National Cement Company

CBM Report for Raw Mill Gearbox Flender KMPS 496

December - **2023**
Prepared by **PM Department**

1. Contents

2. Objective

To provide report about condition of vertical raw mill gearbox FLENDER KMPS 496. Vibration spectrums and thermal graphical photos and oil analysis ferrous count ppm are reported.

3. Introduction

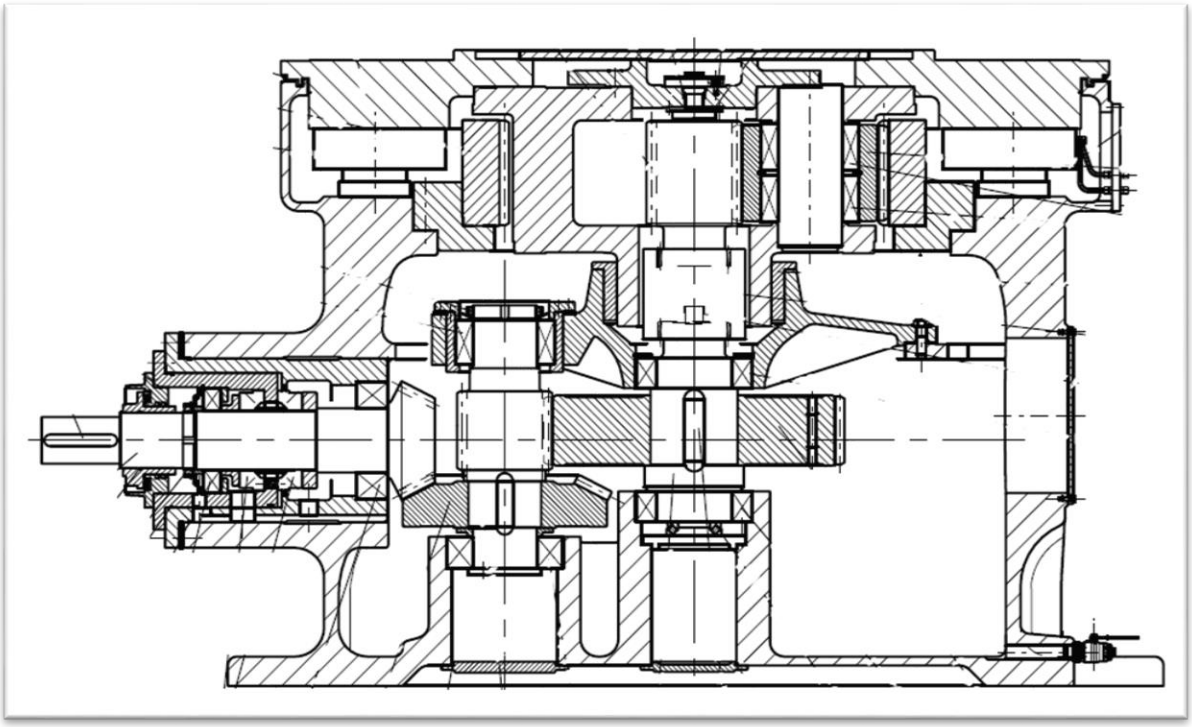
Flender gearbox KMPS 496 driven by an electric motor transmits the required torque to the grinding bowl and at the same time absorbs the forces that are created by the grinding process affecting the grinding bowl.

The type KMPS vertical mill gear unit is a bevel-helical planetary gear unit for a vertical mill drive. The axial forces resulting from the grinding process are conducted via the gear unit housing to the foundation.

All shafts are mounted in rolling bearings. The planet carrier is rigidly connected to the output flange and is guided precisely by a radial sliding bearing and an axial tilting-pad thrust bearing.
An axial tilting-pad thrust bearing is fitted in the upper section of the housing to absorb the high axial load from the grinding process. The axial tilting-pad thrust bearing is designed for hydrostatic lubrication and has a low specific surface load.
This gearbox still running since 2008 where replaced input shaft bearings two times in 2010 and 2022.

4. Data Equipment

Type	: Flender KMPS 496
Motor power	: 3000 kW
Required power	: 3000 kW
Actual ratio	: 40.909
Input speed	: 990 1/min
Output speed	: 24.20 1/min
Weight (without oil filling)	: 77000 kg
Heaviest component weight	: 30500kg
Overall dimensions (l x b x h)	: 4700 x 3400 x 2800 mm
Lubrication	: hydrostatic lubrication
total operating oil quantity	: ~ 4000 l
Oil viscosity	: ISO VG 320 (MIN-oil)

