

Operating Instructions

BW 460, BU 460, BW 460-1, BU 460-1

BW 460 S, BU 460 S, BW 460-1 S, BU 460-1 S

BW 465, BU 465, BW 465-1, BU 465-1

BW 465 S, BU 465 S, BW 465-1 S, BU 465-1 S

BW 465-1 A, BU 465-1 A

BW 465-1 V, BU 465-1 V

BW 461, BU 461

BW 466, BU 466, BW 466 G, BU 466 G

ZF Marine Transmission

BW 460 Series

The following safety instructions appear in this manual.

NOTE

Refers to special processes, techniques, data, use of auxiliary equipment etc.

CAUTION

This is used when incorrect, unprofessional working practices could damage the product.

DANGER

This is used when lack of care could lead to personal injury or death.

Subject to alterations in design

Copyright by ZF

These operating instructions are protected by copyright. Any reproduction and dissemination in whatever form – also in adapted, paraphrased or extracted form – in particular as a reprint, photomechanical or electronic reproduction or as a storage in data-processing equipment or data networks without approval by the holder of the copyright is prohibited and will be prosecuted under civil and criminal law.

Printed in Germany

Printed:

Edition: 11.00

3085 758 105

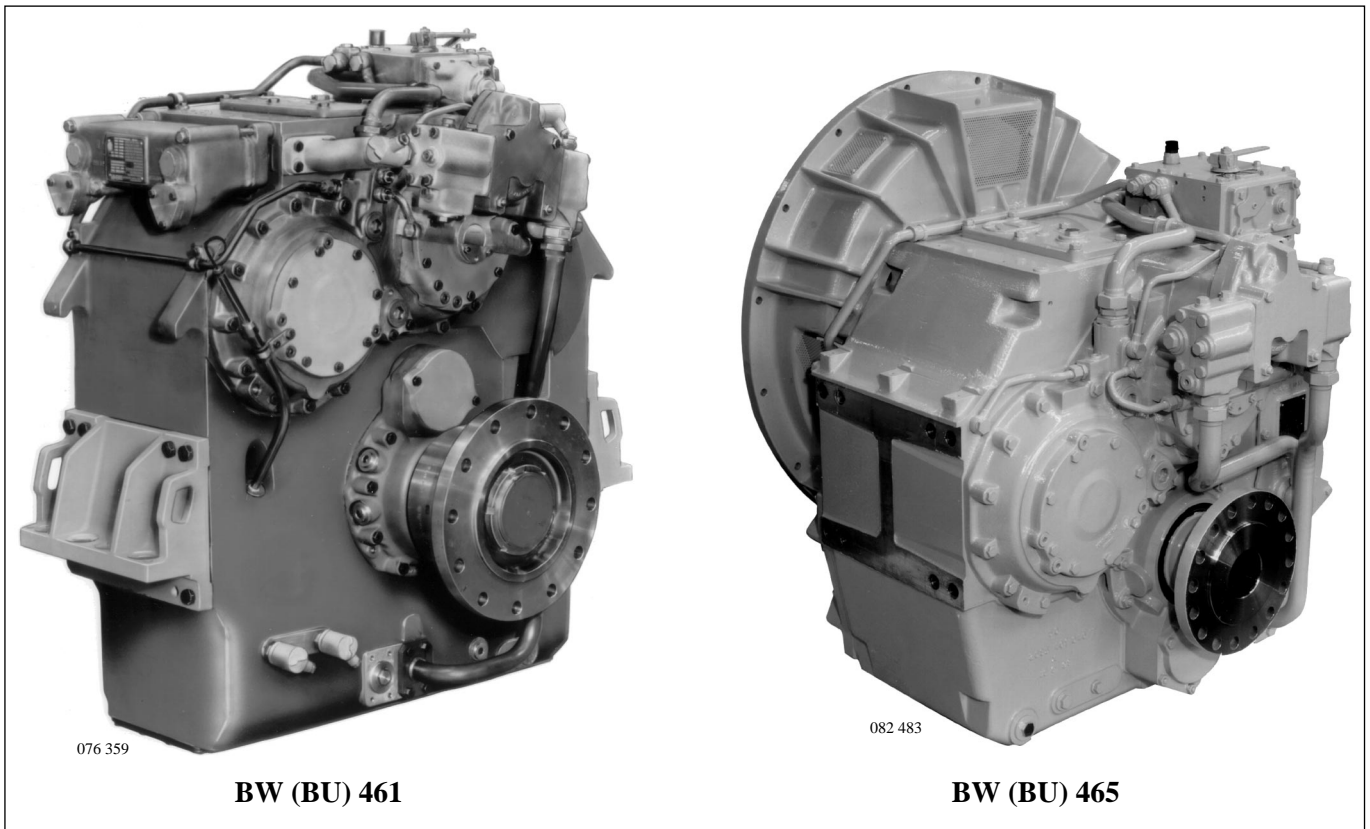
Foreword	5
1 Description	6
1.1 Power, speed, rotation direction, ratio, type plate	6
