

Workshop Service Manual

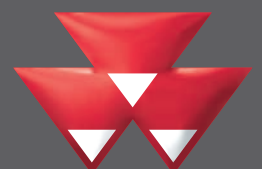
MF2210 / 2225 / 2235

Tractor

Models: 2210 / 2225 / 2235



VISION INNOVATION LEADERSHIP QUALITY RELIABILITY SUPPORT PRIDE COMMITMENT



MASSEY FERGUSON



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INTRODUCTION



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INTRODUCTION



CHAP. 1

Reading the manual

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INTRODUCTION



Sect.1 - Reading the manual

1-1 Introduction

The purpose of this manual is to provide the owner and user of **MF 2210 - 2225 - 2235** tractors with clear instructions on how to split the tractor parts.

It is designed for use by the workshop head since it does not give details about the disassembly, re-assembly and adjustment operations for all the assemblies, but just for those that require particular knowledge or recommendations.

Before reading the manual, it is essential to read sect.3: WORKING IN SAFETY in order to prevent errors or mistakes that could jeopardize the safety of the technicians in the workshop.

The information in this manual was up to date at the time of publication. Massey Ferguson reserves the right to make modifications without being obliged to give notice.

Please contact your area dealer or the importer if discrepancies are discovered or for any other requirement.

1.2 Structure of the manual

The manual is divided into chapters (chap.) and each chapter into sections (sect.). Page numbering begins with 1 for each chapter with the number of the chapter itself alongside.

Example: 5-7 indicates page 7 of chapter 5.

Numbering of the figures also begins with 1 in each chapter with the chapter number alongside.

Example: Fig. 73-5, indicates figure 73 of chapter 5.

The tools required for all the disassembly, re-assembly and adjustment operations are listed at the end of each chapter or important section. Not all the tools listed at the end of the chapter or section are, however, mentioned in the text, just those considered essential for correct disassembly, re-assembly and adjustment of the assembly in question.

The constructional drawings of all the tools described in the various chapters or sections are listed in chapter 12 to allow the dealer to provide his workshop with all those considered of importance.



INTRODUCTION



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Tractor identification and technical specifications

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INTRODUCTION



Sect. 2 - Tractor identification and technical specifications

2-1 Tractor identification

The tractor is identified by a serial number stamped on the rear part of the transmission housing and on the bonnet. The engine also has its own serial number stamped on the engine block.

To ensure a quick and efficient service when ordering spare parts or asking for technical specifications or other information, always state the chassis and engine serial number.

Chassis serial number

Engine serial number

Cab serial number

Type of tractor

Owner / Operator

Dealer's or Agent's address

Delivery date

Warranty expiry date

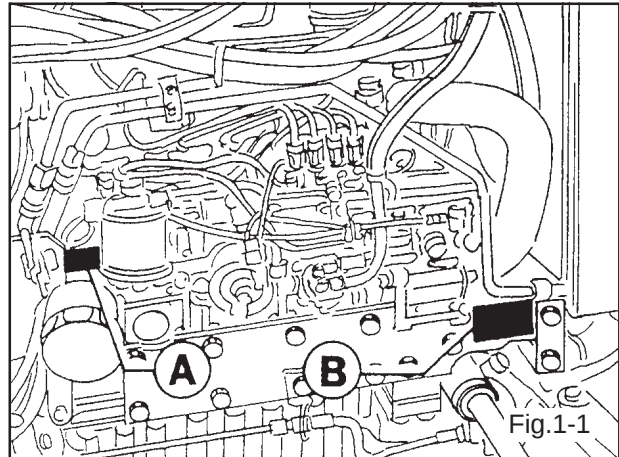


Fig.1-1

A - Engine serial number
(engine block)

B - Chassis type and serial number
(on front radiator core)

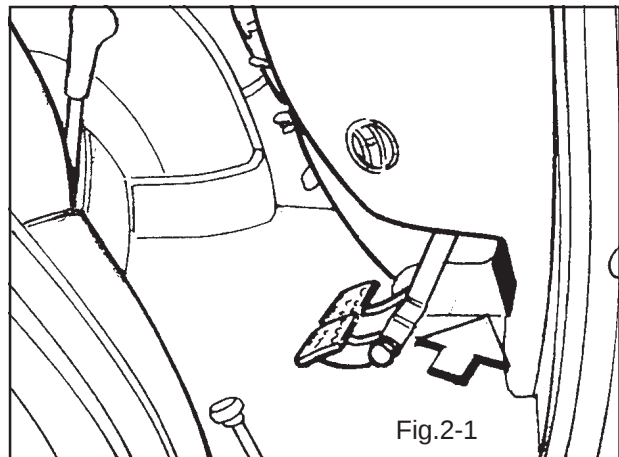


Fig.2-1

Type of tractor and chassis serial number
(lower dashboard panel).

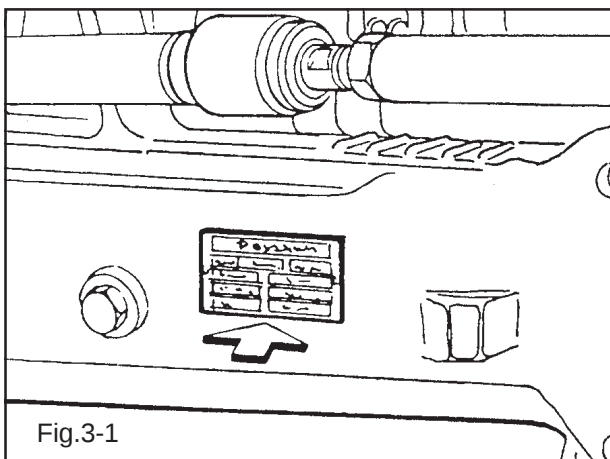


Fig.3-1

Type and serial number of the front axle
(on axle housing).

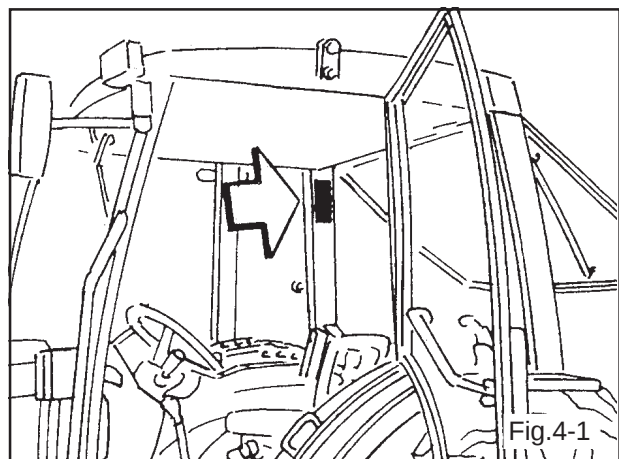


Fig.4-1

Cab type and serial number
(on rear cab pillar).



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Tractor identification and technical specifications

2-2 Weights and dimensions

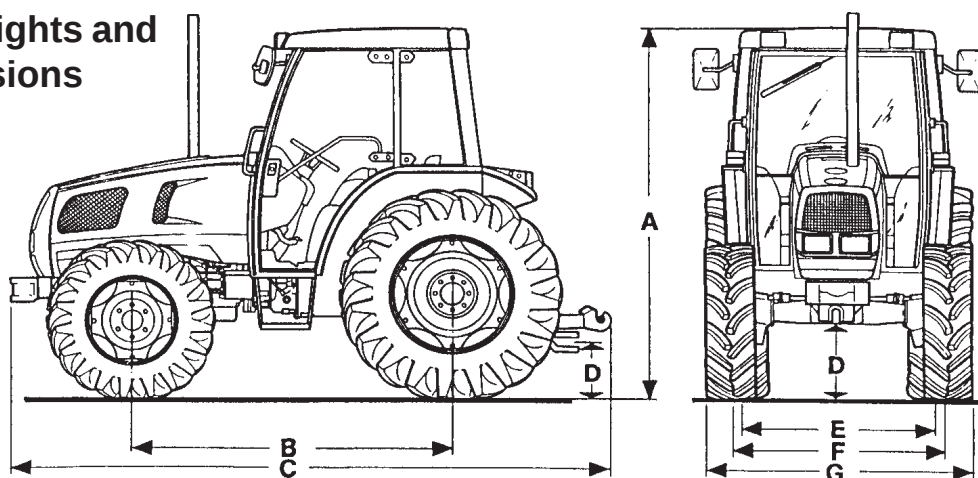


Fig.5-1

GENERAL SPECIFICATIONS		MF 2210		MF 2225		MF 2235	
		2WD	4WD	2WD	4WD	2WD	4WD
With tyres:							
- Front		750-16	320/70 R20	7.50-16	320/70 R24	7.50-16	320/70 R24
- Rear		14.9 R28	420/70 R28	480/70 R30	480/80 R30	480/80 R30	480/70 R30
WEIGHTS							
In running order,							
with cab without ballast	kg	2350	2470	2350	2550	2350	2550
with front / rear ballast	kg	2850	3000	2880	3080	2880	3080
DIMENSIONS							
A - Height at cab	mm	2360	2423	2360	2445	2360	2445
B - Wheelbase	mm	2006	2006	-	2154	-	2154
C - Maximum length							
- without front ballast	mm	3650	3605	-	3708	-	3708
- with front ballast	mm	3915	3915	-	4017	-	4017
D - Ground clearance:							
- under tow hook	mm	250	395	270	455	270	455
- under front axle	mm	-	445	-	415	-	415
E - Rear track (see tables)	mm	1320-1620	1436-1696	1320-1620	1578-1848	1320-1620	1578-1848
F - Front track (see tables)	mm	1354-1850	1562-1962	1562-1962	1562-1962	1562-1962	1562-1962
G - Maximum width:							
- front axle	mm	2245	2270	2348	2348	2348	2348
- rear axle	mm	1732	1755	-	1549	-	1549



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Tractor identification and technical specifications

SHERPA SPECIFICATIONS		MF 2210	MF 2225
With tyres: Front - Rear		280/70-R20 14.9 - R28	300/70-R20 420/70-R28
WEIGHTS			
In running order, with cab without ballast	kg	2430	2500
with front / rear ballast	kg	2960	3030
DIMENSIONS			
A - Height at cab	mm	2354	2385
B - Min/max width	mm	1732/2244	1777/2286
C - Ground clearance	mm	335	345
D - Wheelbase	mm	1996	2123
E - Max length (with 2 ballasts)	mm	3904	3904
F - Tracks: Front min/max	mm	1325/1675	1325/1675
Rear min/max	mm	1354/1866	1354/1866

