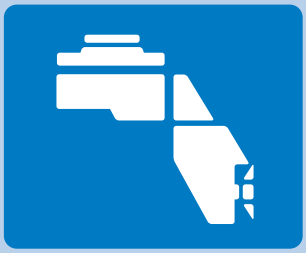
YAMAHA



ME432STI

E

ENGINE SERVICE MANUAL

070029

N64-28197-ZJ-11

NOTICE

This manual has been prepared by Yamaha primarily for use by Yamaha dealers and their trained mechanics when performing maintenance procedures and repairs to Yamaha equipment. It has been written to suit the needs of persons who have a basic understanding of the mechanical and electrical concepts and procedures inherent in the work, for without such knowledge attempted repairs or service to the equipment could render it unsafe or unfit for use.

Because Yamaha has a policy of continuously improving its products, models may differ in detail from the descriptions and illustrations given in this publication. Use only the latest edition of this manual. Authorized Yamaha dealers are notified periodically of modifications and significant changes in specifications and procedures, and these are incorporated in successive editions of this manual.

ME432STI
ENGINE SERVICE MANUAL

1st Edition, July, 2006

Printed in Japan

HOW TO USE THIS MANUAL

MANUAL FORMAT

This manual provides the mechanic with descriptions of the operations of disassembly, repair, assembly and check, each of which is presented in a sequential, step-by-step procedure.

To assist you in finding your way around this manual, the section title and major heading is given at the head of each page.

A table of contents is provided on the first page of each section.

ILLUSTRATIONS

Some illustrations in this manual may differ from the model you have. This is because a procedure described may relate to several models, though only one is illustrated. (The name of the model described will be mentioned in the description).

To help you identify components and understand the correct procedures of disassembly and assembly, exploded diagrams are provided. Steps in the procedure are numbered: 1), 2), 3). Parts shown in the illustrations are identified as: ①, ②, ③.

REFERENCES

These have been kept to a minimum. References to other sections of the manual include the relevant page number.

INPORTANT INFORMATION

In this Service Manual particularly important information is distinguished in the following ways.

⚠ The safety Alert Symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

⚠ WARNING

Failure to follow WARNING instructions could result in severe injury or death to the marine vehicle operator, a bystander, or a person checking or repairing the Stern Drive.

CAUTION:

A CAUTION indicates special precautions that must be taken to avoid damage to the Sterm Drive.

NOTE:

A NOTE provides key information to make procedures easier or clearer.

CONSTRUCTION OF THIS MANUAL

This manual consists of chapters for the main categories of subjects. (See "Symbols" on the next page.)

1st title ① : This is a chapter with its symbol on the upper right of each page.
2nd title ② : This title appears on the top of the each page, to the left of the chapter symbol.
3rd title ③ : This title precedes the paragraphs describing the working procedure.

All the procedures in this manual are organized in a sequential, step-by-step order. The information has been compiled to provide the mechanic with an easy-to-read, handy reference that contains comprehensive explanations of all disassembly, check, repair, and assembly procedures.

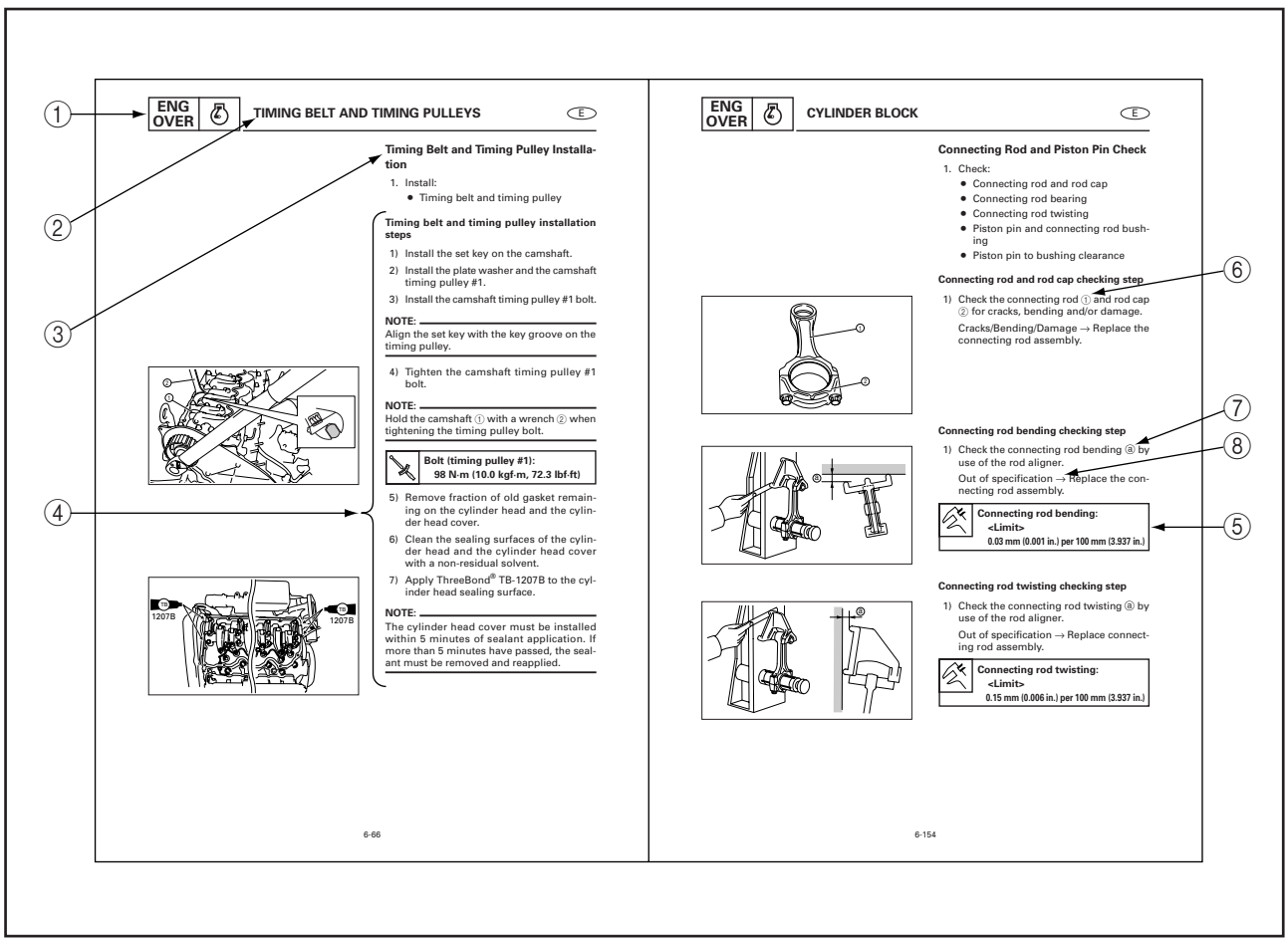
Important procedures including removing, checking, and assembling steps ④ are explained in detail.

