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TOYOTA FBMF 16-30

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FOREWORD

This manual covers the service procedures of the TOYOTA BATTERY FORKLIFT FBMF16 ~ 30 Series. Please use this manual for providing quick, correct servicing of the corresponding forklift models.

This manual deals with the above models as of June 1996. Please understand that disagreement can take place between the descriptions in the manual and actual vehicles due to change in design and specifications. Any change or modifications thereafter will be informed by Toyota Industrial Vehicles' Parts & Service News.

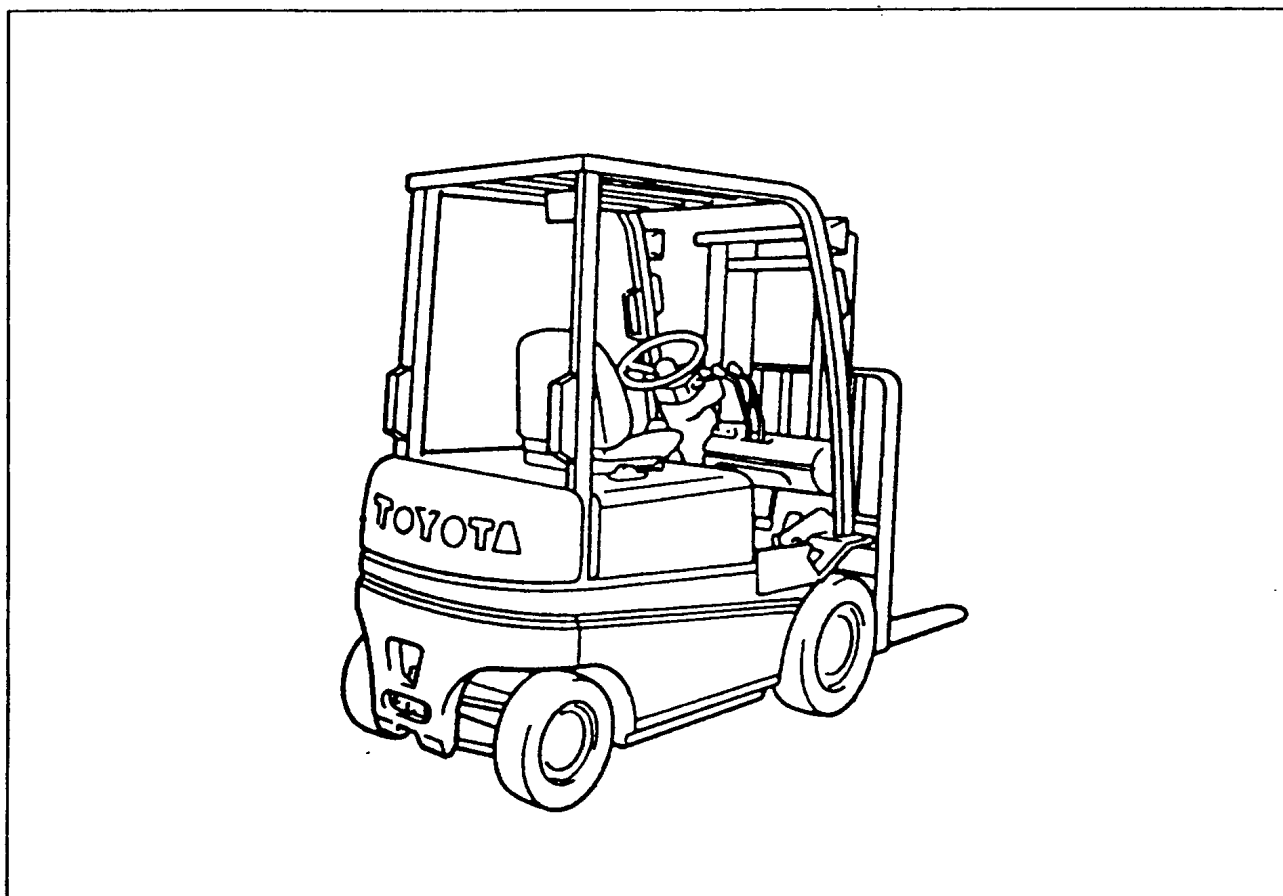
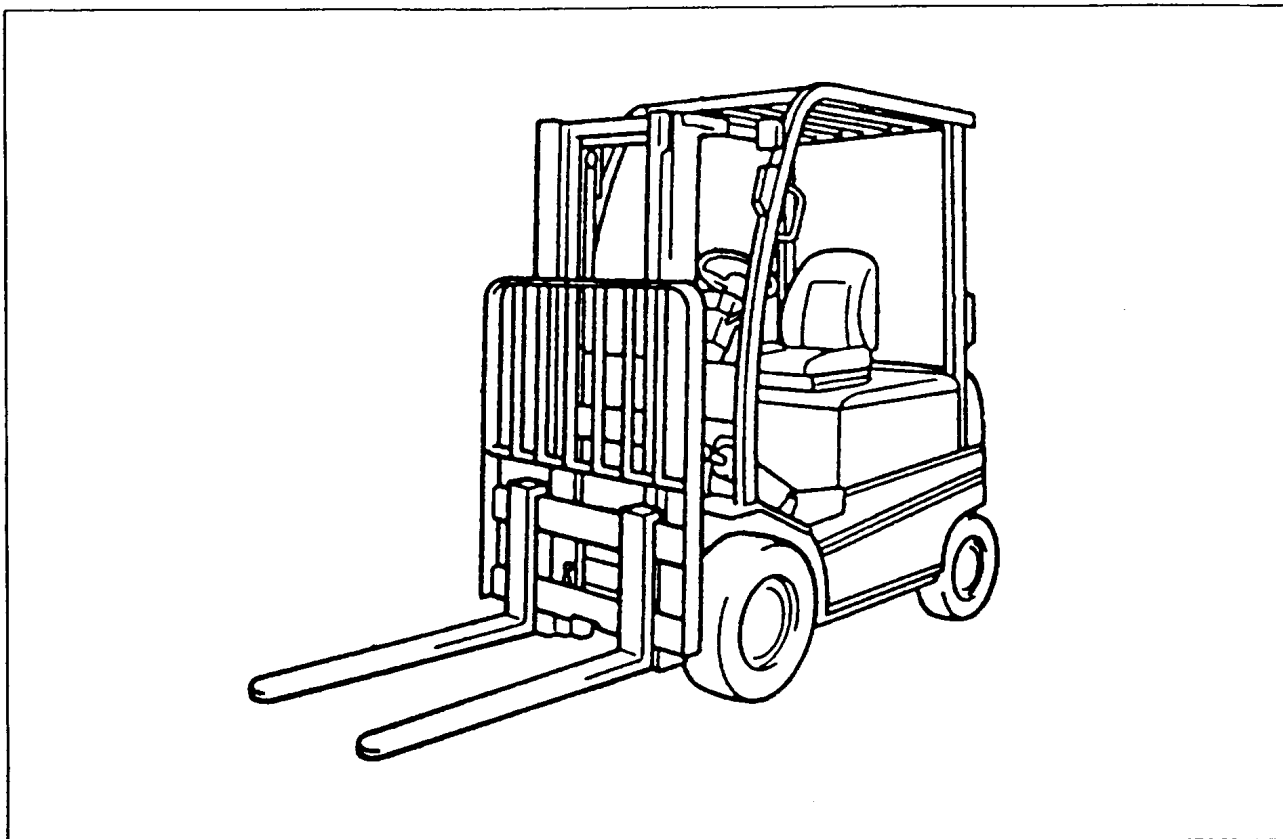
TOYOTA Material Handling Company

