B).
4. Remove relief spring and ball (C).
5. Inspect all parts. (See this group.)

IMPORTANT: Install outer rotor with dimple (D) facing away from crankcase cover, to avoid oil pump damage.

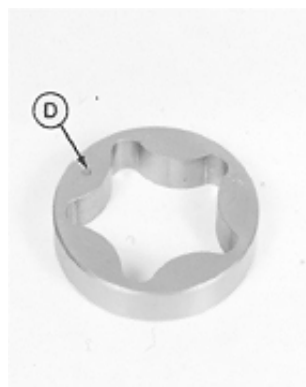
NOTE: Install gear (A) with recess facing away from crankcase cover.

6. Install oil pump assembly.

A—Oil Pump Gear
B—Oil Pump Assembly
C—Relief Spring and Ball
D—Dimple



M80011
-UN-09JAN91



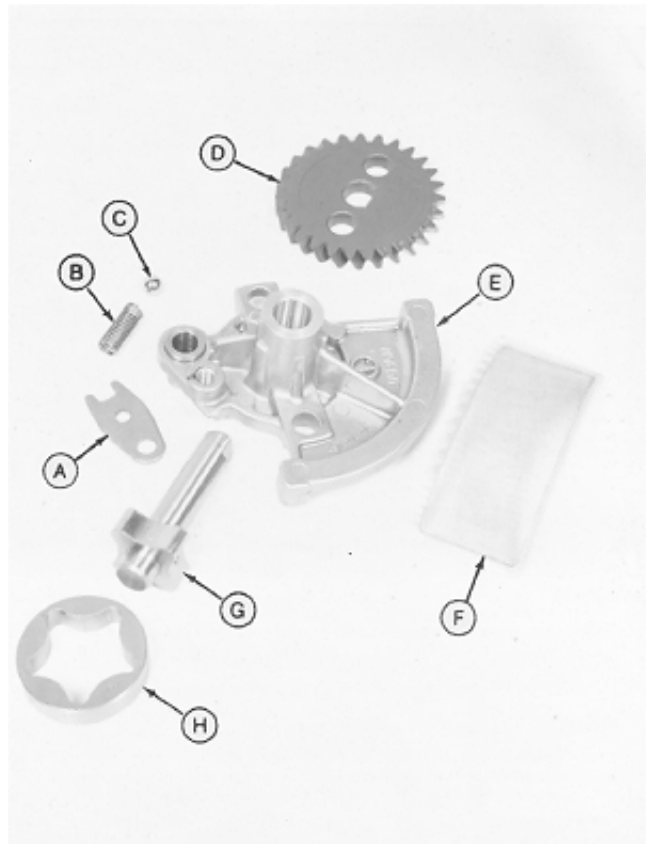
M80012
-UN-09JAN91

MX,4020A1,A45 -19-21OCT92

INSPECT OIL PUMP—FC540V

1. Inspect all parts for wear or damage. Replace as necessary.

- A—Plate
- B—Spring
- C—Ball
- D—Gear
- E—Cover
- F—Screen
- G—Rotor Shaft
- H—Outer Rotor



MX,4020A1,A46 -19-21OCT92

M80013 -UN-09JAN91

2. Measure outside diameters of shaft. Replace both shaft and outer rotor if less than specification.

SPECIFICATIONS

Minimum Shaft O.D. 12.63 mm (0.497 in.)



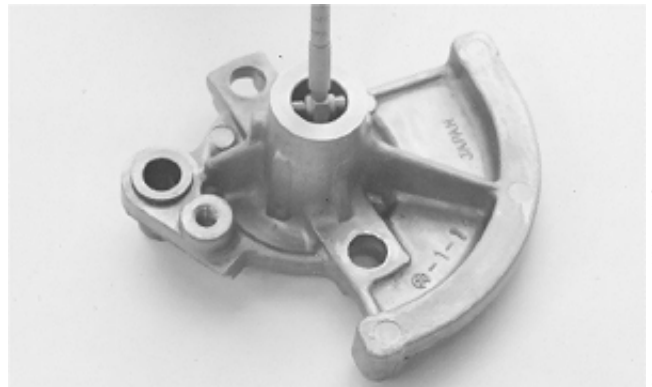
MX,4020A1,A47 -19-21OCT92

M50084 -UN-31AUG88

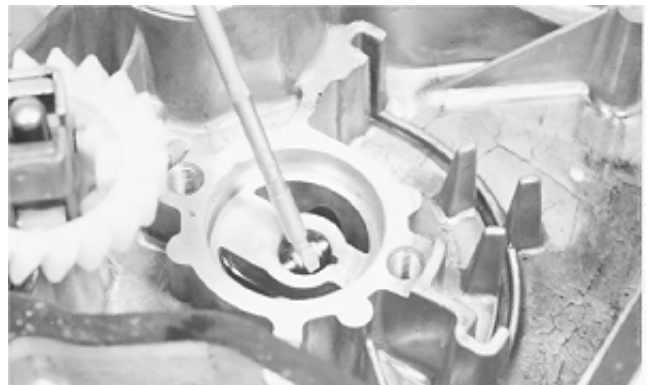
3. Measure rotor shaft bearings. Replace oil pump cover or crankcase cover if greater than specifications.

SPECIFICATIONS

Maximum Rotor Shaft Bearing I.D. 12.76 mm (0.502 in.)



M50089 -UN-31AUG88



M80014 -UN-09JAN91

MX,4020A1,A48 -19-21OCT92

4. Measure thickness of outer rotor. Replace both outer rotor and shaft if less than specifications.

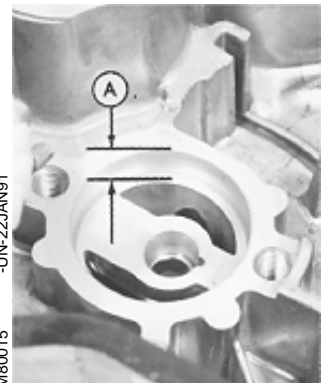
5. Measure outer rotor bearing depth (A). Replace crankcase cover if greater than specifications.

OUTER ROTOR SPECIFICATIONS

Minimum Rotor Thickness 9.92 mm (0.391 in.)
Maximum Bearing Depth 10.17 mm (0.401 in.)



M80015 -UN-22JAN91



M80016 -UN-09JAN91

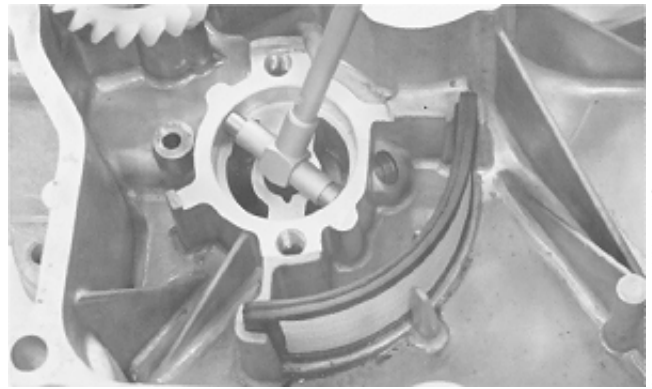
MX,4020A1,A49 -19-21OCT92

6. Measure inside diameter of rotor bearing. Replace crankcase cover if greater than specifications.

7. Measure outside diameter of rotor. Replace both rotor and shaft if less than specifications.

OUTER ROTOR SPECIFICATIONS

Maximum Bearing I.D.	40.77 mm (1.605 in.)
Minimum Rotor O.D.	40.47 mm (1.596 in.)



M50090
-UN-31AUG88



M80017
-UN-09JAN91

MX,4020A1,A50 -19-21OCT92

8. Measure relief valve spring. Replace if free length is less than specification.

SPECIFICATIONS

Minimum Spring Length	19.00 mm (0.750 in.)
---------------------------------	----------------------

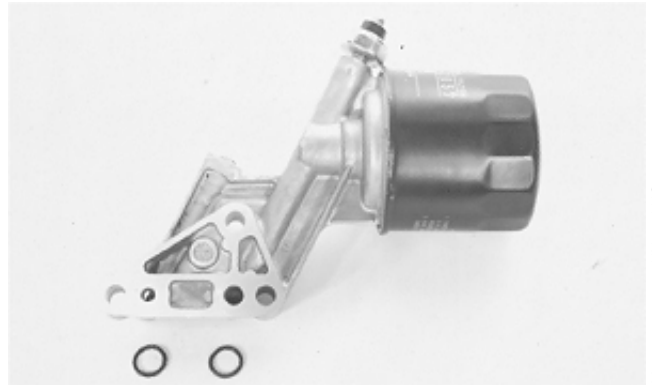


M50083
-UN-31AUG88

MX,4020A1,A44 -19-21OCT92

REMOVE, INSPECT AND INSTALL OIL FILTER MANIFOLD—IF EQUIPPED

1. Remove oil filter and manifold.
2. Inspect oil filter. Replace if excessively contaminated or damaged.
3. Inspect oil passages for clogs. Clean if needed.
4. Inspect rubber gaskets. Replace if worn or damaged.
5. Install filter and manifold.



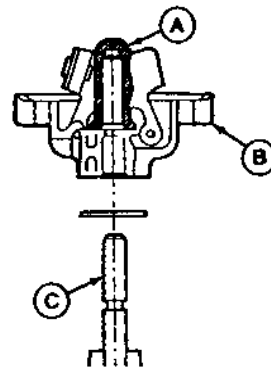
M50077 -UN-31AUG88

MX,4020A1,A51 -19-21OCT92

INSPECT AND REPLACE GOVERNOR

IMPORTANT: Removal damages governor. If not damaged, do not remove.

1. Remove crankcase cover. (See this group.)
2. Inspect governor. If necessary to replace, remove with screwdriver.
3. If removed, press shaft (C) back into block until it protrudes 32.2—32.8 mm (1.267—1.291 in.).



M51762 -UN-07SEP88

NOTE: Assemble sleeve and gear before installing assembly on shaft.

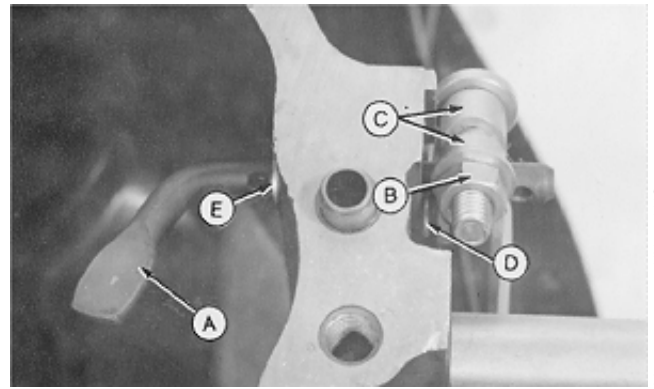
4. Install sleeve (A) onto governor gear (B).
5. Install governor assembly onto shaft. Push down on assembly until it snaps into place.

MX,4020A1,A52 -19-21OCT92

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (A). Replace if damaged.
3. To replace shaft, loosen nut (B) on lever (C).
4. Remove retaining pin (D), governor shaft and washer (E).
5. Install washer, shaft and retaining pin. Tighten nut.



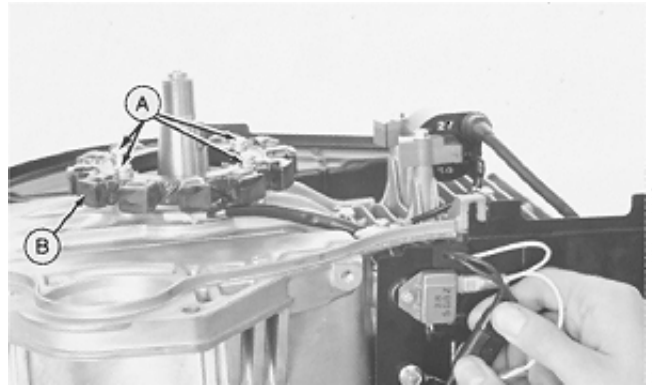
A—Governor Shaft
B—Nut
C—Governor Lever
D—Retaining Pin
E—Washer

MX,4020A1,A53 -19-21OCT92

M50094 -UN-31AUG88

REMOVE AND INSTALL STATOR

1. Remove flywheel. (See Group 10.)
2. Disconnect stator lead.
3. Remove screws (A) and stator (B).
4. Install stator.
5. Connect stator lead.
6. Install flywheel.

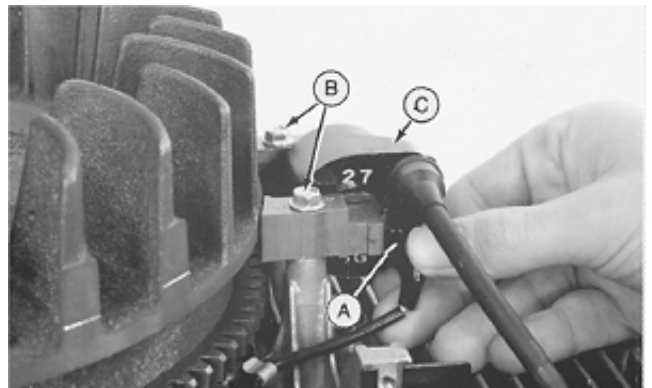


M50146
-UN-31AUG88

MX,4025A1,A1 -19-21OCT92

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove blower housing. (See Group 10.)
2. Disconnect wiring lead (A).
3. Remove cap screws (B) and armature with coil (C).
4. Loosely install armature with coil.
5. Connect wiring lead.
6. Adjust armature air gap. (See this group.)
7. Install blower housing.



M50147
-UN-23FEB89

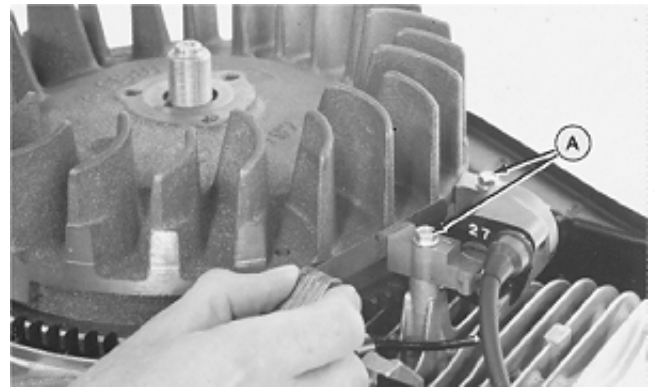
MX,4025A1,A2 -19-21OCT92

ADJUST ARMATURE AIR GAP

1. Turn flywheel magnet away from armature.
2. Insert feeler gauge, between flywheel and armature.
3. Push armature against flywheel and tighten screws (A).
4. Turn flywheel to remove feeler gauge.

AIR GAP SPECIFICATIONS

Feeler Gauge Blade 0.30 mm (0.012 in.)



M50148
-UN-31AUG88

MX,4025A1,A3 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	Mineral Spirits	Clean Armature
	Multipurpose Grease	Grease Starter Parts

M98,2030A,ZB -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Recoil Starter—FC290V
Spring and Case
Pawl and Spring Kit
Complete Starter

Recoil Starter—FC400V/FC420V

Electric Starter
Brush Kit
Clutch Kit
Complete Starter
Complete Solenoid—FC400V/FC420V/FC540V

MX,4030A1,A0 -19-21OCT92

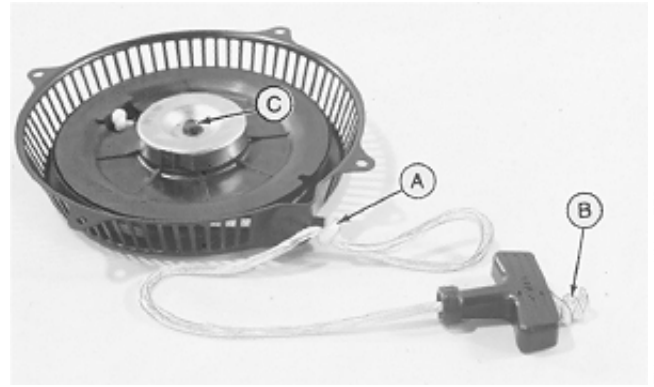
40
30
1

DISASSEMBLE RECOIL STARTER—FC290V/FC400V/FC420V

1. Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (A) to prevent rope from winding back onto reel.
3. Pry knot (B) out of handle and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (A). Slowly release reel tension. Do not let rope get wedged between reel and housing.

CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove screw (C) and ratchet cover.



TY13495 -UN-23FEB89

MX,4030A1,A1 -19-21OCT92

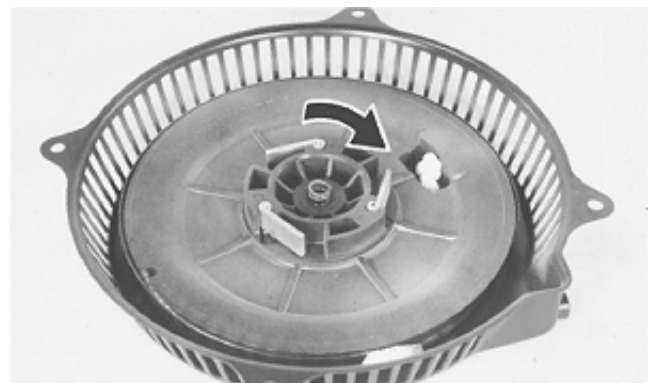
CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

7. Turn the reel one half turn clockwise so no spring tension can be felt.



FC290V

M54499 -UN-09JAN91



FC400V/FC420V

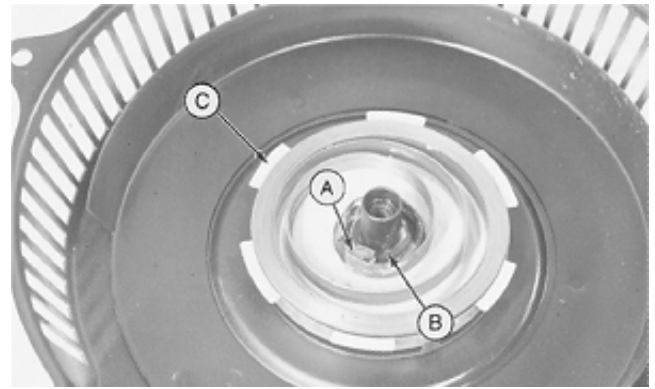
TY13496 -UN-23FEB89

MX,4030A1,A1A -19-21OCT92

8. Spring is stored in spring case (C) in housing. Lift reel straight up so spring remains seated in housing.

9. Carefully unhook spring tang (A) from catch (B).

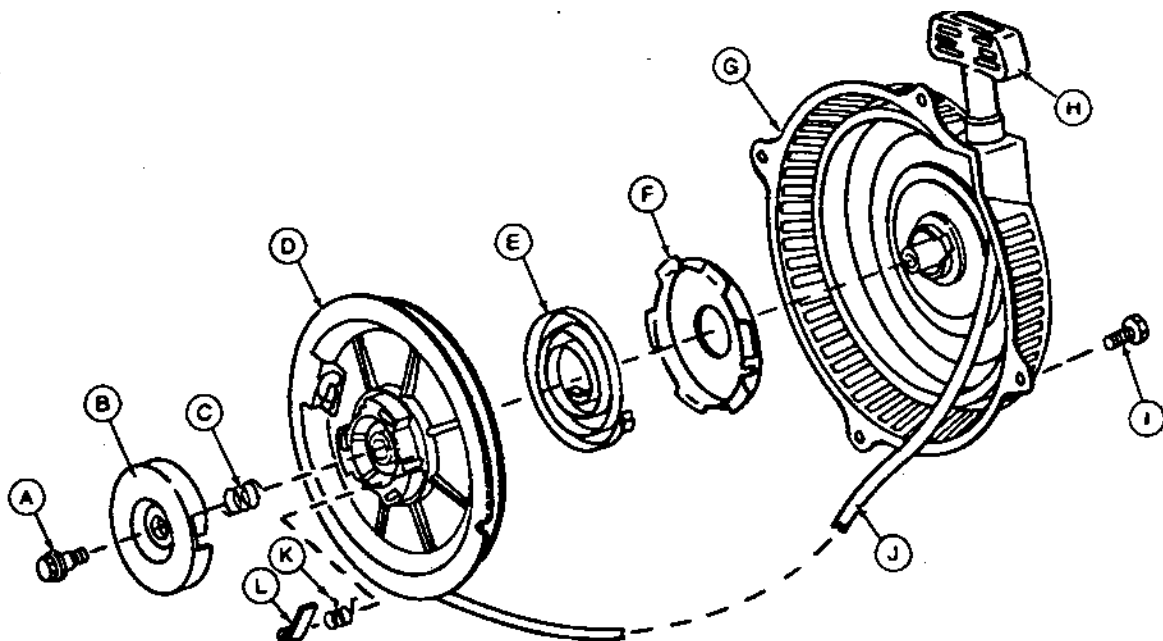
10. Remove spring case from housing.



MX,4030A1,A2 -19-21OCT92

TY13497 -UN-23FEB89

INSPECT RECOIL STARTER—FC290V/FC400V/FC420V



A—Screw
B—Retainer
C—Spring
D—Reel

E—Spring
F—Case (If Equipped)
G—Housing
H—Handle

I—Screw (4 used)
J—Rope
K—Spring (2 used—FC290V)
(3 used—FC400V/420V)

L—Pawl (2 used—FC290V)
(3 used—FC400V/420V)

Inspect and replace all damaged or worn parts.

MX,4030A1,A3 -19-21OCT92

TY13498 -UN-23FEB89

40
30
3

REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

1. Working from the center out, carefully unwind spring from spring case or reel.
2. Hook outside spring tang in reel or case. Wind spring into reel or spring case, working toward center.

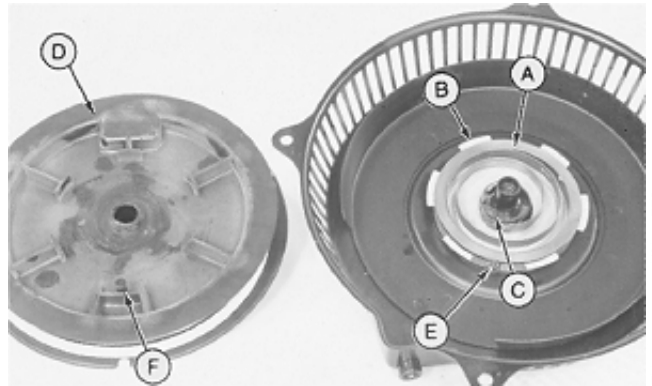


M54497 -UN-09JAN91

MX,4030A1,A4 -19-21OCT92

ASSEMBLE RECOIL STARTER—FC290V/FC400V/FC420V

1. Wind rope counterclockwise onto reel.
2. Place spring case (B) into housing with spring tang over catch (C).
3. Install reel in spring case, with round peg (E) aligned with end of spring (F).
4. Turn reel counterclockwise until you feel tang hook on catch.



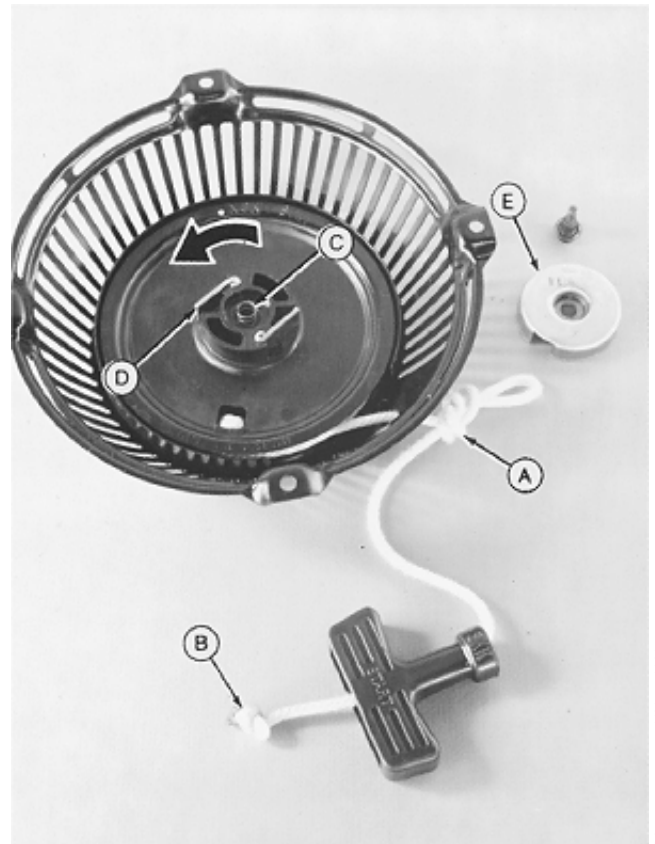
TY13499 -UN-23FEB89

A—Spring
B—Case
C—Catch
D—Reel
E—Round Peg
F—End of Spring

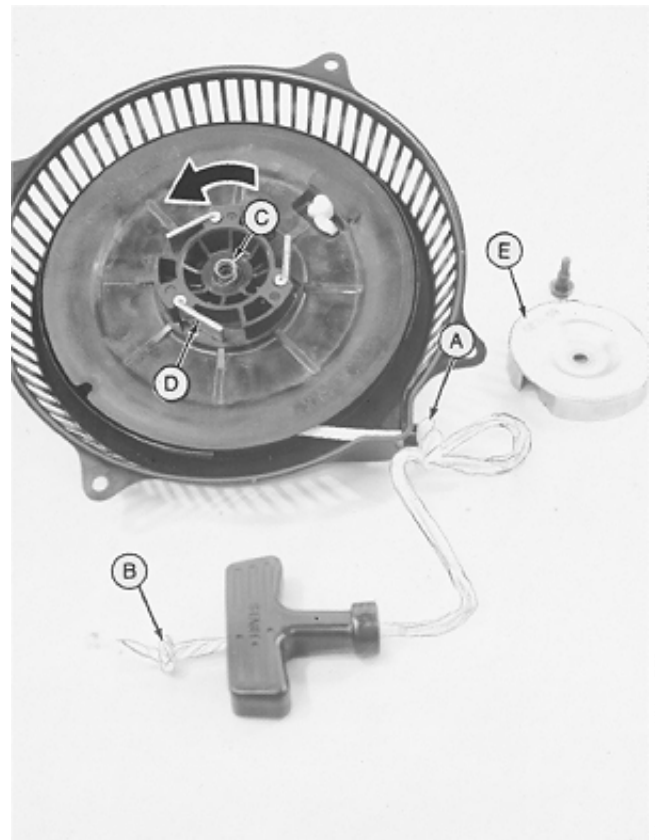
MX,4030A1,A5 -19-21OCT92

5. Turn reel two turns counterclockwise to preload spring.
6. While holding reel to keep it from unwinding, feed end of rope through hole. Tie knot (A) to hold rope.
7. Install handle and secure with knot (B).
8. Remove knot (A).
9. Install spring (C) and ratchet cover (E) with opening(s) in cover over pawl(s) (D). Check for free movement of pawls.
10. Pull rope to check for proper operation.
11. Install recoil starter on engine.

A—Knot
B—Knot
C—Spring
D—Pawls
E—Retainer



FC290V



FC400V/FC420V

MX,4030A1,A5A -19-21OCT92

ANALYZE ELECTRIC STARTER CONDITION

1. The starter overheats because of:

- Long cranking.
- Armature binding.

2. The starter operates poorly because of:

- Armature binding.
- Dirty or damaged starter drive.
- Badly worn brushes or weak brush springs.
- Excessive voltage drop in cranking system.
- Battery or wiring defective.
- Shorts, opens, or grounds in armature.

NOTE: Starter repair is limited to brushes, end caps, and starter drive. Fields in starter are permanent magnets and are not serviceable. If housing or armature is damaged, replace starter.

MX,4030A1,A6 -19-21OCT92

BENCH TEST SOLENOID DRIVE STARTER—FC400V/FC420V/FC540V

NOTE: Perform bench test before disassembling starter motor to determine cause of problem.

IMPORTANT: Never operate motor longer than 20 seconds. Allow at least two minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starting motor.

1. Disconnect battery leads from battery.
2. Remove starter from engine.
3. Connect 12-volt battery (A) to starter battery terminal (B) and starter frame (C) using heavy duty cables.
4. Connect remote start switch (D) between switch terminal (E) and battery terminal (B).

NOTE: A short piece of wire with a small clip on the end will allow a more positive connection at the switch terminal.

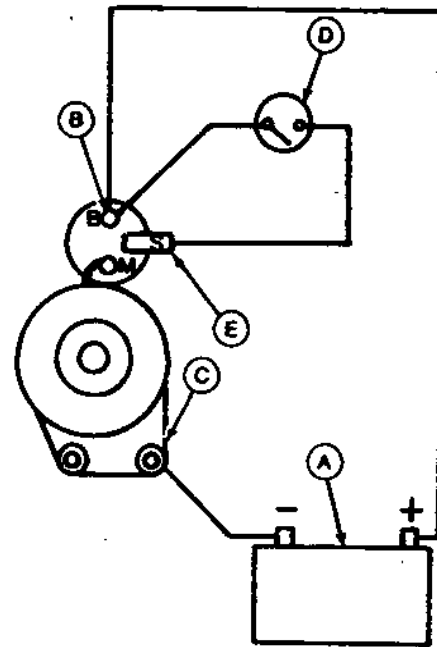
When switch is activated, starter should engage and run.

IF SOLENOID CHATTERS; hold-in winding is open-circuited.

IF NOTHING HAPPENS; either the solenoid pull-in winding is open-circuited or mechanical parts are sticking.

IF SOLENOID ENGAGES, BUT MOTOR DOES NOT RUN; check solenoid switch continuity, brushes, armature and field windings.

Solenoid cannot be repaired, replace it.



A—12-Volt Battery
B—Battery Terminal
C—Starter Frame
D—Remote Start Switch
E—Switch Terminal

MX,4030A1,A7 -19-21OCT92

M37149 -JUN-29AUG88

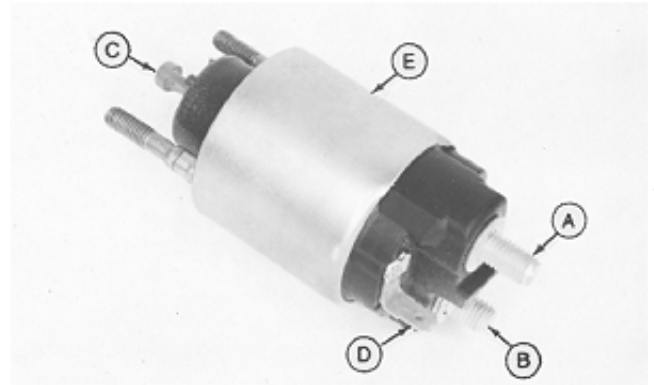
40
30
7

TEST SOLENOID—FC400V/FC420V/FC540V

NOTE: If bench test indicated solenoid problems, use an ohmmeter or test light to check solenoid.

1. Test solenoid terminals (A and B) for continuity. There should be no continuity.
2. Depress switch arm (C). There should be continuity when arm is fully depressed.
3. Test for open circuits between terminal (B) and tang (D). There should be continuity.
4. Test for open circuits between tang (D) and body (E). There should be continuity.

If solenoid fails any test, it is defective and must be replaced.



A—Terminal
B—Terminal
C—Switch Arm
D—Tang
E—Solenoid Body

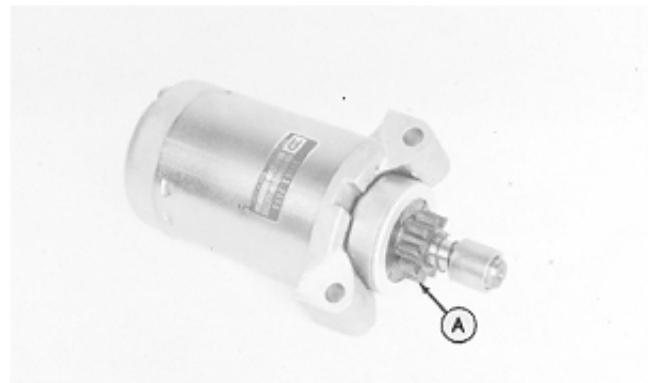
MX,4030A1,A8 -19-21OCT92

M51705 -UN-31AUG88

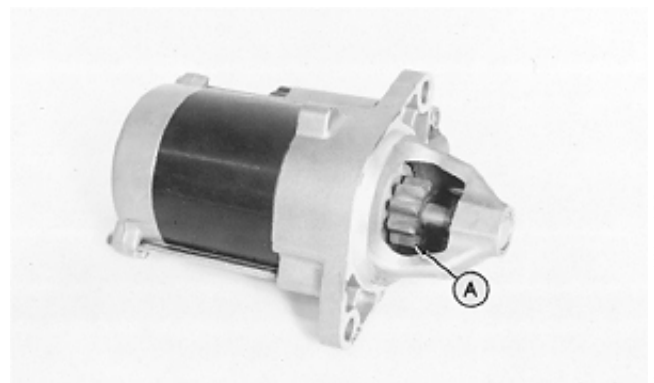
CHECK STARTER ARMATURE ROTATION

1. FC290V: Remove air cleaner and blower housing. (See Groups 05 and 10.)
2. Remove starter.
3. Rotate armature (A).

If armature does not rotate freely, armature may be bent or bearings may be worn. Disassemble, inspect and clean starter. (See this group.)



FC290V

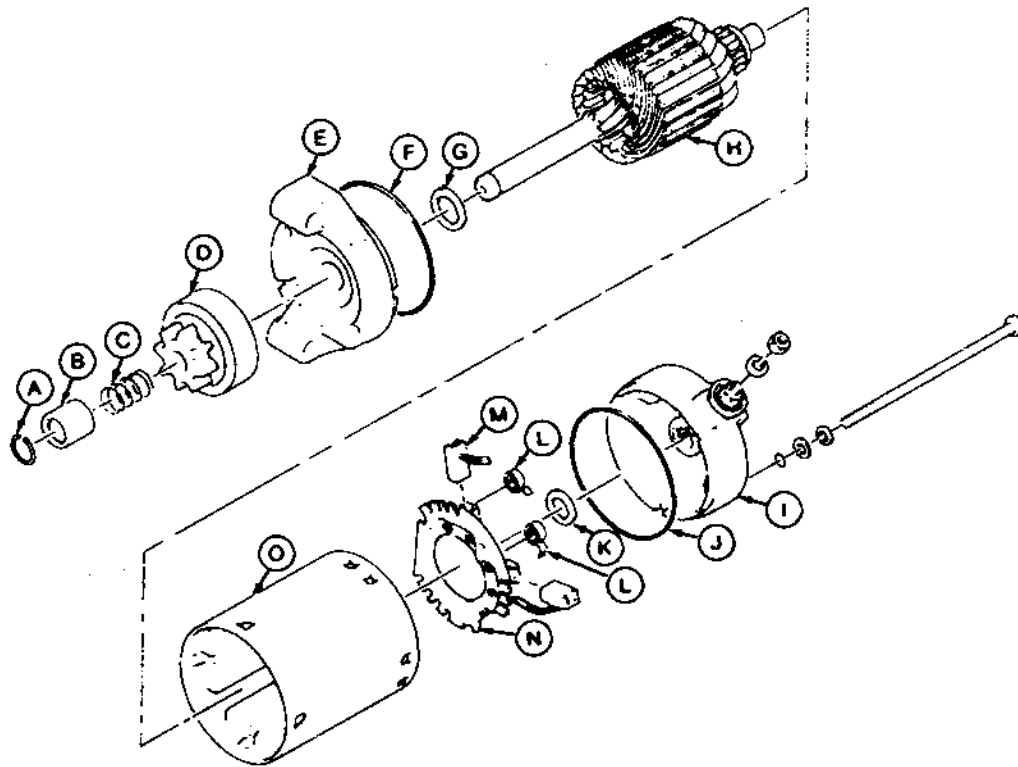


FC400V/FC420V/FC540V

MX,4030A1,A9 -19-21OCT92

M80163 -UN-09JAN91

M53972 -UN-18APR90

INSPECT STARTER—FC290V

A—Snap Ring
B—Pinion Stopper
C—Spring
D—Pinion Assembly

E—Front Cover
F—O-Ring
G—Washer
H—Armature

I—End Cover
J—O-ring
K—Washer
L—Brush Spring

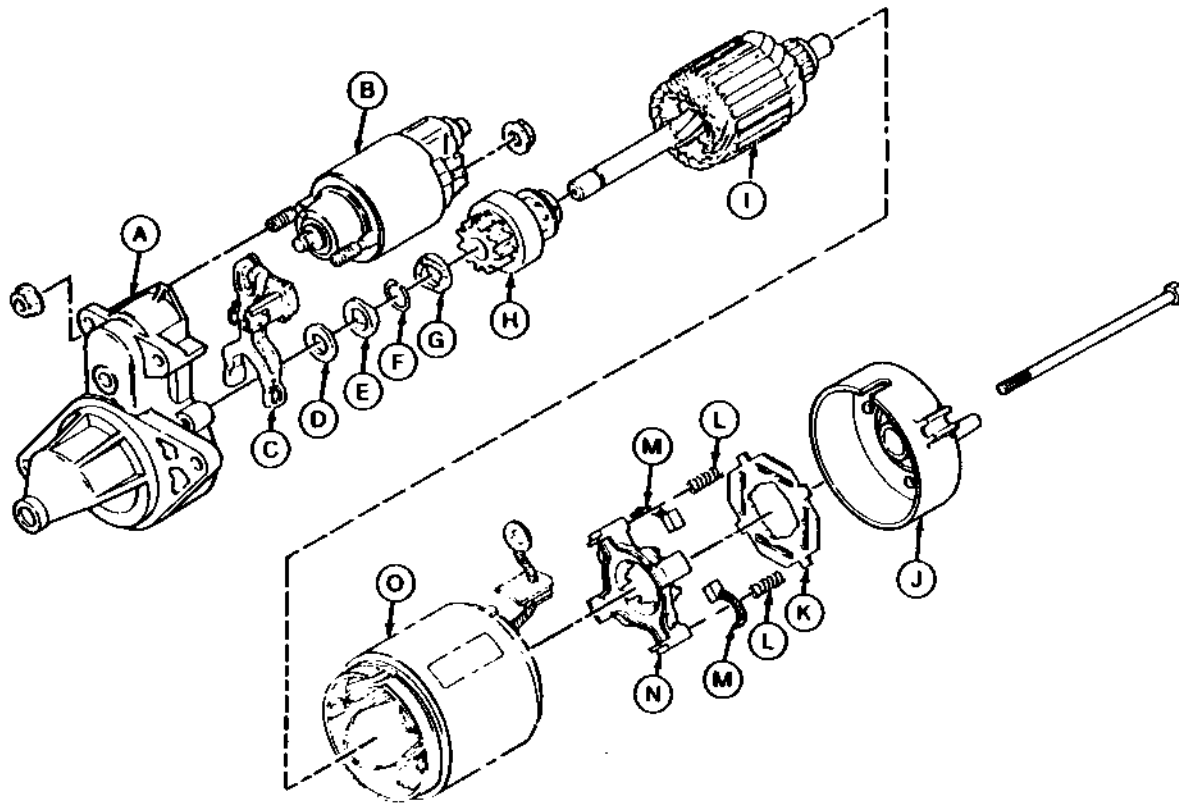
M—Brush
N—Brush Holder
O—Body

1. Mark body and covers for correct alignment during reassembly.
2. Remove nuts and washers from terminal to remove end cover (I).
3. Push pinion stopper (B) toward pinion (D) to remove snap ring (A).
4. Inspect parts for wear or damage.
5. Check magnets in body (O). Replace body if magnetic pull is weak.

6. Measure brushes. Replace brushes as a set if length of any one is less than 8.5 mm (0.335 in.).
7. Test starter armature and brushes. (See this group.)
8. Apply a thin coat of multipurpose grease to:
 - sliding surfaces of armature.
 - armature shaft spline.
 - points where shaft contacts cover.
9. Assemble starter.

M50128 -UN-31AUG88

40
30
9

INSPECT STARTER—FC400V/FC420V

A—Front Cover
B—Solenoid
C—Shift Lever
D—Washer

E—Pinion Stopper Half
F—Retaining Clip
G—Pinion Stopper Half
H—Pinion

I—Armature
J—End Cover
K—Insulator
L—Brush Spring

M—Brush
N—Brush Holder
O—Body

1. Mark body and covers for correct alignment during reassembly.

2. Separate pinion stopper halves (E and G) to remove retaining clip (F).

3. Inspect parts for wear or damage.

4. Measure brushes. Replace brushes as a set if length of any one is less than 6 mm (0.240 in.).

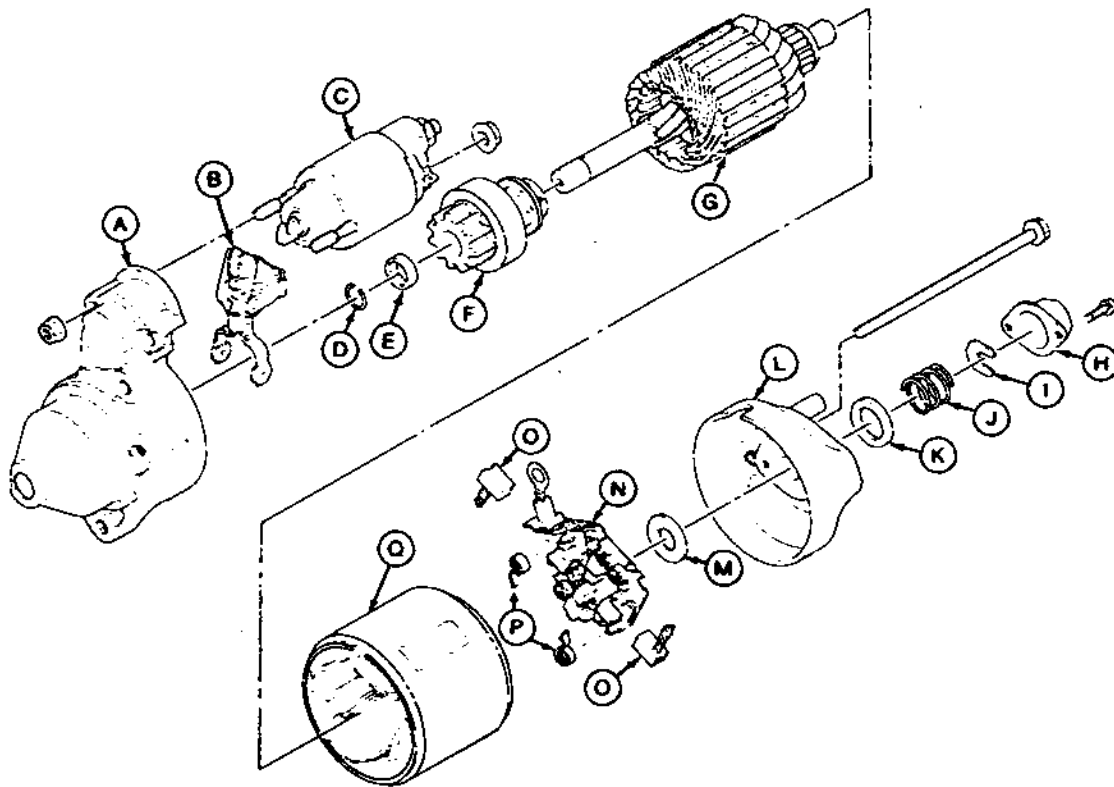
5. Test starter armature and brushes. (See this group.)