2-3 Engine specifications

ENGINE	MF 2210	MF 2225	MF 2235
Type:	Perkins diesel, with direct injection		
Model	903.27	1004.40	1004.42
Aspiration	Natural	Natural	Natural
Number of cylinders	3	4	4
Bore	mm 95	100	103
Stroke	mm 127	127	127
Swept volume	liters 2.7	3.99	4.233
Compression ratio	17.25:1	17.25:1	17.25:1
Power(DIN 700200)	HP/kW 54/39.7	66/48.6	78/57
Max. speed under load	RPM 2300	2200	2200
Max. speed with no load	RPM 2475	2375	2310
Max. torque (DIN 70020)	Nm 193.1	-	284
Max. torque speed	RPM 1350	-	1400
Idling rate	RPM 750	750	750
VALVE GEAR			
Type	Overhead valves controlled by tappets		
tappet gap with engine cold:			
- Intake (mm)	0.20	0.20	0.20
- Exhaust (mm)	0.45	0.45	0.45
FUEL SYSTEM			
Fuel pump	AC-DELCO	AC-DELCO	AC-DELCO
Injection pump	ROTARY LUCAS DP 202	ROTARY LUCAS DP 202	ROTARY LUCAS DP 202
Filter on injection pump delivery	CAV	CAV	CAV
Injection order	1-2-3	1-3-4-2	1-3-4-2
Injectors	PERKINS	PERKINS	PERKINS
Injector pressure setting (bar)	296	296	290
Cold starting device	Thermostarter		
Air filter	Dry, with two elements removable for maintenance		



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Tractor identification and technical specifications

2-4 Clutch specifications

<u>Manufacturer</u>	LX (OX)
<u>Type</u>	Single-plate (with hydraulic PTO) Double-plate (with mechanical PTO)
<u>Dimensions</u>	11" (280 mm.) Single-plate (MF 2210-2225) 11" (245/280 mm.) Double-plate (MF 2210-2225) 12" (304.8 mm.) Single-plate (MF 2235) 12"/11 (304.8/880 mm.) Double-plate (MF 2235)
<u>Material</u>	Gearshift plate with 5 cerametallic plaques Organic PTO plate

2-5 Transmission specifications

<u>Manufacturer</u>	<u>MasseyFerguson</u>
<u>Gearbox</u>	
Speeds	Four synchronized speeds with infinitely meshed helical gears
Type of reduction ranges	Three forward ranges (Slow-Normal-Fast) Creeper (7.333 reduction).
Reverse shuttle	Synchronized on gearbox input
Number of speeds	12 forward and 12 reverse speeds with standard gearbox 15 forward and 15 reverse speeds with optional 24 forward and 24 reverse speeds with creeper 30 forward and 30 reverse speeds with optional gearbox 48/60 forward and 48/60 reverse speeds with Hi-Lo
<u>Rear axle</u>	
Bevel gear pair	9/37 with helical toothing, Gleason type (MF 2210) 11/41 with helical toothing, Gleason type (MF 2225-2235)
Final reduction	Straight-tooth type with 10/51 or 11/49 ratios (MF 2210) or 11/62 ratio (MF 2225-2235) 23.23 or 20.29
Total reduction ratio	With two planetaries
Type of Differential	With mechanical or electrohydraulic control, mechanically engaged
Differential lock	Disengaged by means of the brakes (electrohydraulic control)
<u>Rear brakes</u>	
Type	Oil cooled multiple-plate type
Number of friction disks	8 (4 each side)
Friction disk material	Graphitized resin
Disk diameter	166x110 mm
Total braking area	1900 cm ²
Diameter of braking cylinder	25.4 mm
Parking brake	Mechanical, engaged by a hand lever
<u>Rear brakes</u> (4WD axle)	
Type	Oil cooled multiple plate
Number of friction disks	8 (2 each side)
Friction disk material	Graphitized resin
Disk diameter	143x91 mm
Total braking area	764.5 cm ²



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Tractor identification and technical specifications

MF 2210 Speed in kph with 2200 RPM engine rate.

Gearbox: 4 gears = 30 kph; 5 gears = 40 kph

	Option	Range	Gear	Hi-Lo Engaged			Hi-Lo Disengaged		
				12.4R28 420/70R 24	13.6R28 380/70R 28	14.9R28 420/70R 28 12.4R32	12.4R28 420/70R 24	13.6R28 380/70R 28	14.9R28 420/70R 28 12.4R32
 FORWARDSPEEDS	CREEPER*	 Slow	1	0.16	0.16	0.17	0.19	0.20	0.21
			2	0.21	0.22	0.24	0.26	0.27	0.28
			3	0.30	0.32	0.34	0.37	0.39	0.40
			4	0.41	0.42	0.45	0.50	0.51	1.54
			5	0.55	0.56	0.60	0.66	0.68	0.72
		 Standard	1	0.43	0.45	0.48	0.52	0.54	0.57
			2	0.58	0.60	0.63	0.70	0.72	0.76
			3	0.82	0.86	0.90	0.99	1.03	1.08
			4	1.11	1.14	1.20	1.33	1.37	1.44
			5	1.47	1.52	1.60	1.77	1.83	1.92
		 Fast*	1	1.18	1.22	1.29	1.42	1.47	1.54
			2	1.59	1.64	1.73	1.91	1.97	2.07
			3	2.27	2.34	2.46	3.63	3.75	3.94
			4	3.03	3.13	3.29	3.63	3.75	3.94
			5	4.03	4.17	4.38	4.83	5.00	5.25
 REVERSESHUTTLE	CREEPER	 Slow	1	1.19	1.23	1.29	1.43	1.48	1.56
			2	1.60	1.65	1.74	1.92	1.98	2.08
			3	2.28	2.36	2.48	2.74	2.83	2.97
			4	3.04	3.15	3.31	3.65	3.78	3.96
			5	4.06	4.20	4.40	4.86	5.03	5.27
		 Standard	1	3.19	3.30	3.47	3.83	3.96	4.15
			2	4.28	4.42	4.64	5.13	5.30	5.56
			3	6.11	6.32	6.63	7.32	7.57	7.94
			4	8.15	8.42	8.85	9.76	10.09	10.59
			5	10.8	11.21	11.77	12.99	13.43	14.09
		 Fast	1	8.73	9.02	9.46	10.45	10.80	11.33
			2	11.68	12.08	12.68	13.99	14.47	15.18
			3	16.68	17.24	18.04	19.97	20.64	21.59
			4	22.25	23.00	24.13	26.64	27.54	28.89
			5	29.62	30.63	32.14	35.46	36.67	38.47
 REVERSESHUTTLE	CREEPER	 Slow	1	0.16	0.16	0.17	0.20	0.20	0.21
			2	0.21	0.22	0.24	0.26	0.27	0.29
			3	0.31	1.32	1.34	1.38	0.39	0.41
			4	0.41	0.43	0.45	0.50	0.52	0.54
			5	0.55	0.57	0.61	0.67	0.69	0.73
		 Standard	1	0.44	0.45	0.48	0.53	0.54	0.57
			2	0.59	0.61	0.64	0.71	0.73	0.77
			3	0.84	0.87	0.91	1.01	1.04	1.09
			4	1.11	1.16	1.22	1.34	1.39	1.46
			5	1.49	1.54	1.62	1.79	1.85	1.94
		 Fast	1	1.21	1.25	1.32	1.45	1.50	1.58
			2	1.62	1.68	1.76	1.95	2.02	2.11
			3	2.32	2.39	2.52	2.78	2.87	3.02
			4	3.09	3.20	3.36	3.71	3.83	4.02
			5	4.12	4.27	4.48	4.94	5.11	5.36
 REVERSESHUTTLE	STANDARDSPEEDS	 Slow	1	1.21	1.25	1.31	1.45	1.50	1.57
			2	1.62	1.67	1.75	1.94	2.00	2.10
			3	2.31	2.39	2.51	2.77	2.86	3.00
			4	3.08	3.19	3.34	3.69	3.82	4.00
			5	4.10	4.24	4.45	4.91	5.08	5.33
		 Standard	1	3.23	3.34	3.51	3.87	4.00	4.20
			2	4.32	4.48	4.69	5.18	5.36	5.62
			3	6.18	6.39	6.70	7.40	7.65	8.02
			4	8.23	8.52	8.94	9.86	10.20	10.70
			5	10.96	11.34	11.90	13.13	13.58	14.24
		 Fast	1	8.82	9.12	9.57	10.56	10.92	11.46
			2	11.82	12.22	12.82	14.15	14.63	15.35
			3	16.85	17.42	18.29	20.18	20.86	21.89
			4	22.48	23.35	24.39	26.92	27.83	29.20
			5	29.94	30.96	32.48	35.84	37.06	38.88



INTRODUCTION



Tractor identification and technical specifications

MF 2225-2235 Speed in kph with 2200 RPM engine rate.

