

Litware LT-32 wind turbine - Maintenance manual

Chapter 4 - Gearbox (excerpt). Document LWS-MM-GBX-32 Rev. D, issued 2024-03-15 by Litware Wind Systems.

Field	Value
Document number	LWS-MM-GBX-32
Revision	D
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Applies to	LT-32 turbines (all variants) with Fabrikam FGT-3200 gearbox
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Language	English (original)

SAFETY: Work on the gearbox requires the turbine to be stopped, the rotor locked and the drivetrain isolated according to the operator's lockout procedure. Hot oil up to 80 °C can cause burns. Wear the personal protective equipment defined by the site.

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Changes to the content of this chapter are published by Litware Wind Systems as service bulletins. Always check the bulletin register before planning gearbox work.

4.1 Gearbox description

The LT-32 uses a Fabrikam FGT-3200 three-stage gearbox: one planetary stage followed by two parallel helical stages. The overall ratio is 1:118.4. At the rated rotor speed of 12.7 rpm the output pinion shaft drives the generator at 1,500 rpm. The rated input torque is 2,410 kNm and the dry mass of the gearbox is 21.6 t.

The gearbox is lubricated by splash and by forced lubrication. A shaft-driven pump supplies the bearings and gear meshes during operation; an electric pump runs during start-up and flushing. The oil passes an inline filter (10 micron) and an air/oil cooler with an electric fan. A thermostatic valve sends the oil through the cooler above 45 °C. Three immersion heaters (3 x 1.5 kW) warm the oil sump before a cold start.

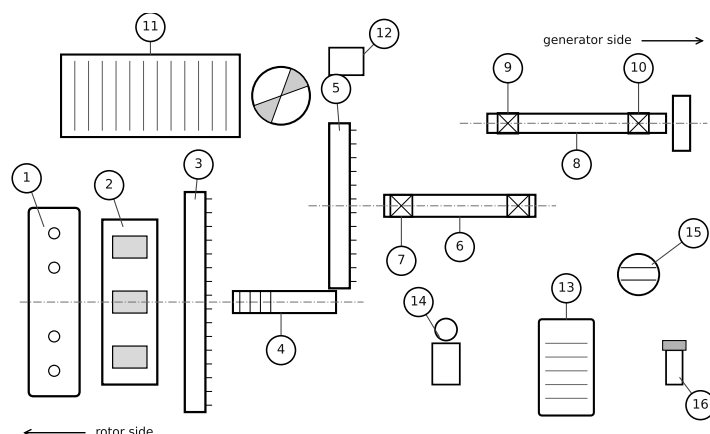


Figure 4-1 - Exploded view of the FGT-3200 gearbox (item numbers in table 4-1)

Table 4-1 - Parts shown in figure 4-1.

Item	Description	Spare part number
1	Housing cover, rotor side	-
2	Planet carrier with three planet gears	-
3	Ring gear	-
4	Sun pinion shaft	-
5	Second-stage gear wheel	-
6	Intermediate pinion shaft	-
7	IMS bearing set	FGT-P-21904
8	Output pinion shaft	-
9	HSS bearing, rotor side	FGT-P-22331
10	HSS bearing, generator side	FGT-P-22328
11	Oil cooler with fan motor 1.5 kW	LWS-P-30418 (fan motor)
12	Thermostatic valve insert	LWS-P-30422
13	Oil filter element, 10 micron	FGT-P-11872
14	Breather with desiccant	FGT-P-11880
15	Oil level sight glass	FGT-P-13010
16	Oil sampling valve	FGT-P-14002

4.2 Lubrication

Only the lubricant listed in table 4-2 is approved for the FGT-3200 gearbox. Do not mix lubricants of different brands or viscosity grades.

Item	Specification
Gear oil	Proseware PWG 320
Viscosity grade	ISO VG 320
Base oil	synthetic PAO
Total oil volume	410 L (gearbox sump 330 L + cooling and filter circuit 80 L)
Oil change interval	5 years, or earlier when the laboratory analysis requires it
Oil sampling interval	6 months
Filter element FGT-P-11872	replace every 12 months or at alarm A2140
Breather FGT-P-11880	replace every 12 months

Table 4-2 - Lubricant specification.