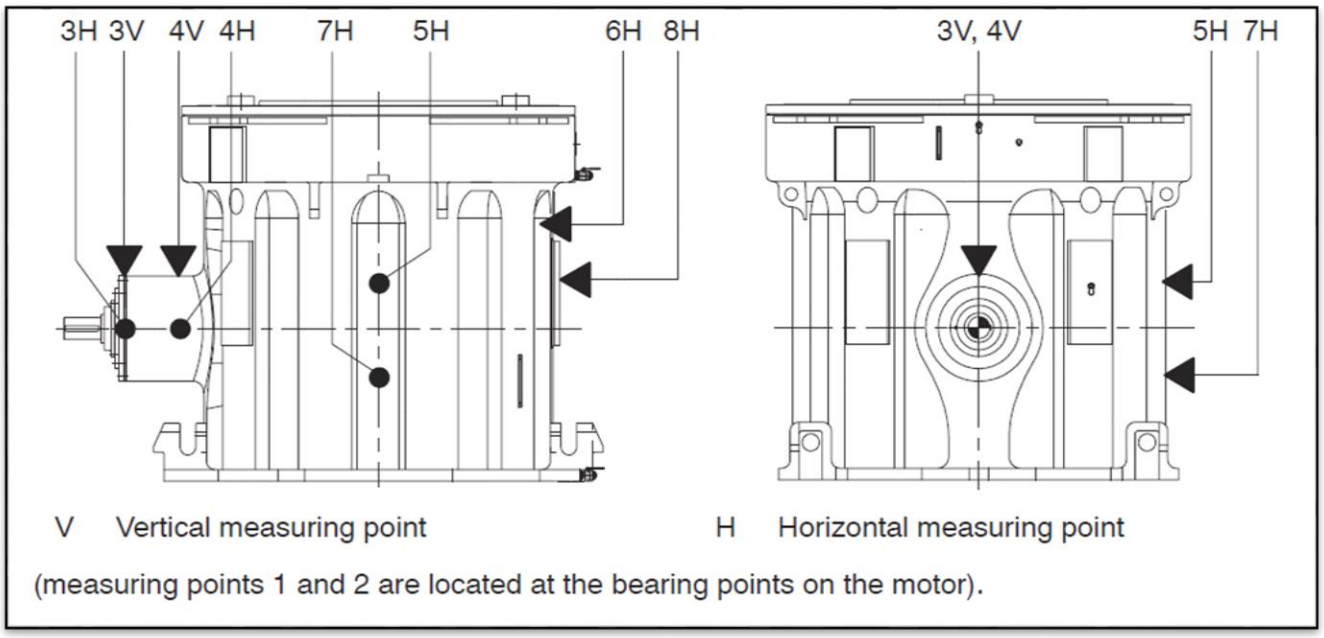


Cross-section Flender KMPS 496

5. Vibration Analysis

5.1 Measurement Points

The measuring points specified in the diagram are standard measuring point as recommended in manual



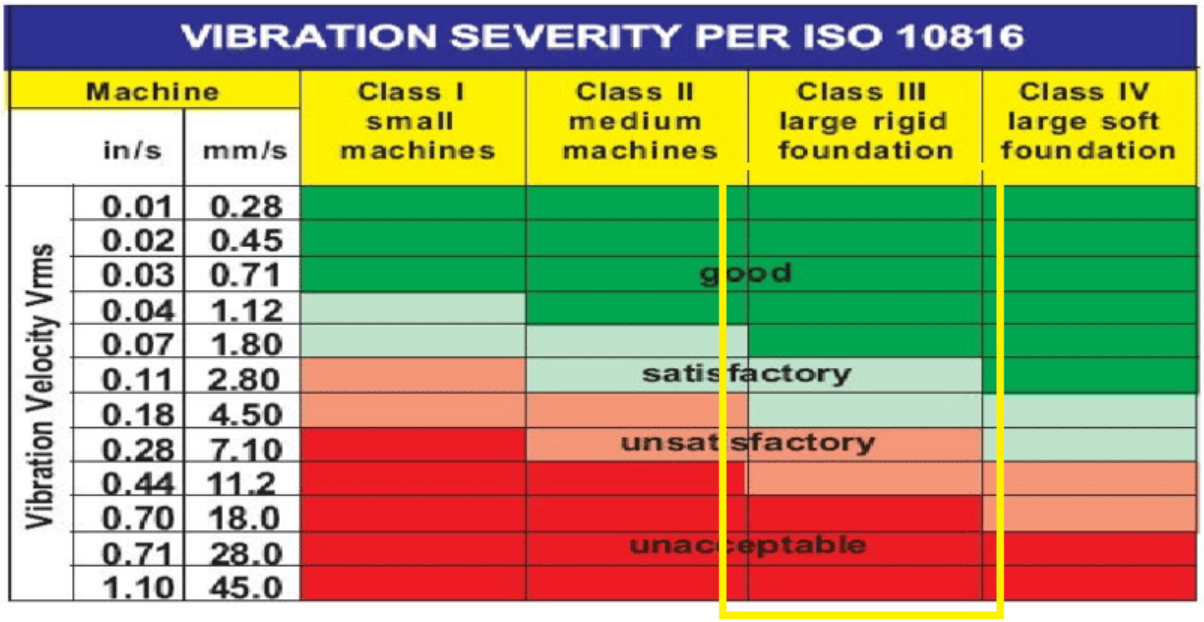
Measurement Points in Gearbox

5.2 Vibration Readings

The vibration readings in velocity unit for the gearbox in mentioned points in above Fig.

RM GB	H, mm/s	V, mm/s	A, mm/s	Acceleration, g	Envelope Acceleration, gE
Input Shaft Point 3	1.9	3.3	2.1	0.22	0.68
Input Shaft Point 4	1.7	1.5	2.1	0.16	1.1
GB Casing Point 5	1.8	-	-	0.17	1.1
GB Casing Point 6	2.1	-	-	0.11	0.8
GB Casing Point 7	2.7	-	-	0.43	2.6
GB Casing Point 8	1.8	-	-	0.11	0.7

As mentioned in manual .For assessing the gear unit to DIN ISO 10816 the classification III applies to this machine.



Compare vibration readings of our gearbox with ISO 10816-3 chart where our equipment in class 3 as recommended in manual we still in good range.