Gearbox: 4 gears = 30 kph; 5 gears = 40 kph

	Option	Range	Gear	Hi-Lo Engaged			Hi-Lo Disengaged		
				14.9R 30 480 / 70R 30	16.9R 28 540 / 65R 28	16.9R 24	14.9R 30 480 / 70R 30	16.9R 28 540 / 65R 28	16.9R 24
	CREEPER	Slow	1	0.18	0.17	0.16	0.22	0.21	0.19
			2	0.24	0.23	0.21	0.29	0.28	0.26
			3	0.35	0.33	0.31	0.42	0.40	0.37
			4	0.46	0.45	0.41	0.56	0.54	1.50
			5	0.62	0.60	0.55	0.74	0.71	0.66
		Standard	1	0.49	0.47	0.43	0.58	0.56	0.52
			2	0.65	0.63	0.58	0.78	0.75	0.70
			3	0.93	0.90	0.83	1.12	1.08	1.00
			4	1.25	1.20	1.11	1.49	1.44	1.33
			5	1.66	1.60	1.48	1.99	1.92	1.77
	STANDARD SPEEDS	Fast	1	1.33	1.29	1.19	1.60	1.54	1.42
			2	1.79	1.72	1.59	2.14	2.06	1.91
			3	2.55	2.46	2.28	3.06	2.95	2.73
			4	3.41	3.28	3.04	4.08	3.93	3.64
			5	4.54	4.37	4.05	5.43	5.24	4.85
		Slow	1	1.34	1.29	1.20	1.61	1.55	1.43
			2	1.80	1.73	1.60	2.15	2.08	1.92
			3	2.57	2.48	2.29	3.08	2.96	2.74
			4	3.43	3.30	3.06	4.10	3.95	3.66
			5	4.56	4.40	4.07	5.46	5.27	4.87
	CREEPER	Standard	1	3.59	3.46	3.20	4.30	4.15	3.84
			2	4.81	4.64	4.29	5.77	5.56	5.14
			3	6.87	6.62	6.13	8.23	7.93	7.34
			4	9.16	8.83	8.17	10.97	10.58	9.79
			5	12.20	11.76	10.88	14.61	14.08	13.03
		Fast	1	9.81	9.46	8.75	11.75	11.32	10.48
			2	13.14	12.67	11.72	15.74	15.17	14.04
			3	18.75	18.07	16.72	22.45	21.64	20.03
			4	25.01	24.11	22.31	29.95	28.87	26.72
			5	33.30	32.10	29.71	39.88	38.44	35.57
	STANDARD SPEEDS	Slow	1	0.18	0.17	0.16	0.22	0.21	0.19
			2	0.24	0.24	0.22	0.29	0.28	0.26
			3	0.35	1.34	1.31	1.42	0.40	0.37
			4	0.47	0.45	0.42	0.56	0.54	0.50
			5	0.62	0.60	0.56	0.75	0.72	0.67
		Standard	1	0.49	0.47	0.44	0.59	0.57	0.53
			2	0.56	0.64	0.59	0.79	0.76	0.70
			3	0.94	0.91	0.84	1.13	1.09	1.01
			4	1.26	1.21	1.12	1.51	1.45	1.34
			5	1.68	1.62	1.50	2.01	1.94	1.79
	STANDARD SPEEDS	Fast	1	1.35	1.30	1.20	1.61	1.56	1.44
			2	1.81	1.74	1.61	2.16	2.09	1.93
			3	2.58	2.49	2.30	3.09	2.98	2.76
			4	3.44	3.32	3.07	4.12	3.98	3.68
			5	4.59	4.42	4.09	5.49	5.29	4.90
		Slow	1	1.36	1.31	1.21	1.62	1.57	1.45
			2	1.82	1.75	1.62	2.18	2.10	1.94
			3	2.60	2.50	2.31	3.11	3.00	2.77
			4	3.46	3.34	3.09	4.15	4.00	3.70
			5	4.61	4.44	4.11	5.52	5.32	4.92
	STANDARD SPEEDS	Standard	1	3.63	3.50	3.24	4.35	4.19	3.88
			2	4.87	4.69	4.34	5.83	5.62	5.20
			3	6.94	6.69	6.19	8.32	8.02	7.42
			4	9.26	8.93	8.26	11.09	10.69	9.89
			5	12.33	11.88	11.00	14.76	14.23	13.17
		Fast	1	9.91	9.56	8.84	11.87	11.44	10.59
			2	13.28	12.80	11.85	15.91	15.33	14.19
			3	18.95	18.27	16.90	22.69	21.87	20.24
			4	25.28	24.37	22.55	30.27	29.18	27.00
			5	33.66	32.45	30.02	40.30	38.85	35.95



INTRODUCTION



Tractor identification and technical specifications

2-6 Power take-off specifications

Type:	Independent
Type of clutch:	Mechanical with two speeds 540/750 or 540/1000 RPM Electrohydraulic with 2 or 4 speeds engaged by a hydraulic clutch and with electrohydraulic control
PTO output shaft	In compliance with Asae standards 13/8 (34.9 mm) with 6 splines
PTO speed	Rotation rate 540 RPM with engine at 2070 RPM 540 ECO RPM with engine at 1339 RPM (Basic assembly). (2-speed PTO). 540 ECO RPM with engine at 1373 RPM (on request). (4-speed hydraulic PTO). 1000 RPM with engine at 2107 RPM (on request). (4-speed hydraulic PTO). 540 RPM PTO with drive reversal with engine at 2061 RPM (on request 4-speed PTO in certain markets only). PTO proportional to ground speed (MF 2210); PTO shaft turns per wheel revolution: 10.677 (10 / 51 rear final drives). PTO proportional to ground speed (MF 2225-2235); PTO shaft turns per wheel revolution: 10.769 (11 / 62 rear final drives).

2-7 2WD axle

Type:	Boxed and swivelling around the central pivot
N° tracks	4
Min. track width	1320 mm
Max. track width	1620 mm
Track width increases	100 mm
Max. turning angle	55°
Max. angle of oscillation	12°

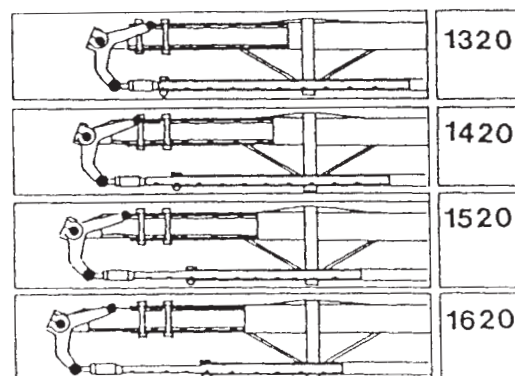


Fig. 6-1



INTRODUCTION



Tractor identification and technical specifications

2-8 4WD (DNX) front axle specifications

Type of axle	In spheroidal cast iron, oscillating with central pivot
Type of reductions	Standard axle with central pinion and ring gear (MF 2210-2225):39/8 Standard axle with central pinion and ring gear (MF 2235):53/13 Sherpa axle with central pinion and ring gear (MF 2210-2225):41/9 Sherpa axle with central pinion and ring gear (MF 2210-2225):51/13 Standard axle with dropped final drive (MF 2210-2225):47/11 Sperpa axle dropped final drive 4.6
Clutch control	Mechanical with hand lever or electrohydraulic
Ratio between front and rear axle	1.430 with 4 WD 2.500 with Fast Run
Type of hydraulic clutch	Hydraulic clutch for 4 WD with oil-cooled disks electrohydraulic control with 1:1 input/output ratio Hydraulic clutch with oil-cooled disks for Fast Run with automatic engagement when the steering angle exceeds 35°. Input/output ratio 1:1.78
Max. steering angle	55°
Max. angle swing	8°
Turning radius	3054 mm.



INTRODUCTION



Tractor identification and technical specifications

2-9 Technical specifications of 4WD front axle with bevel gear pairs

Type of axle	In spheroidal cast iron swivelling around a central pivot
Type of reductions	Central pinion and ring gear 14/32 20/26 and 18/41 double bevel drive and 3.333 epicyclic final drive
Clutch control	Mechanical with hand lever or electrohydraulic
Ratio between front and rear axle	1.430 with 4WD 2.543 with Fast Run
Type of hydraulic clutch	Hydraulic clutch for 4WD with oil-cooled disks, electrohydraulic control and 1:1 input/output ratio Hydraulic clutch with oil-cooled discs for Fast Run with automatic engagement when the steering angle exceeds 35°. 1:1.78 input/output ratio
Max. steering angle	52°
Max. axle swing	8°
Turning radius	3054 mm.



INTRODUCTION



Tractor identification and technical specifications

2-10 Hydraulic circuit specifications

PUMP

Type	Double gear type (in tandem)
Make	Bosch.
Model	A - 510 - 845 - 262
Pump / engine RPM ratio	1: 1.25
Max. operating pressure	180 $\pm$ ⁵ ₀ bar
Max. flow at engine rate	39 l/min MF 2210 / 54 l/min MF 2225 - 2235
Max. flow at engine rate	39 l/min MF 2210 / 54 l/min MF 2225 - 2235
Position	at side of engine
Drive	Timing system gears
Quantity of hydraulic oil / transmission	35 l.
Type of oil	transfluid AS/B.

FILTERS

Type (on the intake)	With single washable metal gauze cartridge
filtering degree	40 micron
Type (on the delivery)	with single replaceable paper cartridge
filtering degree	15/20 micron

STEERING SYSTEM

System	Power steering system
Make	Danfoss
Type	Orbitrol ospc 70 4 W.D. Orbitrol ospc 50 2 W.D.
4 WD nominal cylinder	70 cc. per rev.
2 WD nominal cylinder	50 cc. per rev.

Calibrating valve	155 $\pm$ ⁵ ₀ (built into the valve system block)
Antishock valve calibration	205 bar (built into the valve system block)

Steering cylinder	Quantity 1
Type	double-acting, balanced
Make	Massey Ferguson
dimensions	32 x 48 x 242 / 2 mm.
pump delivery	27.3 l. / min. at 2600 RPM engine rate
steering wheel turns	2 turns to the right
steering wheel turns	1.75 turns to the left
steering wheel diameter	360 mm.

HYDRAULIC POWER PACK

Make	Comatrol
Type	Electrohydraulic
Low pressure calibrating valve	18 bar
Cooling circuit calibrating valve	5 bar
Compensating valve	Modular
Forced lubrication valve	1.5 bar
Oil outlet towards the transmission	Spray lubrication
Uses	BLc - PTO/FRn - STR - DTi
Type of engagement	Electrohydraulic



INTRODUCTION



Tractor identification and technical specifications

AUXILIARY CONTROL VALVES

Make	SLX
Operation	Standard-Single / double acting, hydraulic, with "Kick out" automatic release
Type	Open center with "Push - Pull" quick couplings
Calibrating valve	180 $\pm$ ₀ ⁵ bar
Max. flow rate	35 l. / min.
Max. quantity	3 elements
Connection to circuit	in series
Position	at rear

HYDRAULIC MECHANICAL POWER LIFT

Make	Mita / Massey Ferguson
Operating mode	position / draft control intermix - float mode lowering adjustment
Hydraulic system	with open-center
Standard cylinder	single-acting
Dimensions	ø 90 x 116 stroke
Supplementary cylinders	2 single-acting types
dimensions	ø 40 x 220 stroke
Calibrating valve	180 $\pm$ ₀ ⁵ bar
Antishock valve	200 $\pm$ ₀ ⁵ bar

LIFTING CAPACITY

Standard	2100 Kg.
With 2 supplementary cylinders	3400 Kg.
lower links	Class 1 and 2
third point	with hydraulic ram (optional)



INTRODUCTION



CHAP. 1

Working in safety

INDEX

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INTRODUCTION



Sect.3 - Working in safety

3-1 Essential rules for prevention

The structures, systems and equipment in repair shops must conform to the current laws governing labour safety in order to safeguard the health and safety of each worker.

Although they are obviously only partial, the regulations given in this section inform the workers about the dangers they may encounter on the job.

Always bear your safety and that of others in mind whenever you work on a machine, whichever type it may be.

To work in complete safety, it is essential to know the nature of the job, to correctly use the tools and materials required and to rely on your common sense

To prevent accidents, it is important to:

- **BEHAVE** correctly and act with caution;
- Pay **ATTENTION** and keep your actions under control;
- Comply with the **REGULATIONS** and rules of behaviour of a general character.



This is the warning symbol. Take care when you see it on the machine or in the manual as it indicates a potential danger hazard.