1.2 General information	6
2 Transmission views	8
2.1 BW 460 – transmission views	8
2.2 BW 461 – transmission views	10
2.3 BW 465 A– transmission views	12
2.4 BW 465-1 V – transmission views	14
3 Monitoring data for BW 460 Series	16
4 Functional description	17
5 Oil supply and transmission cooling	18
5.1 Control unit and transmission actuation	18
6 Actuation	19
6.1 Mechanical transmission actuation	19
6.2 Pneumactical transmission actuation	20
6.3 Electrical transmission actuation	21
7 Normal operation	22
7.1 Changeover	22
7.2 Operation with engine at a standstill and propeller driven by the current (trailing operation)	22
7.3 Special versions / special scope of supply	23
8 Manual operation with mechanical actuation	24
8.1 Electrical transmission actuation versions	24
8.2 Mechanical transmission actuation version	25
8.3 Operation using the emergency control	25
9 Trolling	27
9.1 Mechanical actuation device for trolling mode (special scope of supply)	27
9.2 ZF-Autotroll trolling device (special scope of supply)	30
9.3 Appendix (drawings)	39
10 Troubleshooting notes	43
11 Spare parts orders and service centers	47
12 Maintenance	48
12.1 Application group P	48
12.2 Application group L	48
12.3 Application group M	48
12.4 Application group C	48