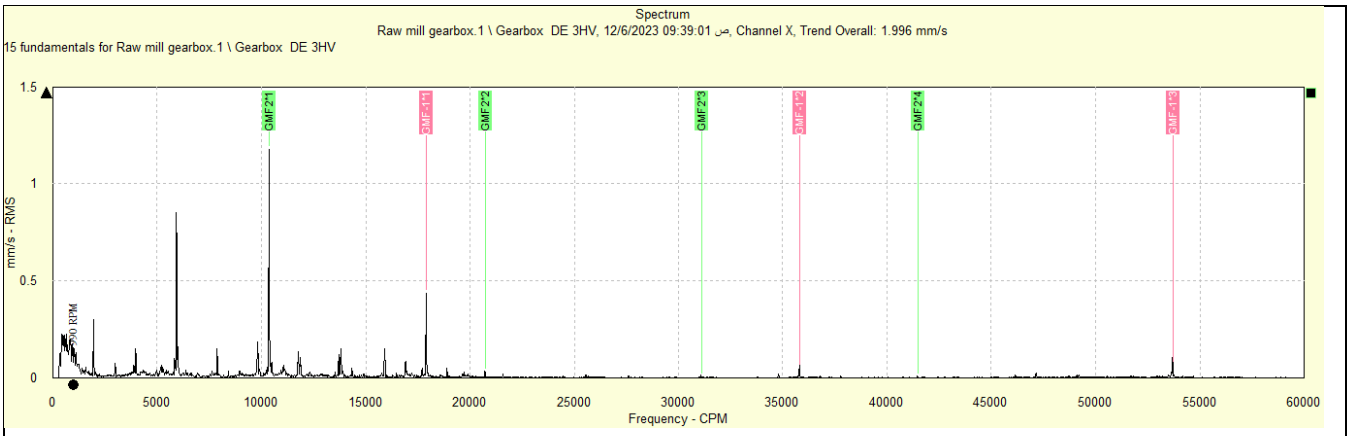
5.3 Vibration Spectrums

CBM section collecting data from this gearbox since 2018 by skf analyzer with accelerometer has sensitivity 100 mV/g

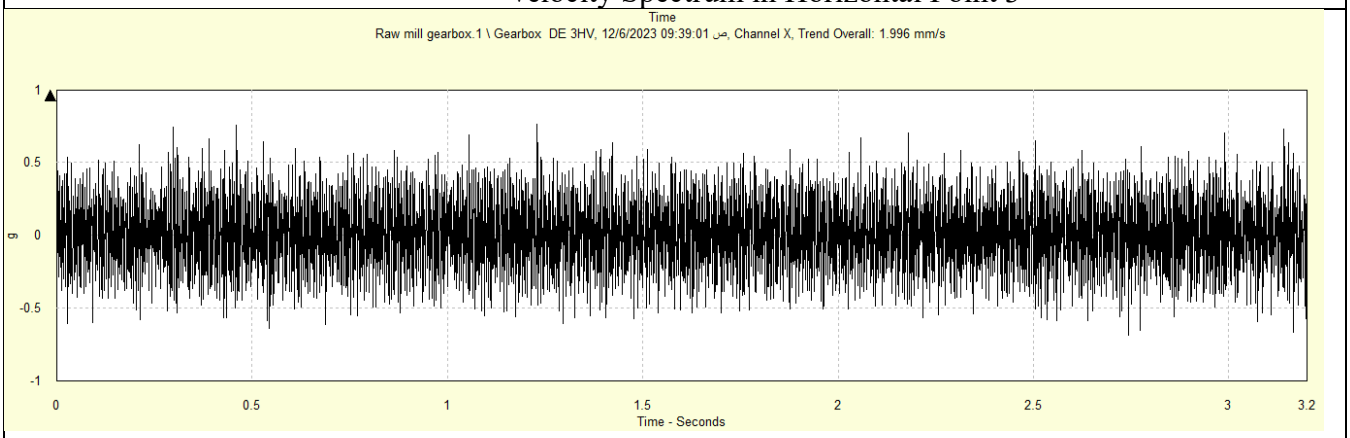
The path transmission of vibration from source to location of data collecting is accessible for input shaft bearings therefore the vibration readings from points 3 & 4 could give us clear indication about the condition of bearings and gear and the other points considered to trend the vibration only.

The peaks of :
GMF1 (Gear mesh frequency first stage),
GMF2 (Gear mesh frequency second stage) and
GMF Planetary (Gear mesh frequency Planetary stage)
The mentioned above peaks shown with us in almost points without any sidebands of related shafts and without impacts in time wave
In regards the bearings of input shaft the related peaks in very little peaks therefore we don't mention to them in spectrums.