6. Apply a thin coat of multipurpose grease to:
—sliding surfaces of armature and solenoid shift lever.
—armature shaft spline.
—points where shaft contacts cover.

7. Assemble starter.

MX,4030A1,A11 -19-21OCT92

M53943 -JUN-19JUN90

INSPECT STARTER—FC540V

A—Front Cover
B—Shift Lever
C—Solenoid
D—Retaining Clip
E—Pinion Stopper

F—Pinion
G—Armature
H—Dust Cap
I—Clip

J—Spring
K—Washer
L—End Cover
M—Washer

N—Brush Holder
O—Brush
P—Brush Spring
Q—Body

1. Mark body and covers for correct alignment during reassembly.
2. Push pinion stopper (E) toward pinion (F) to remove retaining clip (D).
3. Inspect parts for wear or damage.
4. Measure brushes. Replace brushes as a set if length of any one is less than 10.5 mm (0.413 in.).

5. Test starter armature and brushes. (See this group.)
6. Apply a thin coat of multipurpose grease to:
 - sliding surfaces of armature and solenoid shift lever.
 - armature shaft spline.
 - points where shaft contacts cover.
7. Assemble starter.

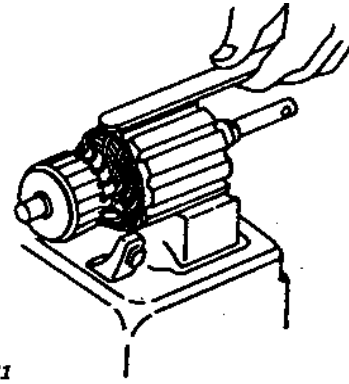
M50120 -JUN-31AUG88

40
30
11

TEST STARTER ARMATURE

IMPORTANT: Do not clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.

1. Locate short circuits by rotating armature on a growler while holding a hacksaw blade or steel strip on armature. The hacksaw blade will vibrate in area of short circuit.
2. Shorts between bars are sometimes caused by dirt or copper between bars. Inspect for this condition.
3. If test indicates short circuited windings, clean the commutator of dust and fillings. Check armature again. If test still indicates short circuit, replace armature.



M24861

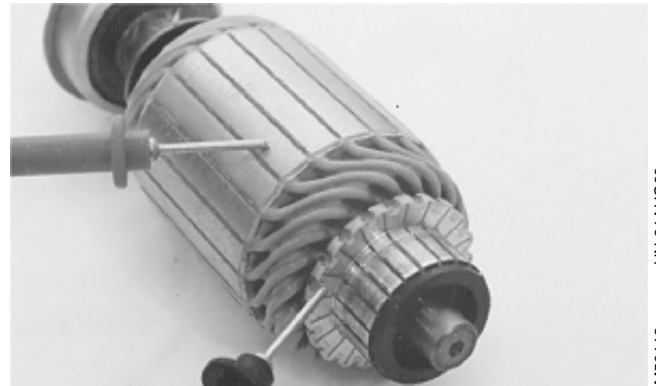
-UN-25AUG88
M24861

M98,2030A,K -19-21OCT92

4. Test for grounded windings using an ohmmeter or test light.

Armature windings are connected in parallel, so each commutator bar needs to be checked.

If test shows continuity, a winding is grounded and the armature must be replaced.

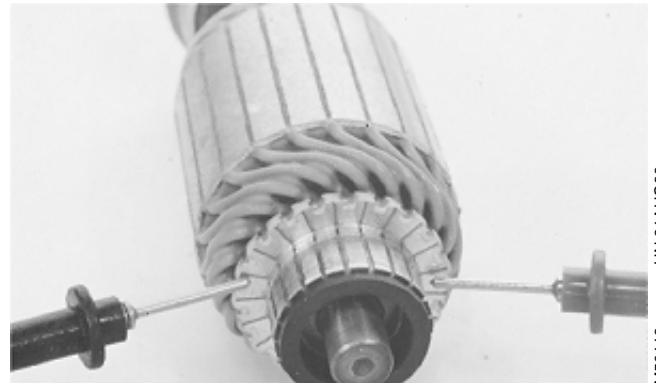


M98,2030A,AH -19-21OCT92

-UN-31AUG88
M50112

5. Test for open circuited windings using an ohmmeter or test light.

If test shows no continuity, there is an open circuit and armature must be replaced.



M98,2030A,M -19-21OCT92

-UN-31AUG88
M50113

TEST FIELD COIL

*NOTE: Continuity tests are similar for all units.
Illustrations are representative only.*

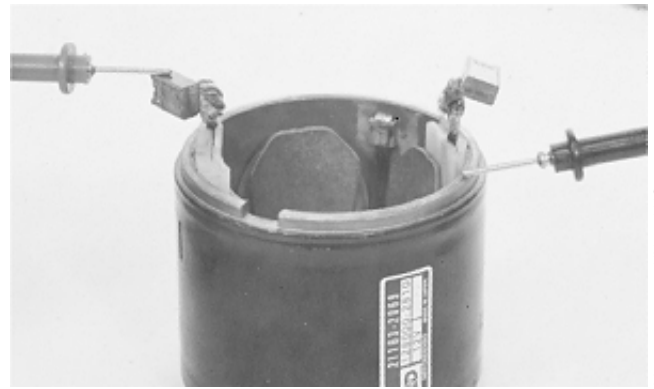
If equipped with brushes on body:

Replace field coil if not according to specifications.

CONTINUITY TEST

Brush-to-Housing Continuity

Brush-to-Brush Continuity



M50115 -UN-31AUG88



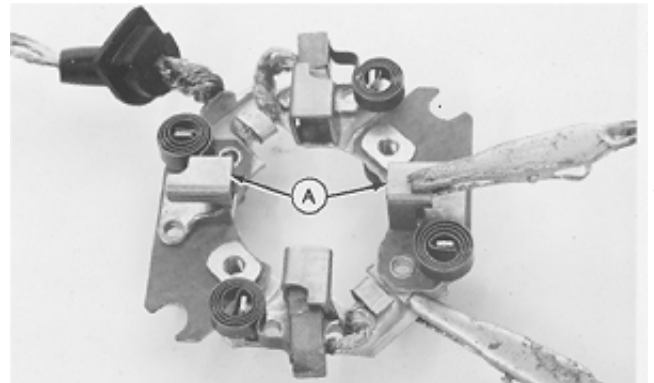
M50116 -UN-31AUG88

MX,4030A1,A13 -19-21OCT92

FC290V:

Test for continuity between each negative brush holder (A) and brush plate. Replace brush holder assembly if there is continuity.

Test for continuity between each positive brush holder and brush plate. Replace brush holder assembly if there is not continuity.



M50114 -UN-31AUG88

MX,4030A1,A14 -19-21OCT92

40
30
13

40
30
14

Section 45

FE290D and FE290R

Contents

	Page	Page
Group 00—Engine Application and Repair Specifications		
Engine Application Chart	45-00-1	
Repair Specifications	45-00-2	
Group 05—Fuel and Air Systems		
Service Parts Kits	45-05-1	
Carburetor		
Remove and Install	45-05-2	
Disassemble, Clean, Inspect and Assemble	45-05-4	
Service Breather	45-05-6	
Group 10—Blower Housing and Flywheel		
Remove and Install		
Blower Housing	45-10-1	
Flywheel	45-10-1	
Group 15—Cylinder Head and Valves		
Essential Tools	45-15-1	
Other Material	45-15-1	
Service Parts Kits	45-15-1	
Rocker Arm Assembly		
Remove and Install	45-15-2	
Inspect	45-15-2	
Remove and Install		
Cylinder Head Assembly	45-15-3	
Valves and Springs	45-15-4	
Inspect and Replace Intake Valve Stem Seal	45-15-4	
Inspect		
Springs	45-15-5	
Cylinder Head	45-15-5	
Valve Guides	45-15-5	
Replace Valve Guide Bushings	45-15-6	
Recondition Valve Seats	45-15-7	
Check Valve Clearance	45-15-8	
Group 20—Cylinder Block and Internal Components		
Other Material	45-20-1	
Service Parts Kits	45-20-1	
Remove and Install Crankcase Cover . . .	45-20-2	
Camshaft		
Remove and Install	45-20-2	
Inspect	45-20-3	
Inspect Plain Bearings	45-20-3	
Inspect Automatic Compression Release .	45-20-4	
Remove, Inspect and Install Tappets . . .	45-20-4	
Reciprocating Balancer		
Remove and Install	45-20-5	
Disassemble and Assemble	45-20-6	
Inspect Assembly	45-20-7	
Replace Link Rod Bushings	45-20-8	
Piston and Connecting Rod		
Remove and Install	45-20-8	
Disassemble, Inspect and Assemble . .	45-20-9	
Inspect Piston	45-20-10	
Inspect Connecting Rod	45-20-12	
Piston Rings		
Remove and Install	45-20-12	
Check End Gap	45-20-13	
Crankshaft		
Remove, Inspect and Install	45-20-14	
Inspect Plain Bearing	45-20-15	
Inspect Ball Bearing	45-20-16	
Check Alignment (TIR)	45-20-16	
Measure End Play	45-20-16	
Adjust End Play	45-20-17	
Inspect		
Oil Seals	45-20-18	
Cylinder Block	45-20-19	
Rebore Cylinder Block	45-20-20	
Oil Pump		
Disassemble and Assemble	45-20-21	
Inspect	45-20-22	
Remove, Inspect & Install Oil Filter		
Manifold—If Equipped	45-20-23	
Inspect and Replace		
Governor	45-20-24	
Governor Shaft	45-20-24	

Continued on next page

Page

Group 25—Ignition and Charging System

Remove and Install

Stator	45-25-1
Armature with Coil	45-25-1
Adjust Armature Air Gap	45-25-2
Replace Ignitor	45-25-2

Group 30—Starting Systems

Other Material	45-30-1
Service Parts Kits	45-30-1
Recoil Starter	
Disassemble, Inspect and Assemble . . .	45-30-2
Replace Spring	45-30-3
Electric Starter	
Analyze Condition	45-30-3
Bench Test Solenoid Drive Starter	45-30-4
Test Solenoid	45-30-5
Check Starter Armature Rotation	45-30-5
Inspect Starter	45-30-6
Test Starter Armature	45-30-7
Test Field Coil	45-30-8

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

Machine	Engine Model No.
AMT622	
(Engine S.N. —010272)	FE290D-AS00
(Engine S.N. 010273—)	FE290D-BS00
(Engine S.N. —025000)	FE290D-AS00
(Engine S.N. 025001—)	FE290D-BS00
AMT626	FE290D-BS00
1200 Bunker and Field Rake	FE290R-AS00
Gator 4 X 2	FE290D-AS08

MX,4500A1,A1 -19-21OCT92

FE290D/FE290R REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Breather	
Maximum Air Gap	0.20 mm (0.008 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	85 N·m (63 lb-ft)
-------------------------------	-------------------

GROUP 15—CYLINDER HEAD AND VALVES

Valve Clearance	0.12 mm (0.005 in.)
---------------------------	---------------------

Rocker Arm	
Minimum Shaft O.D.	11.95 mm (0.470 in.)
Maximum Bearing I.D.	12.07 mm (0.475 in.)
Adjusting Nut Torque	9 N·m (79 lb-in.)

Push Rod	
Maximum Bend	0.30 mm (0.012 in.)

Valves and Springs	
Minimum Spring Free Length	32.75 mm (1.289 in.)
Maximum Valve Guide I.D.	7.07 mm (0.278 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seating Surface	0.50—1.10 mm (0.020—0.043 in.)
Valve Seat and Face Angle	45°
Minimum Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Cylinder Head	
Cylinder Head Flatness	0.05 mm (0.002 in.)
Cap Screw Torque In Sequence	
Initial Torque	18 N·m (159 lb-in.)
Final Torque	24 N·m (212 lb-in.)

Spark Plug Torque	20 N·m (177 lb-in.)
-----------------------------	---------------------

Continued on next page

MX,4500A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS

Item	Specification
Crankcase Cover	
Oil Capacity	1.1 L (2.33 pt)
Cap Screw Torque	26 N·m (230 lb-in.)
Drain Plug Torque	21 N·m (186 lb-in.)
Camshaft	
Minimum End Journals O.D.	22.93 mm (0.903 in.)
Minimum Lobe Height	32.70 mm (1.287 in.)
Maximum Cover and Crankcase Bearing I.D.	23.06 mm (0.908 in.)
Reciprocating Balancer	
Link Rod	
Minimum Journal O.D.	46.86 mm (1.845 in.)
Maximum Small End I.D.	12.06 mm (0.475 in.)
Maximum Large End I.D.	47.12 mm (1.855 in.)
Bushing Depth	1 mm (0.040 in.)
Balancer Weight	
Maximum Bearing I.D.	26.10 mm (1.027 in.)
Support Shaft	
Minimum Shaft O.D.	25.93 mm (1.021 in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.16 mm (0.006 in.)
Second Ring	0.14 mm (0.005 in.)
Oil Control Rings	Not Measured
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	1.20 mm (0.047 in.)
Oil Control Rings	Not Measured
Minimum Pin O.D.	18.98 mm (0.747 in.)
Maximum Pin Bore I.D.	19.03 mm (0.749 in.)
Maximum Piston-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Piston O.D.	77.85—77.87 mm (3.0649—3.0657 in.)
Piston-to-Cylinder Bore Clearance	0.051—0.089 mm (0.002—0.0035 in.)
Connecting Rod	
Maximum Crankshaft Bearing I.D.	35.57 mm (1.400 in.)
Maximum Piston Pin Bearing I.D.	19.06 mm (0.750 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.08 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.14 mm (0.006 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)

Continued on next page

MX,4500A1,A3 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Crankshaft	
Minimum PTO Side Journal O.D.	29.92 mm (1.178 in.)
Minimum Connecting Rod Journal O.D.	35.43 mm (1.395 in.)
Maximum Crankcase Plain Bearing I.D.	30.08 mm (1.184 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.09—0.22 mm (0.004—0.009 in.)
Oil Seal Depth	
PTO End	4 mm (0.158 in.)
Governor Shaft	1.42 mm (0.056 in.)
Cylinder Bore	
Standard I.D.	77.98—78.00 mm (3.070—3.071 in.)
Maximum I.D.	78.07 mm (3.074 in.)
Maximum Out-of-Round	0.056 mm (0.0022 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm (.010 in.)	78.21-78.23 mm (3.079-.080 in.)
0.50 mm (.019 in.)	78.48-78.50 mm (3.089-.090 in.)
0.75 mm (.029 in.)	78.71-78.73 mm (3.099-.100 in.)
Oil Pump	
Minimum Rotor Shaft O.D.	12.63 mm (0.497 in.)
Maximum Rotor Shaft Bearing I.D.	12.77 mm (0.503 in.)
Minimum Outer Rotor Thickness	9.92 mm (0.391 in.)
Maximum Outer Rotor Bore Depth	10.17 mm (0.400 in.)
Minimum Outer Rotor O.D.	40.47 mm (1.596 in.)
Maximum Outer Rotor Bearing I.D.	40.77 mm (1.605 in.)
Minimum Valve Spring Free Length	19.00 mm (0.750 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS

Recoil and Electric Starter

See Starter Specifications in this Group.

MX,4500A1,A4 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

FE290D

- Carburetor Gasket Kit
- Main Jet High Altitude Kit—Standard Air Cleaner
- Main Air Jet—Standard Air Cleaner
- Main Jet Low Temperature—Heavy Duty Air Cleaner
- Main Jet High Temperature/High Altitude Kit—Heavy Duty Air Cleaner
- Main Air Jet—Heavy Duty Air Cleaner
- Complete Carburetor

FE290R

- Carburetor Gasket Kit
- Main Jet High Altitude Kit
- Complete Carburetor

MX,4505A1,A1 -19-21OCT92

45
05
1

REMOVE AND INSTALL CARBURETOR

1. Drain fuel from carburetor.
2. Disconnect hose (B).
3. Disconnect spring (D).
4. Remove duct (A), bracket (E) and gaskets (F).
5. Disconnect linkage (C).
6. Separate carburetor from heat shield (H). Remove carburetor.
7. Remove heat shield (H) and gaskets.
8. Make repairs as necessary. (See procedure in this group.)

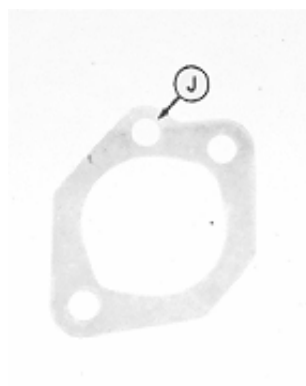
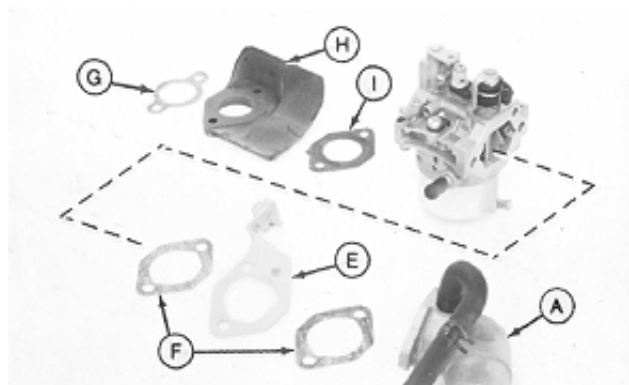
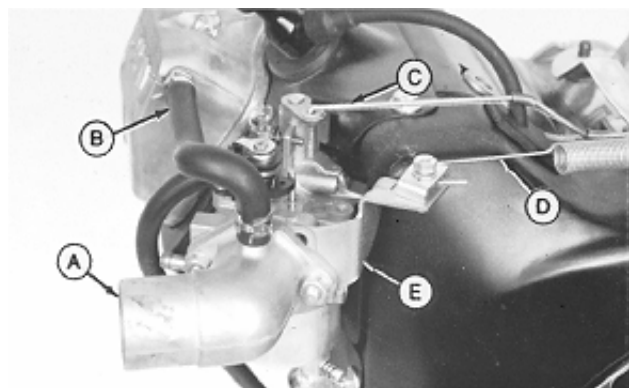
NOTE: Install gasket (I) with tab pointing up on fuel inlet side of carburetor.

9. Install gaskets and heat shield.
10. Install carburetor.
11. Connect linkage.

NOTE: Install gaskets (F) with hole (J) pointing away from fuel inlet side of carburetor.

12. Install gaskets, bracket and duct.
13. Connect return spring.
14. Connect breather hose.

A—Air Intake Duct
B—Breather Hose
C—Throttle Control Linkage
D—Return Spring
E—Bracket
F—Gaskets
G—Gasket
H—Heat Shield
I—Gasket
J—Hole



M80399 -UN-25APR91

M80400 -UN-25APR91

M80401 -UN-25APR91

MX,4505A1,A2 -19-21OCT92

45
05
3

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets, float and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

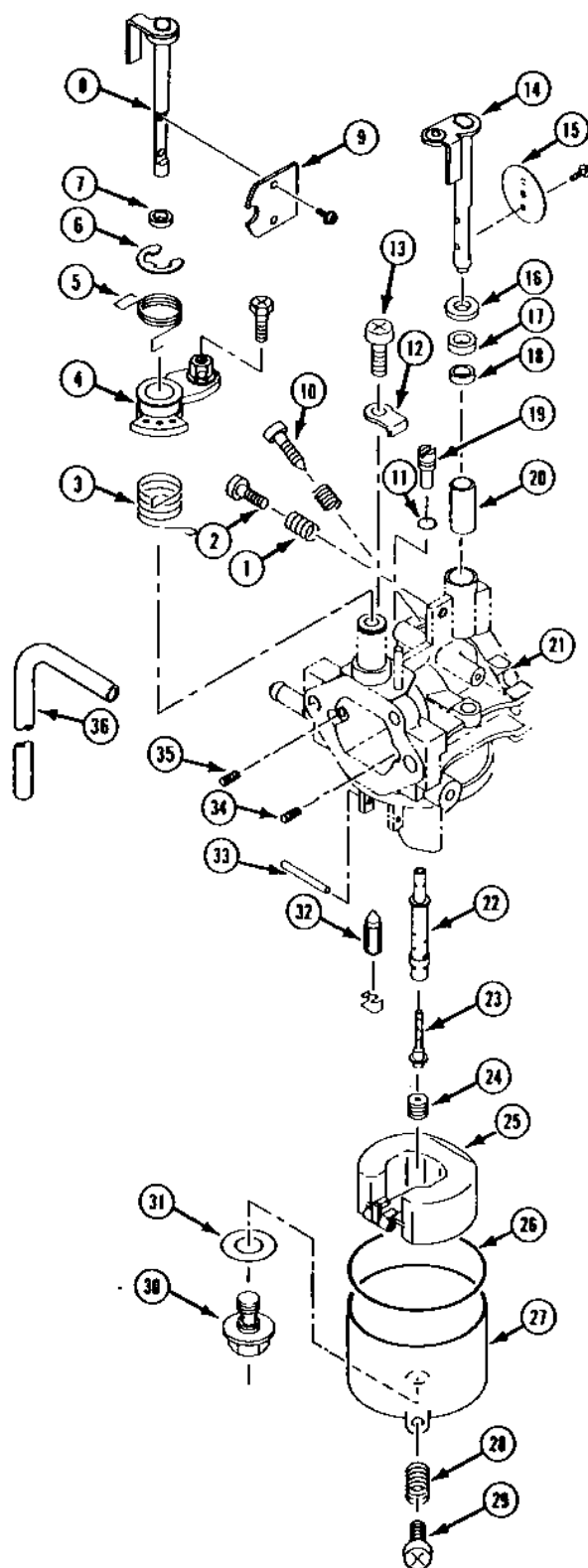
3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.
4. Inspect all parts for wear or damage, replace as necessary.

NOTE: Float is plastic. The float cannot be adjusted. Replace if necessary.

FE290D: Main jet high altitude kits and main air jet kits for standard or heavy duty air cleaners are available through the parts catalog.

FE290R: Main jet high altitude kits are available through the parts catalog.

- 1—Spring (2 used)
- 2—Idle Screw
- 3—Spring
- 4—Lever
- 5—Spring
- 6—E-Clip
- 7—Seal
- 8—Choke Shaft
- 9—Choke Valve
- 10—Pilot Screw
- 11—O-Ring
- 12—Lock Plate
- 13—Screw
- 14—Throttle Shaft
- 15—Throttle Valve
- 16—Washer
- 17—Seal
- 18—Bushing
- 19—Pilot Jet
- 20—Bushing
- 21—Carburetor Body
- 22—Main Nozzle
- 23—Bleed Pipe
- 24—Main Jet
- 25—Float
- 26—Gasket
- 27—Float Chamber
- 28—Spring
- 29—Drain Screw
- 30—Plug
- 31—Washer
- 32—Needle Valve
- 33—Float Pin
- 34—Main Air Jet
- 35—Pilot Air Jet



M80402

45-05-5

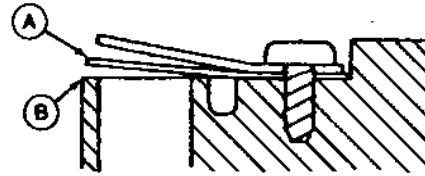
MX,4505A1,A3A -19-21OCT92

SERVICE BREATHER

1. Remove rocker arm cover.
2. Measure air gap between reed valve (A) and valve seat (B) at valve tip. Replace reed valve if gap exceeds specification.
3. Remove breather valve assembly (C).
4. Inspect breather for sticking, binding, cracks or distortion. Replace breather if worn or damaged.
5. Inspect valve seating surface. Surface must be free of nicks or burrs.
6. Install breather assembly.
7. Install rocker arm cover.

SPECIFICATIONS

Air Gap (MAX) 0.20 mm (0.008 in.)



MX,4505A1,A4 -19-21OCT92

-UN-07SEP88

M51757

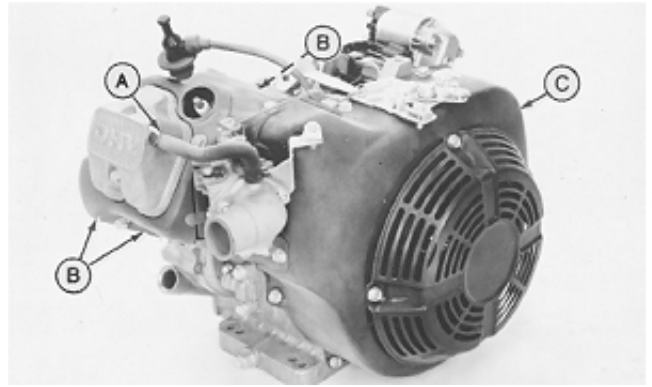
-UN-25APR91

M80403

REMOVE AND INSTALL BLOWER HOUSING

NOTE: It is not necessary to remove recoil starter, if equipped, from blower housing.

1. Disconnect spark plug lead.
2. Disconnect breather hose (A).
3. Remove covers (B).
4. Remove blower housing (C).
5. Install blower housing and covers.
6. Connect hose and spark plug lead.



M53063 -UN-11APR89

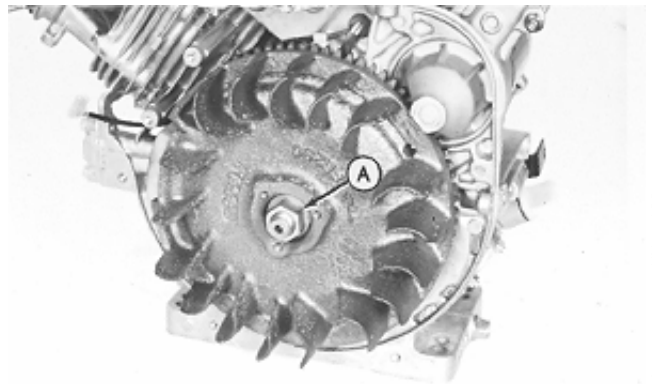
MX,4510A1,A1 -19-21OCT92

REMOVE AND INSTALL FLYWHEEL

1. Remove armature with coil. (See Group 25.)
2. Hold flywheel and remove nut and washer (A).
3. Remove starter cup, if equipped.
4. Remove flywheel using a flywheel puller.
5. Install flywheel and cup, if equipped.

NOTE: Install washer with concave side toward flywheel.

6. Install washer and nut. Tighten nut to 85 N·m (63 lb-ft).
7. Install armature with coil.



M80404 -UN-25APR91

MX,4510A1,A2 -19-21OCT92

45
10
2

SPECIAL OR ESSENTIAL TOOLS

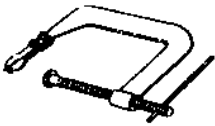
NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

DX,TOOLS-19-05JUN91

Valve Spring Compressor JDM70

Remove and install valve springs.

M51896-UN-26SEP88



MX,JDM70-19-21OCT92

Valve Guide Driver Tool JDG504

Replace valve guide bushings.

MX,JDG504-19-21OCT92

OTHER MATERIAL

Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean Cylinder Head
	Valve Guide Cleaner	Clean Valve Guides
	Stanisol (or Kerosene)	Finish Ream Valve Guide
	Prussian Blue Compound	Check Valve Seat Contact

SCOTCH-BRITE is a trade mark of the 3M Company.

MX,4015A1,A1-19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Overhaul Gasket Kit

M98,2015A,ZD-19-21OCT92

REMOVE AND INSTALL ROCKER ARM ASSEMBLY

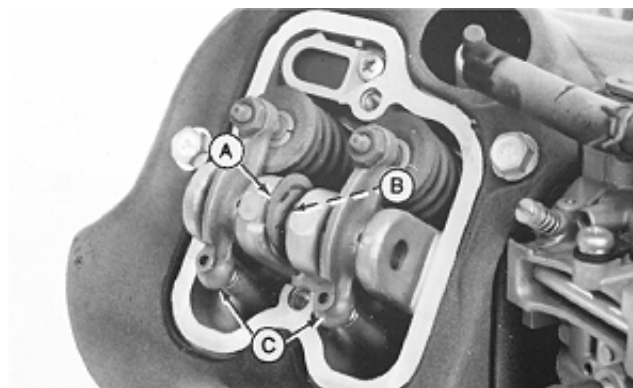
1. Remove rocker arm cover and gasket.
2. Turn crankshaft until piston is at highest position in compression stroke.
3. Remove e-clip (A).
4. Remove rocker shaft, washer (B) and arms (C).

IMPORTANT: Mark push rods for reassembly in original locations.

5. Remove push rods.
6. Inspect parts for wear or damage. (See this group.)

IMPORTANT: Align rocker arms over push rods during assembly.

7. Install push rods and rocker arm assemblies.
8. Install washer, rocker shaft and e-clip.
9. Check valve clearance. (See this group.)
10. Install rocker arm cover and gasket.



M80405 -UN-25APR91

MX,4515A1,A1 -19-21OCT92

INSPECT ROCKER ARM ASSEMBLY

Measure outside diameter of rocker shaft and inside diameter of rocker arm bearing. Replace if not according to specifications.

SPECIFICATIONS

Minimum Shaft O.D.	11.95 mm (0.470 in.)
Maximum Arm I.D.	12.07 mm (0.475 in.)



M80406 -UN-25APR91



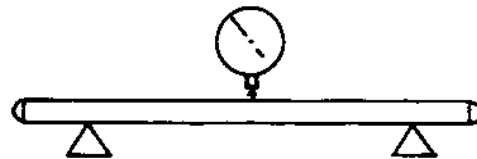
M80407 -UN-25APR91

MX,4515A1,A2 -19-21OCT92

Inspect push rod for bend using V-blocks and a dial indicator. Turn rod slowly and read variation on indicator. Replace if variation is greater than specification.

SPECIFICATION

Push Rod Bend (MAX) 0.30 mm (0.012 in.)

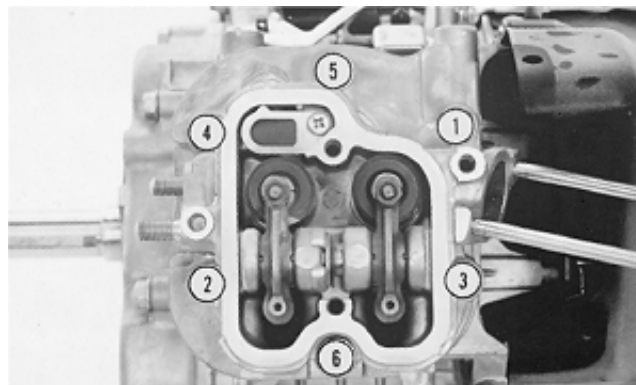


MX,4015A1,A3A -19-21OCT92

M50044 -UN-31AUG88

REMOVE AND INSTALL CYLINDER HEAD ASSEMBLY

1. Remove blower housing. (See Group 10.)
2. Remove carburetor. (See Group 05.)
3. Remove rocker arm assembly. (See this group.)
4. Remove spark plug.
5. Remove cylinder head assembly.
6. Make repairs as necessary. (See procedures in this group.)
7. Install cylinder head assembly with new gasket. Install cap screws and tighten finger tight.
8. Tighten cap screws in sequence shown. Tighten to initial torque specifications.
9. Continue in sequence, 3 N·m (27 lb-in.) at a time, until final torque is as specified.
10. Install spark plug and tighten to specification.
11. Install rocker arm assembly.
12. Install carburetor.
13. Install blower housing.



M53065 -UN-11APR89

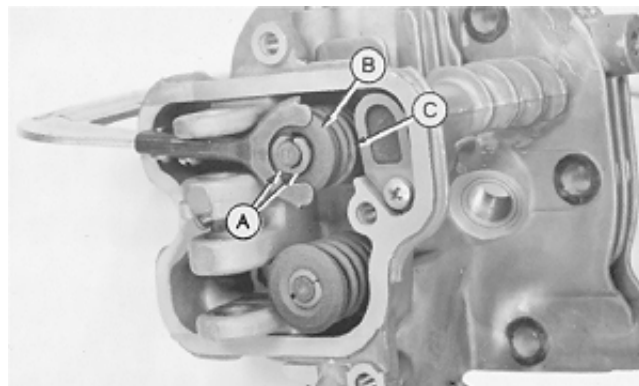
TORQUE SPECIFICATIONS

Initial Torque 18 N·m (159 lb-in.)
 Final Torque 24 N·m (212 lb-in.)
 Spark Plug 20 N·m (177 lb-in.)

MX,4515A1,A3 -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove cylinder head. (See this group.)
2. Compress intake valve spring with JDM70 Valve Spring Compressor and remove collet halves (A).
3. Remove spring retainer (B), spring (C) and valve.
4. Inspect and replace intake valve stem seal if necessary. (See this group.)
5. Inspect and analyze valves. (See Section 100, Group 05.)
6. Inspect springs, valves, guides and seats. (See procedures in this group.)
7. Install valves, springs, retainers, and collet halves.
8. Install cylinder head.



M53066
-UN-11APR89

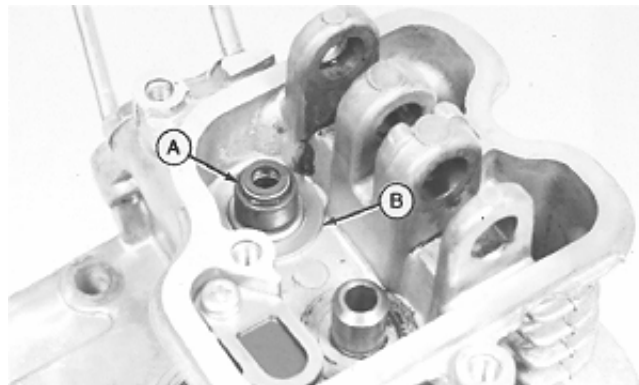
MX,4515A1,A4 -19-21OCT92

INSPECT AND REPLACE INTAKE VALVE STEM SEAL

1. Remove valves and springs. (See this group.)

IMPORTANT: Bottom spring retainer (B) can only be removed with valve stem seal. Removal of retainer or seal damages stem seal. Inspect seal. If seal is not damaged, do not remove it.

2. If necessary to replace stem seal (A), remove with screwdriver.



M80408
-UN-25APR91

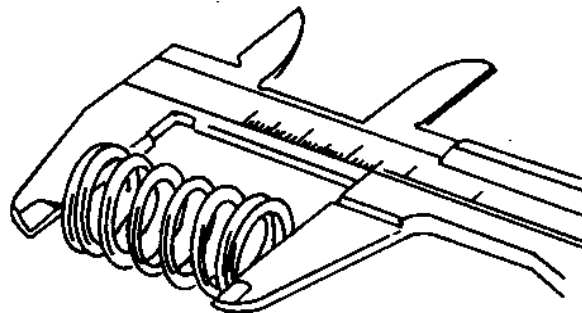
MX,4515A1,A5 -19-21OCT92

INSPECT SPRINGS

Inspect spring free length. Replace if damaged or if less than specifications.

SPECIFICATIONS (MIN)

Spring Free Length 32.75 mm (1.289 in.)

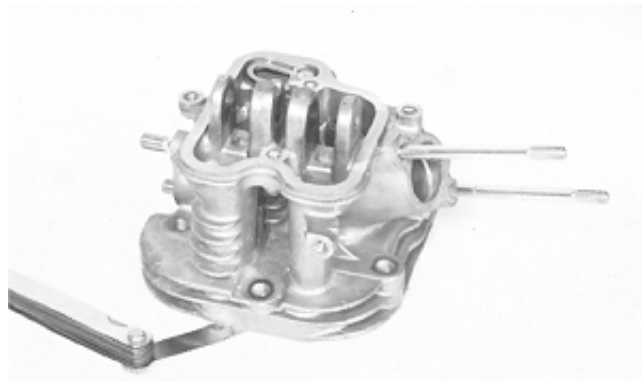


MX,4515A1,A6 -19-21OCT92

M50036 -UN-31AUG88

INSPECT CYLINDER HEAD

1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Check that oil drainback passages are not plugged.
7. Put cylinder head on a surface plate. Check for distortion at several points around the head using a feeler gauge. Replace head if distortion is more than specifications.



SPECIFICATIONS

Cylinder Head Distortion (Max) 0.05 mm (0.002 in.)

MX,4515A1,A7 -19-21OCT92

M80409 -UN-25APR91

INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guides or bushings. Replace bushing if inside diameter is greater than specifications. (See this group.)

SPECIFICATIONS (MAX) I.D.

Intake and Exhaust 7.07 mm (0.278 in.)

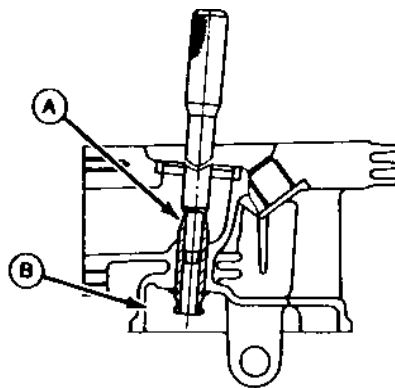


MX,4515A1,A8 -19-21OCT92

M80410 -UN-25APR91

REPLACE VALVE GUIDE BUSHINGS

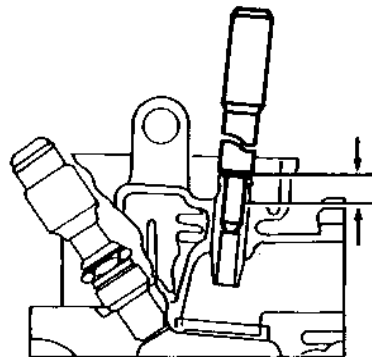
1. Drive valve guide bushing (A) into valve chamber (B) using JDG-504 Valve Guide Driver.



MX,4515A1,A9 -19-21OCT92

M50038 -UN-06APR91

2. Clean carbon deposits from valve guide port.
3. Install new bushing with valve guide driver. Drive in from valve chamber side to an installation depth of 12 mm (0.472 in.) for the FC400V/FC420V and 9.5 mm (0.37 in.) for the FC540V.



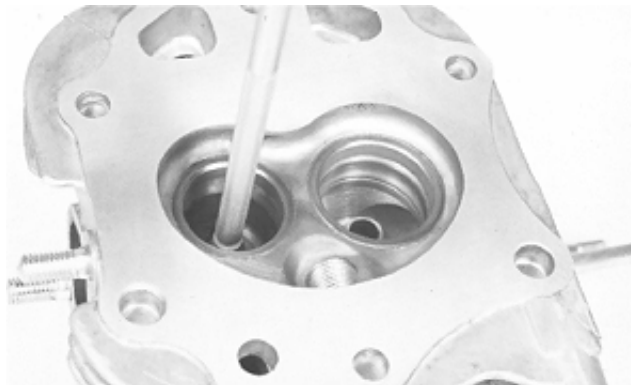
MX,4515A1,A9A -19-21OCT92

M50039 -UN-15OCT92

4. Finish reaming valve guide bushings with stanisol or kerosene lubricant and a 7 mm valve guide reamer. Turn reamer clockwise.
5. Thoroughly clean valve area before assembly.

BUSHING FINISHED I.D. SPECIFICATIONS

Valve Guide 7—7.02 mm (0.275—0.276 in.)



MX,4515A1,A10 -19-21OCT92

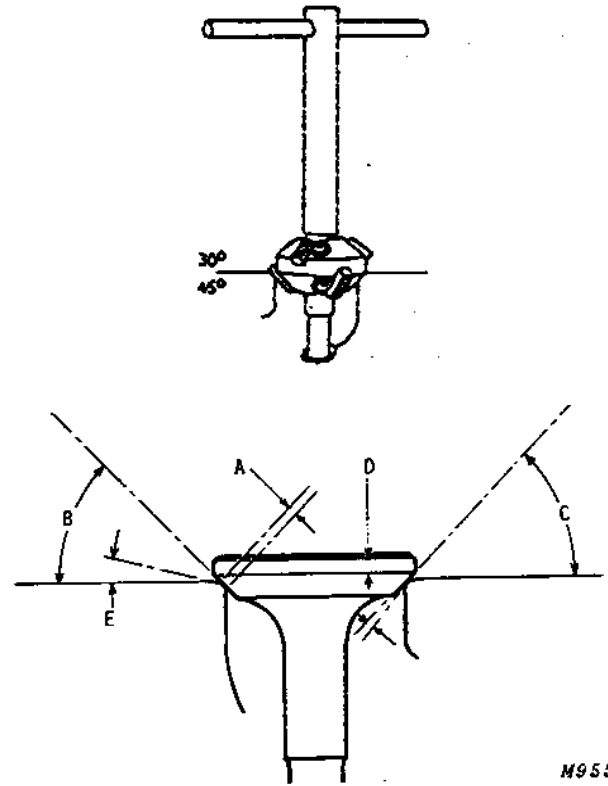
M80411 -UN-25APR91

RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.
2. To recondition valve seat, cut at 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).
3. Cut valve seating surface (A) as close as possible to specifications.
4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface	0.50—1.10 mm (0.020—0.043 in.)
B—Valve Seat Angle	45°
C—Valve Face Angle	45°
D—Valve Margin	0.60 mm (0.020 in.)
E—Valve Narrowing Angle	30°



M955

MX,4515A1,A11 -19-21OCT92

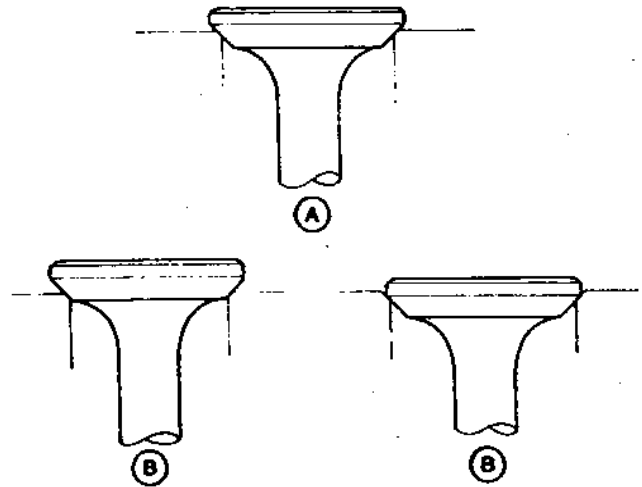
-UN-31AUG88
M51558

-UN-01SEP88

M9552

5. Center valve seat on the valve face:
—(A) shows correct position.
—(B) shows incorrect.

6. Check seat for good contact using Prussion Blue Compound.



MX,4015A1,A11A -19-21OCT92

-UN-07SEP88
M11861545
15
7

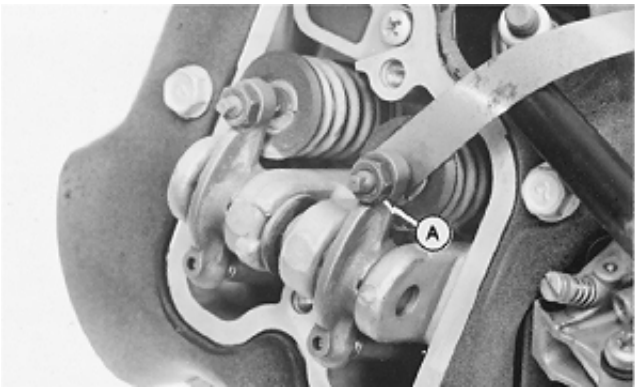
CHECK VALVE CLEARANCE

NOTE: Valve repair changes valve clearance. Check valve clearance. Adjust if needed.