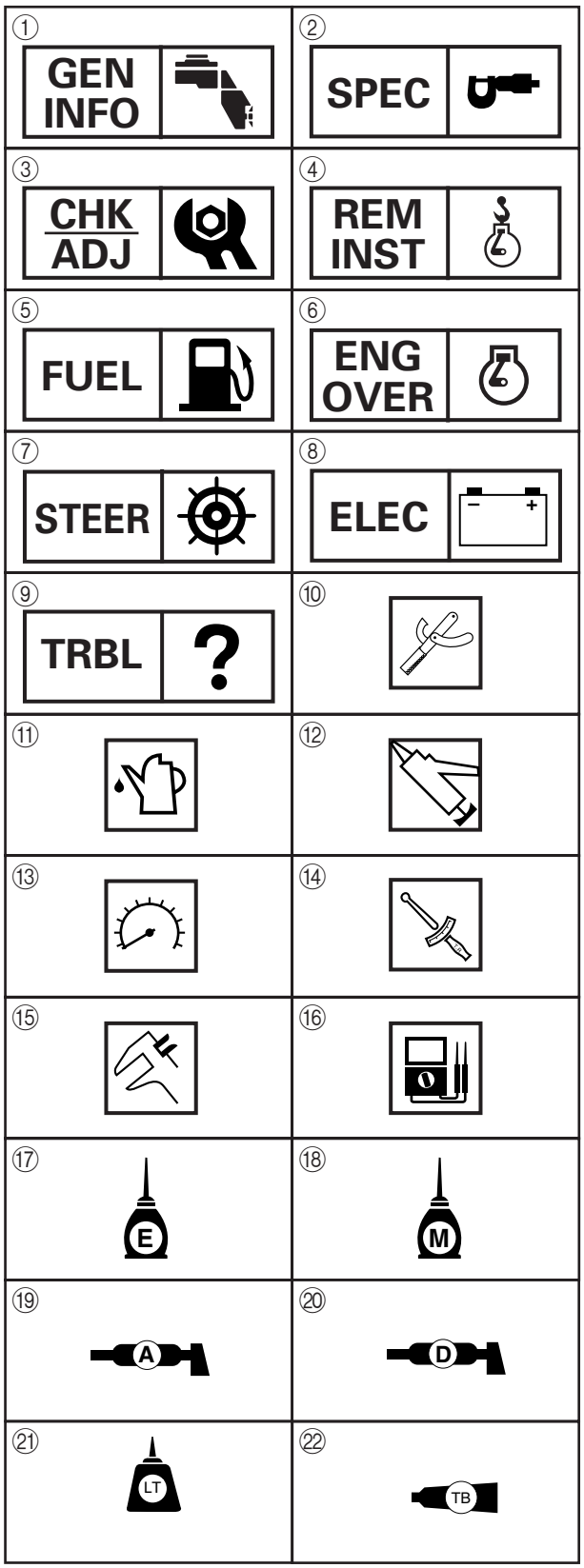
IMPORTANT FEATURES

- Important engine data and information about special tools framed in a box together with an illustrative symbol ⑤.
- A circled numeral ⑥ indicates a part name. A circled lower case letter indicates data or an alignment mark ⑦.
- An arrow ⑧ indicates the course of action required to remedy the started condition of a component.

EXPLODED DIAGRAM

Each chapter begins with exploded diagrams which facilitate correct disassembly and assembly.





SYMBOLS

Symbols ① to ⑨ are designed as thumb-tabs and indicate the content of a chapter.