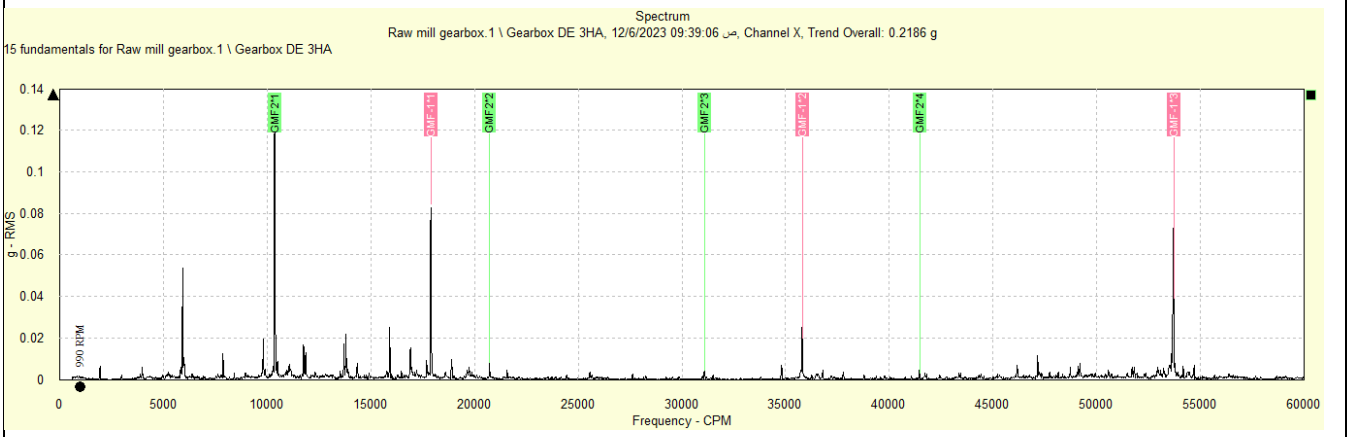
5.3.1 Velocity and acceleration spectrums and time waves in point 3