- 1. Turn crankshaft until piston is at highest position in compression stroke.
- 2. Measure clearance.
- 3. If necessary, loosen nut (A) and turn stud in or out to adjust clearance to specifications. Tighten nut to specifications.

SPECIFICATIONS

Valve Clearance	0.12 mm (0.005 in.)
Adjusting Nut Torque	9 N·m (79 lb-in.)



M53067 -UN-11APR89

MX,4515A1,A12 -19-21OCT92

Group 20 Cylinder Block and Internal Components

OTHER MATERIAL

Number	Name	Use
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,4020A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog.

Piston Ring Kit

Oversized Pistons

Undersized Connecting Rod

Crankshaft End Play Shim Kit

Cylinder Block

Overhaul Gasket Kit

Short Block Kit

MX,4520A1,A1 -19-21OCT92

45
20
1

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is 1.1 L (2.33 pt).

1. Drain crankcase.
2. Remove crankcase cover and gasket.
3. Clean crankcase and crankcase cover gasket surfaces.

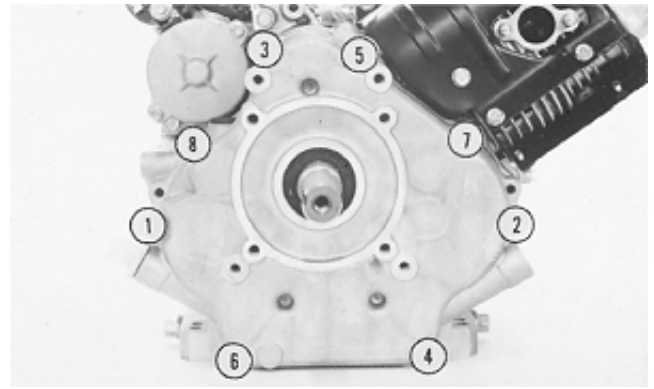
NOTE: Do not force cover. Gears must mesh for proper positioning.

FE290D: Install stud in position (1).

4. Install gasket and cover. Tighten cap screws using the sequence shown.

TORQUE SPECIFICATIONS

Mounting Cap Screws	26 N·m (230 lb-in.)
Oil Drain Plug	21 N·m (186 lb-in.)



M53069 -UN-11APR89

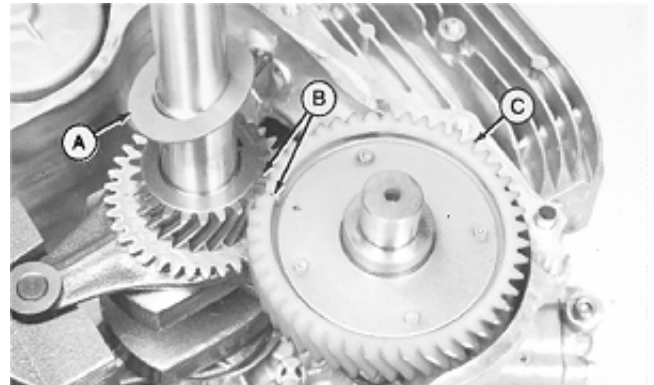
MX,4520A1,A2 -19-21OCT92

REMOVE AND INSTALL CAMSHAFT

1. Remove crankcase cover. (See this group.)
2. Remove crankshaft shim(s) (A).

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

3. Rotate crankshaft until timing marks (B) align.
4. Remove camshaft (C).
5. Inspect camshaft. (See this group.)
6. Apply clean engine oil to camshaft lobes and journals.
7. Align timing marks and install camshaft.
8. Install shim(s) on crankshaft.
9. Install crankcase cover.



M80412 -UN-25APR91

MX,4520A1,A3 -19-21OCT92

INSPECT CAMSHAFT

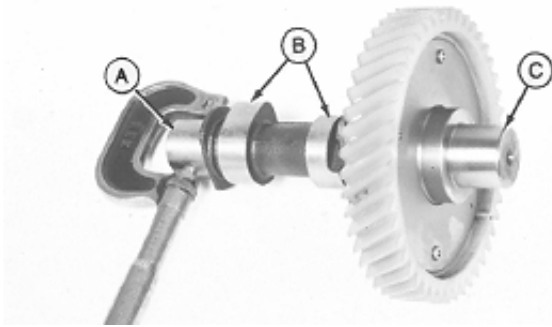
Inspect camshaft for worn or broken teeth.

*NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.*

Measure PTO side journal (C), flywheel side journal (A), and lobes (B). Replace camshaft and tappets if less than specifications.

SPECIFICATIONS (MIN)

PTO Side Journal	Flywheel Side Journal	Cam Lobes
22.93 mm (0.903 in.)	22.93 mm (0.903 in.)	32.70 mm (1.287 in.)



M80413 -UN-25APR91

MX,4520A1,A4 -19-21OCT92

INSPECT CAMSHAFT PLAIN BEARINGS

1. Remove camshaft. (See this group.)
2. Measure camshaft bearings in cylinder block and crankcase cover. Replace block or cover if diameter is greater than specification.
3. Install camshaft.

SPECIFICATIONS (MAX)

Cylinder Block Bearing	Crankcase Cover Bearing
23.06 mm (0.908 in.)	23.06 mm (0.908 in.)



Cylinder Block



Crankcase Cover

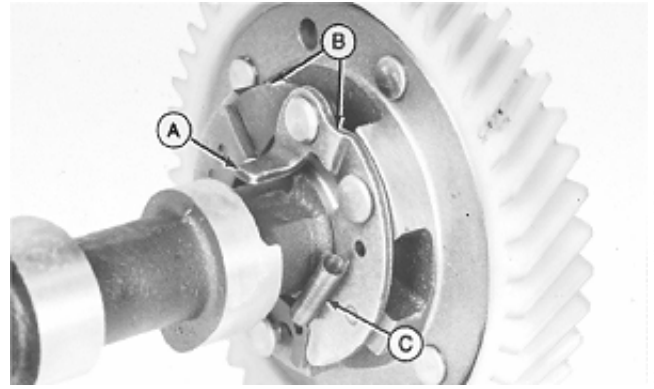
MX,4520A1,A5 -19-21OCT92

M80414 -UN-25APR91

M80415 -UN-25APR91

INSPECT AUTOMATIC COMPRESSION RELEASE (A.C.R.)

1. Remove camshaft. (See this group.)
2. Inspect automatic compression release (A.C.R.) for damage.
3. Inspect spring (C). Replace if worn or damaged.
4. Move weight(s) (B) by hand to check for proper operation.
5. Check that top of tab (A) sits slightly above cam lobe when weights are released. Tab should drop below cam when weights are operated.
6. Replace A.C.R. if it does not operate properly.
7. Install camshaft.

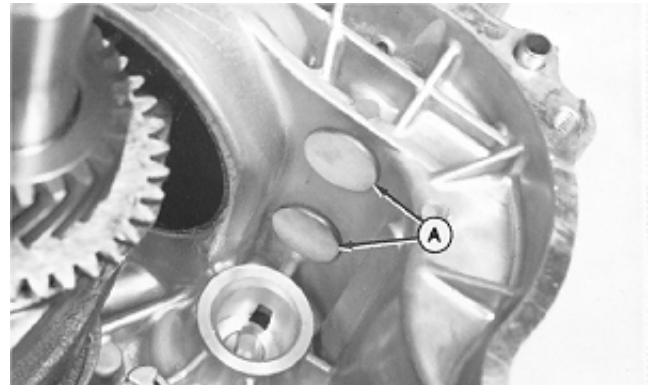


M80416 -UN-25APR91

MX,4520A1,A6 -19-21OCT92

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)
- NOTE: Mark tappets so they can be installed in their original bores during assembly.*
2. Remove tappets (A).
 3. Inspect tappets for wear or damage. Replace if necessary.
 4. Apply clean engine oil to tappets and bores.
 5. Install tappets in original bores.
 6. Install camshaft.

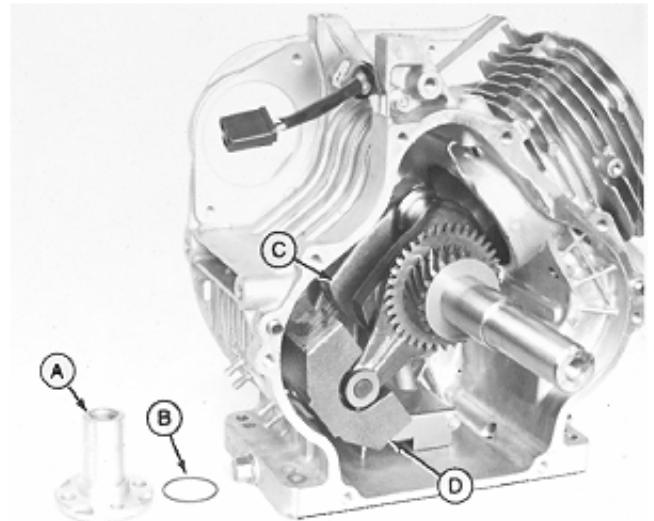


M80417 -UN-25APR91

MX,4520A1,A7 -19-21OCT92

REMOVE AND INSTALL RECIPROCATING BALANCER

1. Remove flywheel. (See Group 10.)
2. Remove camshaft. (See this group.)
3. Remove piston. (See this group.)
4. Remove support shaft (A) and O-ring (B).
5. Remove crankshaft with balancer assembly (C).
6. Make repairs as necessary. (See procedures in this group.)
7. Inspect oil seals. (See this group.)
8. Cover keyway on flywheel end of crankshaft with tape to prevent damage to oil seal when installing assembly.
9. Put light film of oil on crankshaft bearing surfaces.
10. Install balancer assembly with crankshaft into crankcase.
11. Align balancer weight (D) in crankcase and install support shaft and O-ring.
12. Adjust crankshaft end play. (See this group.)
13. Tighten balancer bushing assembly to 7.3 N·m (65 lb-in.).
14. Install piston.
15. Install camshaft.
16. Install flywheel.



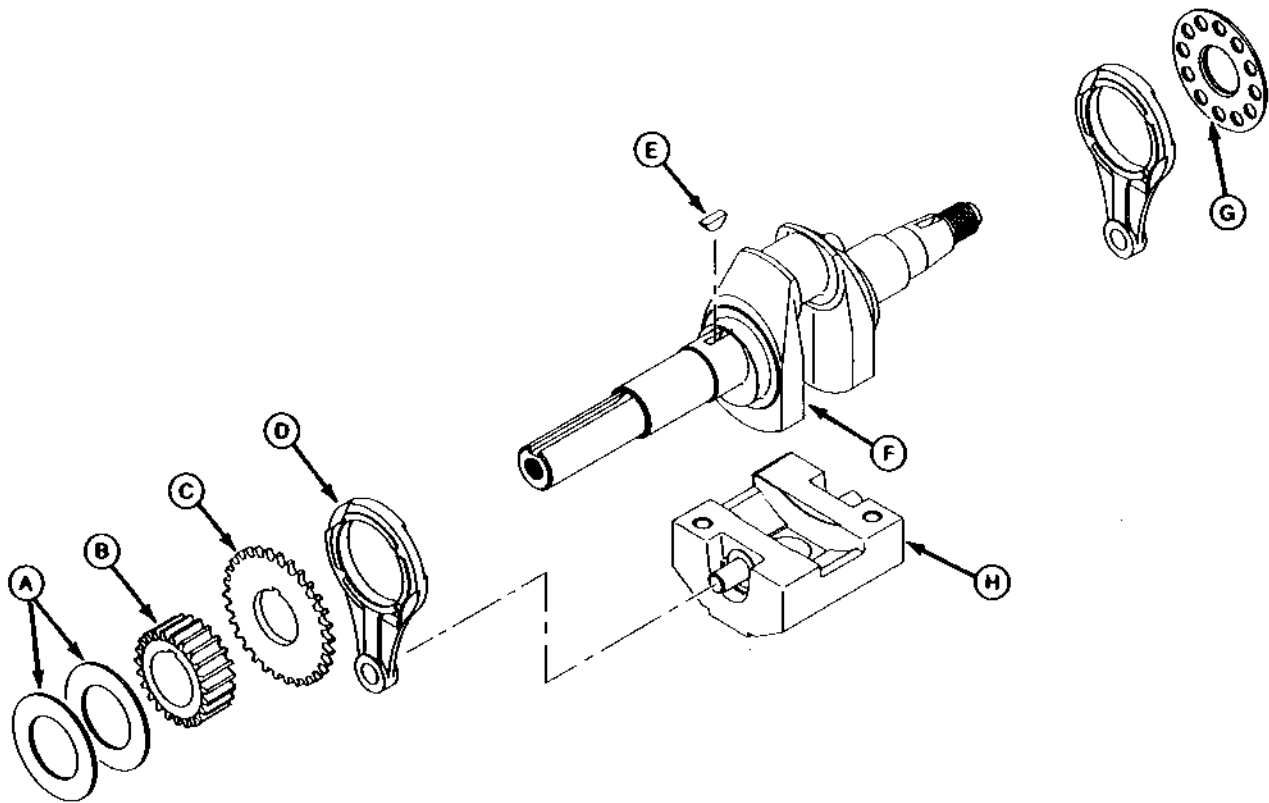
A—Support Shaft
B—O-Ring
C—Balancer Assembly
D—Balancer Weight

M80418 -JUN-25APR91

MX,4520A1,A8 -19-21OCT92

45
20
5

DISASSEMBLE AND ASSEMBLE RECIPROCATING BALANCER



A—Shim(s) (as required)
B—Crank Gear

C—Governor Drive Gear
D—Link Rod (2 used)

E—Woodruff Key
F—Crankshaft

G—Collar
H—Balancer Weight

1. Remove collar (G), gear (B), gear (C) and key (E).
2. Remove rods (D) and crankshaft (F).
3. Inspect crankshaft. (See this group.)
4. Inspect balancer assembly. (See this group.)
5. Put a light film of oil on bearing surfaces.
6. Install link rods on balancer weight (H) and crankshaft.
7. Install collar (G) with flat face toward link rod.
8. Install key and gear (C) with chamfered face toward link rod.
9. Install crank gear (B) with flat face toward governor drive gear.

MX,4520A1,A9 -19-21OCT92

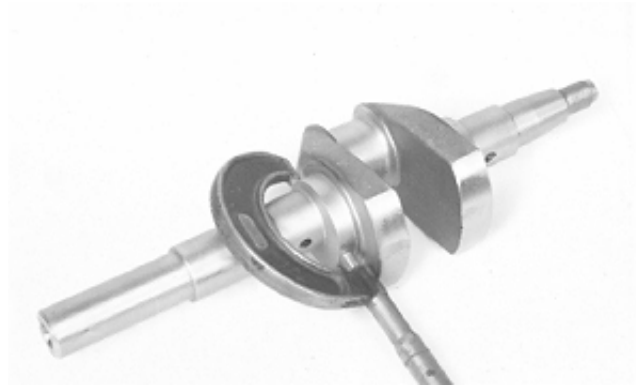
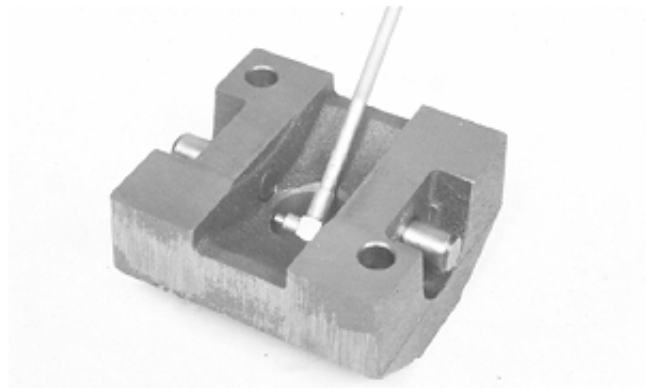
M80419 -JUN-08MAY91

INSPECT BALANCER ASSEMBLY

1. Clean and inspect all parts for wear or damage. Replace parts, if necessary.
2. Measure link rod journals on crankshaft. Replace crankshaft if diameter is less than specifications.
3. Measure inside diameter of link rod bearings. Replace link rod if small end is greater than specifications. Replace bushing if large end is greater than specifications. (See this group.)
4. Measure inside diameter of support shaft bearing in balancer weight. If bearing is greater than specifications, replace balancer weight.
5. Inspect wrist pins for any damage. If necessary, replace balancer weight.
6. Measure support shaft diameter. Replace shaft if diameter is less than specification.

DIAMETER SPECIFICATIONS

Link Rod Journal O.D. (MIN)	46.86 mm (1.845 in.)
Link Rod Small End I.D. (MAX)	12.06 mm (0.475 in.)
Link Rod Large End I.D. (MAX)	47.12 mm (1.855 in.)
Support Shaft Bearing I.D. (MAX)	26.10 mm (1.027 in.)
Support Shaft O.D. (MIN)	25.93 mm (1.021 in.)

*Crankshaft**Link Rod**Balancer Weight**Support Shaft*

MX,4520A1,A10 -19-21OCT92

M80420 -UN-25APR91

M80421 -UN-25APR91

M80422 -UN-25APR91

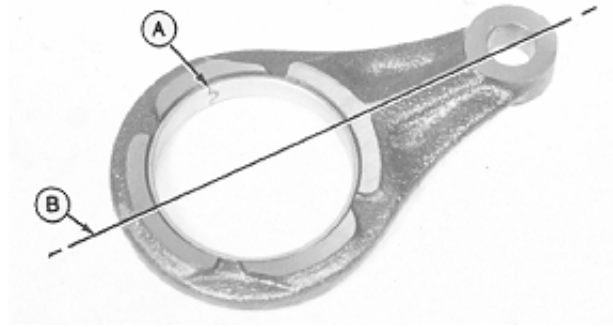
M80423 -UN-25APR91

M80424 -UN-25APR91

REPLACE LINK ROD BUSHINGS

NOTE: Replace bushings using a bearing, bushing and seal driver set and a press.

1. Remove bushings using a bushing, bearing and seal driver set and a press.
2. Install link rod bushings with seam (A) at a 90° angle to centerline (B).
3. Install bushing below surface to specifications.



M80424 -UN-25APR91

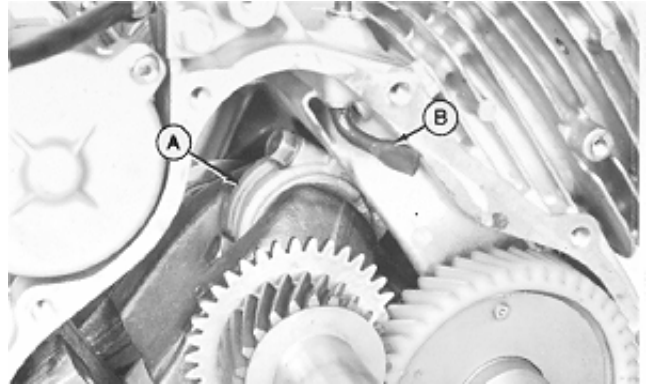
SPECIFICATIONS

Bushing Depth 1.00 mm (0.040 in.)

MX,4520A1,A11 -19-21OCT92

REMOVE AND INSTALL PISTON AND CONNECTING ROD

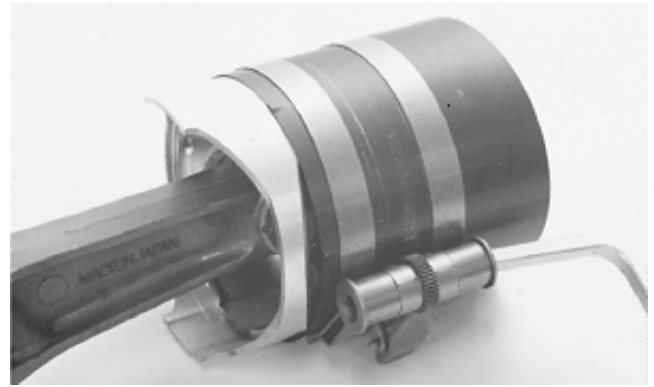
1. Remove cylinder head. (See Group 15.)
2. Remove crankcase cover. (See this group.)
3. Loosen governor arm nut and rotate governor shaft (B).
4. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
5. Remove cap screws and connecting rod cap (A).
6. Push piston and connecting rod from cylinder bore.
7. Make repairs as necessary. (See procedures in this group.)



M80425 -UN-25APR91

MX,4520A1,A12 -19-21OCT92

8. Deglaze cylinder bore. (See Section 100, Group 15.)
9. Stagger piston ring end gaps 180° apart, but do not align with oil ring side rail end gaps.
10. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
11. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
12. Install piston assembly in cylinder bore with engraved match mark/arrow on piston head facing flywheel side of engine.
13. Install connecting rod cap and cap screws. Tighten cap screws to specifications.
14. Rotate governor shaft and tighten nut.
15. Install crankcase cover.
16. Install cylinder head.



M50074 -UN-31AUG88

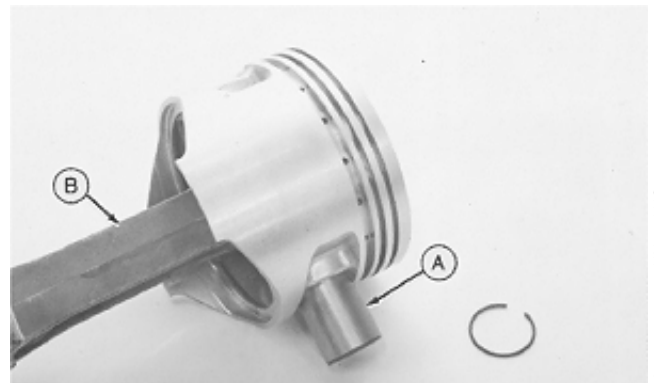
TORQUE SPECIFICATIONS

Connecting Rod Cap Screws 20 N·m (177 lb-in.)

MX,4520A1,A13 -19-21OCT92

DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

1. Remove circlip, piston pin (A) and connecting rod (B).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.

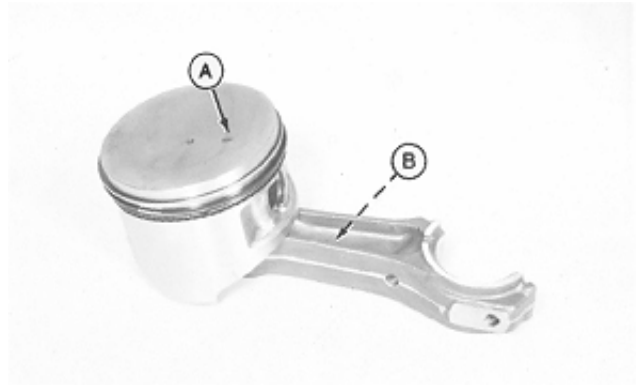


M50063 -UN-31AUG88 45 20 9

MX,4520A1,A14 -19-21OCT92

4. Align arrow match mark (A) on piston head opposite MADE IN JAPAN (B) on connecting rod.

5. Install piston pin and circlip.



MX,4520A1,A15 -19-21OCT92

M80426 -UN-25APR91

INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)

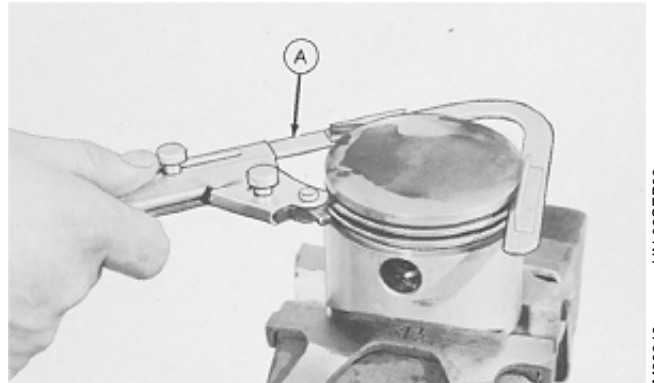
2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.

4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.

5. Check that oil return passages in grooves are open.



MX,4520A1,A16 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.

CLEARANCE SPECIFICATION (MAX)

Top Ring	Second Ring	Oil Control Ring
0.16 mm (0.006 in.)	0.14 mm (0.005 in.)	—



MX,4520A1,A17 -19-21OCT92

M38102 -UN-29AUG88

8. Measure piston pin outer diameter. Replace if less than specification.

9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

Piston Pin O.D. (MIN)

18.98 mm
(0.747 in.)

Piston Bore I.D. (MAX)

19.03 mm
(0.749 in.)



M50064 -UN-31AUG88



M80427 -UN-25APR91

MX,4520A1,A18 -19-21OCT92

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

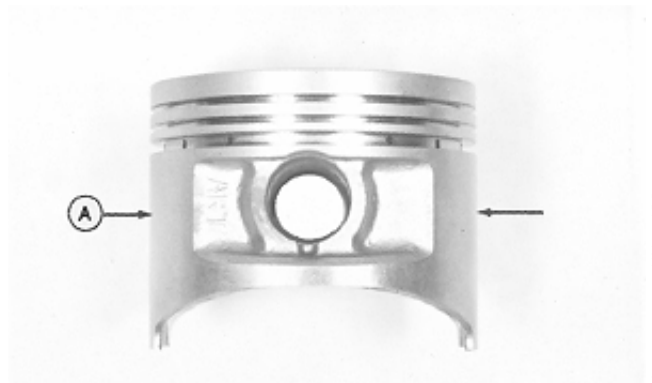
12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)

SPECIFICATIONS

Piston O.D. (A) 77.85—77.87 mm (3.0649—3.0657 in.)

Piston-to-Cylinder
Bore Clearance 0.051—0.089 mm (0.002—0.0035 in.)

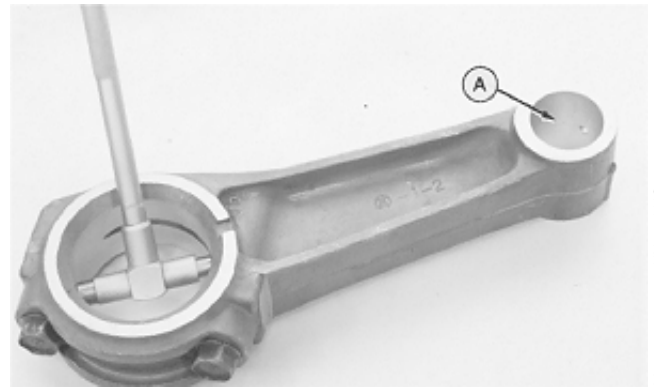


M80428 -UN-25APR91

MX,4520A1,A18A -19-21OCT92

INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.
2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
3. Install connecting rod cap. Tighten to 20 N·m (177 lb-in.).
4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



M50066 -UN-31AUG88

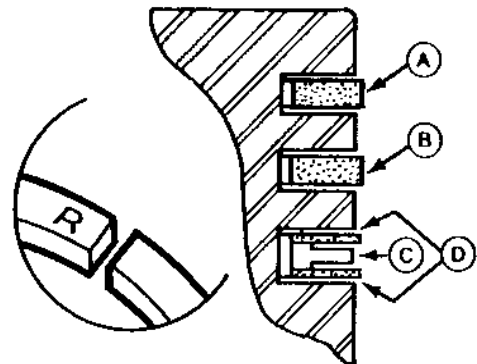
BEARING I.D. SPECIFICATIONS (MAX)

Crankshaft Bearing	Piston Bearing
35.57 mm (1.400 in.)	19.06 mm (0.750 in.)

MX,4520A1,A19 -19-21OCT92

REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)
4. Install top ring (A) and second ring (B) with R or NPR mark facing up. Rings should turn freely in grooves.
5. Oil ring is an assembly. Install spacer (C), then side rails (D). Put side rail end gaps 180° apart.



A—Top Ring
B—Second Ring
C—Spacer
D—Side Rails

M80429 -UN-08MAY91

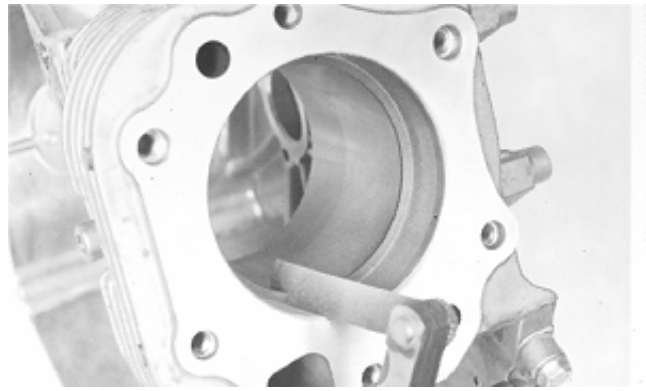
MX,4520A1,A20 -19-21OCT92

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS

Minimum End Gap	0.18 mm (0.007 in.)
Maximum End Gap	
Compression Rings	1.20 mm (0.047 in.)
Oil Ring Side Rails	Not Measured



M80430 -UN-25APR91

MX,4520A1,A21 -19-21OCT92

REMOVE, INSPECT AND INSTALL CRANKSHAFT

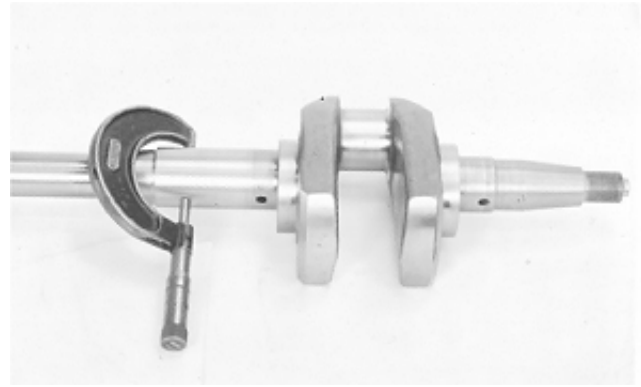
1. Remove camshaft. (See this group.)
2. Remove piston and connecting rod. (See this group.)
3. Remove balancer. (See this group.)
4. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

5. Check crankshaft alignment (T.I.R.). (See this group.)
6. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
7. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
8. Measure crankshaft main bearing journals and connecting rod journal. Replace crankshaft if measurements are less than specifications.

JOURNAL SPECIFICATIONS (MIN)

Main Bearing Journal		Connecting Rod Journal
PTO Side	Flywheel Side	
29.92 mm (1.178 in.)	—	35.43 mm (1.395 in.)



M54495 -UN-09JAN91

NOTE: An under-sized connecting rod is available through the parts catalog, if necessary.

9. Connecting rod journal (A) can be resized to accept under-sized rod. Have grinding done by a reliable repair shop. Before sending crankshaft for grinding, inspect journal radii (B) for cracks.

10. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.

11. Put a light film of oil on crankshaft bearing surfaces.

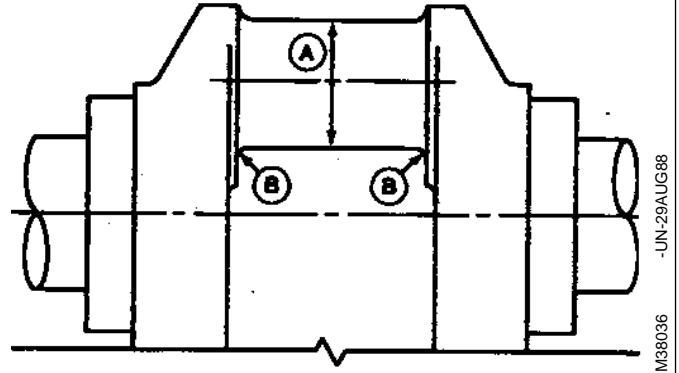
12. Pack grease in oil seals and install crankshaft.

13. Install balancer assembly on crankshaft.

14. Install crankshaft.

15. Install piston and connecting rod.

16. Install camshaft.



MX,4520A1,A23 -19-21OCT92

INSPECT CRANKSHAFT PLAIN BEARING

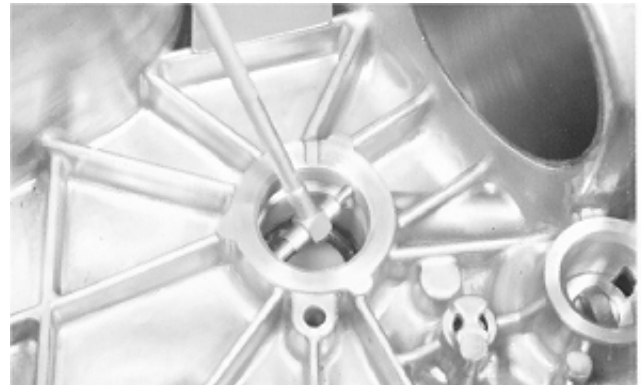
1. Remove crankshaft. (See this group.)

2. Measure crankshaft bearing in crankcase. Replace crankcase, if diameter is greater than specifications. (See this group.)

3. Install crankshaft.

SPECIFICATIONS

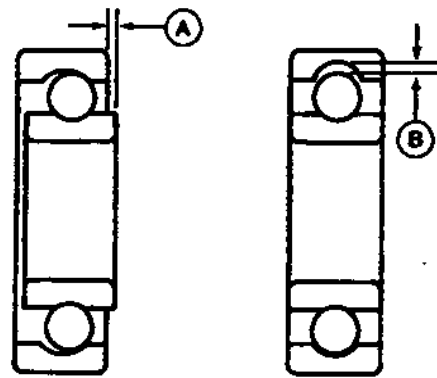
Bearing I.D. (MAX) 30.08 mm (1.184 in.)



MX,4520A1,A24 -19-21OCT92

INSPECT CRANKSHAFT BALL BEARING

1. Remove crankcase cover and oil seal. (See Inspect Oil Seals in this group.)
2. Remove crankshaft bearing using a bearing, bushing and seal driver set.
3. Thoroughly clean bearing in solvent. Dip bearing in light weight oil.
4. Spin the bearing by hand and check for axial (A) and radial (B) free play.
5. Replace the bearing if it is noisy or has too much play.
6. Install bearing flush to inside of crankcase cover using a bearing, bushing and seal driver set.
7. Install oil seal.
8. Install crankcase cover.



MX,4520A1,A25 -19-21OCT92

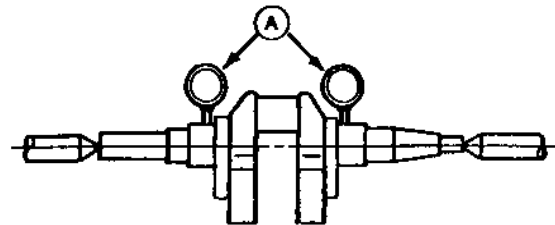
M38073 -UN-29AUG88

CHECK CRANKSHAFT ALIGNMENT (TIR)

Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

Maximum TIR 0.05 mm (0.002 in.)



MX,4520A1,A26 -19-21OCT92

M80432 -UN-08MAY91

MEASURE CRANKSHAFT END PLAY

1. Measure end play using dial indicator (A). Record this measurement.
2. Move crankshaft in and out. Remove crankcase cover and adjust end play if not within specifications. (See this group.)

SPECIFICATIONS

End Play 0.09—0.22 mm (0.004—0.009 in.)



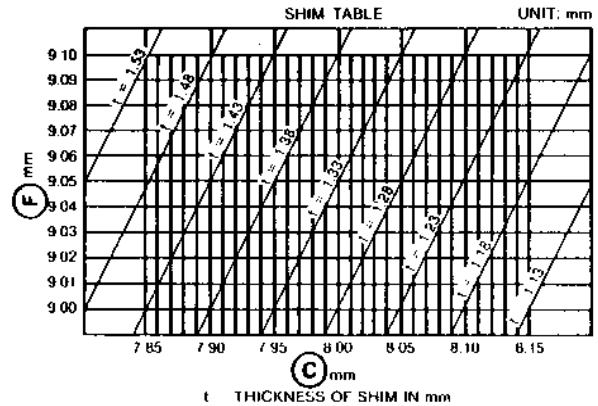
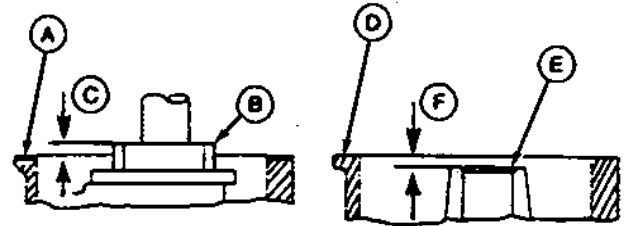
MX,4520A1,A27 -19-21OCT92

M80433 -UN-25APR91

ADJUST CRANKSHAFT END PLAY

1. With gasket (A) installed on crankcase, measure from gasket surface to crankshaft gear surface (B). Record measurement (C).
2. Measure from crankcase cover mounting face (D) to PTO bearing end (E). Record measurement (F).
3. Locate measurements on appropriate table. Follow lines to where recorded measurements intersect. Choose the next smaller shim from the table.
4. Install shim on PTO shaft.
5. Install crankcase cover. (See this group.)

A—Gasket
B—Crank Gear Surface
C—Measurement
D—Crankcase Cover Mounting Face
E—PTO Bearing End
F—Measurement



MX,4520A1,A28 -19-21OCT92

-UN-31AUG88

M51545

-19-25APR91

M80434

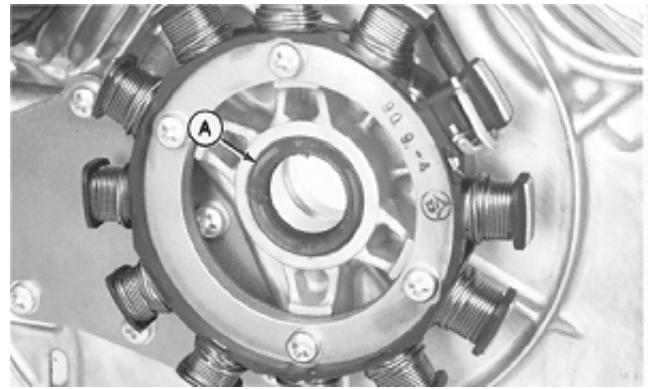
INSPECT OIL SEALS

NOTE: Pack lithium base grease in new or used seals.

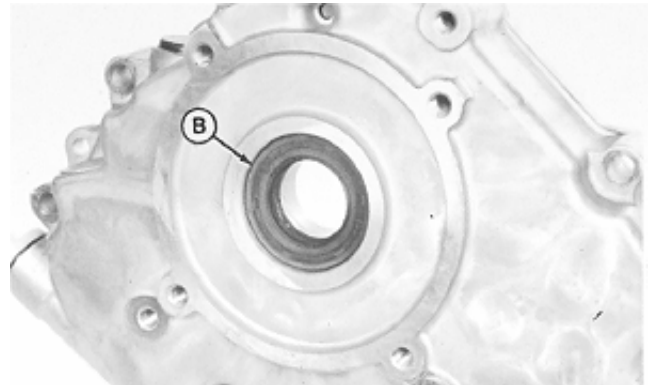
1. Remove flywheel. (See Group 10.)
 2. Remove governor shaft. (See this group.)
 3. Inspect oil seals (A, B and C). Replace if necessary.
 4. Remove crankshaft. (See this group.)
 5. Remove worn or damaged seals with a screwdriver.
 6. Install seals with lip to inside of engine using a bearing, bushing and seal driver set. Press in seal on flywheel end until flush with hub.
- Press in seal on PTO end to specification, below crankcase cover flange surface.
- Press in governor shaft seal to specification, below flange surface.
7. Install crankshaft.
 8. Install flywheel.
 9. Install governor shaft.

SEAL DEPTH SPECIFICATIONS

PTO End	4 mm (0.158 in.)
Governor Shaft	1.42 mm (0.056 in.)



Flywheel End



PTO End



Governor Shaft

MX,4520A1,A29 -19-21OCT92

INSPECT CYLINDER BLOCK

1. Remove crankshaft.
2. Clean and check block for cracks.
3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
4. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,4520A1,A30 -19-21OCT92

NOTE: A bare block is available for service.

5. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

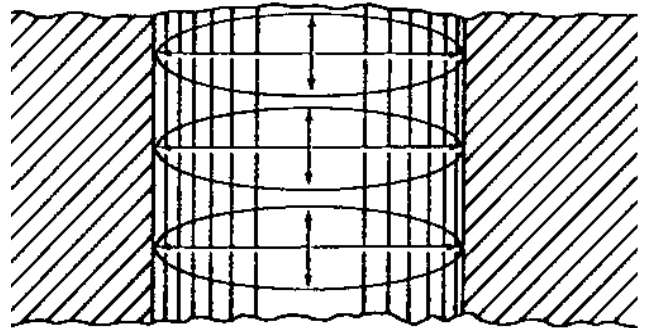
6. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

NOTE: If cylinder is rebored, oversize piston and rings must be installed.

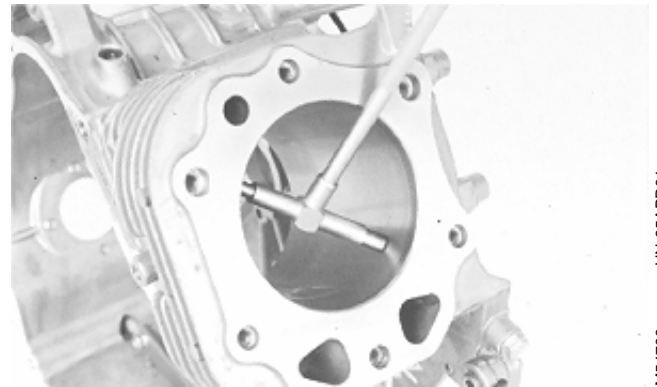
7. Install crankshaft.

