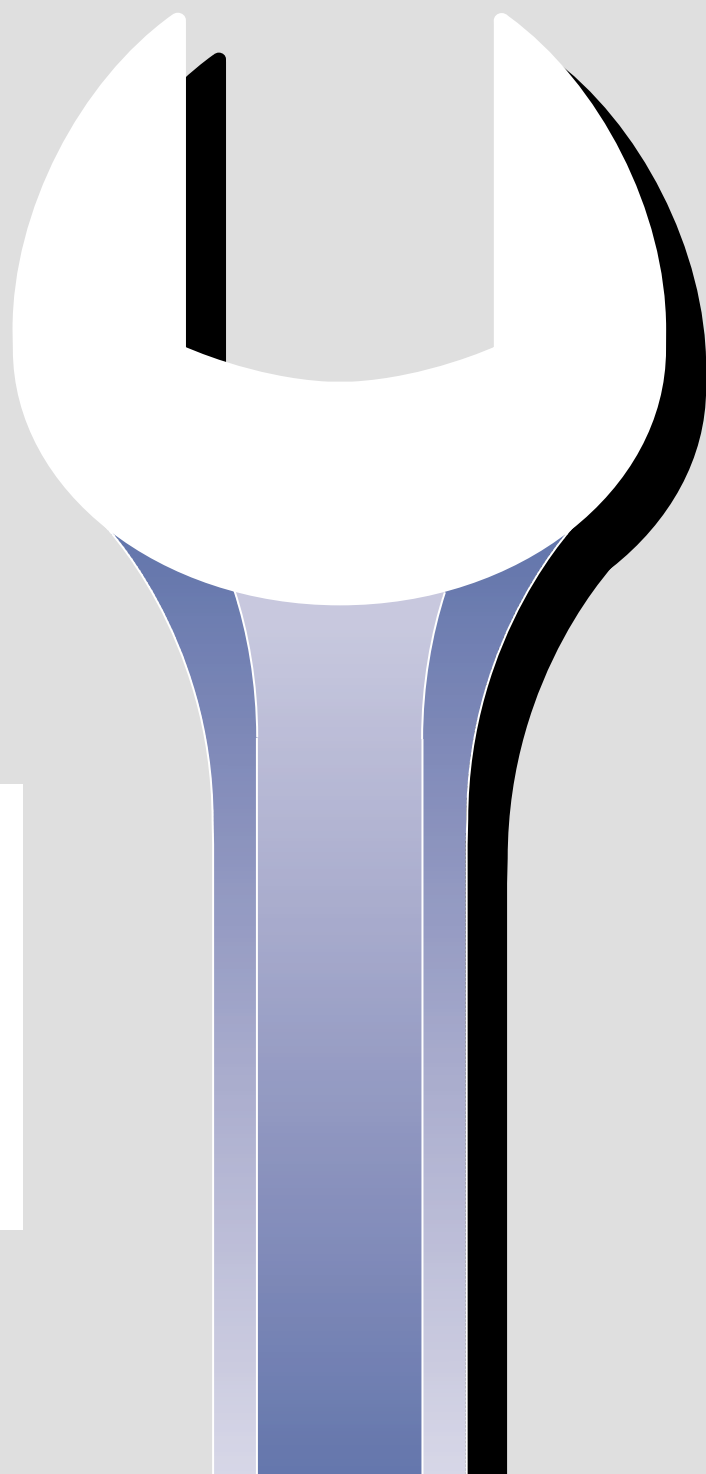




REPAIR MANUAL

ZF 3 M (HBW 35)
ZF 5 M (HBW 50)
ZF 10 M (HBW 100)
ZF 12 M (HBW 125) / HBW 10
ZF 15 M (HBW 150)
ZF 15 MA (HBW 150 A)
ZF 15 MIV (HBW 150 V)
ZF 25 M (HBW 250)
ZF 25 MA
ZF 30 M



This ZF M manual has been prepared for all those who have to do with ZF-HURTH Marine reversing gearbox units of the ZF M line, including models ZF 3 M, ZF 5 M, ZF 10 M, ZF 12 M, ZF 15 M, ZF 15 MA, ZF 25 M, ZF 25 MA, ZF 30 M, ZF 15 MIV, in particular for

- **power plant suppliers**
- **shipyards**
- **craft owners**

The ZF M manual is intended as an aid for handling ZF M transmissions and will answer all questions that may arise in daily operation and in connection with the installation and repair of ZF M transmissions.

This manual contains:

- Technical description of the gearbox units and a number of important technical data;
- Instructions for proper installation of the gearbox in the craft;
- Explanatory notes on correct operation and maintenance;
- Detailed description of all disassembly and reassembly procedures (with drawings);
- Troubleshooting table with possible causes of trouble and the required remedial action;
- Spare parts list with stock numbers of all spare parts;
- Explosion-View drawings showing each part with the reference numerals used in the text.

No problems will be encountered in handling, installing and operating the ZF M gearbox if the instructions in this manual are followed. Should a repair be necessary, a qualified technician will have no difficulty in doing the repair work in accordance with the detailed instructions given on the following pages.

In addition, ZF M Service Stations (distributors and dealers) are available for any repairs and for supplying the spare parts required. The manufacturer will always be glad to name the Service Station nearest to your location.

All transmission units are covered by a worldwide guarantee given by the manufacturer. The manufacturer's warranty will be subject to the condition that:

- the instructions in this manual are strictly observed in handling the transmission.
- no work is performed by persons not authorized by ZF-HURTH Marine.
- no changes or alterations of any kind are made on the transmission.

Failure to observe these points will invalidate all and any warranty claims.

Caution: never start doing any work on the transmission unless and until the engine and the propeller have come to a complete standstill.

Table of contents

1. Description

- 1.1 Brief description
- 1.2 Technical data and main dimensions
 - 1.2.1 ZF 3 M boat reversing gearbox unit
 - 1.2.2 ZF 5 M boat reversing gearbox unit
 - 1.2.3 ZF 10 M boat reversing gearbox unit
 - 1.2.4 ZF 12 M boat reversing gearbox unit
 - 1.2.5 ZF 15 M boat reversing gearbox unit
 - 1.2.6 ZF 15 MA boat reversing gearbox unit
 - 1.2.7 ZF 15 MIV boat reversing gearbox unit
 - 1.2.8 ZF 25 M boat reversing gearbox unit
 - 1.2.9 ZF 25 MA boat reversing gearbox unit
 - 1.2.10 Accessories
 - 1.2.11 Tools
 - 1.2.12 Ident. No.
- 1.3 Gear casing
- 1.4 Gear set
- 1.5 Multiple-disc clutch and clutch operation
- 1.6 Shaft bearings
- 1.7 Shaft seals
- 1.8 Lubrication
- 1.9 Cooling unit

2. Installation

- 2.1 Delivery condition
- 2.2 Transport
- 2.3 Removal of preservative
- 2.4 Painting the gearbox
- 2.5 Connection of gearbox with engine
- 2.6 Connection of gearbox with propeller
- 2.7 Suspension of engine-gearbox assembly in the boat
- 2.8 Position of gearbox in the boat
- 2.9 Operation of gearbox
- 2.10 Cooling unit
- 2.11 Engine-gearbox compartment

3. Operation

- 3.1 General information
- 3.2 Initial operation
- 3.3 Operating temperature
- 3.4 Operation of gearbox
- 3.5 Sailing or moving in tow
- 3.6 Lay-up periods
- 3.7 Preparation for re-use

4. Maintenance

- 4.1 Transmission oil
- 4.2 Oil quantity
- 4.3 Oil level checks
- 4.4 Oil change
- 4.5 Checking the shift cable and linkage
- 4.6 Cooling unit
- 4.7 Automatic transmission fluid List of recommended fluids

5. Disassembly

- 5.1 Removing the cooling unit
- 5.2 Removing and disassembling the actuating lever cover plate
- 5.3 Removing the bearing shields
- 5.4 Separating the gearbox sections and removing the input and output shafts
- 5.5 Removing the shifting fork
- 5.6 Removing the intermediate gear
- 5.7 Disassembling the input shaft
- 5.8 Disassembling the output shaft
- 5.9 Disassembling the quill shaft

6. Reassembly

- 6.1 General information
- 6.2 Pre-assembling the intermediate gear shaft in the gearbox section without opening
- 6.3 Pre-assembling the shifting fork in the gearbox section with opening
- 6.4 Pre-assembling the actuating lever cover plate
- 6.5 Pre-assembling the gears
- 6.6 Measuring the pre-assembled gears to determine setting value «a»
- 6.7 Pre-assembling the bearing shields
- 6.8 Pre-assembling the actuating members
- 6.9 Reassembling the input shaft
- 6.10 Reassembling the output shaft
- 6.11 Reassembling the quill shaft
- 6.12 Final assembly of gearbox
- 6.13 Measuring the gear sets of input shaft and output shaft
- 6.14 Mounting the actuating lever cover plate
- 6.15 Mounting the cooling unit

7. Procedure to adjust the shifting lever cover

8. Troubleshooting

9. Spare parts list

10. Drawings (Explosion view)

1. Description

1.1 Brief description

ZF-HURTH Marine boat reversing gearbox units of the ZF M line are servo-automatically controlled helical gear transmissions developed for use in pleasure craft and commercial craft. The servo-operated multiple-disc clutch requires only minimum effort for shifting, making the ZF M transmission suitable for single-lever remote control via a rod linkage or shift cable.

In emergency situations the ZF M permits direct reversing at engine speed above idle rpm.

The torque capacity of the clutch is exactly rated, preventing shock loads from exceeding a predetermined value to ensure maximum protection of the engine and thus providing the effect of a safety clutch.

The transmission units are characterized by low weight and small overall dimensions. The gearbox castings are made of a high-strength, corrosion-resistant aluminium alloy, chromized for improved seawater resistance and optimum adhesion of paint.

A choice of gear ratios, a high efficiency rating and low-noise operation are other prominent features of the ZF M gearbox units.

The transmissions are immersion-lubricated. Maintenance is restricted to oil level checks (see «Maintenance», chapter 4).

The shafts are supported by heavy-duty taper roller bearings and the gearbox is designed to take the axial propeller thrust (for permissible values see «Technical data», item 1.2).

Transmission sizes are available for right-hand (RH) and left-hand (LH) rotation of the input shaft, the direction of rotation being specified as seen by an observer facing the input shaft.

In gear lever positions A, the engine shaft and the propeller shaft rotate in opposite directions, in position B in the same direction (Fig. 1).

On model ZF 15 MIV, the directions of rotation are the other way round (Fig. 2).

Engine manufacturers should note that the direction of rotation refers to an observer facing the flywheel, so that left-hand rotation of the engine corresponds to right-hand rotation of the gearbox input shaft.

Fig. 1

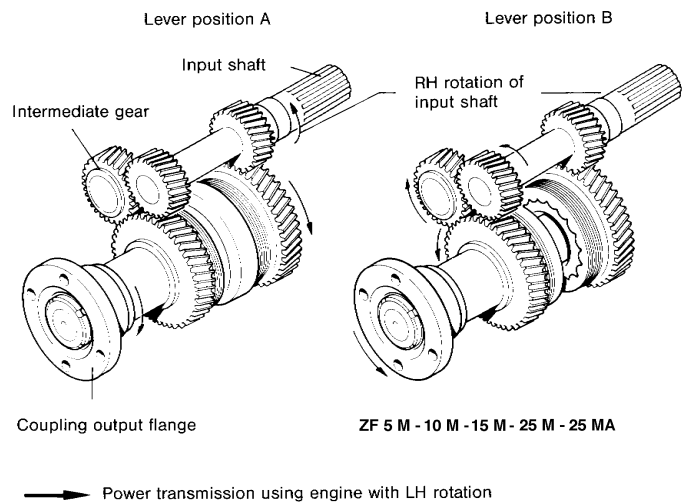
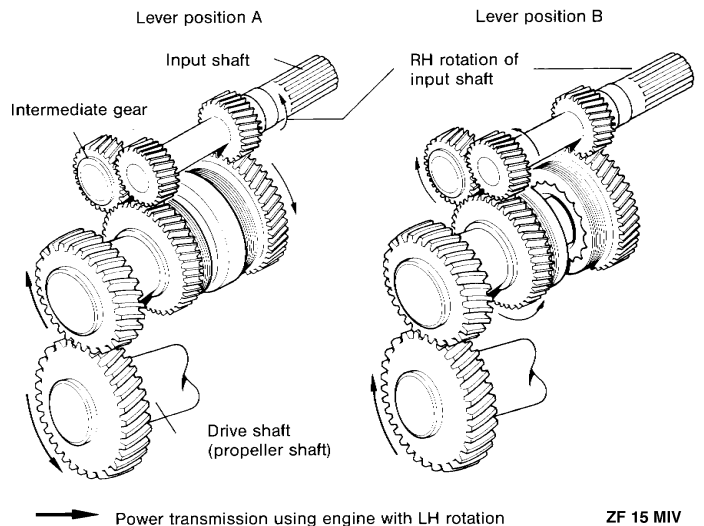
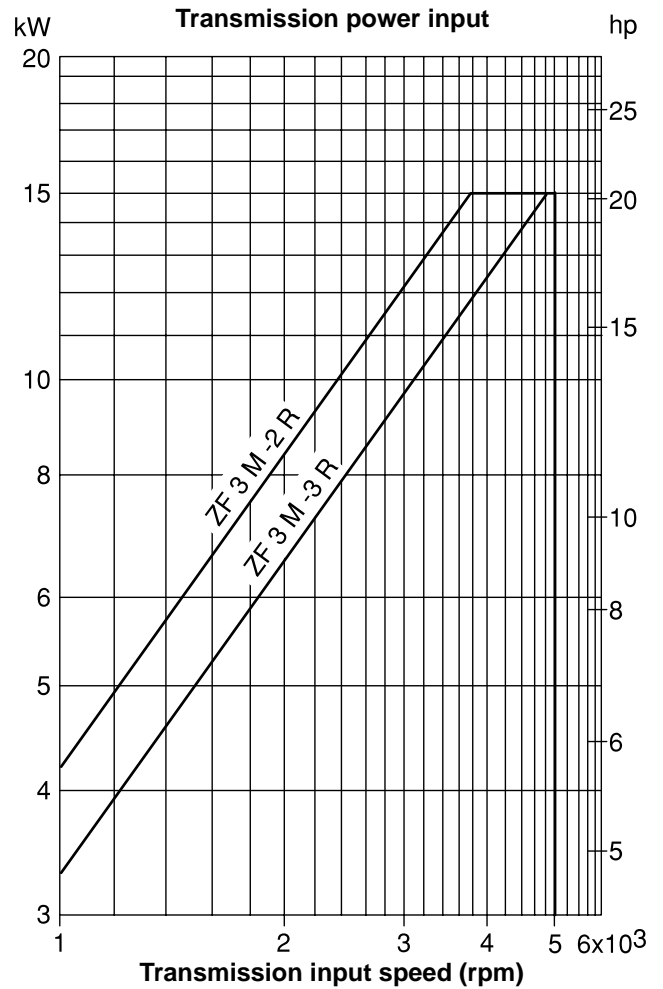


Fig. 2



1.2.1 ZF 3 M

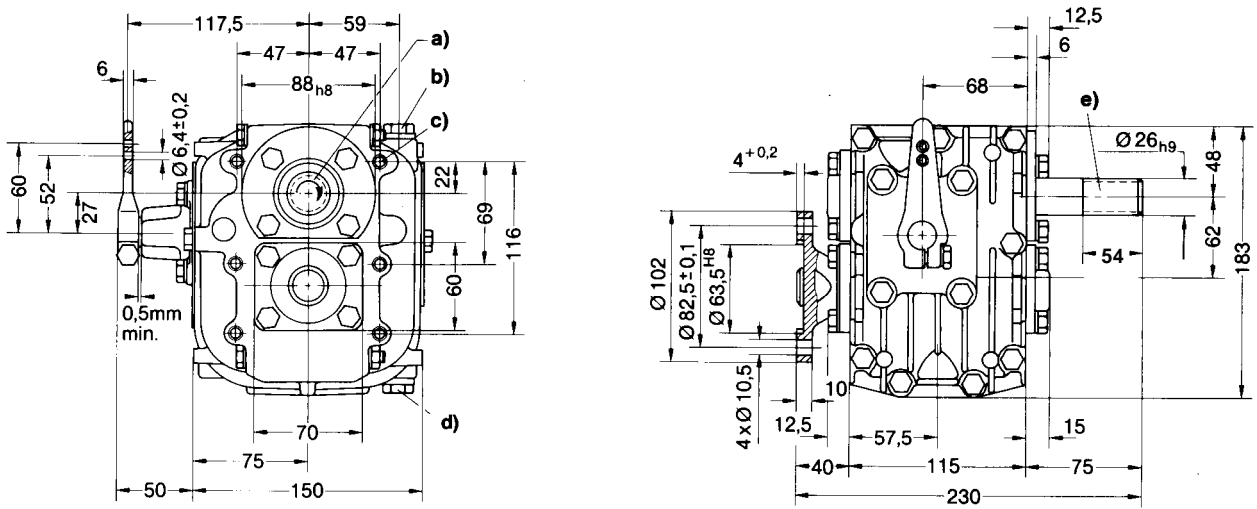


Power diagram

Based on engine power B to DIN 6270;
 shock factor
 K = 1.25 to applied, if engine has 1 cylinder
 K = 1.20 for 2 cylinders
 K = 1.15 for 3 cylinders

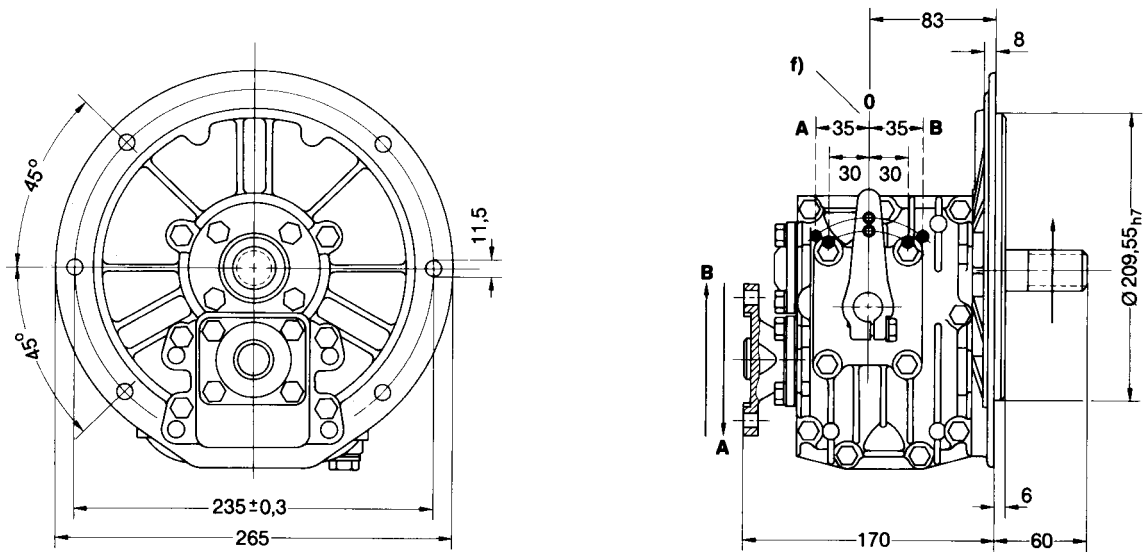
Technical data		ZF 3 M-2 R	ZF 3 M-3 R
Shifting position «A»	ratio	2.05:1	2.72:1
Shifting position «B»	ratio	1.86:1	2.15:1
Input torque max.	Nm (ft lb)	40 (29,5)	30 (22,1)
Power input max.	kW (hp)	15 (20)	
Input speed max.	rpm	5000	
Propeller thrust max.	N (lb)	1000 (225)	
Weight without fluid	kg (lb)	8 (17.7)	
Fluid quantity	liter	0.3	
Fluid grade		Automatic-Transmission-Fluid (ATF)	

Fig. 3 ZF 3 M



Model without mounting flange

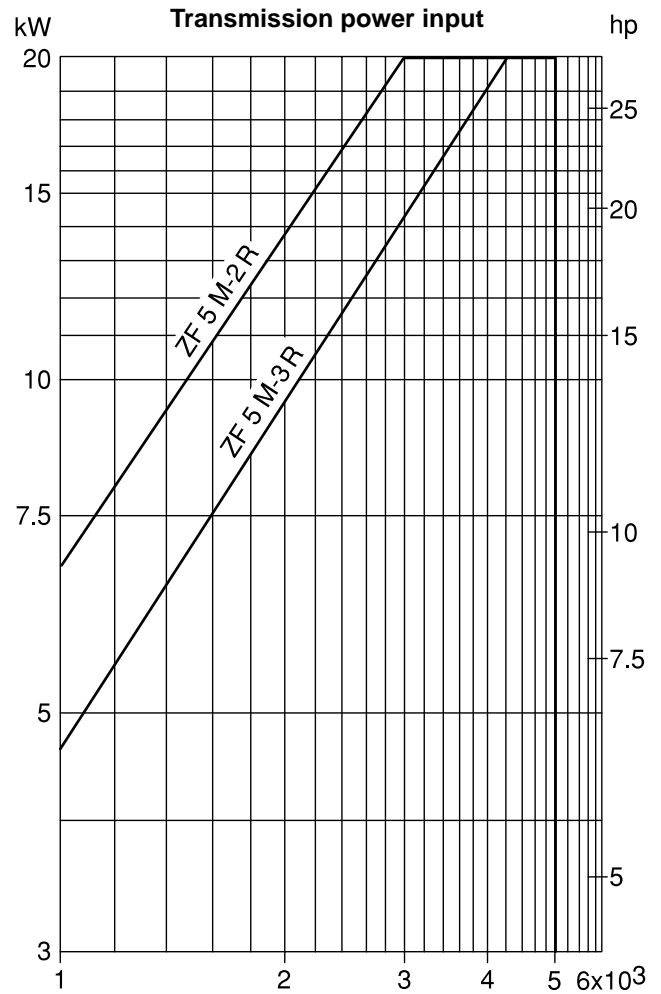
- a) Clockwise rotation b) Oil dipstick and filler screw 17mm c) M 8/12 deep, holes same on both sides d) Oil drain plug 17mm width across flats e) Spline profile similar B 10x23x29 DIN 5464 f) Minimum lever travel



All dimensions in mm

Model with mounting flange

1.2.2 ZF 5 M



Power diagram for Pleasure Craft Duty
 Based on engine power B to DIN 6270;
 shock factor
 K = 1.25 to applied, if engine has 1 cylinder
 K = 1.20 for 2 cylinders
 K = 1.15 for 3 cylinders

MODEL	RATIO		POWER / RPM		INPUT POWER CAPACITY						MAX RPM	WEIGHT		BELL HSGS. AND NOTES
	«A» Pos	«B»Pos	kW	hp	2800 rpm		3000 rpm		3600 rpm			kg	lb	
					kW	hp	kW	hp	kW	hp				
ZF 5 M	2.045 2.722	1.864 2.150	0.0066 0.0047	0.0088 0.0063	18 13	25 18	20 14	27 19	20 17	27 23	5000 5000	8 18	B/W Max input power 15 kW	

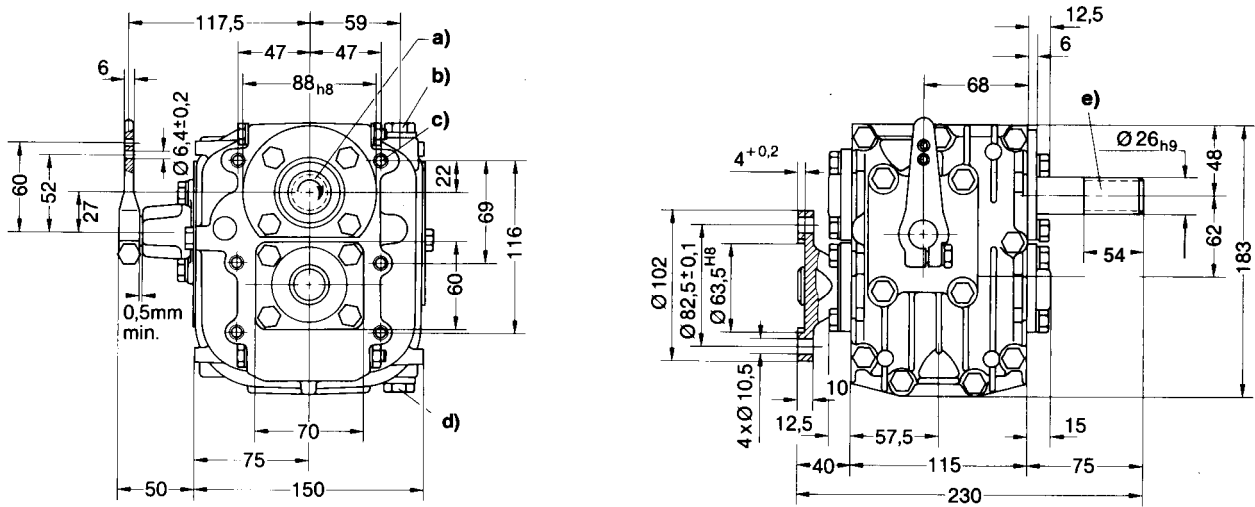
«A» POS = continuous running position (normally AHEAD).

«B» POS = reverse position.

B/W = Borg Warner adaptor.

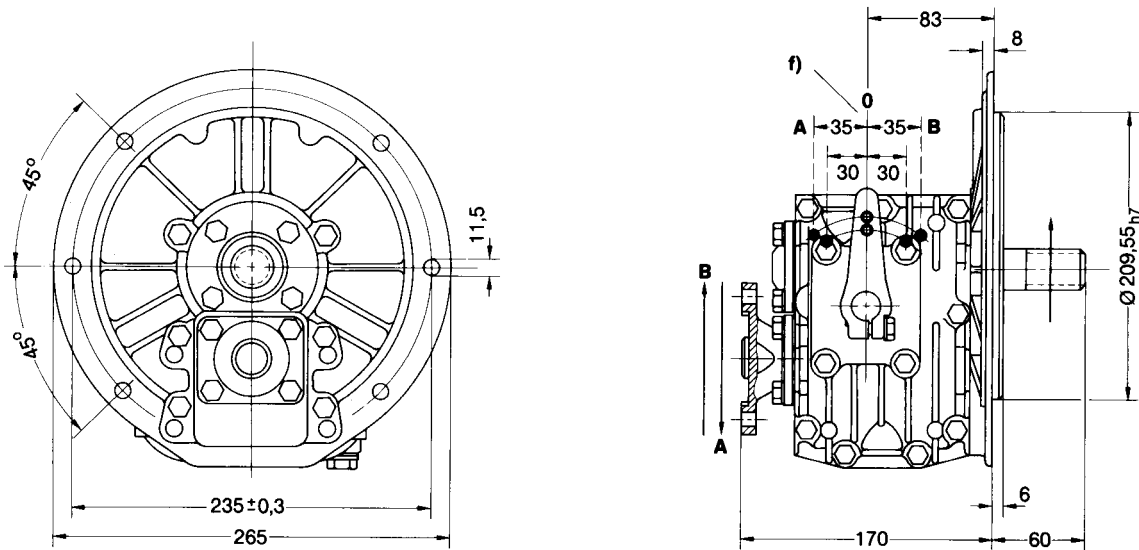
Note = For all «M» (Mechanical) transmission reduce power capacity by the following schock factors: 1 cylinder engine ÷ 1.25, 2 cylinder engine ÷ 1.20, 3 cylinder engine ÷ 1.15.

Fig. 4 ZF 5 M



Model without mounting flange

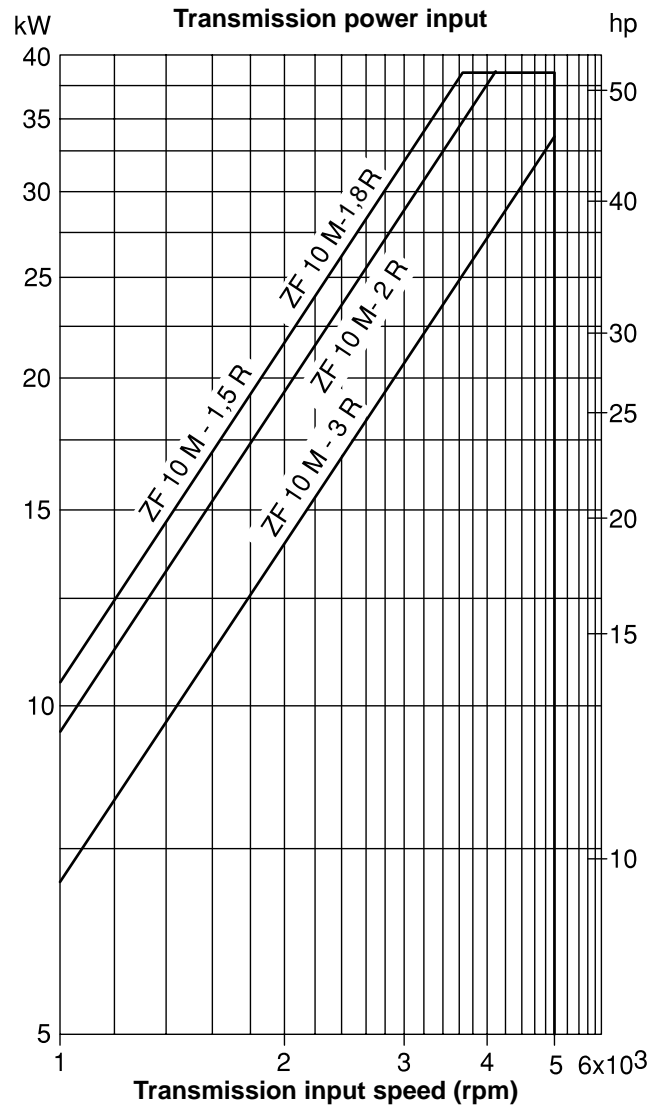
- a) Clockwise rotation b) Oil dipstick and filler screw 17mm c) M 8/12 deep, holes same on both sides d) Oil drain plug 17mm width across flats e) Spline profile similar B 10x23x29 DIN 5464 f) Minimum lever travel



All dimensions in mm

Model with mounting flange

1.2.3 ZF 10 M



Power diagram for Pleasure Craft Duty

Based on engine power B to DIN 6270;
shock factor

K = 1.25 to applied, if engine has 1 cylinder

K = 1.20 for 2 cylinders

K = 1.15 for 3 cylinders

** Max. 95 Nm (70 ft lb) admissible for main travelling direction with gear lever set to «B»

MODEL	RATIO		POWER / RPM		INPUT POWER CAPACITY						MAX RPM	WEIGHT		BELL HSGS. AND NOTES	
	«A» Pos	«B»Pos	kW	hp	2800 rpm		3000 rpm		3600 rpm			kg	lb		
					kW	hp	kW	hp	kW	hp					
ZF 10 M	1.482	1.864	0.0109	0.0146	30	41	33	44	38	51	5000	9.5	21	SAE 4, 5, B/W Max input power 38 kW. Ratio 1.482 «B» Pos. max torque 95 Nm. Ratio 1.792 «B» Pos. max torque 95 Nm.	
	1.792	1.864			27	36	29	38	34	46					5000
	2.045	1.864			19	26	20	27	25	33					5000
	2.722	2.150													

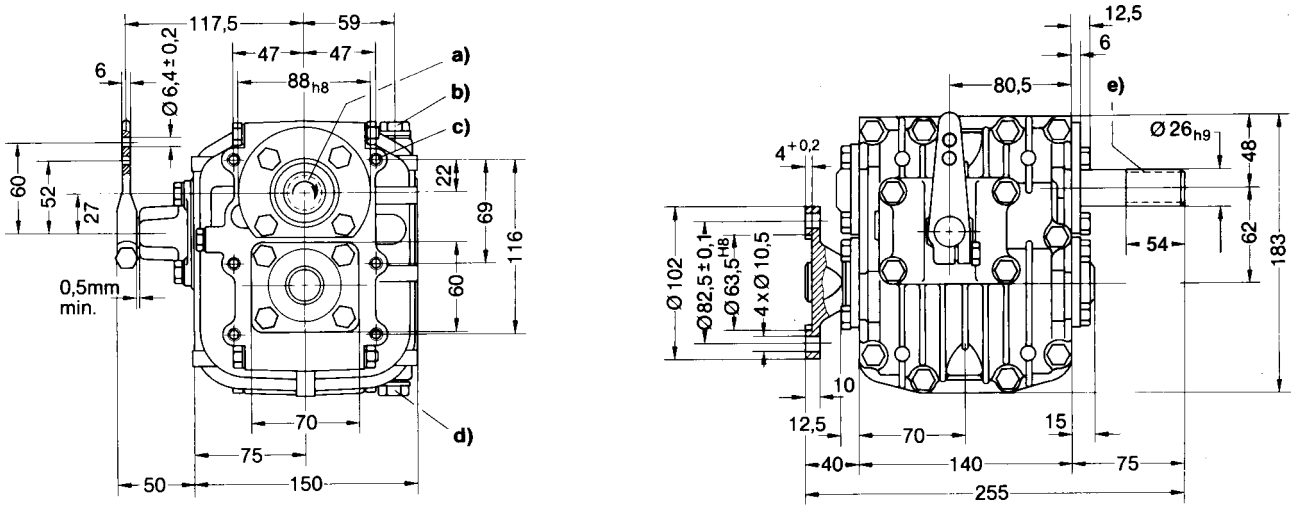
«A» POS = continuous running position (normally AHEAD).

«B» POS = reverse position.

B/W = Borg Warner adaptor.

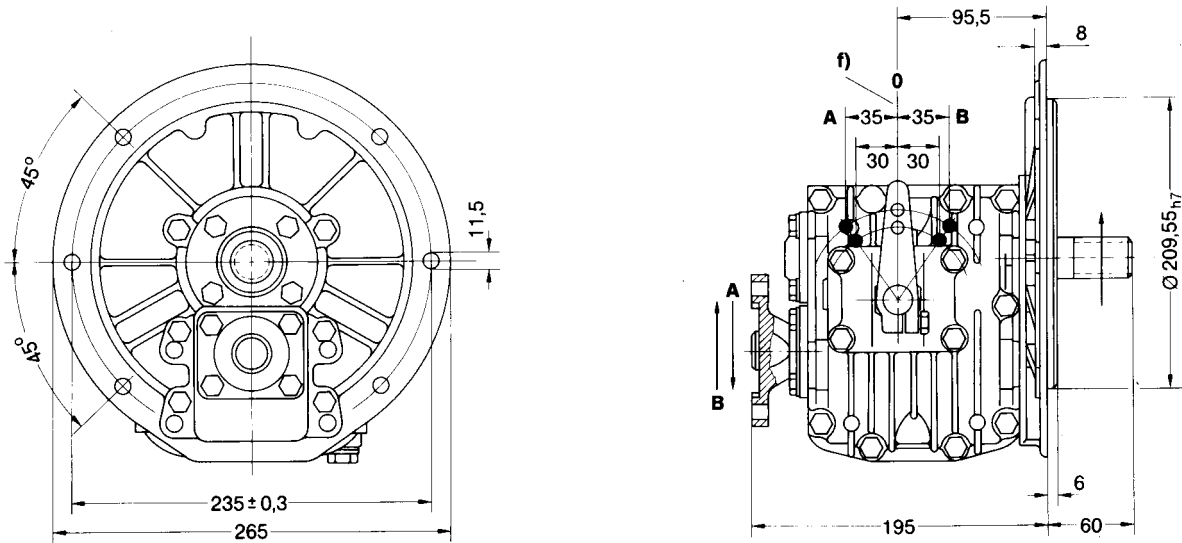
Note = For all «M» (Mechanical) transmission reduce power capacity by the following schock factors: 1 cylinder engine ÷ 1.25, 2 cylinder engine ÷ 1.20, 3 cylinder engine ÷ 1.15.