INTRODUCTION



Working in safety

A - Rules of a general character

Preliminary instructions

- always comply with the instructions received from superiors;
- always comply with the indications on the stickers and signs;
- never use machines or systems without authorization and never carry out operations and manoeuvres that are the competence of others;
- use the safety devices and other means of protection with care;
- inform your superiors if the safety and protective means and devices are defective or about any danger conditions of which you may become aware;
- never remove or modify the safety devices and other means of protection without having been authorized to do so;
- Let your superiors know immediately about any accidents you have had or about which you may have become aware;
- keep your place of work clean and orderly. Keep the floor clear of any materials that are not strictly required for the job in hand and prevent greasy or oily substances from being spilt (clean them up with absorbent paper if this should occur).

Work clothes

- Do not wear loose clothing that can become caught up in moving parts or garments that are not tight at the cuffs;
- do not wear necklaces, rings, bracelets and similar;
- do not clean the garments with inflammable or harmful substances, or using compressed air;
- do not wear sandals, slippers, clogs or shoes with high heels.

Always wear protective clothing (goggles - visors - gloves - footwear, etc.).



Fig. 7-1

Machines and systems

- Before beginning work, make sure that the guards and screens are in place, in a good condition and that the safety devices are functional;
- check the operation of any exhaust or ventilating systems installed;
- never remove the guards or safety devices from the machine unless this is strictly necessary and after having been authorized to do so by your superiors, who will also indicate the precautions that must be taken;
- the protections and safety devices must be fitted back in place and be re-activated as soon as the reasons for their having been temporarily removed have ceased;
- it is forbidden to clean, oil or grease moving parts of machines and systems by hand.
- it is forbidden to adjust or work on moving parts.



INTRODUCTION



Working in safety

Lifting and carrying

By hand

- do not bend your back to lift loads;
- hold the load safely where it is easy to get a good grip;
- do not carry loads with greasy or oily hands;
- hand trucks without drawbars should be pushed, not pulled;
- never deposit loads near stairs, fire-fighting systems, first-aid means or places of transit.

On vehicles

- comply with the capacity limits and regulate your speed according to the road conditions, the load, and the braking distance;
- make sure the loads are well harnessed and fastened;
- avoid passing with hanging loads in places where dropping could cause a danger hazard. If this is inevitable, indicate when the manoeuvre is made or have all bystanders move out of the area.

Internal circulation

People

- use the correct and authorized routes (pedestrian crossings, gangways and similar);
- do not run;
- do not walk or stand under hanging loads or in places where loads could drop;
- do not ride on means of transport or lifting equipment designed for handling materials alone.

Vehicles

- proceed at a moderate speed and with due care, depending on the road conditions. Comply with the farm/company rules and with the road signs.

Electricity

- do not make electrical connections with makeshift means and never ever insert the ends of wet conductors into sockets;
- disconnect plugs from sockets by holding the outer casing, never by pulling the electric cable;
- avoid twisting the cables;
- frequently check the insulating material of conductors and electrical equipment and make sure that it is in a good condition;
- point out any damage to electrical equipment and systems, with particular reference to the condition of the ground conductors;
- do not open cabinets or containers housing electrical equipment or carry out work inside unless you are trained and authorized to do so;
- watch out for overhead electric lines when approaching or working in their vicinity.

Fire outbreaks

In departments or processes where there may be a danger of fire outbreaks owing to the presence or use of inflammable substances:

- it is forbidden to smoke;
- it is forbidden to use equipment with naked flames or to handle glowing materials;
- do not place inflammable materials near heat sources;
- do not store materials in front of extinguishers or fire hydrants;.



INTRODUCTION



Working in safety

Dangerous substances and preparations

Take the following precautions when using dangerous chemical products (fire, explosion, irritation, caustic burning, scalding, intoxication):

- only keep receptacles containing dangerous products open for the time strictly required for their use;
- do not use or transfer dangerous products into containers that are not designed for this use, or into those without indications as to their contents or without the relative markings;
- comply with the indications on the relative labels when using chemical products.

Defence against gas, fumes, dust, harmful vapours

- make sure that the exhausting systems are operating;
- wear protective clothing and equipment;
- install temporary exhausts as near as possible to the sources, if necessary;
- do not work in the direction of the flow of polluting substances blown out by exhaust systems.

Agents of a biological nature

- in the event of fermentation (development of algae), avoid direct contact and act with appropriate protective means. Only enter places where anaerobic fermentation may have taken place and produced fumes (e.g. ammoniacal) after having worn a protective mask.

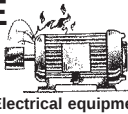
GUIDE TO CHOOSING THE RIGHT EXTINGUISHER					
TYPE OF FIRE	EXTINGUISHING AGENT				
	WATER	POWDER	CO ₂	FOAM	SPECIAL POWDERS
A  Ordinary solid fuels	YES	YES	YES Only for small fires. Does not extinguish the embers	YES	NO
B  Inflammable liquids	NO	YES Unless suitable equipment is used	YES	YES	NO
C  Inflammable gases	NO	YES	YES	NO	NO
D  Combustible metals	NO	NO	NO	NO	YES May react with water
E  Electrical equipment	NO	YES	YES	NO	NO

Fig. 8-1



INTRODUCTION



Working in safety

B - Tools

Makeshift, inadequate or defective tools may cause faults or accidents. Never use the wrong tools since such action could cause injuries and spoil the finished job.

Always use the special tools recommended by the manufacturer when disassembly, overhauling and re-assembly the various parts of a tractor. (Fig. 6-1)
-Use of specific tools will reduce the effort and time required for the job and, consequently, the cost. You will also be certain that the work has been correctly done.

Never use:

- A hammer with a loose head or cracked handle.
- Pincers or pieces of iron instead of a hammer; drill bits or bolts instead of pin drivers.
- Worn or welded wrenches.
- A steel hammer to tap bearings or stress relieved components (use one made of bronze or brass).

The engine and gearbox and the front and rear transmissions must be split for certain jobs on the tractor components. This operation is facilitated and made safer by use of the special divider kit (Fig.7-1).

When lifting weights, make sure that the chains, lifting brackets, hooks, cables or ropes comply with CE standards.

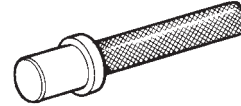
Unless different indications are given, an adjustable bracket must be used when particularly heavy parts are removed.

All chains and cables must be parallel to each other and as near to the vertical as possible, depending on the component being lifted.

C - First Aid

Mechanics are exposed to various risks at work. If anyone should be injured, use sterile materials and disinfectants for first aid purposes. These materials should be kept in the first-aid box, equipped in compliance with the laws in force.

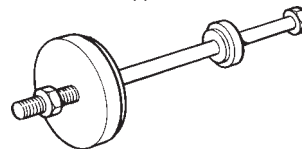
Plug used to mount the bushing on the differential housing.



Plug used to insert the external rings on the taper bearings of the rear differential



Puller for the normal and fast upper shaft mounted on the differential housing



Plug used to mount the needle bearing on the slow reduction range gear shaft

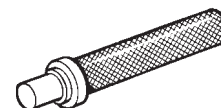


Fig.9-1

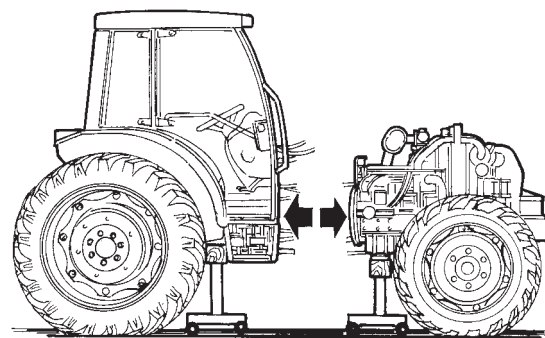


Fig.10-1

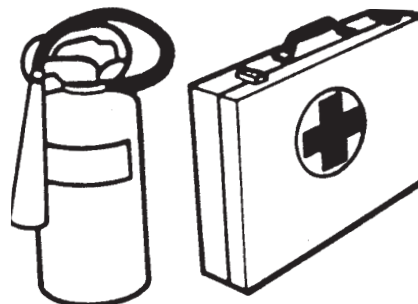


Fig.11-1



INTRODUCTION



Working in safety

D - Tractor safety regulations

Note: Before getting into the tractor, it is essential to read and strictly comply with the instructions in the operation and maintenance manual.

Starting

- Never start the engine in a closed space without an adequate ventilation system able to eliminate the gas fumes.
- Never place your head, body, limbs, feet, hands or fingers near spinning belts or fans.

Engine

- Unscrew the radiator plug very slowly to relieve the pressure from the system before taking it completely off. Coolant fluid must only be topped up with the engine at a standstill or idling, if hot.
- Do not refuel the engine whilst the engine is running, particularly if this hot. Such action could cause a fire outbreak if fuel were to be spilt.
- Never attempt to check or regulate the tension of the fan belts whilst the engine is running. Never adjust the fuel injection pump when the tractor is moving.
- Do not lubricate the tractor when the engine is running.

Electrical system

- If auxiliary batteries are used, remember that the leads at both ends must be connected to the terminals in the indicated way: (+) with (+) and (-) with (-). Avoid short-circuiting the terminals. THE GAS ISSUED BY THE BATTERIES IS HIGHLY INFLAMMABLE.
When recharging, leave the battery compartment uncovered to allow for ventilation. Never ever check the battery charge by placing metal objects on the terminals as "jumpers". Avoid sparks or flames in the battery zone. Do not smoke as there could be a risk of explosion.

- Make sure that there are no fuel leaks before proceeding with any other operation: eliminate any leaks before continuing work.
- Do not recharge batteries in a closed space: make sure that the ventilation is adequate to prevent the risk of accidental explosions caused by accumulations of the gas issued during the recharging phase.
- Always disconnect the battery before carrying out any work on the electrical system.

Hydraulic Plant

- A fluid leaking from a very small hole may be almost invisible but have sufficient force to penetrate under the skin. If you need to check for leaks, use a piece of cardboard or wood. NEVER USE THE HANDS: if the fluid comes into contact with the skin, immediately seek medical help. Series infections or dermatitis may occur unless prompt medical treatment is immediately obtained.
- Use suitable tools when checking the pressure values in the plant.

Lifting and lowering

- Lift and handle all particularly heavy components with lifting means of a suitable carrying capacity. Make sure that the parts are borne by appropriate harness and hooks. Use adequate lifting bolts. Take care of bystanders when lifting the load.
- Handle all parts with the greatest care. Never insert the hands or fingers between one part and the next. Wear approved protective clothing such as goggles, gloves and safety footwear.
- Do not allow metal chains or ropes to twist. Always wear protective gloves when handling cables or chains.



INTRODUCTION



Working in safety

3-2 Safety decals

When replacing a tractor part bearing a sticker with safety warnings (yellow coloured), it is **ESSENTIAL** to affix the same sticker to the spare part.

A complete list of the places where these stickers are applied is given below.