CYLINDER BORE SPECIFICATIONS

Standard	77.98—78.00 mm (3.070—3.071 in)
Wear Limit	78.07 mm (3.074 in.)
Out-of-Round (Max)	0.056 mm (00022 in.)



M51745 -UN-23FEB89



M54799 -UN-25APR91

MX,4520A1,A31 -19-21OCT92

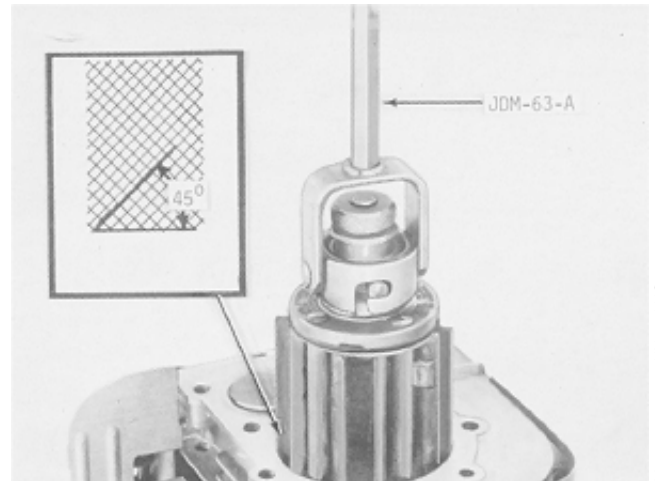
REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use 0.25, 0.50 or 0.75 mm (0.010, 0.020 or 0.030 in.) oversize pistons and rings. Have a reliable repair shop rebore the block, or use the drill press and honing tool.

1. Rebore cylinder with a honing tool to initial and final bore specifications.
2. Align center of bore to press center. Set the press to operate from 200—250 rpm.
3. Lower and raise hone until ends extend 20—25 mm (0.75—1.0 in.) past ends of cylinder.
4. Turn adjusting nut on one hone until stones contact cylinder wall at narrowest point.
5. Coat inside of cylinder with honing oil. Turn hone by hand. If you cannot turn it, hone is too tight.
6. Start drill press. Move hone up and down in cylinder approximately 20 times per minute.
7. Check cylinder diameter regularly during honing. Stop press before measuring. Remove hone from cylinder.

NOTE: Finish should not be smooth, but have a 40—60° cross-hatch pattern.

IMPORTANT: Check stone for wear or damage. Use correct stone for the job.



M24711 -UN-25AUG88

CYLINDER INITIAL BORE SPECIFICATIONS

Piston Oversize:
0.25 mm
(0.010 in.)

78.21—78.23 mm
(3.079—3.080 in.)

Piston Oversize:
0.50 mm
(0.020 in.)

78.46—78.48 mm
(3.089—3.090 in.)

Piston Oversize:
0.75 mm
(0.030 in.)

78.71—78.73 mm
(3.099—3.100 in.)

MX,4520A1,A32 -19-21OCT92

45
20
20

8. Hone the cylinder an additional 0.028—0.030 mm (0.0011—0.0012 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

IMPORTANT: DO NOT use gasoline or commercial solvents to clean cylinder bores. Solvents will not remove metal particles produced during honing.

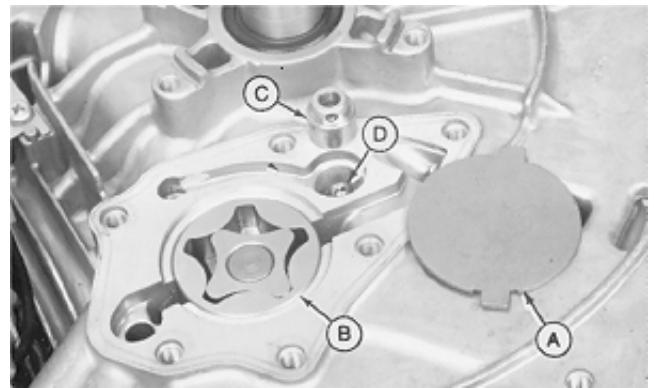
9. Clean the cylinder thoroughly using soap, warm water and clean rags. Continue to clean cylinder until white rags show no discoloration.

10. Dry the cylinder. Apply engine oil to cylinder wall.

M98,2040A,A9 -19-21OCT92

DISASSEMBLE AND ASSEMBLE OIL PUMP

1. Remove stator. (See Group 25.)
2. Remove cover, gasket and plate (A).
3. Remove oil pump assembly (B), relief valve (C), ball and spring (D).
4. Inspect all parts. (See this group.)
5. Install oil pump assembly, relief spring, ball and valve.
6. Install plate, gasket and cover.
7. Install stator.



A—Plate
B—Oil Pump Assembly
C—Relief Valve
D—Relief Spring and Ball

MX,4520A1,A33 -19-21OCT92

M53070 -UN-11APR89

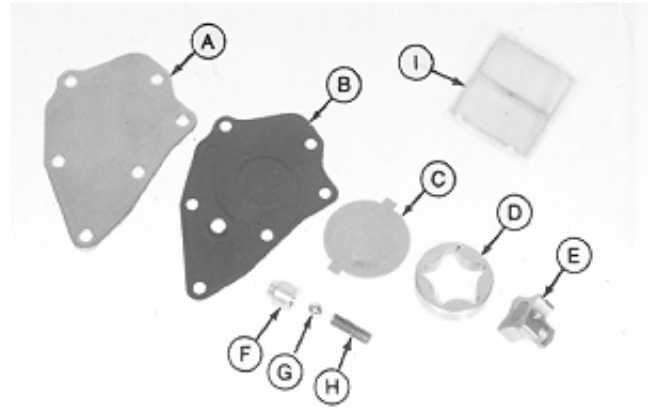
45
20
21

INSPECT OIL PUMP

NOTE: To inspect or clean oil screen (I), remove crankcase cover. (See this group.)

1. Inspect all parts for wear or damage. Replace as necessary.

A—Cover
B—Gasket
C—Rotor Cover
D—Outer Rotor
E—Rotor Shaft
F—Relief Valve
G—Check Ball
H—Relief Spring



M80438 -UN-25APR91

MX,4520A1,A34 -19-21OCT92

2. Measure outside diameter of shaft. Replace both shaft and outer rotor if less than specifications.

3. Measure rotor shaft bearing. Replace crankcase cover if greater than specifications.

ROTOR SHAFT SPECIFICATIONS

Minimum Shaft O.D.	12.63 mm (0.497 in.)
Maximum Bearing I.D.	12.77 mm (0.503 in.)



M80439 -UN-25APR91



M80440 -UN-25APR91

MX,4520A1,A35 -19-21OCT92

4. Measure thickness of outer rotor. Replace both outer rotor and shaft if less than specification.

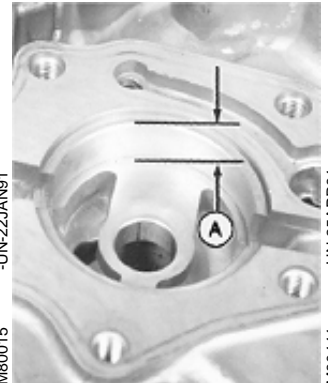
5. Measure outer rotor bearing depth (A). Replace crankcase cover if greater than specification.

OUTER ROTOR SPECIFICATIONS

Minimum Rotor Thickness	9.92 mm (0.391 in.)
Maximum Bearing Depth	10.17 mm (0.400 in.)



M80015 -UN-22JAN91



M80441 -UN-25APR91

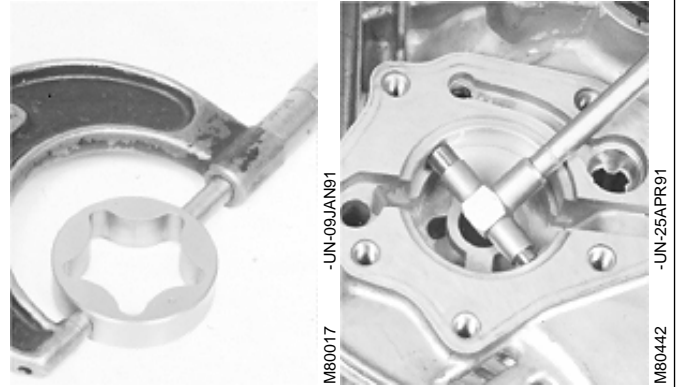
MX,4520A1,A36 -19-21OCT92

6. Measure outside diameter of outer rotor. Replace both outer rotor and shaft if less than specification.

7. Measure inside diameter of rotor bearing. Replace crankcase cover if greater than specification.

OUTER ROTOR SPECIFICATIONS

Minimum Rotor O.D. 40.47 mm (1.596 in.)
Maximum Bearing I.D. 40.77 mm (1.605 in.)

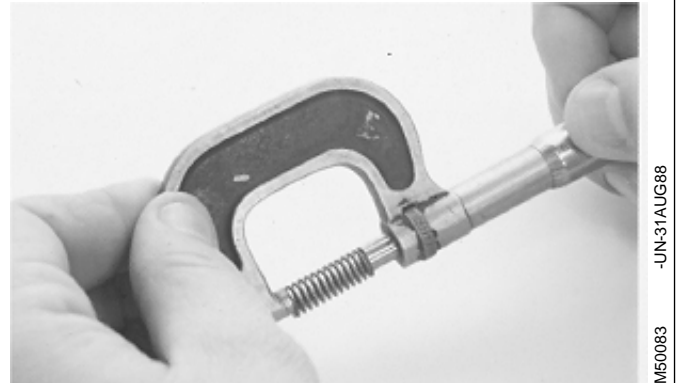


MX,4520A1,A37 -19-21OCT92

8. Measure relief valve spring. Replace if length is less than specifications.

SPECIFICATIONS

Spring Free Length (MIN) 19 mm (0.748 in.)

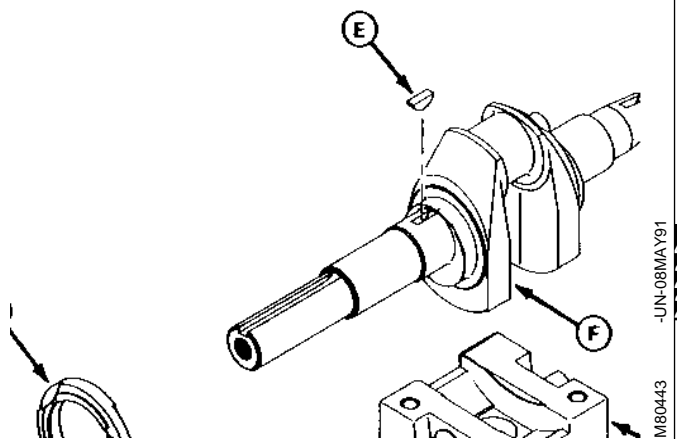


MX,4520A1,A38 -19-21OCT92

REMOVE, INSPECT AND INSTALL OIL FILTER MANIFOLD—IF EQUIPPED

1. Remove oil filter and manifold.
2. Inspect oil filter. Replace if excessively contaminated or damaged.
3. Inspect oil passages for clogs. Clean if needed.
4. Inspect rubber gasket (A). Replace if worn or damaged.
5. Install filter and manifold.

- A—Rubber Gasket
B—Oil Filter Manifold
C—Plug
D—Cap Screw (2 used)
E—Oil Filter



MX,4520A1,A39 -19-21OCT92

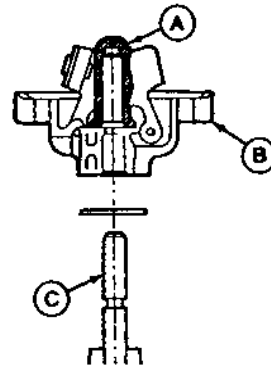
INSPECT AND REPLACE GOVERNOR

IMPORTANT: Removal damages governor. If not damaged, do not remove.

1. Remove crankcase cover. (See this group.)
2. Inspect governor. If necessary to replace, remove with screwdriver.
3. If removed, press shaft (C) back into block until it protrudes 32.2—32.8 mm (1.267—1.291 in.).

NOTE: Assemble sleeve and gear before installing assembly on shaft.

4. Install sleeve (A) onto governor gear (B).
5. Install governor assembly onto shaft. Push down on assembly until it snaps into place.
6. Install crankcase cover.



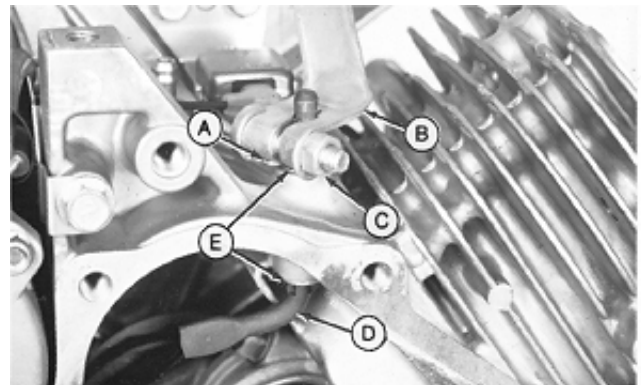
M51762 -UN-07SEP88

MX,4520A1,A40 -19-21OCT92

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless seal is leaking or shaft is damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (D). Replace if damaged.
3. To replace shaft, loosen nut (C) on lever (B).
4. Remove retaining pin (A), governor shaft and washers (E).
5. Install washers, shaft and retaining pin. Tighten nut.



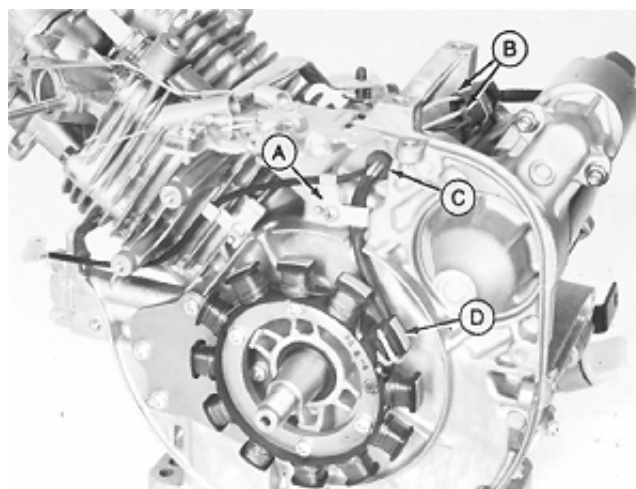
A—Retaining Pin
B—Governor Lever
C—Nut
D—Governor Shaft
E—Washers

M80444 -UN-25APR91

MX,4520A1,A41 -19-21OCT92

REMOVE AND INSTALL STATOR

1. Remove flywheel. (See Group 10.)
2. Disconnect stator wiring leads (B).
3. Remove clamp (A).
4. Remove rubber grommet (C) and wiring leads from crankcase.
5. Remove stator (D).
6. Install stator.
7. Install wiring leads and rubber grommet.
8. Install clamp.
9. Connect stator wiring leads.
10. Install flywheel.

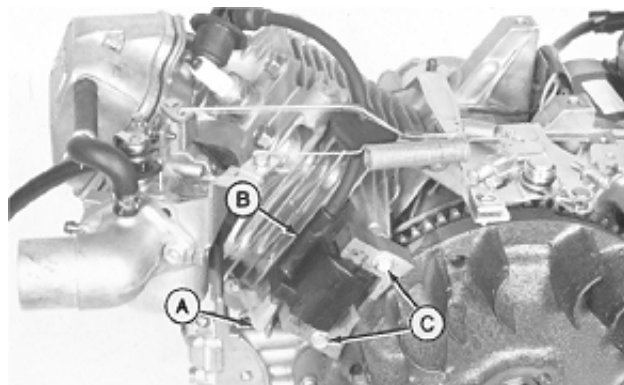


A—Clamp
B—Wiring Leads
C—Rubber Grommet
D—Stator

MX,4525A1,A1 -19-21OCT92

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove blower housing. (See Group 10.)
2. Disconnect wiring lead (A).
3. Remove cap screws (C) and armature with coil (B).
4. Loosely install armature with coil.
5. Connect wiring lead.
6. Adjust armature air gap. (See this group.)
7. Install blower housing.



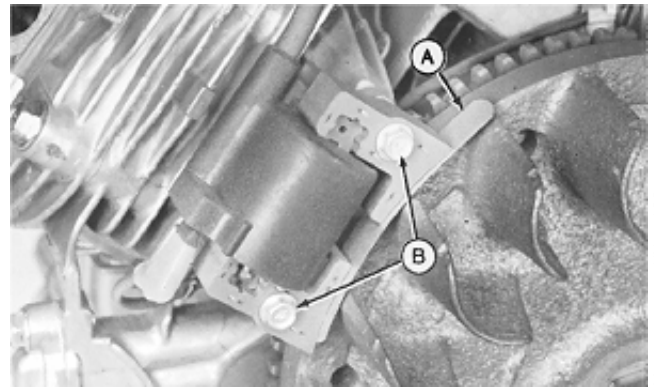
MX,4525A1,A2 -19-21OCT92

ADJUST ARMATURE AIR GAP

1. Turn flywheel magnet away from armature.
2. Insert feeler gauge blade (B), between flywheel and armature.
3. Push armature against flywheel and tighten screws (B).
4. Turn flywheel to remove feeler gauge.

AIR GAP SPECIFICATIONS

Feeler Gauge Blade 0.30 mm (0.012 in.)

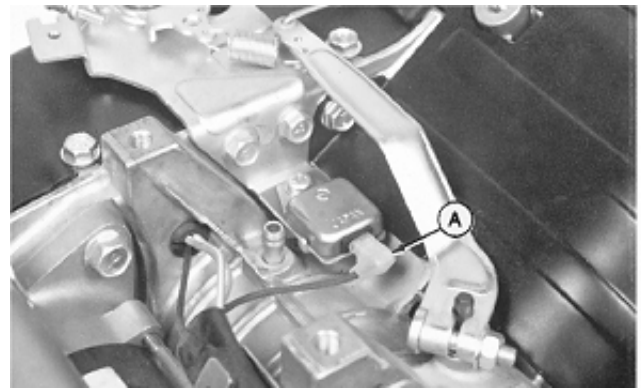


M80447 -UN-25APR91

MX,4525A1,A3 -19-21OCT92

REPLACE IGNITOR

1. Disconnect wiring lead (A).
2. Remove ignitor.
3. Install ignitor.
4. Connect wiring lead.



M80448 -UN-25APR91

MX,4525A1,A4 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	Mineral Spirits	Clean Armature
	Multipurpose Grease	Grease Starter Parts

M98,2030A,ZB -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Recoil Starter Kit

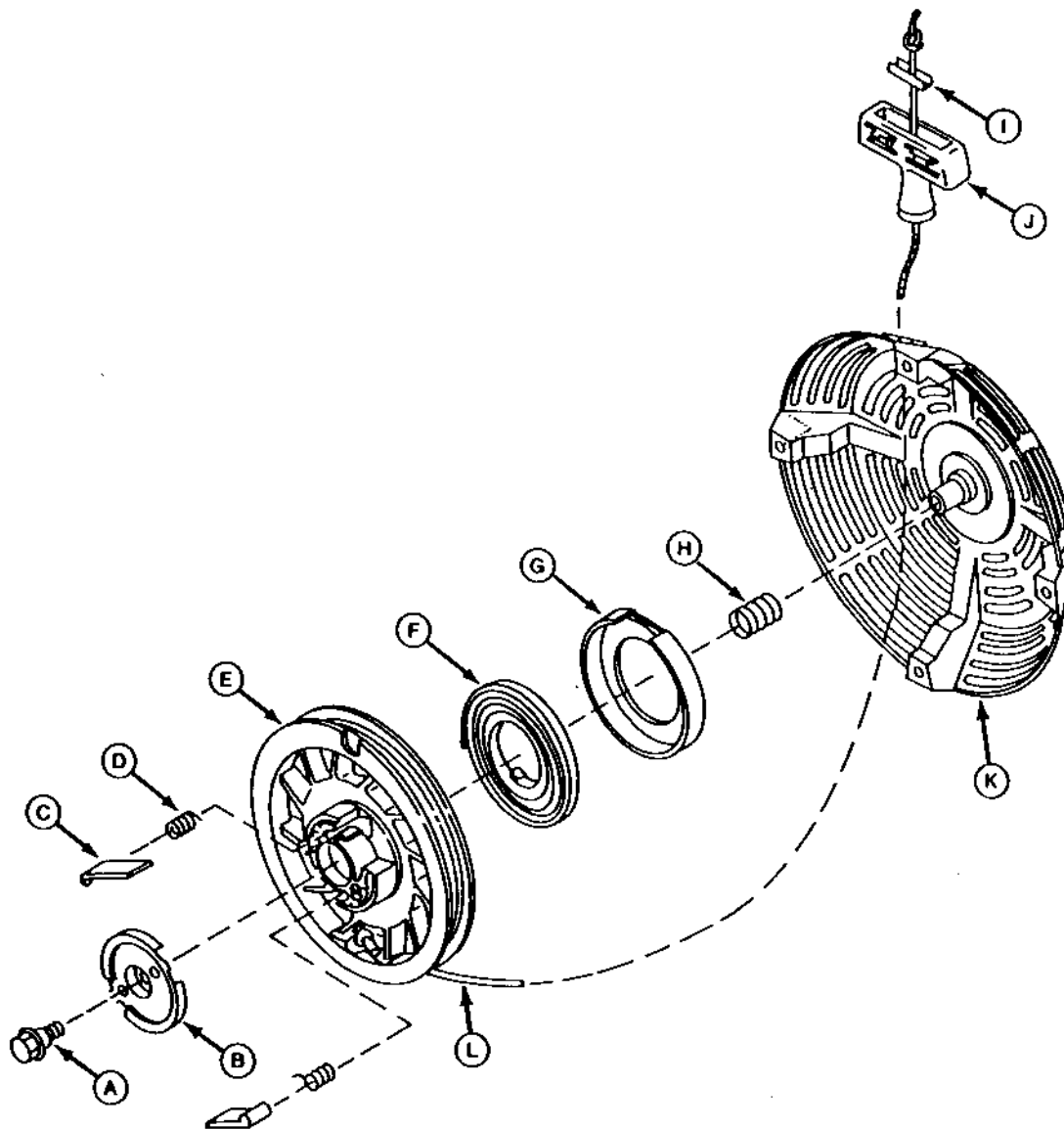
Complete Recoil Starter

Complete Solenoid

Brush Kit

Complete Electric Starter

MX,4530A1,A1 -19-21OCT92

DISASSEMBLE, INSPECT, AND ASSEMBLE RECOIL STARTER—IF EQUIPPED

A—Screw
B—Retainer
C—Pawl (2 used)

D—Spring (2 used)
E—Reel
F—Spring

G—Case
H—Spring
I—Clip

J—Handle
K—Housing
L—Rope

Inspect all parts for wear or damage. Replace as necessary.

45-30-2
M80449 -JUN-08MAY91

MX,4530A1,A2 -19-21OCT92

REPLACE SPRING

⚠ CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

1. Working from the center out, carefully unwind spring from spring case.
2. Hook outside spring tang in case. Wind spring into spring case, working toward center.



M54497 -UN-09JAN91

MX,4530A1,A3 -19-21OCT92

ANALYZE ELECTRIC STARTER CONDITION

1. The starter overheats because of:
 - Long cranking.
 - Armature binding.
2. The starter operates poorly because of:
 - Armature binding.
 - Dirty or damaged starter drive.
 - Badly worn brushes or weak brush springs.
 - Excessive voltage drop in cranking system.
 - Battery or wiring defective.
 - Shorts, opens, or grounds in armature.

NOTE: Starter repair is limited to brushes, end caps, and starter drive. Fields in starter are permanent magnets and are not serviceable. If housing or armature is damaged, replace starter.

MX,4530A1,A4 -19-21OCT92

45
30
3

BENCH TEST SOLENOID DRIVE STARTER

NOTE: Perform bench test before disassembling starter motor to determine cause of problem.

IMPORTANT: Never operate motor longer than 20 seconds. Allow at least two minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starting motor.

1. Disconnect battery leads from battery.
2. Remove starter from engine.
3. Connect 12-volt battery (A) to starter battery terminal (B) and starter frame (C) using heavy duty cables.
4. Connect remote start switch (D) between switch terminal (E) and battery terminal (B).

NOTE: A short piece of wire with a small clip on the end will allow a more positive connection at the switch terminal.

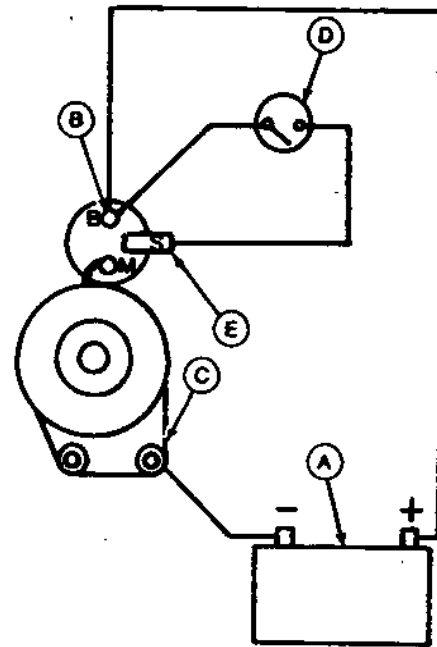
When switch is activated, starter should engage and run.

IF SOLENOID CHATTERS; hold-in winding is open-circuited.

IF NOTHING HAPPENS; either the solenoid pull-in winding is open-circuited or mechanical parts are sticking.

IF SOLENOID ENGAGES, BUT MOTOR DOES NOT RUN; check solenoid switch continuity, brushes, armature and field windings.

Solenoid cannot be repaired, replace it.



A—12-Volt Battery
B—Battery Terminal
C—Starter Frame
D—Remote Start Switch
E—Switch Terminal

M37149 -JUN-29AUG88

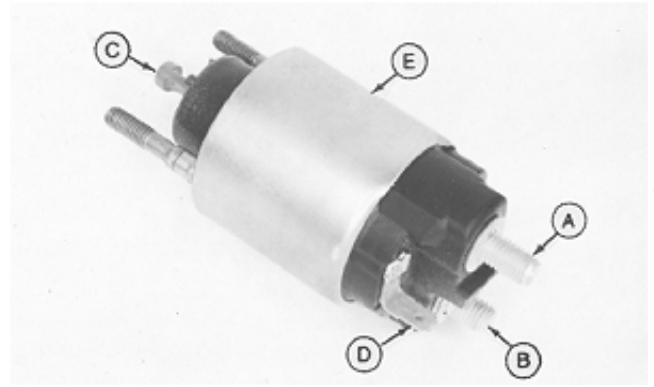
MX,4530A1,A5 -19-21OCT92

TEST SOLENOID

NOTE: If bench test indicated solenoid problems, use an ohmmeter or test light to check solenoid.

1. Test solenoid terminals (A and B) for continuity. There should be no continuity.
2. Depress switch arm (C). There should be continuity when arm is fully depressed.
3. Test for open circuits between terminal (B) and tang (D). There should be continuity.
4. Test for open circuits between tang (D) and body (E). There should be continuity.

If solenoid fails any test, it is defective and must be replaced.



A—Terminal
B—Terminal
C—Switch Arm
D—Tang
E—Solenoid Body

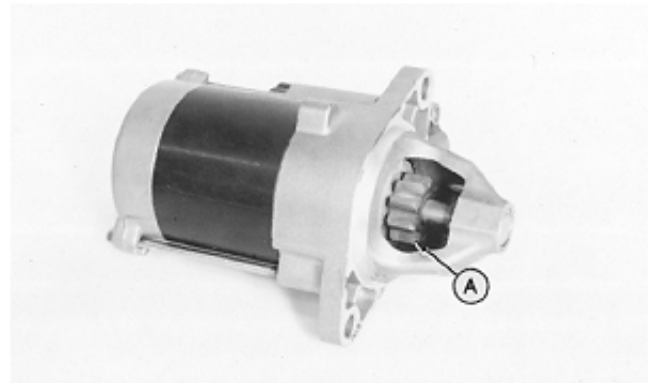
MX,4530A1,A6 -19-21OCT92

M51705 -UN-31AUG88

CHECK STARTER ARMATURE ROTATION

1. Remove starter.
2. Rotate armature (A).

If armature does not rotate freely, armature may be bent or bearings may be worn. Disassemble, inspect and clean starter. (See this group.)

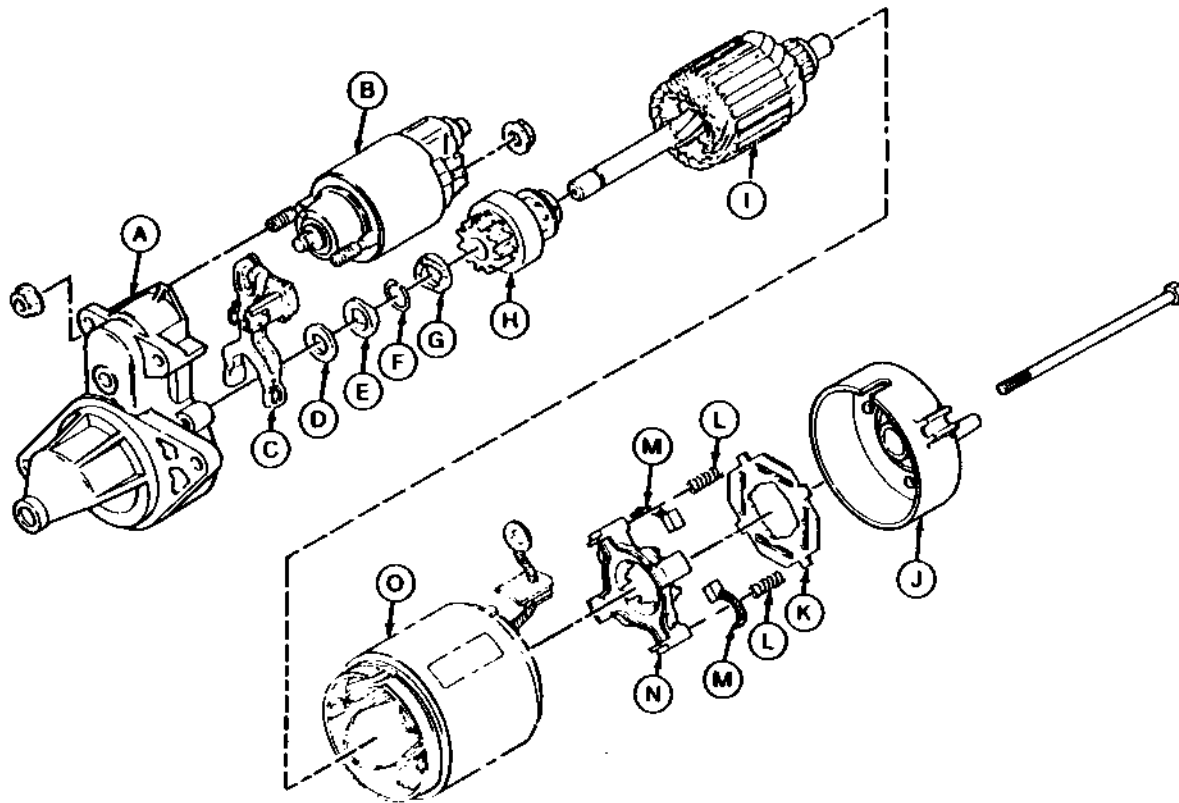


MX,4530A1,A7 -19-21OCT92

M53972 -UN-18APR90

45
30
5

INSPECT STARTER



A—Front Cover
B—Solenoid
C—Shift Lever
D—Washer

E—Pinion Stopper Half
F—Retaining Clip
G—Pinion Stopper Half
H—Pinion

I—Armature
J—End Cover
K—Insulator
L—Brush Spring

M—Brush
N—Brush Holder
O—Body

1. Mark body and covers for correct alignment during reassembly.
2. Separate pinion stopper halves (E and G) to remove retaining clip (F).
3. Inspect parts for wear or damage.
4. Measure brushes. Replace brushes as a set if length of any one is less than 6 mm (0.240 in.).

5. Test starter armature and brushes. (See this group.)
6. Apply a thin coat of multipurpose grease to:
 - sliding surfaces of armature and solenoid shift lever.
 - armature shaft spline.
 - points where shaft contacts cover.
7. Assemble starter.

MX,4530A1,A8 -19-21OCT92

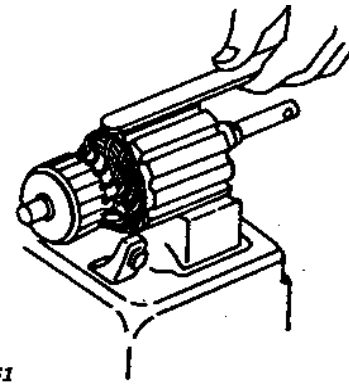
M53943 -JUN-19JUN90

TEST STARTER ARMATURE

IMPORTANT: Do not clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.

1. Locate short circuits by rotating armature on a growler while holding a hacksaw blade or steel strip on armature. The hacksaw blade will vibrate in area of short circuit.
2. Shorts between bars are sometimes caused by dirt or copper between bars. Inspect for this condition.
3. If test indicates short circuited windings, clean the commutator of dust and fillings. Check armature again. If test still indicates short circuit, replace armature.

M24861



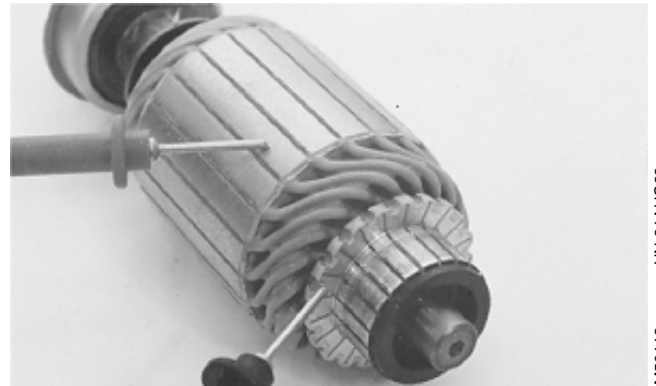
MX,4530A1,A9 -19-21OCT92

M24861 -UN-25AUG88

4. Test for grounded windings using an ohmmeter or test light.

Armature windings are connected in parallel, so each commutator bar needs to be checked.

If test shows continuity, a winding is grounded and the armature must be replaced.

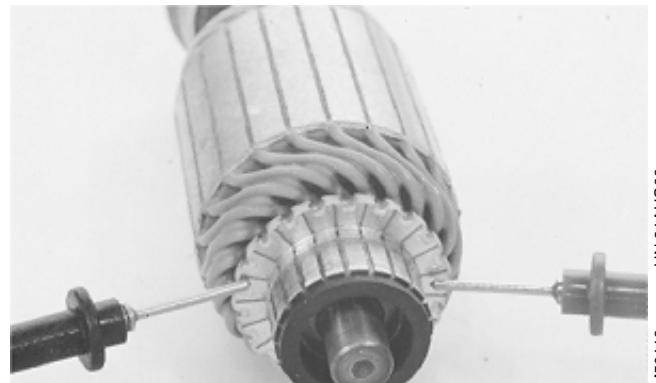


M98,2030A,AH -19-21OCT92

M50112 -UN-31AUG88

5. Test for open circuited windings using an ohmmeter or test light.

If test shows no continuity, there is an open circuit and armature must be replaced.



M98,2030A,M -19-21OCT92

M50113 -UN-31AUG88 45 30 7

TEST FIELD COIL

*NOTE: Continuity tests are similar for all units.
Illustrations are representative only.*

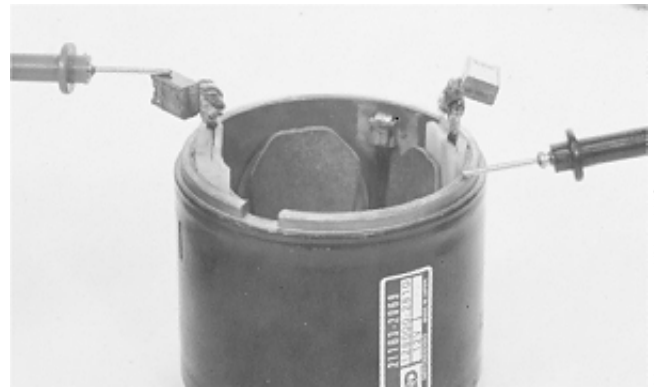
If equipped with brushes on body:

Replace field coil if not according to specifications.

CONTINUITY TEST

Brush-to-Housing Continuity

Brush-to-Brush Continuity



M50115 -UN-31AUG88



M50116 -UN-31AUG88

MX,4530A1,A10 -19-21OCT92

Section 50

FB460V

Contents

	Page		Page
Group 00—Engine Application and Repair Specifications			
Engine Application Chart	50-00-1	Remove, Inspect and Install Tappets	50-20-9
Repair Specifications	50-00-2	Reciprocating Balancer	
Group 05—Fuel and Air Systems			
Service Parts Kits	50-05-1	Remove and Install	50-20-10
Remove and Install		Disassemble and Assemble	50-20-11
Fuel Pump	50-05-1	Inspect Assembly	50-20-12
Carburetor	50-05-2	Replace Bushings	50-20-12
Disassemble, Clean, Inspect and		Piston and Connecting Rod	
Assemble Carburetor	50-05-3	Remove and Install	50-20-13
Service		Disassemble, Inspect and Assemble . . .	50-20-14
Breather	50-05-5	Inspect Piston	50-20-14
Air Cleaner	50-05-6	Inspect Connecting Rod	50-20-16
Group 10—Blower Housing and Flywheel			
Remove and Install Blower Housing		Piston Rings	
Recoil Start	50-10-1	Remove and Install	50-20-17
Electric Start	50-10-2	Check End Gap	50-20-17
Flywheel Screen Adjustment	50-10-2	Crankshaft	
Remove and Install Flywheel	50-10-3	Remove, Inspect and Install	50-20-18
Group 15—Cylinder Head			
Other Materials	50-15-1	Inspect Plain Bearings	50-20-19
Remove and Install Cylinder Head	50-15-1	Inspect Ball Bearing	50-20-20
Inspect Cylinder Head	50-15-2	Check Alignment (TIR)	50-20-20
Group 20—Cylinder Block, Valves and Internal Components			
Essential Tools	50-20-1	Measure End Play	50-20-20
Other Material	50-20-1	Adjust End Play	50-20-21
Service Parts Kits	50-20-2	Inspect	
Remove and Install Valves and Springs . .	50-20-3	Oil Seals	50-20-22
Inspect Valve Springs	50-20-4	Replace Cylinder Head Block Studs	50-20-23
Inspect Valve Guides	50-20-4	Cylinder Block	
Replace Valve Guide Bushings	50-20-4	Inspect	50-20-23
Recondition Valve Seats	50-20-5	Rebore	50-20-25
Check Valve-To-Tappet Clearance	50-20-6	Oil Pump	
Remove and Install Crankcase Cover . . .	50-20-7	Disassemble and Assemble	50-20-26
Camshaft		Inspect	50-20-27
Remove and Install	50-20-7	Remove, Inspect and Install Oil Filter	
Inspect	50-20-8	Manifold—If Equipped	50-20-28
Inspect Plain Bearings	50-20-8	Inspect and Replace	
		Governor	50-20-29
		Governor Shaft	50-20-29
		Group 25—Ignition and Charging System	
		Remove and Install	
		Stator	50-25-1
		Armature with Coil	50-25-1
		Adjust Armature Air Gap	50-25-2

Continued on next page

Page

Group 30—Starting Systems

Other Material	50-30-1
Service Parts Kits	50-30-1
Recoil Starter	
Disassemble	50-30-1
Inspect	50-30-3
Assemble	50-30-4
Electric Starter	
Analyze Condition	50-30-5
Bench Test Starter	50-30-6
Test Solenoid	50-30-7
Check Starter Armature Rotation	50-30-7
Inspect Starter	50-30-8
Test Armature	50-30-9
Test Field Coil	50-30-10

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

LAWN TRACTORS

Machine	Engine Model No.
112 L	FB460V-AS00
160/165 (Engine S.N. —181193)	FB460V-BS00
(Engine S.N. 181194—)	FB460V-CS00

RIDING MOWERS

RX95 (Engine S.N. —181763)	FB460V-AS09
	FB460V-CS09-01
(Engine S.N. 181764—214347)	FB460V-BS09
(Engine S.N. 214372—290474)	FB460V-AS25
(Engine S.N. 290475—)	FB460V-BS25
SX95 (Engine S.N. —181763)	FB460V-AS09
	FB460V-CS09-01
(Engine S.N. 181764—214347)	FB460V-BS09
(Engine S.N. 214348—290474)	FB460V-CS09
(Engine S.N. 290475—)	FB460V-BS25
SRX95	FB460V-BS25

COMMERCIAL WALK-BEHIND MOWERS

32/36/48/52-Inch	FB460V-CS02
----------------------------	-------------

MX,5000A1,A1 -19-21OCT92

50
00
1

FB460V REPAIR SPECIFICATIONS**GROUP 10—BLOWER HOUSING AND FLYWHEEL**

Item	Specification
Flywheel Nut Torque	88 N·m (65 lb-ft)
Flywheel Screen Gap	1—3 mm (0.039—0.118 in.)

GROUP 15—CYLINDER HEAD

Maximum Cylinder Head Warp	0.40 mm (0.015 in.)
Cap Screw Torque In Sequence	
Initial Torque	23 N·m (203 lb-in.)
Final Torque	37 N·m (27 lb-ft)
Spark Plug Torque	24 N·m (212 lb-in.)

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS

Valve Clearance (cold)	0.10—0.16 mm (0.004—0.006 in.)
----------------------------------	--------------------------------

Valves and Springs**Minimum Spring Free Length**

Intake	43 mm (1.710 in.)
Exhaust	39 mm (1.540 in.)