Fig. 5 ZF 10 M



Model with mounting flange

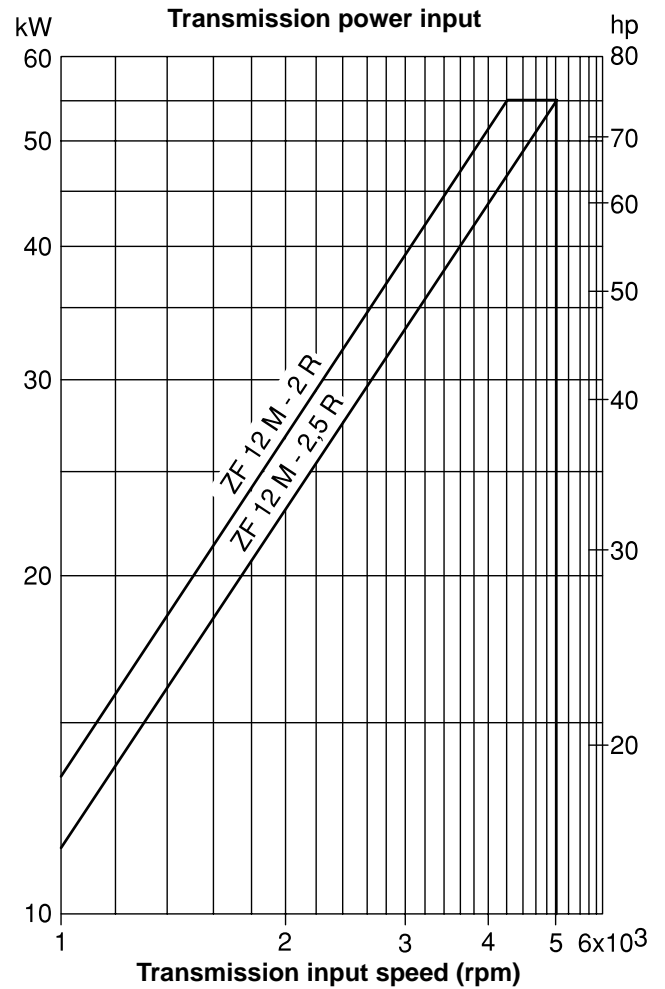
- a) Clockwise rotation b) Oil dipstick and filler screw 17mm c) M 8/12 deep, holes same on both sides d) Oil drain plug 17mm width across flats e) Spline profile similar B 10x23x29 DIN 5464 f) Minimum lever travel



All dimensions in mm

Model without mounting flange

1.2.4 ZF 12 M



Power diagram for pleasure craft
 Based on engine power B to DIN 6270;
 shock factor K = 1.25 to applied,
 if engine has fewer than 4 cylinders.

MODEL	RATIO		POWER / RPM		INPUT POWER CAPACITY						MAX RPM	WEIGHT		BELL HSGS. AND NOTES
	«A» Pos	«B»Pos	kW	hp	2800 rpm		3000 rpm		3600 rpm			kg	lb	
					kW	hp	kW	hp	kW	hp				
ZF 12 M	2.136	1.955	0.0131	0.0176	37	49	39	53	47	63	5000	13	29	SAE 4, 5, B/W Max input power 55 kW
	2.632	1.955	0.0111	0.0149	31	42	33	45	40	54				

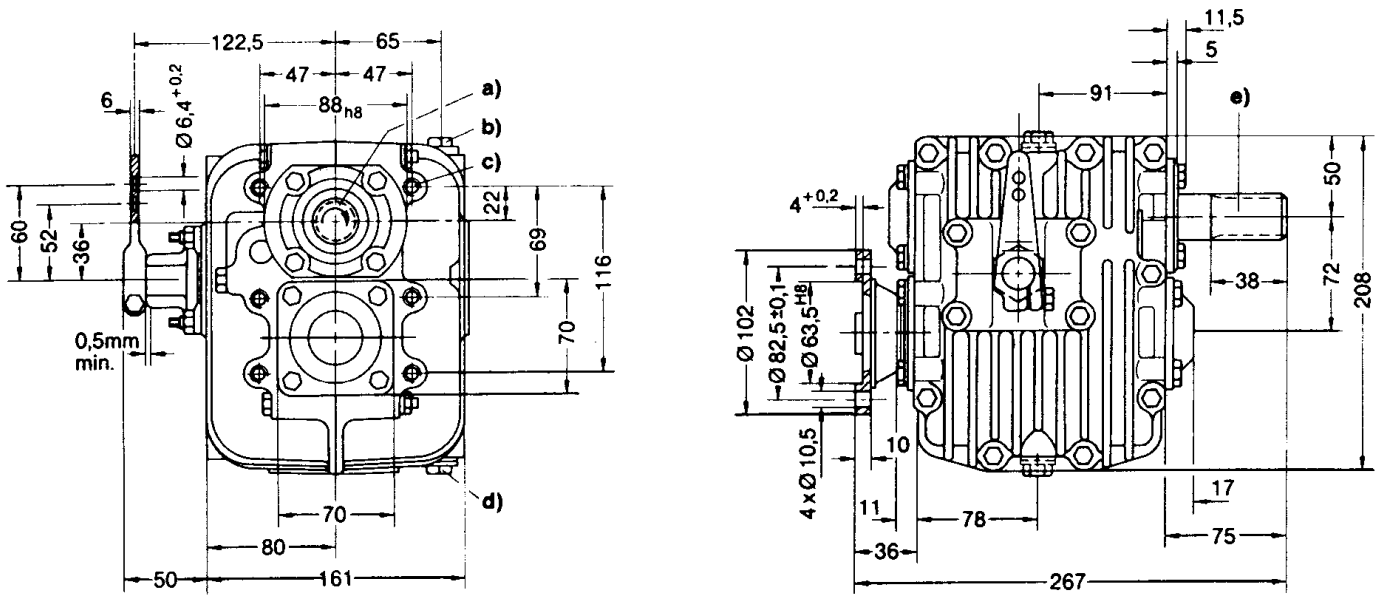
«A» POS = continuous running position (normally AHEAD).

«B» POS = reverse position.

B/W = Borg Warner adaptor.

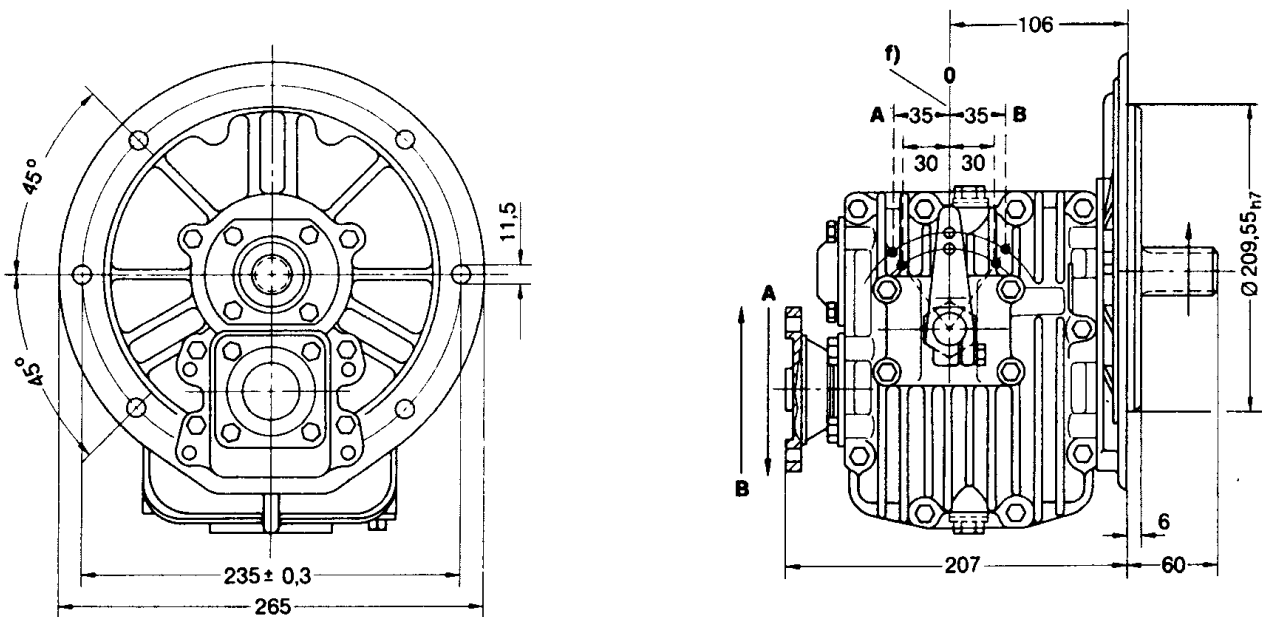
Note = For all «M» (Mechanical) transmission reduce power capacity by the following schock factors: 1 cylinder engine ÷ 1.25, 2 cylinder engine ÷ 1.20, 3 cylinder engine ÷ 1.15.

Fig. 6 ZF 12 M



Model without mounting flange

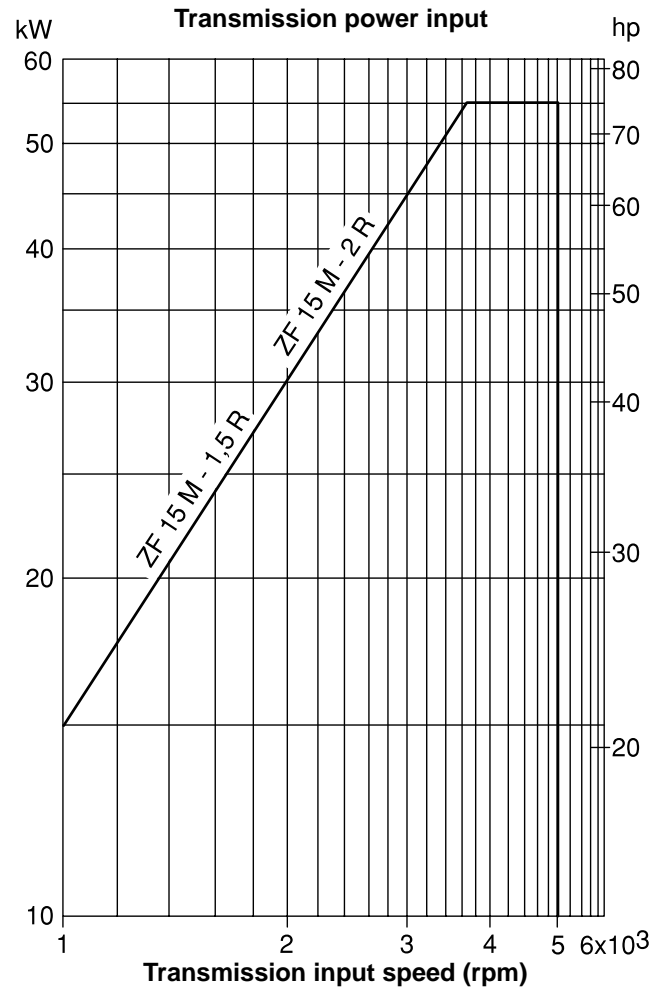
- a) Clockwise rotation b) Oil dipstick and filler screw 17 mm c) M 8/12 deep, holes same on both sides d) Oil drain plug 17 mm width across flats e) Spline profile similar B 10 x 23 x 29 DIN 5464 f) Minimum lever travel



All dimensions in mm

Model with mounting flange

1.2.5 ZF 15 M



Power diagram for Pleasure Craft Duty

Based on engine power B to DIN 6270;
 shock factor
 K = 1.25 to applied, if engine has 1 cylinder
 K = 1.20 for 2 cylinders
 K = 1.15 for 3 cylinders

** Max. 120 Nm (88.5 ft lb) admissible for main travelling direction with gear lever set to «B»

MODEL	RATIO		POWER / RPM		INPUT POWER CAPACITY						MAX RPM	WEIGHT		BELL HSGS. AND NOTES
	«A» Pos	«B»Pos	kW	hp	2800 rpm		3000 rpm		3600 rpm			kg	lb	
					kW	hp	kW	hp	kW	hp				
ZF 15 M	1.556 1.875	1.955 1.955	0.0152	0.0204	43	57	46	61	55	73	5000	13	29	SAE 4, 5, B/W, Yanmar JH Max input power 55 kW. Ratio 1.556 «B» Pos. max torque 120 Nm. Ratio 1.875 «B» Pos. max torque 120 Nm.

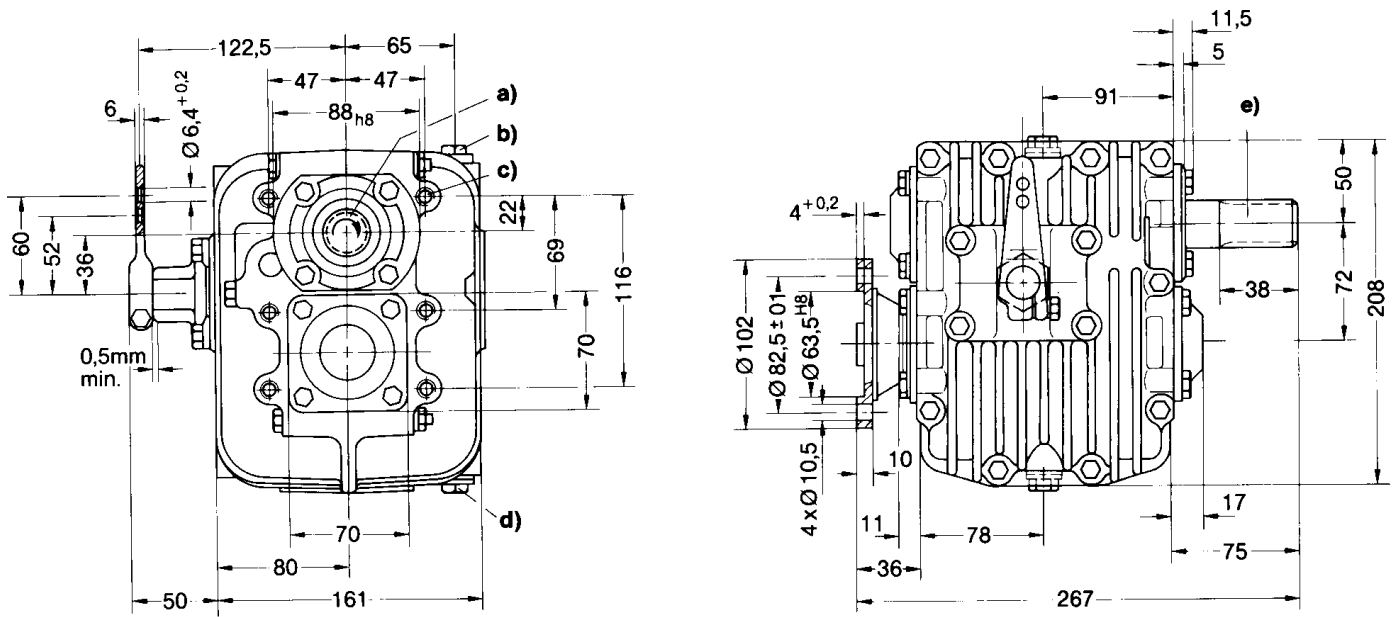
«A» POS = continuous running position (normally AHEAD).

«B» POS = reverse position.

B/W = Borg Warner adaptor.

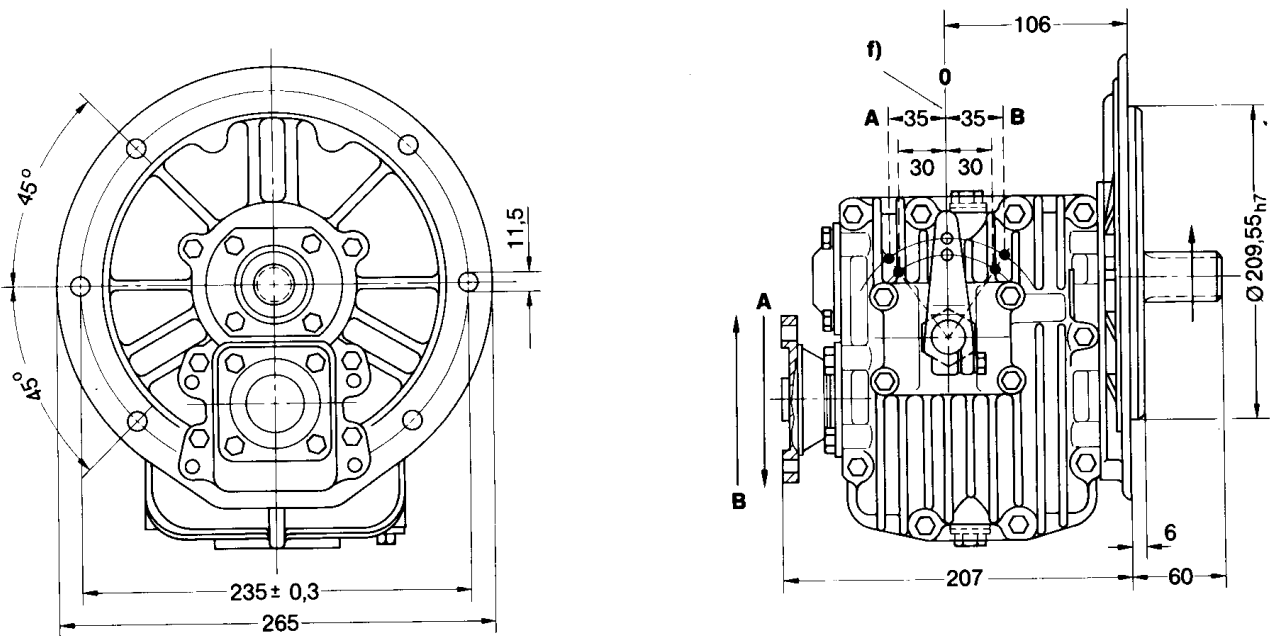
Note = For all «M» (Mechanical) transmission reduce power capacity by the following schock factors: 1 cylinder engine ÷ 1.25, 2 cylinder engine ÷ 1.20, 3 cylinder engine ÷ 1.15.

Fig. 7 ZF 15 M



Model without mounting flange

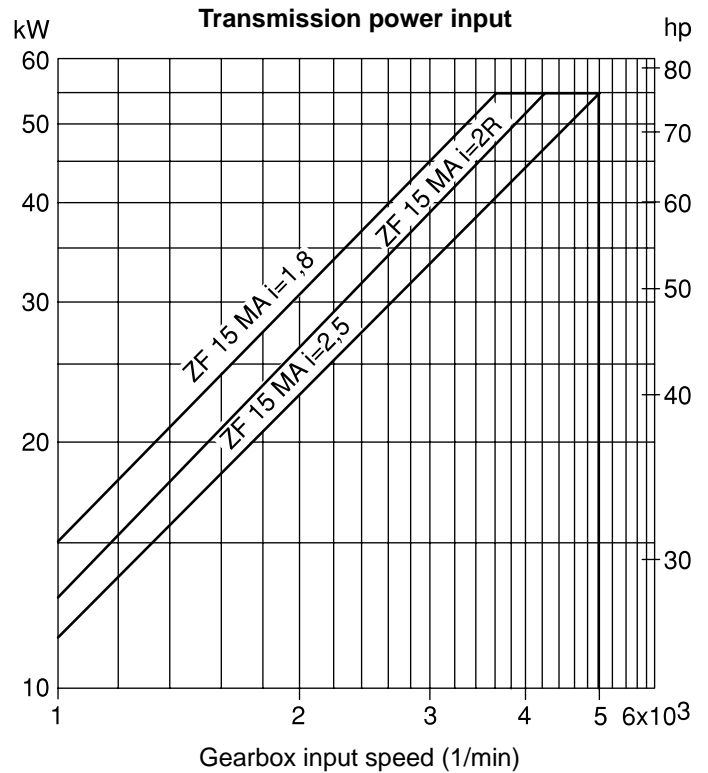
- a) Clockwise rotation b) Oil dipstick and filler screw 17mm c) M 8/12 deep, holes same on both sides d) Oil drain plug 17mm width across flats e) Spline profile similar B 10x23x29 DIN 5464 f) Minimum lever travel



All dimensions in mm

Model with mounting flange

1.2.6 ZF 15 MA



Power diagram for Pleasure Craft Duty

Based on engine power B to DIN 6270;
 shock factor
 K = 1.25 to applied, if engine has 1 cylinder
 K = 1.20 for 2 cylinders
 K = 1.15 for 3 cylinders

** Max. 120 Nm (88.5 ft lb) admissible for main travelling direction with gear lever set to «B»

MODEL	RATIO		POWER / RPM		INPUT POWER CAPACITY						MAX RPM	WEIGHT		BELL HSGS. AND NOTES
	«A» Pos	«B»Pos	kW	hp	2800 rpm		3000 rpm		3600 rpm			kg	lb	
					kW	hp	kW	hp	kW	hp				
ZF 15 MA 8 degrees	1.875 2.136 2.632	1.955 1.955 1.955	0.0152 0.0131 0.0111	0.0204 0.0176 0.0149	43 37 31	57 49 42	46 39 33	61 53 45	55 47 40	73 63 54	5000 5000 5000	13 13 13	29 29 29	SAE 4, 5, B/W, Yanmar JH Max input power 55 kW. Ratio 1.875 «B» Pos. max torque 120 Nm. Ratio 2.136 «B» Pos. max torque 120 Nm.

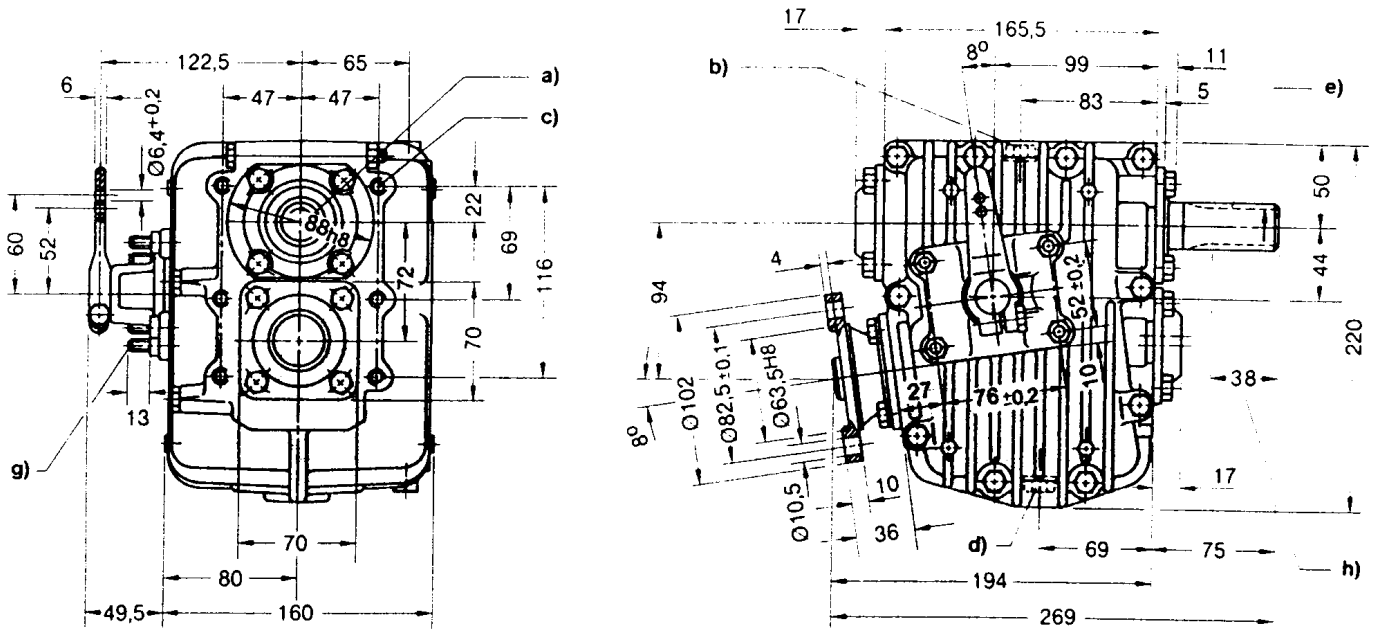
«A» POS = continuous running position (normally AHEAD).

«B» POS = reverse position.

B/W = Borg Warner adaptor.

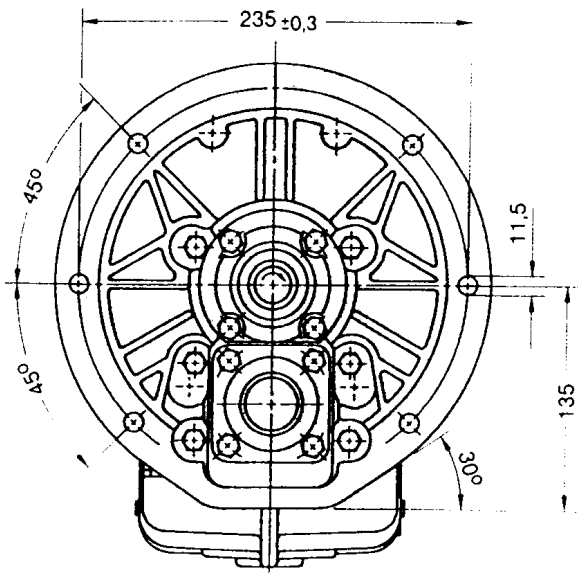
Note = For all «M» (Mechanical) transmission reduce power capacity by the following schock factors: 1 cylinder engine ÷ 1.25, 2 cylinder engine ÷ 1.20, 3 cylinder engine ÷ 1.15.

Fig. 8 ZF 15 MA

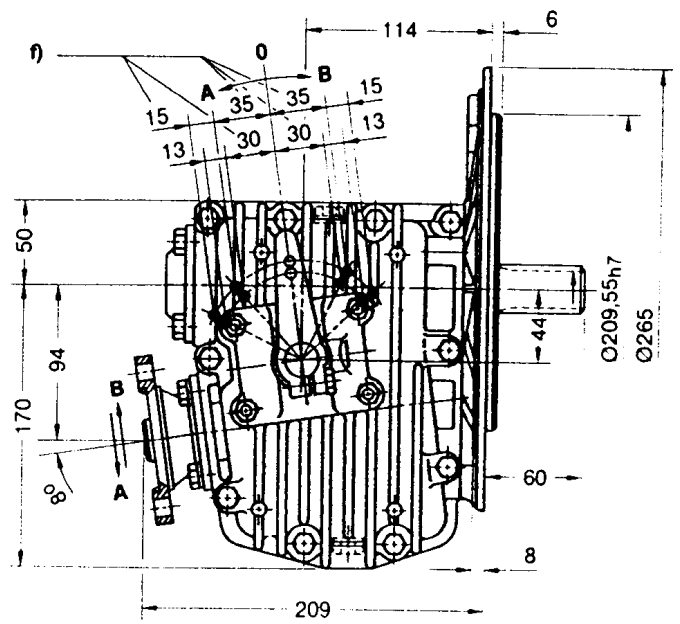


Model without mounting flange

a) Clockwise rotation b) Oil dipstick and filler screw 17 mm c) M 8/12 deep, holes same on both sides d) Oil drain plug 17 mm width across flats e) Spline profile similar B 10 x 23 x 29 DIN 5464 f) Minimum lever travel g) Support for control cable h) full profile

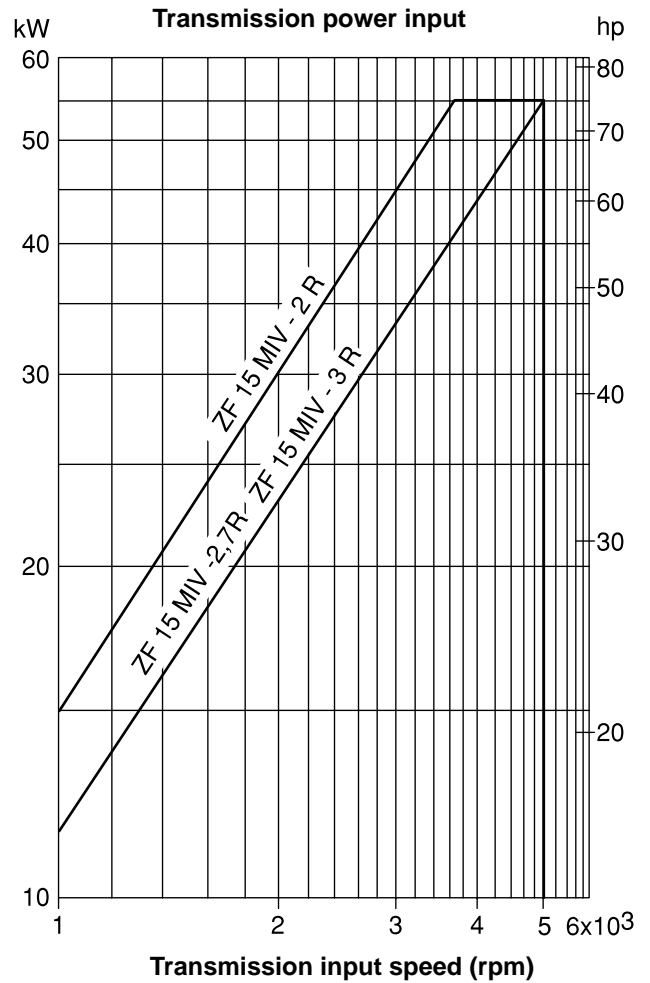


All dimensions in mm



Model with mounting flange

1.2.7 ZF 15 MIV



Power diagram for Pleasure Craft Duty

Based on engine power B to DIN 6270;
 shock factor
 K = 1.25 to applied, if engine has 1 cylinder
 K = 1.20 for 2 cylinders
 K = 1.15 for 3 cylinders

* Max. 120 Nm (88.5 ft lb) admissible for main travelling direction with gear lever set to «B».

** Max 45 kW for main travelling direction with gear lever set to «B».

MODEL	RATIO		POWER / RPM		INPUT POWER CAPACITY						MAX RPM	WEIGHT		BELL HSGS. AND NOTES
	«A» Pos	«B»Pos	kW	hp	2800 rpm		3000 rpm		3600 rpm			kg	lb	
					kW	hp	kW	hp	kW	hp				
ZF 15 MIV 8 degrees	2.134 2.718 2.995	2.224 2.224 2.224	0.0152 0.0111	0.0204 0.0149	43 31	57 42	46 33	61 45	55 40	73 54	5000 5000 5000	20 44	SAE 4, 5, B/W, Yanmar JH Max input power 55 kW. Ratio 2.134 «B» Pos. max torque 120 Nm.	

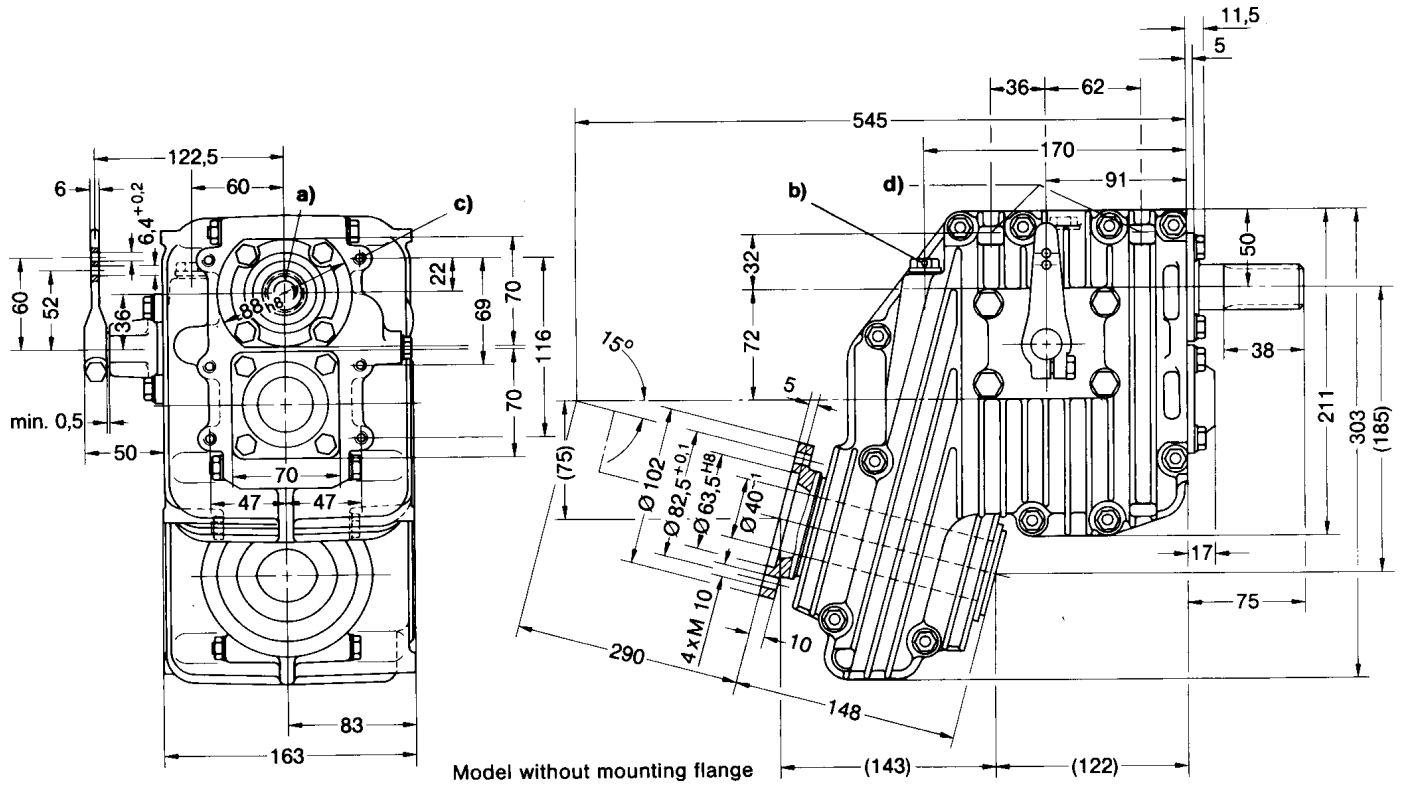
«A» POS = continuous running position (normally AHEAD).

«B» POS = reverse position.

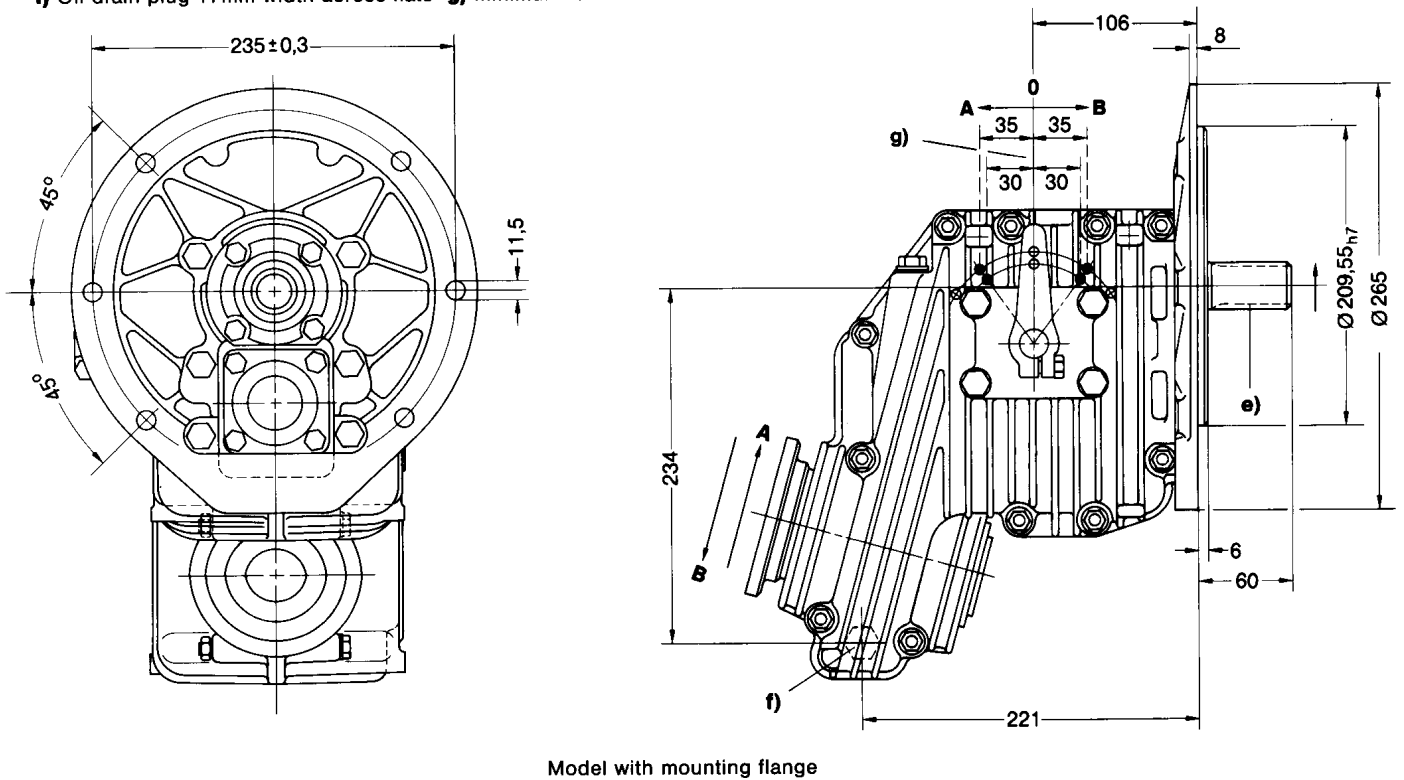
B/W = Borg Warner adaptor.