FIG.12-1 TRACTORS WITH CAB

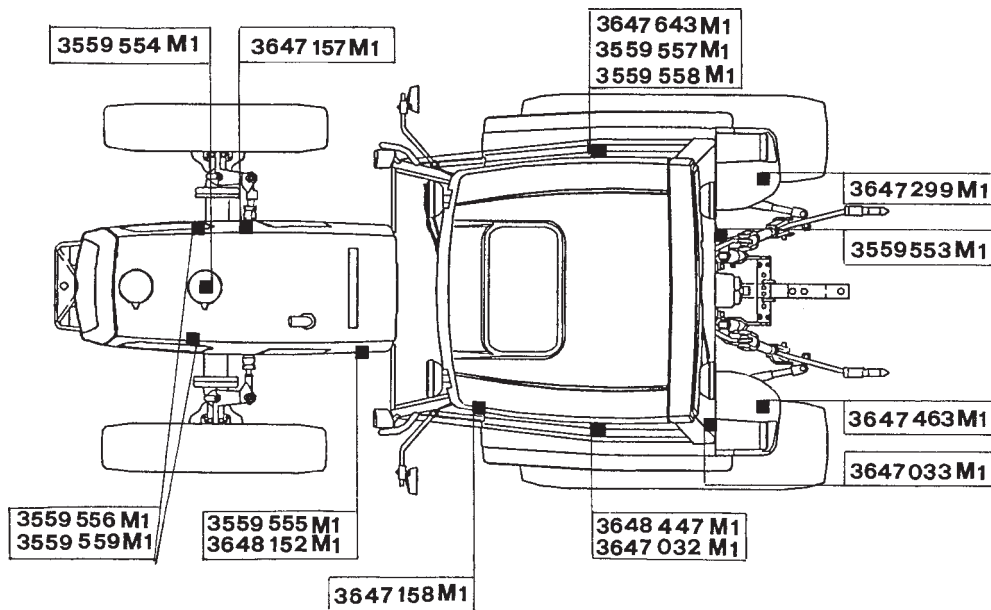
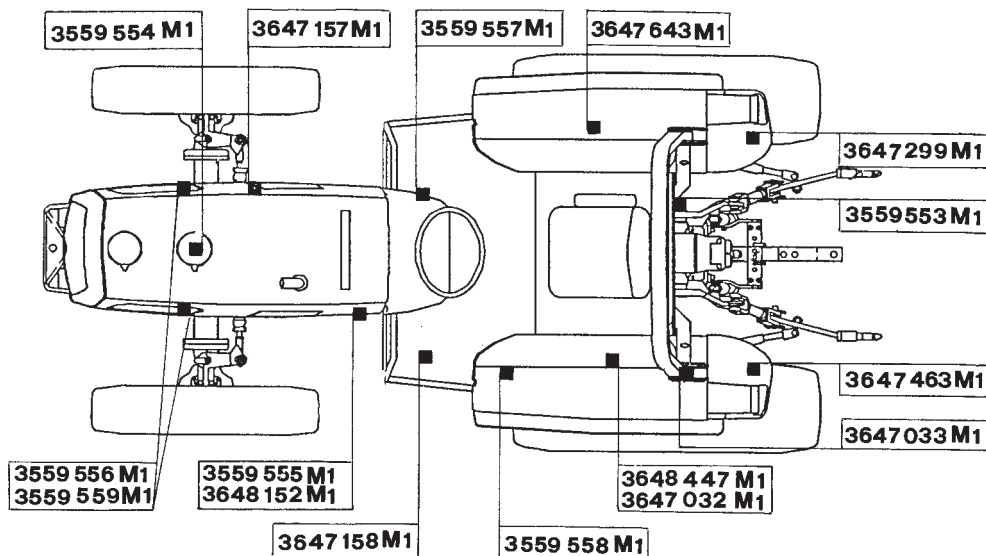


FIG.13-1 FOOTSTEP TRACTORS



Positions where the decals are affixed (WEO market)



INTRODUCTION



Working in safety

3-3 Replacing tractor parts

It is essential to use **genuine Massey Ferguson spare parts** when repairing the tractor.

Pay particular attention to the following instructions when repairing and mounting parts and spares accessories.

Use of spurious spares can jeopardize tractor safety. Strictly comply with the torque wrench values given in the workshop manual and, where indicated, install the relative locking devices when disassembly operations are being carried out.

Installation of spurious spare parts will automatically invalidate your tractor's warranty, since all Massey Ferguson spares are guaranteed by the manufacturer. Massey Ferguson dealers must only supply genuine spare parts.

3-4 Safe use of the tractor

Only qualified and authorized operators are able to use farming tractors in safety. To be qualified you also need to be familiar with the instructions in the operation and maintenance manual and to strictly comply with these indications.

Moreover, operators need to know the labour safety regulations.

For example, some regulations specify that no one under the age of 18 years may use a tractor.

You are responsible for knowing these regulations and for complying with them at work.

They also include the following instructions for safe use of the tractor.



Warning: The operator must never use alcohol or drugs that can affect his attention or the co-ordination of his movements.

Observe the following precautions

- Do not allow children or unauthorized persons to drive

your tractor.

- Fasten your seat belt if the tractor is fitted with a roll-over frame.
- Whenever possible, do not use the tractor near ditches or embankments.
- Reduce speed when turning the tractor, crossing slopes and on rough, slippery or muddy surfaces.
- Keep clear of slopes too steep for safe operation.
- Watch where you are going - especially at row ends and around trees.
- Never let anyone else get on to the tractor or the implement.
- Operate the tractor smoothly, with no sudden movements: do not turn, start or stop abruptly.
- Hitch only to the drawbar and recommended hitch points. Never hitch above the central line of the rear axle.
- Apply the parking brake whenever the tractor is stopped.
- Never alter or remove any part of the equipment.
- Keep others well clear of your work area.
- Never use attachments that are not designed for your tractor.



This is the warning symbol. Take care when you see it on the machine or in the manual as it indicates a potential danger hazard.



INTRODUCTION



Working in safety

Safety frame (ROPS)

Safety frame

Either a roll-over protective structure or a cab is mounted as standard equipment together with a safety belt. You cannot work without the safety frame or cab. A safety structure or cab reduces the risk of injury should the tractor roll over. Rolling over without a safety structure or cab can cause damage and serious injury.

Use

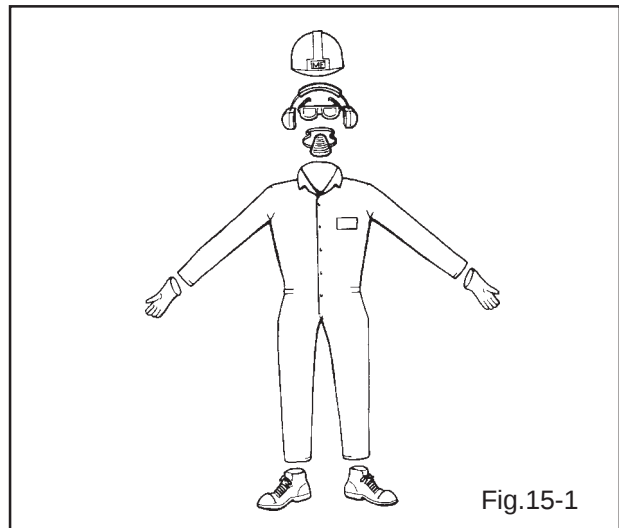
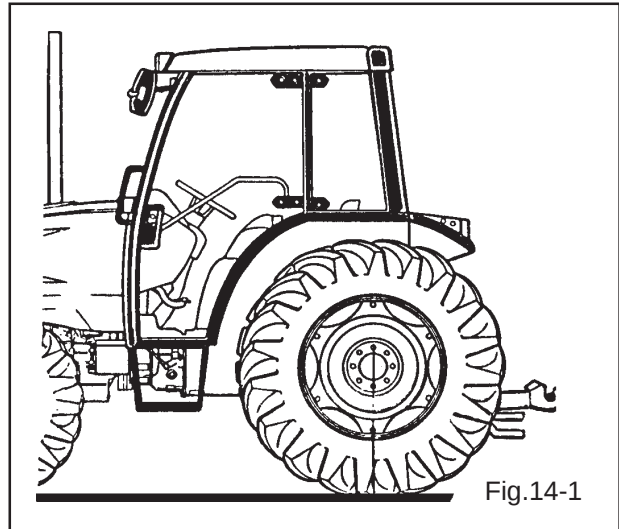
- Before using the tractor, ensure that the ROPS or the cab has not been damaged and that it is securely fastened to the tractor.
- DO NOT attach chains, cables, etc., to the ROPS or to the cab for towing purposes as this could cause the tractor to tip up: always use the draw bar for this purpose.
- Always fasten your safety belt. Do not wear the safety belt if the tractor is not equipped with a ROPS or cab.
- Check the safety belt for damage. Damaged belts must be replaced.

Damaged ROPS or cabs

If the tractor has rolled over and the ROPS or the cab have been damaged (e.g. in the case of a crash against a bridge), they must be replaced in order to ensure the original degree of protection.

After an accident, check the ROPS or cab, the driving seat, the safety belt and the anchor points of the safety belt. Replace all damaged parts before using the tractor again.

DO NOT WELD, DRILL, BEND OR STRAIGHTEN THE ROPS OR CAB: to do so reduces the degree of protection that is ensured by original equipment.





INTRODUCTION



CHAP. 1

Pre-delivery inspections and maintenance

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4-2 Inspections before delivery	1-28
4-3 Routine maintenance guide	1-29



INTRODUCTION



Sect.4 - Pre-delivery inspections & maintenance

4-1 General information

To ensure that the tractor is regularly serviced during the 12 month warranty period, the Massey Ferguson dealer must carry out maintenance work after 50 and 250 hours service.

These operations will ensure your tractor functions with utmost efficiency throughout the warranty period and that it gives reliable service.

4-2 Pre-delivery inspection

The following operations must be carried out both by the agent before delivering to the Dealer and by the Dealer before delivering to the customer or operator:

- Make sure that the instruments, controls and indicator lights operate correctly.
- Check the engine rate on the rev counter using the pedal and hand accelerator.
- Hitch a towed implement and make sure that the hydraulic accessories of the tractor operate correctly.
- Check and regulate the tyre pressure (on the road or ground).
- Make sure that all nuts, bolts, centering pins, pipe unions and fastening devices are correctly fixed.
- Make sure that there are no leaks from the pipes.
- Make sure that the lights are correctly positioned.
- Test the tractor on the road, making sure that the brakes, controls and accessories operate correctly.