Operating temperatures

Parameter	Value
Normal oil sump temperature in operation	50 to 65 °C
Thermostatic valve opening (cooler circuit)	45 °C
Warning A2101 - oil sump temperature high	75 °C
Trip A2102 - oil sump temperature trip	82 °C
Minimum oil sump temperature before start-up	+10 °C (heaters on below +10 °C)

Table 4-3 - Gearbox oil temperatures.

The turbine controller blocks the start of the drivetrain until the oil sump has reached the minimum start-up temperature. Do not bypass the start inhibit.

4.3 Oil change (overview)

The detailed oil change procedure is defined by the operator. The OEM requirements are:

1. Stop the turbine, lock the rotor and isolate the drivetrain.
2. Drain the oil at an oil temperature between 40 and 60 °C so that deposits drain with the oil.
3. Replace the filter element FGT-P-11872 and inspect the magnetic plug.
4. Fill only through a filter cart with a 10 micron element.
5. Check the level at the sight glass after 20 minutes of standstill.
6. Take a reference oil sample after 24 hours of operation.

Joint	Thread	Tightening torque
Drain plug	M48 x 2	280 Nm
Filter housing cover screws	M12	85 Nm
Oil cooler hose flange screws	M16	210 Nm
Sight glass retaining screws	M8	22 Nm

Table 4-4 - Tightening torques for oil change work.

4.4 Inspection and condition monitoring

Task	Interval
Visual inspection and leak check	6 months
Oil sampling and laboratory analysis	6 months
Endoscope inspection of gear teeth and bearings	24 months
Vibration monitoring (condition monitoring system)	continuous
Filter element replacement	12 months
Oil cooler radiator cleaning	as required

Table 4-5 - Inspection intervals.

Oil analysis limits

Parameter	Alert	Alarm
Iron (Fe)	50 ppm	100 ppm
Copper (Cu)	25 ppm	50 ppm
Silicon (Si)	15 ppm	25 ppm
Water	300 ppm	500 ppm
Viscosity change at 40 °C	+/- 10 %	+/- 15 %
PQ index	60	120
Cleanliness ISO 4406 (target 17/15/12)	19/17/14	21/19/16

Table 4-6 - Oil analysis limits.

Vibration limits

For the output stage bearings (HSS bearings, rotor side and generator side) the velocity RMS limits are 3.5 mm/s (alert) and 4.5 mm/s (alarm). Above the alarm level, plan a bearing inspection and reduce load if the trend keeps rising.

4.5 Troubleshooting of gearbox alarms

Code	Message	Possible causes	Checks and actions
A2101	Gearbox oil sump temperature high (75 °C)	Cooler fan motor fault or reduced fan speed; radiator fins blocked; thermostatic valve insert stuck; low oil level; full load at high ambient temperature; bearing damage	Check fan rotation and motor current; clean the radiator; check valve insert LWS-P-30422; check the oil level; review the vibration trend; take an oil sample
A2102	Gearbox oil sump temperature trip (82 °C)	As for A2101; the turbine stops automatically	Inspect the cooling circuit before restart; do not reset more than once without inspection
A2110	Gearbox HSS bearing temperature high (90 °C)	Bearing damage; lubrication starvation	Check the vibration trend; endoscope inspection of the bearing
A2120	Gearbox oil pressure low (0.8 bar)	Cold oil at start-up; pump fault; filter blocked	Allow heater time at cold start; check the pump and the filter
A2130	Gearbox oil level low	Leak at seals, hoses or plugs	Find and repair the leak; top up with the approved oil
A2140	Gearbox oil filter differential pressure high (2.5 bar)	Filter element clogged; cold oil	Replace filter element FGT-P-11872

Table 4-7 - Gearbox alarms.

End of excerpt.