Note = For all «M» (Mechanical) transmission reduce power capacity by the following schock factors: 1 cylinder engine ÷ 1.25, 2 cylinder engine ÷ 1.20, 3 cylinder engine ÷ 1.15.

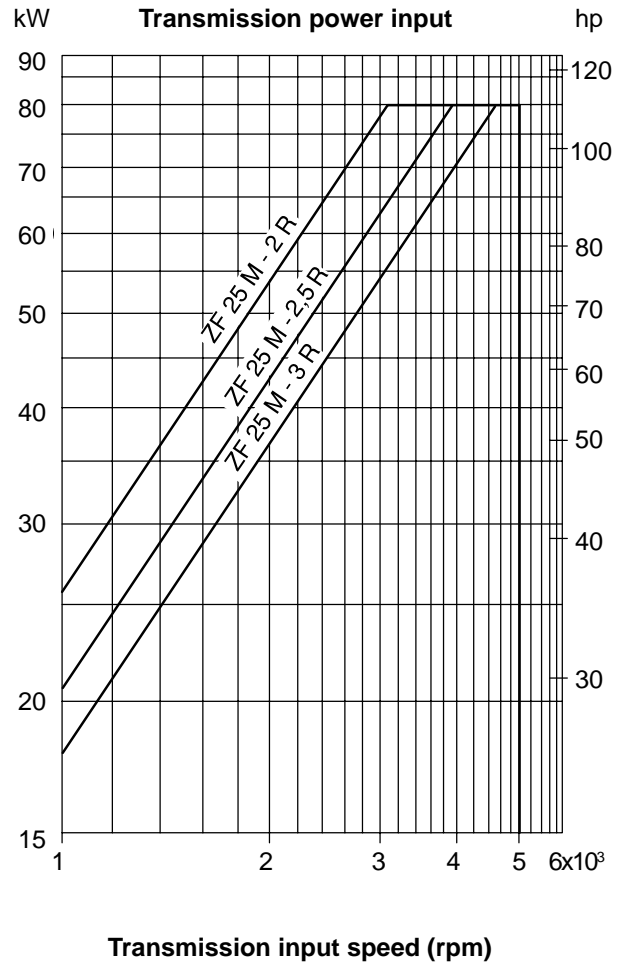
Fig. 9 ZF 15 MIV



- a)** Clockwise rotation **b)** Oil dipstick and filler screw 17mm **c)** M 10/15 deep **d)** M 8/16 deep **e)** Spline profile B 10x23x29 DIN 5464
f) Oil drain plug 17mm width across flats **g)** Minimum lever travel



1.2.8 ZF 25 M



Power diagram for Pleasure Craft Duty

Based on engine power B to DIN 6270;
 shock factor
 K = 1.25 to applied, if engine has 1 cylinder
 K = 1.20 for 2 cylinders
 K = 1.15 for 3 cylinders

** Max. 230 Nm (170 ft lb) admissible for main travelling direction with gear lever set to «B»

MODEL	RATIO		POWER / RPM		INPUT POWER CAPACITY						MAX RPM	WEIGHT		BELL HSGS. AND NOTES	
	«A» Pos	«B»Pos	kW	hp	2800 rpm		3000 rpm		3600 rpm			kg	lb		
					kW	hp	kW	hp	kW	hp					
ZF 25 M	1.880	2.095	0.0262	0.0351	73	98	79	105	80	107	5000	18	40	SAE 4, 5, B/W, Yanmar JH Max input power 80 kW. Ratio 1.880 «B» Pos. max torque 230 Nm.	
	2.273	2.095	0.0216	0.0289	60	81	65	87	78	104					5000
	2.737	2.722	0.0177	0.0237	50	66	53	71	64	85					5000

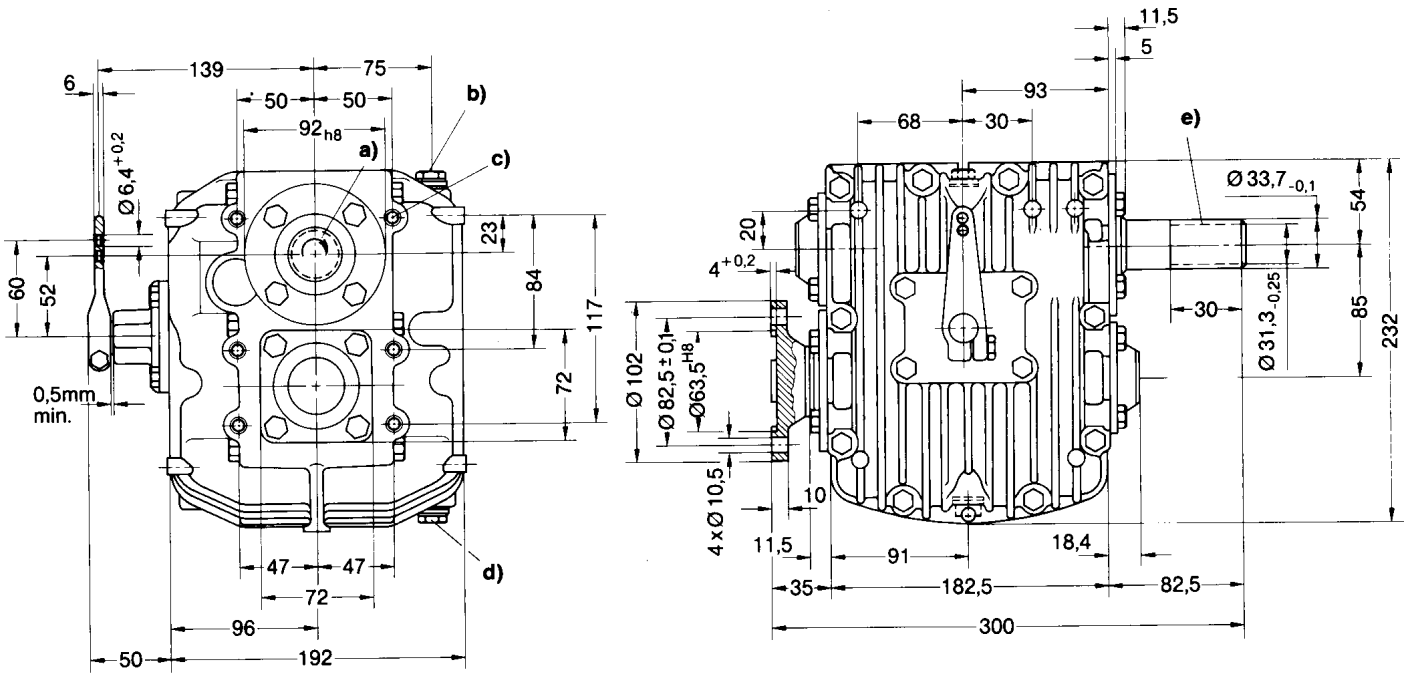
«A» POS = continuous running position (normally AHEAD).

«B» POS = reverse position.

B/W = Borg Warner adaptor.

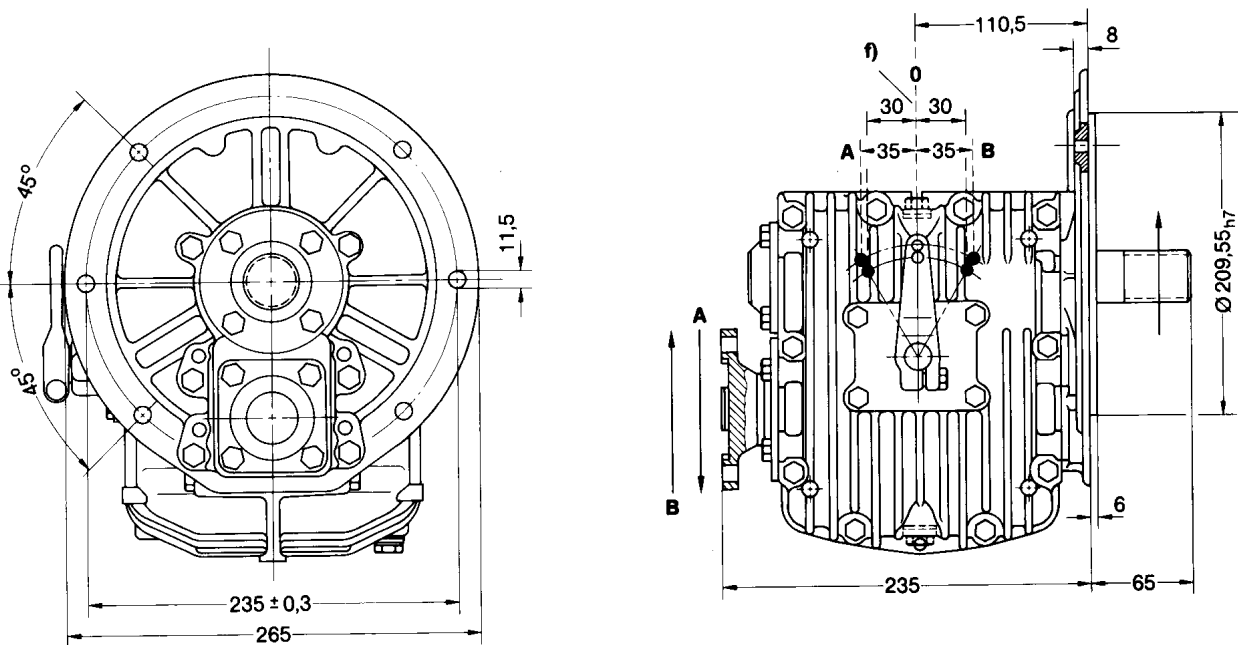
Note = For all «M» (Mechanical) transmission reduce power capacity by the following schock factors: 1 cylinder engine ÷ 1.25, 2 cylinder engine ÷ 1.20, 3 cylinder engine ÷ 1.15.

Fig. 10 ZF 25 M



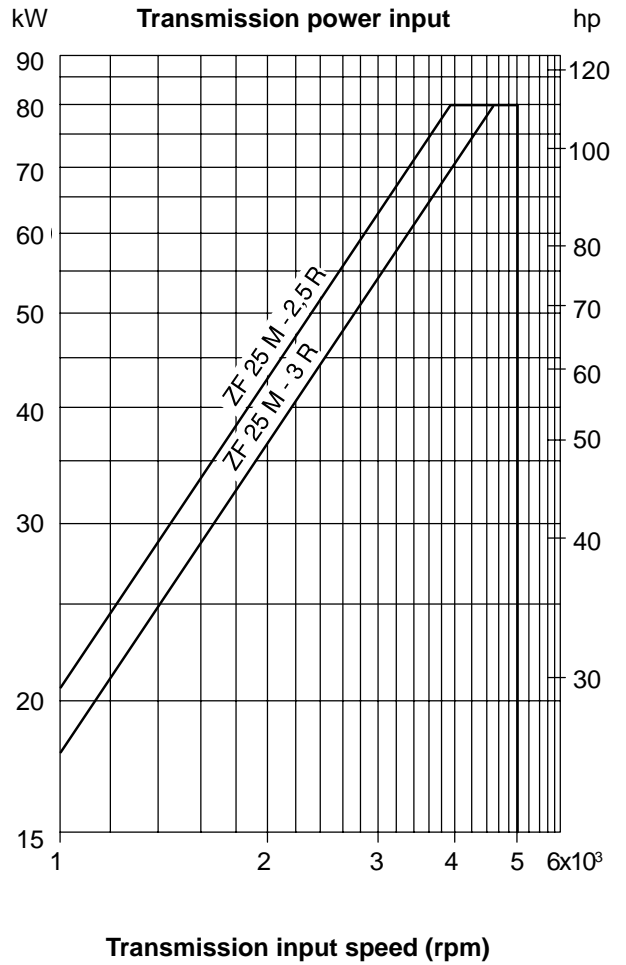
Model without mounting flange

- a)** Clockwise rotation **b)** Oil dipstick and filler screw 17mm **c)** M 10/15 deep, holes same on both sides **d)** Oil drain plug 17mm width across flats **e)** SAE 26 teeth · DP 20/40 · 30° · Flat Root · Class t6 **f)** Minimum lever travel



Model with mounting flange

1.2.9 ZF 25 MA



Power diagram for Pleasure Craft Duty

Based on engine power B to DIN 6270;
 shock factor
 K = 1.25 to applied, if engine has 1 cylinder
 K = 1.20 for 2 cylinders
 K = 1.15 for 3 cylinders

** Max. 169 Nm (125 ft lb) admissible for main travelling direction with gear lever set to «B»

MODEL	RATIO		POWER / RPM		INPUT POWER CAPACITY						MAX RPM	WEIGHT		BELL HSGS. AND NOTES
	«A» Pos	«B»Pos	kW	hp	2800 rpm		3000 rpm		3600 rpm			kg	lb	
					kW	hp	kW	hp	kW	hp				
ZF 25 MA 8 degrees	2.227 2.737	2.737 2.737	0.0215 0.0177	0.0288 0.0237	60 50	81 66	64 53	86 71	77 64	104 85	5000 5000	18 40	SAE 4, 5, B/W, Yanmar JH Max input power 80 kW. Ratio 2.227 «B» Pos. max torque 169 Nm.	

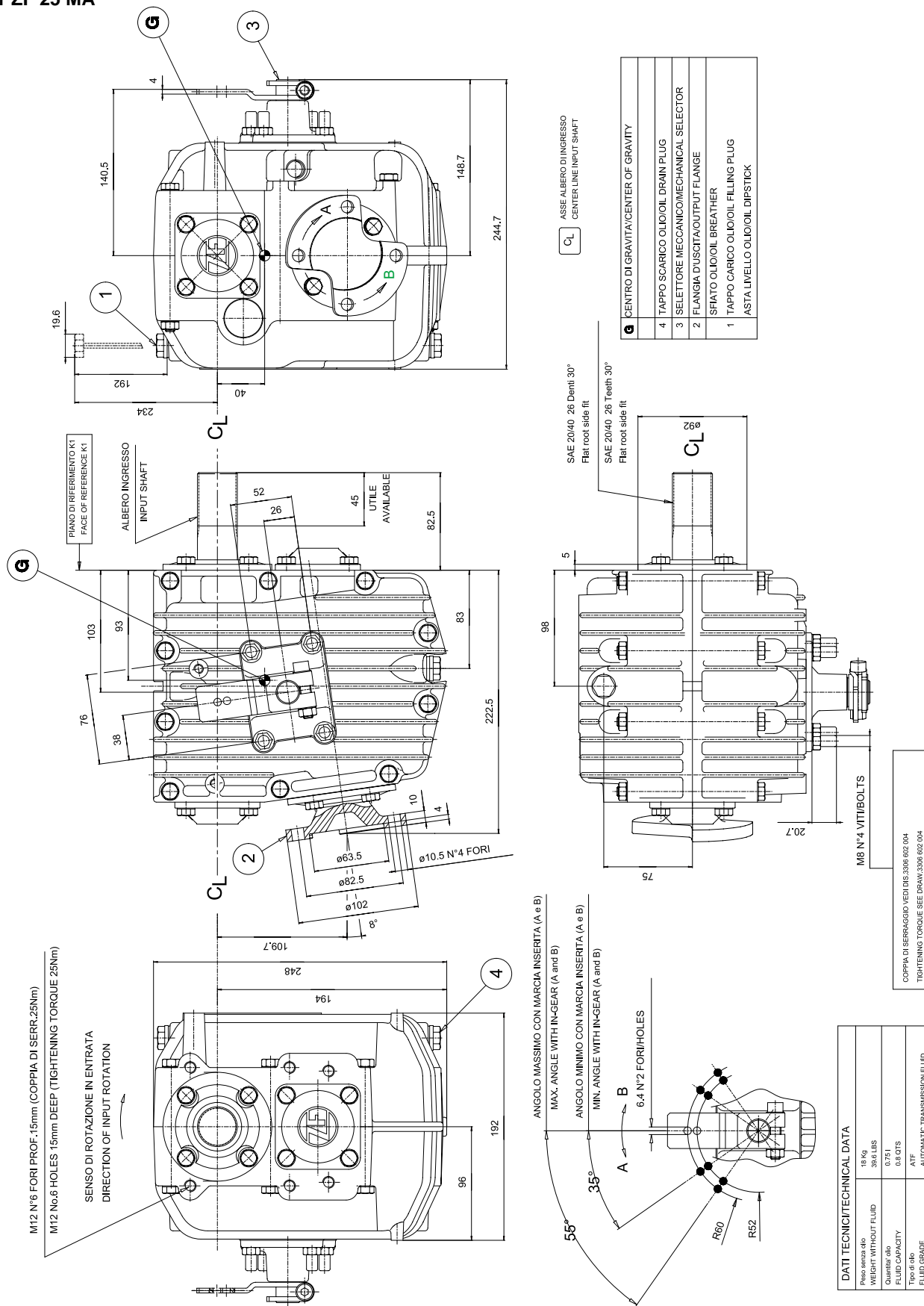
«A» POS = continuous running position (normally AHEAD).

«B» POS = reverse position.

B/W = Borg Warner adaptor.

Note = For all «M» (Mechanical) transmission reduce power capacity by the following schock factors: 1 cylinder engine ÷ 1.25, 2 cylinder engine ÷ 1.20, 3 cylinder engine ÷ 1.15.

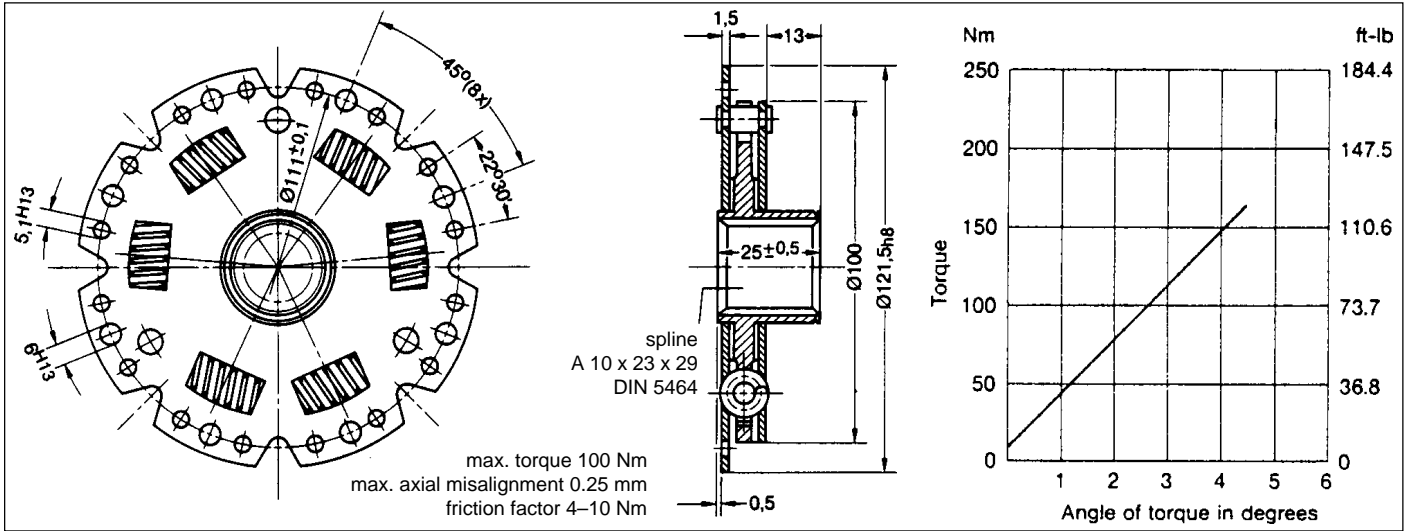
Fig. 11 ZF 25 MA



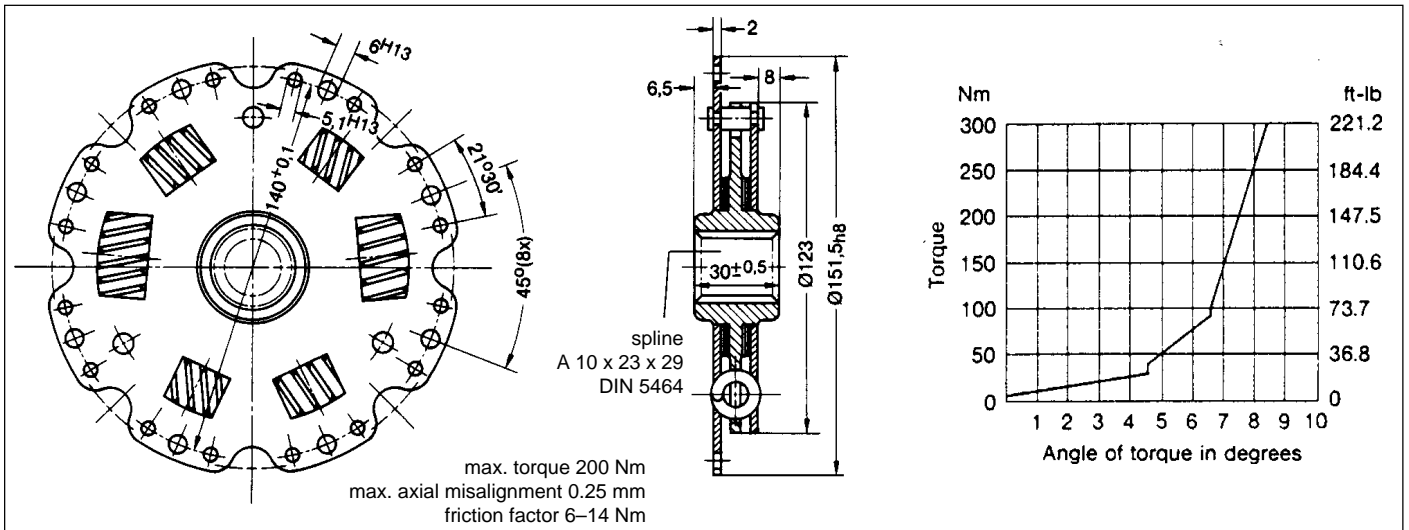
a) Clockwise rotation b) Oil dipstick and filler screw 17 mm c) M 10/15 deep, holes same on both sides d) Oil drain plug 17 mm width across flats e) SAE 26 teeth - DP 20/40 - 30° - Flat Root - Class t6 - f) Minimum lever travel

1.2.10 Accessories

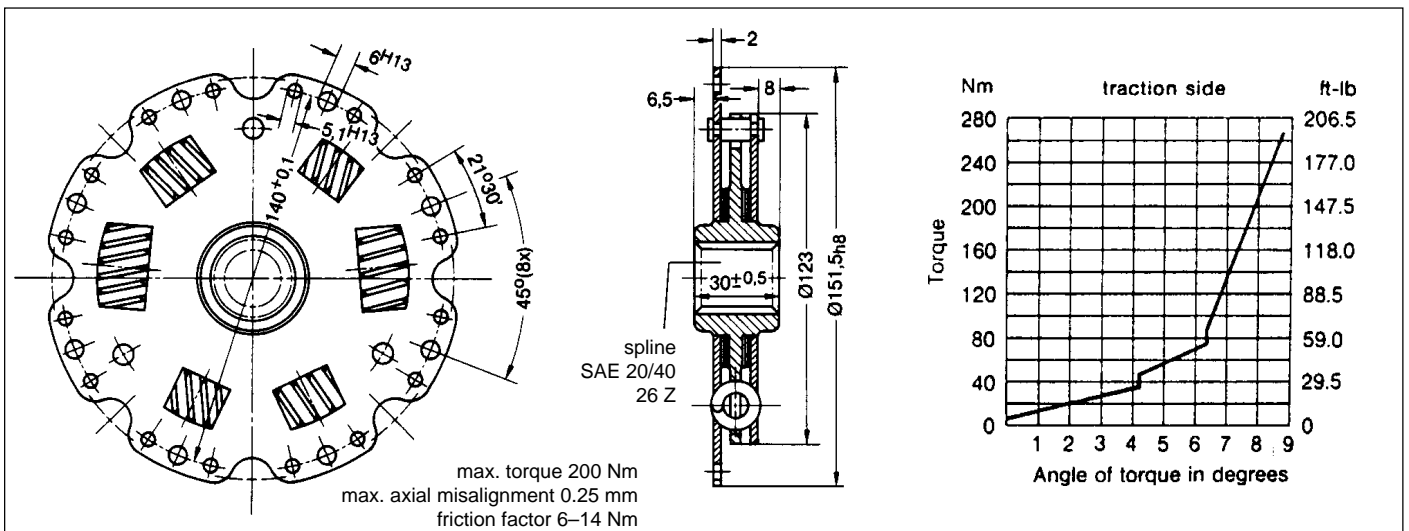
Resilient Coupling for ZF 3 M - ZF 5 M - ZF 10 M Ident-No. 254 750 - 3306 316 001



Resilient Coupling for ZF 10 M - ZF 12 M - ZF 15 M - ZF 15 MA - ZF 15 MIV Ident-No. 254 762 - 3306 316 003

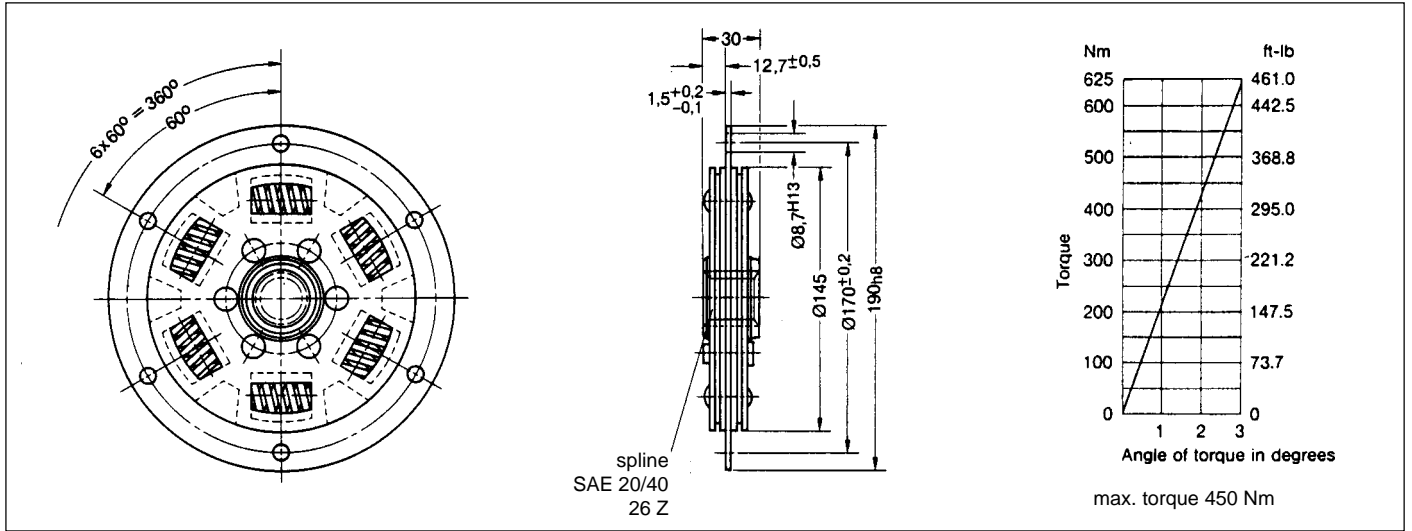


Resilient Coupling for ZF 25 M - ZF 25 MA Ident-No. 256 526 - 3307 316 001

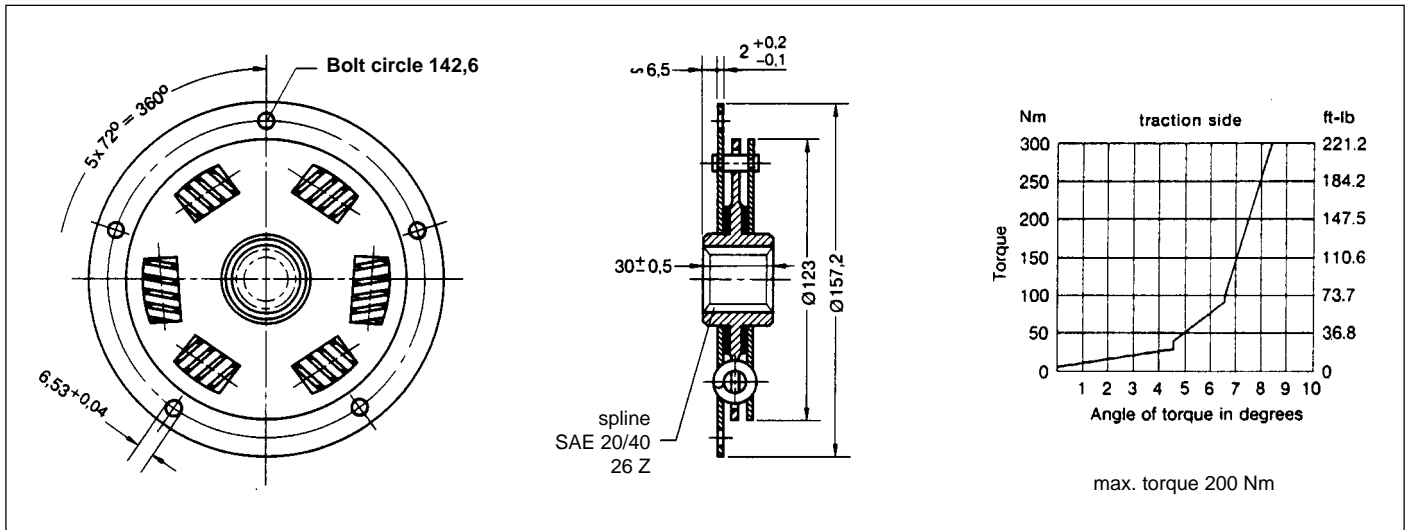


1.2.10 Accessories

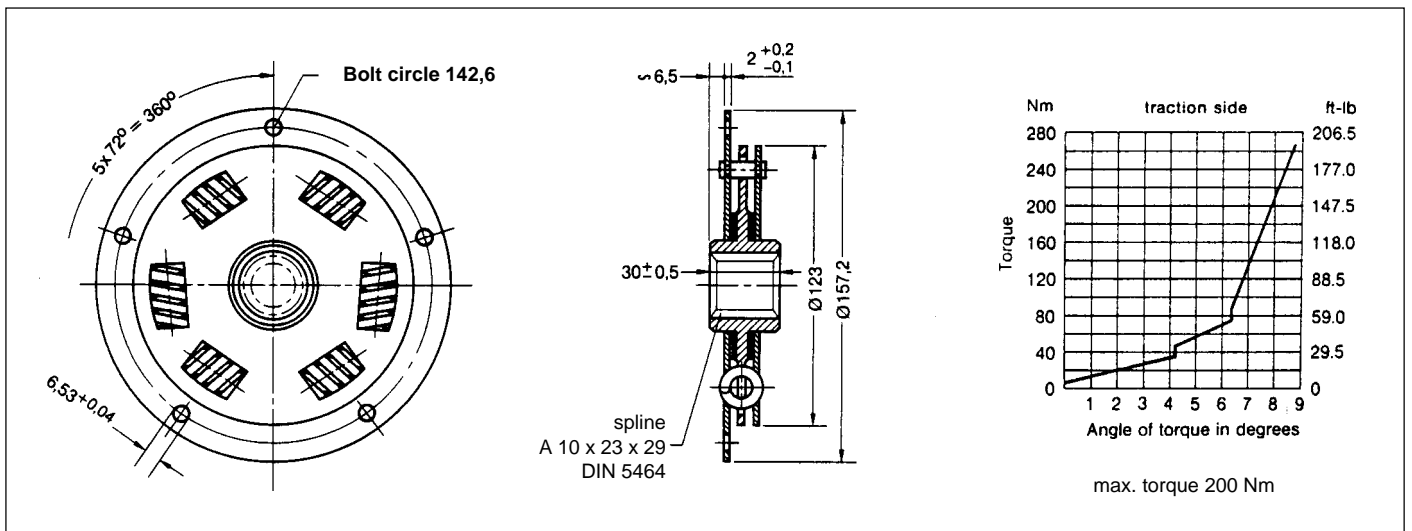
Resilient Coupling for ZF 25 M / 25 MA Ident-No. 223 557 - 3307 316 003



Resilient Coupling PERKINS for ZF 25 M / 25 MA Ident-No. 288 238 - 3307 316 002

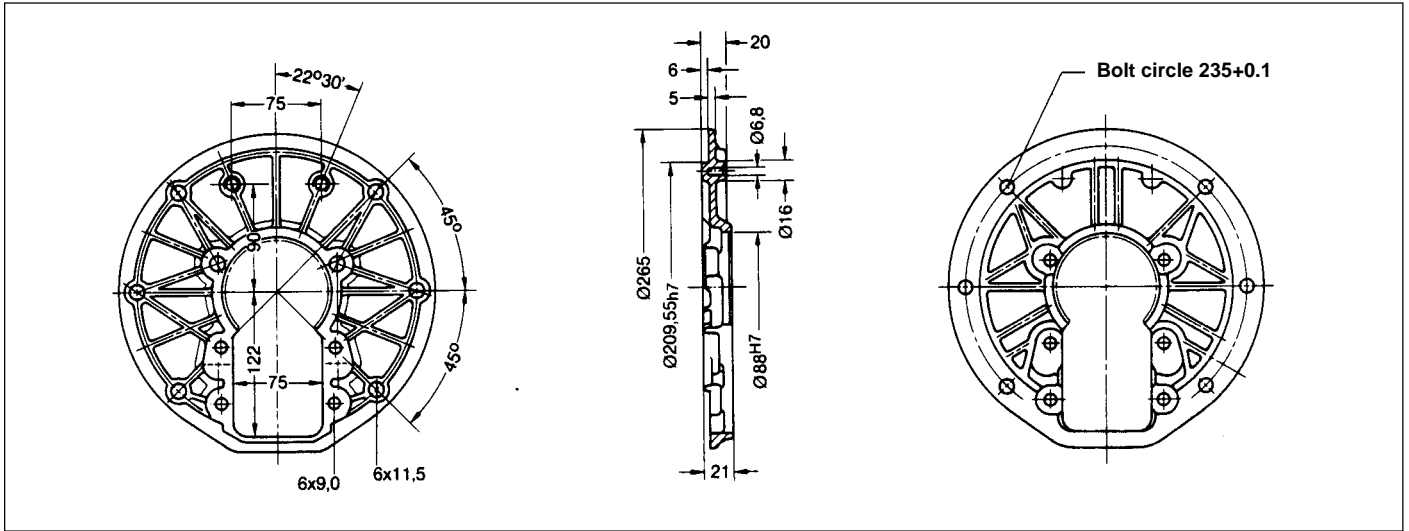


Resilient Coupling PERKINS for ZF 10 M - ZF 12 M - ZF 15 M - ZF 15 MA - ZF 15 MIV Ident-No. 288 240 - 3306 316 002