A Division of TOYOTA INDUSTRIES CORPORATION

GENERAL

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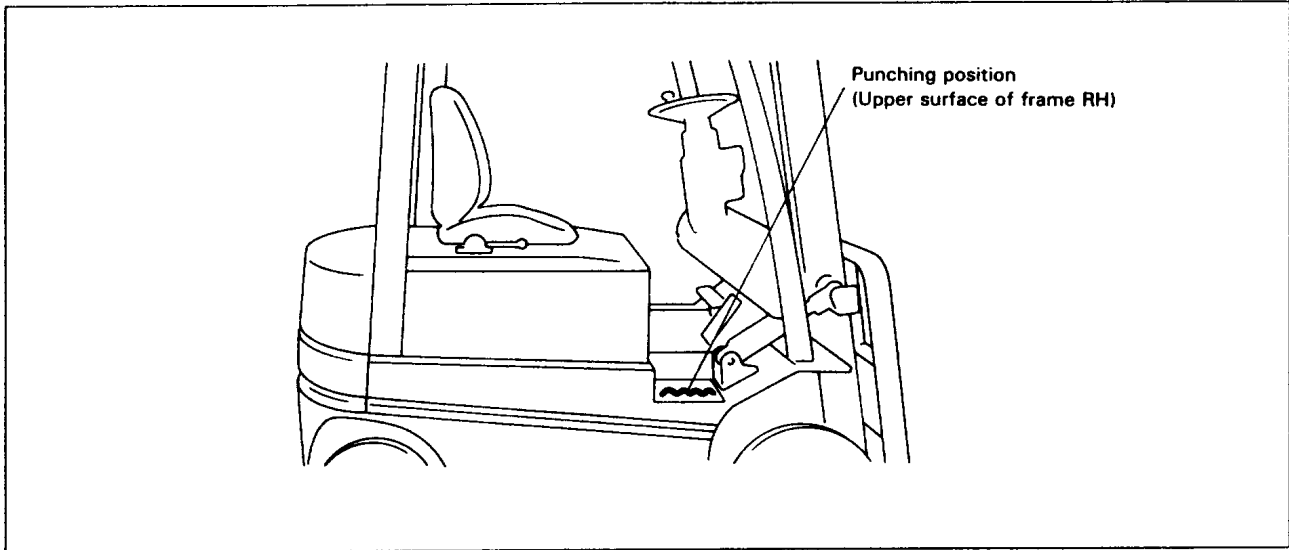
EXTERIOR VIEWS



VEHICLE MODELS

Item		Model	FBMF16	FBMF20	FBMF25	FBMF30
		kg (lb)	1600 (3200)	2000 (4000)	2500 (5000)	3000 (6000)
Voltage		V	72/80	←	←	←
Battely capacity AH/5H	STD capacity		360	480	←	600
	Max. capacity		450	600		750

FRAME NUMBER



Model	Punching format
FBMF16 :	FBMF16 Ⓢ 10001 ~
FBMF20-25:	FBMF25 Ⓢ 10001 ~
FBMF30 :	FBMF30 Ⓢ 10001 ~

LIST OF REFERENCE PAGES IN PUBLISHED NEW MODEL FEATURES

The FBMF16, 20, 25 and 30 are based on the body for FBM 16 to 30.

For the sections not included in this manual, please refer to the published new model features for the FBM16 to 30 (No. PE301). This list shows the reference pages for each section.

Item (published new model features for the FBM16 to 30)		FBMF16·20·25·30
ELECTRICAL SYSTEM	BATTERY	*2-2
	CHARGER	—
	ACCELERATOR	←
	DRIVE MOTOR	←
	PUMP MOTOR	←
	POWER STEERING MOTOR	←
	CONTROLLER	*2-5
POWER TRAIN	DRIVE UNIT	←
DRIVE, STEERING AND BRAKE SYSTEM	FRONT AXLE	←
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*: Only the modified points are described.