① General information
② Specifications
③ Periodic check and adjustment
④ Engine removal and installation
⑤ Fuel system
⑥ Engine overhaul
⑦ Power steering system
⑧ Electrical system
⑨ Troubleshooting

Symbols ⑩ to ⑯ indicate specific data:

⑩ Special tool
⑪ Recommended fuel
⑫ Lubricant
⑬ Engine speed
⑭ Tightening torque
⑮ Specified value, service, limit
⑯ Resistance (Ω), Voltage (V), Electric current (A)

Symbols ⑰ to ⑳ in an exploded diagram indicate grade of lubricant and location of lubrication point:

⑰ Apply Yamaha marine diesel engine oil
⑱ Apply molybdenum disulfide oil
⑲ Apply water resistant grease (Yamaha marine grease A)
⑳ Apply corrosion resistant grease (Yamaha marine grease D)

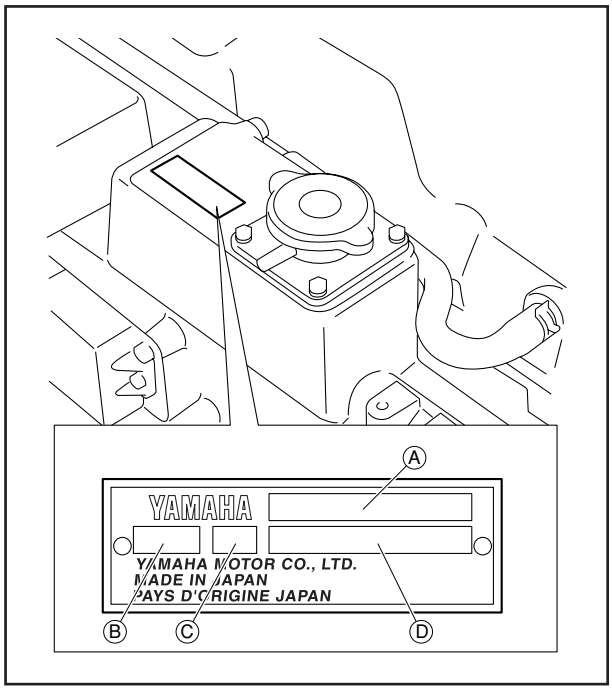
Symbols ㉑ and ㉒ in an exploded diagram indicate grade of sealing or locking agent, and location of application point:

㉑ Apply LOCTITE® No. 243, 271, 572
㉒ Apply ThreeBond® TB-1207B, 1322, 1324

CONTENTS

CHAPTER 1
GENERAL INFORMATION

1



ENGINE IDENTIFICATION

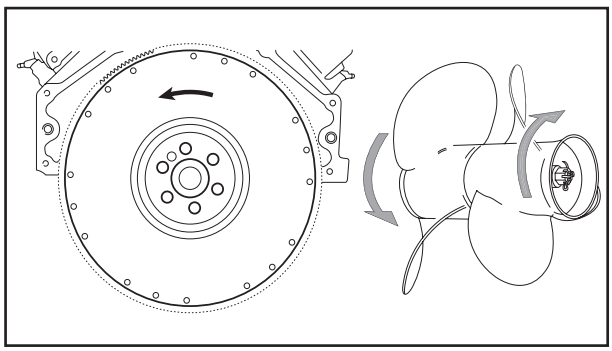
When servicing, inspecting or ordering the spare part of the engine or marine gear, check the identification number as follows.

NOTE:

Because of the identification number plate is sticked with special method, the engine number and the serial number will be invalid when removed.

The model and serial number plate is located on the header tank.
The different models can be identified by checking the model and serial number plate and using the following table.

MODEL Ⓐ	PREFIX Ⓑ	VARIATION Ⓒ	SERIAL NO. Ⓓ
ME432STI P1	N641	SP	******
	N642	P	******

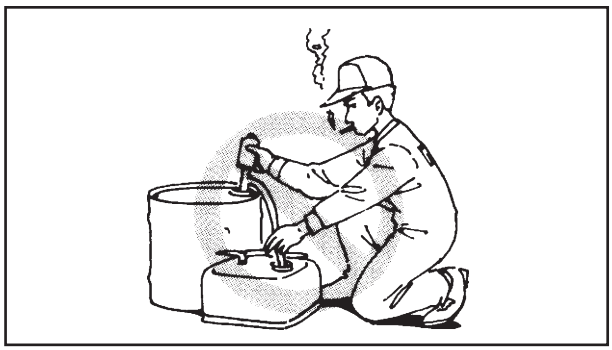


ENGINE AND PROPELLER ROTATION

DO NOT rely on propeller rotation to be in the same direction as engine rotation.
Engine rotation is determined by looking at the flywheel end of the engine. The Yamaha engines covered in this manual rotate counterclockwise to the left as viewed from the flywheel.

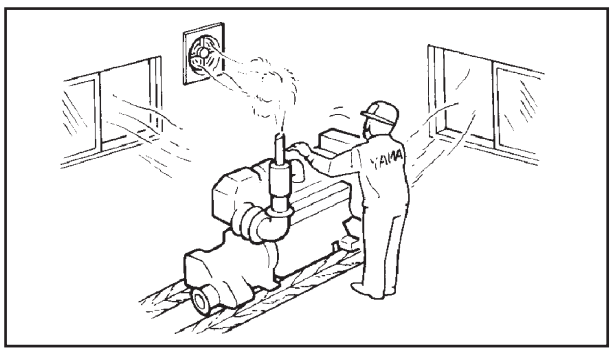
SAFETY WHILE WORKING

The procedures given in this manual are those recommended by Yamaha to be followed by Yamaha dealers and their mechanics.