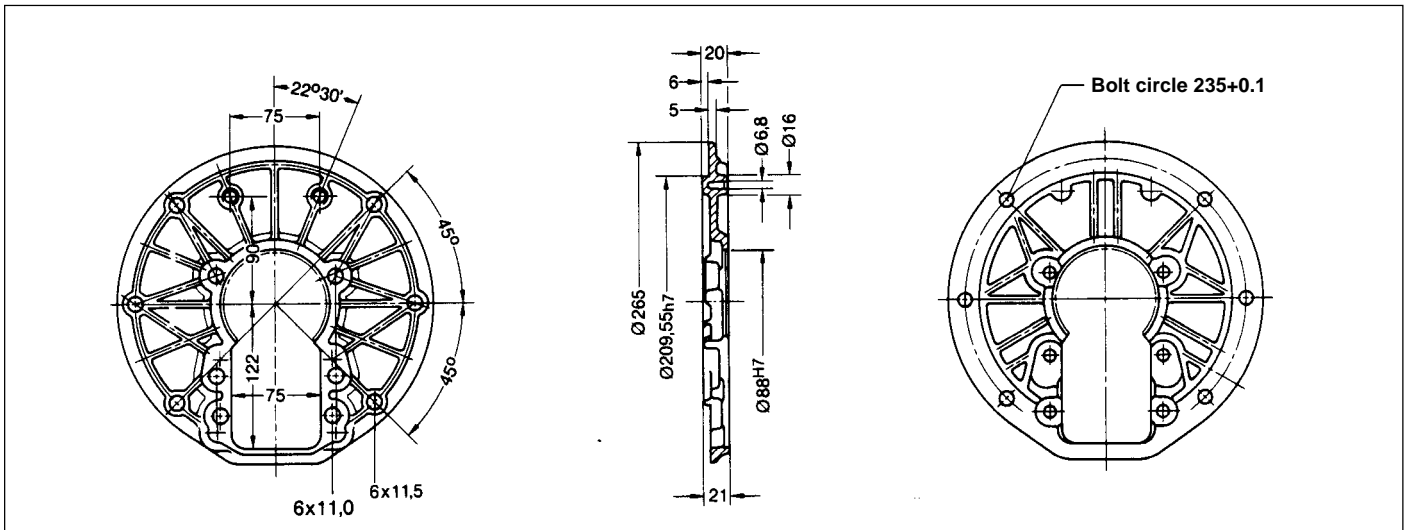


1.2.10 Accessories

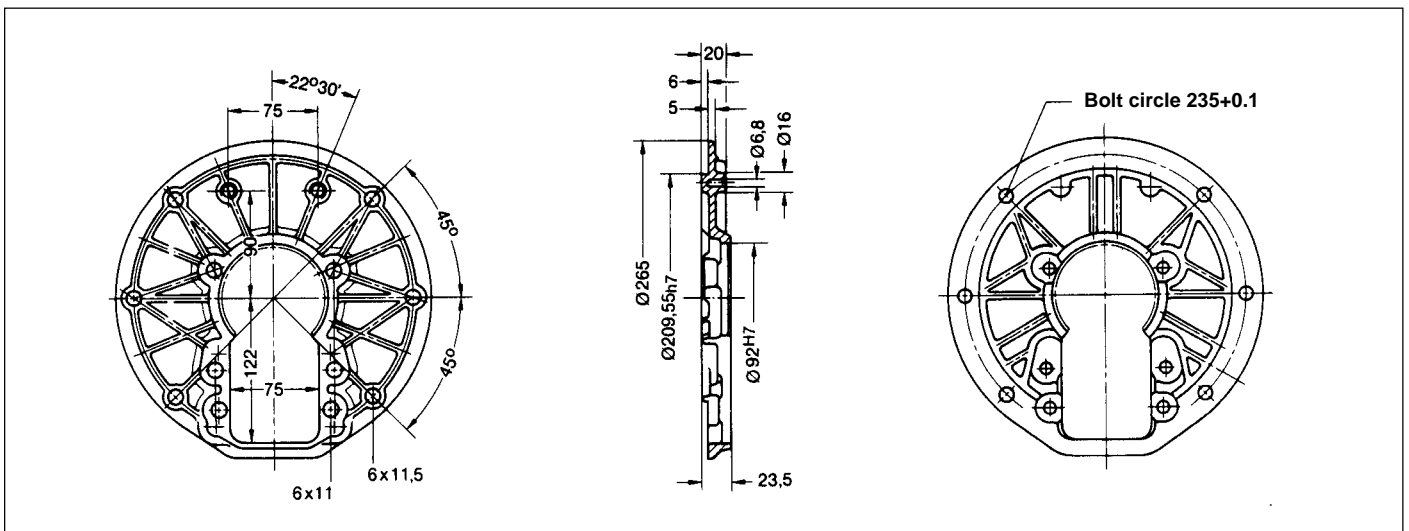
Adapter flange for ZF 3 M - ZF 5 M - ZF 10 M - ZF 12 M - ZF 15 M - ZF 15 MA Ident-No. 344 544 - 3306 116 001 (kit)



Adapter flange ZF 15 MIV Ident-No. 345 965 - 3306 116 004 (kit)

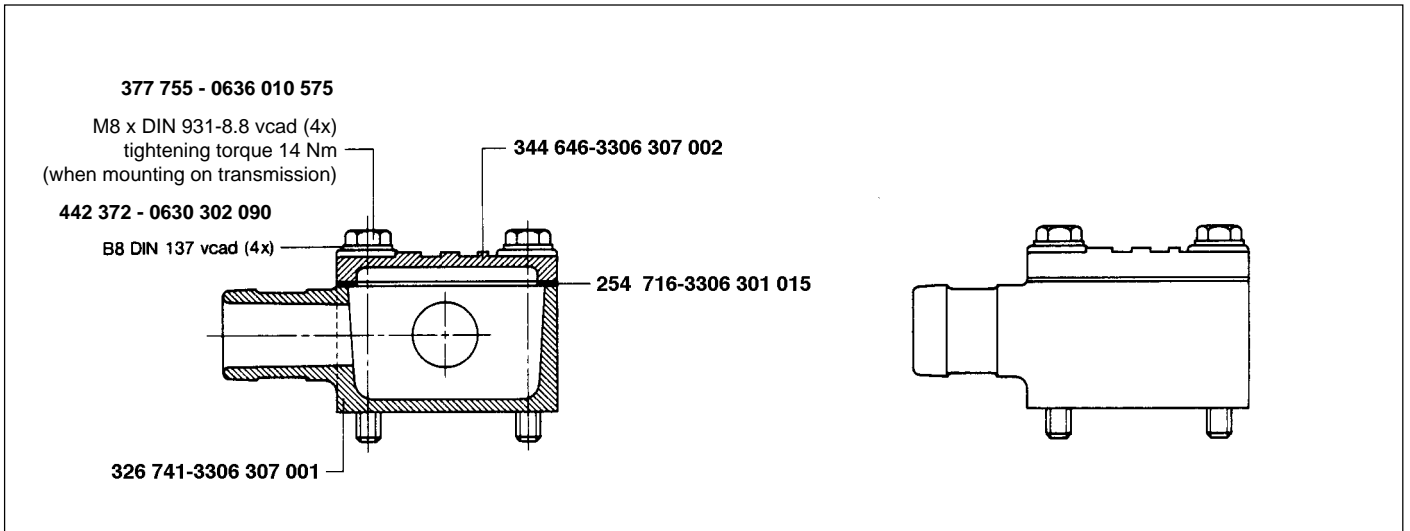


Adapter flange ZF 25 M - ZF 25 MA Ident-No. 345 964 - 3307 116 001 (kit)



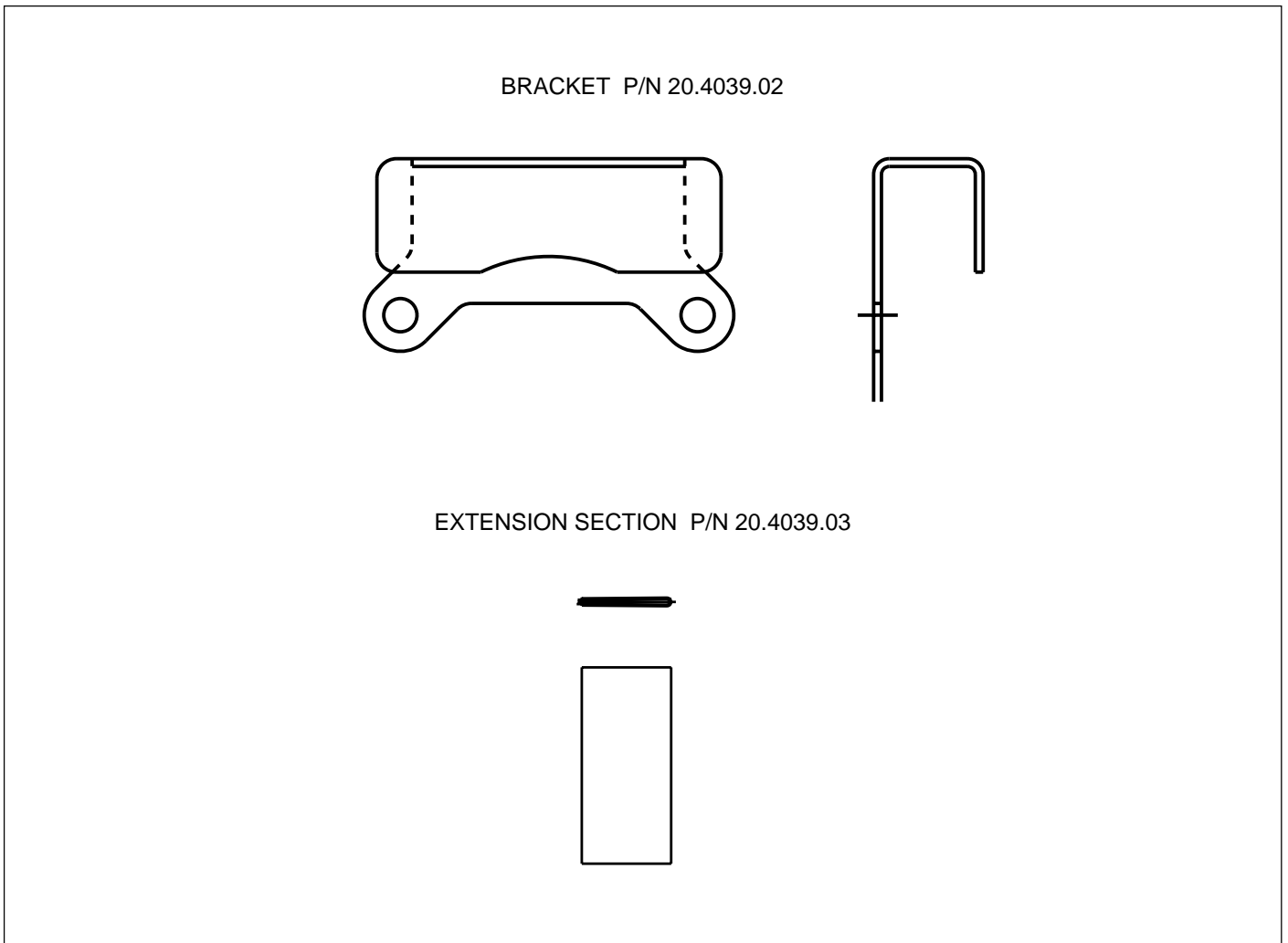
1.2.10 Accessories

Cooler for ZF 10 M - ZF 12 M - ZF 15M - ZF 15 MA - ZF 15 MIV - ZF 25 M - ZF 25 MA Ident-No. 326 742 - 3306 107 001



1.2.11 Tools

Tool to adjust the shifing lever cover on ZF 10 M - ZF 12 M - ZF 15M - ZF 15 MA - ZF 25 M - ZF 25 MA
(See Service Bulletin No. 007/03)



1.2.12 Gearboxes and accessories

Model	prop. turns anti engine	draw. no.	Id. no.	weight
ZF 3 M	2,05:1 2,72:1	487926 487927	3302 002 001 3302 002 002	8 kg 8 kg
Housing adapter Kit		344544	3306 116 001	
Damper plate	up to 100 Nm	254750	3306 316 001	
ZF 5 M	2,05:1 2,72:1	388817 459413	3303 002 001 3303 002 002	8 kg 8 kg
Housing adapter Kit		344544	3306 116 001	
Damper plate	up to 100 Nm	254750	3306 316 001	
ZF 10 M	1,48:1 1,79:1 2,05:1 2,72:1	407345 407346 - 467329	3304 002 003 3304 002 004 3304 002 010 3304 002 005	9,5 kg 9,5 kg 9,5 kg
Housing adapter Kit		344544	3306 116 001	
Housing adapter Kit SAE 5		500013	3306 116 002	
Oil cooler Kit		326742	3306 107 001	
Damper plate	up to 100 Nm	254750	3306 316 001	
Damper plate	up to 200 Nm	254762	3306 316 003	
Damper plate PERKINS	up to 200 Nm	288240	3306 316 002	
ZF 12 M	2,14:1 2,63:1	407205 407206	3305 002 001 3305 002 002	13 kg 13 kg
Housing adapter Kit		344544	3306 116 001	
Housing adapter Kit SAE 5		500013	3306 116 002	
Oil cooler Kit		326742	3306 107 001	
Damper plate	up to 200 Nm	254762	3306 316 003	
Damper plate PERKINS	up to 200 Nm	288240	3306 316 002	
ZF 15 M	1,56:1 1,88:1	407208 407207	3306 002 003 3306 002 004	13 kg 13 kg
Housing adapter Kit		344544	3306 116 001	
Housing adapter Kit SAE 5		500013	3306 116 002	
Oil cooler Kit		326742	3306 107 001	
Damper plate	up to 200 Nm	254762	3306 316 003	
Damper plate PERKINS	up to 200 Nm	288240	3306 316 002	
ZF 15 MA	2,0:1 2,14:1 2,5:1	407461 - 407462	3306 001 004 3306 001 003 3306 001 005	13 kg 13 kg 13 kg
Housing adapter Kit		344544	3306 116 001	
Housing adapter Kit SAE 5		500013	3306 116 002	
Oil cooler Kit		326742	3306 107 001	
Damper plate	up to 200 Nm	254762	3306 316 003	
Damper plate PERKINS	up to 200 Nm	288240	3306 316 002	
ZF 15 MIV	2,13:1 2,72:1 2,99:1	407377 439386 407378	3306 003 001 3306 003 003 3306 003 002	20 kg 20 kg 20 kg
Housing adapter Kit		345965	3306 116 004	
Housing adapter Kit SAE 5		500015	3306 116 003	
Oil cooler Kit		326742	3306 107 001	
Damper plate	up to 200 Nm	254762	3306 316 003	
Damper plate PERKINS	up to 200 Nm	288240	3306 316 002	
ZF 25 M	1,88:1 2,27:1 2,74:1	408089 - 408090	3307 002 001 3307 002 007 3307 002 002	18 kg 18 kg 18 kg
Housing adapter Kit		345964	3307 116 001	
Housing adapter Kit SAE5		-	3315 116 001	
Oil cooler Kit		326742	3306 107 001	
Damper plate	up to 200 Nm	256526	3307 316 001	
Damper plate PERKINS	up to 200 Nm	288238	3307 316 002	
Damper plate	up to 450 Nm	223557	3307 316 003	
ZF 25 MA	2,23:1 2,74:1	- -	3307 001 005 3307 001 006	18 kg 18 kg
Housing adapter Kit		345964	3307 116 001	
Housing adapter Kit SAE5		-	3315 116 001	
Oil cooler Kit		326742	3306 107 001	
Damper plate	up to 200 Nm	256526	3307 316 001	
Damper plate PERKINS	up to 200 Nm	288238	3307 316 002	
Damper plate	up to 450 Nm	223557	3307 316 003	

1.3 Gear Casing

The oil-tight gearbox housing is made of a corrosion-resistant aluminium alloy chromized for added protection from corrosion. The gear casing is divided in a vertical plane into two equal halves. Cooling fins ensure good heat dissipation and mechanical rigidity.

The oil filter screw with dipstick and the oil drain plug are screwed into the gear casing. The filler screw is provided with a breather hole.

The actuating lever, actuating cam and cover plate are a pre-assembled unit fitted laterally to the gearbox unit.

Holes (see «Main dimensions» item 1.2 pos. c) are provided for bolting the transmission to a flywheel housing or an adapter flange.

1.4 Gear set

The transmission is equipped with case hardened helical gears made of forged low-carbon alloy steel and case hardened spiral bevel gears (V drive). The drive shaft with the drive gears are an integral unit.

The splined input shaft connecting the transmission with the engine is hardened as well.

The driven shaft (propeller side) of the transmission, with the exception of the ZF15 MIV model, is fitted with an integrally forged coupling flange.

The servo-automatic clutch system governs the direction of rotation of the input shaft, and ZF M transmission units are available for clockwise: (RH = right hand) or counterclockwise (LH = left hand) rotation.

1.5 Multiple-disc clutch and clutch operation - power train

The engine torque is applied to the input shaft (36) in the specified direction of rotation and, in shifting position A (see Main Dimensions item 1.2), via gear (44), the frictionally engaged clutch discs (51 and 52) to the external disc carrier (57) and from there via the guide sleeve (59) to the output shaft (66).

In shifting position B, the torque is transmitted from the input shaft (36) via intermediate gear (26), gear (65), clutch discs (51 and 52) to the external disc carrier (57), the guide sleeve (59) and the output shaft (66).

Function

The transmission uses a positively driven, mechanically operated multipliedisc clutch system mounted on the output shaft.

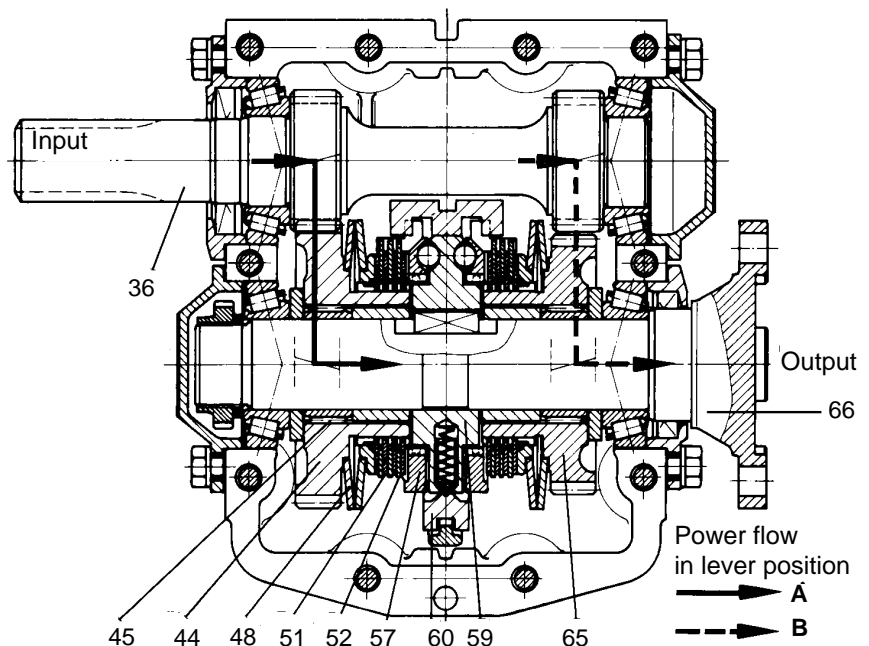
The thrust force required for obtaining positive frictional engagement between the clutch discs is provided by a servo-automatic system.

This essentially comprises a number of balls which, by the rotary movement of the external disc carrier, are urged against inclined surfaces provided in pockets between the guide sleeve and the external disc carrier and in this way exert axial pressure. The thrust force and, as a result, the transmittable friction torque are thus proportional to the input torque applied.

Due to the cup springs (48) supporting the clutch disc stack and a limitation of the range of axial travel of the external disc carrier (57), the thrust force will not exceed a predetermined value.

The actuating sleeve (60) is held in the middle position by spring-loaded pins. To initiate the shifting operation, the actuating sleeve (60) needs merely be displaced axially by the shifting fork until the arresting force has been overcome. Then the actuating sleeve (60) is moved automatically by the spring-loaded pins, while the external disc carrier which follows this movement, is rotated by frictional forces exerted by the clutch discs, and the shifting operation is completed servo-automatically as described above.

Fig. 11



1.6 Shaft bearings

Both the input and the output shafts are carried in amply dimensioned taper roller bearings.

The propeller thrust can be absorbed by the bearings (for permissible values see «Technical data», item 1.2).

The intermediate gear and the movable gears are carried in sturdy needle roller bearings.

1.7 Shaft seals

External sealing of the input and output shafts is provided by radial sealing rings. The running surfaces on the shafts are casehardened.

1.8 Lubrication

The transmissions are immersion-lubricated. The bearings are generously supplied with splash oil.

1.9 Cooling unit

Transmissions intended for use at high ambient temperatures and for continuous operation at high power (especially when shifting position B is used for the main direction of movement of the craft), must be supplied with a cooling unit (see item 2.10).

2. Installation

2.1 Delivery condition

HURTH ZF M gearbox units leave the factory in fully assembled condition. For safety reasons, the gearbox is not filled with oil for shipment. The actuating lever is mounted on the actuating shaft. On request, the gearbox is delivered with the cooling unit (see item 2.10) and flange (see item 1.2) fitted, as well as the previous damper plate between engine and gearbox. The multi-spline shaft is provided with an oil film and protected by a plastic cap. The bright surfaces of the coupling flange on the output side are coated with an anticorrosive agent for shipment and storage. The casing is chromized and thus resistant to seawater.

Before leaving the factory, each transmission is subjected to a test run with the prescribed ATF oil. The residual oil remaining in the transmission after draining acts as a preservative and provides reliable protection against corrosion for at least 1 year if the units are properly stored.

2.2 Transport

Care should be taken when transporting the gearbox or the engine-gearbox assembly to prevent undue shocks and impacts. This applies particularly to the input and output shafts.

2.3 Removal of preservative

Use a suitable solvent for removing the anticorrosive agent, but never use emery cloth or paper, because this could damage the sealing surface and void the warranty.

It is advisable, especially after long periods of storage, to flush the transmission with the prescribed oil and remove residual oil.

2.4 Painting the gearbox

Always cover the running surfaces and sealing lips of the radial sealing rings on both shafts before painting. Make certain that the breather hole on the oil filler screw is not covered by paint. The identification plates should remain clearly legible.

2.5 Connecting the gearbox with engine

Fit a recommended damping plate between the engine and the transmission to compensate for minor alignment errors and protect the input shaft from external forces and loads.

If the flywheel housing of the engine is of suitable design, the gearbox unit should be directly bolted to the housing by means of the holes provided in the gearbox.

Make certain to use bolts with the right appropriate length (see «Main dimensions», item 1.2) and tighten them to the correct torque, M8 = 14 Nm (10 ft lb), M10 = 28 Nm (20 ft lb) using LOCTITE 242 or 262

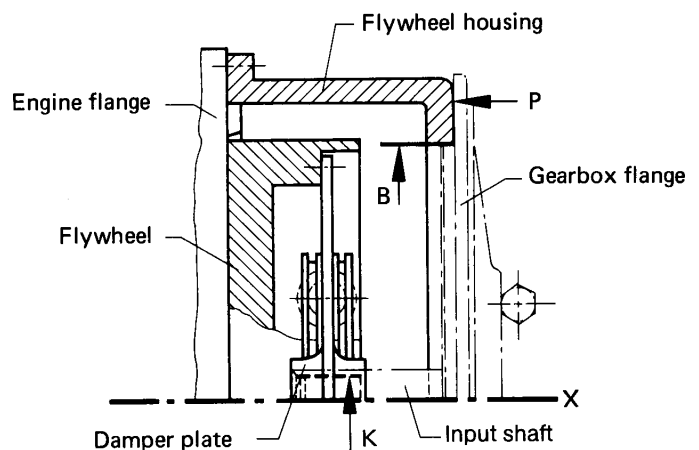
An adapter flange and a damper plate are available on request for each gearbox unit (see «Main dimensions», item 1.2.10).

The radial and axial runout values shown in the drawing Fig. 12 should never be exceeded between the engine and transmission.

The input shaft end is provided with a multi-spline or involute spline profile (see «Main dimensions», item 1.2).

Fig. 12

Connection of gearbox with engine



Permissible radial and axial runout
(0.1 mm = 0.004 inches)

X : B = 0,1 mm X : K = 0,1 mm X : P = 0,1 mm

2.6 Connection of gearbox with propeller

We recommend a flexible connection between the gearbox and the propeller shaft, when the engine is flexibly mounted, in order to compensate for angular deflections. The installation of a special propeller thrust bearing is not required, since the propeller thrust will be taken by the transmission bearing, provided the value specified under «Technical data», item 1.2, is not exceeded. However, the output shaft should be protected from additional loads. Special care should be taken to prevent torsional vibration. When using a universal joint shaft, make certain to observe the manufacturer's instructions.

2.7 Suspension of engine-gearbox assembly in the boat

Special care should be taken to protect the gearbox from detrimental stresses and loads when the engine-transmission assembly is not elastically suspended in the boat or craft.

The gearbox should be conveniently accessible for maintenance. If the oil drain plug of the gearbox is not accessible, the oil will have to be sucked off.

2.8 Position of gearbox in the boat

The inclination of the gearbox unit in the direction of the shafts should not exceed an installation angle of 20 degrees (see Fig.13) and 15° for ZF 15 MIV.

2.9 Operation of gearbox

The gearbox is suitable for single lever remote control. Upon loosening the retaining screw (7), the actuating lever (6) can be moved to any position required for the control elements (cable or rod linkage). (Fig. 14).

IMPORTANT

Make certain that the lever does not contact the actuating lever cover plate (9): the minimum distance between lever and cover must be 0.5 mm.

The control cable should be perpendicular to the actuating lever in the neutral position of the lever.

The zero position of the operating lever on the control console must coincide with the zero position of the actuating lever on the gearbox.

The shifting travel, as measured at the pivot of the actuating lever, between the neutral position and end positions A and B must be at least 35 mm for the outer and 30 mm for the inner pivot point.

A larger amount of lever travel is in no way detrimental.

IMPORTANT

However, if the lever travel is shorter, proper gear engagement might be impeded which, in turn, would mean premature wear, excessive heat generation and resulting damage.

The position of the cover plate underneath the actuating lever is factory-adjusted to ensure equal lever travel from neutral position A and B.

IMPORTANT

If this cover is removed in exceptional cases, proceed as described under item 6.14 of this manual.

When installing the gearbox, make certain that shifting is not impeded by restricted movability of the cable, by unsuitably positioned guide sheaves, too small bending radius, etc.

Fig. 13

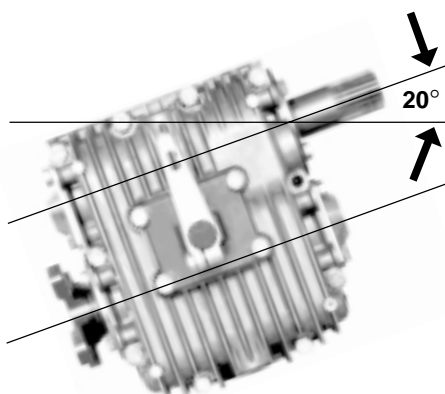
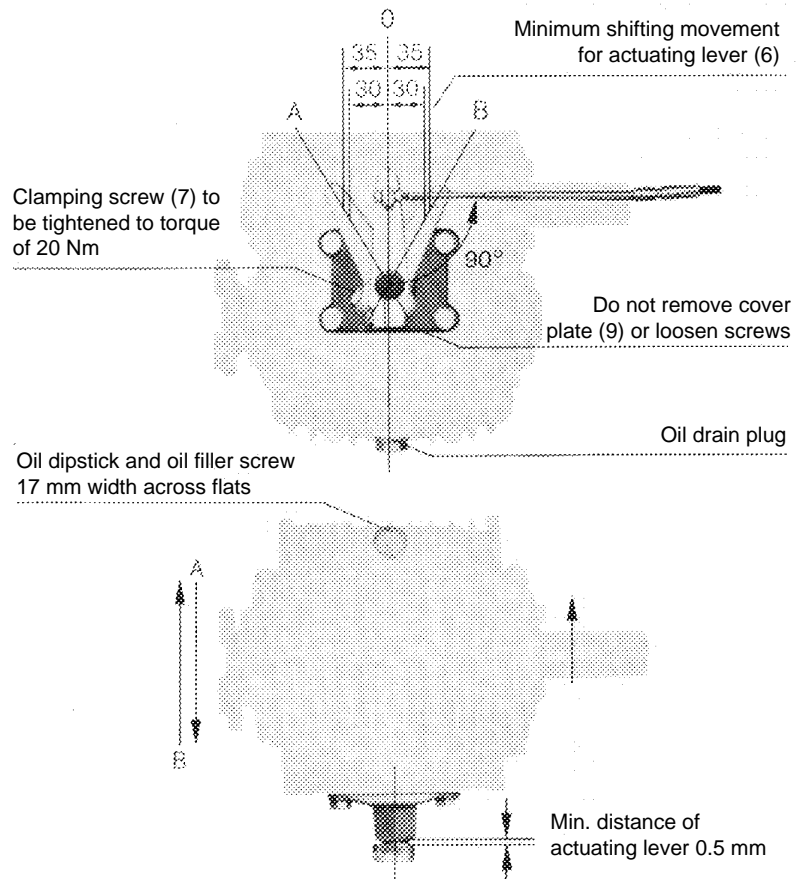


Fig. 14



2.10 Cooling unit

The arrangement of the cooling unit for the ZF 10 M, ZF 12 M, ZF 15 M, ZF 15 MA, ZF 15 MIV, ZF 25 M and 25 MA (no cooling is required for ZF 3 M and 5 M) can be seen from Fig.15.

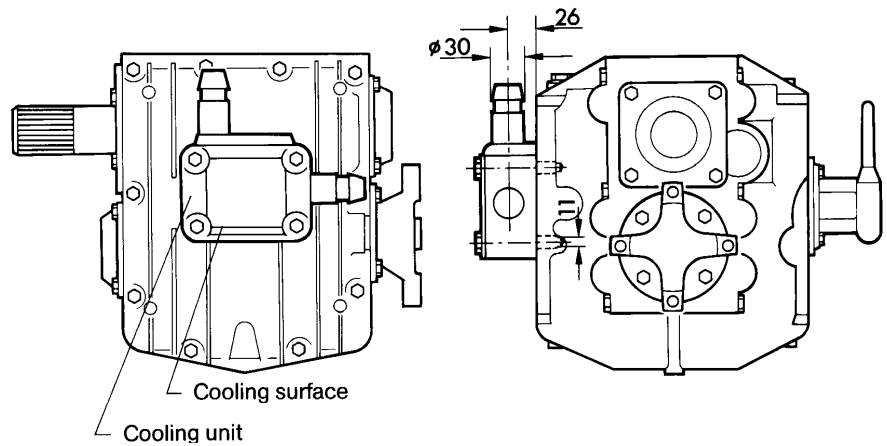
The table below shows the maximum power output in continuous operation (lever position A and B) usable without cooling. When these values are exceeded, a cooling unit is required.

The cooling unit should be connected to the fresh-water pressure line (external circuit) of the engine in accordance with Fig.16. The minimum volume of flow is 10 ltr/min. Retrofitting of the cooling unit involves no problems (see item 6.15).

2.11 Engine-gearbox compartment

Care should be taken that the engine gearbox compartment is properly ventilated.

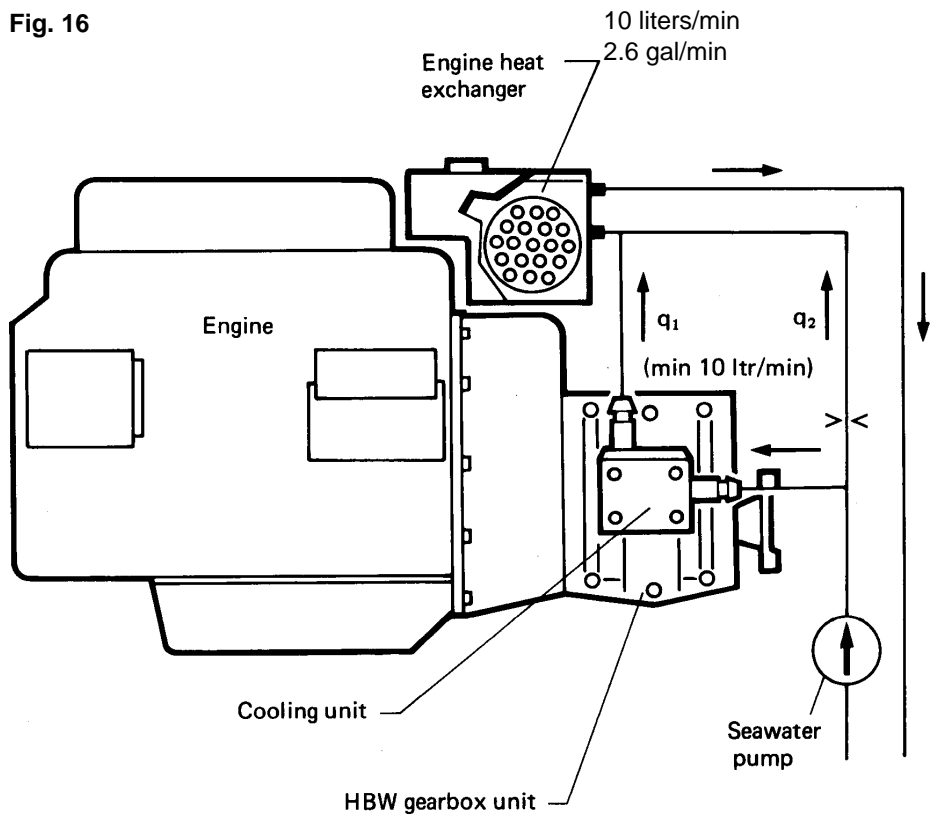
Fig. 15



Max. engine power usable without cooling

Lever position	ZF 3 M ZF 5 M	ZF 10 M	ZF 12 M ZF 15 M ZF 15 MA	ZF 15 MIV	ZF 25 M ZF 25 MA
A	no cooling	no cooling	40 kW 54 hp	25 kW 34 hp	40 kW 54 hp
B	no cooling	25 kW 34 hp	25 kW 34 hp	20 kW 34 hp	always with cooling unit

Fig. 16



3. Operation

3.1 General information

All ZF M boat reversing gearbox units are test-run on a test stand at the factory prior to delivery.

For safety reasons, the oil is drained before shipment.

3.2 Initial operation

Fill the gearbox with oil (ATF), (see 4.7 or recommended fluids). The oil level should be up to the index mark on the dipstick (see fig. 17).

To check the oil level, just insert the dipstick, do not screw in. Retighten the hex screw with the dipstick after the oil level check. Do not forget sealing ring.

3.3 Operating temperature

Normal operating temperature of the transmission oil should be in the range of 50°C (122°F) to 80°C (176°F). Max. permissible ATF temperature of 100°C (212°F) may only be reached for a short time.

3.4 Operation of gearbox

The zero position of the operating lever on the control console must coincide with the zero position of the actuating lever on the transmission. Shifting is initiated by a cable or rod linkage via the shifting lever and an actuating cam. The

completion of the gear changing operation is servo-automatically controlled.

Gear changing should be smooth, not too slow, and continuous (without interruption). Direct changes from forward to reverse are permissible, since the multiple-disc clutch permits gear changing at high rpm, including sudden reversing at top speeds in the event of danger.

3.5 Sailing or moving in tow

Rotation of the propeller while the boat is sailing, being towed, or anchored in a river, as well as operation of the engine with the propeller stopped (for charging the battery), will have no detrimental effects on the gearbox.

IMPORTANT

When the boat is sailing (engine stopped), the gear lever must be in zero position. Never put the gear lever in the position corresponding to the direction of travel of the boat.

Locking the propeller shaft by an additional brake is not required: use the gear lever position opposite your direction of travel for this purpose.