HOW TO READ THIS MANUAL

EXPLANATION METHOD

1. Operation procedure

(1) The operation procedure is described in either pattern A or pattern B below.

Pattern A: Explanation of each operation step with illustration.

Pattern B: Explanation of operation procedure by indicating step numbers in one illustration, followed by explanation of cautions and notes summarized as point operations.

Example of description in pattern B

DISASSEMBLY·INSPECTION·REASSEMBLY Tightening torque unit T = N·m (kgf·cm) [ft·lbf]

If a place or part cannot be indicated directly, the part name is described on the either side of the illustration.

Example: 1 Piping

Disassembly Procedure

- 1 Remove the cover. [Point 1]
- 2 Remove the bush. [Point 2] ← Operation explained later
- 3 Remove the gear.

Point operations Explanation of key point for operation with an illustration

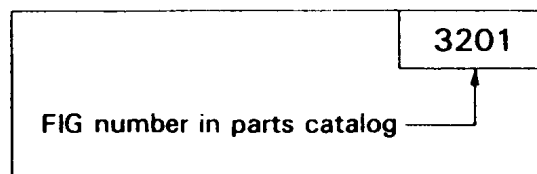
[Point 1] ↓
Disassembly: Put a match mark when removing the pump cover.

[Point 2] ↓
Inspection: Measure the bush inside diameter.
Bush inside diameter limit: 19.12 mm (0.7528 in)

2. How to read components figures

- (1) The components figure uses the illustration in the parts catalog for the vehicle model. Please refer to the catalog for checking the part name.
The number at the right shoulder of each components figure indicates the Fig. number in the parts catalog.

(Example)



3. Matters omitted in this manual

- (1) This manual omits description of the following jobs, but perform them in actual operation:
- ① Cleaning and washing of removed parts as required
 - ② Visual inspection (partially described)

TERMINOLOGY**Caution:**

Important matters of which negligence may cause accidents. Be sure to observe them.

Note:

Important items of which negligence may cause accidents, or matters in operation procedure requiring special attention.

Standard: Values showing allowable range in inspection and adjustment.

Limit: Maximum or minimum allowable value in inspection or adjustment.

ABBREVIATIONS

Abbreviation (code)	Meaning	Abbreviation (code)	Meaning
ASSY	Assembly	SST	Special service tool
LH	Left hand	STD	Standard
LLC	Long life coolant	T =	Tightening torque
OPT	Option	○ ○ T	Number of teeth (○ ○)
O/S	Oversize	U/S	Undersize
PS	Power steering	W/	With
RH	Right hand	L/	Less
SAE	Society of Automotive Engineers (USA)		

ELECTRICAL SYMBOLS

Symbol	Name	Symbol	Name	Symbol	Name
ANL	Analyzer	EPS	Electrical Power	PB _{SPS}	SPS Print Board
ASSY	Assembly		Steering	PL _w	Working Pilot Lamp
BATT	Battery	F1	Drive Fuse	PS	Power Steering
B _z	Buzzer	F2	Pump Fuse	RAD	Drive Absorber Resistor
CAD	Drive Absorber	F3	Power Steering Fuse	RAP	Pump Absorber Resistor
	Capacitor	F4	Lamp Fuse	RCK1/2	Check Resistor, No 1/2
CAG	Regenerative Absorber	F5	Control Circuit Fuse	RAG	Regenerative Absorber
	Capacitor	F6	Power supply		Resistor
CAP	Pump Absorber	FR	Flasher Relay	ROM	Read Only Memory
	Capacitor	GND	Ground	RG	Regenerative Resistor
CHI _{F/R}	Chime,	H	Horn	RH	Right Hand
	Forward/Reverse	L _{BU-R/L}	Back-Up Lamp, RH/LH	SA	Surge Absorber
CHI _{F&R}	Chime, Forward &	L _{C-R/L}	Clearance Lamp, RH/LH	SDD	Drive SIT Driver
	Reverse	L _{F-R/L}	Flasher Lamp, RH/LH	SDP	Pump SIT Driver
CO	Overall Capacitor	L _{F-R/LR}	Flasher Lamp, RH/LH	SLL	Lequid Level Sensor
CSD	Drive Current Sensor		(Rear)	SN1-5	Snubber, No 1-5
CSP	Pump Current Sensor	L _{H-R/L}	Head Lamp, RH/LH	SSP1/2	Speed Sensor, No 1/2
DAD	Drive Absorber Diode	L _{L-R/L}	Licence Lamp, RH/LH	SST	Special Service Tool
DAG	Regenerative Absorber	L _{R-F/R}	Rotaly Lamp,	ST	Steering Torque Sensor
	Diode		Forward/Reverse	STD	Standard
DAP	Pump Absorber Diode	L _{ST-R/L}	Stop Lamp, RH/LH	STH	Thermo Sensor
DC-CD	DC-CD Converter &	L _{T-R/L}	Tail Lamp, RH/LH	SUB-	
	Contact Drive	L _w	Working Lamp	ASSY	Subassembly
DCD	Drive Clip Diode	LH	Left Hand	SW _{AC}	Accelerator Switch
DCP	Pump Clip Diode	LS _{ATT}	Attachment Limit	SW _B	Brake Switch
DF1-3	Flywheel Diode,		Switch	SW _F	Flasher Switch
	No. 1-3	LS _D	Dead Man Limit Switch	SW _H	Horn Switch
DG	Regenerative Diode	LS _L	Lift Limit Switch	SW _{ky}	Key Switch
DISP	Display	LS _{PB}	Parking Brake Limit	SW _I	Light Switch
DM _D	Drive Motor		Switch	SW _{SC}	Speed Control Switch
DM _P	Pump Motor	LS _{ST}	Stop Lamp Limit Switch	TG	Regenerative Transistor
DM _{PS}	Power Steering Motor	LS _T	Tilt Limit Switch	TM	Main Transistor
DRD	Drive Reverse Diode	MB	Battery contactor	TMP	Main Transistor, Pump
DRP	Pump Reverse Diode	MCS-II	Multipurpose Computer	TM _{PS}	Main Transistor, Power
DS _{BU}	Buck-Up Optional		Control System-II		Steering
	Direction Switch	MF	Forward Contactor	U/S	Undersize
DS _F	Forward Direction	MG	Regenerative Contactor	VRA	Drive Accel Variable
	Switch	MP	Pump Contactor (For old type)		Resistor
DS _{FO}	Forward Optional	MR	Reverse Contactor	VRAP	Pump Variable Resistor
	Direction Switch	OPT	Option	VRB	Brake Variable Resistor
DS _R	Reverse Direction	O/S	Oversize	W/	With
	Switch	PB _{CPU}	Computer print Board		