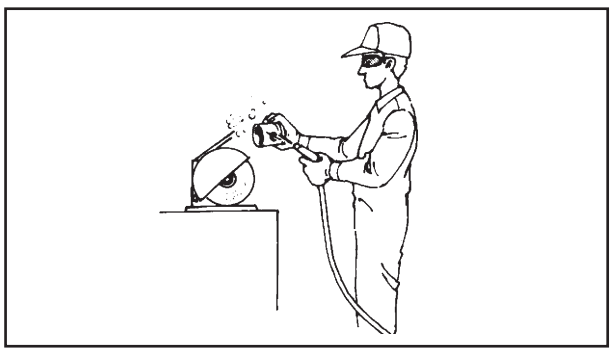
Fire Prevention

When handling fuel, be sure to keep away from any open flames or heated materials. If spilling fuel, wipe it off immediately.



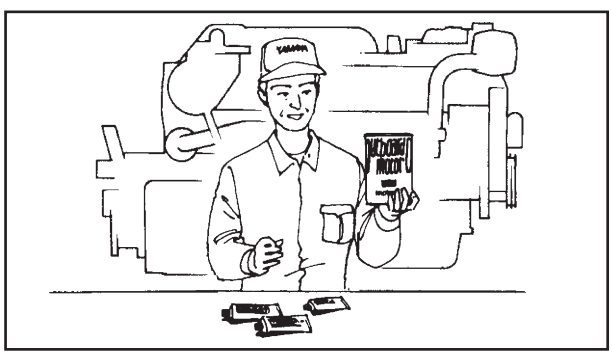
Ventilation

Engine exhaust gases are harmful to health. When test-running an engine indoors, maintain good ventilation.



Self-protection

Protect your eyes with suitable safety glasses or safety goggles, when grinding or when doing any operation which may cause particles to fly off. Protect hands and feet by wearing safety gloves or protective shoes if appropriate to the work you are doing.



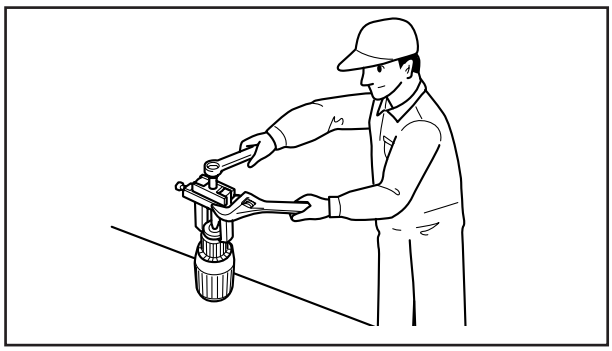
Oils, Greases and Sealing Fluids

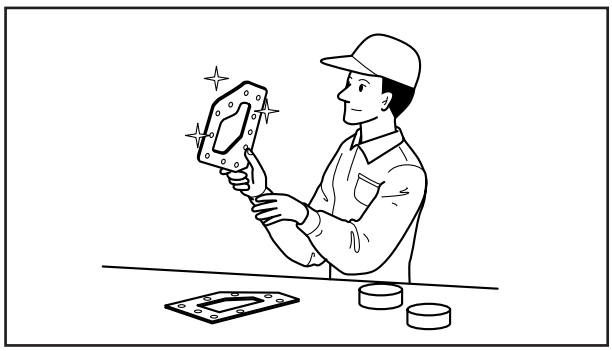
Use only genuine Yamaha oils, greases and sealing fluids or those recommended by Yamaha.

NOTE:

Under normal conditions or use, there should be no hazards from the use of the lubricants mentioned in this manual, but safety is all-important, and by adopting good safety practices, any risk is minimized. A summary of the most important precautions is as follows:

1. While working, maintain good standards of personal and industrial hygiene.
2. Clothing which has become contaminated with lubricants should be changed as soon as practicable, and laundered before further use.
3. Avoid skin contact with lubricants; do not, for example, place a soiled wiping-rag in your pocket.
4. Hands and any other part of the body which have been in contact with lubricants or lubricant-contaminated clothing, should be thoroughly washed with hot water and soap as soon as practicable.
5. To protect the skin, the application of a suitable barrier cream to the hands before working, is recommended.
6. A supply of clean lint-free cloths should be available for wiping purposes.





Good Working Practices

1. The right tools

1) Use the recommended special tools to protect parts from damage. Use the right tool in the right manner - do not improvise.
2) When checking with a tester, make sure that battery in the tester can supply sufficient power.

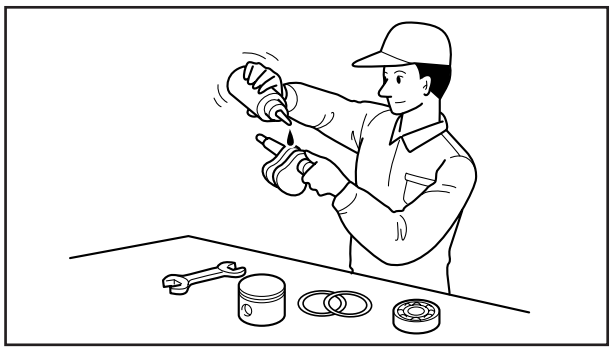
2. Tightening torque

Follow the tightening torque instructions. When tightening bolts, nuts and screws, tighten the large sizes first, and tighten inner-positioned fixings before outer-positioned ones.