3.6 Lay-up periods

If the transmission is not used for periods of more than 1 year it should be completely filled with oil of the same grade to prevent corrosion. Protect the input shaft and the output flange by means of an anticorrosive coating if required.

3.7 Preparation for re-use

See item 2.3

4. Maintenance

4.1 Transmission oil

To ensure trouble-free operation of the clutch only use Automatic Transmission Fluid (ATF).

4.2 Oil quantity

ZF 3 M	0.30 ltr	0.32 qts
ZF 5 M	0.30 ltr	0.32 qts
ZF 10 M	0,35 ltr	0.37 qts
ZF 12 M	0.56 ltr	0.59 qts
ZF 15 M	0.56 ltr	0.59 qts
ZF 15 MA	0.47 ltr	0.50 qts
ZF 15 MIV	1.00 ltr	1.06 qts
ZF 25 M	0.75 ltr	0.79 qts
ZF 25 MA	0.75 ltr	0.79 qts
ZF 30 M	min. 0.90 ltr max. 1.10 ltr	min. 0.95 qts max. 1.17 qts

Use the index mark on the dipstick as a reference (see item 3.2)

4.3 Oil level checks

Check the oil level in the gearbox about once a month. Correct oil level: index mark on dipstick (see item 3.2). Always use the same oil grade when topping up. Don't overfill the gearbox. This will create higher operating temperatures.

4.4 Oil change

Change the oil the first time after about 25 hours of operation, then at intervals of at least 1 year.

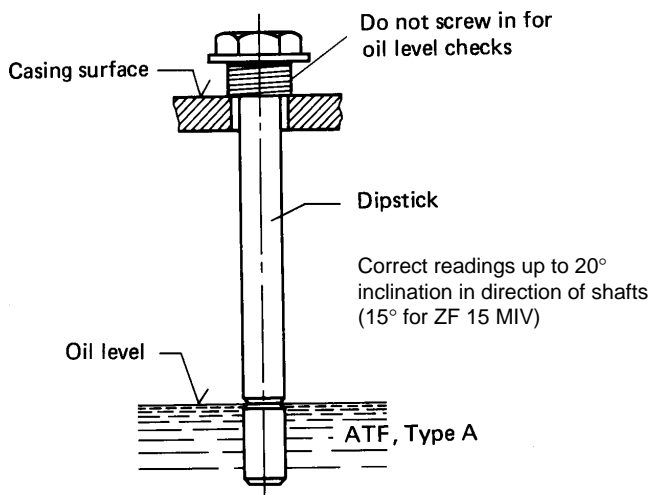
4.5 Checking the control cable linkage

The control cable or rod linkage should be checked at shorter time intervals. Check the zero position of the operating lever (on the control console) and of the shifting lever (on the gearbox) on this occasion. The minimum lever travel from the neutral position to operating positions (0-A = 0-B) should be 35 mm (1.38 in) for the outer and 30 mm (1.18 in) for the inner pivot point. Make certain that these minimum values are safely reached. Check the cable for easy movability (see item 2.9).

4.6 Cooling

If the transmission is equipped with a cooling unit, drain the cooling water before long periods of non-use when temperature is below freezing point.

Fig. 17



4.7 Automatic Transmission Fluid

List of recommended fluids

For ZF-HURTH ZF M Marine Transmissions Automatic Transmission Fluid (ATF) must be used as lubricant.

ADDINOL MINERALÖL GMBH, KRUMPA/D	ADDINOL ATF D IID	KUWAIT PETROLEUM, HOOGLVIET/NL	Q8 AUTO 14 (IID-21883)
ADDINOL MINERALÖL GMBH, KRUMPA/D	ADDINOL ATF D III	LEPRINCE+SIVEKE GMBH, HERFORD/D	LEPRINXOL FLUID CN
AGIP PETROLI SPA, ROM/I	AGIP ATF II D	LIQUI MOLY / MEGUIN, ULM/D	LIQUI IE
AGIP PETROLI SPA, ROM/I	AGIP ATF D 309	LIQUI MOLY / MEGUIN, ULM/D	MEGOL ATF IID
AGIP PETROLI SPA, ROM/I	AGIP ATF PLUS	LUBRICATION ENGIN., FORT WORTH/USA	AUTOMATIC TRANSMISSION FLUID
AGIP PETROLI SPA, ROM/I	AGIP DEXRON III	MAURAN SA, ODARS/F	INTER OIL INTER Matic ATF D2
AGIP SCHMIERTECHNIK, WÜRZBURG/D	AUTOL GETRIEBEÖL ATF-D	MIN.ÖL-RAFFIN. DOLLBERGEN, UETZE/D	PENNASOL FLUID-GETR.ÖL TYP PCN
AGIP SCHMIERTECHNIK, WÜRZBURG/D	AUTOL GETRIEBEÖL ATF III D	MOBIL OIL, WEDEL/D	MOBIL ATF 220 D20104 / D21685
ARAL LUBRICANTS GMBH, BOCHUM/D	ARAL GETRIEBEÖL ATF 22	MOBIL OIL, WEDEL/D	MOBIL ATF F-30107
ARAL LUBRICANTS GMBH, BOCHUM/D	ARAL GETR.ÖL ATF 55 F-30589	MOBIL OIL, WEDEL/D	MOBIL ATF 220 D21412 / D22187
AVIA MINERALÖL-AG, MÜNCHEN/D	AVIA FLUID ATF 86	MOBIL SEKIYU KABUS.KAISHA, TOKYO/J	MOBIL ATF 220Y (D-21412)
BLASER SWISSLUBE, HASLE-RÜEGSAU/CH	BLASOL 229	MOL HUNGARIAN OIL, KOMARON/H	CARRIER ATF
BP OIL DEUTSCHLAND, HAMBURG/D	FRONTOL UNIVERSAL-ATF 100	MORRIS LUBRICANTS, SHREWSBURY/GB	LIQUIMATIC DII
BP OIL INTERNATIONAL, LONDON/GB	AUTRAN DX II	NAFTEC, ALGIER/DZ	TASSILIA
BP OIL INTERNATIONAL, LONDON/GB	AUTRAN MBX	NANHAI SUPERIOR LUB-OIL, CHINA	NANHAI ATF (D2)
BP OIL INTERNATIONAL, LONDON/GB	AUTRAN DX III (F-30370)	NIS-RAFINERIJA NAFTE BEOGRAD/YU	GALAX Matic DAC
BP OIL INTERNATIONAL, LONDON/GB	AUTRAN DX III (F-30381)	OEST G. MIN.ÖLWERK, FREUDENSTADT/D	ATF T 4011
BUCHER+CIE AG, LANGENTHAL/CH	MOTOREX ATF SUPER D-22656	OMEX PETROLEUM PTY, BELLEVUE/AUS	OMEX ATF DEXRON II
BUCHER+CIE AG, LANGENTHAL/CH	MOTOREX ATF DEXRON III MC	OMV AG, SCHWECHAT/A	OMV ATF D II (D22427)
CALPAM GMBH, ASCHAFFENBURG/D	PAMATIC FLUID 289	OMV AG, SCHWECHAT/A	OMV ATF III (F-30580)
CALPAM GMBH, ASCHAFFENBURG/D	CALPAMATIC FLUID III F	OPTIMOL ÖLWERKE, HAMBURG/D	OPTIMOL ATF T 4011
CALTEX PETROLEUM CORP., LONDON/GB	CALTEX ATF-HDA	OSWALD KLUTH, BARGFELD-STEGEN/D	UNIVERSAL ATF-D
CALTEX PETROLEUM CORP., LONDON/GB	CALTEX ATF-HDM	PAKELO MOTOR OIL, SAN BONIFACIO/I	MULTIPURPOSE TRANSM. FLUID IID
CALTEX PETROLEUM CORP., LONDON/GB	CALTEX TEXAMATIC 1278	PANOLIN AG, MADETSWIL/CH	PANOLIN ATF MULTI 21996
CALTEX PETROLEUM CORP., LONDON/GB	CALTEX TEXAMATIC 7045	PANOLIN AG, MADETSWIL/CH	PANOLIN ATF DEXRON III
CALTEX PETROLEUM CORP., LONDON/GB	CALTEX TEXAMATIC 12054	PARS OIL CO., TEHRAN/IR	PARS ENTEGHAL-E AUTOMATIC OIL
CASTROL LTD, SWINDON/GB	CASTROL TQ-D (22765)	PAZ LUBRICANTS&CHEMICALS, HAIFA/IL	PAZBO EZF
CASTROL LTD, SWINDON/GB	CASTROL TQ DEXRON III F-30520	PENNZOIL PRODUCT COMP., HOUSTON/USA	PENNZOIL ATF F-30110
CASTROL LTD, SWINDON/GB	CASTROL TRANSMAX S (F-30319)	PETRO-CANADA, MISSISSAUGA/CDN	DEXRON III/MERC.ATF (F-30395)
CASTROL LTD, SWINDON/GB	CASTROL TRANSMAX T (F-30359)	PETROL OFISI A.S., BAKANLIKLAR/TR	PETROL OFISI ATF II
CASTROL LTD, SWINDON/GB	CASTROL TQ-D (21289)	PETROLEX, KWIDZYN/PL	VECO Matic IID
CASTROL LTD, SWINDON/GB	CASTROL ATF 21293	PRINZ-SCHULTE, FRECHEN/D	AERO-LINE ATF-2
CEPSA, MADRID/E	CEPSA ATF-70	PRINZ-SCHULTE, FRECHEN/D	AERO-LINE ATF-D
CHEVRON PRODUCTS CO., RICHMOND/USA	CHEVRON ATF F-30108	REPSOL DISTRIBUCION SA, MADRID/E	REPSOL Matic ATF
CITGO PETROLEUM CORP., TULSA/USA	CITGO ATF DEXRON III F-30167	S.A.E.I., ALCOBENDAS/E	GULF ATF DII D-22233
C.J.DIEDERICHS SÖHNE, WUPPERTAL/D	CIDISOL-HYDR.-FLUID DEXRON IID	SASOL OIL, RANDBURG/ZA	SASOL ATF DXII
DE OLIEBRON B.V., ZWIJNDRECHT/NL	ATF DMM	SCHMIERSTOFFRAFFINERIE SALZBERGEN/D	WINTERSHALL ATF D
DE OLIEBRON B.V., ZWIJNDRECHT/NL	ATF 289	SHELL ASEOL AG, BERN/CH	ASEOL ATF DB UNIVERSAL
DEA MINERALÖL AG, HAMBURG/D	DEAMATIC	SHELL INTERNATIONAL, LONDON/GB	SHELL DONAX TA (D-21666)
DEA MINERALÖL AG, HAMBURG/D	DEAFLUID 4011	SHELL INTERNATIONAL, LONDON/GB	SHELL DONAX TG (F-30358)
DEA MINERALÖL AG, HAMBURG/D	DEAFLUID 3003	SLOVNAFT JS CO, BRATISLAVA/SLO	MADIT AUTOMATIC
DEUTSCHE SHELL AG, HAMBURG/D	MAC ATF D-21666	SONOL ISRAEL LTD, HAIFA/IL	DEXRON 2 D
DUCKHAMS OIL, BROMLEY/GB	UNIMATIC	SOPROGRASA SA, MADRID/E	SOPRAL 164
ELF LUBRIFIANTS, PARIS/F	TRANSANTAR DF2	STATOIL STAVANGER/N	TRANSWAY DX III (F-30373)
ELF LUBRIFIANTS, PARIS/F	ANTAR 22329	STATOIL STAVANGER/N	TRANSWAY DX II
ELF LUBRIFIANTS, PARIS/F	ELFMATIC G2 22329	STL TECNOL, ESCALQUENS/F	TECNOL TECMATIC D2
ELF LUBRIFIANTS, PARIS/F	HUILE RENAULT DIESEL STARMATIC	SUN OIL COMPANY, AARTSELAAR/B	SUNAMATIC 149
ELF LUBRIFIANTS, PARIS/F	ELFMATIC G3	SUN OIL COMPANY, AARTSELAAR/B	SUNAMATIC 153
ELF LUBRIFIANTS, PARIS/F	TRANSANTAR DF3	SUOMEN PETROOLI OY, HAMINA/SF	TEBOIL FLUID E (F-30301)
ELLER-MONTAN-COMP., DUISBURG/D	ELLMO-AUTOMATIK-FLUID 22233	SUOMEN PETROOLI OY, HAMINA/SF	TEBOIL FLUID D
ENGEN PETROLEUM, CAPE TOWN/ZA	ENGEN ATF 22D	SVENSKA STATOIL AB, NYNÄSHAMN/S	TRANSWAY DX III (F-30373)
ERTOIL SA, MADRID/E	TRANSMISIONES AUTOMATICAS D2	TAMOIL LUBES, GENEVA/CH	TAMOIL ATF II D
ESSO AG, HAMBURG/D	ESSO ATF D (21611)	TEXACO LUBRICANTS COMP., BEACON/USA	ATF MERCON / DEXRON III
ESSO AG, HAMBURG/D	ESSO ATF F-30320	TEXACO SERVICES LTD, BRÜSSEL/B	TEXAMATIC 7045
ESSO AG, HAMBURG/D	ESSO ATF D (21065)	TEXACO SERVICES LTD, BRÜSSEL/B	TEXAMATIC 4261
FIAT LUBRIFICANTI, VILLASTELLONE/I	TUTELA GI/A	TEXACO SERVICES LTD, BRÜSSEL/B	TEXAMATIC 7080
FINA EUROPE SA, BRÜSSEL/B	FINAMATIC II-D	TEXACO SERVICES LTD, BRÜSSEL/B	TEXTRAN PSM
FUCHS LUBRICANTS (UK), DERBY/GB	SILKTRAN MP-ATF	TEXACO SERVICES LTD, BRÜSSEL/B	TEXAMATIC 4011
FUCHS LUBRICANTS (UK), DERBY/GB	SILKTRAN PSV ATF	TEXACO SERVICES LTD, BRÜSSEL/B	TEXAMATIC 4291
FUCHS MINERALÖLWERKE, MANNHEIM/D	TITAN ATF 4000	TEXACO SERVICES LTD, BRÜSSEL/B	TEXAMATIC 9226
GINOUVES GEORGES SA, LA FARLEDE/F	YORK LT 785	TOTAL RAFFINAGE DISTR., PARIS/F	TOTAL FLUIDE ATX
GULF OIL (GB) LTD, CHELTENHAM/GB	UNIFLUID	TOTAL RAFFINAGE DISTR., PARIS/F	TOTAL FLUIDE IID
GULF OIL (GB) LTD, CHELTENHAM/GB	ATF 2	TOTAL RAFFINAGE DISTR., PARIS/F	TOTAL FLUIDE AT 42
HANDELSMIJ NOVIOL B.V., NIJMEGEN/NL	KENDALL ATF DEXRON IID	TOTAL SOUTH AFRICA, JOHANNESBURG/ZA	TOTAL FLUIDE ATD
HOMBERG GMBH+CO KG, WUPPERTAL/D	HOMBERG-GETRIEBE-FLUID D	TURBOTANK BÖSCHE+BÖDEKER, BREMEN/D	TURBO UNIV. ATF MERCON 4011
IGOL FRANCE, PARIS/F	IGOL ATF 420	UFANEFTECHIM REFINERY, UFA/RUS	UFALUB ATF
INA RAFINERIJA ZAGREB/CROATIA	INA-ATF SUPER	UNIL DEUTSCHLAND GMBH, BREMEN/D	UNIL Matic CN T 4011
ITALIANA PETROLI, GENOVA/I	TRANSMISSION FLUID DX	VALVOLINE INC., LEXINGTON/USA	VALVOLINE MULTI-PURPOSE ATF
JAPAN ENERGY CORP., TOKYO/JAPAN	JOMO ATF K	VALVOLINE INTERNAT., DORDRECHT/NL	VALVOLINE ATF TYPE D
KÄPPLER K., STUTTGART/D	SELECTOL FLUID GETR.ÖL IID 23	VEBA OEL AG, GELSENKIRCHEN/D	MOVARA ATF-GETRIEBEÖL DIID
KLÖCKNER ENERGIEHANDEL GMBH, KÖLN/D	DEUTZ OEL ATF-D	VEEDOL INTERNATIONAL, SWINDON/GB	VEEDOL ATF-M (22764)
KROON OIL BV, ALMELO/NL	ATF DEXRON IID	VEEDOL INTERNATIONAL, SWINDON/GB	VEEDOL ATF DEXRON III F-30521
KROON OIL BV, ALMELO/NL	ALMIROL ATF	VEEDOL INTERNATIONAL, SWINDON/GB	VEEDOL UNITRANS S PLUS
KUWAIT PETROLEUM, HOOGLVIET/NL	Q8 AUTO 15	YACCO SA, ST PIERRE-LES-ELBEUF/F	YACCO ATF D
KUWAIT PETROLEUM, HOOGLVIET/NL	Q8 AUTO 14 (IID-21677)	ZELLER+GMELIN GMBH&CO, EISLINGEN/D	DIVINOL FLUID 666
KUWAIT PETROLEUM, HOOGLVIET/NL	Q8 AUTO 14 (IID)		

5. Disassembly

Note: fold out illustration sheets 1 and 2 or (for ZF 15 MIV) sheets 3 and 4 (exploded views) for reference.

5.1 Removing the cooling unit (if present)

Unscrew 4 hex head screws M8x50 and take off unit (see illustration under item 6.14.2).

5.2 Removing and disassembling the actuating lever cover plate

5.2.1 Always set actuating lever to neutral position.

5.2.2 Remove hex nuts (22) from cover plate (9), using 13 mm spanner (wrench), and take off spring washers (4).

5.2.3 Remove cover plate assembly (12), lever (6) and actuating cam (11).

5.2.4 Remove screw (7) from lever (6). Pull off lever (6). Remove actuating cam (11) and needle bearing (70) only in models ZF 12 M - 15 M - 25 M - 30 M. Remove actuating cam sealing ring (8).

5.3 Removing the bearing shields

5.3.1 Remove hex head screw (5) from bearing shields (2) and (3), using 13 mm spanner (wrench), and take off spring washers (4).

5.3.2 Remove cover (3) and bearing shield (2) on input shaft (36) together with seals (28).

5.4 Separating the gearbox sections and removing the input and output shafts

5.4.1 Remove hex nuts (22) from gearbox (1), using 13 mm spanner (wrench), take off spring washers (4) and remove screws (21).

5.4.2 Separate the two halves of gearbox (1) by light hammer blows on the oil filler screw and oil drain plug (19 and 20).

5.4.3 Remove shims (37, 38, 39, 40) from the input and output shafts and keep separately. For proper reassembly it is advisable to note down the thickness and location of each of the shims to obtain the correct bearing play. If none of the parts (2, 3, 32, 33, 36) on the input shaft and of the parts (2, 3, 34, 35, 43, 46, 47, 59) of the output shaft are replaced, the shims can be re-used in the same positions. When any of these parts are replaced, the dimensions of the gear set relative to the casing have to be measured anew and suitable shims have to be installed.

5.5. Removing the shifting fork (15)

5.5.1 Remove screw plug (17) (not necessary in ZF 3 M - 5 M since there is no plug but only a O-ring).

5.5.2 Pull actuating shaft (16) out of the hole in the half housing.

5.5.3 Remove shifting fork (15).

5.6 Removing the intermediate gear (26)

5.6.1 Heat gearbox section with intermediate gear to a temperature of approx. 80°C (176 F); in ZF 3 M - 5 M only, first remove the retaining ring (23).

5.6.2 Knock pin (24) out of its bearing by light hammer blows, using a driving pin of suitable size.

5.6.3 Remove intermediate gear (26), retaining plates (25) and roller cage (27).

5.7 Disassembling the input shaft (36)

5.7.1 Remove outer bearing races (32).

5.7.2 In the event of bearing damage, cautiously drive inner races (33) off the input shaft (36) with a punch (away from gear).

5.8 Disassembling the output shaft (66)

5.8.1 Mount support rail on a vice with the pins pointing upwards (not on ZF 15 MIV).

5.8.2 Place output shaft (66) vertically on the support rail with the flange side down.

5.8.3 Remove screw (41) spacer (42) and outer bearing race (34). Only in models ZF 3 M - 5 M remove also shims (68) and in model ZF 15 MA spacer (68).

5.8.4 Place side of gear (65) adjacent to shaft flange against a suitable support (a divided flange or two brackets of suitable section) and use pin of suitable size to press off the output shaft. Do not place the support neither against the gear's (65) teeth nor against the friction washer (43). But place it as shown on the drawing below.

The parts removed from the upside of the shaft are not interchangeable with the parts removed from the flange side. Keep separately.

5.8.5 Remove keys (67) from the output shaft and keep in a separate place (1 key for ZF 3 M and 5 M, 2 keys for ZF 10 M, 12 M, 15 M, 15 MA, and 4 keys for ZF 25 M, 25 MA and ZF 30 M).

Fig. 18

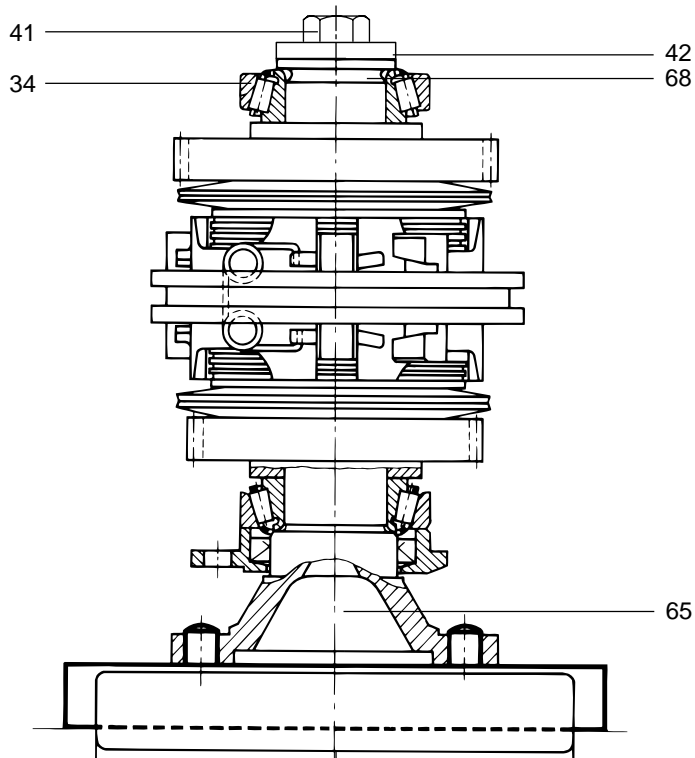
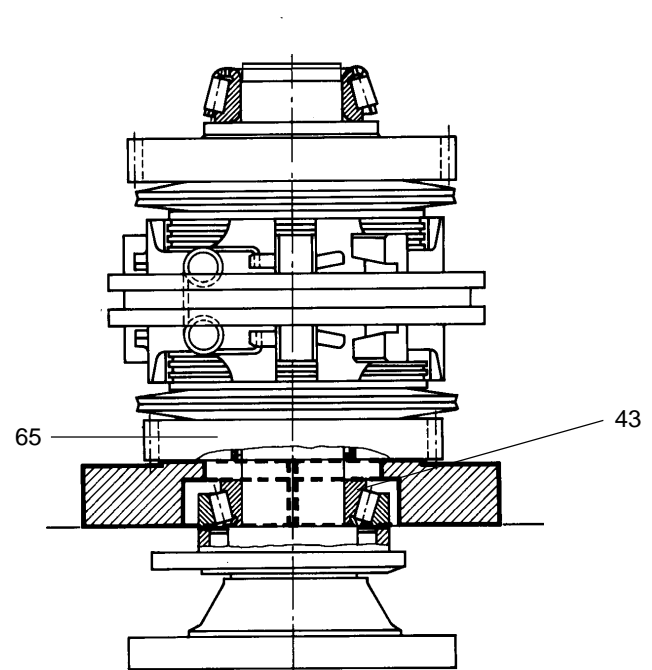


Fig. 19



5.8.6 Put off shims (53, 54, 55, 56), spacer (47) and needle bearing (45) from the output shaft.

5.8.7 Attach divided flange to face side of bearing shield (2) and pull off thrust washer (43), inner race (46) and taper roller bearing (34, 35) with shield. On ZF 15 MIV only pull off taper roller bearing (34, 35).

5.8.8 Remove internal and external clutch discs from gears (44) and (65).

5.8.9 Dismantling the gears
Compress cup springs (48) (only one each side for ZF 3 M - 5 M) by means of dismantling tool. Remove circlip (50) and take off thrust plate (49).

5.8.10 Dismantling the actuating members.
Detach springs (64), watching for balls (58).

5.8.11 Remove disc carrier (57).

5.8.12 Place actuating sleeve (60) on a plane surface and press out guide sleeve (59). Watch for detent pins and springs jumping off the guide sleeve. It will be advisable to wrap a rag around the actuating sleeve (60) and the guide sleeve (59) to catch any parts that might jump off.

5.9 Disassembling the quill shaft (ZF 15 MIV).

Note: see drawing page 38.

5.9.1 Remove grooved ring nut (83) by means of socket spanner and take off ring (34) with sealing ring (31).

5.9.2 Place divided flange against face side of bevel gear (80) and force bevel gear (80) spacer ring (76) and bearing (74) off quill shaft.

5.9.3 Remove key (81) and spacer ring (76).

5.9.4 Force off bearing (74) by means of divided flange.

Fig. 20

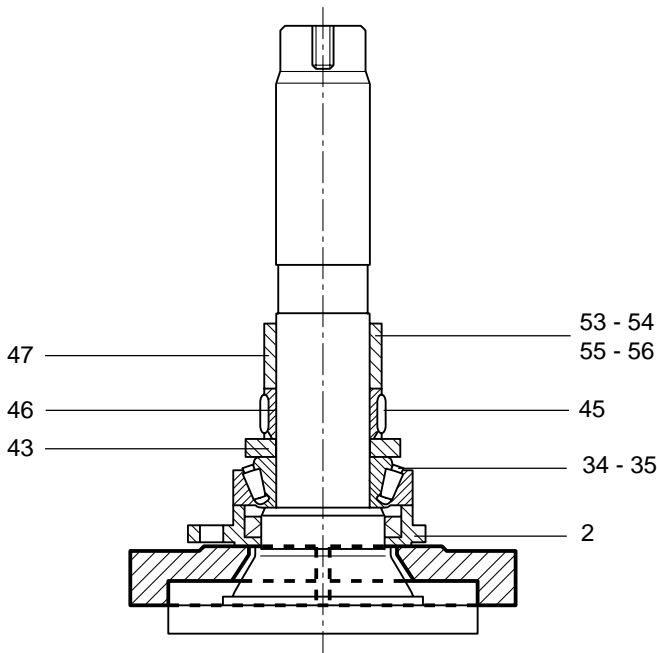


Fig. 22

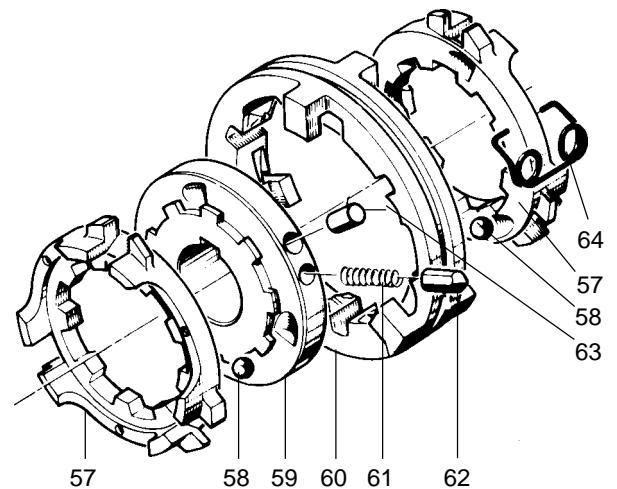
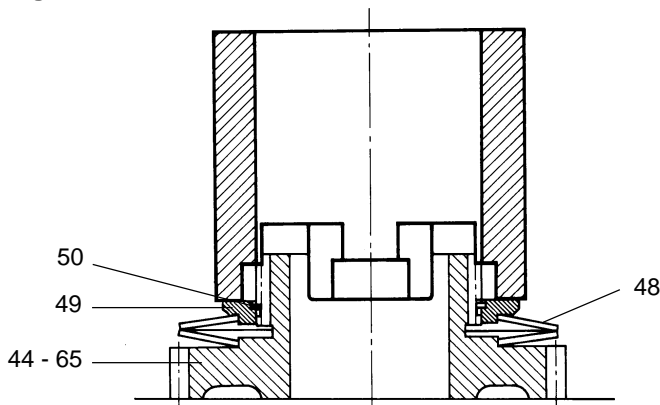


Fig. 21



6. Reassembly

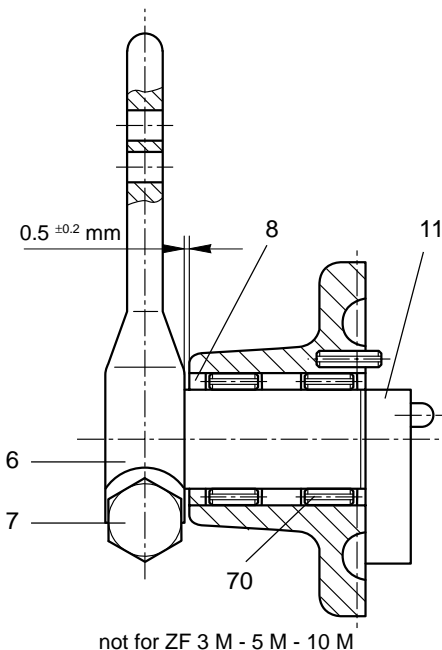
Note: fold out illustration sheets 1 and 2 (exploded views) for reference. For ZF 15 MIV use illustration sheets 3 and 4.

6.1 General information

The following points should be observed when reassembling the gearbox:

- Clean all parts thoroughly, especially sealing surfaces, inspect for wear, damage and cracks, and replace if required.
- Check shifting fork (15) for wear. The contact surfaces of this fork are provided with amolybdenum coating. Should this coating be worn away at any point, replace the shifting fork. Max wear on guiding surfaces 0.2 mm (0.008 in) on each side.
- Thrust rings (43) require replacement if wear exceeds 0.25 mm (0.0098 in).
- Internal discs (51) have a sintered metal coating of 0.3 mm (0.012 in) on each side. If the surface structure (after clean-ing) shows indications of wear, replace the discs.
- Apply thin coat of oil to antifriction bearings before installation.

Fig. 23



6.2 Assembling the intermediate gear shaft in gearbox section side cooler

6.2.1 Insert retaining plate (25).

IMPORTANT:

Note that the bevelled corners of retaining plates (25) have to be placed in different positions (see illustration on sheet 1).

6.2.2 Insert needle cage (27) into intermediate gear (26) and place complete assembly with retaining plate (25).

6.2.3 Insert second retaining plate (25). Not for ZF 3 M - 5 M.

6.2.4 Fit O-ring (23) to intermediate gear shaft (24)* and drive it into gearbox section by knocking slightly on a drive pin.

* on ZF 3 M - 5 M insert intermediate gear shaft with seeger 23 and Loctite 574.

* on ZF 25 M - 25 MA and ZF 30 M, insert intermediate gear shaft (24) without O-ring (23) and close bore in gearbox section with sealing compound by pressing in a plug (23) with Loctite 574. (see illustration on sheet 1).

* on ZF 15 MIV insert intermediate shaft (24) and stop it in its place by knocking with a driver pin on the edge of the hole of the housing. Close the outsider hole in the housing by pressing in plug (23) with Loctite 574.

6.3 Assembling the shifting fork in gearbox section side shifting cover

6.3.1 Insert shifting fork (15) into gearbox section (1) side the actuating lever in such a way that the long arm of the fork points downwards.

6.3.2 Insert shifting rod (16) through bores in gearbox and shifting fork.

6.3.3 Fit screw plug (17) to gearbox, making certain that the clearance between shifting rod (16) and screw plug (17) is min. 0.5 mm (0.02 in). Seal screw plug with Loctite 242 (ZF 3 M - 5 M only O-Ring).

6.3.4 Check shifting fork for easy movability.

6.4 Pre-assembling the actuating lever cover plate

Use punch tool to press sealing ring (8) into cover plate (9). Spread antifriction bearing grease between sealing lips.

6.4.1 Insert actuating cam assembly (11) into cover plate (9).

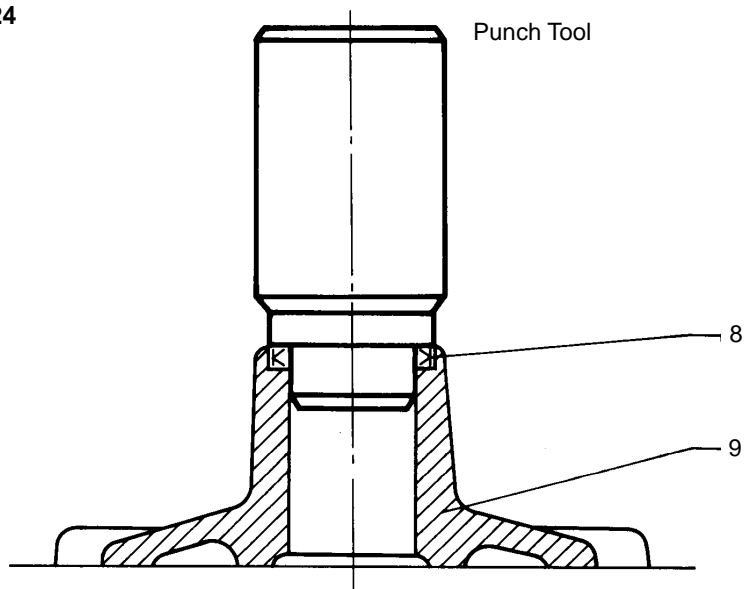
6.4.2 Fit actuating lever (6).

IMPORTANT:

Clearance between actuating lever and cover plate 0.5 mm (0.02 in).

6.4.3 Clamp actuating lever by means of retaining screw (7), using a 13 mm spanner (wrench). Screw in with torque of 20 Nm.

Fig. 24



6.5 Pre-assembling the gears (65) and (44) with cup springs (48) and clutch discs (51 and 52)

IMPORTANT:

If previously disassembled parts are used, make certain that only mating and associated parts are reassembled.

6.5.1 Join two cup springs (48) (only one cup spring for ZF 3 M - 5 M) face to face (external diameters in contact) and place them on the centering collar of gears (65) and (44).

6.5.2 Place thrust ring (49) on cup springs.

6.5.3 Place circlip (50) on gear hub and use mounting tool and press to fit circlip into groove on hub. Don't press completely the cup springs and be sure that the tool presses at least on three points on the thrust washer (49).

6.5.4 Attach clutch discs (51 and 52), first internal disc (51), then alternatively external disc (52), internal disc (51), etc.

6.6 Measuring the pre-assembled gears (65) and (44) to determine setting value «a».

If no parts had to be replaced, the previously disassembled shims (53, 54, 55, 56) can be re-used in their former arrangement and positions without any measuring operation.

If measuring is required, proceed as follows:

6.6.1 Place pre-assembled gear (65), and subsequently gear (44) on thrust washer (43), (end face of hub downwards, see illustration).

IMPORTANT:

On ZF 3 M - 5 M - 10 M there is a step on the thrust washer (43). Put the side of the washer with the step against the gear. Be sure that the needle bearing inner race (46) is fitted into it.