OPERATIONAL TIPS

1. Safe operation

- (1) After jacking up, always support with rigid stands.
- (2) When hoisting the vehicle or its heavy component, use wire rope(s) with a sufficient reserve in load capacity.
- (3) Always disconnect the battery plugs before the inspection or servicing of electrical parts.

2. Protection of functional parts

- (1) After the end of vehicle inspection and/or maintenance, carefully check each connector for perfect connection without omission before connecting the battery plug.
Omission of connection of any connector related to the controller, especially, may cause damage of controller internal elements.

3. Tactful operation

- (1) Prepare the mechanic tools, necessary measuring instruments (circuit tester, megger, oil pressure gage, etc.) and SSTs before starting operation.
- (2) Before disconnecting wiring, always check the cable color and wiring state.
- (3) When overhauling functional parts, complicated portions or related mechanisms, arrange the parts neatly to prevent confusion.
- (4) When disassembling and inspecting such a precision part as the control valve, use clean tools and operate in a clean location.
- (5) Follow the described procedures for disassembly, inspection and reassembly.
- (6) Replace gaskets, packings and O-rings with new ones each time of disassembly.
- (7) Use genuine Toyota parts for replacement.
- (8) Use specified bolts and nuts. Observe the specified tightening torque at the time of reassembly. If no tightening torque is specified, tighten the bolt or nut according to the standard tightening torque table.

4. Grasping the trouble state

When a trouble occurs, do not attempt immediate disassembly or replacement but first check if the trouble requires disassembly or replacement for correction.

CIRCUIT TESTER

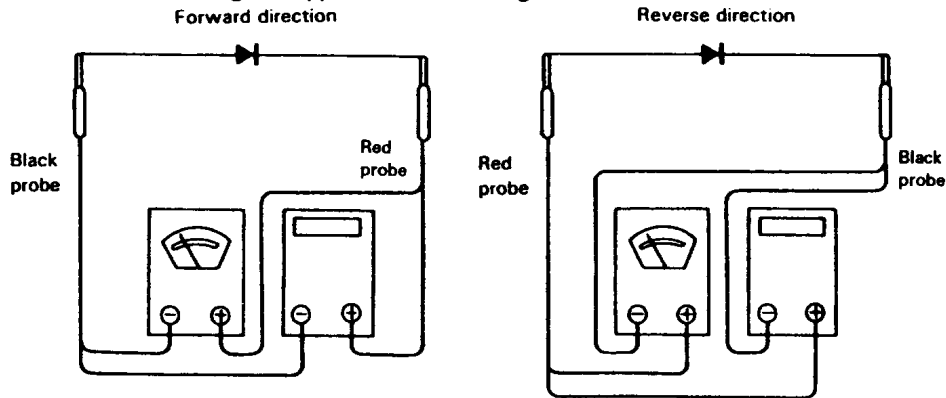
Circuit testers are available in both the analog and digital types. They should be used selectively according to the purpose of measurement.

Analog type: This type is convenient for observing movement during operation, but the measured value should only be used for reference or rough judgment.

Digital type: Fairly accurate reading is possible, but it is difficult to observe the variation or movement.

1. Difference between measurement results with the digital type and analog type
 - * The result may be different between measurements with the analog type and digital type. Always use a circuit tester according to its operation manual. Cautions when the polarities are different between the analog type and digital type are described below.

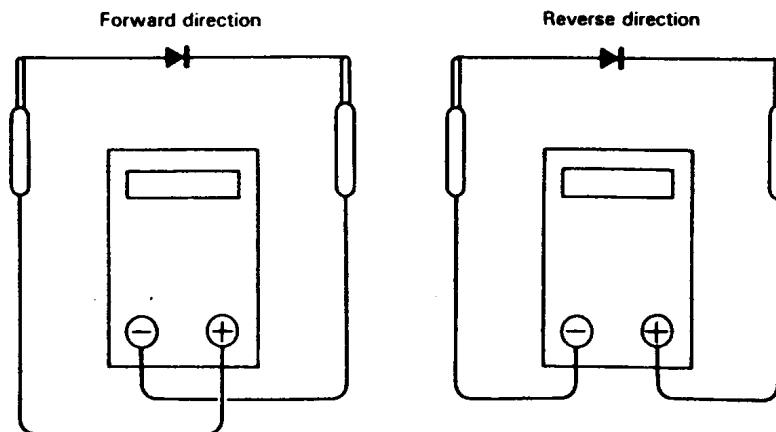
Circuit tester range: Analog type → KΩ range
 Digital type → 2 MΩ range