Maximum Valve Guide I.D.	8.08 mm (0.318 in.)
----------------------------------	---------------------

Valve Guide Bushing Depth	30 mm (1.178 in.)
-------------------------------------	-------------------

Maximum Valve Stem Bend	0.03 mm (0.001 in.)
-----------------------------------	---------------------

Valve Seat and Face Angle	45°
-------------------------------------	-----

Valve Seating Width	1.30 mm (0.050 in.)
-------------------------------	---------------------

Valve Margin	0.60 mm (0.020 in.)
------------------------	---------------------

Valve Narrowing Angle	30°
---------------------------------	-----

Continued on next page

MX,5000A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Crankcase Cover	
Oil Capacity	
With Filter	1.6 L (3.38 pt)
Without Filter	1.4 L (2.96 pt)
Cap Screw Torque	20 N·m (177 lb-in.)
Camshaft	
Minimum End Journal O.D.	
PTO Side	19.91 mm (0.784 in.)
Magnetos Side	15.91 mm (0.627 in.)
Minimum Lobe Height	35.40 mm (1.395 in.)
Maximum Bearing I.D.	
Crankcase	16.07 mm (0.633 in.)
Oil Pump Cover	20.07 mm (0.790 in.)
Reciprocating Balancer	
Link Rod	
Minimum Journal O.D.	53.95 mm (2.124 in.)
Maximum Small End I.D.	12.60 mm (0.475 in.)
Maximum Large End I.D.	54.12 mm (2.132 in.)
Bushing Depth	0.50 mm (0.020 in.)
Balancer Weight	
Maximum Bearing I.D.	26.10 mm (1.027 in.)
Support Shaft	
Minimum Shaft O.D.	25.93 mm (1.021 in.)
Support Shaft Assy Torque	7.3 N·m (65 lb-in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.16 mm (0.006 in.)
Second Ring	0.14 mm (0.005 in.)
Oil Ring	0.19 mm (0.007 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	0.70 mm (0.028 in.)
Oil Ring	1.20 mm (0.047 in.)
Minimum Pin O.D.	20.98 mm (0.827 in.)
Maximum Pin Bore I.D.	21.03 mm (0.829 in.)
Maximum Piston-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Piston O.D.	88.81—88.83 mm (3.4991—3.4999 in.)
Piston-to-Cylinder Bore Clearance	0.156 mm (0.0061 in.)
Connecting Rod	
Maximum Crankshaft Bearing I.D.	37.02 mm (1.459 in.)
Maximum Piston Pin Bearing I.D.	21.01 mm (0.829 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.03 mm (0.001 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.09 mm (0.004 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)

Continued on next page.

MX,5000A1,A3 -19-21OCT92

GROUP 20—CYLINDER BLOCK, VALVES AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Crankshaft	
Minimum PTO Side Journal O.D.	34.91 mm (1.374 in.)
Minimum Connecting Rod Journal O.D.	36.95 mm (1.455 in.)
Maximum Crankcase Cover Plain Bearing I.D.	35.06 mm (1.380 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.09—0.22 mm (0.004—0.009 in.)
PTO Side Oil Seal Depth	0.50 mm (0.020 in.)
Cylinder Block	
Crankcase/Block Stud Torque	36 N·m (27 lb-ft)
Cylinder Bore	
Standard Cylinder Bore I.D.	88.90—89.00 mm (3.500—3.504 in.)
Maximum Cylinder Bore I.D.	89.06 mm (3.506 in.)
Maximum Out-of-Round	0.063 mm (0.0025 in.)
Maximum Taper	0.076 mm (0.003 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	89.21—89.23 mm (3.512—3.513 in.)
0.50 mm	89.46—89.48 mm (3.522—3.523 in.)
0.75 mm	89.71—89.73 mm (3.532—3.533 in.)
Oil Pump	
Cover Cap Screw Torque	17—23 N·m (150—204 lb-in.)
Minimum Rotor Shaft O.D.	12.63 mm (0.497 in.)
Maximum Rotor Shaft Bearing I.D.	12.76 mm (0.502 in.)
Outer Rotor	
Minimum Thickness	11.92 mm (0.470 in.)
Minimum O.D.	28.90 mm (1.139 in.)
Outer Rotor Bearing	
Maximum Depth	12.14 mm (0.478 in.)
Maximum I.D.	29.15 mm (1.148 in.)
Minimum Valve Spring Free Length	19.00 mm (0.750 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS**Electric Starter**

See Starter Specifications in this Group.

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Fuel Pump Gasket Kit

Complete Fuel Pump

Carburetor Gasket Kit

Main Jet High Altitude Kit

Complete Carburetor

Air Cleaner Assembly

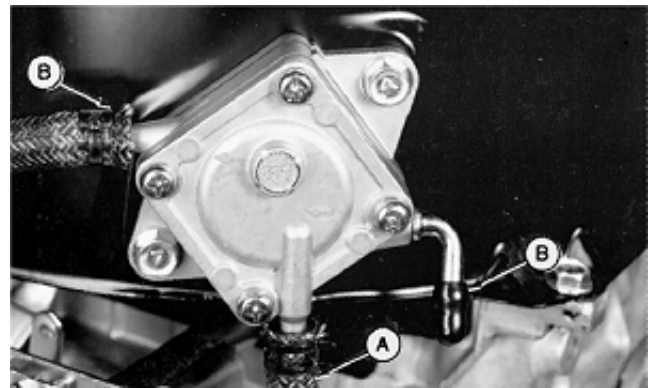
MX,5005A1,A0 -19-21OCT92

REMOVE AND INSTALL FUEL PUMP



CAUTION: Gasoline is dangerous. Avoid fires due to smoking or careless maintenance practices.

1. Disconnect vacuum line (A) and fuel lines (B). Close all openings using caps and plugs.
2. Remove fuel pump.
3. Inspect pump for wear or damage. Repair or replace as necessary.
4. Install fuel pump.
5. Connect vacuum and fuel lines.



M54481 -UN-25SEP90

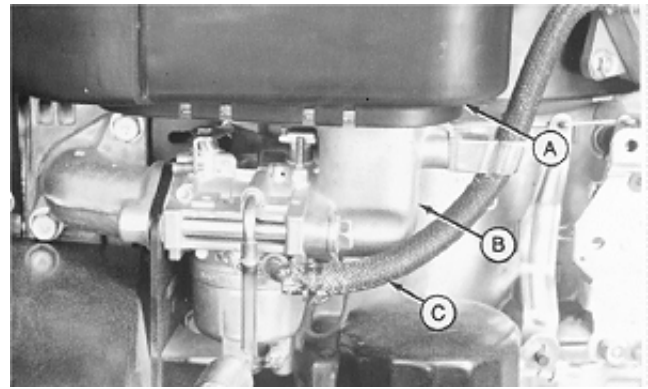
MX,5005A1,A1 -19-21OCT92

REMOVE AND INSTALL CARBURETOR

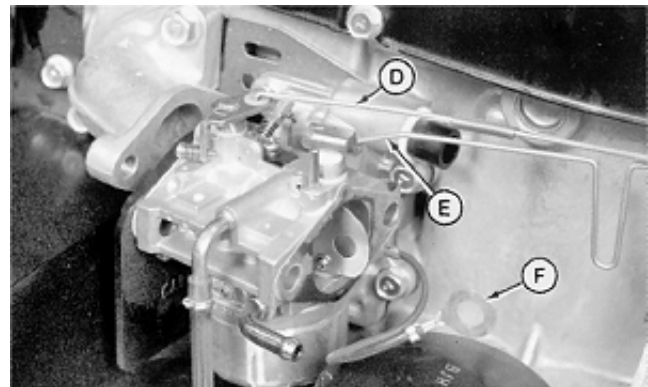
1. Remove air cleaner assembly (A).
2. Disconnect hose (C). Close all openings using caps and plugs.
3. Remove cap screws and duct (B).
4. Disconnect linkage (D and E).
5. Remove carburetor with gaskets.
6. Make repairs as necessary. (See procedures in this group.)
7. Connect linkage.

NOTE: When installing cap screws make sure to install ground wire (F), if equipped, between head of cap screw and air intake duct.

8. Install carburetor, gaskets and duct. Tighten cap screws.
9. Connect fuel hose.
10. Install air cleaner assembly.



M54781 -UN-19FEB91

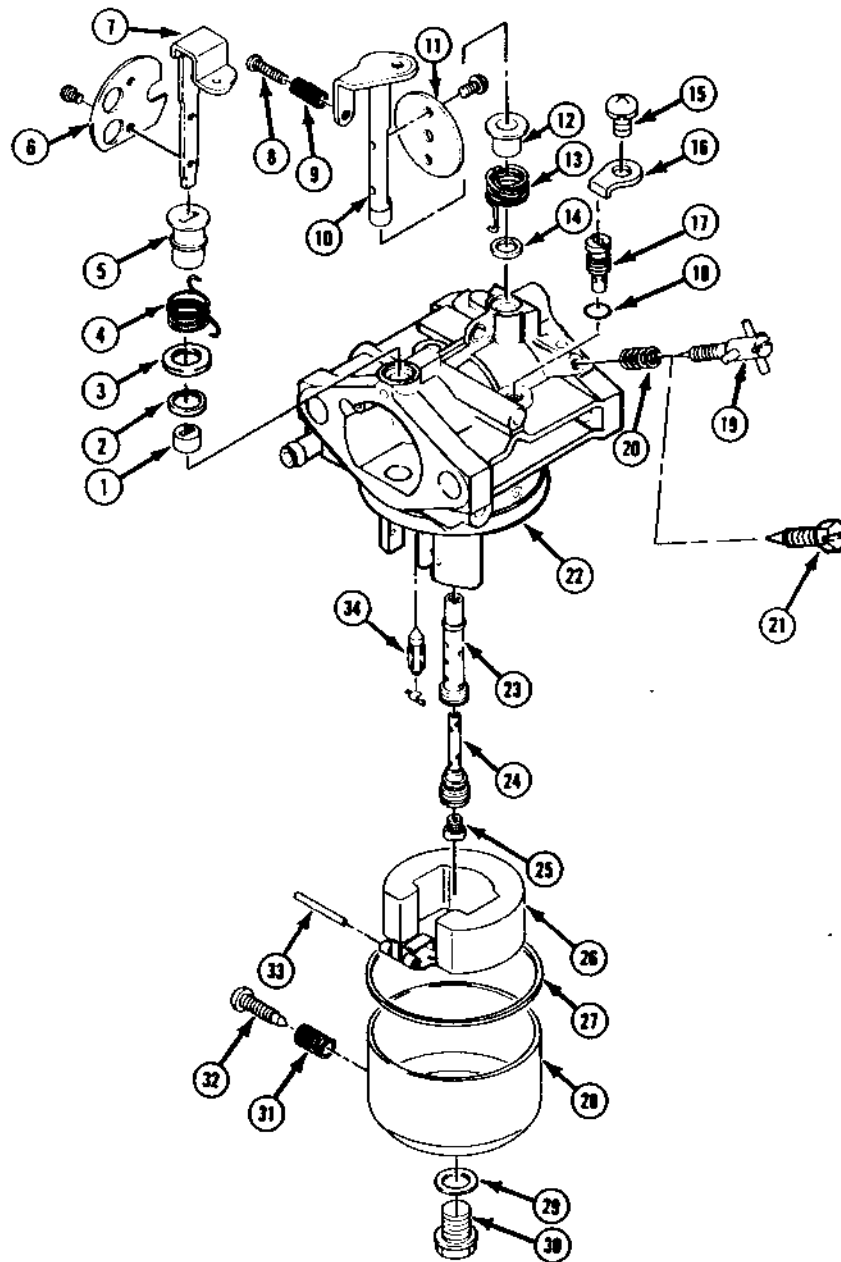


M54575 -UN-21SEP90

A—Air Cleaner Assembly
 B—Air Intake Duct
 C—Fuel Hose
 D—Throttle Control Linkage
 E—Choke Control Linkage
 F—Ground Wire

MX,5005A1,A2 -19-21OCT92

DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR



- | | | | |
|---------------|--------------------|--------------------|------------------|
| 1—Collar | 10—Throttle Shaft | 19—Screw** | 27—Gasket |
| 2—Seal** | 11—Throttle Plate | 20—Spring | 28—Float Chamber |
| 3—Washer** | 12—Ring | 21—Screw* | 29—Washer |
| 4—Spring | 13—Spring | 22—Carburetor Body | 30—Plug |
| 5—Collar | 14—Seal | 23—Main Nozzle | 31—Spring |
| 6—Choke Plate | 15—Screw** | 24—Bleed Pipe | 32—Drain Screw |
| 7—Choke Shaft | 16—Plate** | 25—Main Jet | 33—Float Pin |
| 8—Idle Screw | 17—Fixed Pilot Jet | 26—Float | 34—Needle Valve |
| 9—Spring | 18—O-Ring** | | |

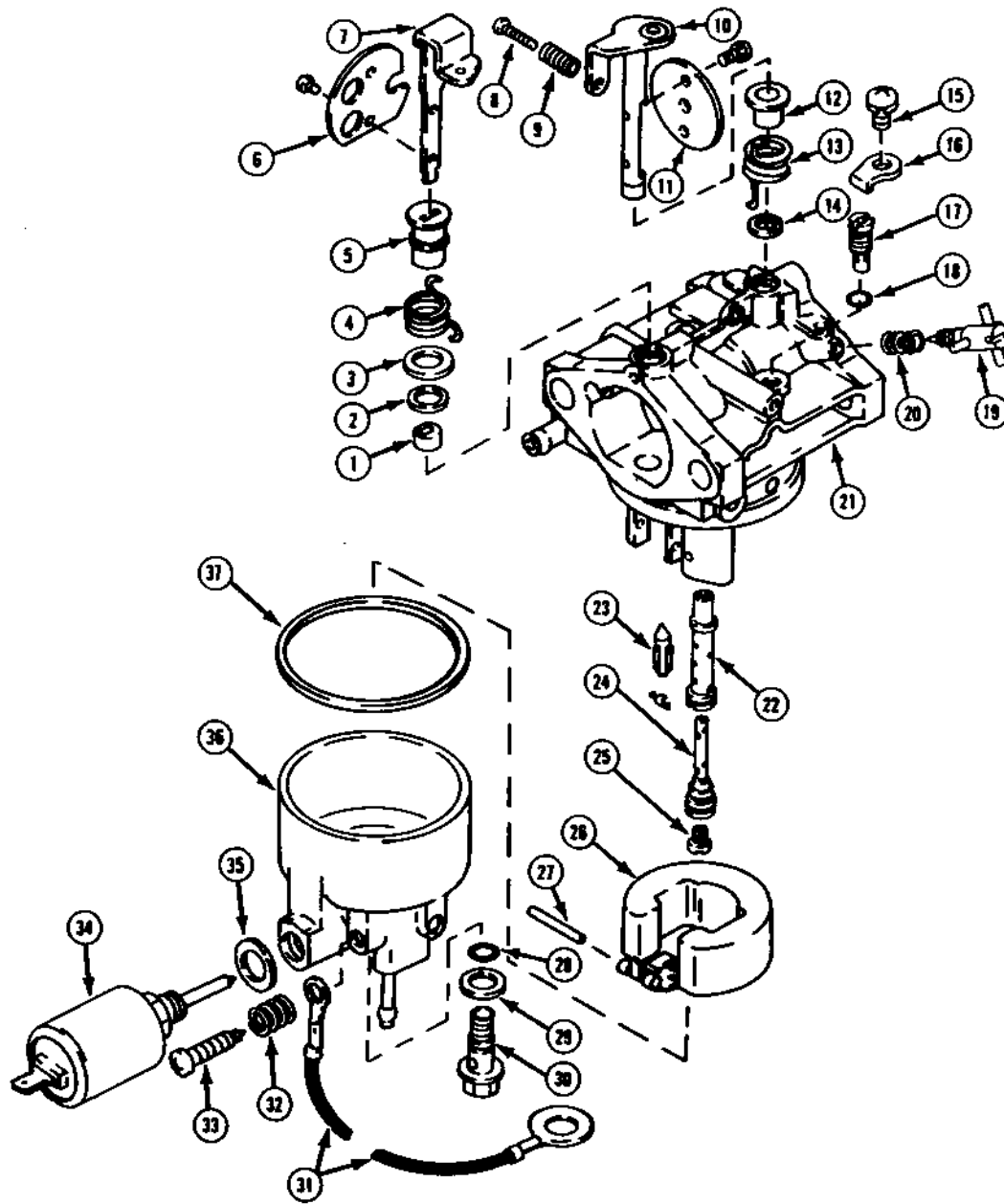
Without Fuel Shutoff Solenoid

* Used without fixed pilot jet

** Used with fixed pilot jet

M54782 -JUN-19FEB91

50
05
3



- | | | | |
|-------------------|--------------------|--------------------|--------------------------|
| 1—Collar | 11—Throttle Plate | 20—Spring | 29—Washer |
| 2—Seal | 12—Ring | 21—Carburetor Body | 30—Plug |
| 3—Washer | 13—Spring | 22—Main Nozzle | 31—Ground Wiring Lead |
| 4—Spring | 14—Seal | 23—Needle Valve | 32—Spring |
| 5—Collar | 15—Screw | 24—Bleed Pipe | 33—Drain Screw |
| 6—Choke Plate | 16—Plate | 25—Main Jet | 34—Fuel Shutoff Solenoid |
| 7—Choke Shaft | 17—Fixed Pilot Jet | 26—Float | 35—Washer |
| 8—Idle Screw | 18—O-Ring | 27—Float Pin | 36—Float Chamber |
| 9—Spring | 19—Screw | 28—O-Ring | 37—Gasket |
| 10—Throttle Shaft | | | |

With Fuel Shutoff Solenoid

M80202 -JUN-19FEB91

MX,5005A1,A4 -19-21OCT92

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets, float and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.

4. Inspect all parts for wear or damage, replace as necessary.

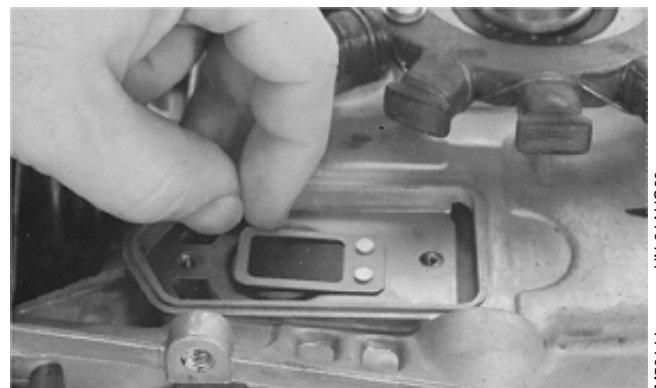
NOTE: Main jet high altitude kits are available.

Float is plastic. The float cannot be adjusted. Replace if necessary.

MX,3005A1,A4 -19-21OCT92

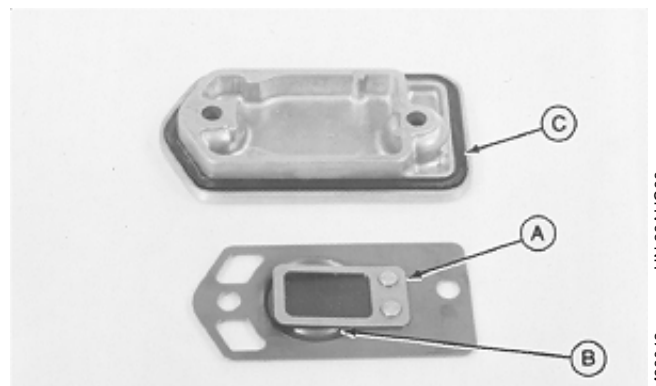
SERVICE BREATHER

1. Remove flywheel. (See Group 10.)
2. Remove breather cover and valve.



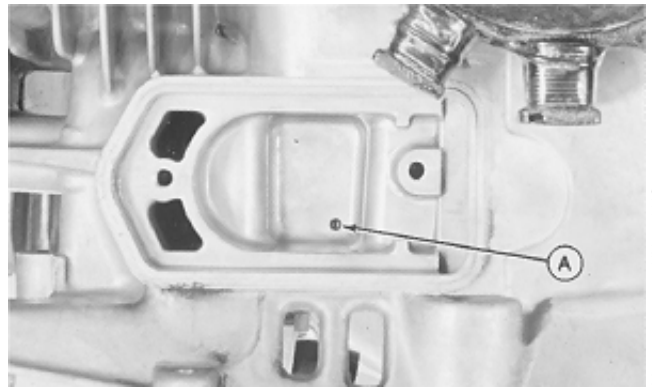
MX,5005A1,A5 -19-21OCT92

3. Inspect breather valve (A), valve seating surface (B) and rubber gasket (C) for wear or damage. Replace parts if necessary.



MX,5005A1,A6 -19-21OCT92

4. Check that drainback hole (A) in bottom breather chamber is open before installing breather valve.
5. Install breather valve, gasket and cover.
6. Install flywheel.



MX,5005A1,A7 -19-21OCT92

M38043 -UN-29AUG88

SERVICE AIR CLEANER

1. Remove and disassemble air cleaner.

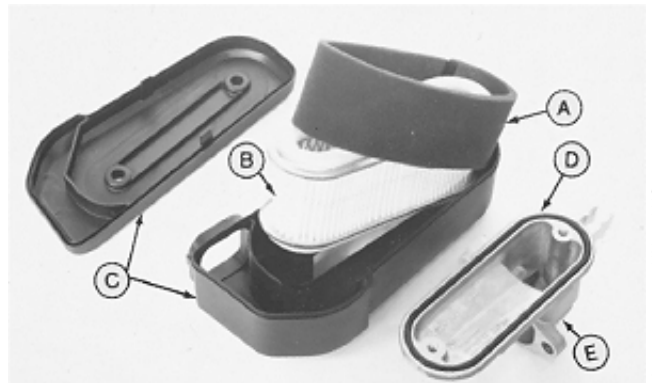
IMPORTANT: Do not clean paper element.

2. Wash foam element (A) in detergent and water. Dry element.
3. Put 12—15 drops of engine oil on foam element (A). Squeeze out excess oil.
4. Replace paper element (B) if:
 - Element is oily, dirty, bent, torn, crushed, or obstructed in any way.
 - Seal is damaged.
 - Engine performance is poor.
5. Inspect body (C), gasket (D), and base (E) for damage. Replace if necessary.

IMPORTANT: Any time air cleaner base is removed, use a silicon sealant (flexible sealant or RTV) on the outside diameter of the breather hose where it is inserted into the aluminum air intake housing.

6. Assemble and install air cleaner.

NOTE: After air cleaner assembly is installed, check for free choke operation.



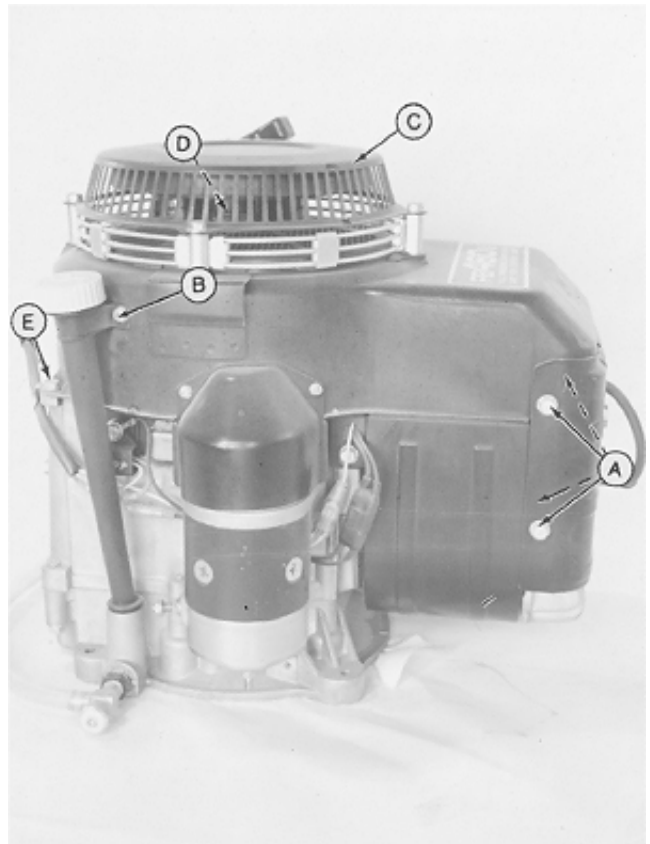
A—Foam Element
B—Paper Element
C—Body
D—Gasket
E—Base

M50023 -UN-31AUG88

REMOVE AND INSTALL BLOWER HOUSING—RECOIL START

1. Disconnect spark plug cap.
2. Remove air cleaner assembly.
3. Remove dipstick tube (B).
4. Remove recoil starter (C) and guard.
5. Remove starter cup (D) and spacer(s).
6. Remove cap screws (A and E) and blower housing.
7. Install blower housing.
8. Install spacer(s) and starter cup.
9. Adjust flywheel screen. (See this group.)
10. Install recoil starter and guard.
11. Install dipstick tube.
12. Install air cleaner assembly.

A—Cap Screws
B—Dipstick Tube
C—Recoil Starter
D—Starter Cup
E—Cap Screws

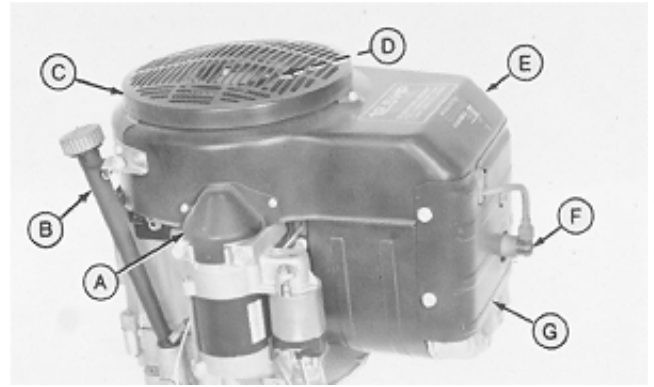


TY13365 -UN-23AUG88

MX,5010A1,A1 -19-21OCT92

REMOVE AND INSTALL BLOWER HOUSING—ELECTRIC START

1. Disconnect spark plug cap (F).
2. Remove air cleaner assembly.
3. Remove fuel pump. (See Group 05.)
4. Remove cover (G).
5. Remove cover (A).
6. Remove dipstick tube (B).
7. Remove guard (C), screen (D) and spacer(s).
8. Remove blower housing (E).
9. Install blower housing.
10. Install spacer(s), screen and guard.
11. Adjust flywheel screen. (See this group.)
12. Install cylinder head cover and dipstick tube.
13. Install starter cover.
14. Install fuel pump.
15. Install air cleaner assembly.



A—Starter Cover
B—Dipstick Tube
C—Guard
D—Screen
E—Blower Housing
F—Spark Plug Cap
G—Cylinder Head Cover

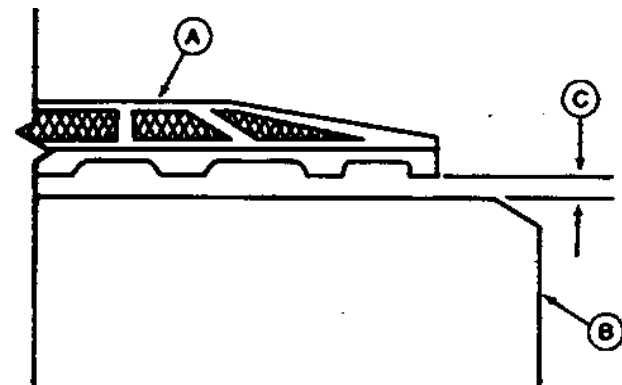
MX,5010A1,A2 -19-21OCT92

FLYWHEEL SCREEN ADJUSTMENT

Adjust gap (C) between the blades under screen (A) and blower housing (B) to specifications using spacers.

SPECIFICATIONS

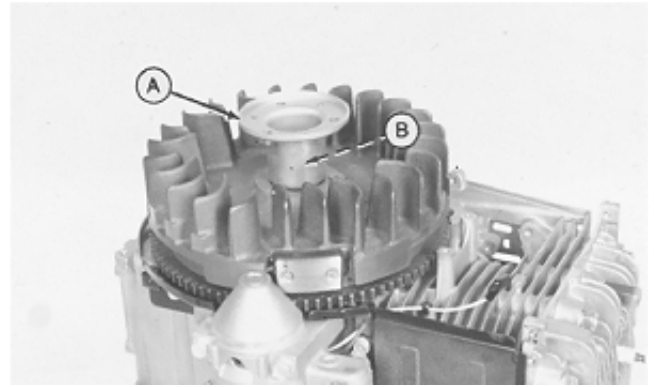
Gap 1—3 mm (0.039—0.118 in.)



MX,5010A1,A3 -19-21OCT92

REMOVE AND INSTALL FLYWHEEL

1. Remove armature with coil. (See Group 25.)
2. Hold flywheel and remove nut and washer (B).
3. Remove bracket (A), if equipped.
4. Remove flywheel using a flywheel puller.
5. Install flywheel and bracket, if equipped.
6. Install washer and nut. Tighten nut to 88 N·m (65 lb-ft).
7. Install armature with coil.



M54783 -UN-19FEB91

MX,5010A1,A4 -19-21OCT92

50
10
3

OTHER MATERIAL

Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean cylinder head

SCOTCH-BRITE is a trade mark of the 3M Company.

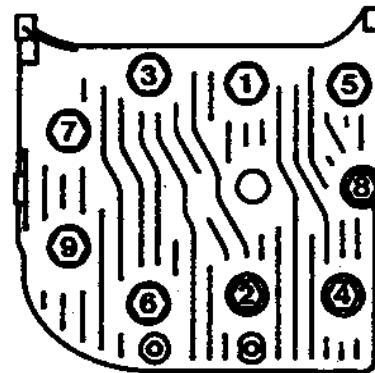
MX,5015A1,A1 -19-21OCT92

REMOVE AND INSTALL CYLINDER HEAD

1. Remove blower housing. (See Group 10.)
2. Remove spark plug.
3. Remove cylinder head and gasket.
4. Make repairs as necessary. (See procedures in this group.)
5. Install cylinder head with new gasket. Install cap screws and tighten finger tight.
6. Tighten cap screws in sequence shown. Tighten to initial torque specifications.
7. Continue in sequence, 4 N·m (35 lb-in.) at a time, until final torque is as specified.
8. Install spark plug and tighten to specification.
9. Install blower housing.

TORQUE SPECIFICATIONS

Initial Torque	23 N·m (203 lb-in.)
Final Torque	37 N·m (27 lb-ft)
Spark Plug	24 N·m (212 lb-in.)



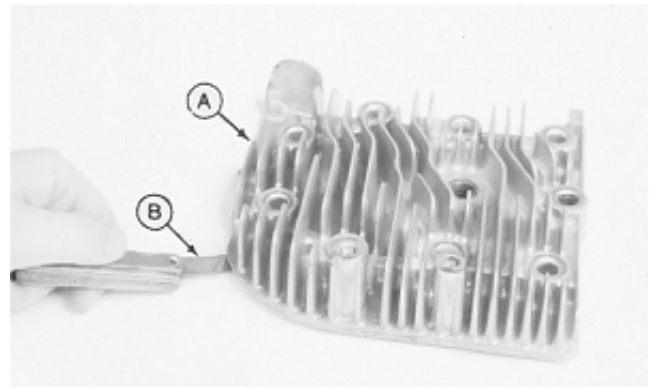
M38035 -UN-29AUG88

MX,5015A1,A2 -19-21OCT92

50
15
1

INSPECT CYLINDER HEAD

1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Put cylinder head (A) on a surface plate. Check for distortion at several points around the head using a feeler gauge (B). Replace head if distortion is more than specifications.



M38039 -UN-29AUG88

SPECIFICATIONS

Cylinder Head Distortion (Max) 0.40 mm (0.015 in.)

MX,5015A1,A3 -19-21OCT92

Cylinder Block, Valves and Internal Components

Group 20

SPECIAL OR ESSENTIAL TOOLS

NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

DX,TOOLS -19-05JUN91

Valve Guide Driver Tool JDG118

Replace valve guide bushings.

MX,JDG118 -19-21OCT92

Valve Guide Reamer JDG497

Ream valve guide bushings.

MX,JDG497 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	Valve Guide Cleaner	Clean valve guides
	Stanisol (or Kerosene)	Finish ream valve guide
	Prussian Blue Compound	Check valve seat contact
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,5020A1,A1 -19-21OCT92

50
20
1

SERVICE PARTS KITS

The following kits are available through your parts catalogue.

Camshaft and Tappet Kit

Piston Ring Kit

Oversized Pistons

Oversized Piston Rings

Undersized Connecting Rod

Cylinder Block

Overhaul Gasket Kit

Short Block Kit

Crankshaft End Play Shim Kit

Governor Kit

MX,5020A1,A1A -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove carburetor. (See Group 05.)
2. Remove cylinder head. (See Group 15.)
3. Remove tappet chamber cover and gasket.

IMPORTANT: Mark and keep springs and valves together.

4. Compress valve spring (A) with a spring compressor (B) and move spring retainer (C) so larger hole is around valve stem.

5. Remove compressor, valves, springs, retainers and exhaust valve rotator (D).

NOTE: Exhaust valve spring is shorter than intake valve spring.

6. Inspect and analyze valves. (See Section 100, Group 05.)

7. Inspect springs, valve guides and seats. (See this group.)

8. Check valve-to-tappet clearance. (See this group.)

9. Check that drainback hole (E) is open.

10. Align valve springs, retainers and valve rotator in tappet chamber.

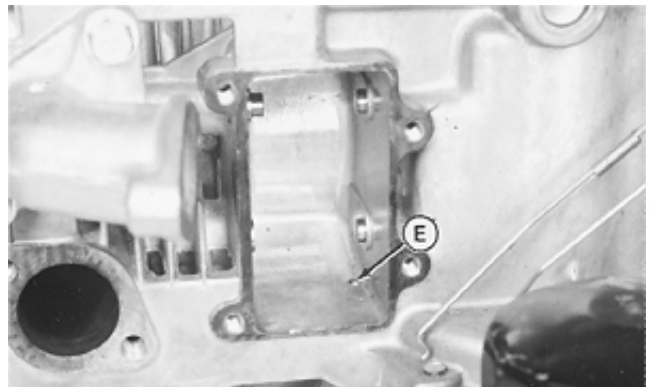
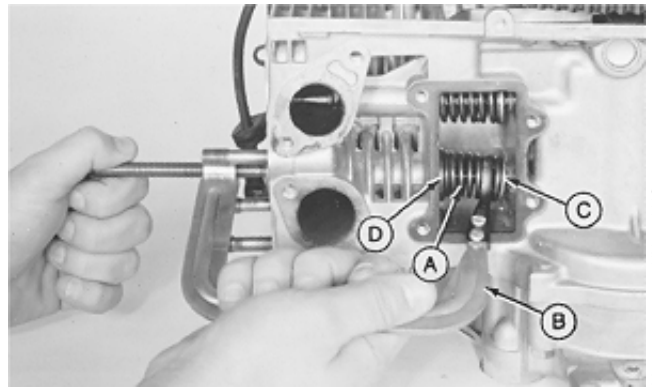
11. Coat valve stems with oil and install in cylinder block.

12. Compress each spring and position retainer so smaller hole is around valve stem.

13. Install tappet chamber cover and new gasket.

14. Install cylinder head.

15. Install carburetor.



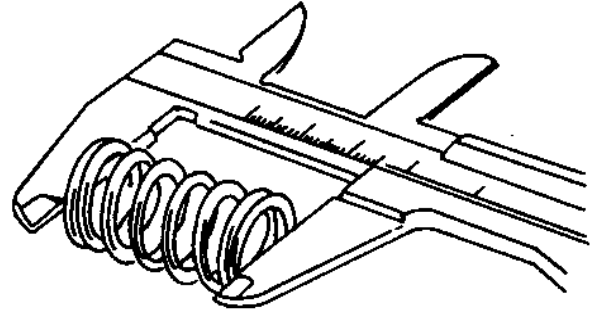
A—Valve Spring
B—Spring Compressor
C—Spring Retainer
D—Valve Rotator
E—Drainback Hole

INSPECT VALVE SPRINGS

Inspect valve springs. Replace springs if damaged or if free length is less than specification.

FREE LENGTH SPECIFICATION (MIN)

Intake	43.30 mm (1.710 in.)
Exhaust	39.00 mm (1.540 in.)



MX,5020A1,A3 -19-21OCT92

M50036 -UN-31AUG88

INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guide bushings (A). Replace bushings if inside diameters are greater than specifications. (See this group.)

SPECIFICATIONS (MAX) I.D.

Intake and Exhaust	8.08 mm (0.318 in.)
--------------------------	---------------------

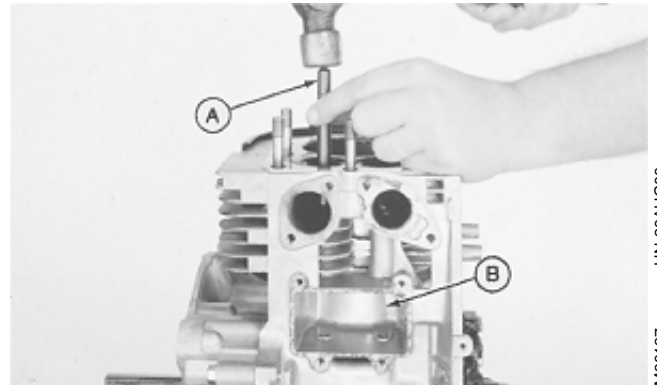


MX,5020A1,A4 -19-21OCT92

M38126 -UN-29AUG88

REPLACE VALVE GUIDE BUSHINGS

1. Drive valve guide bushing into tappet chamber (B) using JDG118 Valve Guide Driver (A). Use a locking pliers to crush end of bushing in chamber. Drive remaining part of bushing into chamber and remove.



MX,5020A1,A5 -19-21OCT92

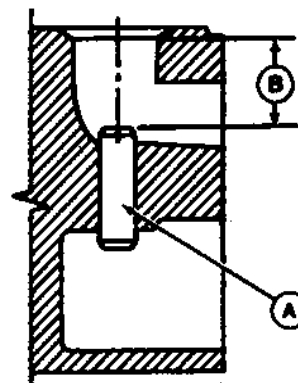
M38127 -UN-29AUG88

2. Use valve guide driver to install new bushing (A).

Drive bushing into cylinder body until distance (B), from valve seat counterbore to top of bushing, is according specifications.

SPECIFICATIONS

Distance (B)	30 mm (1.178 in.)
--------------------	-------------------



(B)	IN	30MM
	EX	30MM

MX,5020A1,A6 -19-21OCT92

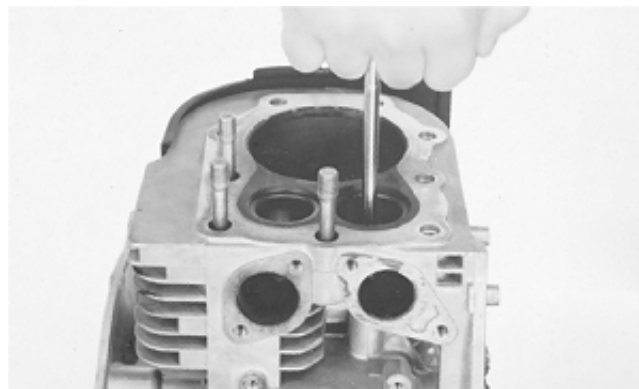
M38128 -UN-29AUG88

3. Finish reaming valve guide bushings with stanisol or kerosene lubricant and a JDG497 8 mm, Valve Guide Reamer. Turn reamer clockwise.

4. Thoroughly clean valve area before assembly.

FINISHED I.D. SPECIFICATIONS

Valve Guides 8—8.02 mm (0.315—0.316)



MX,5020A1,A7 -19-21OCT92

M38129 -UN-29AUG88

RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.

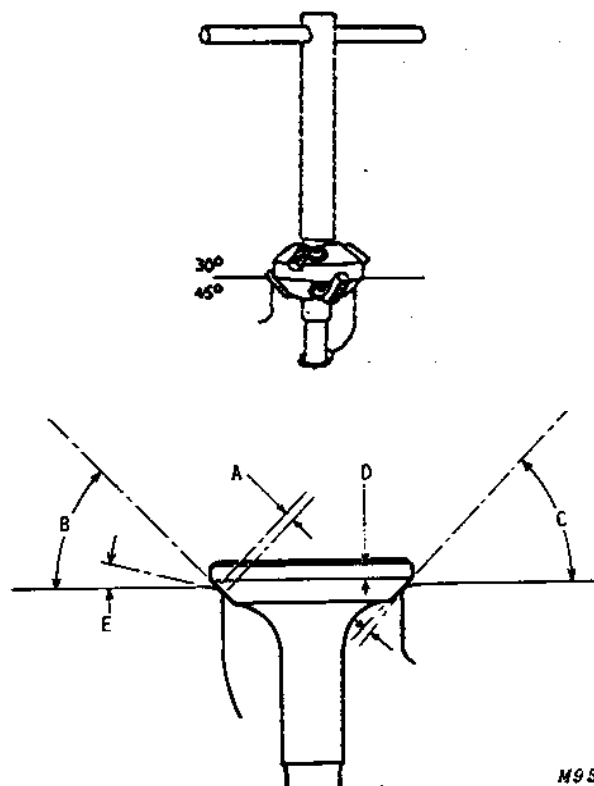
2. To recondition valve seat, cut a 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).

3. Cut valve seating surface (A) as close as possible to specifications.

4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface 1.30 mm (0.050 in.)
 B—Valve Seat Angle 45°
 C—Valve Face Angle 45°
 D—Valve Margin 0.60 mm (0.020 in.)
 E—Valve Narrowing Angle 30°



M955

MX,5020A1,A8 -19-21OCT92

-UN-31AUG88

M51558

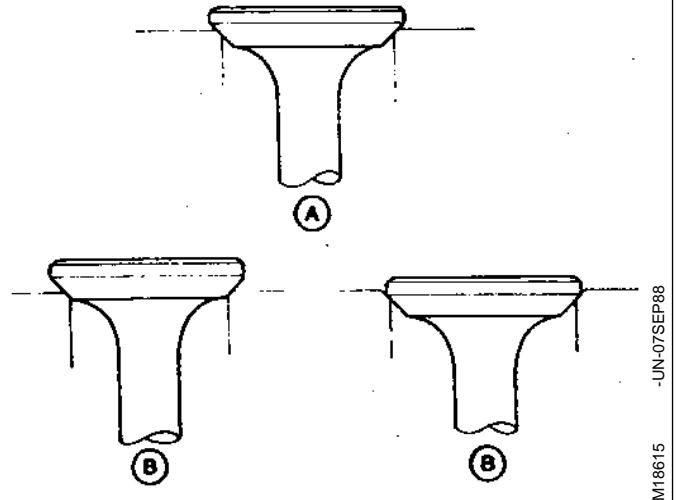
-UN-01SEP88

M9552

5. Center valve seat on the valve face:

- (A) shows correct position.
- (B) shows incorrect.