6.6.2 Insert needle cage (45), inner race (46) and spacer (47) into bore of gear.

6.6.3 Fit shims (53, 54, 55, 56), as required, until prescribed setting value «a» is obtained (see illustration).

6.6.4 Shims are available in thicknesses of 0.4 - 0.5 - 0.6 and 0.7 mm. (0.016 - 0.020 - 0.024 and 0.028 in)

Setting value «a»

Type	mm	inches
ZF 3 M	8.0±0.1	0.315±0.004
ZF 5 M		
ZF 10 M	13.0±0.1	0.512±0.004
HBW 10		
ZF 12 M		
ZF 15 M	12.4±0.1	0.488±0.004
ZF 15 MA		
ZF 15 MIV		
ZF 25 M / 25 MA	16.2±0.1	0.638±0.004
ZF 30 M	19.75±0.1	0.778±0.004
Old versions (4+3 external clutch discs)		
HBW 10 (versions from 01 to 08)	13.2±0.1	0.520±0.004
HBW 150 (versions from 09 to 14)		
HBW 150 V (versions from 01 to 07)		

Fig. 25

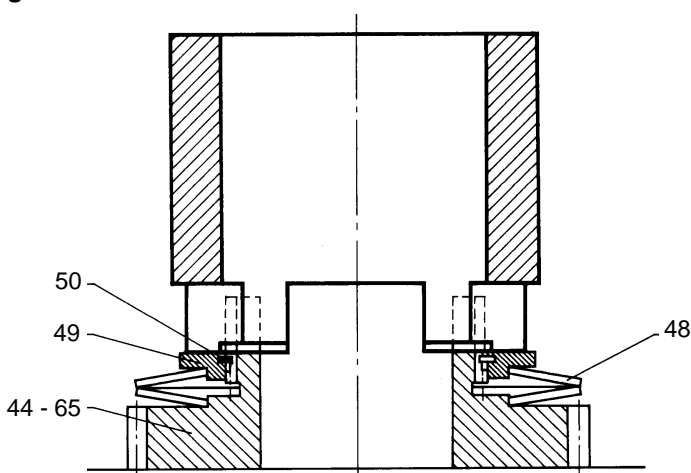
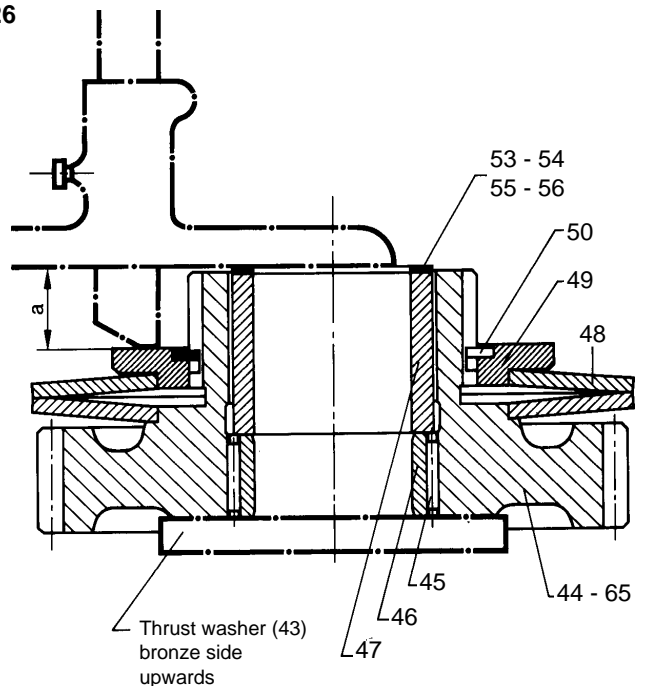


Fig. 26



6.7 Pre-assembling the bearing shields (2) for the input and output shafts

Use a driver tool to press sealing rings (30 - input and 31 - output) into shield (2).

6.8 Pre-assembling the clutch members

6.8.1 Fit driving pins (63), springs (61) and detent pins (62) to guide sleeve (59).

6.8.2 Place actuating sleeve (60) on plane press surface.

6.8.3 Place guide sleeve (59) on top of actuating sleeve (60) with the three driving pins (63) in alignment with the three grooves in the actuating sleeve. Watch for correct position of detent pins (62) relative to angular pockets of sleeve.

6.8.4 Press guide sleeve (59) into actuating sleeve (60) up to midway position (noticeable click).

6.8.5 Insert balls (58) into ball pockets of guide sleeve, attach disc carrier (57), turn upside down then fit balls in opposite face side and attach second disc carrier (57).

6.8.6 Attach springs (64) with closed part of spring windings pointing outwards.

6.9 Reassembling the input shaft

Preheat inner races (33) of taper roller bearings to a temperature of 100° C (212F) and, using tubular or punch tool, press races on input shaft (36) on both sides.

IMPORTANT:

Repress after cooling down, so that no gap is left.

Fig. 27

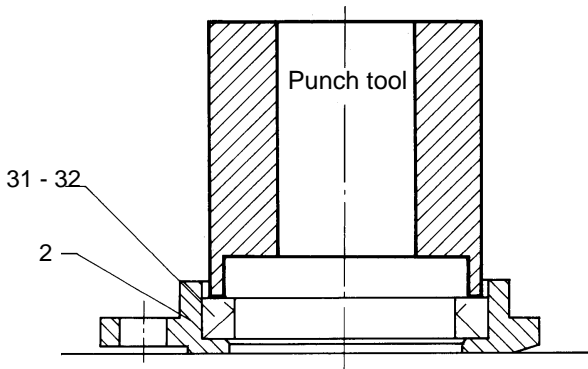


Fig. 28

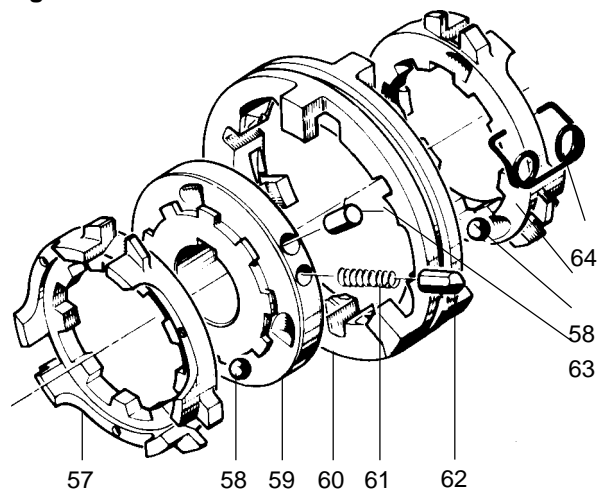


Fig. 29

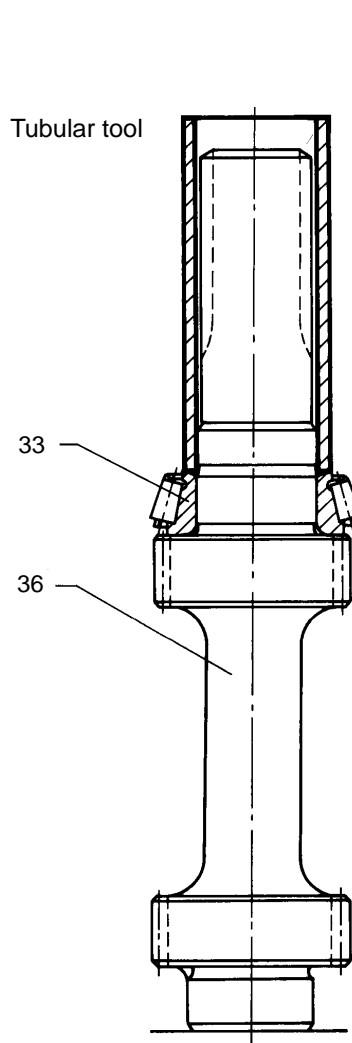
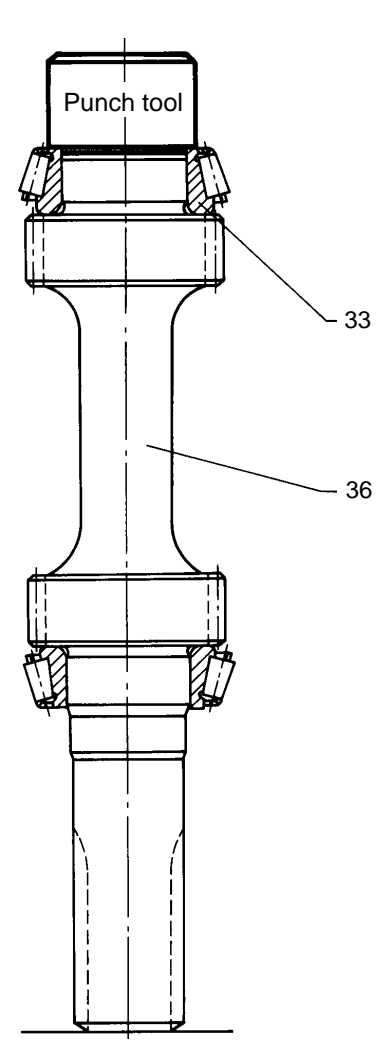


Fig. 30



6.10 Reassembling the output shaft

6.10.1 Place pre-assembled bearing shield (item 6.7) with seal (28) on output shaft (66) (not applicable to ZF 15 MIV).

6.10.2 Attach outer race (34) of taper roller bearing.

6.10.3 Pre-heat inner race (35) of taper roller bearing to a temperature of approx. 100°C (212 F) and press on output shaft (66) in hot condition.
On ZF 15 MIV press complete bearing (68) on shaft (66).

IMPORTANT:

Repress after cooling down, so that no gap is left.

6.10.4 Fit thrust ring (43) in such a way that sintered surface (brown colour) faces gear.

6.10.5 Use tubular tool to press on inner race (46) of needle bearing for gear (65).

6.10.6 Attach needle cages (45) and completely pre-assembled gear (65) with clutch discs (51 and 52).

6.10.7 Fit spacer (47) and shims (53, 54, 55, 56) to gear (65).

6.10.8 Fit keys (67) to shaft (1 for ZF 3 M, 5 M, 2 keys for 10 M, 12 M, 15 M, 15 MA, 4 for ZF 25 M - 25 MA and ZF 30 M).

6.10.9 Press pre-assembled actuating members (see item 6.8) on output shaft (66).

IMPORTANT:

Align keys radially relative to guide sleeve (59).

Fig. 31

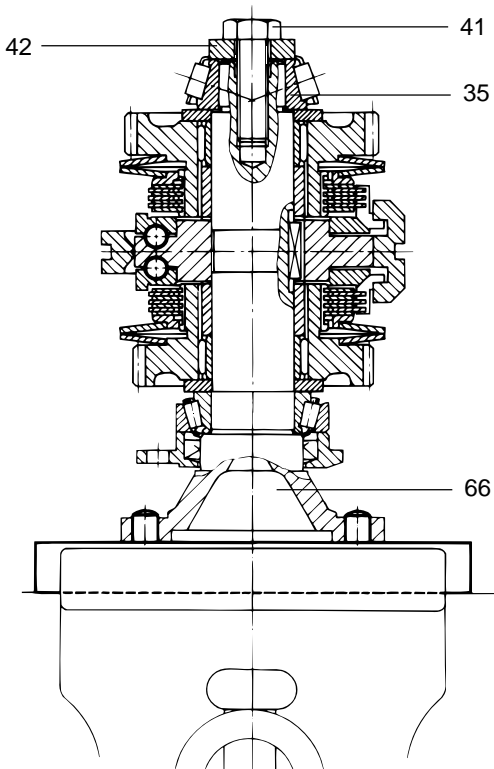
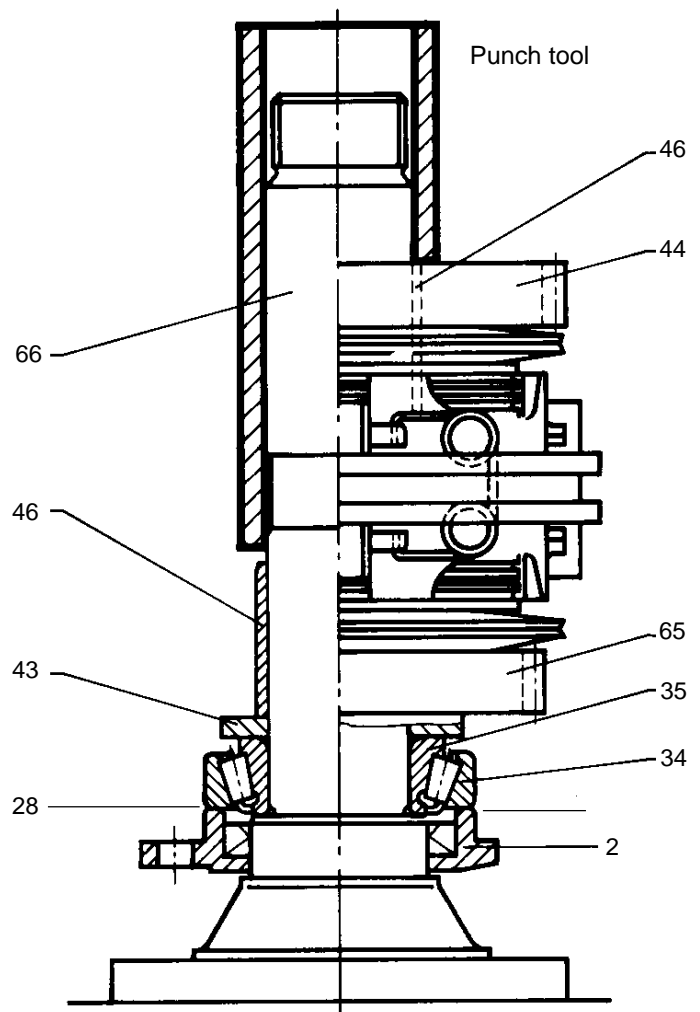


Fig. 32



6.10.10 Attach shims (53,54,55, 56) to gear (44).

6.10.11 Attach spacer (47) to gear (44).

6.10.12 Use tubular tool to press on inner race (46) of needle bearing for gear (44).

6.10.13 Attach pre-assembled gear (44) with needle cage (45) and clutch discs (51 and 52).

Align external discs for proper engagement with actuating member.

6.10.14 Attach thrust ring (43) in such a way that sintered surface (brown colour) faces gear.

6.10.15 Pre-heat inner race (35) of taper roller bearing to a temperature of approx. 100°C (212 F) and press it on shaft.

IMPORTANT:

Repress after cooling down, so that no gap is left.

6.10.16 Screw on bolt (41), (supplied with Loctite) and tighten to torque:

ZF 3 M - 5 M	50 Nm	37 ft lb
ZF 10 M	60 Nm	44 ft lb
ZF 12 M - 15 M	100 Nm	74 ft lb
ZF 15 MA - 15 MIV	100 Nm	74 ft lb
ZF 25 M - 25 MA	120 Nm	89 ft lb
ZF 30 M	120 Nm	89 ft lb

6.10.17 (ZF 3 M, ZF 5 M only) attach shims (68) to end shaft (66). The gap has to be 0.2 ± 0.05 mm (0.0079±0.0019 in).

6.10.18 (ZF 15 MA only) attach spacer (68).

6.10.19 Check gears (44) and (65) for free movability in an axial direction.

6.10.20 Attach outer race (34) of taper roller bearing.

6.11 Reassembling the quill shaft ZF 15 MIV

6.11.1 Fit radial sealing ring (31) and clip (84) together with O-ring (86).

6.11.2 First bearing: Press on bearing inner race (74). Fit bearing outer race (75).

6.11.3 Fit spacer ring (76).

6.11.4 Fit key (81).

6.11.5 Press on gear (80).

6.11.6 Fit second spacer ring (76).

6.11.7 Second bearing: Press on inner race (74). Fit outer race (75).

6.11.8 Push on clip (73) together with O-ring (85).

6.11.9 Tighten grooved ring nut (83) to a torque of 95 Nm (70 lbf), using a socket spanner, and then secure by pressing rim into groove in shaft.

6.11.10 Fit radial sealing ring (31) and cup (84) together with O-Ring (86).

Fig. 33

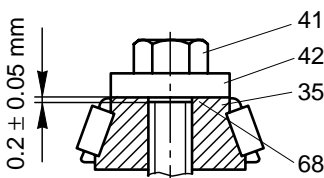


Fig. 34

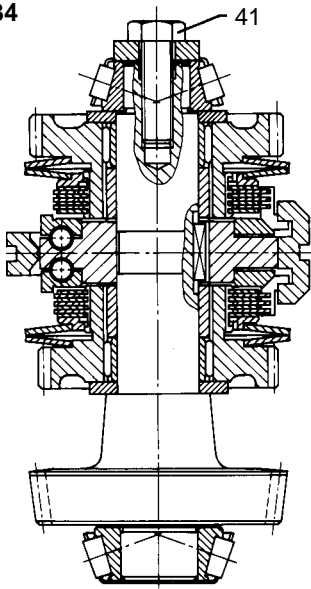
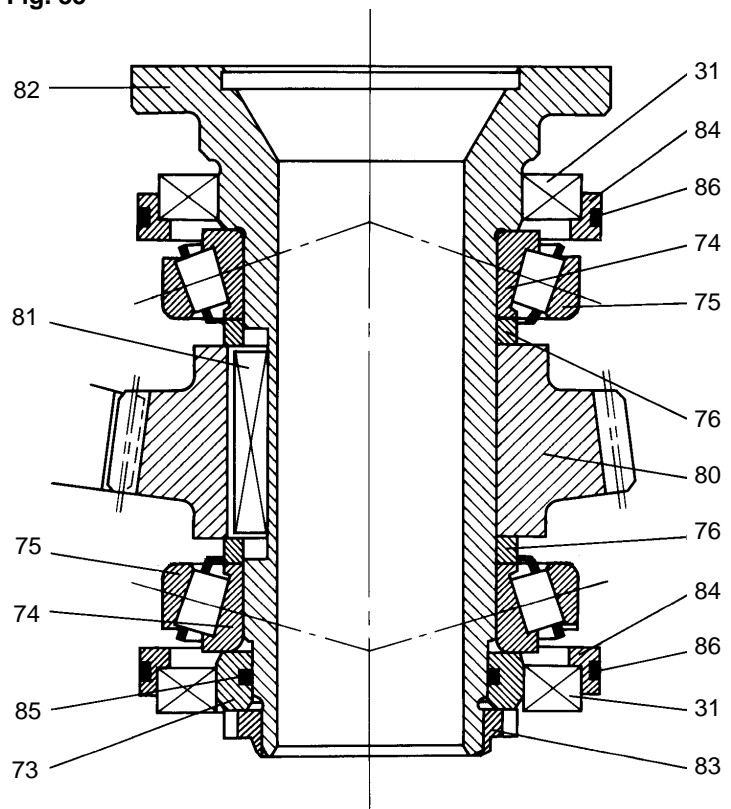


Fig. 35



6.12 Final assembly of gearbox

6.12.1 Place pre-assembled gearbox section (1) - (with intermediate gear) - on side wall.

6.12.2 Place pre-assembled output shaft (66) in lower part of gearbox with flange side towards intermediate gear side (on ZF 15 MIV, bevel gear towards intermediate gear side).

6.12.3 Place pre-assembled input shaft (36) in upper part of gearbox.

6.12.4 (ZF 15 MIV only) Place pre-assembled quill shaft (73) in lower part of gearbox (watching to correct engagement of marked teeth).
Add shims 78 on quill shaft:
1.2 mm on side input shaft and 2.2 mm on side output flange.
Add shims (70) on clutch shaft 2 x 0.1 mm on side output flange.

6.12.5 (ZF 15 MIV only) Check backlash 0.08 to 0.13 mm (0.003 to 0.005 in). Between teeth of bevel gears using a dial indicator in contact with tooth surface.

To correct backlash:
Replace shim 78 side output flange with a thicker one to decrease backlash and vice-versa.
If the correction is not enough to reach the correct backlash, modify shimming (70) on clutch shaft side output flange and repeat procedure.

To correct axial play (quill shaft):
Check axial play 0.05 ± 0.02 mm (0.002 ± 0.0008 in).
Compensate for difference by inserting shims (78) side input shaft.

6.12.6 Seal with LOCTITE 574 surface of pre-assembled gearbox section (1) (with shifting fork) and place upper section on lower section of gearbox.

6.12.7 Insert screws (21) preferably in the middle, and screw in low-tight to secure the two gearbox sections together.

6.12.8 Use a plastic hammer to align the two gearbox section (1) by tapping them gently into position.

6.12.9 Fit bearing shield (2) with gasket (28) to output shaft (66) by means of spring washers (4) and screws (5), using a 13 mm spanner (wrench).
Tighten to torque of 14 Nm (10 ft lb).

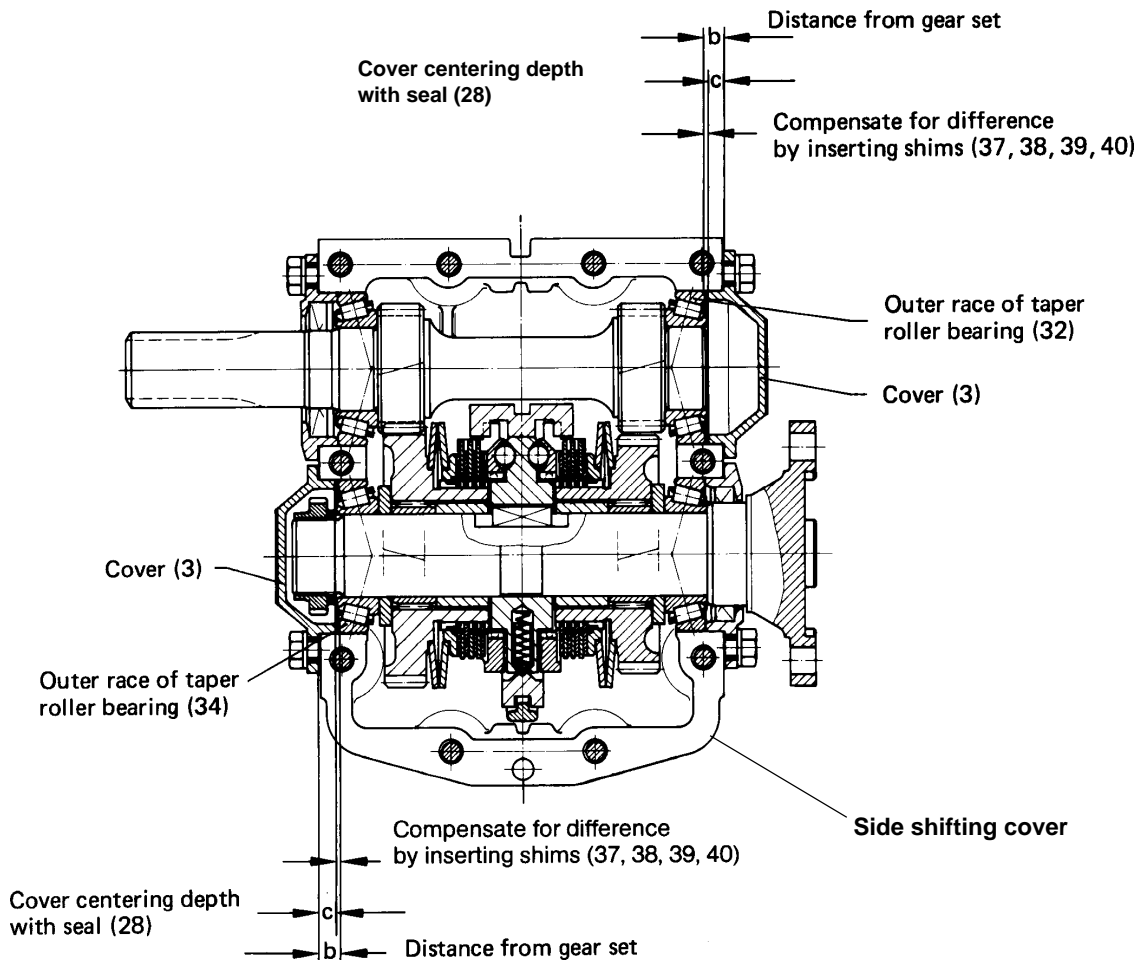
6.12.10 Slide pre-assembled bearing shield (2) with gasket (28) over input shaft and secure by means of spring washer (4) and screws (5), using a 13 mm spanner (wrench).
Tighten to torque of 14 Nm (10 ft lb).

6.13 Measuring the gears sets of input shaft and output shaft (see illustration)

6.13.1 Tap outer races (32) and (34) on output and input shafts to eliminate bearing play, simultaneously rotating the shafts.

6.13.2 Determine dimension «b» by means of depth gauge (see illustration).

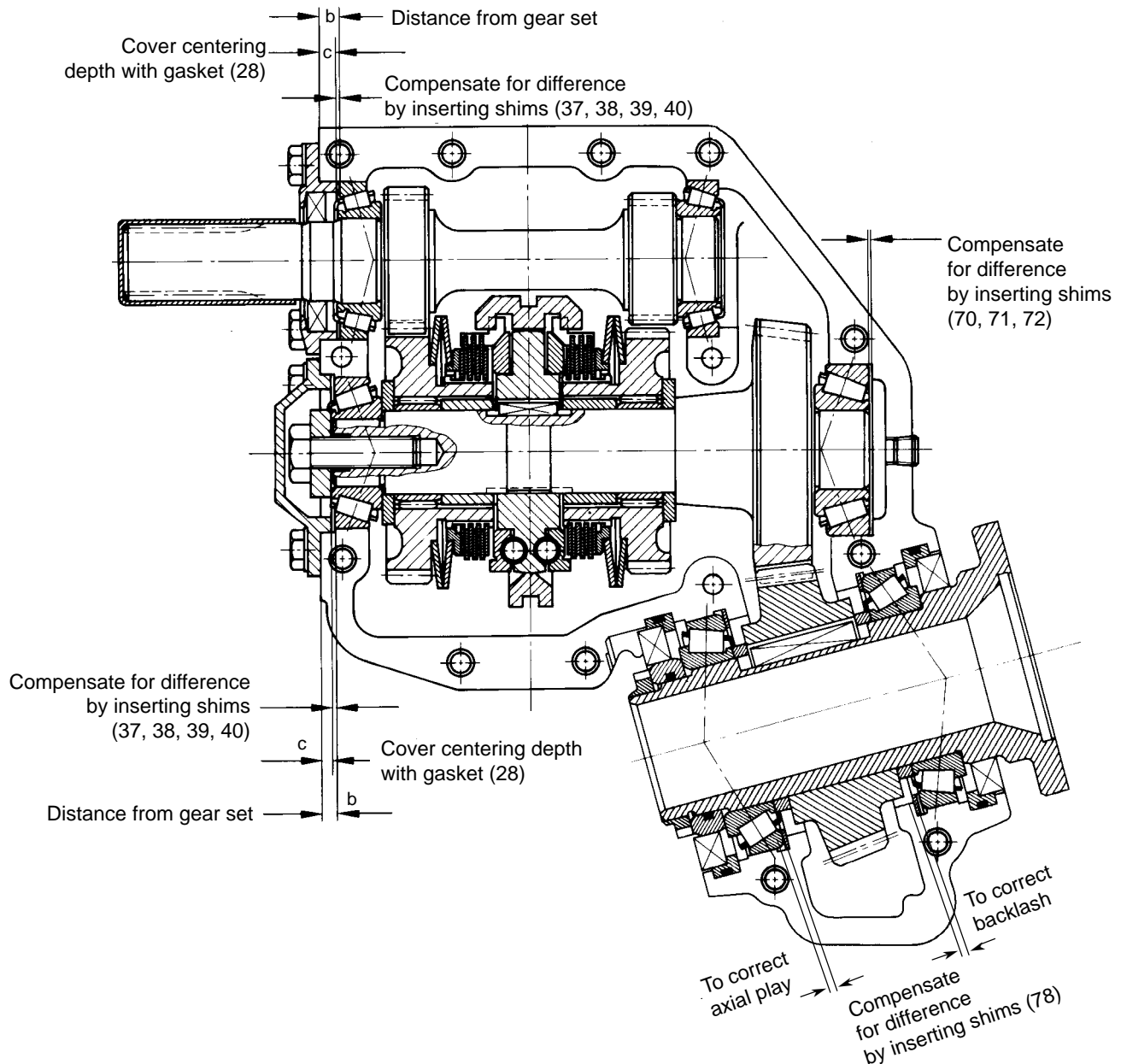
Fig. 36



6.13.3 Measure dimension «c» on cover (3) with gasket (28) installed, using a depth gauge (see illustration). The difference between the two dimensions indicates the distance to be filled up with shims (37, 38, 39, 40). Shims are available in thicknesses of 0.1 - 0.15-02.-03. and 0.5 mm.

On ZF 15 MIV, a hole is provided on the output side of the housing to permit this measuring operation: move shaft via gear (65) by means of a lever through opening in gearbox (see illustration next page).

Fig. 37



6.13.4 Insert the required number of shims into the bearing bores of the gearbox to obtain an axial clearance of the output and input shafts of 0.05 ± 0.02 mm.

If no parts had to be replaced (see item 5.4.4), the previously disassembled shims (37, 38, 39, 40) can be re-used in the previous arrangement and positions. It will be advisable, however, to check the bearing clearance and correct it if required.

6.13.5 Mount the previously measured covers (3) on the output and input shafts by means of spring washers (4) and screws (5), using a 13 mm spanner (wrench). Tighten to torque of 14 Nm (10 ft lb).

6.13.6 Place spring washers (4) underneath all screws (21) and tighten screws to a torque of 22 Nm (16 ft lb), using a 13 mm spanner (wrench).

6.13.7 Tap output and input shafts lightly in an axial direction while rotating the shafts, to ensure freedom of movement.

6.13.8 Axial clearance of input and output shafts: 0.05 ± 0.02 mm, measured by means of dial indicator in contact with end face of shaft (see illustration).

6.13.9 Measure axial clearance of quill shaft (on ZF 15 MIV), also with dial indicator in contact with end face of the shaft (see illustration).
Permissible clearance: 0.05 ± 0.02 mm.

Fig. 38

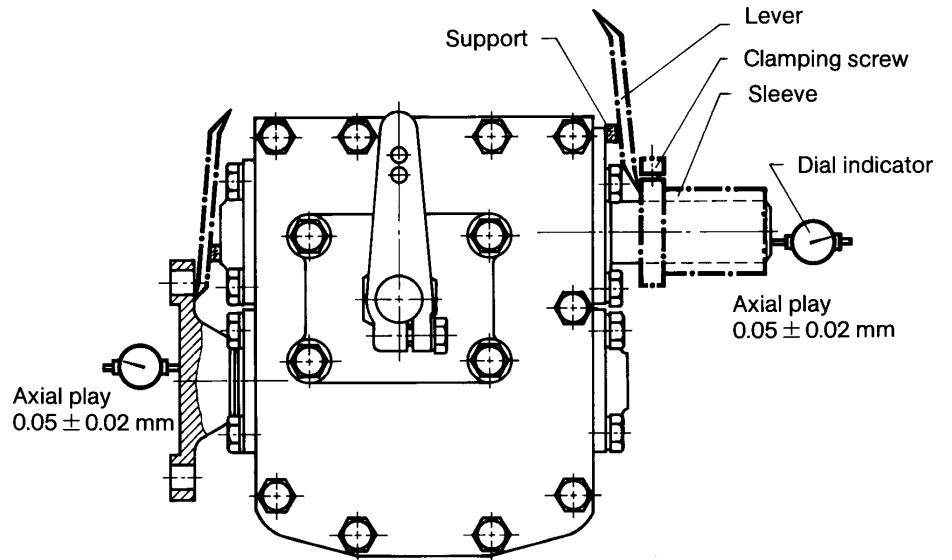
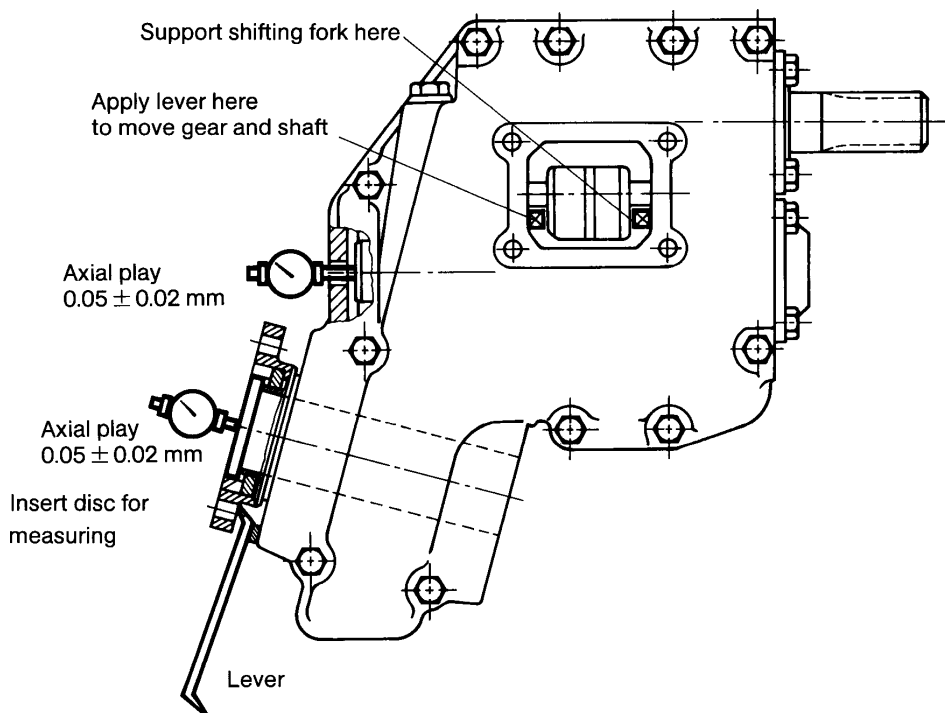


Fig. 39



0.05 ± 0.02 mm
 0.002 ± 0.0008 in

6.14 Mounting the actuating lever cover plate

6.14.1 Place gasket (29) or Loctite 574 on pre-assembled cover plate and fit it to gearbox. Watch for proper engagement of actuating cam and shifting fork. The cover plate can be mounted when the shifting fork is in the middle (=neutral) position. It is important to adjust the actuating lever to exactly midway position in neutral.

Screw the cover plate in place in this position.

The lever travel from 0 to A and from 0 to B should be equal. After a lever travel of 28 to 31 mm (1.10 to 1.22 in) the transmission should be in gear.

If the lever travel from «0» to «A» and from «0» to «B» is not equal adjust cover position by light hammer blows on the cover up to reach the equal travels. Fit spring washer (4) and screw nuts (22). Tighten to a torque of 20 Nm (15 ft lb). If studs (69) need to be replaced, fit them with Loctite 270 on the housing.

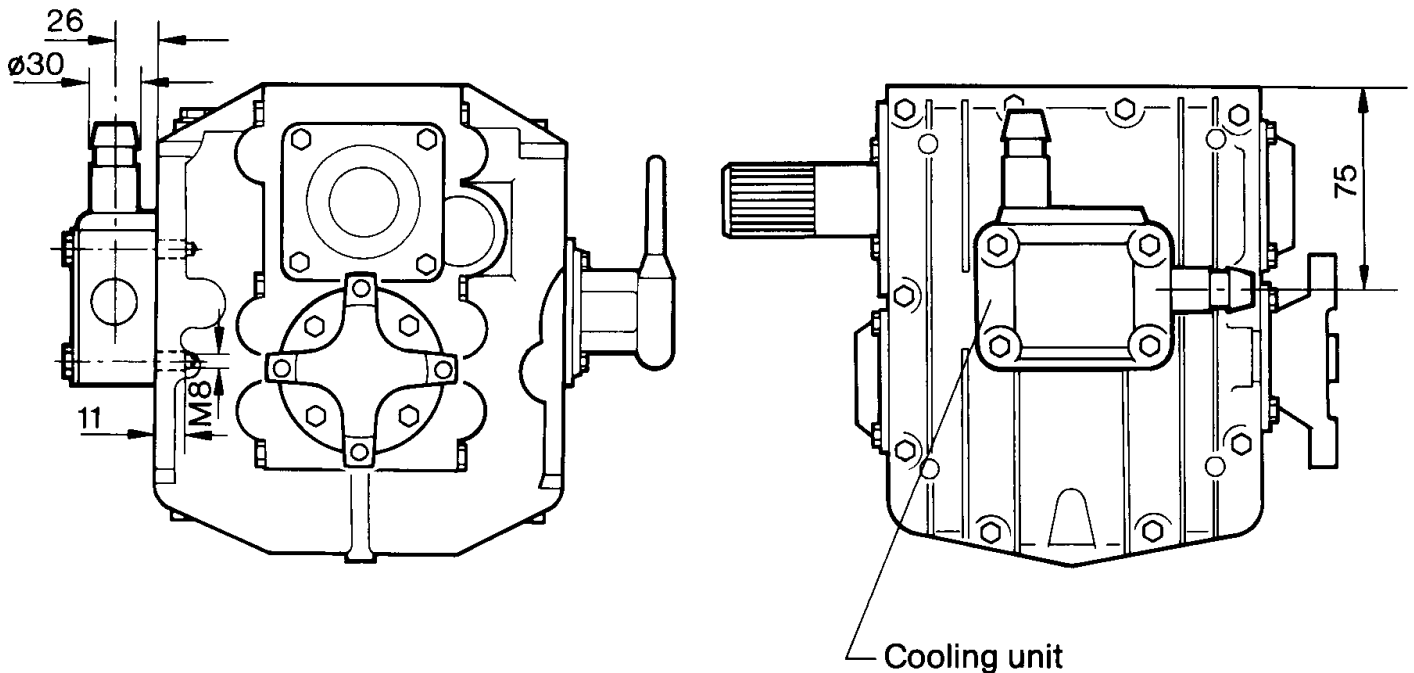
6.14.2 Fit spring washers (4) and screws (5), using a 13 mm spanner (wrench). Tighten to a torque of 14 Nm (10 ft lb). Check actuating lever for proper operation.