Measurement result example

	Analog type	Digital type
Forward	Continuity shall exist	No continuity
	11 KΩ	1
Reverse	No continuity	Continuity shall exist
	∞	2 MΩ

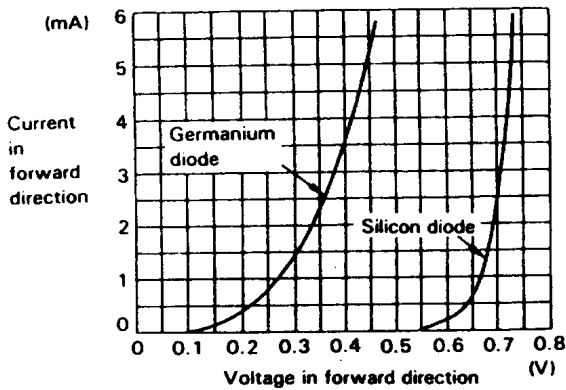
As seen from the example above, the measurement results with the analog and digital types are reverse. In measurement with a digital type circuit tester, therefore, use the tester probes as shown below.



2. Difference in result of measurement with circuit tester

The circuit tester power supply voltage depends on the tester type. 1.5V, 3.0V or 6.0V is used. The resistance of a semiconductor such as a diode varies with the circuit tester power supply voltage.

The diode characteristics are shown in the figure below.



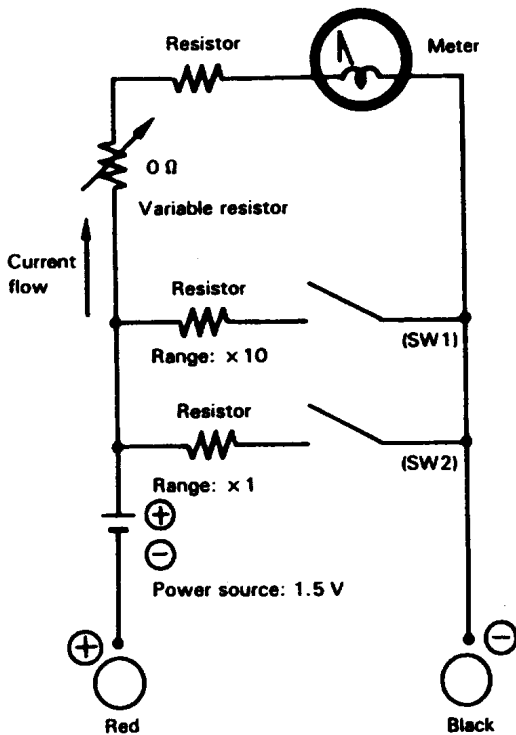
The resistance values of the same semiconductor measured with two types of circuit testers having different power supply voltages are different.

This manual describes the results of measurement with a circuit tester whose power supply voltage is 3.0 V.

3. Difference in measurement result by measurement range (analog type)

In the analog type circuit tester, changing the measurement range switches over the internal circuit to vary the circuit resistance. Even when the same diode is measured, the measurement result varies with the measurement range.

Always use the range described in the repair manual for measurement.













STANDARD BOLT & NUT TIGHTENING TORQUE

Standard bolt and tightening torques are not indicated.
Judge the standard tightening torque as shown below.

1. Find out the type of the bolt from the list below and then find the bolt tightening torque from the table.
2. The nut tightening torque can be judged from the mating bolt type.

BOLT STRENGTH TYPE IDENTIFICATION METHOD

1. Identification by bolt shape

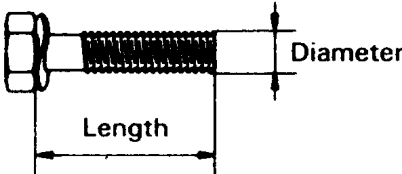
	Shape and class	Class
Hexagon head bolt	 Bolt head No.	4 = 4T 5 = 5T 6 = 6T 7 = 7T 8 = 8T
	 No mark	4T
Hexagon flange bolt	 No mark	4T
Hexagon head bolt	 Two protruding lines	5T
Hexagon flange bolt	 Two protruding lines	6T
Hexagon head bolt	 Three protruding lines	7T
Hexagon head bolt	 Four protruding lines	8T
Welded bolt		4T
Stud bolt	 No mark	4T
	 Grooved	6T