13	Maintenance time schedule	49
13.1	Regular maintenance jobs	49
13.2	Additional one-off maintenance jobs on new or overhauled transmission	49
13.3	Anti-corrosion protection measures after long periods of downtime	49
14	Maintenance job schedule	50
14.1	Maintenance level / maintenance jobs	50
15	Tool kit for maintenance.	51
15.1	Tool kit W1	51
16	Maintenance system job sheets	53
	Job sheets	54 – 98
	Sealers.	100
	Corrosion-profing and anti-corrosion protection	Appendix

Operating Instructions

Foreword

ZF Marine Transmission



The operating instructions apply to the standard version of the transmission. Variations are possible according to special customer requirements and operating conditions. If the data contained in the operating instructions are different to the data contained in the technical or commercial specifications, the data in the specifications shall apply.

Important!

Ensure that these operating instructions are always kept to hand. Carefully read the operating instructions. Pay particular attention to the safety instructions.

Some of the illustrations contained in the operating instructions may differ from your installed transmission. Furthermore, safety devices and covers may sometimes be omitted to enable clearer illustration.

1 Description

1.1 Power, speed, rotation direction, ratio, type plate

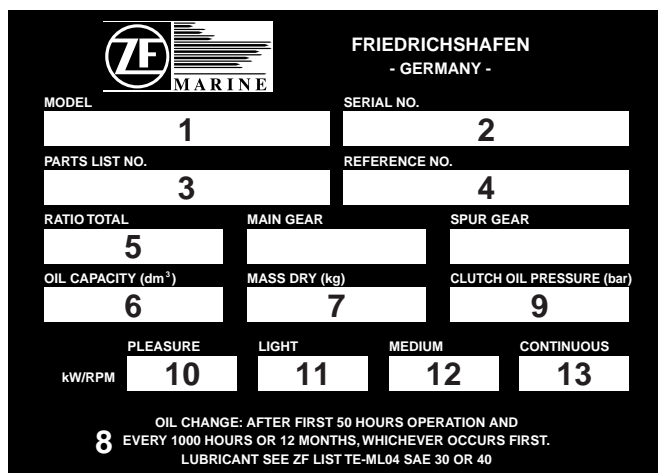
ZF marine transmissions are designed and manufactured according to the regulations of the various classification societies. The input powers approved by the classification societies depend on the input speed, the class of the craft and the different design regulations currently in force. In most cases, the maximum torques approved by ZF are also fully accepted by the classification societies.

If requested, the classification society specified by the customer can carry out a full test or factory acceptance test (test stand).

Normally, the input shaft rotates in a clockwise direction (looking at the transmission input flange). Transmissions which are specially designed for anti-clockwise input shaft rotation (looking at the transmission input flange) have an arrow on the transmission input end to show the rotation direction.

The total ratio is stamped on the transmission type plate which is located on top of the transmission housing.

Data included on the type plate:



Key

- 1 Model
- 2 Serial no.
- 3 Parts list no.
- 4 Customer reference no.
- 5 Total ratio and code letter for oil pump ratio
- 6 Oil capacity
- 7 Mass (dry)
- 8 Lubricant, see ZF List of Lubricants TE-ML 04
- 9 Clutch oil pressure (nominal)
- 10 Max. power/speed ratio for intermittent operation at very widely differing engine speeds
- 11 Max. power/speed ratio for intermittent operation at widely differing engine speeds
- 12 Max. power/speed ratio for intermittent operation at differing engine speeds
- 13 Max. power/speed ratio for continuous operation at max. engine power

NOTE

For items 10 to 13, also refer to section 12 “Maintenance”.

Information under 1, 2, 3 and 5 must be quoted when querying problems and ordering spare parts etc.

The letter stamped after the total ratio (5) has the following meaning:

Letter	Rated engine speed for continuous operation	Engine idle speed
A	1650 to 2300	≥ 415
B	1100 to 1650	≥ 275
C	750 to 1100	≥ 190

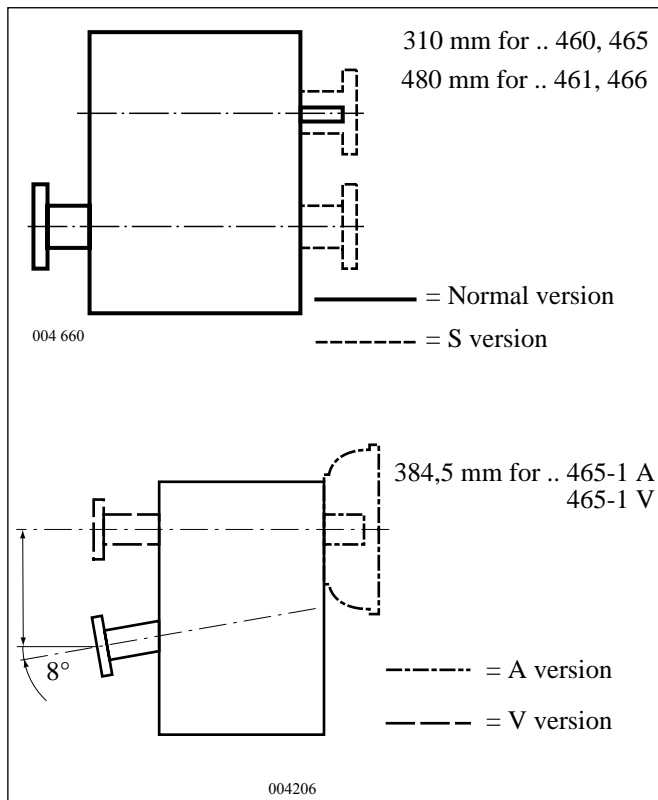
Oil pump ratio A is the standard version.