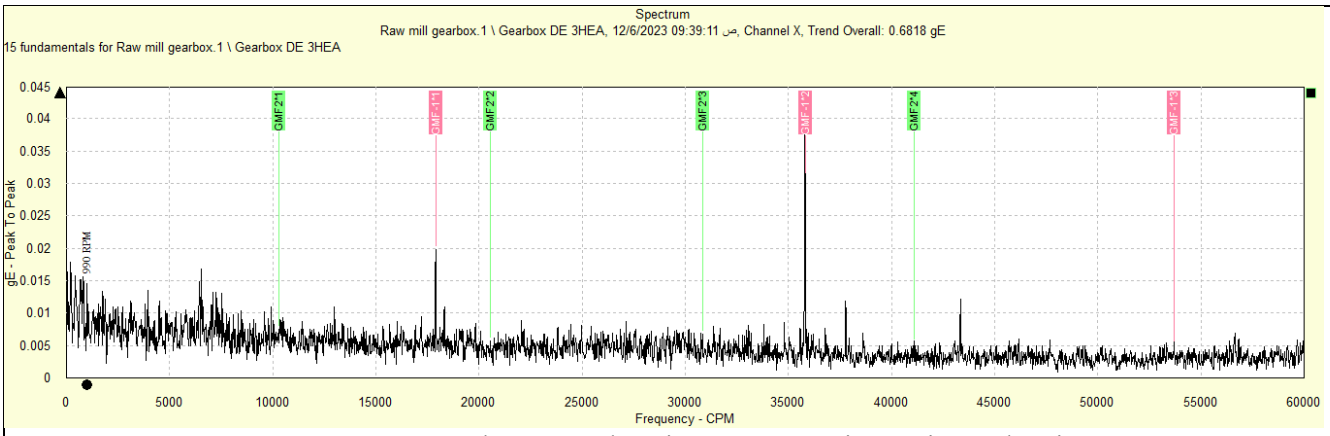
Velocity Spectrum in Horizontal Point 3



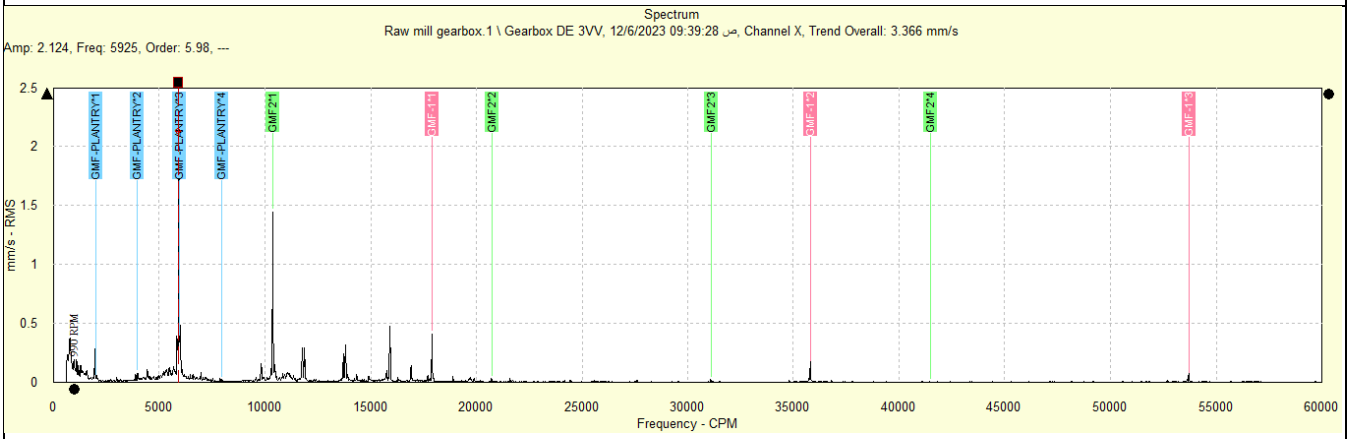
Time wave in Horizontal Point 3



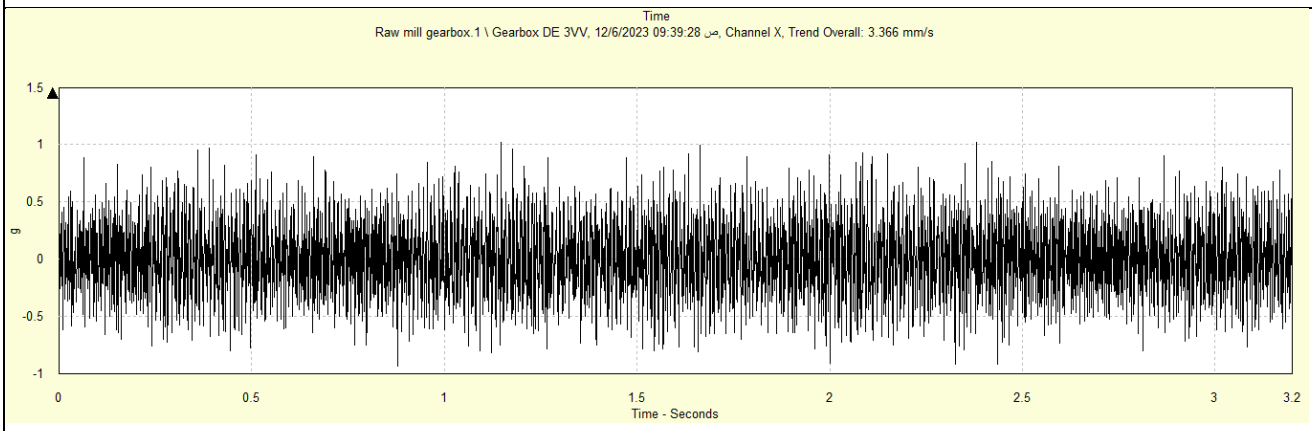
Acceleration Spectrum in Horizontal Point 3



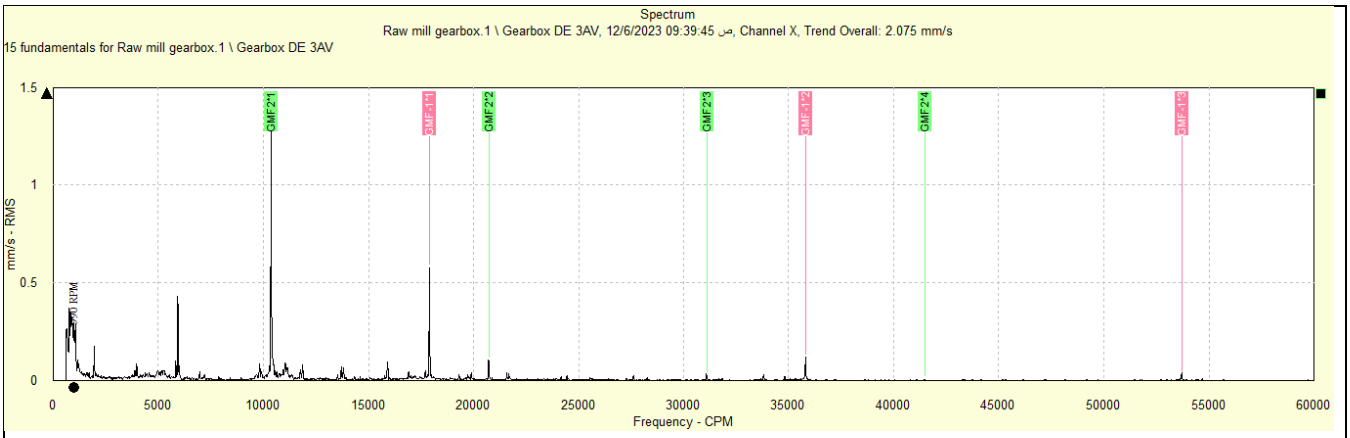
Envelope Acceleration Spectrum in Horizontal Point 3