1 General installation

- Clean the lower surface of the batteries and spread the terminals with vaseline.
- Charge the battery if necessary.
- Check all battery connections. Make sure that all leads, tubes and indicator lights are well fixed.
- Check and top up the oil in the engine and transmission housings.
- Lubricate all parts requiring grease.
- Check the tension of the belts (alternator, fan, servo-control pump and air-conditioning compressor) and adjust if necessary.
- Flush out the cooling circuit and fill it with fresh water (unless it contains antifreeze).
- Make sure that the tank contains sufficient fuel and that this is the right type.
- Make sure that the nuts and bolts that fix the cylinder head have been driven to the right torque. Make sure that the fixing nuts and bolts on the intake and exhaust manifolds are tight.
- Check and adjust the tappet play and visually inspect the valve springs.
- Check the injectors. Bleed the fuel circuit and tighten all the fuel pipe unions.
- Make sure that the engine air filtering pipes are well fixed.
- Check the adjustment of the engine articulations, making sure that they operate smoothly.
- Start the engine.

2. Electronic systems

- Make sure that the electronic lift operates correctly.

3. Driving torques

- Check the driving torques of the bolts or nuts that fix the various chassis components:
 - Front axle/Engine
 - Engine/Gearbox
 - Gearbox/Rear axle
 - Axle shaft housings/Rear axle- Check the driving torque of the nuts or bolts that fix the wheels and wheel plates.



INTRODUCTION



Pre-delivery inspection and maintenance

4-3 Routine maintenance guide

PERFORM THE FOLLOWING OPERATIONS		EVERY					AS indicated
	DESCRIPTION	Daily or as required	100 hours	250 hours	500 hours	1000 hours	Servicing points (Fig.11-1)
LUBRICATION	Perform general lubrication		○				A B C D
	Lubricate three-point hitch	○					E
	Front wheel hub for axle with 2 driving wheels				○		-
ENGINE	Check engine oil level	○					3
	Change engine oil			●			12
	Change engine oil filter			●			14
	Check valve clearance				□		-
FUEL SYSTEM	Clean fuel filter bowls	○					18
	Change fuel filter cartridges				●		18
	Check injector settings					□	-
	Dry air filter: clean drain valve	○					15
	Dry air filter: clean or change cartridge	○					15
	Drain sludge from fuel tank					q	-
COOLING SYSTEM	Check coolant level in radiator	○					2
	Clean radiator fins	q					2
	Wash out cooling circuit					q	-
TRANSMISSION - BRAKES HYDRAULIC SYSTEM AND STEERING CIRCUIT	Check oil levels in gearbox (steering and hydraulic systems), front axle differential and front final drives	q					4-5-6
	Change oil in gearbox ⁽²⁾ (steering and hydraulic system), front axle differential and rear final drives					●	8-9-10-11
	Clean oil filter on the intake ⁽³⁾			q	●		16
	Change oil filter on the delivery side ⁽³⁾ of the steering circuit			●			17
	Clean the transmission and hydraulic system oil cooler	q					-
	Check and adjust free travel of brake pedals	○					-
	Check and adjust free travel of clutch pedal and PTO clutch	○					-
	Check oil level in brake circuit	○					6
ELECTRIC SYSTEM	Check level of electrolyte in battery	○					20
	Check fan belt tension	○					21
	Check efficiency of alternator and starter motor					□	-
CAB AND AIR CONDITIONING	Check level of screen wash liquid	●					-
	Check and clean cab air filter	q					19
	Change cab air filter element					●	19
	Check charge of air conditioning system	○					-
	Clean condenser of air conditioning system	q					-
	Check tension of compressor belt	○					-
OTHERS	Check tyre pressure	○					-
	Check wheel nut tightness	○					-
	Check tightness of nuts and bolts in general	○					-

REFERENCE MARKS FOR THE OPERATIONS

- Inspection, filling, lubrication or adjustment.
● Replacement.

q Cleaning or washing

□ Operations that must be carried out by the Dealer

- Operation to be carried out at least once a year.
- Initially after the first 500 hours service and then every 1000 hours.
- ATTENTION: Change the filter on the delivery side of the steering circuit after the first 50 hours service to safeguard the circuit itself. Following this, replace the filter on the delivery every 250 hours. Clean (or replace) the filter on the intake side of the hydraulic pumps after the first 250 hours service. After this, clean the filter after every 250 hours service and change it every 500 hours.**

ATTENTION: use your own discretion and experience when deciding the actual intervals for variable interval service and maintenance operations. Always remember however, that it is better to perform them too often than not often enough.



INTRODUCTION



Pre-delivery inspections and maintenance

Maintenance and service points

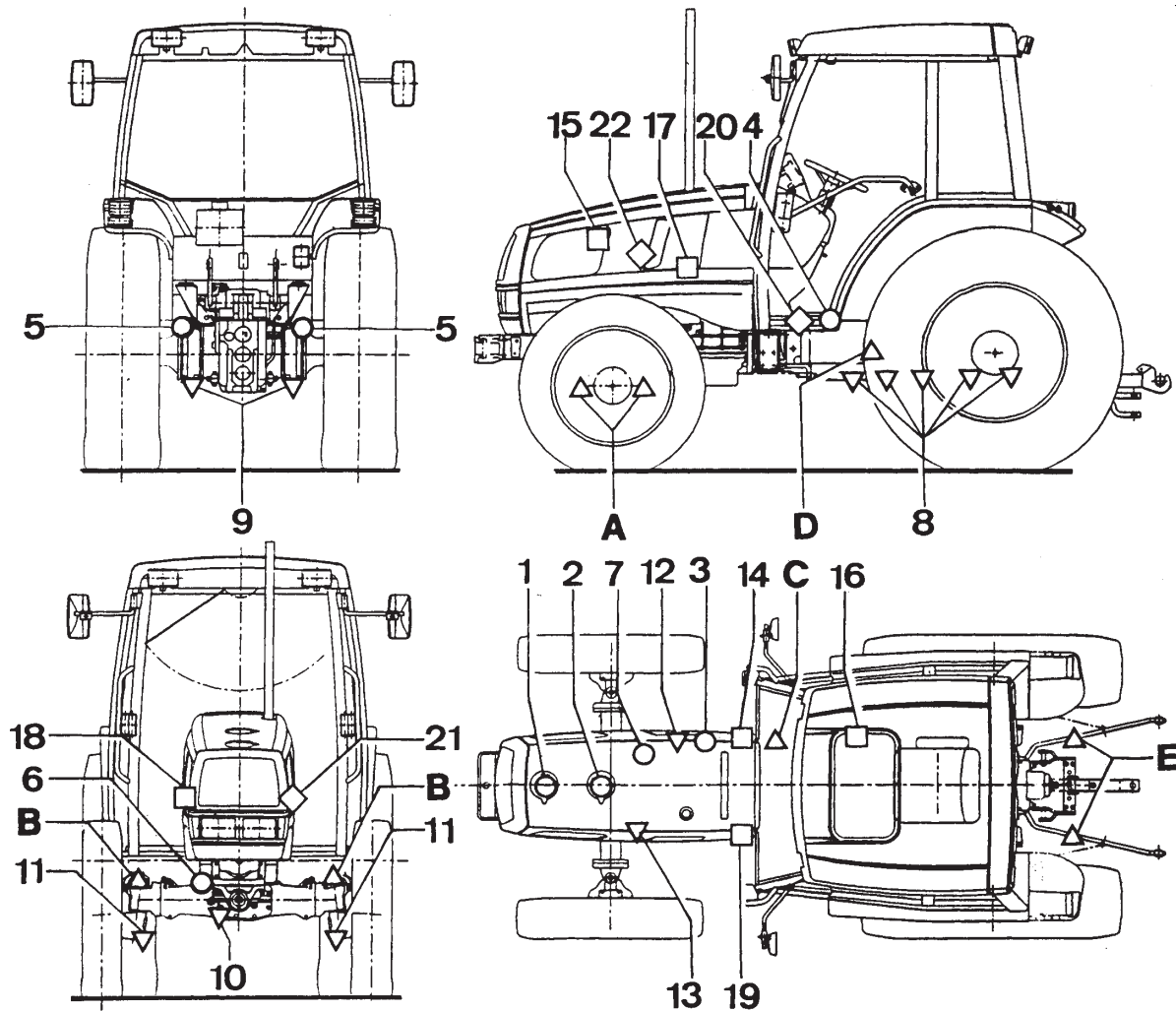


Fig.16-1

○ FILLING	□ DRAINING POINTS	□ FILTERS	◇ A/C AND ELECTRIC SYSTEMS	Q LUBRICATION
1 - Diesel fuel tank. 2 - Coolant radiator. 3 - Engine oil dipstick and fill plug. 4 - Gearbox oil. 5 - Rear final drives. 6 - Front axle. 7 - Brake fluid reservoir.	8 - Transmission oil (5 plugs). 9 - Rear final drives (2 plugs). 10 - Front axle. 11 - Front final drives. 12 - Engine oil drain plug. 13 - Engine coolant drain plug.	14 - Engine oil filter. 15 - Engine air filter. 16 - Transmission oil filter in washable gauze. 17 - Replaceable paper oil filter of the hydraulic system and steering circuit. 18 - Fuel filter. 19 - Cab air filter.	20 - Battery electrolyte level. 21 - Check fan belt tension. 22 - Check dryer/reservoir charge of A/C system.	A - Front axle hinge points (2 grease nipples). B - Steering arms (2 grease nipples). C - Thrust bearing. D - Rear brake control shaft. E - Three-point linkage.