1.2 General information

(See the end of this section for different features of the “BU” series)

The BW 460 Series transmissions are abaxial reversing and step-up gears of 3-shaft design with a clutch on both the transmission input shaft and the reversing shaft. The general design is the same for all transmissions. The main components subject to wear can be accessed

through an aperture in the housing, even if the transmission is still installed.



The cast transmission housings are extremely torsionally rigid and, with the exception of the BW 461, are made from a light metal alloy which is almost totally resistant to salt water. The BW 461 transmission housing is made from gray-cast iron. The machined surfaces and tapped holes required for attaching the transmission mountings and the bell housing are included as standard.

In order to ensure long life and quiet operation, all power-transmitting gearing is designed with high safety levels in mind, case-hardened, ground and then specially treated.

The shafts run in anti-friction bearings. A propeller thrust bearing is installed in the transmission to absorb the propeller thrust. The reversing clutches arranged on the input shaft and the reversing shaft are multi-disc clutches with steel/sinter discs. They are operated by means of oil pressure.

The high delivery rate of the oil pump ensures rapid clutch response. The contact pressure of the clutch is modulated during shifting to ensure smooth operation.

At the same time, the flow of oil to the operating clutch is increased, i.e. the heat generated during shifting is quickly dissipated, which means that the clutches can operate efficiently under extreme load. The heat generated in trolling mode is also reliably dissipated, even during continuous operation.

In the event of faults in the operating oil circuit, both multi-disc clutches (not in BW 465-1 V; clutch on the input shaft only in BW 465-1 A) can be mechanically pressed together by means of three bolts (for each clutch) which are accessible from the outside (only when the transmission is at a standstill). This emergency control feature can be used to engage “enginewise” propulsion (not in BW 465-1 A and BW 465-1 V) or “counter-enginewise” propulsion (not in BW 465-1 V).

An easily replaceable control unit – fitted with all the valves, slides and control equipment for the operating and lubricating oil circuits – is built onto the transmission housing.

In the basic version of the transmission, the BW 465 / BW 461 control unit is actuated mechanically. If required, the BW 465 / BW 461 can also be supplied with electrical actuation.

The mechanical actuation system can be supplied with a mechanical trolling valve. The electrical transmission actuation system can also be supplied with an electrical trolling valve (ZF-Autotroll).

Differences in the BU Series:

The BU ... Series transmissions are step-up gears with one clutch which can be arranged either on the input shaft or on the reversing shaft.