Velocity Spectrum in Vertical Point 3

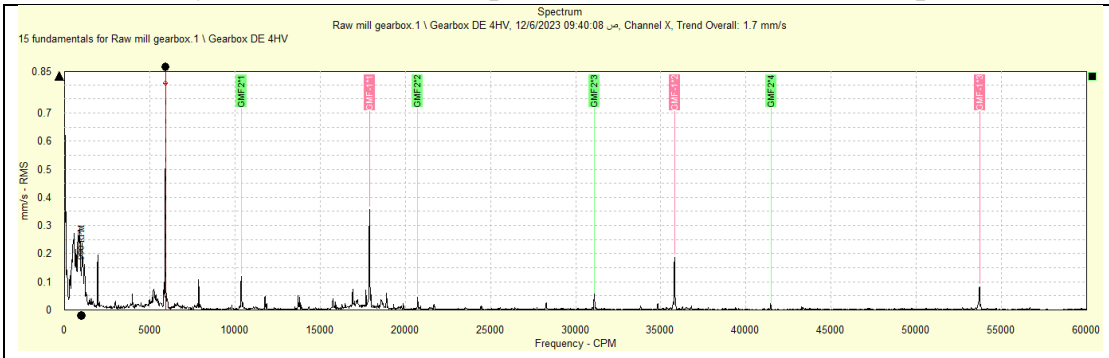


Time wave in Vertical Point 3

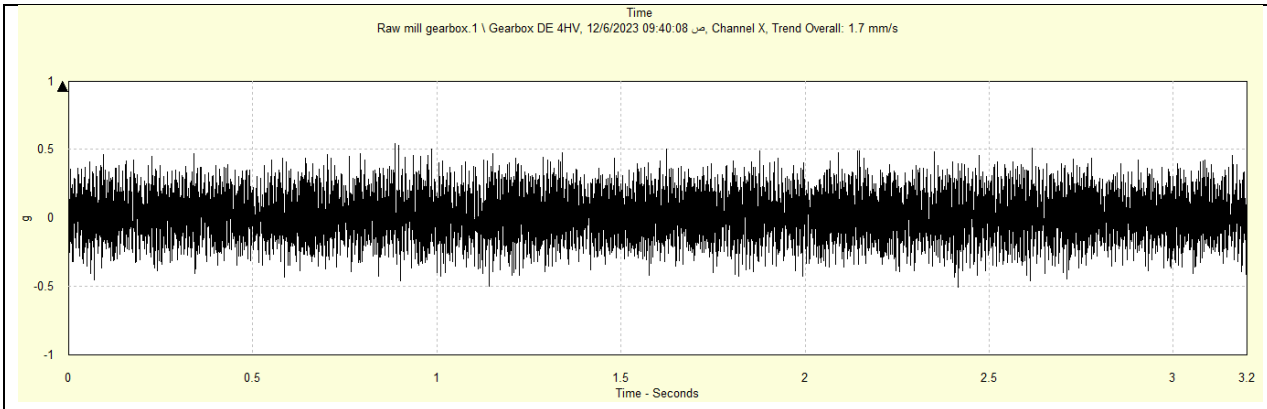


Velocity Spectrum in Axial Point 3

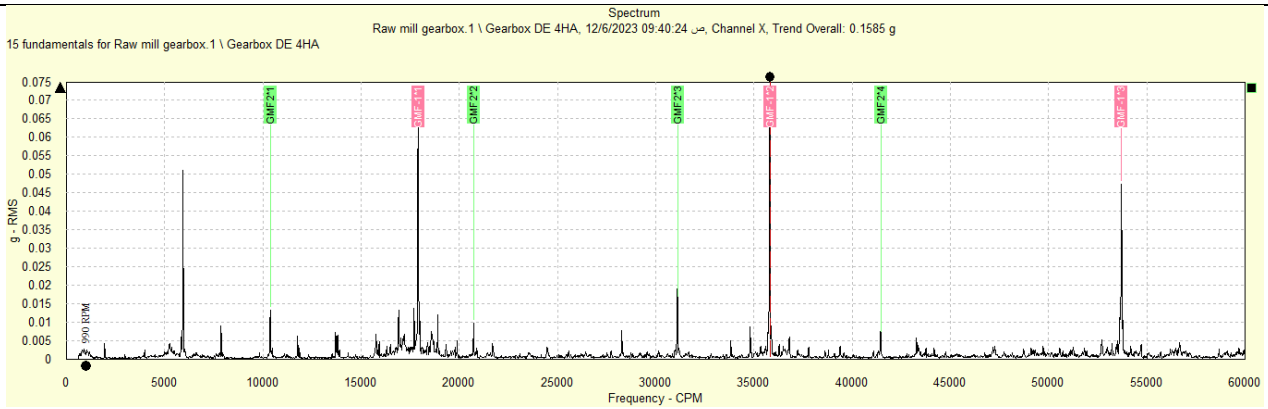
5.3.2 Velocity and acceleration spectrums and time waves in point 4