6. Check seat for good contact using Prussian Blue Compound.



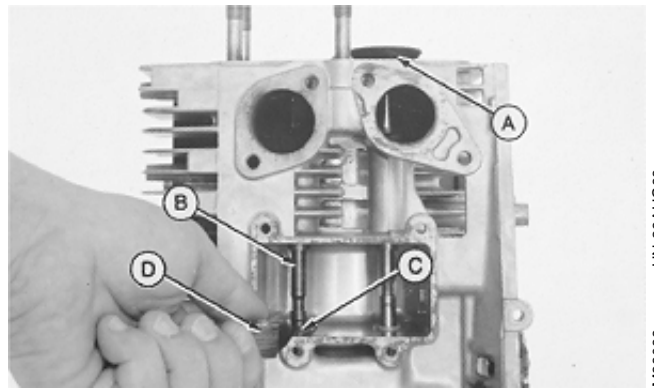
MX,3015A1,A9 -19-21OCT92

M18615 -UN-07SEP88

CHECK VALVE-TO-TAPPET CLEARANCE

NOTE: Valve grinding changes the valve-to-tappet clearance. Check clearance when engine is cold.

1. Install valves in cylinder block.
2. Turn crankshaft until intake valve (A) is at its highest position. Check clearance between valve (B) and tappet (C), with feeler gauge (D) and compare to specifications.
3. Grind end of valve stem to obtain proper clearance.



VALVE CLEARANCE SPECIFICATIONS

Intake and Exhaust 0.10—0.16 mm (0.004—0.006 in.)

A—Intake Valve
B—Exhaust Valve
C—Tappet
D—Feeler Gauge

MX,5020A1,A9 -19-21OCT92

M38089 -UN-29AUG88

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is:

With Filter1.6L (3.38 pt)

Without Filter1.4L (2.96 pt)

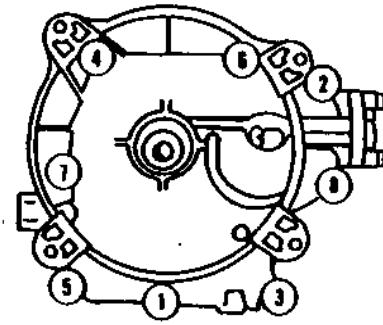
1. Drain crankcase.
2. Remove crankcase cover and gasket.
3. Clean crankcase and crankcase cover gasket surfaces.

NOTE: Do not force cover. Gears must mesh for proper positioning.

4. Install gasket and cover. Tighten cap screws using the sequence shown.

TORQUE SPECIFICATIONS

Mounting Cap Screws 20 N·m (177 lb-in.)



M80205 -UN-19FEB91

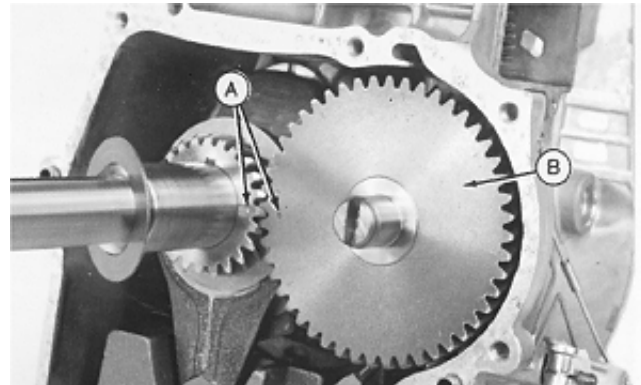
MX,5020A1,A10 -19-21OCT92

REMOVE AND INSTALL CAMSHAFT

1. Remove crankcase cover. (See this group.)

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

2. Rotate crankshaft until timing marks (A) align.
3. Remove camshaft (B).
4. Inspect camshaft. (See this group.)
5. Apply clean engine oil to camshaft lobes and journals.
6. Align timing marks and install camshaft.
7. Install crankcase cover.



M54784 -UN-19FEB91

MX,5020A1,A11 -19-21OCT92

INSPECT CAMSHAFT

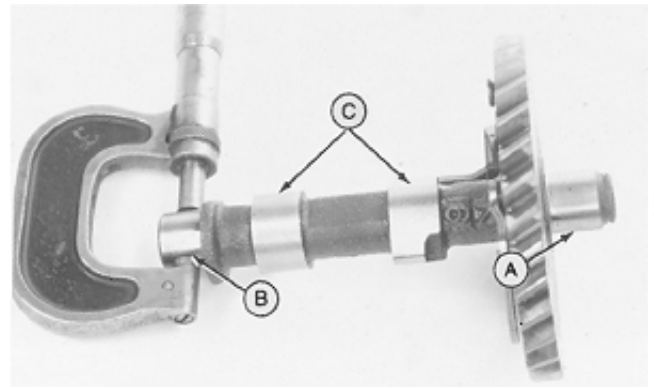
Inspect camshaft for worn or broken teeth.

NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.

Measure PTO side journal (A), flywheel side journal (B), and lobes (C). Replace camshaft and tappets if less than specifications.

SPECIFICATIONS (MIN)

PTO Side Journal	Flywheel Side Journal	Cam Lobes
19.91 mm (0.784 in.)	15.91 mm (0.627 in.)	35.40 mm (1.395 in.)



M80172 -UN-11FEB91

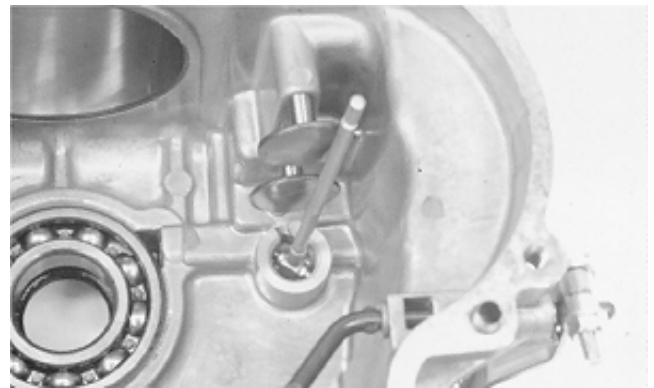
MX,5020A1,A12 -19-21OCT92

INSPECT CAMSHAFT PLAIN BEARINGS

1. Remove camshaft. (See this group.)
2. Measure camshaft bearings in cylinder block and oil pump cover. Replace block or cover if diameter is greater than specification.
3. Install camshaft.

SPECIFICATIONS (MAX)

Cylinder Block Bearing	Oil Pump Cover Bearing
16.07 mm (0.633 in.)	20.07 mm (0.790 in.)



Cylinder Block



Oil Pump Cover

MX,5020A1,A13 -19-21OCT92

M54785 -UN-19FEB91

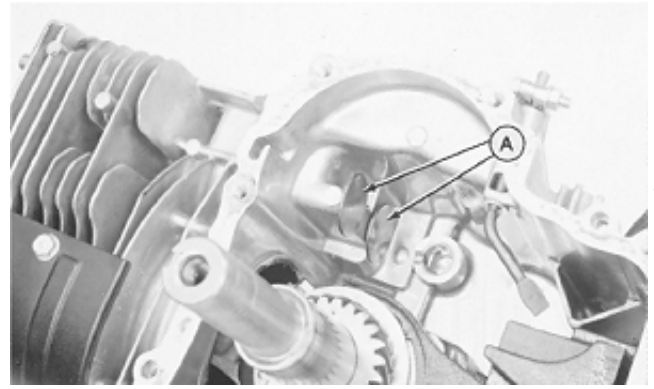
M54786 -UN-19FEB91

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)

NOTE: Mark tappets so they can be installed in their original bores during assembly.

2. Remove tappets (A).
3. Inspect tappets for wear or damage. Replace if necessary.
4. Apply clean engine oil to tappets and bores.
5. Install tappets in original bores.
6. Install camshaft.



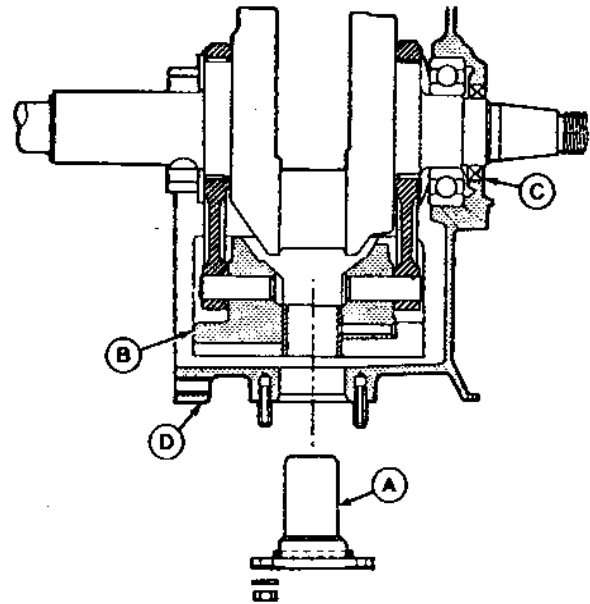
M38092
-UN-29AUG88

MX,5020A1,A14 -19-21OCT92

50
20
9

REMOVE AND INSTALL RECIPROCATING BALANCER

1. Remove flywheel. (See Group 10.)
2. Remove camshaft. (See this group.)
3. Remove piston. (See this group.)
4. Remove support shaft (A).
5. Remove crankshaft with balancer assembly (B).
6. Make repairs as necessary. (See procedures in this group.)
7. Inspect oil seals. (See this group.)
8. Cover keyway on flywheel end of crankshaft with tape to prevent damage to seal (C) when installing assembly.
9. Put light film of oil on crankshaft bearing surfaces.
10. Pack lithium based grease in oil seals.
11. Install balancer assembly with crankshaft into crankcase (D).
12. Align balancer weight in crankcase and install support shaft.
13. Adjust crankshaft end play. (See this group.)
14. Install Support shaft bushing nut and torque to 7.3 N·m (65 lb-in.).
15. Install piston.
16. Install camshaft.
16. Install flywheel.



A—Support Shaft
B—Balancer Assembly
C—Seal
D—Crankcase

M51758 -JUN-07SEP88

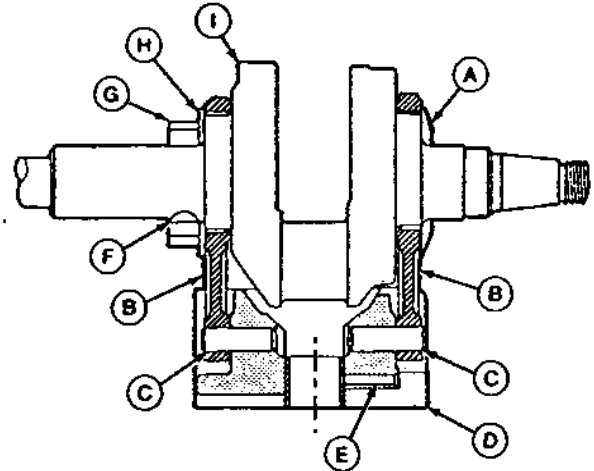
DISASSEMBLE AND ASSEMBLE RECIPROCATING BALANCER

1. Remove collar (A), gear (G), key (F) and spacer (H).
2. Remove rods (B) and crankshaft (I).
3. Inspect crankshaft. (See this group.)
4. Inspect balancer assembly. (See this group.)
5. Put a light film of oil on bearing surfaces.

NOTE: Oil grooves of link rods (B) must face away from crankwebs.

6. Install balance weight to crankshaft with oil hole (E), if equipped, facing flywheel side.
7. Install collar (A).
8. Install spacer (H) with chamfered face toward link rod.
9. Install key and crank gear.

A—Collar
 B—Link Rod
 C—Wrist Pin
 D—Balance Weight
 E—Oil Hole
 F—Woodruff Key
 G—Crank Gear
 H—Spacer
 I—Crankshaft



MX,5020A1,A16 -19-21OCT92

M51759 -JUN-07SEP88

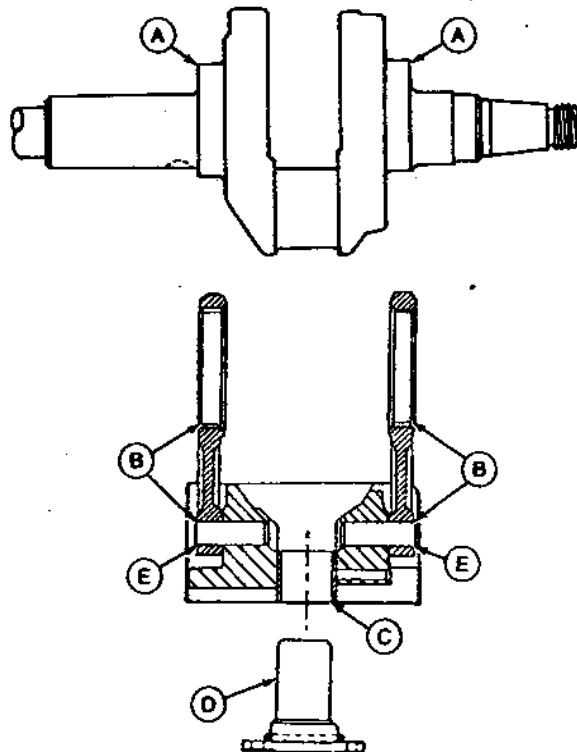
50
20
11

INSPECT BALANCER ASSEMBLY

1. Clean and inspect all parts for wear or damage. Replace parts, if necessary.
2. Measure crankshaft journals (A). Replace crankshaft if diameter is less than specifications.
3. Measure inside diameter of bearings (B). Replace link rod if small end is greater than specifications. Replace bushing if large end is greater than specifications. (See this group.)
4. Measure inside diameter of support shaft bearing (C). If bearing is greater than specifications, replace bushing. (See this group.)
5. Measure support shaft diameter (D). Replace shaft if diameter is less than specification.
6. Inspect wrist pins (E) for any damage. If necessary, replace weight.

DIAMETER SPECIFICATIONS

Link Rod Journal O.D. (MIN)	53.95 mm (2.124 in.)
Link Rod Small End I.D. (MAX)	12.06 mm (0.475 in.)
Link Rod Large End I.D. (MAX)	54.12 mm (2.132 in.)
Support Shaft O.D. (MIN)	25.93 mm (1.021 in.)
Support Shaft Bearing I.D. (MAX)	26.10 mm (1.027 in.)



A—Link Rod Journals
B—Link Rod Bearings
C—Shaft Bearing
D—Support Shaft
E—Wrist Pins

MX,5020A1,A17 -19-21OCT92

M51760 -JUN-07SEP88

REPLACE BALANCER BUSHINGS

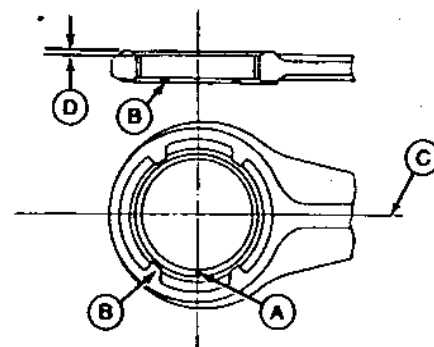
NOTE: Remove bushings using a bearing, bushing and seal driver set and a press.

Remove link rod bushings with oil groove side facing up.

1. Remove bushings.
2. Install link rod bushings with seam (A) at a 90° angle to centerline (C).
3. Install bushing below surface to specifications.

SPECIFICATIONS

Bushing Depth (D)	0.50 mm (0.020 in.)
-------------------	---------------------

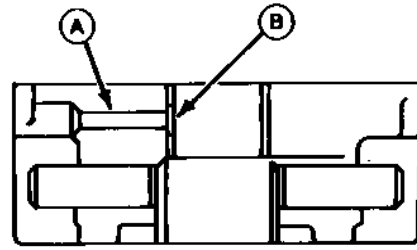


A—Bushing Seam
B—Oil Grooves
C—Link Rod Centerline
D—Measurement

MX,5020A1,A18 -19-21OCT92

M51681 -JUN-31AUG88

4. Align oil hole (B) in bushing and oil passage (A) in weight. Install bushing flush to outside surface of weight.

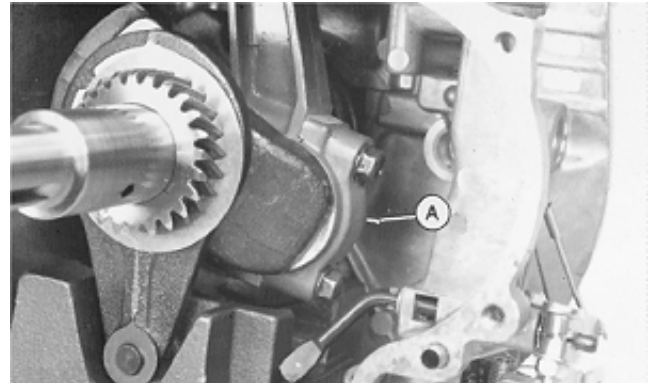


MX,5020A1,A19 -19-21OCT92

M80209 -UN-19FEB91

REMOVE AND INSTALL PISTON AND CONNECTING ROD

1. Remove cylinder head. (See Group 15.)
2. Remove crankcase cover. (See this group.)
3. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
4. Remove cap screws and connecting rod cap (A).
5. Push piston and connecting rod from cylinder bore.
6. Make repairs as necessary. (See procedures in this group.)



MX,5020A1,A20 -19-21OCT92

M54787 -UN-19FEB91

7. Deglaze cylinder bore. (See Section 100, Group 15.)
8. Stagger piston ring end gaps 180° apart, but do not align with oil ring side rail end gaps.
9. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
10. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
11. Install piston assembly in cylinder bore with engraved match mark/arrow on piston head facing flywheel side of engine.
12. Install connecting rod cap and cap screws. Tighten cap screws to 20 N·m (177 lb-in.).

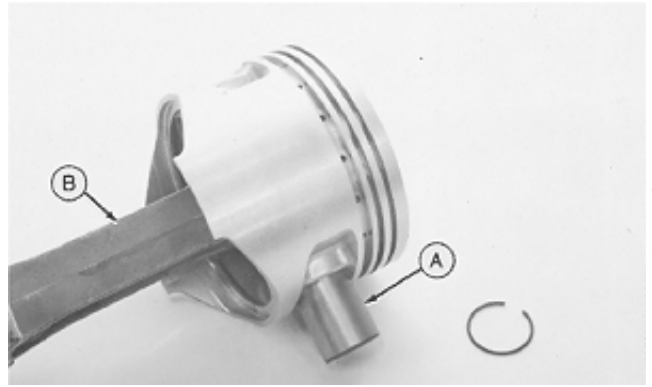


MX,5020A1,A21 -19-21OCT92

M50074 -UN-31AUG88

DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

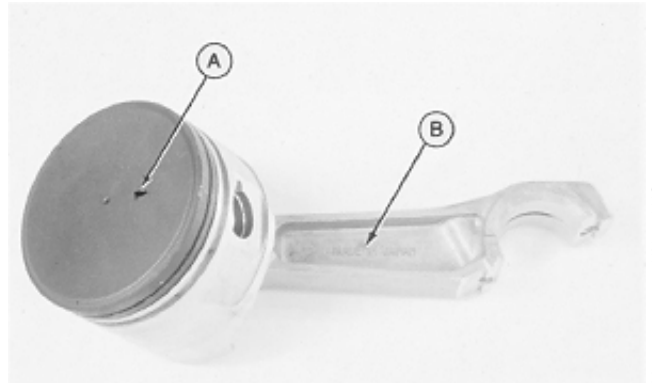
1. Remove circlip, piston pin (A) and connecting rod (B).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.



MX,5020A1,A22 -19-21OCT92

M50063 -UN-31AUG88

4. Align arrow match mark (A) on piston head with MADE IN JAPAN (B) on connecting rod, or if piston is marked with R and L align the R on the piston with the Japanese characters on the connecting rod.
5. Install piston pin and circlip.



MX,4020A1,A18 -19-21OCT92

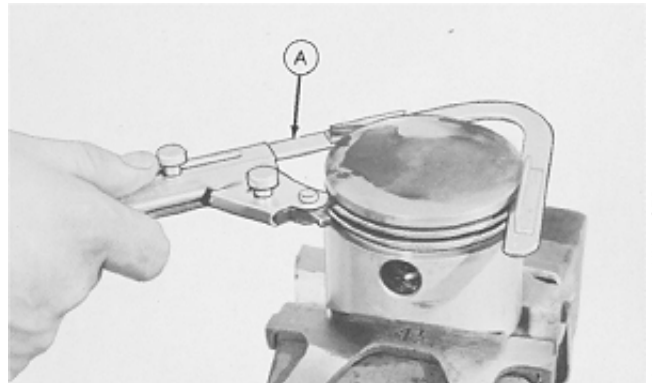
M38111 -UN-29AUG88

INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)
2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.
4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.
5. Check that oil return passages in grooves are open.



MX,5020A1,A23 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.

CLEARANCE SPECIFICATION (MAX)

Top Ring	Second Ring	Oil Control Ring
0.16 mm (0.006 in.)	0.14 mm (0.005 in.)	0.19 mm (0.007 in.)



M38102 -UN-29AUG88

MX,5020A1,A24 -19-21OCT92

8. Measure piston pin outer diameter. Replace if less than specification.

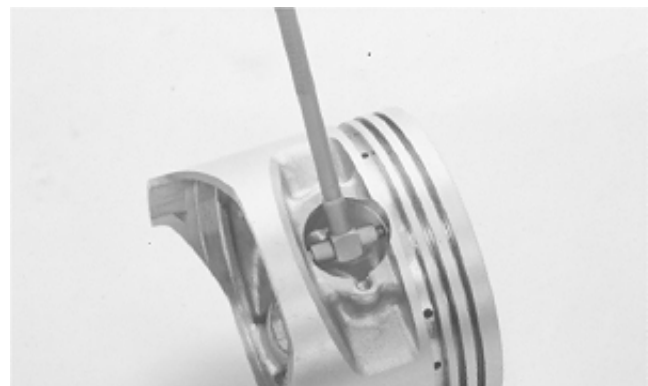
9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

Piston Pin O.D. (MIN)	Piston Bore I.D. (MAX)
20.98 mm (0.827 in.)	21.03 mm (0.829 in.)



M50064 -UN-31AUG88



M50065 -UN-31AUG88

MX,5020A1,A25 -19-21OCT92

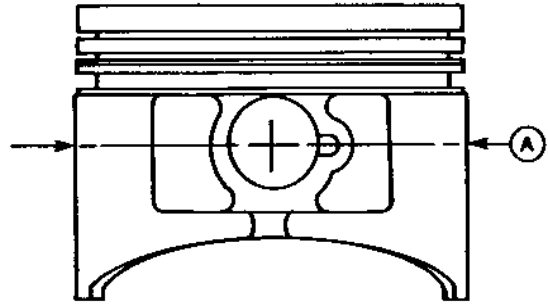
50
20
15

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)



SPECIFICATIONS

Piston O.D. (A) 88.81—88.83 mm (3.4991—3.4999 in.)

Piston-to-Cylinder
Bore Clearance 0.156 mm (0.0061 in.)

MX,5020A1,A26 -19-21OCT92

M80398 -UN-06APR91

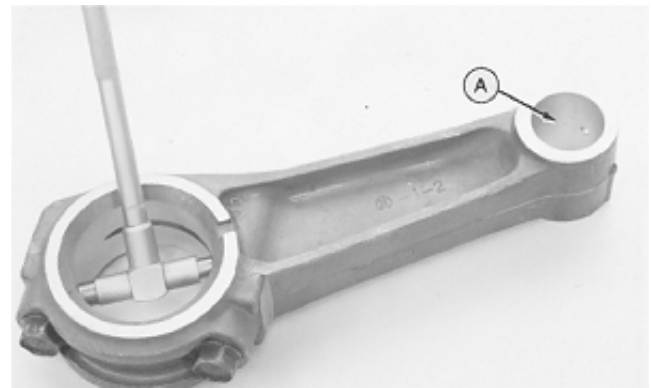
INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.

2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)

3. Install connecting rod cap. Tighten to 20 N·m (177 lb-in.)

4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



BEARING I.D. SPECIFICATIONS (MAX)

Crankshaft Bearing

37.02 mm
(1.459 in.)

Piston Bearing

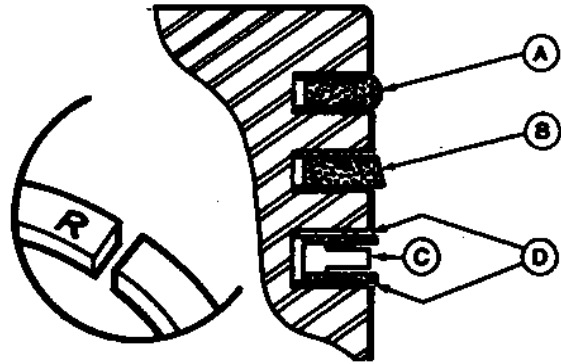
21.01 mm
(0.829 in.)

MX,5020A1,A27 -19-21OCT92

M50066 -UN-31AUG88

REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)
4. Install top ring (A) and second ring (B) with R or NPR mark facing up. Rings should turn freely in grooves.
5. Oil ring is an assembly. Install spacer (C), then side rails (D). Put side rail end gaps 180° apart.



A—Top Ring
B—Second Ring
C—Spacer
D—Side Rails

MX,5020A1,A28 -19-21OCT92

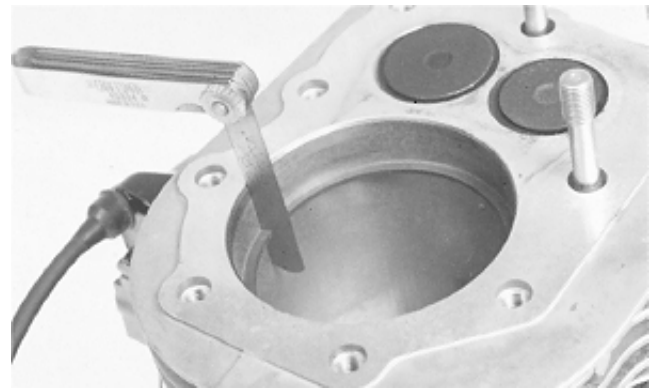
M38074 -UN-29AUG88

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS (MAX)

Minimum End Gap	0.18 mm (0.007 in.)
Maximum End Gap	
Compression Rings	0.70 mm (0.028 in.)
Oil Ring Side Rails	1.20 mm (0.047 in.)



MX,5020A1,A29 -19-21OCT92

M54788 -UN-19FEB91

REMOVE, INSPECT AND INSTALL CRANKSHAFT

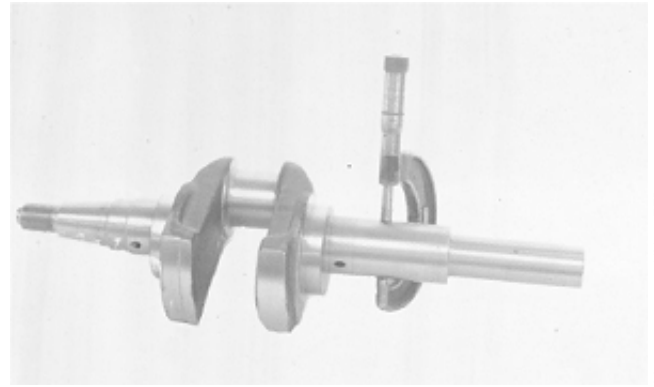
1. Remove camshaft. (See this group.)
2. Remove piston and connecting rod. (See this group.)
3. Remove balancer. (See this group.)
4. Remove crankshaft from balancer. (See Disassemble and Assemble Balancer in this group.)

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

5. Check crankshaft alignment (T.I.R.). (See this group.)
6. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
7. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
8. Measure crankshaft main bearing journals and connecting rod journal. Replace crankshaft if measurements are less than specifications.

JOURNAL SPECIFICATIONS (MIN)

Main Bearing Journal		Connecting Rod Journal
PTO Side	Flywheel Side	
34.91 mm (1.374 in.)	—	36.95 mm (1.455 in.)



M54789 -UN-19FEB91

MX,5020A1,A30 -19-21OCT92

NOTE: An under-sized connecting rod is available through the parts catalog, if necessary.

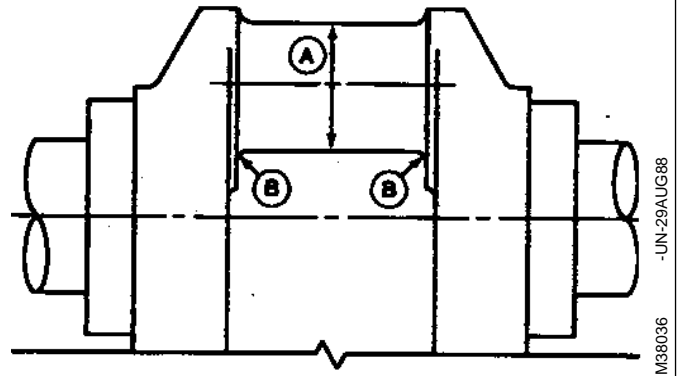
9. Connecting rod journal (A) can be resized to accept under-sized rod. Have grinding done by a reliable repair shop. Before sending crankshaft for grinding, inspect journal radii (B) for cracks.

10. Install balancer on crankshaft.

11. Install balancer.

12. Install piston and connecting rod.

13. Install camshaft.



MX,5020A1,A31 -19-21OCT92

INSPECT CRANKSHAFT PLAIN BEARING

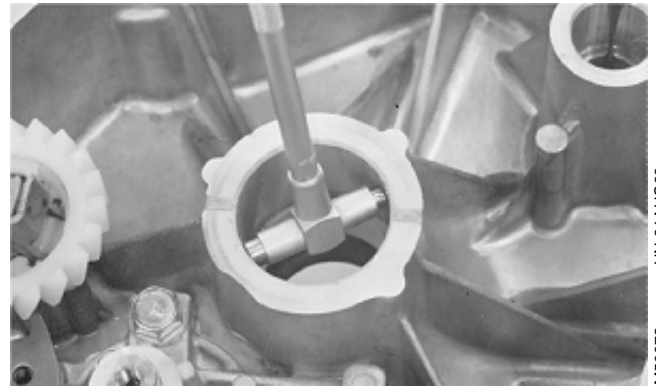
1. Remove crankshaft. (See this group.)

2. Measure crankshaft bearing in crankcase cover. Replace cover if diameter is greater than specifications. (See this group.)

3. Install crankshaft.

SPECIFICATIONS

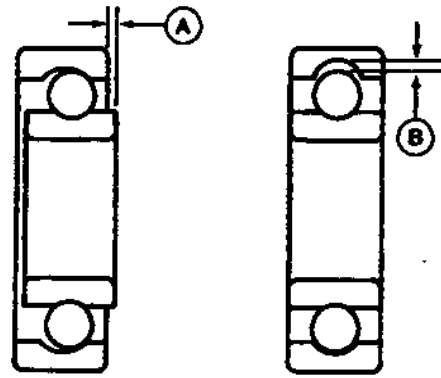
Bearing ID (Max) 35.06 mm (1.380 in.)



MX,5020A1,A32 -19-21OCT92

INSPECT CRANKSHAFT BALL BEARING

1. Remove flywheel end oil seal. (See Inspect Oil Seals in this group.)
2. Remove crankshaft bearing using a bearing, bushing and seal driver set.
3. Thoroughly clean bearing in solvent. Dip bearing in light weight oil.
4. Spin the bearing by hand and check for axial (A) and radial (B) free play.
5. Replace the bearing if it is noisy or has too much play.
6. Install bearing flush to inside of crankcase using a bearing, bushing and seal driver set.
7. Install oil seal.



M38073 -UN-29AUG88

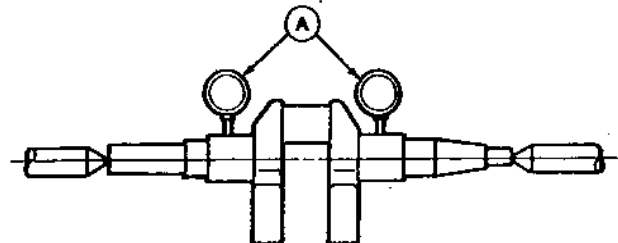
MX,5020A1,A33 -19-21OCT92

CHECK CRANKSHAFT ALIGNMENT (TIR)

Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

Maximum TIR 0.05 mm (0.002 in.)



M51761 -UN-07SEP88

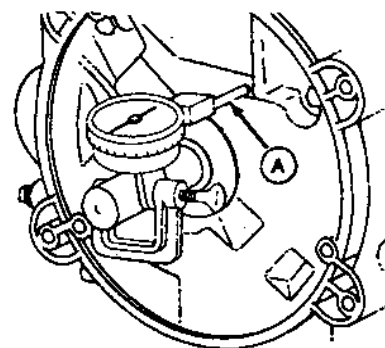
MX,5020A1,A34 -19-21OCT92

MEASURE CRANKSHAFT END PLAY

1. Measure end play using dial indicator (A). Record this measurement.
2. Move crankshaft in and out. Remove crankcase cover and adjust end play if not within specifications. (See this group.)

SPECIFICATIONS

End Play 0.09—0.22 mm (0.004—0.009 in.)



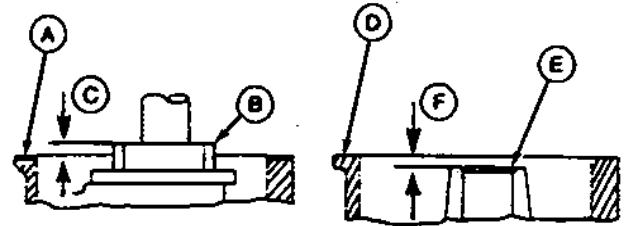
M30048 -UN-06SEP88

MX,5020A1,A35 -19-21OCT92

ADJUST CRANKSHAFT END PLAY

1. With gasket (A) installed on crankcase, measure from gasket surface to crankshaft gear surface (B). Record measurement (C).

2. Measure from crankcase cover mounting face (D) to PTO bearing end (E). Record measurement (F).



- A—Gasket
- B—Crank Gear Surface
- C—Measurement
- D—Crankcase Cover Mounting Face
- E—PTO Bearing End
- F—Measurement

MX,5020A1,A36 -19-21OCT92

3. Locate end play measurement in column one of chart. Choose appropriate shim from column two.

4. Install shim on PTO shaft.

5. Install crankcase cover. (See this group.)

DIFFERENCE (a-b)	THICKNESS OF SHIM
0.0755 – 0.0748 in. (1.92 – 1.99) mm	0.0685 in. 1.74 mm
0.0728 – 0.0755 in. (1.85 – 1.92) mm	0.0657 in. 1.67 mm
0.0700 – 0.0728 in. (1.78 – 1.85) mm	0.0629 in. 1.60 mm
0.0673 – 0.0700 in. (1.71 – 1.79) mm	0.0602 in. 1.53 mm
0.0645 – 0.0673 in. (1.64 – 1.71) mm	0.0574 in. 1.46 mm
0.0618 – 0.0645 in. (1.57 – 1.64) mm	0.0547 in. 1.39 mm
0.0590 – 0.0618 in. (1.50 – 1.57) mm	0.0519 in. 1.32 mm
0.0562 – 0.0590 in. (1.43 – 1.50) mm	0.0492 in. 1.25 mm
0.0535 – 0.0562 in. (1.36 – 1.43) mm	0.0464 in. 1.18 mm

MX,5020A1,A37 -19-21OCT92

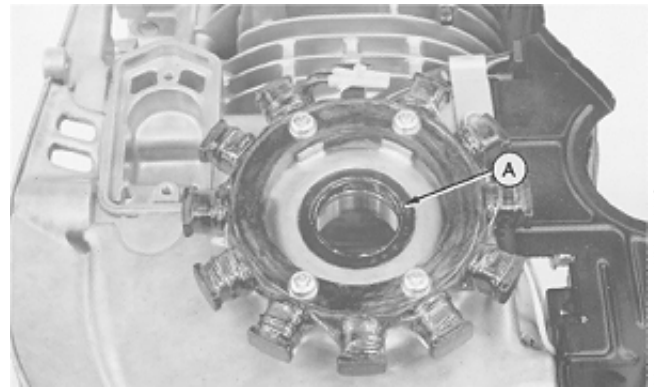
INSPECT OIL SEALS

NOTE: Pack lithium base grease in new or used seals.

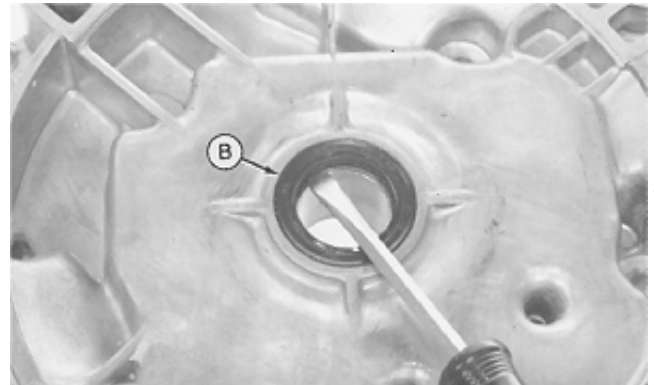
1. Remove flywheel. (See Group 10.)
 2. Inspect oil seals (A and B) at flywheel end and PTO end for wear or damage. Replace if necessary.
 3. Remove crankshaft. (See this group.)
 4. Remove worn or damaged seals with a screwdriver.
 5. Install seals with lip to inside of engine using a bearing, bushing and seal driver set. Press in seal on flywheel side until flush with hub.
- Press in seal on PTO side to specification, below crankcase cover flange surface.
6. Install crankshaft.
 7. Install flywheel.

SPECIFICATIONS

Seal Depth 5 mm (0.200 in.)



Flywheel Side

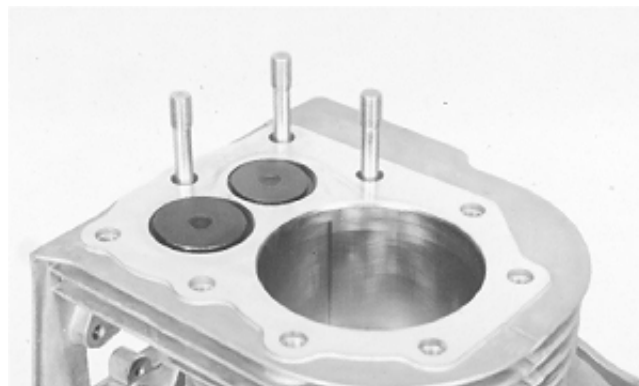


PTO Side

MX,5020A1,A38 -19-21OCT92

REPLACE CYLINDER HEAD/BLOCK STUDS

1. Remove cylinder head. (See Group 15.)
2. Inspect studs for cracks or wear. Replace if necessary.
3. Install two nuts on stud and tighten together. Remove stud.
4. Put thread lock and sealer (medium strength) on threads of stud and install in block. Tighten to specification.
5. Install cylinder head.



M80230 -UN-19FEB91

TORQUE SPECIFICATIONS

Cylinder Head-to-Block Studs 36 N·m (27 lb-ft)

MX,5020A1,A38A -19-21OCT92

INSPECT CYLINDER BLOCK

1. Remove crankshaft. (See this group.)
2. Clean and check block for cracks.
3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
4. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,5020A1,A39 -19-21OCT92

50
20
23

NOTE: A bare block is available for service.

5. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

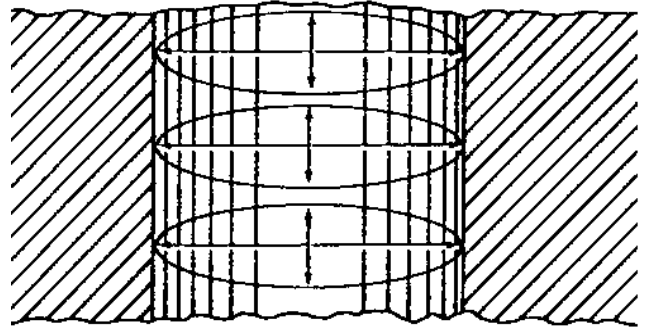
6. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

NOTE: If cylinder is rebored, oversize piston and rings must be installed.

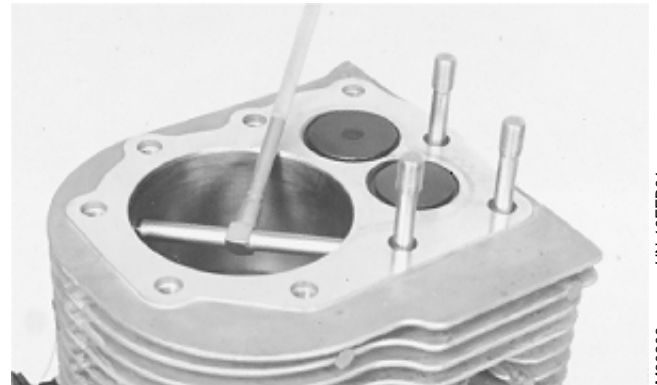
7. Install crankshaft.

CYLINDER BORE SPECIFICATIONS

Standard	88.98—89.00 mm (3.503—3.504 in.)
Wear Limit	89.06 mm (3.506 in.)
Out-of-Round (MAX)	0.063 mm (0.0025 in.)
Taper (MAX)	0.076 mm (0.003 in.)



M51745 -UN-23FEB89



M80206 -UN-19FEB91

MX,5020A1,A40 -19-21OCT92

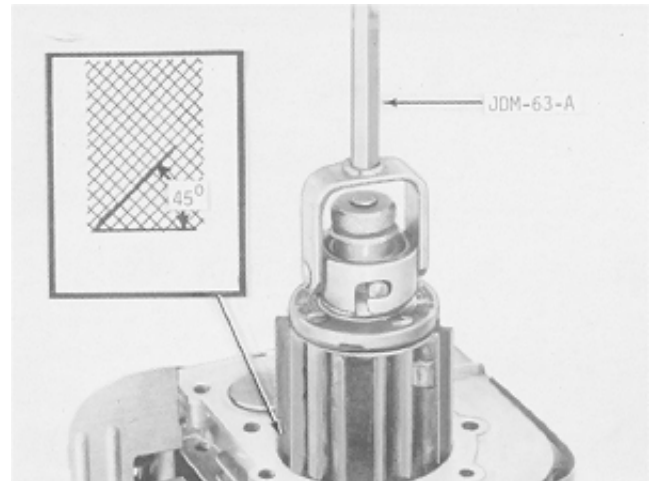
REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use 0.25, 0.50 or 0.75 mm (0.010, 0.020 or 0.030 in.) oversize pistons and rings. Have a reliable repair shop rebore the block, or use the drill press and honing tool.