6.14.3 Fit oil drain plug (20) with sealing ring (18) and oil dipstick (19) with sealing ring (18). Tighten to a torque of 20 Nm (15 ft lb).

6.15 Mounting the cooling unit (if provided)

6.15.1 Attach the cooling unit on the side opposite the cover plate (9). By means of 4 screws M8x65 and washers (available on kit pag. 23 item 1.2.10).

Fig. 40



7. Procedure to adjust the shifting lever cover

New bracket p/n 20.4039.02 to adjust the shifting lever cover (see picture 1).

A) Before mounting the cover clean the mating surfaces and adjust the shifting fork to the neutral position.

B) Apply Loctite 574 (or alternatively 518) on the cover surface and position it with the lever in neutral (see picture 2).

Only for ZF 25 M, 25 MA: Push towards the bottom (see picture 3).

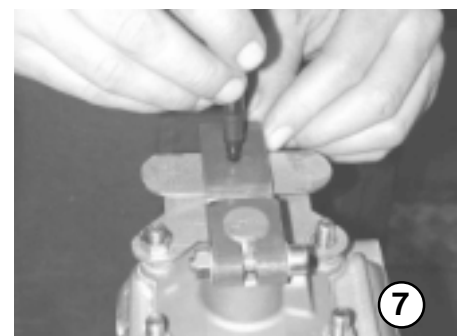
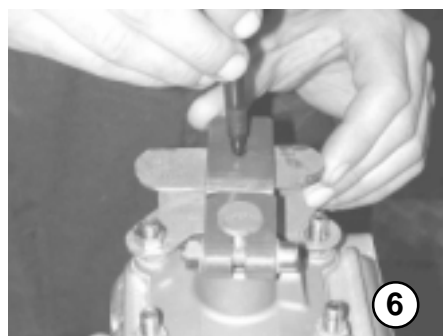
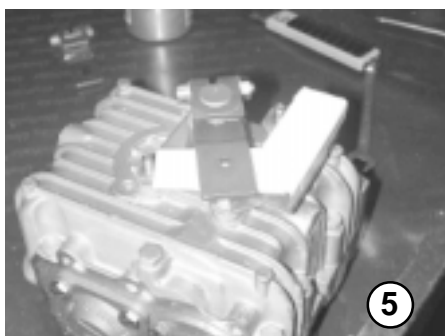
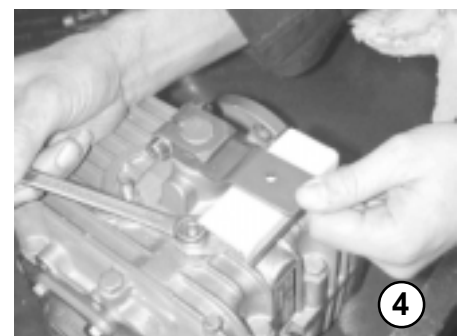
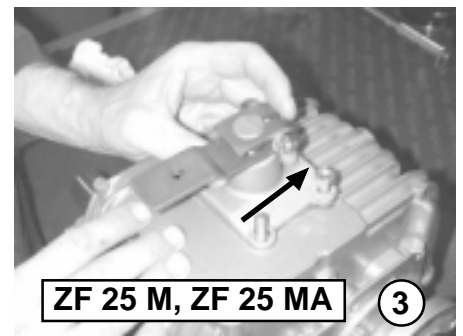
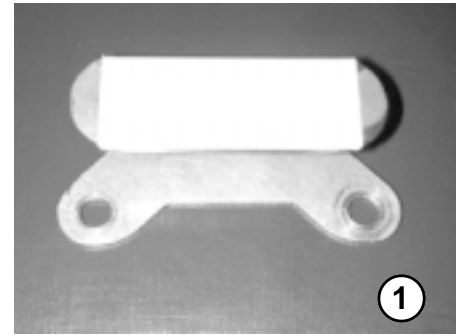
C) Lightly tighten the four nuts.

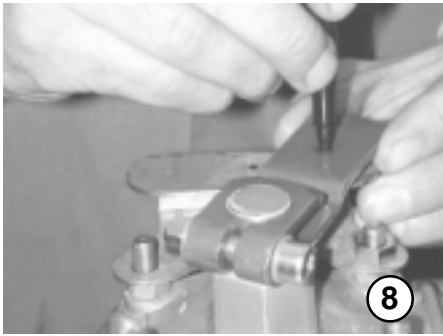
D) Adjust the cover roughly in the middle.

E) Fit the adjusting bracket p/n 20.4039.02 using only one nut lightly tighten: the cover must be free to move with light hammer taps (see picture 4).

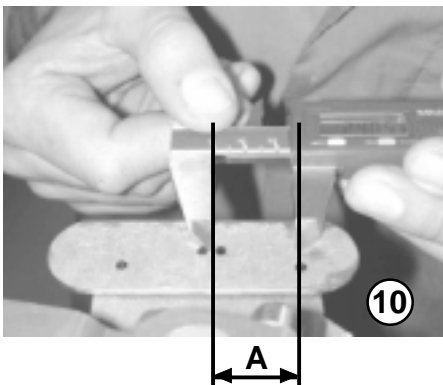
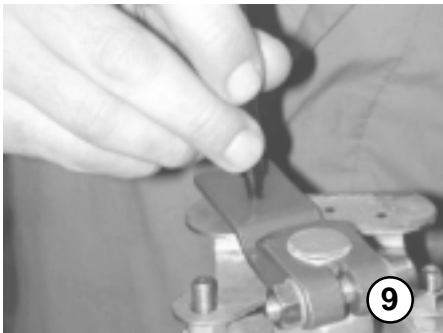
If the shifting lever in neutral has been rotated from the original vertical position apply on the adjusting bracket the suitable extension section P/N 20.4039.03 (see picture 5).

F) Move the lever toward the detent A without engaging the clutch and mark the position; repeat the same for the detent B. **If the shifting lever has two holes refer to the inner hole** (see picture 6 and 7).





G) Engage the clutch, turn back the lever to the engaging point and mark the position; repeat the same procedure for the other clutch (see picture 8 and 9).



H) Consider the centre line between the internal marks and measure the distance from this line and the centre of the external marks (see picture 10 and 11).

The maximum allowed distance between the centre line and the external marks must be 24 mm.

The maximum difference between the two measurements must be less than 3 mm.

A must always be < 24 mm

B must always be < 24 mm

A - B < 3 mm

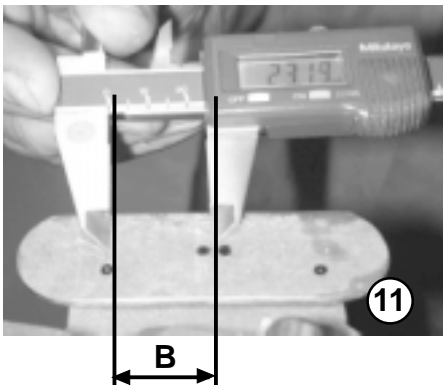
EX.:

A = 20 mm, B = 24 mm

A - B = 4 mm > 3 mm **NOT ALLOWED**

A = 21 mm, B = 23 mm

A - B = 2 mm < 3 mm **OK**



If the above conditions are not reached, move the cover toward the opposite direction where the measurement is largest by light hammer taps and repeat the marking operation.

If it is not possible to adjust the cover to maximum 24 mm, the gearbox needs to be exchanged.

I) After the correct adjusting measurement is reached tighten the four nuts with 22 Nm (16 lb.ft) torque.

6) **Connect the shifting cable to the inner hole (if two holes) of the lever. Adjust the neutral position of the cable by the middle of the play of the lever in neutral.**

The control cable should be perpendicular to the actuating lever in neutral position of the lever.

7) Make sure that the way of the control cable is enough long to move the inner hole of the lever at least 30 mm.

8. Troubelshooting

Possible Troubles and Remedies			
Kind of trouble	Noticeable effect	Possible cause	Remedy
Delay of gear engagement	Propeller will start rotating with several seconds delay or only after increase in engine speed.	<p>Lever travel 0-A not equal to lever travel 0-B.</p> <p>Insufficient clearence between actuating lever and cover plate (9).</p> <p>Shift cable fails to move lever through required min. travel 0-A=0-B = 35 mm/30 mm (1.37 in/1.18 in).</p>	<p>Detach shift cable and operate gearbox by hand to find whether malfunctions is caused by gear box or cable.</p> <p>If caused by transmission:</p> <p>Adjust cover plate (9) until lever is exactly in midway position. Travel 0-A = 0-B = 35 mm/30 mm 1.37 in/1.18 in</p> <p>Adjust to min. clearance of 0.5 mm (0.02 in).</p> <p>If caused by shift cable:</p> <p>Check total travel of shift cable. If too short, adjust accordingly.</p>
Transmission fails to move in gear	Excessive effort required to move actuating lever.	<p>Insufficient clearance between actuating lever and cover plate (9).</p> <p>Guide sheaves for shift cable unsuitably positioned: radius too small.</p>	<p>Detach shift cable and operate lever by hand. If lever jams, adjust clearance to 0.5 mm (0.02 in).</p> <p>Check and adjust accordingly.</p>
Boat fails to attain top speed specified	Increased operating temperature.	<p>Use of wrong oil.</p> <p>Boat operated without cooling unit.</p> <p>Transmission operating in upper limit range.</p>	<p>Use ATF oil and check oil level.</p> <p>Install cooling unit.</p> <p>Use suitable ZF M transmission unit.</p>
Oil leakage	Oil leakage visible on transmission unit.	<p>Corrosion effects in area of radial sealing ring and shaft; damaged radial sealing rings.</p> <p>Improper installation of seal.</p> <p>Misalignment of output flanges.</p>	<p>Check and correct oil level.</p> <p>Remove and dismantle transmission remachine shafts, replace radial sealing rings</p> <p>Check alignment to be within 0.08 mm (0.003 in) radially.</p>

9. Spare Parts List

Preface

The spare parts list is only valid for the type and versions of transmission, as shown below.

You will find the transmission type and version on your transmission name plate.

If the type and version indicated differs from that printed in this Manual, the relative Spare Parts List should be ordered from ZF -HURTH Marine.

The indicated dimensions and standards are as such not enough for ordering parts.

When ordering parts, please state:

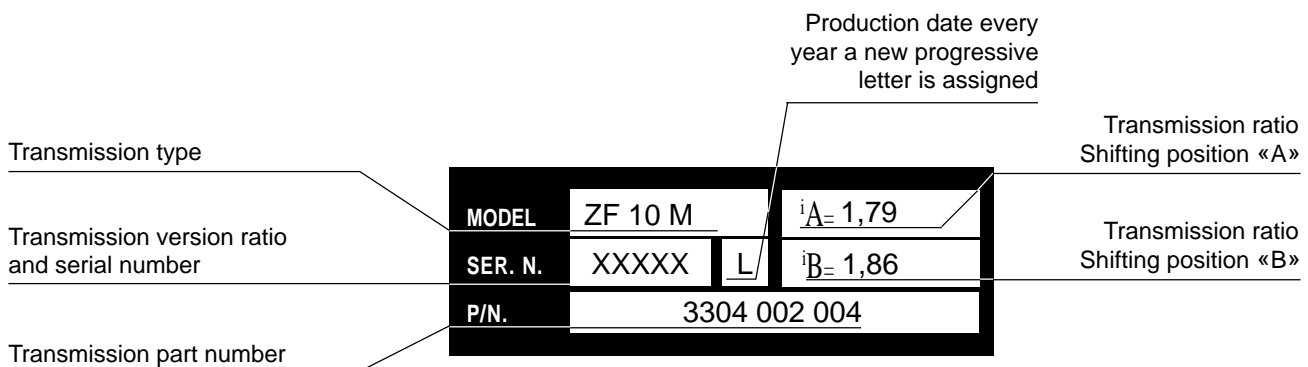
- transmission type
- serial number
- item no. part name, ident no. and quantity of parts required.

The spare parts list is referring to the following versions:

ZF 3 M	versions 001; 002	HBW 35	versions 25; 26;
ZF 5 M	versions 001; 002	HBW 50	versions 09; 10; 11; 12; 14
ZF 10 M	versions 003; 004; 005; 010	HBW 100	versions 14; 15; 16; 17; 20; 21
ZF 12 M	versions 001; 002	HBW 125/HBW 10	versions 15; 16
ZF 15 M	versions 003; 004	HBW 150	versions 18; 17; 20; 22
ZF 15 MA	versions 003; 004; 005	HBW 150 A	versions 01; 02
ZF 15 MIV	versions 001; 002; 003	HBW 150 V	versions 08; 09; 10; 11
ZF 25 M	versions 001; 002; 007	HBW 250	versions 13; 16; 17; 18; 19; 20; 22; 23
ZF 25 MA	versions 005; 006		
ZF 30 M	versions 001; 002		

Name Plate

The name plate is mounted to the transmission



Manual and Spare Parts List ZF M line



Item No	Part name	Number per gearbox	ZF 3 M - ZF 5 M		ZF 10 M		HBW 10/ZF-12 M/15 M		ZF 15 MA		ZF 25 M		ZF 25 MA		ZF 30 M		
			Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No
1	Housing assy HBW 50 - 2L «11»	1	3303 201 001	325952													
1	Housing assy ZF 5 M - 2.05R «001»	1	3303 201 001	325952													
1	Housing assy HBW 50 - 2R «12»	1	3303 201 001	325952													
1	Housing assy HBW 50 - 3R «10»	1	3303 201 002	387532													
1	Housing assy ZF 5 M - 2.72R «002»	1	3303 201 002	387532													
1	Housing assy ZF 3 M - 2.05R «001»	1	3303 201 001	325952													
1	Housing assy ZF 3 M - 2.72R «002»	1	3303 201 002	387532													
1	Housing assy ZF 10 M - 1.48R «003»	1			3304 201 003	288079											
1	Housing assy ZF 10 M - 1.79R «004»	1			3304 201 003	288079											
1	Housing assy ZF 10 M - 2.05R «010»	1			3304 201 003	-											
1	Housing assy ZF 10 M - 2.72R «005»	1			3304 201 004	465642											
1	Housing assy HBW 100 - 3R «16»	1			3304 201 003	288079											
1	Housing assy HBW 100 - 2L «17»	1			3304 201 003	288079											
1	Housing assy HBW 100 - 2.5R «21»	1			3304 201 004	465642											
1	Housing assy HBW 10 / ZF 12 M / ZF 15 M	1					3306 201 003	206447									
1	Housing assy ZF 15 MA	1							3306 201 001	407465							
1	Housing assy HBW 250 - 2L «20»	1									3307 201 003	345517					
1	Housing assy HBW 250 - 3L «19»	1									3307 201 004	345519					
1	Housing assy HBW 250 - 1.5R «16»	1									3307 201 003	345517					
1	Housing assy ZF 25 M - 1.88R «001» & «22»	1									3307 201 003	345517					
1	Housing assy ZF 25 M - 2.27R «007»	1									3307 201 003	-					
1	Housing assy ZF 25 M - 2.74R «002» & «23»	1									3307 201 004	345519					
1	Housing assy HBW 250 - 3.5R «13»	1									3307 201 004	345519					
1	Housing assy ZF 25 MA - 2.23R «005»												3307 201 001	-			
1	Housing assy ZF 25 MA - 2.74R «006»												3307 201 001	-			
1	Housing assy ZF 30 M - 2.7R «001»														3320 201 001	-	
1	Housing assy ZF 30 M - 2.15R «002»														3320 201 001	-	
2	Bearing shield input	1	3304 301 012	288768	3304 301 012	288768	3306 301 010	206450	3306 301 010	206450	3307 301 008	274248	3307 301 008	274248	3307 301 008	-	-
2	Bearing shield output	1	3304 301 011	288787	3304 301 011	288787	3306 301 010	206450	3306 301 010	206450	3307 301 008	274248	3307 301 008	274248	3307 301 008	-	-
3	Cover	1							3306 301 011	206452			3307 301 009	274219			
3	Cover	2	3304 301 013	288730	3304 301 013	288730	3306 301 011	206452			3307 301 009	274219			3307 301 009	-	-
3A	Cover	1							3306 301 008	407475			3307 301 003	-			
4	Spring washer	38	0630 302 090	442372					0630 302 090	442372							
4	Spring washer	40			0630 302 090	442372	0630 302 090	442372					0630 302 090	442372			
4	Spring washer	42									0630 302 090	442372					
4	Spring washer	46														0630 302 090	-
5	Hex head screw (cover)	16	0636 015 289	215870	0636 015 289	215870	0636 015 289	215870	0636 015 289	215870	0636 015 289	215870	0636 015 289	215870	0636 015 289	-	-
6	Actuating lever*	1	947 23 006.01	195062	947 23 006.01	195062	947 23 006.01	195062	947 23 006.01	195062	947 23 006.01	195062	947 23 006.01	195062	947 23 006.01	-	-
6	Actuating lever	1	3306 308 001	500635	3306 308 001	500635	3306 308 001	500635	3306 308 001	500635	3306 308 001	500635	3306 308 001	500635	3306 308 001	-	-

* Up to letter «E» production date (see name plate description pag.50)

Item No	Part name	ZF 3 M - ZF 5 M		ZF 10 M		HBW 10/ZF 12 M/15 M		ZF 15 MA		ZF 25 M		ZF 25 MA		ZF 30 M	
		Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n
7	Hex head screw (actuating lever)*	0636 015 299	199807	0636 015 299	199807	0636 015 299	199807	0636 015 299	199807	0636 015 299	199807	0636 101 727	442377	0636 101 727	442377
7	Hex head screw (actuating lever)	0636 101 727	442377	0636 101 727	442377	0636 101 727	442377	0636 101 727	442377	0636 101 727	442377	0636 101 727	442377	0636 101 727	442377
8	Radial sealing ring for shift cover	0634 502 009	106864	0634 502 009	106864	0634 502 009	106864	0634 502 009	106864	0634 502 009	106864	0634 502 009	106864	0634 502 009	106864
9	Cover plate	3304 308 001	206448	3304 308 001	206448	3306 308 002	388242	3306 308 002	388242	3306 308 002	388242	3306 308 002	388242	3306 308 002	388242
10	Spring dowel pin	0631 329 032	104559	0631 329 032	104559	0631 329 032	104559	0631 329 032	104559	0631 329 032	104559	0631 329 032	104559	0631 329 032	104559
11	Actuating cam assy	3304 199 006	304332	3304 199 006	304332	3306 199 008	407211	3306 199 008	407211	3306 199 008	407211	3306 199 008	407211	3306 199 008	407211
12	Shift cover assembly	3303 108 001	326208	3304 108 002	248459	3306 108 002	407210	3306 108 002	407210	3306 108 002	407210	3306 108 002	407210	3306 108 002	407210
15	Shifting fork assy	3304 208 001	326000	3304 208 001	326000	3306 208 001	223563	3306 208 001	223563	3307 208 001	327374	3307 208 001	327374	3307 208 001	327374
16	Actuating shaft	3303 308 001	325963	3306 308 004	206484	3306 308 004	206484	3306 308 004	206484	3307 301 012	288673	3307 301 012	288673	3307 301 012	288673
17	Plug (O-ring for ZF 3 M - ZF 5 M)	0634 306 179	105524	0636 301 041	442373	0636 301 041	442373	0636 301 041	442373	0636 301 041	442373	0636 301 041	442373	0636 301 041	442373
18	Sealing ring	3306 301 016	326578	3306 301 016	326578	3306 301 016	326578	3306 301 016	326578	3306 301 016	326578	3306 301 016	326578	3306 301 016	326578
19	Oil dipstick/breather assy	3304 201 006	288729	3304 201 006	288729	3306 201 005	206929	3306 201 002	408451	3307 201 005	274217	3307 201 005	274217	3307 201 005	274217
20	Oil drain plug	3306 301 013	228566	3306 301 013	228566	3306 301 013	228566	3306 301 013	228566	3306 301 013	228566	3306 301 013	228566	3306 301 013	228566
21	Hex head screw	0636 010 376	215869					0636 010 376	215869						
21	Hex head screw			0636 010 376	215869	0636 010 376	215869			0636 010 563	279058				
21	Hex head screw											0636 010 564			
21	Hex head screw													0636 010 563	
21A	Hex head screw							0636 010 375	337982						
21B	Hex head screw											0636 010 548	500924		
22	Hex nut														
22	Hex nut			0637 006 157	455785										
22	Hex nut									0637 006 157	455785				
22	Hex nut											0637 006 157	455785		
22	Hex nut													0637 006 157	
23	O-ring (Seeger ZF 3 M - ZF 5 M / Plug ZF 25 M - ZF 30 M)	0630 501 012	104807	0634 306 011	105679	0634 303 118	105530	0634 303 118	105530	0630 361 039	285375	0630 361 039	285375	0630 361 039	285375
24	Intermediate gear shaft	3303 303 002	325962	3304 303 002	288741	3306 303 002	206470	3306 303 002	206470	3307 303 001	274225	3307 303 001	274225	3320 303 001	
25	Retaining plate	3304 303 003	288743												
25	Retaining plate			3304 303 003	288743	3306 303 003	206473	3306 303 003	206473	3307 303 002	288702	3307 303 002	288702	3320 303 003	
26	Intermediate gear	3303 303 001	325961	3304 303 001	-	3306 303 001	254730	3306 303 001	254730	3307 303 003	274226	3307 303 003	274226	3320 303 002	
27	Cage	0635 300 526	106589	0635 300 530	280128	3306 303 007	215878	3306 303 007	215878	3307 303 004	222273	3307 303 004	222273		
27	Cage													0635 300 114	
28	Gasket cover	3304 301 015	288739	3304 301 015	288739	3306 301 014	254715	3306 301 014	254715	3307 301 011	274251	3307 301 011	274251	3307 301 011	
29	Gasket cover plate (or LOCTITE 574)	3306 301 015	254716	3306 301 015	254716	3306 301 015	254716	3306 301 015	254716	3306 301 015	254716	3306 301 015	254716	3306 301 015	
30	Radial sealing ring, input (No HBW 250 «22-23»)	0634 301 830	280135	0634 301 830	280135	0634 301 833	215875	0634 301 833	215875	0634 301 832	284260	0634 301 832	284260	0634 311 025	
30	Radial sealing ring, input (only vers. «22-23»)									0634 311 025	501151				
31	Radial sealing ring, output (No HBW 250 «22-23»)	0634 300 371	105153	0634 300 371	105153	0634 300 466	105159	0634 300 466	105159	0634 300 466	105159	0634 300 466	105159	0634 311 026	
31	Radial sealing ring, output (only vers. «22-23»)									0634 311 026	501152				
32	Tapered roller bearing, input shaft	0635 501 943	-	0635 501 943	-	0635 501 597	-	0635 501 597	-	0635 370 042	167210	0635 370 042	167210	0635 370 042	-

* Up to letter «E» production date (see name plate description pag.50)

Manual and Spare Parts List ZF M line



Item No	Part name	Number per gearbox	ZF 3 M - ZF 5 M		ZF 10 M		HBW 10/ZF 12 M/15 M		ZF 15 MA		ZF 25 M		ZF 25 MA		ZF 30 M	
			Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n
34	Tapered roller bearing, output shaft	2	0635 501 943	-	0635 501 943	-	0635 501 597	-	0635 501 597	-	0635 370 051	-	0635 370 051	-	0635 370 051	-
36	Input shaft HBW 50 - 2L «11» z = 22/22	1	947.72.001.03	325970												
36	Input shaft ZF 5 M - 2.05R «001» Z1/Z3=22/22	1	3303 302 001	326900												
36	Input shaft HBW 50 2R 12 Z=22/22	1	947.72.001.03	325970												
36	Input shaft HBW 50 3R 10 Z=18/20	1	947.72.001.07	387535												
36	Input shaft ZF 5 M - 2.72R «002» Z1/Z3=18/20	1	3303 302 002	458163												
36	Input shaft ZF 3 M - 2.05R «001» Z1/Z3=22/22	1	3303 302 001	326900												
36	Input shaft ZF 3 M - 2.72R «002» Z1/Z3=18/20	1	3303 302 002	458163												
36	Input shaft ZF 10 M - 1.48R «003» Z1/Z3=27/22	1			3304 302 004	304059										
36	Input shaft ZF 10 M - 1.79R «004» Z1/Z3=24/22	1			3304 302 005	305605										
36	Input shaft ZF 10 M - 2.05R «010» Z1/Z3=22/22	1			3304 302 018	-										
36	Input shaft ZF 10 M - 2.72R «005» Z1/Z3=18/20	1			3304 302 006	465465										
36	Input shaft HBW 100 - 3R «16» z = 18/22	1			947.62.001.06	304074										
36	Input shaft HBW 100 - 2L «17» z = 24/22	1			947.62.001.08	327229										
36	Input shaft HBW 100 - 2.5R «21» z = 19/20	1			3304 302 007	470902										
36	Input shaft HBW 10 - 2L «21» z = 22/22	1					3306 302 005	206460								
36	Input shaft HBW 10/ZF 12M - 2.14R «001» Z1/Z3=22/22	1					3306 302 005	206460								
36	Input shaft ZF 12 M - 2.63R «002» Z1/Z3=19/22	1					3306 302 007	313952								
36	Input shaft ZF 15 M - 1.56R «003» Z1/Z3=27/22	1					3306 302 006	304088								
36	Input shaft ZF 15 M - 1.88R «004» Z1/Z3=24/22	1					3306 302 008	325811								
36	Input shaft HBW 150 - 2.4R «20» z = 18/22	1					3306 302 009	439197								
36	Input shaft HBW 150 - 3R «22» z = 18/22	1					3306 302 010	468211								
36	Input shaft ZF 15 MA - 2R «004» Z1/Z3=24/22	1							3306 302 002	407468						
36	Input shaft ZF 15 MA 2.14R «003» Z=22/22	1							3306 302 001	-						
36	Input shaft ZF 15 MA - 2.63R «005» Z1/Z3=19/22	1														
36	Input shaft HBW 250 - 2L «20» z = 21/25	1														
36	Input shaft HBW 250 - 3L «19» z = 18/19	1														
36	Input shaft HBW 250 - 1.5R «16» z = 28/21	1														
36	Input shaft ZF 25 M - 1.88R «001» & «22» Z1/Z3=25/21	1														
36	Input shaft ZF 25 M - 2.27R «007» Z1/Z3=22/21	1														
36	Input shaft ZF 25 M - 2.74R «002» & «23» Z1/Z3=19/18	1														
36	Input shaft HBW 250 - 3.5R «13» z = 16/18	1														
36	Input shaft ZF 25 MA 2.23R «005» Z1/Z3=22/19	1														
36	Input shaft ZF 25 MA 2.74R «006» Z1/Z3=19/19	1														
36	Input shaft ZF 30 M 2.7R «001» Z1/Z3=23/22	1														
36	Input shaft ZF 30 M 2.15R «002» Z1/Z3=27/22	1														
37	Shim 0.1 mm	2	3304 302 011	288731	3304 302 011	288731	3306 302 011	206474	3306 302 011	206474	3307 302 006	274252	3307 302 006	274252	3307 302 006	-
38	Shim 0.15 mm	2	3304 302 012	288732	3304 302 012	288732	3306 302 012	206475	3306 302 012	206475	3307 302 007	274253	3307 302 007	274253	3307 302 007	-
39	Shim 0.30 mm	2	3304 302 014	288734	3304 302 014	288734	3306 302 014	206477	3306 302 014	206477	3307 302 008	274254	3307 302 008	274254	3307 302 008	-

Item No	Part name	ZF 3 M - ZF 5 M		ZF 10 M		HBW 10/ZF 12 M/15 M		ZF 15 MA		ZF 25 M		ZF 25 MA		ZF 30 M	
		Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n
40	Shim 0.50 mm	3304 302 015	288735	3304 302 015	288735	3306 302 015	228540	3306 302 015	228540	3307 302 009	274255	3307 302 009	274255	3307 302 009	-
41	Screw	3303 304 014	320681	3304 304 038	450870	3306 304 057	420280	3306 304 057	420280	3306 304 057	420280	3306 304 057	420280	3306 304 057	-
42	Spacer	3303 304 007	325960	3304 304 026	439611	3306 304 028	407281	3306 304 028	407281	3306 304 028	407281	3306 304 028	407281	3306 304 028	-
43	Thrust washer	3304 304 019	288748	3304 304 019	288748	3306 304 029	344787	3306 304 029	344787	3307 304 020	327395	3307 304 020	327395	3307 304 020	-
44	Forward gear HBW 50 - 2L «11» z = 45	3303 304 001	325971												
44	Forward gear ZF 5 M - 2.05R «001» Z2=45	3303 304 001	325971												
44	Forward gear ZF 5 M - 2.72R «002» Z2=49	3303 304 002	325971												
44	Forward gear HBW 50 - 2R «12» z = 45	3303 304 001	325971												
44	Forward gear HBW 50 - 3R «10» z = 49	3303 304 002	325976												
44	Forward gear ZF 3 M - 2.05R «001» Z2=45	3303 304 001	325971												
44	Forward gear ZF 3 M - 2.72R «002» Z2=49	3303 304 002	325976												
44	Forward gear ZF 10 M - 1.48R «003» Z2=40			3304 304 007	304060										
44	Forward gear ZF 10 M - 1.79R «004» Z2=43			3304 304 008	305607										
44	Forward gear ZF 10 M - 2.05R «010» Z2=45			3304 304 039	-										
44	Forward gear ZF 10 M - 2.72R «005» Z2=49			3304 304 006	287455										
44	Forward gear HBW 100 - 3R «16» z = 49			3304 304 006	287455										
44	Forward gear HBW 100 - 2L «17» z = 43			3304 304 008	305607										
44	Forward gear HBW 100 - 2.5R «21» z = 48			3304 304 009	470903										
44	Forward gear HBW 10 - 2L «21» z = 47					3306 304 012	407218								
44	Forward gear HBW 10 / ZF 12 M - 2.14R «001» Z2=47					3306 304 012	407218								
44	Forward gear ZF 12 M - 2.63R «002» Z2=50					3306 304 013	407219								
44	Forward gear ZF 15 M - 1.56R «003» Z2=42					3306 304 015	407221								
44	Forward gear ZF 15 M - 1.88R «004» Z2=45					3306 304 014	407220								
44	Forward gear HBW 150 - 2.4R «20» z = 43					3306 304 016	439198								
44	Forward gear HBW 150 - 3R «22» z = 51					3306 304 017	468212								
44	Forward gear ZF 15 MA - 1.88R «004» Z2=45							3306 304 003	407469						
44	Forward gear ZF 15 MA 2.14R «003» Z=47							3306 304 001	-						
44	Forward gear ZF 15 MA - 2.63R «005» Z2=50							3306 304 005	407483						
44	Forward gear HBW 250 - 2L «20» z = 47									3307 304 007	305813				
44	Forward gear HBW 250 - 3L «19» z = 52									3307 304 010	288971				
44	Forward gear HBW 250 - 1.5R «16» z = 43									947.52.002.03	304083				
44	Forward gear ZF 25 M - 1.88R «001» & «22» Z2=47									3307 304 007	305813				
44	Forward gear ZF 25 M - 2.27R «007» Z2=50									3307 304 008	-				
44	Forward gear ZF 25 M - 2.74R «002» & «23» Z2=52									3307 304 010	288971				
44	Forward gear HBW 250 - 3.5R «13» z = 56									947.52.003.04	439200				
44	Forward gear ZF 25 MA - 2.23R «005» Z2=49											3307 304 001	-		
44	Forward gear ZF 25 MA - 2.74R «006» Z2=52											3307 304 003	-		
44	Forward gear ZF 30 M - 2.7R «001» Z2=62													3320 304 004	-
44	Forward gear ZF 30 M - 2.15R «002» Z2=58													3320 304 007	-

Manual and Spare Parts List ZF M line



Item No	Part name	Number per gearbox	ZF 3 M - ZF 5 M		ZF 10 M		HBW 10/ZF 12 M/15 M		ZF 15 MA		ZF 25 M		ZF 25 MA		ZF 30 M	
			Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n
45	Needle cage	2	0635 300 411	320678	3304 304 037	280132	0635 300 148	201187	0635 300 148	201187	0635 300 148	201187	0635 300 148	201187	0635 300 148	-
45	Needle cage	4														
46	Needle bearing inner race	2	3303 304 012	326060	3304 304 022	288759	3306 304 021	251524	3306 304 021	251524	3306 304 021	251524	3306 304 021	251524	3306 304 021	-
46	Needle bearing inner race	4													3306 304 021	-
47	Spacer	2	3303 304 011	326026	3304 304 017	288756	3306 304 025	250992	3306 304 025	250992	3307 304 018	274242	3307 304 018	274242	3320 304 006	-
48	Cup spring	2	3303 304 005	325958												
48	Cup spring	4			3304 304 018	305537	3306 304 026	387391	3306 304 026	387391	3307 304 019	305536	3307 304 019	305536	3307 304 019	-
49	Thrust ring/end disc	2	3303 304 006	325959	3304 304 014	288755	3306 304 030	407139	3306 304 030	407139	3307 304 014	274271	3307 304 014	274271	3307 304 014	-
50	Circlip	2	0630 503 040	320677	0630 513 059	280131					0630 502 031	277055	0630 502 031	277055	0630 502 031	-
50	Half ring	4					3306 304 011	326830	3306 304 011	326830						
51	Internal clutch disc	4	3304 304 040													
51	Internal clutch disc	8			3304 304 040		3306 304 027	407231	3306 304 027	407231						
51	Internal clutch disc (old versions)	8					947.42.017.01	288912								
51	Internal clutch disc	10									3307 304 021		3307 304 021		3307 304 021	
51	Internal clutch disc	12														
52	External clutch disc	4	3304 304 021	288758												
52	External clutch disc	6			3304 304 021	288758										
52	External clutch disc	8					3306 304 031	407230	3306 304 031	407230						
52	External clutch disc (old version)	6					947.22.024.01	187872								
52	External clutch disc	10														
53	Shim 0.4 mm	2	3304 304 032	288760	3304 304 032	288760	3306 304 035	195714	3306 304 035	195714	3306 304 035	195714	3306 304 035	195714	3306 304 035	-
54	Shim 0.5 mm	2	3304 304 033	288761	3304 304 033	288761	3306 304 036	195715	3306 304 036	195715	3306 304 036	195715	3306 304 036	195715	3306 304 036	-
55	Shim 0.6 mm	2	3304 304 034	288762	3304 304 034	288762	3306 304 037	195716	3306 304 037	195716	3306 304 037	195716	3306 304 037	195716	3306 304 037	-
56	Shim 0.7 mm	2	3304 304 035	288763	3304 304 035	288763	3306 304 038	195717	3306 304 038	195717	3306 304 038	195717	3306 304 038	195717	3306 304 038	-
57	Disc carrier	2	3303 304 008	325967	3304 304 016	288713	3306 304 032	407233	3306 304 032	407233	3307 304 017	326486	3307 304 017	326486	3320 304 003	-
58	Ball	6	0635 460 061	280133	0635 460 061	280133	0635 460 015	106700	0635 460 015	106700	0635 460 019	106732	0635 460 019	106732	0635 460 019	-
59	Guide sleeve	1	3303 304 010	438961	3304 304 015	438960	3306 304 022	439603	3306 304 022	439603	3307 304 015	274247	3307 304 015	274247	3320 304 010	-
60	Actuating sleeve	1	3304 304 027	326063	3304 304 027	326063	3306 304 023	206817	3306 304 023	206817	3307 304 016	408093	3307 304 016	408093	3307 304 016	-
61	Compression spring (actuating members)	3	3304 304 023	287525	3304 304 023	287525	3306 304 006	287401	3306 304 006	287401	3306 304 006	287401	3306 304 006	287401	3306 304 006	-
62	Delant pin	3	3304 304 024	288766	3304 304 024	288766	3306 304 033	187840	3306 304 033	187840	3306 304 033	187840	3306 304 033	187840	3306 304 033	-
63	Driving pin	3	3304 304 025	288767	3304 304 025	288767	3306 304 008	195271	3306 304 008	195271	3306 304 008	195271	3306 304 008	195271	3306 304 008	-
64	Spring	3	3306 304 024	206798	3306 304 024	206798	3306 304 024	206798	3306 304 024	206798	3306 304 024	206798	3306 304 024	206798	3306 304 024	-
65	Reverse gear HBW 50 - 2L «11» z = 41	1	3303 304 003	325966												
65	Reverse gear ZF 5 M - 2.05R «001» Z5=41	1	3303 304 003	325966												
65	Reverse gear HBW 50 - 2R «12» z = 41	1	3303 304 003	325966												
65	Reverse gear HBW 50 - 3R «10» z = 43	1	3303 304 009	387539												
65	Reverse gear ZF 5 M - 2.72R «002» Z5=43	1	3303 304 009	387539												
65	Reverse gear ZF 3 M - 2.05R «001» Z5=41	1	3303 304 003	325966												
65	Reverse gear ZF 3 M - 2.72R «002» Z5=43	1	3303 304 009	387539												