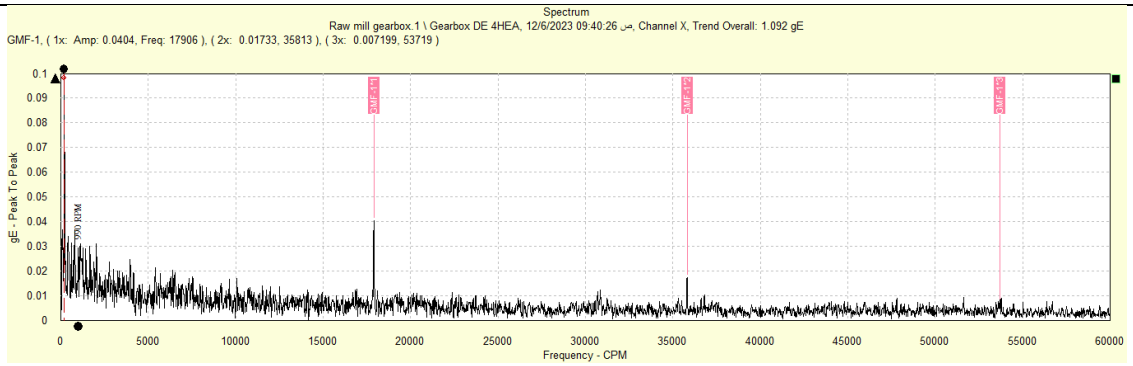
Velocity Spectrum in Horizontal Point 4



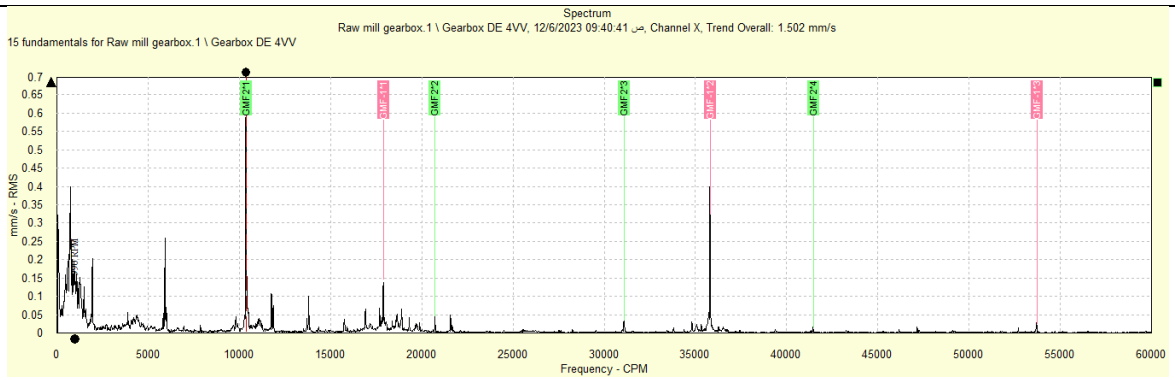
Time wave in Horizontal Point 4



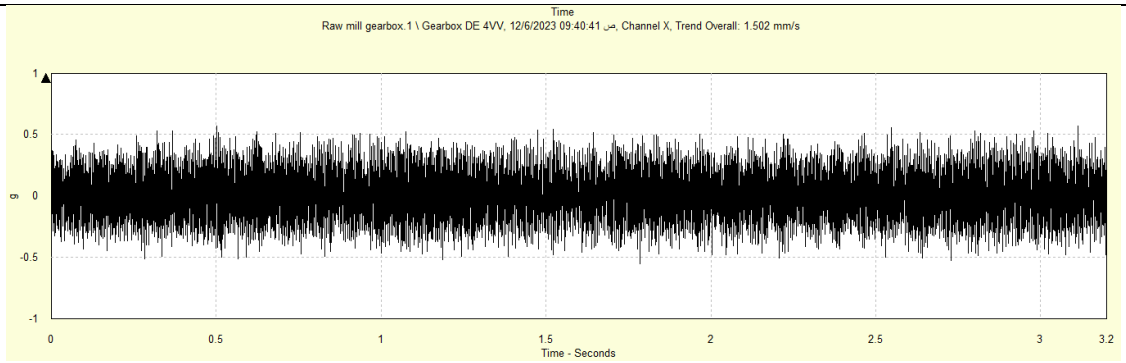
Acceleration Spectrum in Horizontal Point 4



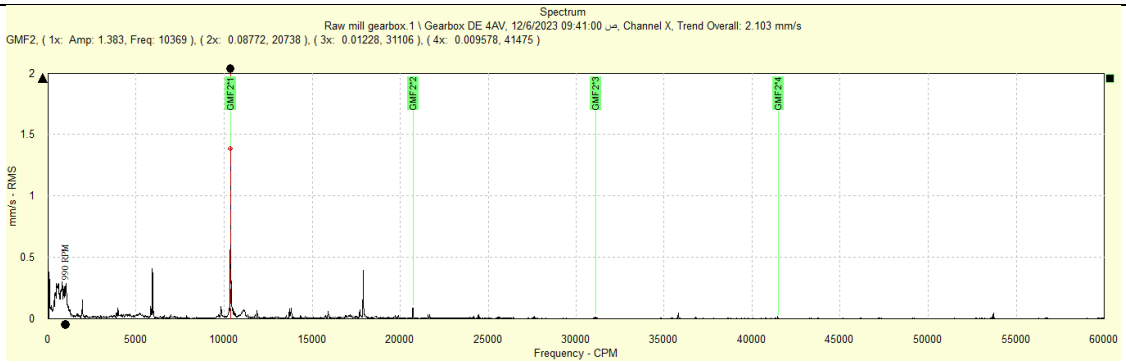
Envelope Acceleration Spectrum in Horizontal Point 4