INTRODUCTION



CHAP. 1

Conversion tables

INDEX

Sect. 5 Conversion tables

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INTRODUCTION



Sect. 5 - Conversion tables

5-1 Length

From mm to inches							
mm	inches	mm	inches	mm	inches	mm	inches
1	0.0394	26	1.0236	51	2.0079	76	2.9921
2	0.0387	27	1.0630	52	2.0472	77	3.0315
3	0.1181	28	1.1024	53	2.0866	78	3.0709
4	0.1575	29	1.1417	54	2.1260	79	3.1102
5	0.1968	30	1.1811	55	2.1653	80	3.1496
6	0.2362	31	1.2205	56	2.2047	81	3.1890
7	0.2756	32	1.2598	57	2.2441	82	3.2283
8	0.3150	33	1.2992	58	2.2835	83	3.2677
9	0.3543	34	1.3386	59	2.3228	84	3.3071
10	0.3937	35	1.3779	60	2.3622	85	3.3464
11	0.4331	36	1.4173	61	2.4016	86	3.3858
12	0.4724	37	1.4567	62	2.4409	87	3.4252
13	0.5118	38	1.4961	63	2.4803	88	3.4646
14	0.5512	39	1.5354	64	2.5197	89	3.5039
15	0.5905	40	1.5748	65	2.5590	90	3.5433
16	0.6299	41	1.6142	66	2.5984	91	3.5827
17	0.6693	42	1.6535	67	2.6378	92	3.6220
18	0.7087	43	1.6929	68	2.6772	93	3.6614
19	0.7480	44	1.7323	69	2.7165	94	3.7008
20	0.7874	45	1.7716	70	2.7559	95	3.7401
21	0.8268	46	1.8110	71	2.7953	96	3.7795
22	0.8661	47	1.8504	72	2.8346	97	3.8189
23	0.9055	48	1.8898	73	2.8740	98	3.8583
24	0.9449	49	1.9291	74	2.9134	99	3.8976
25	0.9842	50	1.9685	75	2.9527	100	3.9370

From inches to mm			
inches	mm	inches	mm
1/64	0.3969	33/64	13.0969
1/32	0.7937	17/32	13.4937
3/64	1.1906	35/64	13.8906
1/16	1.5875	9/16	14.2875
5/64	1.9844	37/64	14.6844
3/32	2.3812	19/32	15.0812
7/64	2.7781	39/64	15.4781
1/8	3.1750	5/8	15.8750
9/64	3.5719	41/64	16.2719
5/32	3.9687	21/32	16.6687
11/64	4.3656	43/64	17.0656
3/16	4.7625	11/16	17.4625
13/64	5.1594	45/64	17.8594
7/32	5.5562	23/32	18.2562
15/64	5.9531	47/64	18.6531
1/4	6.3500	3/4	19.0500

From inches to mm			
inches	mm	inches	mm
17/64	6.7469	49/64	19.4469
9/32	7.1437	25/32	19.8437
19/64	7.5406	51/64	20.2406
5/16	7.9375	13/16	20.6375
21/64	8.3344	53/64	21.0344
11/32	8.7312	27/32	21.4312
23/64	9.1281	55/64	21.8281
3/8	9.5250	7/8	22.2250
25/64	9.9219	57/64	22.6219
13/32	10.3187	29/32	23.0187
27/64	10.7156	9/64	23.4156
7/16	11.1125	15/16	23.8125
29/64	11.5094	21/64	24.2094
15/32	11.9062	31/32	24.6062
31/64	12.3031	63/64	25.0031
1/2	12.7000	1	25.4



INTRODUCTION



Conversion tables

From Ft to Meters					
ft.	0	1	2	3	4
	m	m	m	m	m
-		0.305	0.610	0.914	1.219
10	3.048	3.353	3.658	3.962	4.267
20	6.096	6.401	6.706	7.010	7.315
30	9.144	9.449	9.754	10.058	10.363
40	12.192	12.497	12.802	13.106	13.411
50	15.240	15.545	15.850	16.154	16.459
60	18.288	18.593	18.898	19.202	19.507
70	21.336	21.641	21.946	22.250	22.555
80	24.384	24.689	24.994	25.298	25.603
90	27.432	27.737	28.042	28.346	28.651
100	30.480	30.785	31.090	31.394	31.699
ft.	5	6	7	8	9
	m	m	m	m	m
-	1.524	1.829	2.134	2.438	2.743
10	4.572	4.877	5.182	5.486	5.791
20	7.620	7.925	8.230	8.534	8.839
30	10.668	10.973	11.278	11.582	11.887
40	13.716	14.021	14.326	14.630	14.935
50	16.764	17.069	17.374	17.678	17.983
60	19.812	20.117	20.422	20.726	21.031
70	22.860	23.165	23.470	23.774	24.079
80	25.908	26.213	26.518	26.822	27.127
90	28.956	29.261	29.566	29.870	30.175
100	32.004	32.309	32.614	32.918	33.223

From Meters to Ft					
m	0	1	2	3	4
	ft.	ft.	ft.	ft.	ft.
-		3.2808	6.5617	9.8425	13.1234
10	32.8084	36.0892	39.3701	42.6509	45.9318
20	65.6168	68.8976	72.1785	75.4593	78.7402
30	98.4252	101.7060	104.9869	108.2677	111.5486
40	131.2336	134.5144	137.7953	141.0761	144.3570
50	164.0420	167.3228	170.6037	173.8845	177.1654
60	196.8504	200.1312	203.4121	206.6929	209.9738
70	229.6588	232.9396	236.2205	239.5013	242.7822
80	262.4672	265.7480	269.0289	272.3097	275.5906
90	295.2756	298.5564	301.8373	305.1181	308.3990
100	328.0840	331.3648	334.6457	337.9265	341.2074
m	5	6	7	8	9
	ft.	ft.	ft.	ft.	ft.
-	16.4042	19.6850	22.9659	26.2467	29.5276
10	49.2126	52.4934	55.7743	59.0551	62.3360
20	82.0210	85.3018	88.5827	91.8635	95.1444
30	114.8294	118.1102	121.3911	124.6719	127.9528
40	147.6378	150.9186	154.1995	157.4803	160.7612
50	180.4462	183.7270	187.0079	190.2887	193.5696
60	213.2546	216.5354	219.8163	223.0971	226.3780
70	246.0630	249.3438	252.6247	255.9055	259.1864
80	278.8714	282.1522	285.4331	288.7139	291.9948
90	311.6798	314.9606	318.2415	321.5223	324.8032
100	344.4882	347.7690	351.0499	354.3307	357.6116



INTRODUCTION



Conversion tables

From Miles to Kilometers					
miles	0	1	2	3	4
	Km	Km	Km	Km	Km
-		1.609	3.219	4.828	6.437
10	16.093	17.703	19.312	20.921	22.531
20	32.187	33.796	35.406	37.015	38.624
30	48.280	49.890	51.499	53.108	54.718
40	64.374	65.983	67.593	69.202	70.811
50	80.467	82.077	83.686	85.295	86.905
60	96.561	98.170	99.779	101.390	103.000
70	112.650	114.260	115.870	117.480	119.090
80	128.750	130.360	131.970	133.580	135.190
90	144.840	146.450	148.060	149.670	151.280
100	160.930	162.540	164.150	165.760	167.370
miles	5	6	7	8	9
	Km	Km	Km	Km	Km
-	8.047	9.656	11.265	12.875	14.484
10	24.140	25.750	27.359	28.968	30.578
20	40.234	41.843	43.452	45.062	46.671
30	56.327	57.936	59.546	61.155	62.764
40	72.421	74.030	75.639	77.249	78.858
50	88.514	90.123	91.733	93.342	94.951
60	104.610	106.220	107.830	109.440	111.040
70	120.700	122.310	123.920	125.530	127.140
80	136.790	138.400	140.010	141.620	143.230
90	152.890	154.500	156.110	157.720	159.330
100	168.980	170.590	172.200	173.810	175.420

From Kilometers to Miles					
Km	0	1	2	3	4
	miles	miles	miles	miles	miles
-		0.621	1.243	1.864	2.486
10	6.214	6.835	7.457	8.078	8.699
20	12.427	13.049	13.670	14.292	14.913
30	18.641	19.263	19.884	20.506	21.127
40	24.855	25.477	26.098	26.720	27.341
50	31.069	31.690	32.311	32.933	33.554
60	37.282	37.904	38.525	39.147	39.768
70	43.497	44.118	44.739	45.361	45.982
80	49.711	50.332	50.953	51.575	52.196
90	55.924	56.545	57.166	57.788	58.409
100	62.138	62.759	63.380	64.002	64.623
Km	5	6	7	8	9
	miles	miles	miles	miles	miles
-	3.107	3.728	4.350	4.971	5.592
10	9.321	9.942	10.562	11.185	11.805
20	15.534	16.156	16.776	17.399	18.019
30	21.748	22.370	22.990	23.613	24.233
40	27.962	28.584	29.204	29.827	30.447
50	34.175	34.797	35.417	36.040	36.660
60	40.389	41.011	41.631	42.254	42.874
70	46.603	47.225	47.845	48.468	49.088
80	52.817	53.439	54.059	54.682	55.302
90	59.030	59.652	60.272	60.895	61.515
100	65.244	65.866	66.486	67.109	67.729



INTRODUCTION



Conversion tables

5-2 Area

From square inches to square centimeters					
in ⁽²⁾	0	1	2	3	4
	cm ⁽²⁾	cm ⁽²⁾	cm ⁽²⁾	cm ⁽²⁾	cm ⁽²⁾
-		6.452	12.903	19.355	25.806
10	64.516	70.968	77.419	83.871	90.322
20	129.032	135.484	141.935	148.387	154.838
30	193.548	200.000	206.451	212.903	219.354
40	258.064	264.516	270.967	277.419	283.870
50	322.580	329.032	335.483	341.935	348.386
60	397.096	393.548	399.999	406.451	412.902
70	451.612	458.064	464.515	470.967	477.418
80	516.128	522.580	529.031	535.483	541.934
90	580.644	587.096	593.547	599.999	606.450
100	645.160	651.612	658.063	664.515	670.966

in ⁽²⁾	5	6	7	8	9
	cm ⁽²⁾	cm ⁽²⁾	cm ⁽²⁾	cm ⁽²⁾	cm ⁽²⁾
-	32.258	38.710	45.161	51.613	58.064
10	96.774	103.226	109.677	116.129	122.580
20	161.290	167.742	174.193	180.645	187.096
30	225.806	232.258	238.709	245.161	251.612
40	290.322	296.774	303.225	309.677	316.128
50	354.838	361.290	367.741	374.193	380.644
60	419.354	425.806	432.357	438.709	445.160
70	483.870	490.322	496.773	503.225	509.676
80	548.386	554.838	561.289	567.741	574.192
90	612.902	619.354	625.805	632.257	638.708
100	677.418	683.870	690.321	696.773	703.224

From square centimeters to square inches					
cm ⁽²⁾	0	1	2	3	4
	in ⁽²⁾	in ⁽²⁾	in ⁽²⁾	in ⁽²⁾	in ⁽²⁾
-		0.155	0.310	0.465	0.620
10	1.550	1.705	1.860	2.015	2.170
20	3.100	3.255	3.410	3.565	3.720
30	4.650	4.805	4.960	5.115	5.270
40	6.200	6.355	6.510	6.665	6.820
50	7.750	7.905	8.060	8.215	8.370
60	9.300	9.455	9.610	9.765	9.920
70	10.850	11.005	11.160	11.315	11.470
80	12.400	12.555	12.710	12.865	13.020
90	13.950	14.105	14.260	14.415	14.570
100	15.500	15.655	15.810	15.965	16.120

cm ⁽²⁾	5	6	7	8	9
	in ⁽²⁾	in ⁽²⁾	in ⁽²⁾	in ⁽²⁾	in ⁽²⁾
-	0.775	0.930	1.085	1.240	1.395
10	2.325	2.480	2.635	2.790	2.945
20	3.875	4.030	4.185	4.340	4.495
30	5.425	5.580	5.735	5.890	6.045
40	6.975	7.130	7.285	7.440	7.595
50	8.525	8.680	8.835	8.990	9.145
60	10.075	10.230	10.385	10.540	10.695
70	11.625	11.780	11.935	12.090	12.245
80	13.175	13.330	13.485	13.640	13.795
90	14.725	14.880	15.035	15.190	15.345
100	16.275	16.430	16.385	16.740	16.895