2. Identification by part No.

Hexagon head bolt

Parts No.
91611-40625

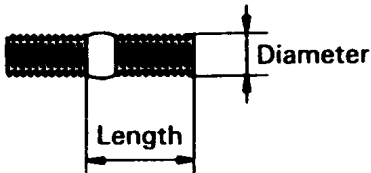
Length (mm)
Diameter (mm)
Class





Stud bolt

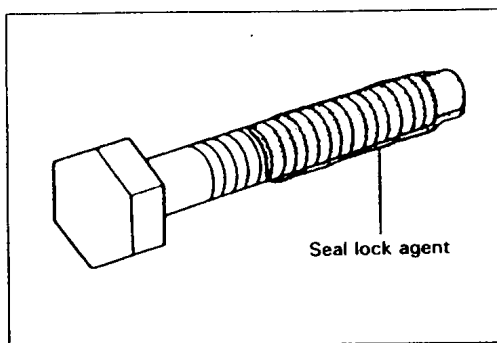
Part No.
92132-40614

Length (mm)
Diameter (mm)
Class



TIGHTENING TORQUE TABLE

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt 			Hexagon flange bolt 		
			N·m	kgf·cm	ft-lbf	N·m	kgf·cm	ft-lbf
4T	6	1.0	5.4	55	48 in-lbf	5.9	60	52 in-lbf
	8	1.25	13	130	9	14	145	10
	10	1.25	25	260	19	28	290	21
	12	1.25	47	480	35	53	540	39
	14	1.5	75	760	55	83	850	61
	16	1.5	113	1150	83	—	—	—
5T	6	1.0	6.4	65	56 in-lbf	7.5	75	65 in-lbf
	8	1.25	16	160	12	18	175	13
	10	1.25	32	330	24	36	360	26
	12	1.25	59	600	43	65	670	48
	14	1.5	91	930	67	100	1050	76
	16	1.5	137	1400	101	157	1600	116
6T	6	1.0	7.8	80	69 in-lbf	8.8	90	78 in-lbf
	8	1.25	19	195	14	21	215	16
	10	1.25	38	400	29	43	440	32
	12	1.25	72	730	53	79	810	59
	14	1.5	110	1100	80	123	1250	90
	16	1.5	170	1750	127	191	1950	141
7T	6	1.0	11	110	8	12	120	9
	8	1.25	25	260	19	28	290	21
	10	1.25	52	530	38	58	590	43
	12	1.25	95	970	70	103	1050	76
	14	1.5	147	1500	108	167	1700	123
	16	1.5	226	2300	166	—	—	—
8T	6	1.0	12	125	9	14	145	9
	8	1.25	29	300	22	32	330	24
	10	1.25	61	620	45	68	690	50
	12	1.25	108	1100	80	123	1250	90
	14	1.5	172	1750	127	196	2000	145
	16	1.5	265	2700	195	299	3050	221



PRECOAT BOLTS

(Bolts with seal lock agent coating on threads)

1. Do not use the precoat bolt as it is in either of the following cases.
 - (a) After it is removed.
 - (b) When the precoat bolt is moved (loosened or tightened) by tightness check, etc.

Note:

For torque check, use the lower limit of the allowable tightening torque range. If the bolt moves, retighten it according to the steps below.

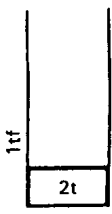
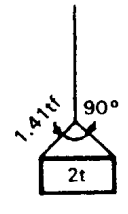
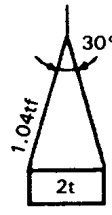
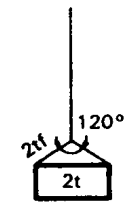
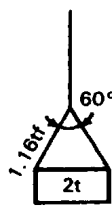
2. Method for reuse of precoat bolts
 - (1) Wash the bolt and threaded hole. (The threaded hole must be washed even for replacement of the bolt.)
 - (2) Perfectly dry the washed parts by air blowing.
 - (3) Coat the specified seal lock agent to the threaded portion of the bolt.

HIGH PRESSURE HOSE FITTING TIGHTENING TORQUE

1. When connecting a high pressure hose, wipe the hose fitting and mating nipple contact surfaces with clean cloth to remove foreign matters and dirt. Also check no dent or other damage on the contact surfaces before installation.
2. When connecting a high pressure hose, hold the hose to align the fitting with the nipple and tighten the fitting.
3. The maximum tightening torque must not exceed twice the standard tightening torque.

Nominal diameter of screw	Standard tightening torque N·m (kgf·cm) [ft·lbf]		Hose inside diameter mm (in)
	Standard	Tightening range	
7/16 – 20UNF	25 (250) [18.1]	24 ~ 26 (240 ~ 270) [17.4 ~ 19.5]	6 (0.24)
9/16 – 18UNF	49 (500) [36.2]	47 ~ 52 (480 ~ 530) [34.7 ~ 38.3]	9 (0.35)
3/4 – 16UNF	59 (600) [43.4]	56 ~ 62 (570 ~ 630) [41.2 ~ 45.6]	12 (0.47)
7/8 – 14UNF	59 (600) [43.4]	56 ~ 62 (570 ~ 630) [41.2 ~ 45.6]	12 (0.47)
7/8 – 14UNF	78 (800) [57.9]	74 ~ 82 (760 ~ 840) [55.0 ~ 60.8]	15 (0.59)
1.1/16 – 12UNF	118 (1200) [86.8]	112 ~ 123 (1140 ~ 1250) [82.5 ~ 90.4]	19 (0.75)
1.5/16 – 12UNF	137 (1400) [101.3]	130 ~ 144 (1330 ~ 1470) [96.2 ~ 106.4]	25 (0.98)
PF1/4	25 (250) [18.1]	24 ~ 26 (240 ~ 270) [17.4 ~ 19.5]	6 (0.24)
PF3/8	49 (500) [36.2]	47 ~ 52 (480 ~ 530) [34.7 ~ 38.3]	9 (0.35)
PF1/2	59 (600) [43.4]	56 ~ 62 (570 ~ 630) [41.2 ~ 45.6]	12 (0.47)
PF3/4	118 (1200) [86.8]	112 ~ 123 (1140 ~ 1250) [82.5 ~ 90.4]	19 (0.75)
PF1	137 (1400) [101.3]	130 ~ 144 (1330 ~ 1470) [96.2 ~ 106.4]	25 (0.98)

WIRE ROPE SUSPENSION ANGLE LIST

Suspension angle	Tension	Compression	Suspension method	Suspension angle	Tension	Compression	Suspension method
0°	1.00 time	0 time		90°	1.41 time	1.00 time	
30°	1.04 time	0.27 time		120°	2.00 time	1.73 time	
60°	1.16 time	0.58 time					

SAFE LOAD FOR EACH WIRE ROPE SUSPENSION ANGLE Unit: N (tonf) [lbf]