Item No	Part name	Number per gearbox	ZF 3 M - ZF 5 M		ZF 10 M		HBW 10/ZF 12 M/15 M		ZF 15 MA		ZF 25 M		ZF 25 MA		ZF 30 M		
			Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No	Old p/n	Part No
65	Reverse gear ZF 10 M - 1.48R «003» Z5=41	1	3304 304 011	288084													
65	Reverse gear ZF 10 M - 1.79R «004» Z5=41	1	3304 304 011	288084													
65	Reverse gear ZF 10 M - 2.05R «010» Z5=41	1	3304 304 011	288084													
65	Reverse gear ZF 10 M - 2.72R «005» Z5=43	1	3304 304 012	465466													
65	Reverse gear HBW 100 - 3R «16» z = 41	1	3304 304 011	288084													
65	Reverse gear HBW 100 2L «17» z = 41	1	3304 304 011	288084													
65	Reverse gear HBW 100 - 2.5R «21» z = 43	1	3304 304 012	465466													
65	Reverse gear HBW 10 / ZF 12 M / ZF 15 M Z5=43	1			3306 304 018	407235											
65	Reverse gear ZF 15 MA Z5=43	1					3306 304 004	407480									
65	Reverse gear HBW 250 - 2L «20» z = 44	1									3307 304 009	274240					
65	Reverse gear HBW 250 - 3L «19» z = 49	1									3307 304 006	288969					
65	Reverse gear HBW 250 - 1.5R «16» z = 44	1									3307 304 009	274240					
65	Reverse gear ZF 25 M - 1.88R «001» & «22» Z5=44	1									3307 304 009	274240					
65	Reverse gear ZF 25 M - 2.27R «007» Z5=44	1									3307 304 006	288969					
65	Reverse gear ZF 25 M - 2.74R «002» & «23» Z5=49	1									3307 304 006	288969					
65	Reverse gear HBW 250 - 3.5R «13» z = 49	1															
65	Reverse gear ZF 25 MA - 2.23R «005» Z5=52	1															
65	Reverse gear ZF 25 MA - 2.74R «006» Z5=52	1															
65	Reverse gear ZF 30 M - 2.7R «001» Z5=58	1															
65	Reverse gear ZF 30 M - 2.15R «002» Z5=58	1															
66	Output shaft	1	3303 304 004	325957	3304 304 013	439448											
67	Key	1	0631 501 634	280130	0631 501 634	280130											
67	Key	2					3306 304 007	187841									
67	Key	4							3306 304 007	187841							
68a	Shim 0.1 mm	1	0630 004 177	-													
68b	Shim 0.2 mm	1	0630 000 257	337665													
68c	Shim 0.5 mm	1	0630 004 179	337664													
68d	Shim 1.0 mm	1	0630 004 180	337662													
69	Stud	4	0636 610 232	396330	0636 610 232	396330											
70	Needle bearing for shift cover	2															
72	Nut (actuating lever)	1	0637 006 157	455785	0637 006 157	455785											
73	Spacer ZF 15 MA - ZF 25 MA	1															
74	Name plate	1	3306 301 005	-	3306 301 005	-											
75	Oil name plate	1	3304 301 016	-	3304 301 016	-											

Manual and Spare Parts List ZF M line



Item No	Part name	Number per gearbox	ZF 15 MIV	
			Part No	Old p/n
1	Housing assy	1	3306 201 004	344768
2	Cover	1	3306 301 010	206450
3	Cover	1	3306 301 023	326369
4	Spring washer	39	0630 302 090	442372
5	Hex screw	8	0636 015 289	215870
6	Actuating lever *	1	947.23.006.01	195062
6	Actuating lever	1	3306 308 001	500635
7	Hex. head screw *	1	0636 015 299	199807
7	Hex. head screw (actuating lever)	1	0636 101 727	442377
8	Shaft seal ring	1	0634 502 009	106864
9	Cover	1	3306 308 002	388242
10	Dowel pin	1	0631 329 032	104559
11	Actuating cam assembly	1	3306 199 008	407211
12	Shift cover assembly	1	3306 108 002	407210
15	Shift fork	1	3306 208 001	223563
16	Shift rod	1	3307 301 012	288673
17	Plug	1	0636 301 041	442373
18	Sealing ring	1	3306 301 016	326578
19	Dipstick	1	3306 201 006	345480
20	Oil drain plug	1	3306 301 013	228566
21	Hex screw	14	0636 010 376	215869
22	Hex nut	15	0637 006 157	455785
23	Plug	1	0630 361 101	322382
24	Intermediate shaft	1	3306 303 006	468772
25	Disc	2	3307 303 002	288702
26	Intermediate gear	1	3306 303 001	254730
27	Needle bearing	1	3306 303 007	215878
28	Gasket	2	3306 301 014	254715
29	Gasket cover plate (or LOCTITE 574)	1	3306 301 015	254716
30	Shaft seal, input	1	0634 301 833	215875
31	Seal ring	2	0634 300 146	401647
32	Tapered roller bearing	2	0635 501 597	-
34	Tapered roller bearing	1	0635 370 050	-
36	Input shaft HBW 150 V - 1.8R «08» z = 27/22	1	3306 302 006	304088
36	Input shaft ZF 15 MIV - 2.13R «001» z1/z3 = 24/22	1	3306 302 008	325811
36	Input shaft ZF 15 MIV - 2.72R «003» z1/z3 = 18/22	1	3306 302 009	439197
36	Input shaft ZF 15 MIV - 2.99R «002» z1/z3 = 19/22	1	3306 302 007	313952
37	Shim 0.10 mm	2	3306 302 011	206474
38	Shim 0.15 mm	2	3306 302 012	206475
39	Shim 0.50 mm	2	3306 302 015	228540
40	Shim 1.00 mm	2	3306 302 016	228539
41	Hex head screw	1	3306 304 057	420280
42	Spacer	1	3306 303 004	326257
43	Thrust ring	2	3306 304 029	344787
44	Gear HBW 150V - 1,8R «08» z = 42	1	3306 304 015	407221
44	Gear ZF 15 MIV - 2.13R «001» z2 = 45	1	3306 304 014	407220
44	Gear ZF 15 MIV - 2.72R «003» z2 = 43	1	3306 304 016	439198
44	Gear ZF 15 MIV - 2.99R «002» z2 = 50	1	3306 304 013	407219
45	Needle bearing	2	0635 300 148	201187
46	Needle bearing	2	3306 304 021	251524
47	Spacer	2	3306 304 025	250992
48	Spring	4	3306 304 026	387391

* Up to letter «E» production date (see name plate description pag.46)

Item No	Part name	Number per gearbox	ZF 15 MIV	
			Part No	Old p/n
49	Disc	2	3306 304 030	407139
50	Ring half	4	3306 304 011	326830
51	Internal clutch disc	8	3306 304 027	407231
52	External clutch disc	8	3306 304 031	407230
53	Shim 0.4 mm	2	3306 304 035	195714
54	Shim 0.5 mm	2	3306 304 036	195715
55	Shim 0.6 mm	2	3306 304 037	195716
56	Shim 0.7 mm	2	3306 304 038	195717
57	Disc carrier	2	3306 304 032	407233
58	Ball	6	0635 460 015	106700
59	Guide sleeve	1	3306 304 022	439603
60	Change selector	1	3306 304 023	206817
61	Pressure spring	3	3306 304 006	287401
62	Stop pin	3	3306 304 033	187840
63	Guide pin	3	3306 304 008	195271
64	Torsion spring	3	3306 304 024	206798
65	Gear z5= 43	1	3306 304 018	407235
66	Intermediate shaft z6=29	1	3306 303 005	388411
67	Cotter	2	3306 304 007	187841
68	Tapered roller bearing	1	0635 370 053	-
70	Shim 0.1 mm	2	0630 004 260	280839
71	Shim 0.3 mm	1	0630 004 259	280840
72	Shim 0.5 mm	1	0630 004 258	280841
72	Nut (actuating lever)	1	0637 006 157	455785
73	Ring	1	3306 304 054	344690
74	Tapered roller bearing	2	0635 501 936	-
76	Spacer ring	2	3306 304 009	327115
78	Shim 1.3 mm	2	3306 304 042	345469
78	Shim 1.4 mm	2	3306 304 043	345470
78	Shim 1.5 mm	2	3306 304 044	344673
78	Shim 1.6 mm	2	3306 304 045	344674
78	Shim 1.7 mm	2	3306 304 046	344675
78	Shim 1.8 mm	2	3306 304 047	344676
78	Shim 1.9 mm	2	3306 304 048	344677
78	Shim 2.0 mm	2	3306 304 049	344678
78	Shim 2.1 mm	2	3306 304 050	344679
78	Shim 2.2 mm	2	3306 304 051	344680
78	Shim 2.3 mm	2	3306 304 052	344681
78	Shim 2.4 mm	2	3306 304 053	344682
80	Gear z = 33	1	3306 304 039	388410
81	Key	1	0631 501 182	105334
82	Output shaft	1	3306 304 041	344670
83	Ring nut	1	3306 304 010	195413
84	Ring	2	3306 304 040	344644
85	O-Ring	1	0634 306 072	105590
86	O-Ring	2	0634 303 690	291618
87	Needle bearing	2	0635 303 056	268620
88	Stud	4	0636 610 232	396330
89	Plug	4	0636 301 039	338805
90	Name Plate	1	3306 301 005	-
91	Oil name plate	1	3304 301 016	387428

* Up to letter «E» production date (see name plate description pag.46)

ZF M SPARE PARTS KITS

SEAL KITS

ZF 3M - ZF 5M

KIT P/N 3303 199 001 ID/N 500426

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
O-Ring	1	0634 306 179	105524	Shift fork shaft
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	4	3304 301 015	288739	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 830	280135	Input shaft
Sealing ring	1	0634 300 371	105153	Output shaft

ZF 10 M

KIT P/N 3304 199 003 ID/N 500427

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
O-Ring	1	0634 306 011	105679	Intermediate shaft
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	4	3304 301 015	288739	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 830	280135	Input shaft
Sealing ring	1	0634 300 371	105153	Output shaft

HBW 10 - ZF 12 M - ZF 15 M - ZF 15 MA

KIT P/N 3306 199 001 ID/N 500428

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
O-Ring	1	0634 303 118	105530	Intermediate shaft
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	4	3306 301 014	254715	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 833	215875	Input shaft
Sealing ring	1	0634 300 466	105159	Output shaft

ZF 15 MIV

KIT P/N 3306 199 004 ID/N 500429

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	2	3306 301 014	254715	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 833	215875	Input shaft
Sealing ring	2	0634 300 146	401647	Output shaft
O-Ring	1	0634 306 072	105590	Output shaft
O-Ring	2	0634 303 690	291618	Output shaft

ZF 25 M - ZF 25 MA

KIT P/N 3307 199 001 ID/N 500430 (EXCL. VERS. 22; 23)

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	4	3307 301 011	274251	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 832	284260	Input shaft
Sealing ring	1	0634 300 466	105159	Output shaft

ZF 30 M

KIT P/N 3320 199 001

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	-	Shift cover
Sealing ring	2	3306 301 016	-	Drain plug/oil dipstick
Gasket	4	3307 301 011	-	Cover
Sealing ring	1	0634 311 025	-	Input shaft
Sealing ring	1	0634 311 026	-	Output shaft

SEAL + CLUTCH PACK KITS

ZF 3 M - ZF 5 M

KIT P/N 3303 199 002

ID/N 500436

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
O-Ring	1	0634 306 179	105524	Shift fork shaft
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	4	3304 301 015	288739	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 830	280135	Input shaft
Sealing ring	1	0634 300 371	105153	Output shaft
Thrust washer	2	3304 304 019	288748	Bearing/gear
Inner clutch disc	4	3304 304 040	-	Clutch pack
Outer clutch disc	4	3304 304 021	288758	Clutch pack
Shim 0.4 mm	2	3304 304 032	288760	Clutch pack
Shim 0.5 mm	2	3304 304 033	288761	Clutch pack
Spring	3	3306 304 024	206798	Disc carrier

ZF 10 M

KIT P/N 3304 199 004

ID/N 500437

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
O-Ring	1	0634 306 011	105679	Intermediate shaft
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	4	3304 301 015	288739	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 830	280135	Input shaft
Sealing ring	1	0634 300 371	105153	Output shaft
Thrust washer	2	3304 304 019	288748	Bearing/gear
Inner clutch disc	8	3304 304 040	-	Clutch pack
Outer clutch disc	6	3304 304 021	288758	Clutch pack
Shim 0.4 mm	2	3304 304 032	288760	Clutch pack
Shim 0.5 mm	2	3304 304 033	288761	Clutch pack
Spring	3	3306 304 024	206798	Disc carrier

HBW 10 - ZF 12 M - ZF 15 M - ZF 15 MA

KIT P/N 3306 199 007

ID/N 500438

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
O-Ring	1	0634 303 118	105530	Intermediate shaft
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	4	3306 301 014	254715	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 833	215875	Input shaft
Sealing ring	1	0634 300 466	105159	Output shaft
Thrust washer	2	3306 304 029	344787	Bearing/gear
Inner clutch disc	8	3306 304 027	407231	Clutch pack
Outer clutch disc	8	3306 304 031	407230	Clutch pack
Shim 0.4 mm	2	3306 304 035	195714	Clutch pack
Shim 0.5 mm	2	3306 304 036	195715	Clutch pack
Spring	3	3306 304 024	206798	Disc carrier

SEAL + CLUTCH PACK KITS**ZF 15 MIV KIT P/N 3306 199 005 ID/N 500439**

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	2	3306 301 014	254715	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 833	215875	Input shaft
Sealing ring	2	0634 300 146	401647	Output shaft
O-Ring	1	0634 306 072	105590	Output shaft
O-Ring	2	0634 303 690	291618	Output shaft
Thrust washer	2	3306 304 029	344787	Bearing/gear
Inner clutch disc	8	3306 304 027	407231	Clutch pack
Outer clutch disc	8	3306 304 031	407230	Clutch pack
Shim 0.4 mm	2	3306 304 035	195714	Clutch pack
Shim 0.5 mm	2	3306 304 036	195715	Clutch pack
Spring	3	3306 304 024	206798	Disc carrier

ZF 25 M - ZF 25 MA KIT P/N 3307 199 002 ID/N 500440 (EXCL. VERS. 22; 23)

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	106864	Shift cover
Sealing ring	2	3306 301 016	326578	Drain plug/oil dipstick
Gasket	4	3307 301 011	274251	Cover
Gasket	1	3306 301 015	254716	Shifting cover
Sealing ring	1	0634 301 832	284260	Input shaft
Sealing ring	1	0634 300 466	105159	Output shaft
Thrust washer	2	3307 304 020	327395	Bearing/gear
Inner clutch disc	10	3307 304 021	-	Clutch pack
Outer clutch disc	8	3307 304 005	206026	Clutch pack
Shim 0.4 mm	2	3306 304 035	195714	Clutch pack
Shim 0.5 mm	2	3306 304 036	195715	Clutch pack
Spring	3	3306 304 024	206798	Disc carrier

ZF 30 M KIT P/N 3320 199 003

PART NAME	Q.TY	P/N	ID/N	POSITION
Sealing ring	1	0634 502 009	-	Shift cover
Sealing ring	2	3306 301 016	-	Drain plug/oil dipstick
Gasket	4	3307 301 011	-	Cover
Sealing ring	1	0634 311 025	-	Input shaft
Sealing ring	1	0634 311 026	-	Output shaft
Thrust washer	2	3307 304 020	-	Bearing/gear
Inner clutch disc	12	3307 304 013	-	Clutch pack
Outer clutch disc	10	3307 304 005	-	Clutch pack
Shim 0.4 mm	2	3306 304 035	-	Clutch pack
Shim 0.5 mm	2	3306 304 036	-	Clutch pack
Spring	3	3306 304 024	-	Disc carrier

BEARING KITS (ALL VERSIONS)

ZF 3 M - ZF 5 M KIT 501220 P/N 3303 199 003

PART NUMBER	DESCRIPTION	LOCATION	Q.TY
0635 501 943	Tapered roller bearing	Input + Output shaft	4
0635 300 526	Cage	Intermediate shaft	1
0635 300 411	Needle cage	Reverse gear	2
3303 304 012	Needle bearing inner race	Reverse gear	2
3304 302 011	Shim 0.10 mm	Input + Output shaft	4

ZF 10 M KIT 501221 P/N 3304 199 005

PART NUMBER	DESCRIPTION	LOCATION	Q.TY
0635 501 943	Tapered roller bearing	Input + Output shaft	4
0635 300 530	Cage	Intermediate shaft	1
3304 304 037	Needle cage	Reverse gear	2
3304 304 022	Needle bearing inner race	Reverse gear	2
3304 302 011	Shim 0.10 mm	Input + Output shaft	4

HBW 10 - ZF 12 M - ZF 15 M KIT 501222 P/N 3306 199 003

PART NUMBER	DESCRIPTION	LOCATION	Q.TY
0635 501 597	Tapered roller bearing	Input + Output shaft	4
0635 300 148	Needle cage	Reverse gear	2
3306 304 021	Needle bearing inner race	Reverse gear	2
3306 303 007	Cage	Intermediate shaft	1
0635 303 056	Needle bearing	Shift cover	2
3306 302 011	Shim 0.10 mm	Input + Output shaft	4

ZF 15 MIV KIT 501223 P/N 3306 199 006

PART NUMBER	DESCRIPTION	LOCATION	Q.TY
0635 501 597	Tapered roller bearing	Input shaft	2
0635 370 050	Tapered roller bearing	Clutch shaft	1
0635 370 053	Tapered roller bearing	Clutch shaft	1
3306 303 007	Cage	Intermediate shaft	1
0635 501 936	Tapered roller bearing	Output shaft	2
0635 300 148	Needle cage	Reverse gear	2
3306 304 021	Needle bearing inner race	Reverse gear	2
0635 303 056	Needle bearing	Shift cover	1
0630 004 260	Shim 0.10 mm	Clutch shaft	2
3306 302 011	Shim 0.10 mm	Input + Output shaft	4

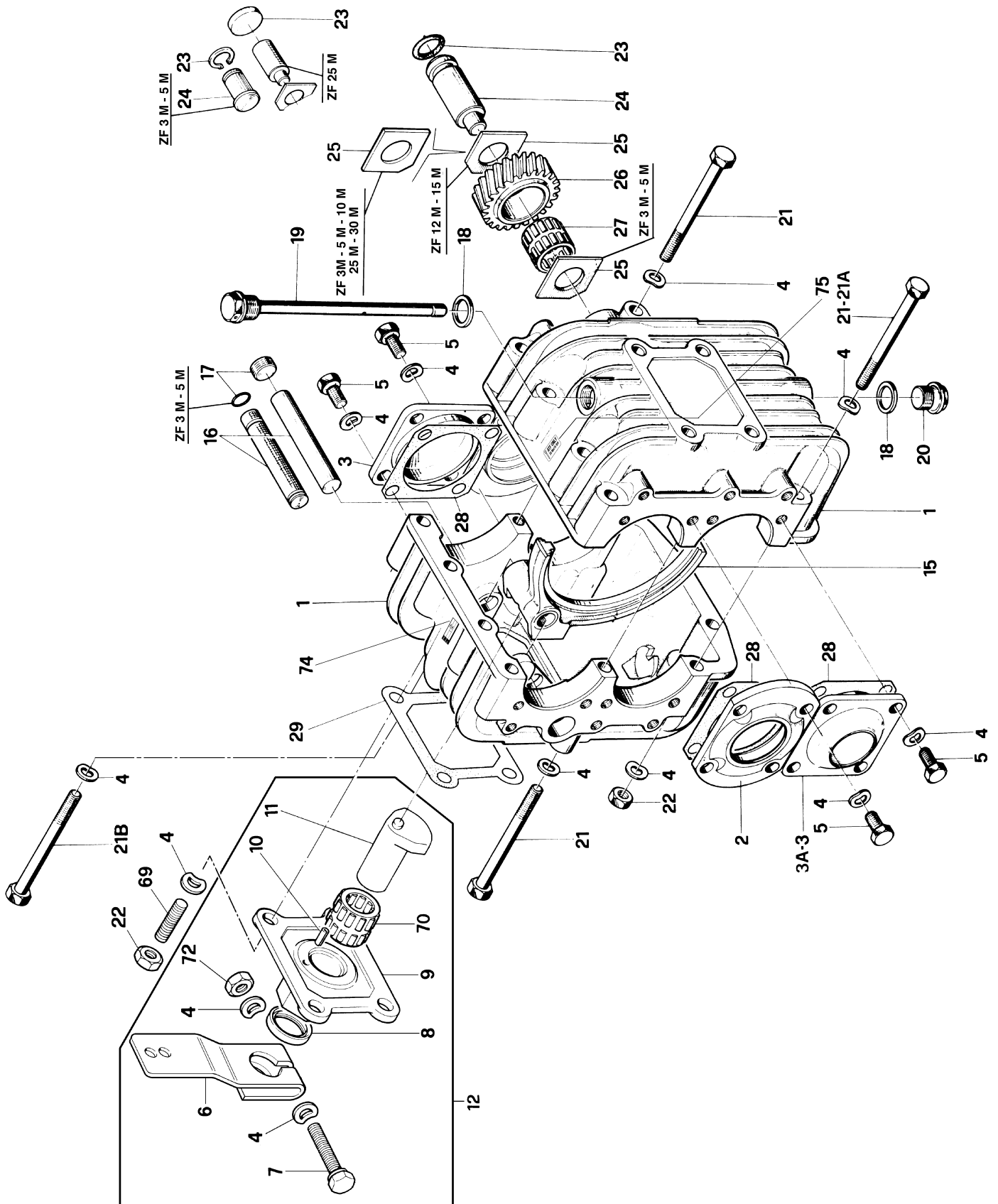
ZF 25 M - ZF 25 MA KIT 501224 P/N 3307 199 003

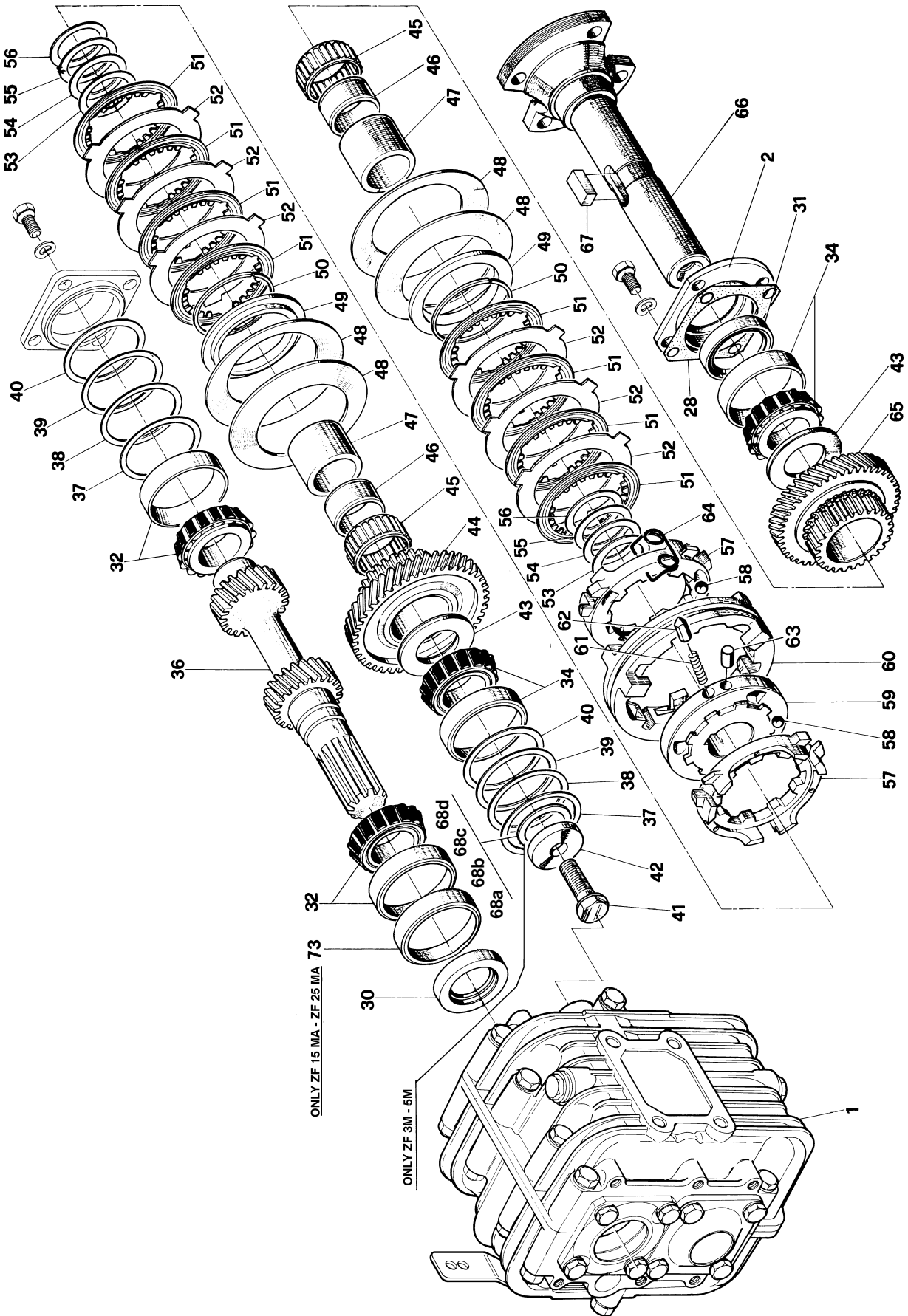
PART NUMBER	DESCRIPTION	LOCATION	Q.TY
0635 370 042	Tapered roller bearing	Input shaft	2
0635 370 051	Tapered roller bearing	Output shaft	2
0635 300 148	Needle cage	Reverse gear	2
3306 304 021	Needle bearing inner race	Reverse gear	2
3307 303 004	Cage	Intermediate shaft	1
0635 303 056	Needle bearing	Shift cover	2
3307 302 006	Shim 0.10 mm	Input + Output shaft	4

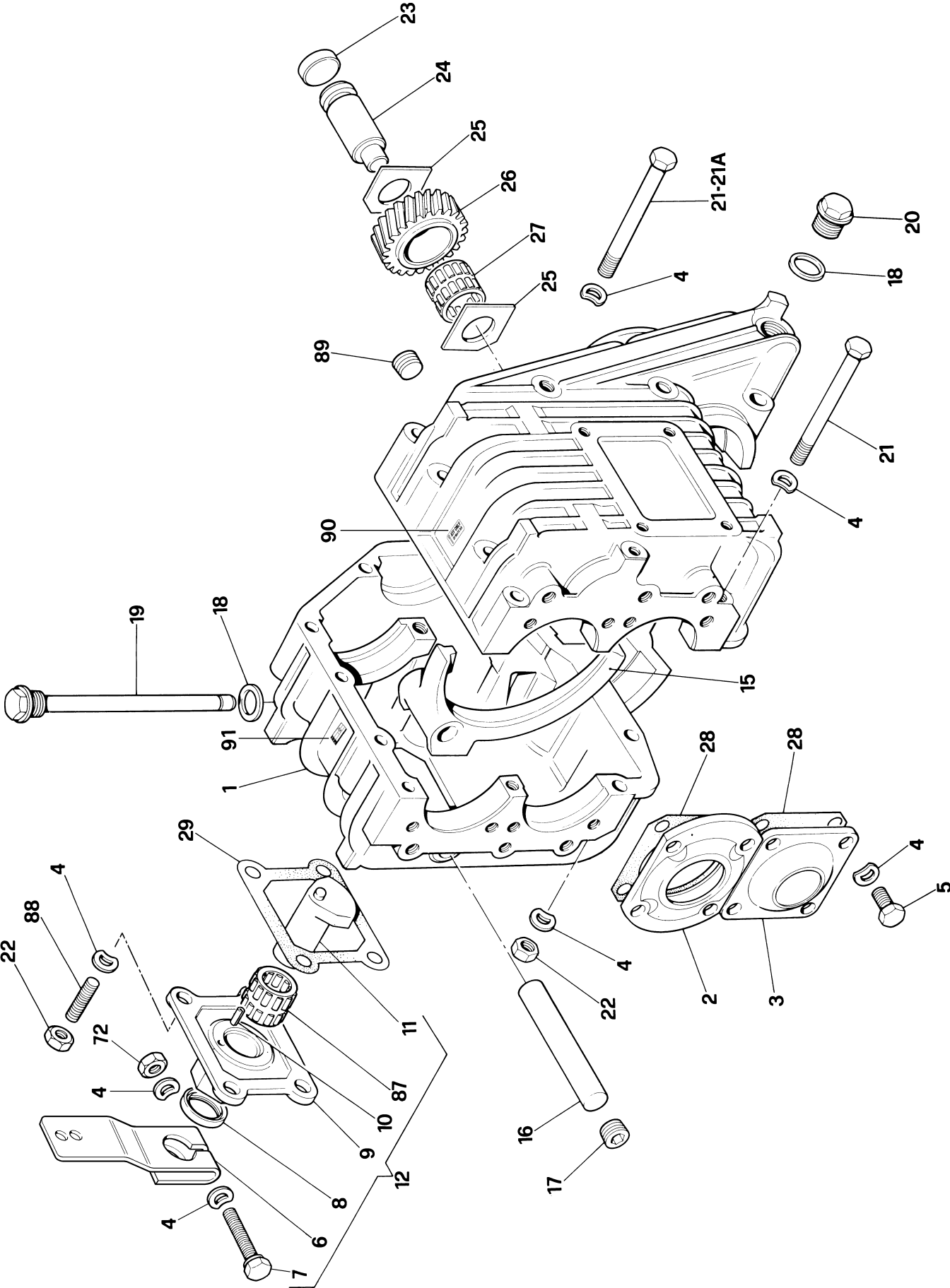
ZF 30 M P/N 3307 199 002

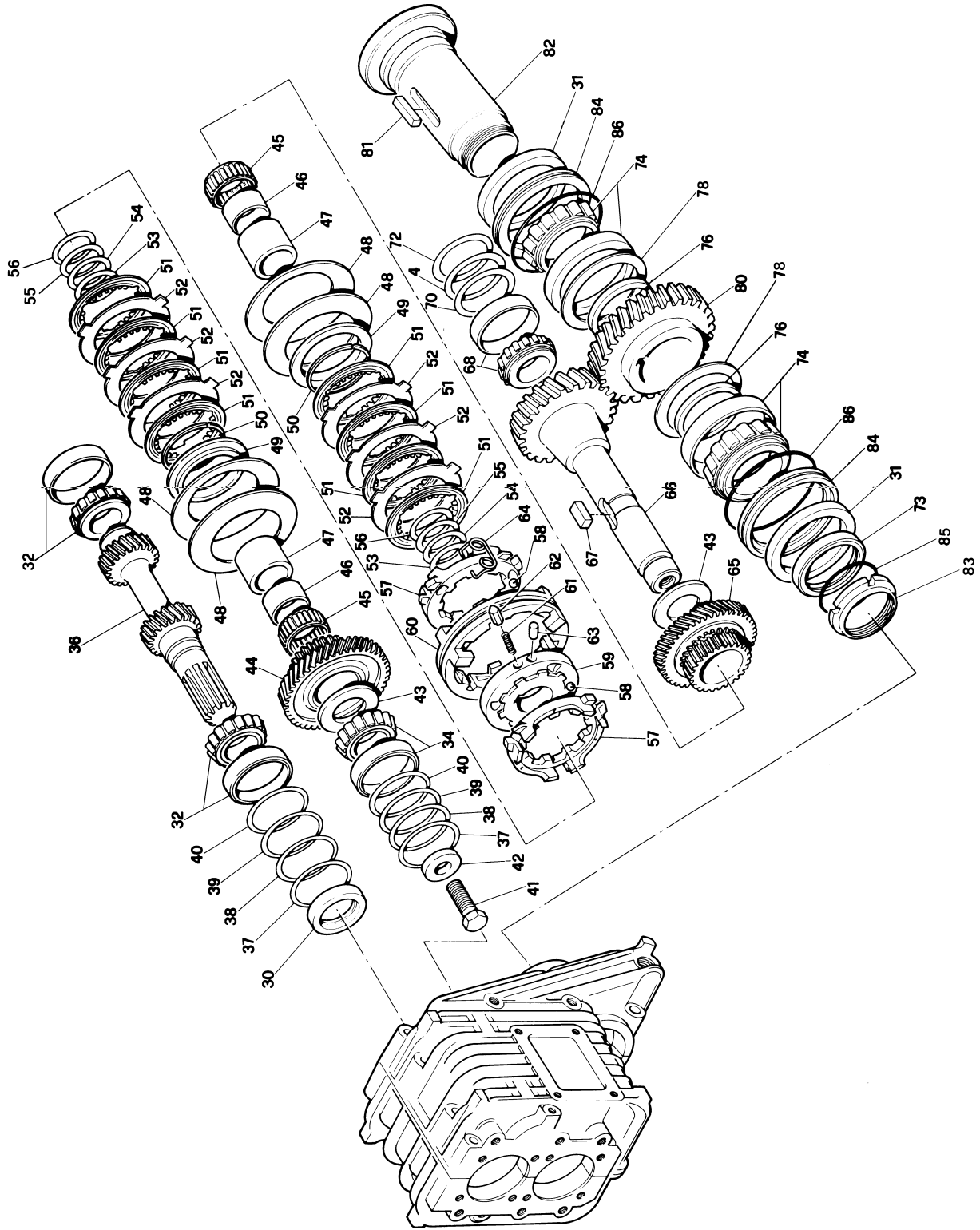
PART NUMBER	DESCRIPTION	LOCATION	Q.TY
0635 370 042	Tapered roller bearing	Input shaft	2
0635 370 051	Tapered roller bearing	Output shaft	2
0635 300 148	Needle cage	Reverse gear	4
3306 304 021	Needle bearing inner race	Reverse gear	4
0635 300 114	Cage	Intermediate shaft	2
0635 303 056	Needle bearing	Shift cover	2
3307 302 006	Shim 0.10 mm	Input + Output shaft	4

10. Drawings (Explosion view)











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