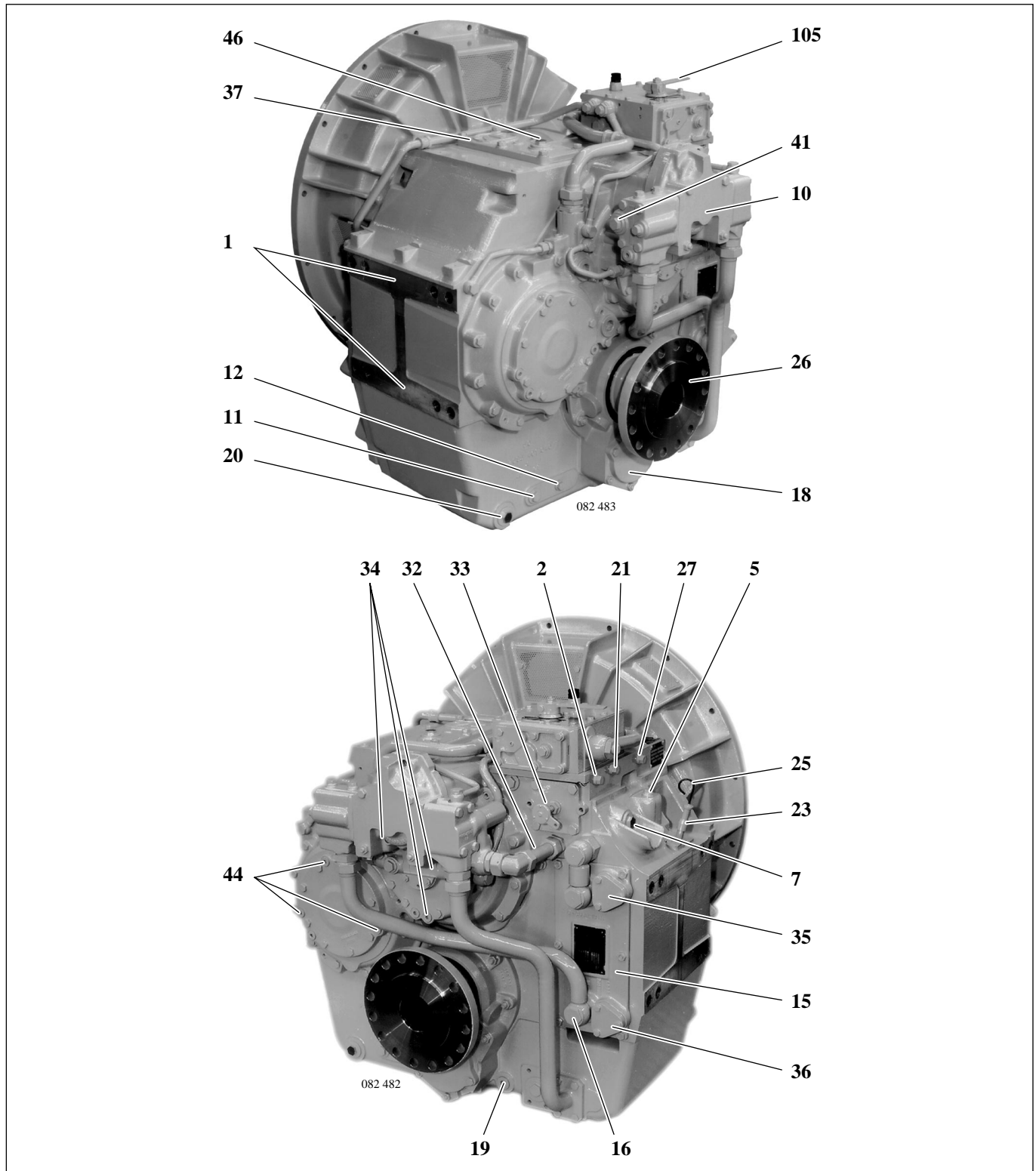
Depending on the version, the output rotation direction can be the same as or opposite to the input rotation direction. Otherwise, the design and the external dimensions are exactly the same as in the BW Series.