Rope diameter	Cutting load	Single-rope suspension	Two-rope suspension				Four-rope suspension			
		0°	0°	30°	60°	90°	0°	30°	60°	90°
6 mm (0.24 in)	21380 (2.18) [4807]	3040 (0.31) [683.6]	6080 (0.62) [1367]	5880 (0.6) [1323]	5200 (0.53) [1169]	4310 (0.44) [970]	12160 (1.24) [2734]	11770 (1.2) [2646]	10400 (1.06) [2337]	8630 (0.88) [1940]
8 mm (0.32 in)	31480 (3.21) [7078]	4410 (0.45) [992.3]	8830 (0.9) [1985]	8530 (0.87) [1918]	7650 (0.78) [1720]	6280 (0.64) [1411]	17650 (1.8) [3969]	17060 (1.74) [3937]	15300 (1.56) [3440]	12550 (1.28) [2822]
10 mm (0.4 in)	49230 (5.02) [11069]	6960 (0.71) [1565.6]	14020 (1.43) [3153]	13440 (1.37) [3021]	11770 (1.2) [2646]	9810 (1.0) [2205]	27460 (2.8) [6174]	26480 (2.7) [5954]	23540 (2.4) [5292]	19610 (2.0) [4410]
12.5 mm (0.5 in)	76880 (7.84) [17387]	10980 (1.12) [2469.5]	21570 (2.2) [4851]	21280 (2.1) [4631]	18630 (1.9) [4190]	14710 (1.5) [3308]	43150 (4.4) [9702]	41190 (4.2) [9261]	37270 (3.8) [8379]	29420 (3.0) [6615]
14 mm (0.56 in)	96400 (9.83) [21675]	13730 (1.4) [3087]	27460 (2.8) [6174]	26480 (2.7) [5954]	23540 (2.4) [5292]	18630 (1.9) [4190]	54920 (5.6) [12348]	52960 (5.4) [11907]	47070 (4.8) [10584]	37270 (3.8) [8379]

COMPONENTS WEIGHT

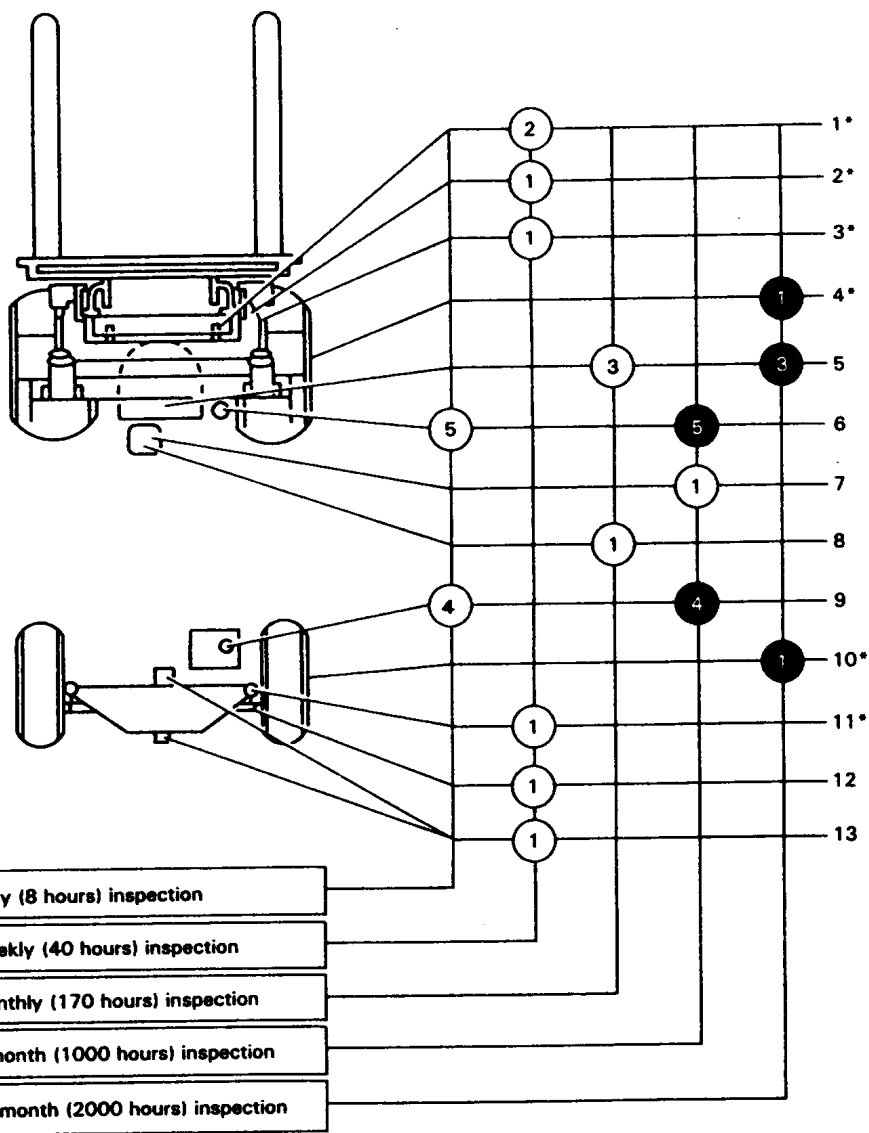
Unit: kg (lb)

Component	Model	FBMF16	FBMF20-25	FBMF30
	Total weight (L/battery)		2230 (4910)	20: 2510 (5520) 25: 2840 (6250)
Drive motor		81 (179)	114 (251)	114 (251)
Pump motor		63.5 (140.0)	70.5 (155.4)	73 (161.0)
Drive unit ASSY (L/motor)		Approx. 235 (518)	Approx. 275 (606)	Approx. 295 (650)
Counter weight		408 (900)	20: 434 (957) 25: 772 (1702)	972 (2143)
V mast ASSY W/lift bracket (W/lift cylinder, L/fork) (Max. lifting height: 3300 mm (130 in))		460 (1014)	520 (1147)	630 (1389)