1. Rebore cylinder with a honing tool to initial and final bore specifications.
2. Align center of bore to press center. Set the press to operate from 200—250 rpm.
3. Lower and raise hone until ends extend 20—25 mm (0.75—1.0 in.) past ends of cylinder.
4. Turn adjusting nut on one hone until stones contact cylinder wall at narrowest point.
5. Coat inside of cylinder with honing oil. Turn hone by hand. If you cannot turn it, hone is too tight.
6. Start drill press. Move hone up and down in cylinder approximately 20 times per minute.
7. Check cylinder diameter regularly during honing. Stop press before measuring. Remove hone from cylinder.

NOTE: Finish should not be smooth, but have a 40—60° cross-hatch pattern.

IMPORTANT: Check stone for wear or damage. Use correct stone for the job.



M24711 -UN-25AUG88

CYLINDER INITIAL BORE SPECIFICATIONS

Piston Oversize:
0.25 mm
(0.010 in.)

89.21—89.23 mm
(3.512—3.513 in.)

Piston Oversize:
0.50 mm
(0.020 in.)

89.46—89.48 mm
(3.522—3.523 in.)

Piston Oversize:
0.75 mm
(0.030 in.)

89.72—89.73 mm
(3.532—3.533 in.)

MX,5020A1,A41 -19-21OCT92

50
20
25

8. Hone the cylinder an additional 0.028—0.030 mm (0.0011—0.0012 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

IMPORTANT: DO NOT use gasoline or commercial solvents to clean cylinder bores. Solvents will not remove metal particles produced during honing.

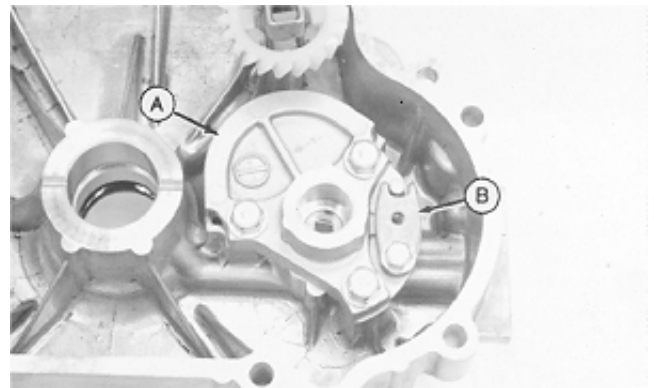
9. Clean the cylinder thoroughly using soap, warm water and clean rags. Continue to clean cylinder until white rags show no discoloration.

10. Dry the cylinder. Apply engine oil to cylinder wall.

M98,2040A,A9 -19-21OCT92

DISASSEMBLE AND ASSEMBLE OIL PUMP

1. Remove crankcase cover. (See this group.)
2. Remove oil pump assembly (A).
3. Remove relief spring and ball (B).
4. Inspect all parts. (See this group.)
5. Install oil pump assembly. Tighten pump cover cap screws to specifications.
6. Install relief spring and ball.
7. Install crankcase cover.



M54791 -UN-19FEB91

TORQUE SPECIFICATIONS

Pump Cover Cap Screws 17—23 N·m (150—204 lb-in.)

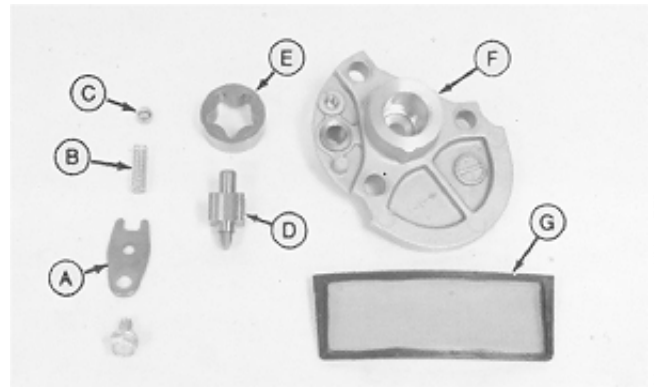
50
20
26

MX,5020A1,A43 -19-21OCT92

INSPECT OIL PUMP

1. Inspect all parts for wear or damage. Replace as necessary.

A—Plate
B—Spring
C—Ball
D—Rotor Shaft
E—Outer Rotor
F—Cover
G—Screen



MX,5020A1,A44 -19-21OCT92

M54792 -UN-19FEB91

2. Measure outside diameters of shaft. Replace both shaft and outer rotor if less than specification.

SPECIFICATIONS

Minimum Shaft O.D. 12.63 mm (0.497 in.)



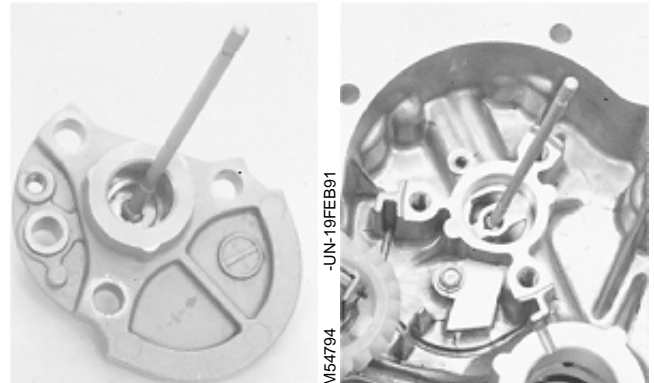
MX,5020A1,A45 -19-21OCT92

M54793 -UN-19FEB91

3. Measure rotor shaft bearings. Replace oil pump cover or crankcase cover if greater than specifications.

SPECIFICATIONS

Maximum Rotor Shaft Bearing I.D. 12.76 mm (0.502 in.)



MX,5020A1,A46 -19-21OCT92

M54794 -UN-19FEB91
M54795 -UN-19FEB91

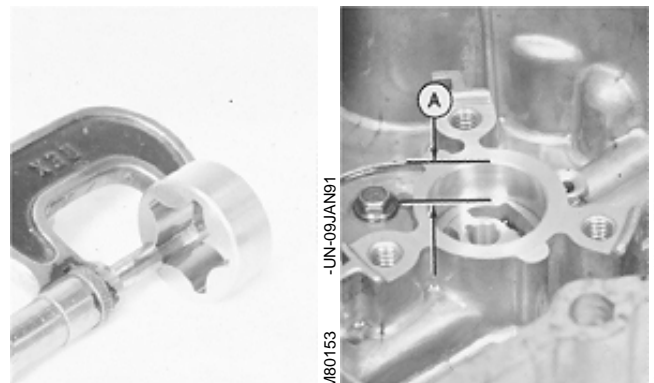
4. Measure thickness of outer rotor. Replace both outer rotor and shaft if less than specifications.

5. Measure out rotor bearing depth (A). Replace oil pump cover if greater than specifications.

OUTER ROTOR SPECIFICATIONS

Minimum Rotor Thickness 11.92 mm (0.470 in.)

Maximum Bearing Depth 12.14 mm (0.478 in.)



MX,5020A1,A47 -19-21OCT92

M80153 -UN-09JAN91
M80207 -UN-19FEB91

6. Measure inside diameter of rotor bearing. Replace oil pump cover if greater than specifications.

7. Measure outside diameter of rotor. Replace both rotor and shaft if less than specifications.

OUTER ROTOR SPECIFICATIONS

Maximum Bearing I.D.	29.15 mm (1.148 in.)
Minimum Rotor O.D.	28.90 mm (1.139 in.)



M54796
-UN-19FEB91



M80156
-UN-09JAN91

MX,5020A1,A48 -19-21OCT92

8. Measure relief valve spring. Replace if free length is less than specification.

SPECIFICATIONS

Minimum Spring Length	19.00 mm (0.750 in.)
---------------------------------	----------------------



M50083
-UN-31AUG88

MX,5020A1,A49 -19-21OCT92

REMOVE, INSPECT AND INSTALL OIL FILTER MANIFOLD—IF EQUIPPED

1. Remove oil filter and manifold.
2. Inspect oil filter. Replace if excessively contaminated or damaged.
3. Inspect oil passages for clogs. Clean if needed.
4. Inspect rubber gasket. Replace if worn or damaged.
5. Install filter and manifold.



M54790
-UN-19FEB91

MX,5020A1,A50 -19-21OCT92

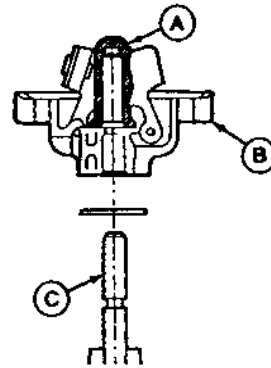
INSPECT AND REPLACE GOVERNOR

IMPORTANT: Removal damages governor. If not damaged, do not remove.

1. Remove crankcase cover. (See this group.)
2. Inspect governor. If necessary to replace, remove with screwdriver.
3. If removed, press shaft (C) back into block until it protrudes 32.2—32.8 mm (1.267—1.291 in.).

NOTE: Assemble sleeve and gear before installing assembly on shaft.

4. Install sleeve (A) onto governor gear (B).
5. Install governor assembly onto shaft. Push down on assembly until it snaps into place.



-UN-07SEP88

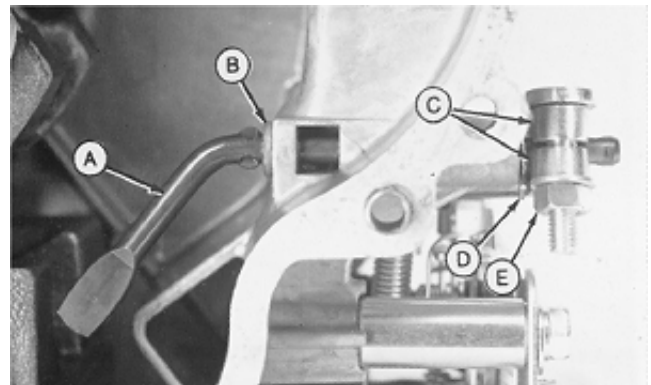
M51762

MX,5020A1,A51 -19-21OCT92

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (A). Replace if damaged.
3. To replace shaft, loosen nut (E) on lever (C).
4. Remove retaining pin (D), governor shaft and washer (B).
5. Install washer, shaft and retaining pin. Tighten nut to 7 N·m (62 lb-in.).



A—Governor Shaft
B—Washer
C—Governor Lever
D—Retaining Pin
E—Nut

-UN-19FEB91

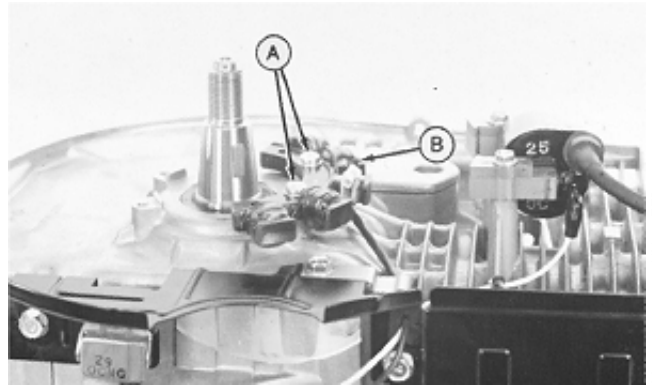
M54797

MX,5020A1,A52 -19-21OCT92

50
20
29

REMOVE AND INSTALL STATOR

1. Remove flywheel. (See Group 10.)
2. Disconnect stator lead.
3. Remove screws (A) and stator (B).
4. Install stator.
5. Connect stator lead.
6. Install flywheel.

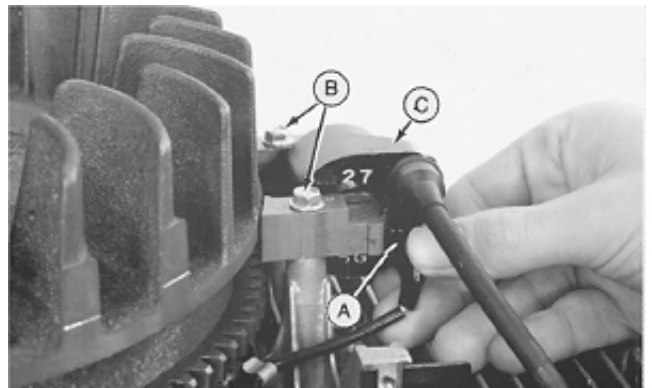


M54798 -UN-19FEB91

MX,5025A1,A1 -19-21OCT92

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove blower housing. (See Group 10.)
2. Disconnect wiring lead (A).
3. Remove cap screws (B) and armature with coil (C).
4. Loosely install armature with coil.
5. Connect wiring lead.
6. Adjust armature air gap. (See this group.)
7. Install blower housing.



M50147 -UN-23FEB89

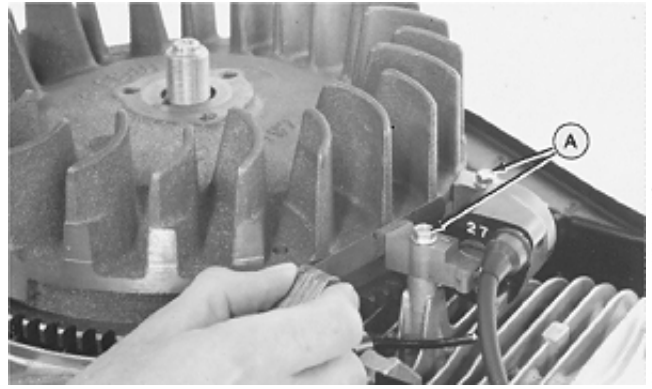
MX,5025A1,A2 -19-21OCT92

ADJUST ARMATURE AIR GAP

1. Turn flywheel magnet away from armature.
2. Insert feeler gauge, between flywheel and armature.
3. Push armature against flywheel and tighten screws (A).
4. Turn flywheel to remove feeler gauge.

AIR GAP SPECIFICATIONS

Feeler Gauge Blade 0.30 mm (0.012 in.)



M50148
-UN-31AUG88

MX,5025A1,A3 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	Mineral Spirits	Clean Armature
	Multipurpose Grease	Grease Starter Parts

M98,2030A,ZB -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Complete Recoil Starter

Electric Starter

Complete Starter
Brush Kit
Clutch Kit

MX,5030A1,A0 -19-21OCT92

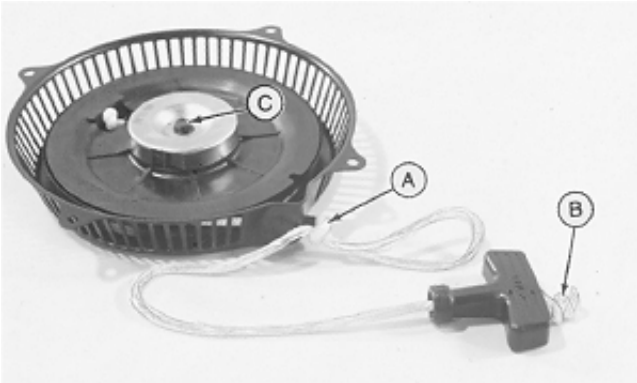
DISASSEMBLE RECOIL STARTER—IF
EQUIPPED

1. Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (A) to prevent rope from winding back onto reel.
3. Pry knot (B) out of handle and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (A). Slowly release reel tension. Do not let rope get wedged between reel and housing.



CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove screw (C) and ratchet cover.



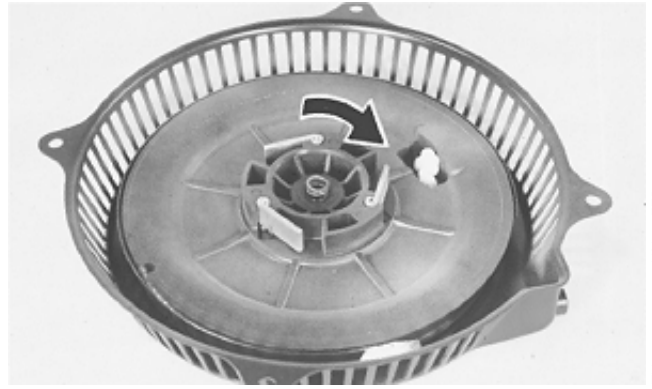
TY13495 -UN-23FEB89

MX,5030A1,A1 -19-21OCT92



CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

7. Turn the reel one half turn clockwise so no spring tension can be felt.



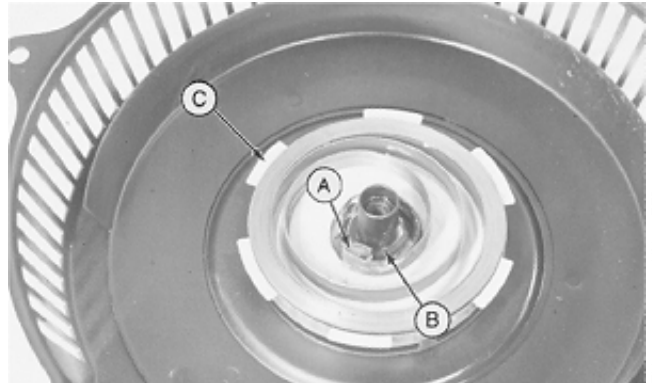
MX,5030A1,A2 -19-21OCT92

TY13496 -UN-23FEB89

8. Spring is stored in spring case (C) in housing. Lift reel straight up so spring remains seated in housing.

9. Carefully unhook spring tang (A) from catch (B).

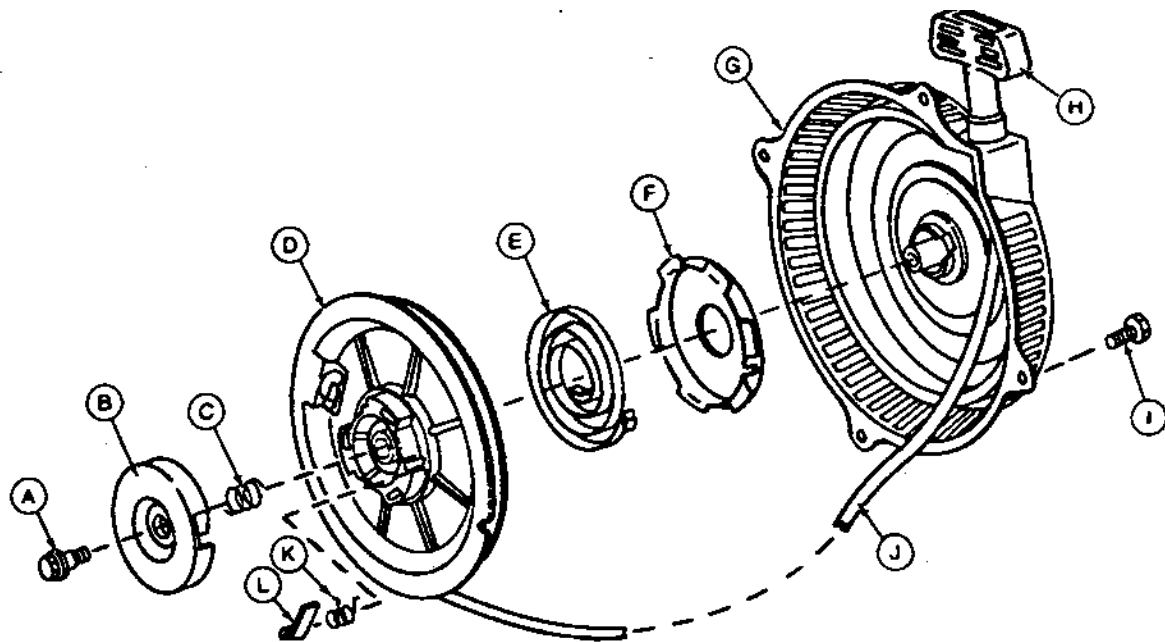
10. Remove spring case from housing.



MX,4030A1,A2 -19-21OCT92

TY13497 -UN-23FEB89

INSPECT RECOIL STARTER



A—Screw
B—Retainer
C—Spring

D—Reel
E—Spring
F—Case

G—Housing
H—Handle
I—Screw (4 used)

J—Rope
K—Spring
L—Pawl

Inspect and replace all damaged or worn parts.

MX,5030A1,A3 -19-21OCT92

TY13498 -UN-23FEB89

REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

1. Working from the center out, carefully unwind spring from spring case or reel.
2. Hook outside spring tang in reel or case. Wind spring into reel or spring case, working toward center.



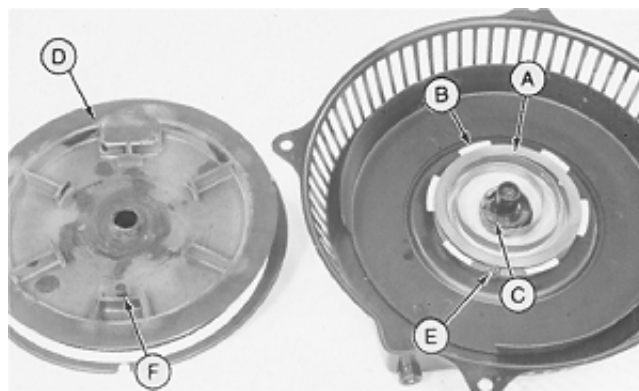
M54497 -UN-09JAN91

MX,5030A1,A4 -19-21OCT92

ASSEMBLE RECOIL STARTER

1. Wind rope counterclockwise onto reel.
2. Place spring case (B) into housing with spring tang over catch (C).
3. Install reel in spring case, with round peg (E) aligned with end of spring (F).
4. Turn reel counterclockwise until you feel tang hook on catch.

A—Spring
 B—Case
 C—Catch
 D—Reel
 E—Round Peg
 F—End of Spring

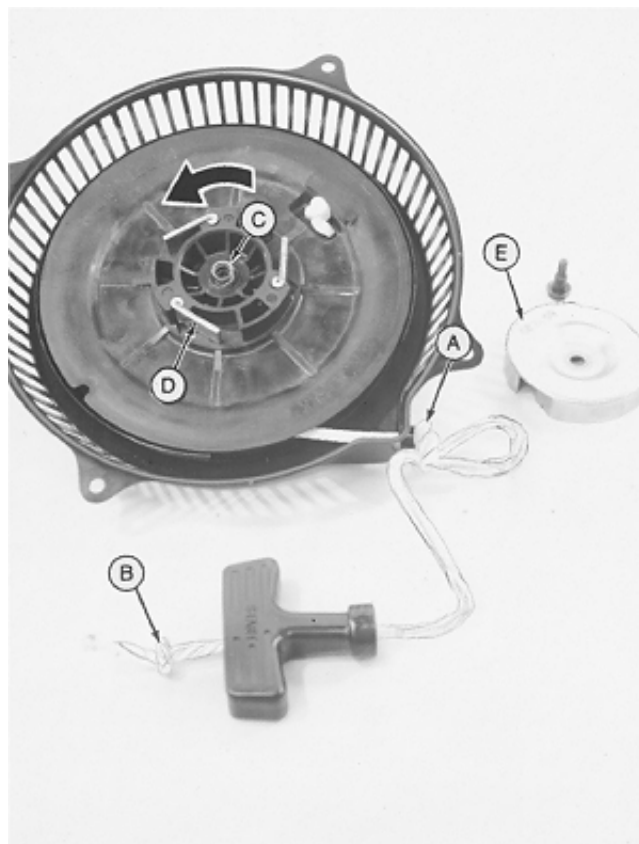


TY13499 -UN-23FEB89

MX,5030A1,A5 -19-21OCT92

5. Turn reel two turns counterclockwise to preload spring.
6. While holding reel to keep it from unwinding, feed end of rope through hole. Tie knot (A) to hold rope.
7. Install handle and secure with knot (B).
8. Remove knot (A).
9. Install spring (C) and ratchet cover (E) with opening(s) in cover over pawl(s) (D). Check for free movement of pawls.
10. Pull rope to check for proper operation.
11. Install recoil starter on engine.

A—Knot
 B—Knot
 C—Spring
 D—Pawls
 E—Retainer



TY13500 -UN-23FEB89

MX,5030A1,A6 -19-21OCT92

ANALYZE ELECTRIC STARTER CONDITION

1. The starter overheats because of:

- Long cranking.
- Armature binding.

2. The starter operates poorly because of:

- Armature binding.
- Dirty or damaged starter drive.
- Badly worn brushes or weak brush springs.
- Excessive voltage drop in cranking system.
- Battery or wiring defective.
- Shorts, opens, or grounds in armature.

NOTE: Starter repair is limited to brushes, end caps, and starter drive. Fields in starter are permanent magnets and are not serviceable. If housing or armature is damaged, replace starter.

MX,5030A1,A7 -19-21OCT92

50
30
5

BENCH TEST SOLENOID DRIVE STARTER

NOTE: Perform bench test before disassembling starter motor to determine cause of problem.

IMPORTANT: Never operate motor longer than 20 seconds. Allow at least two minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starting motor.

1. Disconnect battery leads from battery.
2. Remove starter from engine.
3. Connect 12-volt battery (A) to starter battery terminal (B) and starter frame (C) using heavy duty cables.
4. Connect remote start switch (D) between switch terminal (E) and battery terminal (B).

NOTE: A short piece of wire with a small clip on the end will allow a more positive connection at the switch terminal.

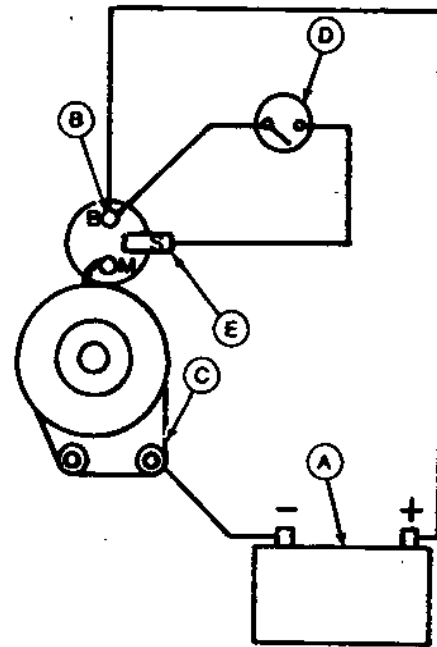
When switch is activated, starter should engage and run.

IF SOLENOID CHATTERS; hold-in winding is open-circuited.

IF NOTHING HAPPENS; either the solenoid pull-in winding is open-circuited or mechanical parts are sticking.

IF SOLENOID ENGAGES, BUT MOTOR DOES NOT RUN; check solenoid switch continuity, brushes, armature and field windings.

Solenoid cannot be repaired, replace it.



A—12-Volt Battery
B—Battery Terminal
C—Starter Frame
D—Remote Start Switch
E—Switch Terminal

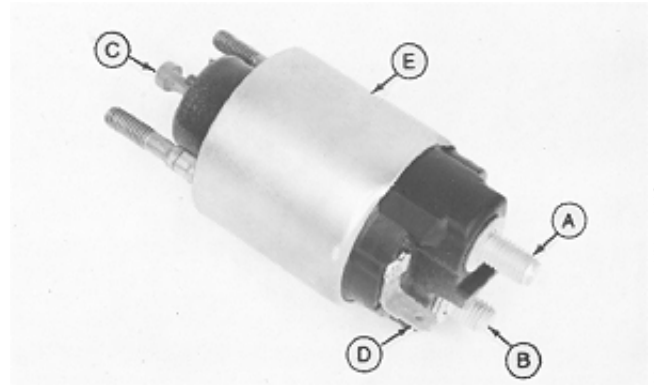
M37149 -JUN-29AUG88

TEST SOLENOID

NOTE: If bench test indicated solenoid problems, use an ohmmeter or test light to check solenoid.

1. Test solenoid terminals (A and B) for continuity. There should be no continuity.
2. Depress switch arm (C). There should be continuity when arm is fully depressed.
3. Test for open circuits between terminal (B) and tang (D). There should be continuity.
4. Test for open circuits between tang (D) and body (E). There should be continuity.

If solenoid fails any test, it is defective and must be replaced.



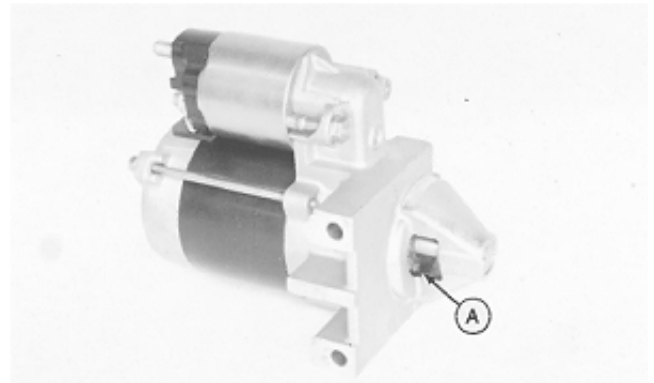
A—Terminal
B—Terminal
C—Switch Arm
D—Tang
E—Solenoid Body

M51705 -UN-31AUG88

MX,5030A1,A9 -19-21OCT92

CHECK STARTER ARMATURE ROTATION

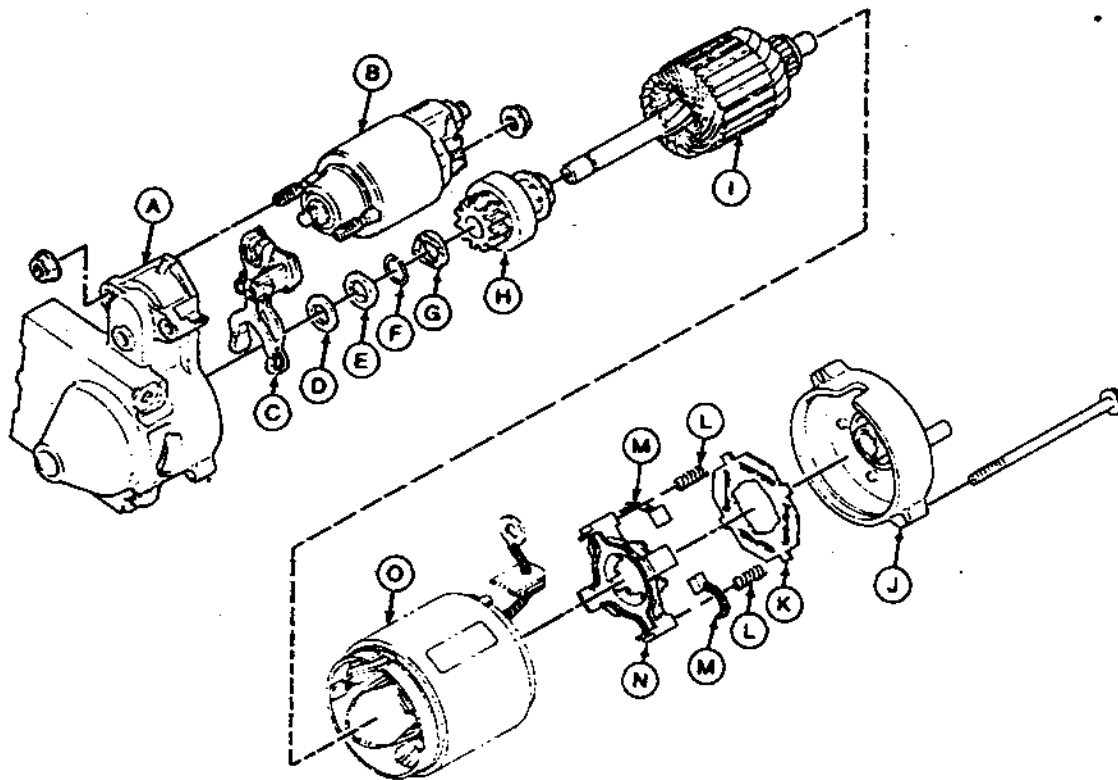
1. Remove starter cover.
2. Remove starter.
3. Rotate armature (A).
4. If armature does not rotate freely, armature may be bent or bearings may be worn. Disassemble and inspect starter. (See this group.)
5. Install starter and cover.



M80208 -UN-19FEB91

MX,5030A1,A10 -19-21OCT92

INSPECT STARTER



A—Front Cover
B—Solenoid
C—Shift Lever
D—Washer

E—Pinion Stopper Half
F—Retaining Clip
G—Pinion Stopper Half
H—Pinion

I—Armature
J—End Cover
K—Insulator
L—Brush Spring

M—Brush
N—Brush Holder
O—Body

1. Mark body and covers for correct alignment during reassembly.
2. Separate pinion stopper halves (E and G) to remove retaining clip (F).
3. Inspect parts for wear or damage.
4. Measure brushes. Replace brushes as a set if length of any one is less than 6 mm (0.240 in.).

5. Test starter armature and brushes. (See this group.)
6. Apply a thin coat of multipurpose grease to:
 - sliding surfaces of armature and solenoid shift lever.
 - armature shaft spline.
 - points where shaft contacts cover.
7. Assemble starter.

M50121 -UN-31AUG88

50
30
8

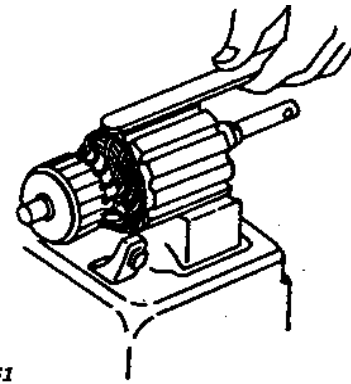
MX,5030A1,A11 -19-21OCT92

TEST STARTER ARMATURE

IMPORTANT: Do not clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.

1. Locate short circuits by rotating armature on a growler while holding a hacksaw blade or steel strip on armature. The hacksaw blade will vibrate in area of short circuit.
2. Shorts between bars are sometimes caused by dirt or copper between bars. Inspect for this condition.
3. If test indicates short circuited windings, clean the commutator of dust and fillings. Check armature again. If test still indicates short circuit, replace armature.

M24861

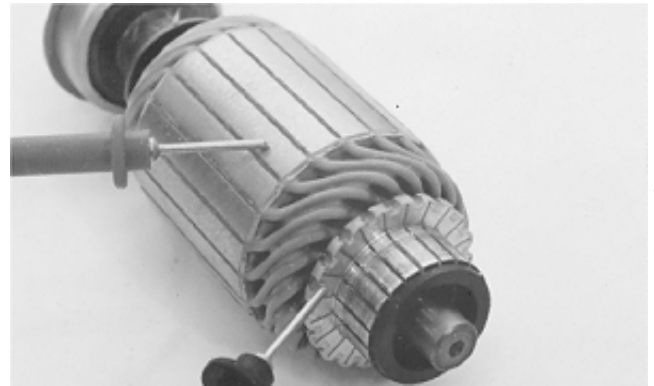


MX,5030A1,A12 -19-21OCT92

4. Test for grounded windings using an ohmmeter or test light.

Armature windings are connected in parallel, so each commutator bar needs to be checked.

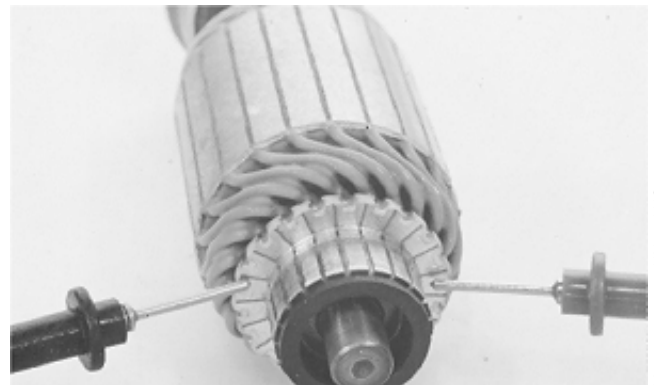
If test shows continuity, a winding is grounded and the armature must be replaced.



M98,2030A,AH -19-21OCT92

5. Test for open circuited windings using an ohmmeter or test light.

If test shows no continuity, there is an open circuit and armature must be replaced.



M98,2030A,M -19-21OCT92

TEST FIELD COIL

*NOTE: Continuity tests are similar for all units.
Illustrations are representative only.*

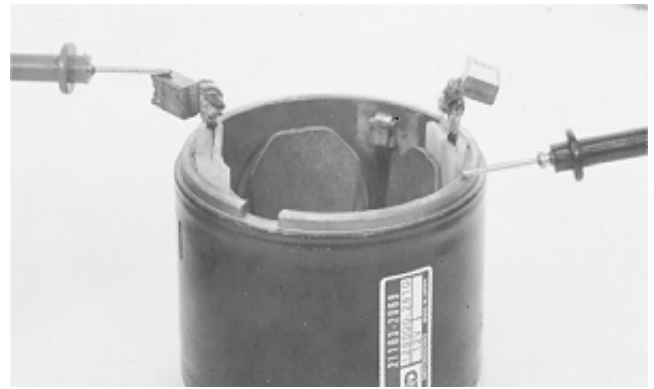
If equipped with brushes on body:

Replace field coil if not according to specifications.

CONTINUITY TEST

Brush-to-Housing Continuity

Brush-to-Brush Continuity



M50115 -UN-31AUG88



M50116 -UN-31AUG88

MX,5030A1,A13 -19-21OCT92

Section 100

COMPONENT ANALYSIS AND GENERAL REPAIR

Contents

Page

Group 05—Valves

Valves

Inspect	100-05-1
Analyze	100-05-1
Lap	100-05-3

Group 10—Piston, Piston Rings, Crankshaft and Connecting Rod

Analyze

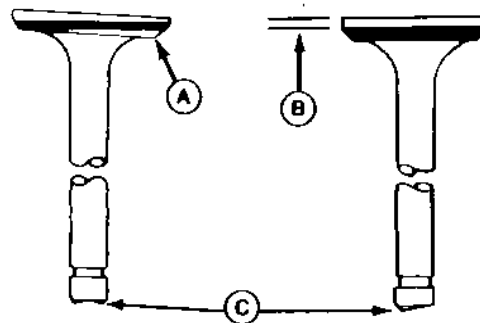
Piston Ring Wear	100-10-1
Piston Wear	100-10-3
Crankshaft and Connecting Rod Wear	100-10-5

Group 15—Cylinder Block

Deglaze Cylinder Bore	100-15-1
---------------------------------	----------

INSPECT VALVES

1. Remove carbon from valve head, face and stem with a power-operated wire brush. Be sure carbon is removed, not merely burnished.
2. Check valve faces, heads and stems for defects.
3. Replace warped valves (A) or valves with less than 0.6 mm (0.02 in.) margin (B). Valve stem ends (C) should be ground square before you check valve-to-tappet clearance.



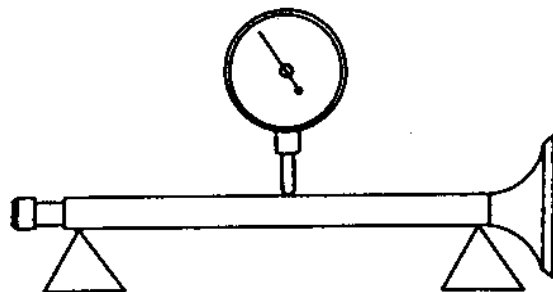
MX,10005A1,A1 -19-21OCT92

M38087 -UN-21AUG92

4. Inspect valve stem for bend using V-blocks and a dial indicator. Turn valve slowly and read variation on indicator. Replace if variation is greater than specification.

BEND SPECIFICATION (MAX)

Valve Stem 0.03 mm (0.001 in.)



M98,2015A,A18 -19-21OCT92

M51753 -UN-07SEP88

ANALYZE VALVES

Lead deposits on the intake valve are caused by exhaust gas leakage past the valve. This indicates that the valve is not seating properly.

IMPORTANT: Do not grind the exhaust valve or valve life will be shortened.

Grind intake valve and reface the seat to correct this condition.

NOTE: Be sure to reset valve-to-tappet clearance after grinding valves.



MX,10005A1,A2 -19-21OCT92

M29934 -UN-06SEP88

Valve stem corrosion is caused by moisture in the engine. Moisture in the fuel-air-mixture can condense inside the engine when the engine is stopped and cools down.

Valve corrosion can also occur during storage. Fogging or pouring oil in the combustion chamber before storing helps prevent valve corrosion.

Corroded or pitted valves collect deposits and may cause sticking valves. Replace badly corroded or pitted valves.



M5563 -UN-31AUG88

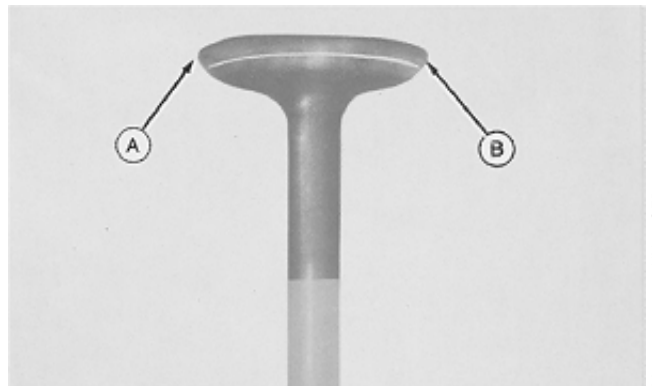
MX,2415G,37 -19-21OCT92

Exhaust valves are designed to function in temperatures exceeding (2760°C) 5000°F. However, when operating at high temperatures for long periods of time, valve burning may occur. Valves running too hot will show a dark discoloration of the valve stem into the area protected by the valve guide. Another indication is distortion of the valve margin (A) and valve face (B). Valve inserts may also begin to burn away.

IMPORTANT: Do not run the engine with blower housing removed.

Poor engine cooling due to dirt or obstructions is a common cause for overheating an engine and the valves. Remove blower housing and clean the engine cooling fins.

Other causes for valves running hot are worn valve guides or valve springs, incorrect valve clearance, lean fuel-air mixture and incorrect or overheated spark plug.



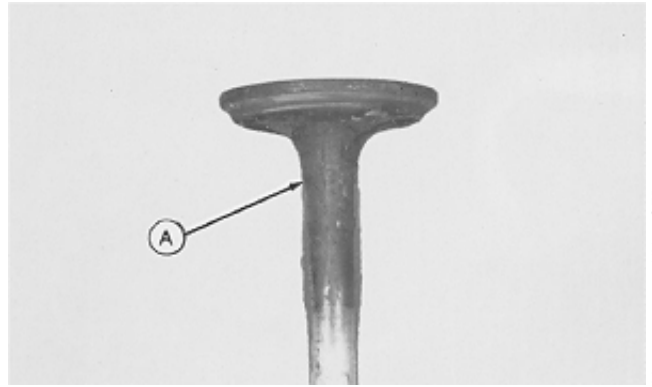
M30024 -UN-06SEP88

MX,2415G,38 -19-21OCT92

Using old or stale gasoline is a common cause for sticky valves (A).

This gummy deposit can be seen on the valve. When this condition exists, the carburetor may also contain gum deposits and will require a complete cleaning.

Always use fresh gasoline and drain fuel tank, lines, and carburetor before storing tractor.