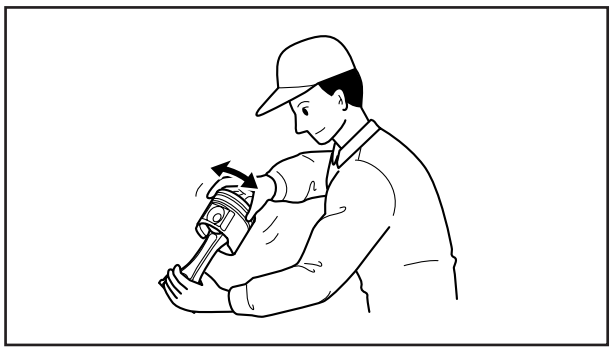
3. Non-reusable items

Always use new gaskets, packings, O-rings, split-pins, circlips, etc., on reassembly.

4. Disassembly and Assembly



1) Clean parts with compressed air when disassembling.
2) Oil the contact surfaces of moving parts before assembly.



3) After assembly, check that moving parts operate normally.
4) Install bearings with the manufacturer's markings on the side exposed to view, and liberally oil the bearings. Press the bearing at the outer race when installing it in the bearing case, and press it at the inner race when installing it on the shaft. Keep bearing parallel to the case or the shaft during the press fitting.
5) When installing oil seals, apply a light coating of water-resistant grease to the lip and the outside diameter.

CAUTION:

When inspecting and servicing, stop the engine except inspection or service is needed immediately. And wait for the engine cooling down.

SPECIAL TOOLS

The proper special tools are necessary for complete and accurate adjustment and assembly. Using special tools will help avoid damage caused by the use of improper tools or incorrect procedures.

(These special tools are recommended by Yamaha. The tool numbers indicated below are those of TOYOTA Motor Corporation, except for the tools marked with *.)

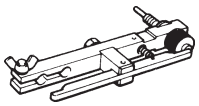
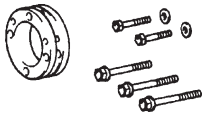
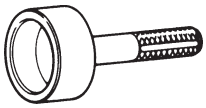
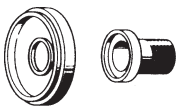
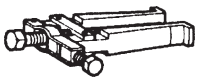
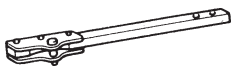
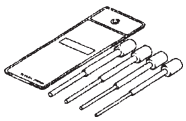
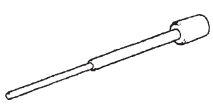
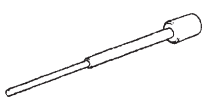
ILLUSTRATION	TOOL No.	TOOL NAME	REMARKS
	09275-54011	Plunger stroke measuring tool	To Check injection timing
	*TDG-13 (from BANZAI) *NO.44 (from IYASAKA)	Compression gauge attachment	To measure compression
	09213-58013	Crankshaft pulley holding tool	To secure crankshaft pulley
	09223-56010	Crankshaft rear oil seal replacer	To install crankshaft rear oil seal
	09223-78010	Crankshaft oil seal replacer	To install crankshaft front oil seal
	09308-10010	Oil seal puller	To remove crankshaft front oil seal
	09316-20011	Transfer bearing replacer	To install injection pump oil seal
	09330-00021	Companion flange holding tool	To secure crankshaft pulley
	09032-00100	Oil pan seal cutter	To remove oil pan
	09201-10000	Valve guide bush remover & replacer set	
	• 09201-01070	Valve guide bush remover & replacer 7	To remove and install valve guide bush
	• 09201-01080	Valve guide bush remover & replacer 8	To remove and install valve guide bush

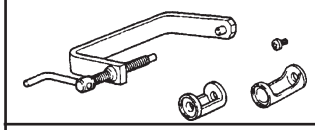
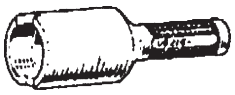
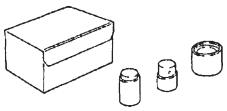
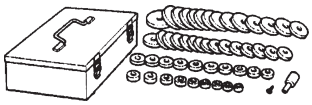
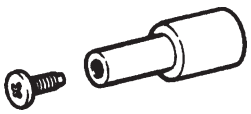
ILLUSTRATION	TOOL No.	TOOL NAME	REMARKS
	09202-70020	Valve spring compressor	To remove and install valve
	09214-76011	Crankshaft pulley replacer	To install injection pump drive gear oil seal
	09222-17011	Connecting rod bush remover & replacer	
	• 09222-05021	Remover & replacer	To remove and install connecting rod bush
	• 09222-05031	Guide	To install connecting rod bush
	• 09222-05041	Base	To remove and install connecting rod bush
	09223-00010	Cover & seal replacer	To mount crankshaft timing gear and pump drive shaft gear
	09950-60010	Replacer set	
	• 09951-00190	Replacer 19	To remove oil pump drive shaft gear
	• 09951-00340	Replacer 34	To install oil pump drive shaft gear
	• 09951-00320	Replacer 32	To mount camshaft oil seal
	• 09951-00500	Replacer 50	To mount camshaft oil seal
	• 09951-00640	Replacer 64	To injection pump drive gear oil seal
	• 09952-06010	Adapter	To mount camshaft oil seal