RECOMMENDED LUBRICANTS AND CAPACITIES

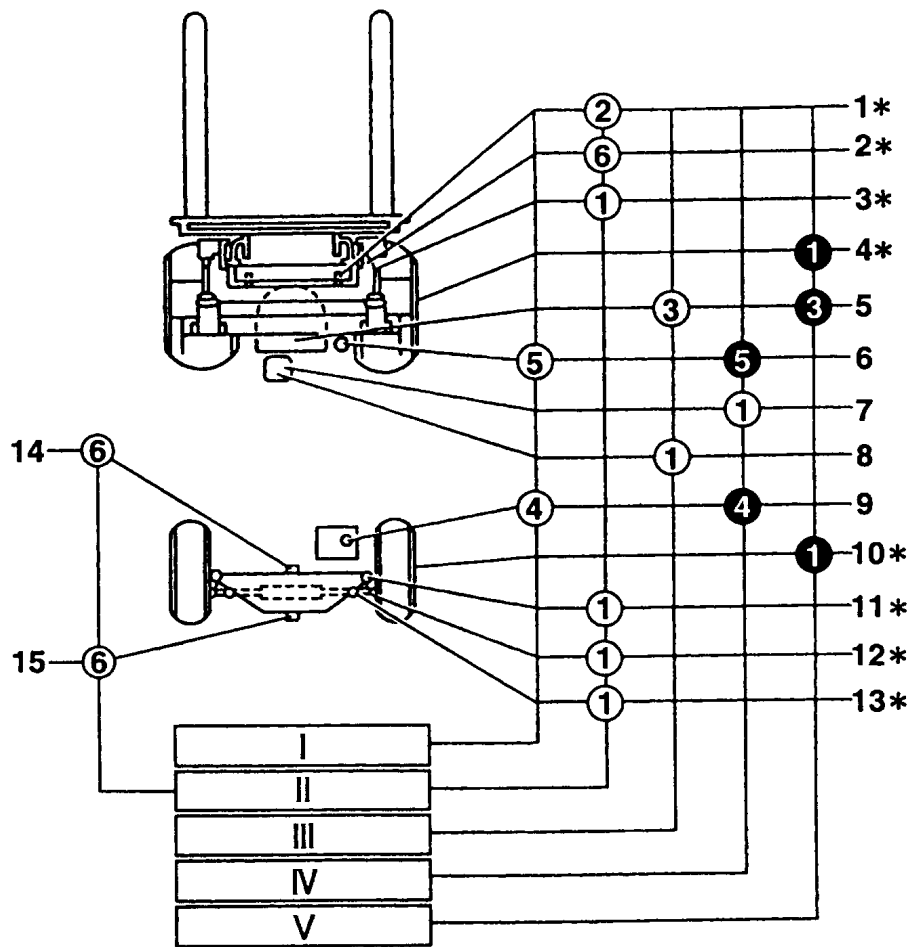
Application	Class	Model	Capacity
Differential & drive unit	API GL-4 or 5	Hypoid gear oil (SAE 85W-90)	5.5 ℓ (1.45 US gal)
Hydraulic oil	ISO VG-32	Hydraulic oil	22.5 ℓ (5.94 US gal)
Brake line	—	SAE J-1703 DOT-3	Proper quantity
Chassis parts	—	MP grease No. 2	Proper quantity
Battery electrolyte	—	Distilled water	Proper quantity

LUBRICATION CHART (Up to May 1999)



- | | | |
|-------------------|------------------------------|-----------------------------------|
| ● MP grease | 1 Chain | 7 Tilt steering locking mechanism |
| ● Engine oil | 2 Mast support busing | 8 Tilt steering universal joint |
| ● Hypoid gear oil | 3 Tilt cylinder front pin | 9 Oil tank |
| ● Hydraulic oil | 4 Front wheel bearing | 10 Rear wheel bearing |
| ● Brake fluid | 5 Differential & drive unit | 11 Steering knuckle king pin |
| *: Both RH & LH | 6 Brake fluid reservoir tank | 12 Rear axle beam, front |
| ○: Inspection | | 13 Rear axle beam, rear |
| ●: Replacement | | |

LUBRICATION CHART (From June 1999)



1. Chain
 2. Mast support bushing
 3. Tilt cylinder front pin
 4. Front wheel bearing
 5. Differential & drive unit
 6. Brake fluid reservoir tank
 7. Tilt steering locking mechanism
 8. Tilt steering universal joint
 9. Oil tank
 10. Rear wheel bearing
 11. Steering knuckle king pin
 12. Tie rod end pin
 13. Rear axle cylinder end pin
 14. Rear axle beam front pin
 15. Rear axle beam rear pin
- *: Located on right and left sides

- | | |
|-----|--------------------------------------|
| I | Inspect every 8 hours (daily) |
| II | Inspect every 40 hours (weekly) |
| III | Inspect every 170 hours (monthly) |
| IV | Inspect every 1000 hours (6 monthly) |
| V | Inspect every 2000 hours (annually) |
| ○ | Inspect and service |
| ● | Replace |
| ① | MP grease |
| ② | Engine oil |
| ③ | Hypoid gear oil |
| ④ | Hydraulic oil |
| ⑤ | Brake fluid |
| ⑥ | Molybdenum disulfide grease |

Toyota Forklift Fbmf 16 30 Shop Manual

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