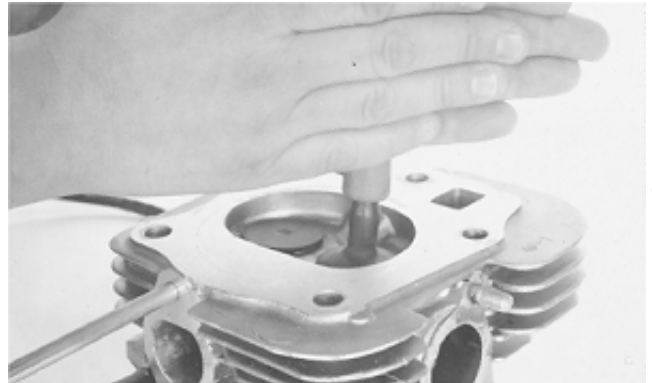


M29936 -UN-06SEP88

MX,2415G,39 -19-21OCT92

LAP VALVES

1. If seat does not make proper contact, lap the valve into the seat.
2. Apply small amount of fine lapping compound to face of valve.
3. Grip top of valve with a vacuum cup tool. Turn valve to lap valve to seat.
4. Lift valve from seat every 8 to 10 strokes. Lap until a uniform ring appears around the surface of the valve face.
5. Wash all parts in solvent to remove lapping compound. Dry parts.
6. Check position of lap mark on valve face. Lap mark must be on or near center of valve face.



M50041 -UN-31AUG88

MX10005A1,A3 -19-21OCT92

100
05
4

ANALYZE PISTON RING WEAR

Rings of the wrong size or rings having improper end gap will not conform to the shape of the cylinder. This results in high oil consumption and excessive blow-by.

Ring end gaps should be staggered on the piston during installation. End gaps in alignment can also cause oil consumption and blow-by.

Light scuffing or scoring (A) of both rings and piston occurs when unusually high friction and combustion temperatures approach the melting point of the piston material.

When this condition exists, it is due to one or more of the following probable causes:

1. Dirty cooling shroud and cylinder head.
2. Lack of cylinder lubrication.
3. Improper combustion.
4. Wrong bearing or piston clearance.
5. Too much oil in crankcase causing fluid friction.



M29943 -UN-06SEP88

MX10010A1,A1 -19-21OCT92

The engine operating at abnormally high temperatures may cause varnish, lacquer or carbon deposits (A) to form in the piston grooves making the rings stick. When this happens, excessive oil consumption and blow-by will occur.

Engine overheating and ring sticking is usually caused by one or more of the following:

1. Overloading.
2. Incorrect ignition timing.
3. Lean fuel mixture.
4. Dirty cooling fins.
5. Incorrect oil.
6. Low oil supply.
7. Stale fuel.



M29944 -UN-06SEP88

MX,2420G,69 -19-21OCT92

Vertical scratches (A) across the piston rings are due to an abrasive in the engine. Abrasives may be airborne, may have been left in the engine during overhaul or may be loose lead and carbon deposits.

When this condition exists, check for one or more of the following:

1. Damaged, collapsed or improperly installed air filter.
2. Loose connection or damaged gasket between air cleaner and carburetor.
3. Air leak around carburetor-to-cylinder block gasket.
4. Air leakage around throttle shaft.
5. Failure to properly clean cylinder bore after reconditioning engine.



M29945 -UN-06SEP88

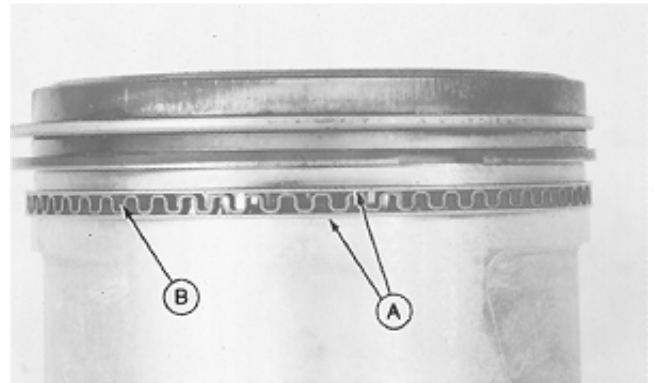
MX,2420G,70 -19-21OCT92

Abrasive particles in engine oil cause scratches on side rails (A) of oil control ring. Inner spacer (B) wear or distortion may cause:

- High oil consumption.
- Increased deposits in combustion chamber.
- Sticking compression rings.

Increased oil consumption may be caused by:

- Worn side rails with low tension.
- Worn or distorted inner spacer.



M38101 -UN-29AUG88

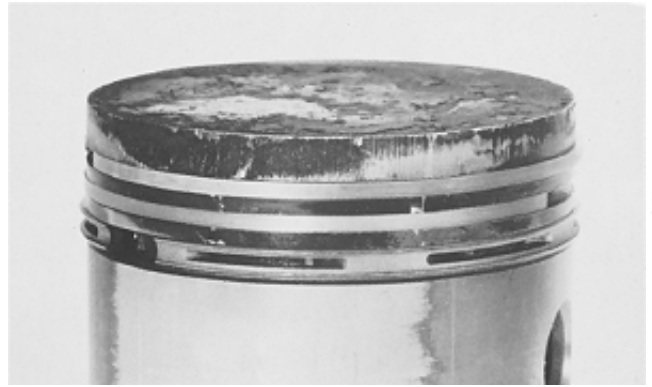
MX,2420G,24 -19-21OCT92

ANALYZE PISTON WEAR

Detonation, is abnormal combustion causing excessive temperature and pressure in the combustion chamber. Commonly called carbon knock, spark knock or timing knock, detonation occurs as the compressed fuel-air mixture ignites spontaneously to interrupt the normal ignition.

The following is a list of possible causes for detonation:

1. Lean fuel mixture.
2. Low octane fuel.
3. Advanced ignition timing.
4. Engine lugging.
5. Build-up of carbon deposits on piston or cylinder head, causing excessive compression.
6. Wrong cylinder head or milling of head increasing compression ratio.



M29947 -UN-06SEP88

MX10010A1,A2 -19-21OCT92

Pre-ignition is the igniting of the fuel-air mixture prior to regular ignition spark. Pre-ignition causes internal shock, resulting in pings, vibration, detonation and power loss. Severe damage to piston (A), rings and valves results from pre-ignition.

Check the following for causes of pre-ignition:

1. Internal carbon deposits.
2. Incorrect spark plug (high heat range).
3. Broken ceramic in spark plug.
4. Sharp edges on valves.



M30039 -UN-06SEP88

MX,2420G,72 -19-21OCT92

Check rod and piston alignment when piston shows a diagonal wear pattern (A) extending across the skirt of the piston. Contact with the cylinder wall shows on bottom of skirt at left and ring lands on the right.

A cylinder bored at an angle to the crankshaft can also cause improper ring contact with the cylinder.

This condition causes:

1. Rapid piston wear.
2. Uneven piston wear.
3. Excessive oil consumption.



M29948 -UN-06SEP88

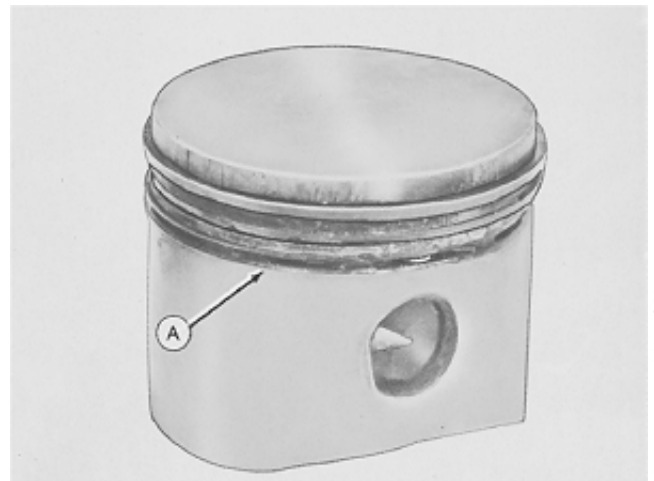
MX,2420G,73 -19-21OCT92

A broken retaining ring caused the damage (A) shown.

Retaining rings loosen or break due to:

1. Rod misalignment.
2. Excessive crankshaft end play.
3. Crankshaft journal taper.
4. Weak retaining rings.
5. Incorrectly installed retaining rings.

Inertia can cause a broken retaining ring to beat out the piston and cylinder, causing extensive damage.



M29949 -UN-06SEP88

MX,2420G,74 -19-21OCT92

ANALYZE CRANKSHAFT AND CONNECTING ROD WEAR

Check connecting rod and cap for damage or unusual wear patterns.

Lack of lubrication or improper lubrication can cause the connecting rod and cap to seize the crankshaft.

When the rod and cap seize to the crankshaft, the connecting rod and piston may both break causing other internal damage. Inspect block carefully before rebuilding engine.

Crankshaft and connecting rod damage can result from:

1. Engine run low on oil or without oil.
2. Oil not changed regularly.
3. Bearing cap installed incorrectly.

MX10010A1,A3 -19-21OCT92

100
10
5

DEGLAZE CYLINDER BORE

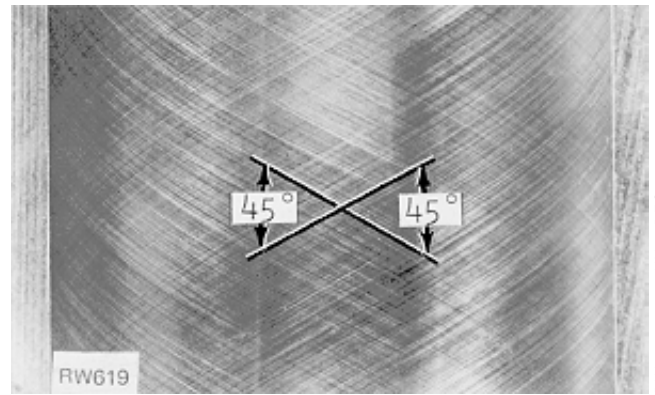
1. Deglaze cylinder bore using a rigid hone with a 220 to 300 grit stone.

NOTE: A cutaway of a cylinder bore is shown for clarity of photograph.

2. Use hone as instructed by manufacturer to obtain 45° crosshatch pattern as shown.

IMPORTANT: Do not use gasoline, kerosene, or commercial solvent to clean cylinder bores. Solvents will not remove all abrasives from cylinder walls.

3. Clean cylinder walls using clean white rags and water. Continue to clean cylinder until white rags show no discoloration.



MX10015A1,A1 -19-21OCT92

Index

	Page		Page
A		Automatic compression release—Continued	
Air cleaner		Inspect—FC290V/FC400V/FC420V/FC540V40-20-4	
Service—FA130D-AS16/AN00	20-05-7	Inspect—FE290D	45-20-4
Service—FA210D-AS19-01	20-06-12	Inspect—FE290R	45-20-4
Service—FA210D-AS20/AS17/BS17 . . .	20-06-12	Automatic compression release mechanism	
Service—FA210D-CS17	20-06-12	Inspect—FA210V	21-20-7
Service—FA210V	21-05-5		
Service—FB460V	50-05-6	B	
Service—FC150V	30-05-4	Blower housing	
Service—FC290V/FC400V/FC420V/FC540V40-05-10		Remove and install—FA130D	20-10-1
Service—FG150D	25-05-6	Remove and install—FA210D-AS17 . . .	20-10-2
Service—FG150G	25-05-6	Remove and install—FA210D-AS19-01 .	20-10-2
Service—KF82D/FZ340D	35-05-4	Remove and install—FA210D-AS20 . . .	20-10-1
Armature—FA130D		Remove and install—FA210D-BS17 . . .	20-10-2
Adjust air gap	20-25-1	Remove and install—FA210D-CS17 . . .	20-10-2
Remove and install	20-25-1	Remove and install—FA210V	21-10-1
Armature—FA210D		Remove and install—FE290D	45-10-1
Adjust air gap	20-25-1	Remove and install—FE290R	45-10-1
Remove and install	20-25-1	Remove and install—FG150D	25-10-1
Armature—FA210V		Remove and install—FG150G	25-10-1
Adjust air gap	21-25-1	Remove and install—KF82D/FZ340D . .	35-10-1
Remove and install	21-25-1	Blower housing—Electric start	
Armature—FB460V		Remove and install—FB460V	50-10-2
Adjust air gap	50-25-2	Remove and install—FC290V	40-10-2
Remove and install	50-25-1	Remove and install—FC400V/FC420V .	40-10-2
Armature—FC150V		Remove and install—FC540V	40-10-2
Adjust air gap	30-25-2	Blower housing—Recoil starter	
Remove and install	30-25-1	Remove and install—FB460V	50-10-1
Armature—FC290V/FC400V/FC420V/FC540V		Remove/install—FC290V/FC400V/FC420V	40-10-1
Adjust air gap	40-25-2	Breather	
Remove and install	40-25-1	Service primary—FA210V	21-05-3
Armature—FE290D		Service secondary—FA210V	21-05-4
Adjust air gap	45-25-2	Service—FA130D-AN00	20-05-6
Remove and install	45-25-1	Service—FA130D-AS16/AS19	20-05-5
Armature—FE290R		Service—FA210D-AS17/BS17/CS17 . . .	20-06-11
Adjust air gap	45-25-2	Service—FA210D-AS19-01	20-06-11
Remove and install	45-25-1	Service—FA210D-AS20	20-06-10
Armature—FG150D		Service—FB460V	50-05-5
Adjust air gap	25-25-1	Service—FC150V	30-05-3
Remove and install	25-25-1	Service—FC290V/FC400V/FC420V/FC540V40-05-9	
Armature—FG150G		Service—FE290D	45-05-6
Adjust air gap	25-25-1	Service—FE290R	45-05-6
Remove and install	25-25-1	Service—FG150D	25-05-6
Armature—KF82D/FZ340D		Service—FG150G	25-05-6
Remove and install	35-25-2	Service—KF82D/FZ340D	35-05-3
Automatic compression release			
Inspect—FA210D-AS20	20-20-8	C	
Inspect—FC150V	30-20-4		

	Page		Page
Camshaft—FA130D		Carburetor—FA130D-AS16/AS19	
Inspect	20-20-7	Disassemble, inspect and assemble . . .	20-05-3
Inspect plain bearings	20-20-7	Remove and install	20-05-2
Remove and install	20-20-6	Carburetor—FA210D-AS17/BS17/CS17	
Camshaft—FA210D		Disassemble, inspect and assemble . . .	20-06-6
Inspect	20-20-7	Remove and install	20-06-3
Inspect plain bearings	20-20-7	Carburetor—FA210D-AS19-01	
Remove and install	20-20-6	Disassemble, inspect and assemble . . .	20-06-6
Camshaft—FA210V		Remove and install	20-06-4
Inspect	21-20-6	Carburetor—FA210D-AS20	
Inspect plain bearings	21-20-6	Disassemble, inspect and assemble . . .	20-06-5
Remove and install	21-20-5	Remove and install	20-06-2
Camshaft—FB460V		Carburetor—FA210V	
Inspect	50-20-8	Disassemble, inspect and assemble . . .	21-05-2
Inspect plain bearings	50-20-8	Remove and install	21-05-1
Remove and install	50-20-7	Carburetor—FB460V	
Camshaft—FC150V		Disassemble, inspect and assemble . . .	50-05-3
Inspect	30-20-3	Remove and Install	50-05-2
Inspect plain bearings	30-20-3	Carburetor—FC150V	
Remove and install	30-20-2	Disassemble, inspect and assemble . . .	30-05-2
Camshaft—FC290V/FC400V/FC420V/FC540V		Remove and install	30-05-1
Adjust axial play—FC290V/FC540V . . .	40-20-6	Carburetor—FC290V	
Inspect	40-20-3	Disassemble, inspect and assemble . . .	40-05-5
Inspect plain bearings	40-20-4	Remove and install	40-05-1
Remove and install	40-20-3	Carburetor—FC400V	
Camshaft—FE290D		Disassemble, inspect and assemble . . .	40-05-5
Inspect	45-20-3	Remove and install	40-05-2
Inspect plain bearings	45-20-3	Carburetor—FC420V	
Remove and install	45-20-2	Disassemble, inspect and assemble . . .	40-05-5
Camshaft—FE290R		Remove and install	40-05-2
Inspect	45-20-3	Carburetor—FC540V	
Inspect plain bearings	45-20-3	Disassemble, inspect and assemble . . .	40-05-5
Remove and install	45-20-2	Remove and install	40-05-4
Camshaft—FG150D		Carburetor—FE290D	
Inspect	25-20-7	Disassemble, inspect and assemble . . .	45-05-4
Inspect plain bearings	25-20-8	Remove and install	45-05-2
Remove and install	25-20-6	Carburetor—FE290R	
Camshaft—FG150G		Disassemble, inspect and assemble . . .	45-05-4
Inspect	25-20-7	Remove and install	45-05-2
Inspect ball bearing	25-20-8	Carburetor—FG150D	
Inspect plain bearings	25-20-8	Disassemble, inspect and assemble . . .	25-05-4
Remove and install	25-20-6	Remove and install	25-05-3
Camshaft—KF82D/FZ340D		Carburetor—FG150G	
Remove and install	35-20-6	Disassemble, inspect and assemble . . .	25-05-4
Adjust end play	35-20-8	Remove and install	25-05-3
Inspect	35-20-7	Carburetor—KF82D/FZ340D	
Inspect ball bearings	35-20-7	Disassemble, inspect and assemble . . .	35-05-2
Carburetor serial number location	10-15-5	Remove and install	35-05-1
Carburetor—FA130D-AN00		Connecting rod, analyze wear	100-10-5
Disassemble, inspect and assemble . . .	20-05-4		
Remove and install	20-05-2		

	Page		Page
Connecting rod—FA130D		Crankcase cover—Continued	
Disassemble, inspect and assemble . . .	20-20-10	Remove and install—FC290V	40-20-2
Inspect	20-20-13	Remove and install—FC400V/FC420V .	40-20-2
Remove and install	20-20-9	Remove and install—FC540V	40-20-2
Connecting rod—FA210D		Remove and install—FE290D	45-20-2
Disassemble, inspect and assemble . . .	20-20-10	Remove and install—FE290R	45-20-2
Inspect	20-20-13	Remove and install—FG150D	25-20-6
Remove and install	20-20-9	Remove and install—FG150G	25-20-6
Connecting rod—FA210V		Remove and install—KF82D/FZ340D . .	35-20-6
Disassemble, inspect and assemble . . .	21-20-9	Crankshaft, analyze wear	100-10-5
Inspect	21-20-12	Crankshaft—FA130D	
Remove and install	21-20-8	Check alignment (TIR)	20-20-17
Connecting rod—FB460V		Inspect ball bearing	20-20-17
Disassemble, inspect and assemble . . .	50-20-14	Inspect plain bearing	20-20-16
Inspect	50-20-16	Measure end play	20-20-17
Remove and install	50-20-13	Remove, inspect and install	20-20-15
Connecting rod—FC150V		Replace bearing shell	20-20-16
Disassemble, inspect and assemble . . .	30-20-5	Crankshaft—FA210D	
Inspect	30-20-8	Check alignment (TIR)	20-20-17
Remove and install	30-20-5	Inspect ball bearing	20-20-17
Connecting rod—FC290V/400V/420V/540V		Inspect plain bearing	20-20-16
Disassemble, inspect and assemble . . .	40-20-12	Measure end play	20-20-17
Inspect	40-20-14	Remove, inspect and install	20-20-15
Remove and install	40-20-11	Replace bearing shell	20-20-16
Connecting rod—FE290D		Crankshaft—FA210V	
Disassemble, inspect and assemble . . .	45-20-9	Check alignment (TIR)	21-20-16
Inspect	45-20-12	Inspect plain bearings	21-20-15
Remove and install	45-20-8	Measure end play	21-20-16
Connecting rod—FE290R		Remove, inspect and install	21-20-14
Disassemble, inspect and assemble . . .	45-20-9	Replace bearing shell	21-20-15
Inspect	45-20-12	Crankshaft—FB460V	
Connecting rod—FG150D		Adjust end play	50-20-21
Disassemble, inspect and assemble . . .	25-20-11	Check alignment (TIR)	50-20-20
Inspect	25-20-13	Inspect ball bearing	50-20-20
Remove and install	25-20-10	Inspect plain bearing	50-20-19
Connecting rod—FG150G		Measure end play	50-20-20
Disassemble, inspect and assemble . . .	25-20-11	Remove, inspect and install	50-20-18
Inspect	25-20-13	Crankshaft—FC150V	
Remove and install	25-20-10	Check alignment (TIR)	30-20-11
Connecting rod—KF82D/FZ340D		Inspect ball bearing	30-20-11
Inspect	35-20-14	Inspect plain bearing	30-20-10
Disassemble, inspect and assemble . . .	35-20-11	Measure end play	30-20-11
Remove and install	35-20-10	Remove, inspect and install	30-20-9
Crankcase cover		Crankshaft—FC290V/FC400V/FC420V/FC540	
Remove and install—FA130D	20-20-6	Remove, inspect and install	40-20-16
Remove and install—FA210D	20-20-6	Crankshaft—FC290V/FC400V/FC420V/FC540V	
Remove and install—FA210V	21-20-5	Adjust end play	40-20-19
Remove and install—FB460V	50-20-7	Check alignment (TIR)	40-20-19
Remove and install—FC150V	30-20-2	Inspect ball bearing	40-20-18
		Inspect plain bearing	40-20-17
		Measure end play	40-20-19
		Replace bearing shell—FC290V	40-20-18

	Page		Page
Crankshaft—FE290D		Cylinder block—FE290R	
Adjust end play	45-20-17	Inspect	45-20-19
Check alignment (TIR)	45-20-16	Rebore	45-20-20
Inspect ball bearing	45-20-16	Cylinder block—FG150D	
Inspect plain bearing	45-20-15	Inspect	25-20-18
Measure end play	45-20-16	Rebore	25-20-20
Remove, inspect and install	45-20-14	Cylinder block—FG150G	
Crankshaft—FE290R		Inspect	25-20-18
Adjust end play	45-20-17	Rebore	25-20-20
Check alignment (TIR)	45-20-16	Cylinder block—KF82D/FZ340D	
Inspect ball bearing	45-20-16	Inspect	35-20-20
Inspect plain bearing	45-20-15	Rebore	35-20-21
Measure end play	45-20-16	Remove and install	35-20-19
Remove, inspect and install	45-20-14	Replace studs	35-20-19
Crankshaft—FG150D		Cylinder bore, deglaze	100-15-1
Check alignment (TIR)	25-20-17	Cylinder head assem—FC400V/FC420V	
Inspect ball bearings	25-20-17	Remove and install	40-15-3
Remove, inspect and install	25-20-15	Cylinder head assembly—FC150V	
Crankshaft—FG150G		Inspect	30-15-6
Check alignment (TIR)	25-20-17	Remove and install	30-15-3
Inspect ball bearings	25-20-16	Cylinder head assembly—FC290V	
Remove, inspect and install	25-20-15	Inspect	40-15-6
Crankshaft—KF82D/FZ340D		Remove and install	40-15-3
Measure and adjust end play	35-20-18	Cylinder head assembly—FC400V/FC420V	
Remove, inspect and install	35-20-16	Inspect	40-15-6
Check alignment (TIR)	35-20-17	Cylinder head assembly—FC540V	
Inspect ball bearings	35-20-17	Inspect	40-15-6
Cylinder block—FA130D		Remove and install	40-15-3
Inspect	20-20-18	Cylinder head assembly—FE290D	
Rebore	20-20-19	Inspect	45-15-5
Cylinder block—FA210D		Remove and install	45-15-3
Inspect	20-20-18	Cylinder head assembly—FE290R	
Rebore	20-20-19	Inspect	45-15-5
Cylinder block—FA210V		Remove and install	45-15-3
Inspect	21-20-17	Cylinder head—FA130D	
Rebore	21-20-18	Inspect	20-15-3
Cylinder block—FB460V		Remove and install	20-15-2
Inspect	50-20-23	Cylinder head—FA210D	
Rebore	50-20-25	Inspect	20-15-3
Replace studs	50-20-23	Remove and install	20-15-2
Cylinder block—FC150V		Cylinder head—FA210V	
Inspect	30-20-12	Inspect	21-15-2
Rebore	30-20-14	Remove and install	21-15-1
Cylinder block—FC290V/400V/420V/540V		Cylinder head—FB460V	
Inspect	40-20-21	Inspect	50-15-2
Rebore	40-20-23	Remove and install	50-15-1
Cylinder block—FE290D		Cylinder head—FG150D	
Inspect	45-20-19	Inspect	25-15-3
Rebore	45-20-20	Remove and install	25-15-2

	Page		Page
Cylinder head—FG150G		Electric starter—FE290R—Continued	
Inspect	25-15-3	Check armature rotation	45-30-5
Remove and install	25-15-2	Inspect	45-30-6
Cylinder head—KF82D/FZ340D		Test armature	45-30-7
Inspect	35-15-2	Test Field Coil	45-30-8
Remove and install	35-15-1	Test solenoid	45-30-5
D		Electric starter—KF82D/FZ340D	
Dynamic balancer—KF82D/FZ340D		Analyze condition	35-30-1
Inspect ball bearings	35-20-9	Bench test solenoid	35-30-2
Remove, inspect and install	35-20-9	Check armature rotation	35-30-3
E		Inspect	35-30-4
Electric starter—FB460V		Replace brushes	35-30-6
Analyze condition	50-30-5	Test armature	35-30-5
Bench test solenoid	50-30-6	Test field coil	35-30-6
Check armature rotation	50-30-7	Test solenoid	35-30-3
Inspect	50-30-8	Engine	
Test armature	50-30-9	Basic applications chart	10-10-2, 10-10-3
Test field coil	50-30-10	Basic specifications	10-10-1
Test solenoid	50-30-7	Engine applications chart	
Electric starter—FC150V		FA130D and FA210D	20-00-1
Analyze condition	30-30-4	FA210V	21-00-1
Check armature rotation	30-30-5	FB460V	50-00-1
Inspect	30-30-6	FC150V	30-00-1
Electric starter—FC290V/400V/420V/540V		FC290V/FC420V/FC540V	40-00-1
Analyze condition	40-30-6	FE290D	45-00-1
Bench test solenoid—FC400V/420V/540V	40-30-7	FE290R	45-00-1
Check armature rotation	40-30-8	FG150D	25-00-1
Inspect—FC290V	40-30-9	FG150G	25-00-1
Inspect—FC400V/FC420V	40-30-10	KF82D/FZ340D	35-00-1
Inspect—FC540V	40-30-11	Engine cover—FC150V	
Test field coil	40-30-13	Remove and install	30-10-2
Test		Engine Designation (Kawasaki)	10-15-1
solenoid—FC400V/FC420V/FC540V	40-30-8	Engine serial number location	10-15-2
Electric starter—FE290D		Engine specifications	10-10-1
Analyze condition	45-30-3	F	
Bench test solenoid	45-30-4	Features	
Check armature rotation	45-30-5	FA130D	10-20-1
Inspect	45-30-6	FA210D	10-20-1
Test armature	45-30-7	FA210V	10-20-2
Test Field Coil	45-30-8	FB460V	10-20-6
Test solenoid	45-30-5	FC150V	10-20-3
Electric starter—FE290R		FC290V	10-20-4
Analyze condition	45-30-3	FC400V	10-20-4
Bench test solenoid	45-30-4	FC420V	10-20-5
		FC540V	10-20-5
		FE290D/FE290R	10-20-6
		FG150G/FG150D	10-20-2

	Page		Page
Flywheel		Governor—Continued	
Remove and install—FA130D	20-10-3	Adjustment—FA210D-BS17	20-20-23
Remove and install—FA210D-AS17 . . .	20-10-3	Adjustment—FA210D-CS17	20-20-23
Remove and install—FA210D-AS19-01 .	20-10-3	Inspect and replace—FA130D	20-20-21
Remove and install—FA210D-AS20 . . .	20-10-3	Inspect and replace—FA210D	20-20-21
Remove and install—FA210D-BS17 . . .	20-10-3	Inspect and replace—FA210V	21-20-19
Remove and install—FA210D-CS17 . . .	20-10-3	Inspect and replace—FB460V	50-20-29
Remove and install—FA210V	21-10-2	Inspect and replace—FC150V	30-20-18
Remove and install—FB460V	50-10-3	Inspect and replace—FC290V	40-20-32
Remove and install—FC150V	30-10-4	Inspect and replace—FC400V/FC420V .	40-20-32
Remove and install—FC290V	40-10-3	Inspect and replace—FC540V	40-20-32
Remove and install—FE290D	45-10-1	Inspect and replace—FE290D	45-20-24
Remove and install—FE290R	45-10-1	Inspect and replace—FE290R	45-20-24
Remove and install—FG150D	25-10-1	Inspect and replace—FG150D	25-20-21
Remove and install—FG150G	25-10-1	Inspect and replace—FG150G	25-20-21
Remove and install—KF82D/FZ340D . .	35-10-1	Inspect and replace—KF82D/FZ340D . .	35-20-23
Remove/install—FC400V/FC420V/FC540V	40-10-3	Governor shaft	
Flywheel brake band—FC150V		Inspect and replace—FA130D	20-20-22
Remove and install	30-10-3	Inspect and replace—FA210D	20-20-22
Flywheel screen		Inspect and replace—FA210V	21-20-20
Adjust—FC290V/FC400V/FC420V/FC540V	40-10-2	Inspect and replace—FB460V	50-20-29
Adjustment—FA130D and FA210D	20-10-2	Inspect and replace—FC150V	30-20-19
Adjustment—FA210V	21-10-1	Inspect and replace—FC290V	40-20-33
Adjustment—FB460V	50-10-2	Inspect and replace—FC400V/FC420V .	40-20-33
Adjustment—FC150V	30-10-3	Inspect and replace—FC540V	40-20-33
Fuel filter/shutoff valve		Inspect and replace—FE290D	45-20-24
Replace—FG150D	25-05-2	Inspect and replace—FE290R	45-20-24
Replace—FG150G	25-05-2	Inspect and replace—FG150D	25-20-22
Fuel pump		Inspect and replace—FG150G	25-20-22
R & I—FA210D-AS17/BS17/CS17	20-06-2	Inspect and replace—KF82D/FZ340D . .	35-20-23
Remove and install—FB460V	50-05-1		
Remove and install—FC290V	40-05-1	I	
Remove and install—FC400V/FC420V .	40-05-1	Ignitor	
Remove and install—FC540V	40-05-1	Replace—FA130D	20-25-2
Fuel tank		Replace—FA210D	20-25-2
Remove/Inspect/Install—FA210D-AS20 .	20-06-1	Replace—FA210V	21-25-1
Remove, inspect and install—FG150G .	25-05-1	Replace—FE290D	45-25-2
Remove, inspect and install—FG150D .	25-05-1	Replace—FE290R	45-25-2
Remove, inspect, and install—FA130D .	20-05-1	Replace—FG150D	25-25-2
		Replace—FG150G	25-25-2
G		Intake manifold	
Governor		R & I—FA210D-AS17/BS17/CS	20-06-10
Adjustment—FA130D-AN00	20-20-23	Remove and install—FA210D-AS19-01 .	20-06-10
Adjustment—FA130D-AS16	20-20-22	Remove and install—FA210V	21-05-3
Adjustment—FA130D-AS19	20-20-22		
Adjustment—FA210D-AS17	20-20-23	M	
Adjustment—FA210D-AS19-01	20-20-23	Metric torque values	10-10-4
Adjustment—FA210D-AS20	20-20-22		

	Page		Page
O		P	
Oil filter manifold		Piston ring, analyze wear	100-10-1
Remove/inspect/install—FC400V/FC420 .	40-20-32	Piston rings—FA130D	
Remove, inspect and install—FB460V . .	50-20-28	Check end gap	20-20-14
Remove, inspect and install—FC150V .	30-20-18	Remove and install	20-20-14
Remove, inspect and install—FC290V .	40-20-32	Piston rings—FA210D	
Remove, inspect and install—FC540V .	40-20-32	Check end gap	20-20-14
Remove, inspect and install—FE290D .	45-20-23	Remove and install	20-20-14
Remove, inspect and install—FE290R .	45-20-23	Piston rings—FA210V	
Oil level sensor		Check end gap	21-20-13
Check—FA130D-AN00	20-20-20	Remove and install	21-20-13
Oil pump—FB460V		Piston rings—FB460V	
Disassemble and assemble	50-20-26	Check end gap	50-20-17
Inspect	50-20-27	Remove and install	50-20-17
Oil pump—FC150V		Piston rings—FC150V	
Disassemble and assemble	30-20-16	Check end gap	30-20-9
Inspect	30-20-16	Remove and install	30-20-8
Oil pump—FC400V/FC420V		Piston rings—FC290V/400V/420V/540V	
Disassemble and assemble	40-20-25	Check end gap	40-20-15
Inspect	40-20-26	Remove and install	40-20-15
Oil pump—FC540V		Piston rings—FE290D	
Disassemble and assemble	40-20-28	Check end gap	45-20-13
Inspect	40-20-29	Remove and install	45-20-12
Oil pump—FE290D		Piston rings—FE290R	
Disassemble and assemble	45-20-21	Check end gap	45-20-13
Inspect	45-20-22	Remove and install	45-20-12
Oil pump—FE290R		Piston rings—FG150D	
Disassemble and assemble	45-20-21	Check end gap	25-20-14
Inspect	45-20-22	Remove and install	25-20-14
Oil seals		Piston rings—FG150G	
Inspect—FA130D	20-20-18	Check end gap	25-20-14
Inspect—FA210D	20-20-18	Remove and install	25-20-14
Inspect—FA210V	21-20-17	Piston rings—KF82D/FZ340D	
Inspect—FB460V	50-20-22	Check end gap	35-20-15
Inspect—FC150V	30-20-12	Remove and install	35-20-14
Inspect—FC290V/FC400V/FC420V/FC540V	40-20-21	Piston, analyze wear	100-10-3
Inspect—FE290D	45-20-18	Piston—FA130D	
Inspect—FE290R	45-20-18	Disassemble, inspect and assemble . . .	20-20-10
Inspect—FG150D	25-20-18	Inspect	20-20-11
Inspect—FG150G	25-20-18	Remove and install	20-20-9
Inspect—KF82D/FZ340D	35-20-18	Piston—FA210D	
Oil slinger		Disassemble, inspect and assemble . . .	20-20-10
Inspect and replace—FC150V	30-20-15	Inspect	20-20-11
Inspect and replace—FC290V	40-20-25	Remove and install	20-20-9
Inspect and replace—F210V	21-20-19	Piston—FA210V	
Oil splasher		Disassemble, inspect and assemble . . .	21-20-9
Inspect and replace—FA130D	20-20-20	Inspect	21-20-10
Inspect and replace—FA210D	20-20-20	Remove and install	21-20-8
Inspect and replace—KF82D/FZ340D . .	35-20-22		

R

	Page
Reciprocating balancer—FC400V/FC420V—Continued	
Remove and install	40-20-7
Replace bushings	40-20-10
Reciprocating balancer—FC540V	
Disassemble and assemble	40-20-8
Inspect	40-20-9
Remove and install	40-20-7
Replace bushings	40-20-10
Reciprocating balancer—FE290D	
Disassemble and assemble	45-20-6
Inspect	45-20-7
Remove and install	45-20-5
Replace bushings	45-20-8
Reciprocating balancer—FE290R	
Disassemble and assemble	45-20-6
Inspect	45-20-7
Remove and install	45-20-5
Replace bushings	45-20-8
Recoil starter—FA130D-AN00	
Assemble	20-30-7
Disassemble	20-30-4
Inspect	20-30-6
Replace spring	20-30-3, 20-30-7
Recoil starter—FA130D-AS16/AS19	
Assemble	20-30-3
Disassemble	20-30-1
Inspect	20-30-2
Replace spring	20-30-3, 20-30-7
Recoil starter—FA210D	
Assemble	20-31-4
Disassemble	20-31-1
Inspect	20-31-2
Replace spring	20-31-4
Recoil starter—FA210V	
Assemble	21-30-3
Disassemble	21-30-1
Inspect	21-30-2
Replace spring	21-30-3
Recoil starter—FB460V	
Assemble	50-30-4
Disassemble	50-30-1
Inspect	50-30-3
Replace spring	50-30-3
Recoil starter—FC150V	
Assemble	30-30-3
Disassemble	30-30-1
Inspect	30-30-2
Replace spring	30-30-3

	Page		Page
Recoil starter—FC290V/FC400V/FC420V			
Assemble	40-30-4		
Inspect	40-30-3		
Replace spring	40-30-4		
Recoil starter—FE290D			
Disassemble, inspect and assemble . . .	45-30-2		
Replace spring	45-30-3		
Recoil starter—FE290R			
Disassemble, inspect and assemble . . .	45-30-2		
Replace spring	45-30-3		
Recoil starter—FG150D			
Assemble	25-30-3		
Disassemble	25-30-1		
Inspect	25-30-2		
Replace spring	25-30-3		
Recoil starter—FG150G			
Assemble	25-30-3		
Disassemble	25-30-1		
Inspect	25-30-2		
Replace spring	25-30-3		
Repair specifications			
FA130D	20-00-2		
FA210D	20-00-4		
FA210V	21-00-1		
FB460V	50-00-2		
FC150V	30-00-2		
FC290V	40-00-2		
FC400V/FC420V	40-00-5		
FC540V	40-00-8		
FE290D	45-00-2		
FE290R	45-00-2		
FG150D	25-00-1		
FG150G	25-00-1		
KF82D/FZ340D	35-00-2		
Rocker arm assem—FC290V/FC400V/FC420V			
Inspect	40-15-2		
Remove and install	40-15-2		
Rocker arm assembly—FC150V			
Remove, inspect and install	30-15-2		
Rocker arm assembly—FC540V			
Inspect	40-15-2		
Remove and install	40-15-2		
Rocker arm assembly—FE290D			
Inspect	45-15-2		
Remove and install	45-15-2		
Rocker arm assembly—FE290R			
Inspect	45-15-2		
Remove and install	45-15-2		
		S	
		Serial number location	
		Carburetor	10-15-5
		Engine	10-15-2
		Springs	
		Inspect—FC150V	30-15-5
		Inspect—FC290V/FC400V/FC420V/FC540V	40-15-6
		Inspect—FE290D	45-15-5
		Inspect—FE290R	45-15-5
		Stator	
		Remove and install—FB460V	50-25-1
		Remove and install—FC150V	30-25-1
		Remove and install—FC290V	40-25-1
		Remove and install—FC400V/FC420V .	40-25-1
		Remove and install—FC540V	40-25-1
		Remove and install—FE290D	45-25-1
		Remove and install—FE290R	45-25-1
		Remove and install—KF82D/FZ340D .	35-25-1
		Stem seals	
		Inspect and replace—FC290V	40-15-5
		Inspect and replace—FC400V/FC420V .	40-15-5
		Inspect and replace—FC540V	40-15-5
		Inspect and replace—FE290D	45-15-4
		Inspect and replace—FE290R	45-15-4
		T	
		Tappet caps, change—KF82D/FZ340D . .	35-20-5
		Tappets	
		Inspect—KF82D/FZ340D	35-20-8
		Remove and install—KF82D/FZ340D .	35-20-8
		Remove/inspect/install—FC400V/FC420	40-20-5
		Remove, inspect and install—FA130D .	20-20-8
		Remove, inspect and install—FA210D .	20-20-8
		Remove, inspect and install—FA210V .	21-20-7
		Remove, inspect and install—FB460V .	50-20-9
		Remove, inspect and install—FC150V .	30-20-4
		Remove, inspect and install—FC290V .	40-20-5
		Remove, inspect and install—FC540V .	40-20-5
		Remove, inspect and install—FE290D .	45-20-4
		Remove, inspect and install—FE290R .	45-20-4
		Remove, inspect and install—FG150G .	25-20-9
		Remove, inspect and install—FG150D .	25-20-9
		Torque values	
		Metric	10-10-4

V

	Page		Page
Valve seats		Valve springs—Continued	
Recondition—FA210V	21-20-3	Inspect—FA210V	21-20-3
Recondition—FC150V	30-15-7	Inspect—FB460V	50-20-4
Recondition—FC290V/FC400V/FC420V/FC40-15-8		Inspect—FG150D	25-20-3
Valve clearance		Inspect—FG150G	25-20-3
Check—FA130D	20-20-5	Inspect—KF82D/FZ340D	35-20-2
Check—FA210D	20-20-5	Valves	
Check—FA210V	21-20-4	Analyze	100-05-1
Check—FB460V	50-20-6	Inspect	100-05-1
Check—FC150V	30-15-8	Lap	100-05-3
Check—FC290V/FC400V/FC420V/FC540V 40-15-9		Valves and springs	
Check—FE290D	45-15-8	Remove and install—FA130D	20-20-2
Check—FE290R	45-15-8	Remove and install—FA210D	20-20-2
Check—FG150D	25-20-5	Remove and install—FA210V	21-20-2
Check—FG150G	25-20-5	Remove and install—FB460V	50-20-3
Check—KF82D/FZ340D	35-20-4	Remove and install—FC150V	30-15-5
Valve guide bushings		Remove and install—FC290V	40-15-5
Replace—FB460V	50-20-4	Remove and install—FC400V/FC420V	40-15-5
Replace—FC290V/FC400V/FC420V/FC540V 40-15-7		Remove and install—FC540V	40-15-5
Replace—FE290D	45-15-6	Remove and install—FE290D	45-15-4
Replace—FE290R	45-15-6	Remove and install—FE290R	45-15-4
Replace—FG150D	25-20-3	Remove and install—FG150D	25-20-2
Replace—FG150G	25-20-3	Remove and install—FG150G	25-20-2
Valve guides		Remove and install—KF82D/FZ340D	35-20-2
Inspect—FA130D	20-20-3		
Inspect—FA210D	20-20-3		
Inspect—FA210V	21-20-3		
Inspect—FB460V	50-20-4		
Inspect—FC150V	30-15-6		
Inspect—FC290V/FC400V/FC420V/FC540V 40-15-6			
Inspect—FE290D	45-15-5		
Inspect—FE290R	45-15-5		
Inspect—FG150D	25-20-3		
Inspect—FG150G	25-20-3		
Inspect—KF82D/FZ340D	35-20-3		
Valve seats			
Recondition—FA130D	20-20-4		
Recondition—FA210D	20-20-4		
Recondition—FB460V	50-20-5		
Recondition—FE290D	45-15-7		
Recondition—FE290R	45-15-7		
Recondition—FG150D	25-20-4		
Recondition—FG150G	25-20-4		
Recondition—KF82D/FZ340D	35-20-3		
Valve springs			
Inspect—FA130D	20-20-3		
Inspect—FA210D	20-20-3		