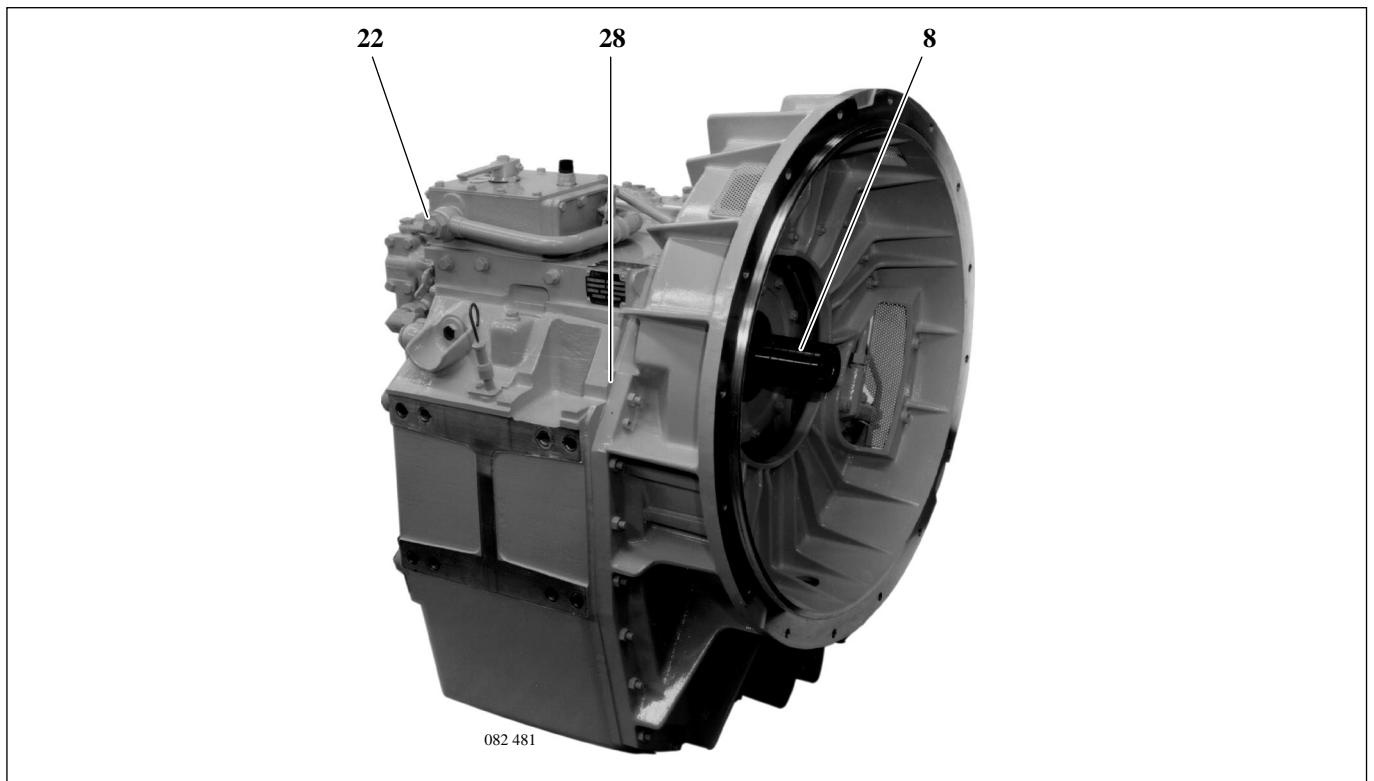
2 Transmission views

2.1 BW 460 – transmission views

ZF marine transmissions BW 460, BU 460, BW 460-1, BU 460-1, BW 465, BU 465, BW 465-1, BU 465-1

The pictures below depict the BW 465-1 (the SAE00 clutch bell housing shown is part of a special scope of supply). The add-ons, connections and pipes on your transmission may be different to those pictured here.





Key:

1	Transmission mounting faces	23	Transmission breather
2, 21, 27	Measuring point for clutch oil pressure	25	Oil dipstick
5	Measuring point for oil pressure upstream of filter	26	Output
7	Filter chamber, sediment drain	28	Flange-mounting face for bell housing
8	Input	32	Oil chamber drain
10	Engine-driven oil pump	33	Oil filter
11, 12, 41	Measuring points for oil temperature	34	Emergency control (counter-enginewise rotation)
15	Oil cooler	35	Coolant inlet
16	Pressure side connection for standby pump	36	Coolant outlet
18	Position for trailing oil pump	37	Inspection hole cover, transmission housing
19	Suction side connection for standby pump	44	Emergency control (enginewise rotation)
20	Oil drain plug	46	Oil filler hole
22	Measuring point for lubricating oil pressure	105	Control lever for mechanical actuation

2.2 BW 461 – transmission views

ZF marine transmissions BW 461, BU 461, BW 466, BU 466, BW 466 G, BU 466 G

The pictures below depict the BW 461 with rigid mounting and monitoring equipment (special scope of supply). The add-ons, connections and pipes on your transmission may be different to those pictured here.