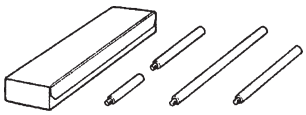
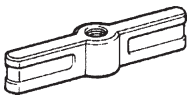
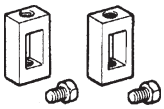
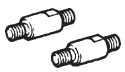
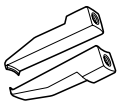
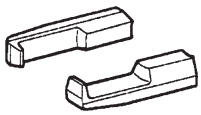
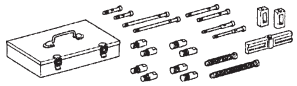
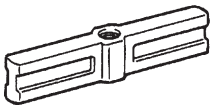
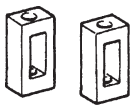
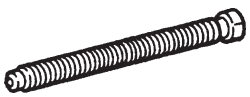
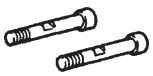
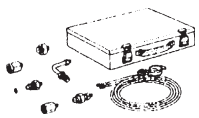
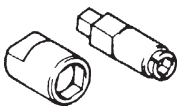
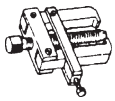
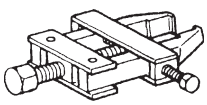
ILLUSTRATION	TOOL No.	TOOL NAME	REMARKS
	09950-70010	Handle set	
	• 09951-07150	Handle 150	To install the camshaft oil seal
	09950-40011	Puller B set	
	• 09951-04010	Hanger 150	To remove camshaft timing pulley, pump drive shaft gear, crankshaft timing gear, and injection pump drive gear bearing
	• 09952-04010	Slide arm	To remove camshaft timing pulley, pump drive shaft gear, crankshaft timing gear, and injection pump drive gear bearing
	• 09953-04020	Center bolt 150	To remove camshaft timing pulley, pump drive shaft gear, crankshaft timing gear, and injection pump drive gear bearing
	• 09954-04010	Arm 25	To remove camshaft timing pulley, pump drive shaft gear, crankshaft timing gear, and injection pump drive gear bearing
	• 09955-04011	Claw No. 1	To remove injection pump drive gear bearing
	• 09955-04061	Claw No. 6	To remove camshaft timing pulley, pump drive shaft gear, crankshaft timing gear, and injection pump drive gear bearing
	• 09957-04010	Attachment	To remove injection pump drive gear bearing

ILLUSTRATION	TOOL No.	TOOL NAME	REMARKS
	09950-50013	Puller C set	
	• 09951-05010	Hanger 150	To remove crankshaft pulley and injection pump drive gear
	• 09952-05010	Slide arm	To remove crankshaft pulley and injection pump drive gear
	• 09953-05010	Center bolt 100	To remove injection pump drive gear
	• 09953-05020	Center bolt 150	To remove crankshaft pulley
	• 09954-05021	Claw No.2	To remove crankshaft pulley and injection pump drive gear
	*TCP-2TB (from BANZAI)	Turbocharger pressure gauge	To check for leakage from nozzle leakage pipe #1
	*PSG-6TB (from BANZAI)	Power steering fluid pressure gauge set	To check power steering fluid pressure
	09820-63010	Alternator wrench	To remove and install alternator pulley
	09286-46011	Alternator bearing puller	To remove alternator rectifier end fram and starter motor armature bearing
	09820-00021	Alternator bearing puller	To remove alternator rotor bearing

OTHER EQUIPMENT TOOLS

TOOL NAME	REMARKS
Vernier caliper	
Outside micrometer	0 ~ 25 mm, 25 ~ 50 mm, 50 ~ 75 mm, 75 ~ 100 mm
V Block	
Power wrench (4 times)	
Cylinder gauge	50 ~ 150 mm
Battery hydrometer	
Radiator cap tester	
Compound (Red lead)	
Valve lapping compound	
Hand valve lapper	
Piston ring tool	
Piston oil heater	
Piston vise	
Piston ring compressor	
Straight edge	
Square gauge	
Plasti gauge	
Surface plate	
Digital circuit tester	
Oil pressure gauge	0 ~ 500 kPa
Thickness gauge (Filler gauge)	
Torque wrench	~ 100 kgf/cm, ~ 450 kgf/cm, ~ 900 kgf/cm, ~ 1800 kgf/cm
Dial gauge	
Magnetic base	
Heater gun	
Flat chisel	
Diesel compression gauge set	
Diesel tacho tester	
Nozzle tester	
Snap ring plier	
Pin punch	
Thermometer	100°C

