

# General Turbo-Gear Inspection/Commissioning Checks of a Rotor Set relating to Gear Toothing

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## 1. INITIAL TOOTH CONTACT PATTERN CHECK (PRUSSIAN BLUE INK TEST)

The normally load bearing tooth flanks (dependent on direction of rotation) have been ground with profile and longitudinal modifications. This is done to ensure a proper contact of the meshing gear teeth over their full height and width under dynamic operating conditions of load and temperature.

The “tooth contact assembly drawing” (in possession of the service technician) shows a sketch with the proper tooth contact pattern with no-load and at ambient temperature. It is established during the manufacturing phase in a level and undistorted position and must always be re-checked during the installation on site. Only this can guarantee correct mounting and a sufficient foundation.

It is recommended to do this check with the upper part of gear casing initially un-mounted and then again mounted. It can be performed as follows:

- a) Cover 3-5 teeth of the bull wheel with (Prussian) blue ink.
- b) Turn the wheel back and forth up to 3-4 times until the imprint on the pinion becomes visible.
- c) Check the generated pattern and record it in the “Acceptance report”
- d) Once the cover is mounted this procedure can be again performed through the inspection hole.


Notes:

- ❖ Only Artec Service specialists and authorized personnel can perform the tooth contact pattern check.
- ❖ For the tooth contact pattern check, the gearbox must be firmly bolted to the foundation. Driving and driven machines are NOT allowed to be coupled.
- ❖ When removing the inspection cover, no dirt or foreign debris can be allowed to fall into the gearbox.

## 2. LUBRICATING OIL

The lubricating oil supply for the gearbox is integrated in the lubrication system of the installation with common monitoring of pressures and temperatures.

The lubricating oil used must always be a high quality turbo machinery lubricating oil. The lubricating oil must comply with the prescriptions (FZG test) as previously noted. API 613/5<sup>th</sup> edition mandates oils with minimum

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FZG load stage 5 pass 6. Oils with higher FGZ values will provide the gear with better protection against scuffing.

The lubricating oil must be free from mineral acids, alkalis and asphalt as well as "free" from water. Oil brands containing EP-additives are not recommended.

The lubricating oil should be filtered to 25 µm or better. For extreme conditions, centrifugal purifiers are recommended.

The entire oil system must be flushed thoroughly before the lubricating pipes are connected to the gearbox.

At the beginning of the flushing process, until the filter remains reasonably clean, the gearbox needs to be excluded (via bypass).

Only after the flushing process can the lubricating pipes can be connected.

- **ATTENTION**  
Corresponding flat seals must be installed between the flanges and the oil lines

If the gearbox is included into the flushing process, it is necessary that a sieve is installed at the entrance of the oil system. In this event, we recommend proceeding as described below (see IMPORTANT).

- **IMPORTANT**  
If it is not possible to by-pass the gearbox you should proceed as follows:
  1. Protect the inlet to the gearbox with a rigid, conical auxiliary sieve. It needs a straining mesh with a mesh width about 25 µm. Thus a rupture of the straining mesh can be prevented, which would then require a dismantling and cleaning the gearbox
  2. Flush the lubrication system until the filters remain reasonably clean.

- ❖ **ATTENTION**  
Sieve (and other potentially necessary utensils) must be removed before commissioning.



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### 3. TEMPERATURES

We recommend setting the thermostats AFTER having established actual full load indications. The expected oil inlet temperature fluctuation also should be taken into account:

Alarm setting: 5°C (9°F) above the actual maximum full load temperature reading  
Shut-down setting: 10°C (18°F) above the actual maximum full load temperature reading

The bearing temperatures as measured during commissioning as well as the calculated alarm and shut-down values must be noted in the instruction manual by the end user for future reference.

In due consideration of bearing metal strength, the limit temperatures as indicated in the original manufactures equipment, are NOT to be exceeded in any case.

The gear train, furthermore, is to be shut down in the event of temperature fluctuation at constant speed, load and oil inlet temperature.

### 4. VIBRATIONS

The settings for alarm and shut-down are to determined during the commissioning of the gear. They should be set as low as possible but sufficiently high so as not to shut down the plant installation during transient instabilities.

As a guide line for vibration limits use:

Shaft vibrations: ALARM – twice the specified API limit (mils/pp)  
SHUT DOWN – Alarm setting + 1 mil

Casing vibrations: ISO 8579-2 Norm (1993)

### 5 CHECK AFTER THE COMMISSIONING - TOOTH LOAD BEARING PATTERN CHECK (DYKEM RED)

The load bearing pattern of the gears must be checked by the responsible engineers during start-up commissioning:

1. The FIRST check needs to be performed after some “partly loaded” operation time or after 2 or 3 start-ups. The observed pattern should clearly indicate the transition from the NO\_LOAD contact pattern (Prussian blue) to FULL LOAD (Dykem red) bearing pattern
2. After 8-10 hours of full load operation or, if no part load checks were possible, after a maximum of 1 hour FULL LOAD, the tooth load bearing pattern is to be checked again. It should extend over at least 90% of the face width without indication of heavier loading to one side.
3. For an unsatisfactory tooth contact see “Procedure with a POOR tooth load bearing pattern”.

In order to check the load bearing pattern, several teeth on the circumference of the pinion and the gears are coated during the assembly of the gearbox with a thin, even layer of red lacquer (Dykem red). It clearly indicates the load contact by being worn away after a short operating time.

### PROCEDURE FOR THE LOAD BEARING PATTERN CHECK

1. Stop the installation
2. Loosen and remove the inspection cover.
3. Evaluation of the load bearing pattern:

*During the guarantee period ONLY Artec Service specialists can perform, check and accept the load bearing pattern.*

#### a) PROCEDURE AFTER A GOOD TOOTH LOAD BEARING PATTERN

1. Clean the teeth free of grease.
2. Renew the Dykem Red Lacquer coating.
3. Re-mount the inspection cover.

The system can be started again.

#### b) PROCEDURE WITH A POOR TOOTH LOAD BEARING PATTERN

1. If the load bearing pattern is NOT satisfactory, the shaft positions must be changed. This might require the correction of the alignment of the entire gear train.

A change of the shaft position may only be carried out by Artec Service specialists.

Corrections to the tooth patterns by external modifications (racking) or internal modifications (changing position of bearings) may only be carried out by Artec Service specialists or accordingly trained and authorized personnel.

## 6 ACCEPTANCE

The acceptance takes place according to the contractual agreement with the operator.



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