INTRODUCTION



Conversion tables

5-3 Volume

From cubic inches to cubic centimeters					
in ⁽³⁾	0	1	2	3	4
	cm ⁽³⁾ (cc)	cm ⁽³⁾ (cc)	cm ⁽³⁾ (cc)	cm ⁽³⁾ (cc)	cm ⁽³⁾ (cc)
-		16.387	32.774	49.161	65.548
10	163.871	180.258	196.645	213.032	229.419
20	327.741	344.128	360.515	376.902	393.290
30	491.612	507.999	524.386	540.773	557.160
40	655.483	671.870	688.257	704.644	721.031
50	819.353	835.740	852.127	868.514	884.901
60	983.224	999.611	1015.998	1032.385	1048.772
70	1147.094	1163.482	1179.869	1196.256	1212.643
80	1310.965	1327.352	1343.739	1360.126	1376.513
90	1474.836	1491.223	1507.610	1523.997	1540.384
100	1638.706	1655.093	1671.481	1687.868	1704.255
in ⁽³⁾	5	6	7	8	9
	cm ⁽³⁾ (cc)	cm ⁽³⁾ (cc)	cm ⁽³⁾ (cc)	cm ⁽³⁾ (cc)	cm ⁽³⁾ (cc)
-	81.935	98.322	114.709	131.097	147.484
10	245.806	262.193	278.580	294.967	311.354
20	209.677	426.064	442.451	458.838	475.225
30	573.547	589.934	606.321	622.708	639.095
40	737.418	753.805	770.192	786.579	802.966
50	901.289	917.676	934.063	950.450	966.837
60	1065.159	1081.546	1097.933	1114.320	1130.707
70	1229.030	1245.417	1261.804	1278.191	1294.578
80	1392.200	1409.288	1425.675	1442.062	1458.449
90	1556.771	1573.158	1589.545	1605.932	1622.319
100	1720.642	1737.029	1753.416	1769.803	1786.190

From cubic centimeters to cubic inches					
cm ⁽³⁾ (cc)	0	1	2	3	4
	in ⁽³⁾	in ⁽³⁾	in ⁽³⁾	in ⁽³⁾	in ⁽³⁾
-		0.0610	0.1220	0.1831	0.2441
10	0.6102	0.6713	0.7323	0.7933	0.8543
20	1.2205	1.2815	1.3425	1.4035	1.4646
30	1.8307	1.8917	1.9528	2.0138	2.0748
40	2.4409	2.5020	2.5630	2.6240	2.6850
50	3.0512	3.1122	3.1732	3.2343	3.2953
60	3.6614	3.7224	3.7835	3.8445	3.9055
70	4.2717	4.3327	4.3937	4.4547	4.5158
80	4.8819	4.9429	5.0039	5.0650	5.1260
90	5.4921	5.5532	5.6142	5.6752	5.7362
100	6.1024	6.1634	6.2244	6.2854	6.3465
cm ⁽³⁾ (cc)	5	6	7	8	9
	in ⁽³⁾	in ⁽³⁾	in ⁽³⁾	in ⁽³⁾	in ⁽³⁾
-	0.3051	0.3661	0.4272	0.4882	0.5492
10	0.9154	0.9764	1.0374	1.0984	1.1595
20	1.5256	1.5866	1.6476	1.7087	1.7697
30	2.1358	2.1969	2.2579	2.3189	2.3799
40	2.7461	2.8071	2.8681	2.9291	2.9902
50	3.3563	3.4173	3.4784	3.5394	3.6004
60	3.9665	4.0276	4.0886	4.1495	4.2106
70	4.5768	4.6378	4.6988	4.7599	4.8209
80	5.1870	5.2480	5.3091	5.3701	5.4311
90	5.7973	5.8583	5.9193	5.9803	6.0414
100	6.4075	6.4685	6.5295	6.5906	6.6516



INTRODUCTION



Conversion tables

From gallons (U.S.) to liters					
U.S. gal.	0	1	2	3	4
	liters	liters	liters	liters	liters
-		3.7854	7.5709	11.3563	15.1417
10	37.8543	41.6397	45.4251	49.2105	52.9960
20	75.7085	79.4940	83.2794	87.0648	90.8502
30	113.5528	117.3482	121.1337	124.9191	128.7045
40	151.4171	155.2025	158.9879	162.7734	166.5588
50	189.2713	193.0568	196.8422	200.6276	204.4131
60	227.1256	230.9110	234.6965	238.4819	242.2673
70	264.9799	268.7653	272.5507	276.3362	280.1216
80	302.8342	306.6196	310.4050	314.1904	317.9759
90	340.6884	344.4738	348.2593	352.0447	355.8301
100	378.5427	382.3281	386.1135	389.8990	393.6844
U.S. gal.	5	6	7	8	9
	liters	liters	liters	liters	liters
-	18.9271	22.7126	26.4980	30.2834	34.0638
10	56.7814	60.5668	64.3523	68.1377	71.9231
20	94.6357	98.4211	102.2065	105.9920	109.7774
30	132.4899	136.2754	140.0608	143.8462	147.6316
40	170.3442	174.1296	177.9151	181.7005	185.4859
50	208.1985	211.9839	215.7693	219.5548	223.3402
60	246.0527	249.8382	253.6236	257.4090	261.1945
70	283.9070	287.6924	291.4779	295.2633	299.0487
80	321.7613	325.5467	329.3321	333.1176	336.9030
90	359.6156	363.4010	367.1864	370.9718	374.7573
100	397.4698	401.2553	405.0407	408.8261	412.6115

From liters to gallons (U.S.)					
Liters	0	1	2	3	4
	gal.	gal.	gal.	gal.	gal.
-		0.2642	0.5283	0.7925	1.0567
10	2.6417	2.9059	3.1701	3.4342	3.6984
20	5.2834	5.5476	5.8118	6.0759	6.3401
30	7.9251	8.1893	8.4535	8.7176	8.9818
40	10.5668	10.8310	11.0952	11.3594	11.6235
50	13.2086	13.4727	13.7369	14.0011	14.2652
60	15.8503	16.1144	16.3786	16.6428	16.9069
70	18.4920	18.7561	19.0203	19.2845	19.5487
80	21.1337	21.3979	21.6620	21.9262	22.1904
90	23.7754	24.0396	24.3037	24.5679	24.8321
100	26.4171	26.6813	26.9454	27.2096	27.4738
Liters	5	6	7	8	9
	gal.	gal.	gal.	gal.	gal.
-	1.3209	1.5850	1.8492	2.1134	2.3775
10	3.9626	4.2267	4.4909	4.7551	5.0192
20	6.6043	6.8684	7.1326	7.3968	7.6610
30	9.2460	9.5102	9.7743	10.0385	10.3027
40	11.8877	12.1519	12.4160	12.6802	12.9444
50	14.5294	14.7936	15.0577	15.3219	15.5861
60	17.1711	17.4353	17.6995	17.9636	18.2278
70	19.8128	20.0770	20.3412	20.6053	20.8695
80	22.4545	22.7187	22.9829	23.2470	23.5112
90	25.0962	25.3604	25.6246	25.8888	26.1529
100	27.7380	28.0021	28.2663	28.5305	28.7946



INTRODUCTION



Conversion tables

From gallons (IMP) to liters					
Imp gal.	0	1	2	3	4
	liters	liters	liters	liters	liters
-		4.5460	9.0919	13.6379	18.1838
10	45.4596	50.0056	54.5515	59.0975	63.6434
20	90.9192	95.4652	100.0111	104.5571	109.1030
30	136.3788	140.9248	145.4707	150.0167	154.5626
40	181.8384	186.3844	190.9303	195.4763	200.0222
50	227.2980	231.8440	236.3899	240.9359	245.4818
60	272.7576	277.3036	281.8495	286.3955	290.9414
70	318.2172	322.7632	327.3091	331.8551	336.4010
80	363.6768	368.2223	372.7687	377.3147	381.8606
90	409.1364	413.6824	418.2283	422.7743	427.3202
100	454.5960	459.1420	463.6879	468.2339	472.7798
Imp gal.	5	6	7	8	9
	liters	liters	liters	liters	liters
-	22.7298	27.2758	31.8217	36.3677	40.9136
10	68.1894	72.2354	77.2813	81.8275	86.3732
20	113.6490	118.1950	122.7409	127.2869	131.8328
30	159.1086	163.6546	168.0005	172.7465	177.2924
40	204.5682	209.1142	213.6601	218.2061	222.7520
50	250.0278	254.5738	259.1197	263.6657	268.2116
60	295.4874	300.0334	304.5793	309.1253	313.6712
70	340.9470	345.4930	350.0389	354.5849	359.1308
80	386.4066	390.9526	395.4985	400.0445	404.5004
90	431.8662	436.4122	440.9581	445.9041	450.0500
100	477.3258	481.8718	486.4177	490.9637	495.5096

From liters to gallons (IMP)					
Liters	0	1	2	3	4
	gal.	gal.	gal.	gal.	gal.
-		0.2200	0.4400	0.6599	0.8799
10	2.1998	2.4197	2.6397	2.8597	3.0797
20	4.3995	4.6195	4.8395	5.0594	5.2794
30	6.5993	6.8193	7.0392	7.2592	7.4792
40	8.7990	9.0190	9.2390	9.4590	9.6789
50	10.9988	11.2188	11.4388	11.6587	11.8787
60	13.1986	13.4185	13.6385	13.8585	14.0785
70	15.3983	15.6183	15.8383	16.0582	16.2782
80	17.5981	17.8181	18.0380	18.2580	18.4780
90	19.7978	20.0178	20.2378	20.4578	20.6777
100	21.9976	22.2176	22.4376	22.6575	22.8775
Liters	5	6	7	8	9
	gal.	gal.	gal.	gal.	gal.
-	1.0999	1.3199	1.5398	1.7598	1.9798
10	3.2996	3.5196	3.7396	3.9596	4.1795
20	5.4994	5.7194	5.9394	6.1593	6.3793
30	7.6992	7.9191	8.1391	8.3591	8.5791
40	9.8989	10.9189	10.3389	10.5588	10.7788
50	12.0987	12.3187	12.5386	12.7586	12.9786
60	14.2984	14.5184	14.7384	14.9584	15.1783
70	16.4982	16.7182	16.9382	17.1581	17.3781
80	18.6980	18.9179	19.1379	19.3579	19.5779
90	20.8977	21.1177	21.3377	21.5576	21.7776
100	23.0975	23.3175	23.5374	23.7574	23.9774