HANDLING OF LIQUID GASKET

Sealant Application Points and Types of Sealant to Be Applied

Sealant application points	Sealant types to be applied	Standing time required after assembly	Reference page No.
Timing belt cover x Timing belt cover gasket	ThreeBond® TB-1207B	2 hours	6-70
Semi-circular plug joint area x Cylinder head cover gasket			6-66
Timing gear cover x Timing gear case (oil pump)			6-87
Cylinder head x Semi-circular plug			6-112
Camshaft oil seal retainer x Cylinder head			6-75
Camshaft oil seal retainer joint area x Cylinder head cover gasket			6-66
Camshaft oil seal retainer joint area x Timing gear cover			6-70
Main bearing cap (rudder frame) x Cylinder block			6-172
Rear oil seal retainer x Cylinder block			6-176
Heat exchanger x Gasket			6-21
Heat exchanger side plates x Gasket			6-21
Inter cooler rear side x Gasket			6-30
Oil pan x Main bearing cap (rudder frame)			6-130
Cylinder head x Tight plug	ThreeBond® TB-1324	1 hour	–
Cylinder head x Water by-pass pipe #3			–
Cylinder block x Tight plug			–
Oil cooler cover x Drain cock			–
Timing gear case (oil pump) x Tapered screw plug			6-129
Main bearing cap (radder frame) x Oil return pipe			–
Rear engine mount x Between the nut and bolt	ThreeBond® TB-1322	1 hour	4-5
2-stage rate coupling x Damper stud threads	LOCTITE® No. 271	2 hour	6-6
2-stage rate coupling x Nuts			6-6
Heat exchanger x Bolt threads	LOCTITE® No. 572	6 hour	6-21
Inter cooler x Seawater sensor threads			6-29
Inter cooler x Elbow joint threads			6-29
Intake manifold x Joint plug threads			6-51
Power steering pump x Bolt threads			7-8
Heat exchanger x Anodes	LOCTITE® No. 243	1 hour	3-37
Inter cooler x Anodes			3-37
Mixing elbow x Plug			6-57
Mixing elbow x Joint plug			6-57
Cylinder block x Oil pressure switch joint			6-177
Exhaust manifold x Thremo switch			6-58
Exhaust manifold x Coolant temperature sensor			6-58

STANDARD ABBREVIATIONS AND SYMBOLS

Measurement

m	: meter	ft or ′	: foot
mm	: millimeter	in or ″	: inch
L	: liter	gal	: U.S. gallon
N·m	: Newton meter	lb·ft	: pounds foot
Kgf·m	: kilogram meter	lb·in	: pounds inch
m^3	: cubic meter	ft^3	: cubic foot

The following abbreviations and symbols are used:

Color Codes

B	: Black	P	: Pink
Br	: Brown	Pu	: Purple
G	: Green	R	: Red
Gy	: Gray	Sb	: Sky blue
L	: Blue	T	: Tan
Lg	: Light green	W	: White
O	: Orange	Y	: Yellow

Wiring diagrams use the following standard abbreviations:
For wires which use tracer stripes, the main color is followed by a slash (or dash) and then the tracer color.

For example:
R/G = Red wire with a green tracer stripe
Y/R = Yellow wire with a red tracer stripe

CHAPTER 2
SPECIFICATIONS

GENERAL SPECIFICATIONS

ITEMS		MODEL / UNIT	ME432STI P1 (N641, N642)
GENERAL:			
Base engine			TOYOTA 1HD-FT
Engine type			Vertical, 4-stroke, inline
Number of cylinders			6
Combustion chamber type			Direct injection
Fuel type			Grade 2-D ASTMD975 or EN590 Minimum cetane rating: 48
Max. output at flywheel end *1		kW (HP) r/min.	235 (315)/3600
Max. output at flywheel end *2		kW (HP) r/min.	220 (295)/3600
Max. output at propeller end *1		kW (HP) r/min.	225 (301)/3600
Max. output at propeller end *2		kW (HP) r/min.	210 (282)/3600
Bore		mm	94
Stroke		mm	100
Total displacement		L	4160
Compression ratio			15.7
Compression pressure (standard)		MPa/r/min.	2.7 ± 0.3/280
Compression pressure (maintenance limit)		MPa/r/min.	1.96/280
Injection order			1 – 4 – 2 – 6 – 3 – 5
Max. no-load speed		r/min.	4100 – 4200
Propeller matching speed		r/min.	3670 – 3770
Engine idling speed		r/min.	650 – 700
Engine dry weight		kg	460
VALVE SYSTEM:			
Driving mechanism			OHC
Valve clearance (cold engine)	IN	mm	0.2 ± 0.03
	EX	mm	0.5 ± 0.03
FUEL SYSTEM:			
Injection pump type			Distribution injection (VE type)
Governor type			Mechanical all speed type
Rotation direction (viewed from drive gear)			Clockwise
Injection timing (static)		degree/BTDC	21
	Plunger stroke (with dial gauge)	mm (in.)	1.88 (0.074)
Injector	Type		Multiport (long stem type)
	Number of injection port		6
	Valve opening pressure: 1st stage	MPa	17.7 + 0.98 – 0
	Valve opening pressure: 2nd stage	MPa	22.6 + 0.98 – 0
Fuel filter			Integrated with sedimenter
LUBRICATION SYSTEM:			
Engine oil type		API/SAE	CD or CE/15W-40
Engine oil capacity (with oil filter)		L	Max. 9.9, Min. 8.2
Oil pressure	at idle *3	kPa	Min. 98
	at 3600 r/min. *4	kPa	Min. 343
Oil pump type			Trochoid pump (5 lobes (inner rotor), 6 divisions (outer rotor))
Oil cooler			Fresh water multiplate type
Lubrication system			Full flow type
Oil filter			Full-flow, spin-on type

ITEMS			MODEL / UNIT	ME432STI P1 (N641, N642)
COOLING SYSTEM:				
Cooling mechanism				Indirect fresh water cooling type
Coolant capacity			L	13.0
Heat exchanger				Seawater cooling multipipe type
Seawater pump				Rubber impeller type
Seawater pump max. discharge			L/min.	130 ± 10
Coolant pump				Centrifugal pump
Coolant cap opening pressure			kPa	88
Coolant temperature (at max. output)			°C	85 ± 3 *5
Thermostatic valve opening temperature			°C	76.5 ± 2
INTAKE, EXHAUST SYSTEM:				
Turbo charging system				Exhaust turbo-supercharging
Turbocharger type				Water cooled turbine CT26AC (Aisan)
Charge air pressure (at max. output)			kPa	176 ± 10
Intercooler				Seawater cooling multipipe type
Air filter				Air-purifying type
Exhaust back pressure (at max. output)			kPa	45 ± 5
ELECTRICAL SYSTEM:				
System voltage			V	12
Recommended battery capacity			AH	140 Min.
Starter motor output			kW	2.5
Alternator output			A	80
Pre-heating system				Intake airheater
Pre-heating lamp turn-out time			sec	10 ± 0.3
Oil pressure switch operating pressure			kPa	29.4 ± 9.8
Water temperature switch operating temperature			°C	100 ± 2
Fuse	Load on gauges		A	20
	Main		A	100
	Intake airheater control		A	10
OTHERS:				
Power steering fluid				Automatic Transmission Fluid (ATF) Dexron Type II
Power steering fluid capacity			L	0.8
Belt deflection (with pressure of 98 N (10 kg))*6	Alternator	New	mm	10 – 12 (per belt)
		At service	mm	12 – 14 (per belt)

NOTE:

*1: Output power at 25 °C fuel temperature: ISO 3046-1.

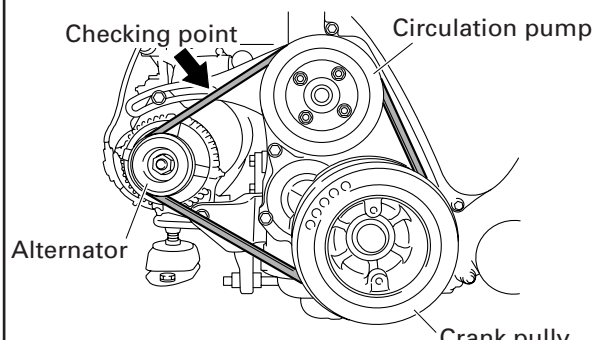
*2: Output power at 40 °C fuel temperature: ISO 8665.

*3: Oil temperature at main gallery: 70 – 80 °C

*4: Oil temperature at main gallery: 110 – 120 °C.

*5: At seawater inlet temperature 28 °C.

*6: See the figure on the right for belt deflection checking point.



MAINTENANCE SPECIFICATIONS

Engine

Item			Unit	Model
				ME432STI P1
Cylinder head:				
Warpage		Limit	mm (in.)	0.20 (0.0079)
New Cylinder head gasket thickness				
Numbers of cutout	"1"		mm (in.)	0.85 – 0.95 (0.0335 – 0.0374)
	"3"			0.95 – 1.05 (0.0374 – 0.0413)
	"5"			1.05 – 1.15 (0.0413 – 0.0453)
Cylinder:				
Cylinder head matching face warpage				
		Limit		0.20 (0.008)
Cylinder bore diameter				
	STD	Mark "1"		94.000 – 94.010 (3.70079 – 3.70118)
		Mark "2"		94.011 – 94.020 (3.70122 – 3.70157)
		Mark "3"		94.021 – 94.030 (3.70161 – 3.70197)
	Limit			94.23 (3.70984)
Main journal bore diameter				
	STD	Mark "A"		71.0000 – 71.0009 (2.79528 – 2.79531)
		Mark "B"		71.0010 – 71.0019 (2.79531 – 2.79535)
		Mark "C"		71.0020 – 71.0029 (2.79535 – 2.79539)
		Mark "D"		71.0030 – 71.0039 (2.79539 – 2.79543)
		Mark "E"	mm (in.)	71.0040 – 71.0049 (2.79543 – 2.79547)
		Mark "H"		71.0050 – 71.0059 (2.79547 – 2.79551)
		Mark "4"		71.0060 – 71.0069 (2.79551 – 2.79555)
		Mark "5"		71.0070 – 71.0079 (2.79555 – 2.79559)
		Mark "6"		71.0080 – 71.0089 (2.79559 – 2.79563)
		Mark "7"		71.0090 – 71.0099 (2.79563 – 2.79567)
		Mark "8"		71.0100 – 71.0109 (2.79567 – 2.79570)
		Mark "9"		71.0110 – 71.0119 (2.79571 – 2.79574)
		Mark "L"		71.0120 – 71.0129 (2.79575 – 2.79578)
		Mark "M"		71.0130 – 71.0139 (2.79579 – 2.79582)
		Mark "R"		71.0140 – 71.0149 (2.79583 – 2.79586)
		Mark "S"		71.0150 – 71.0159 (2.79587 – 2.79590)
		Mark "U"		71.0160 – 71.0169 (2.79591 – 2.79594)
		Mark "X"		71.0170 – 71.0180 (2.79594 – 2.79598)