Velocity Spectrum in Vertical Point 4

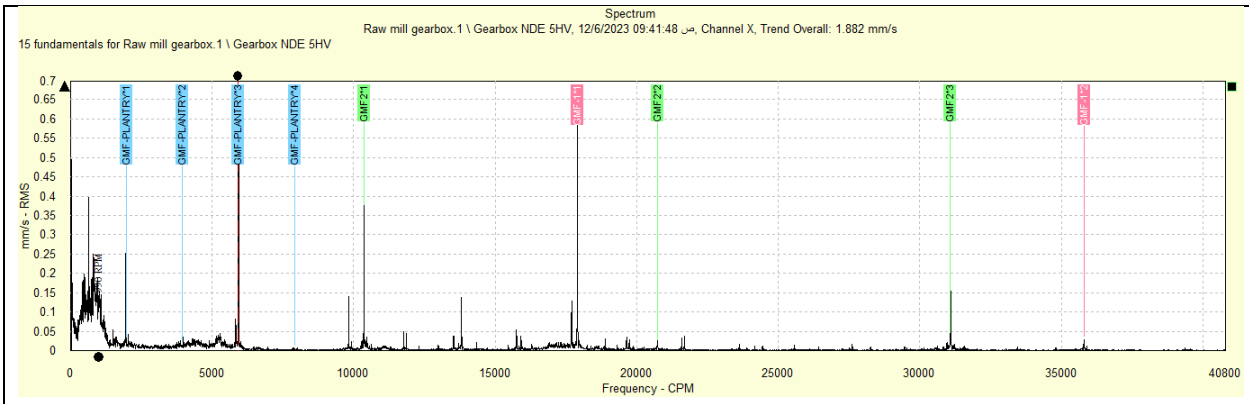


Time wave in Vertical Point 4

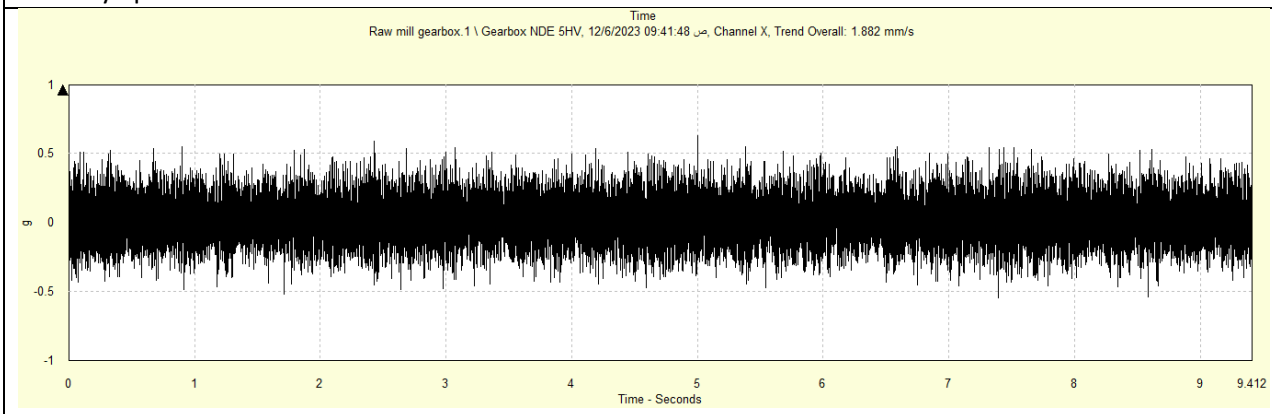


Velocity Spectrum in Axial Point 4

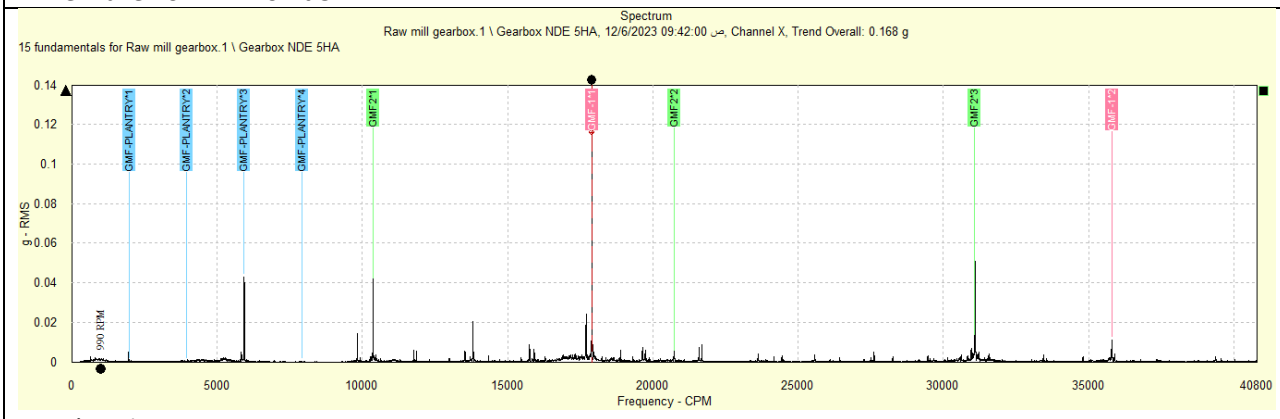
5.3.3 Velocity and acceleration spectrums and time wave in point 5



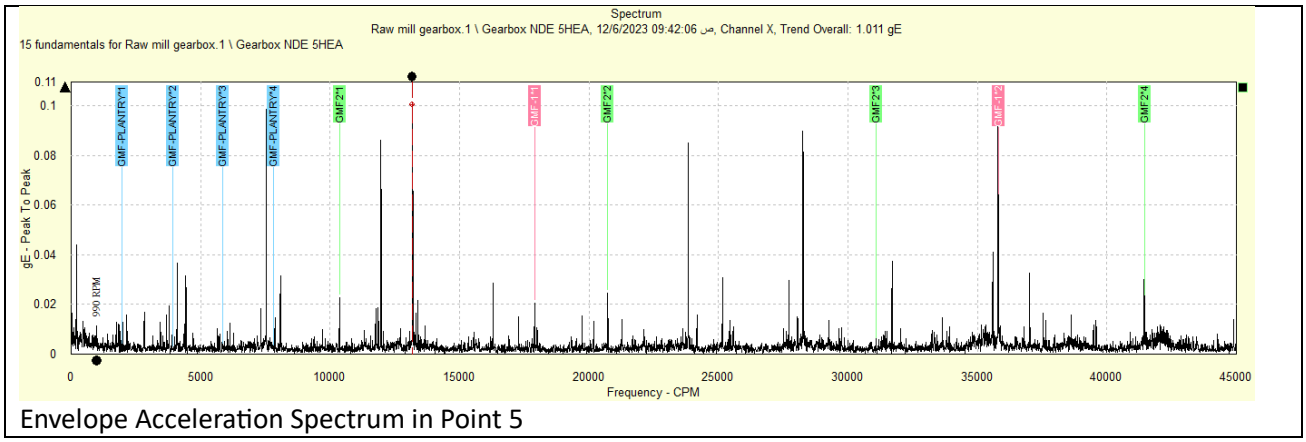
Velocity Spectrum in Point 5



Time wave Form in Point 5

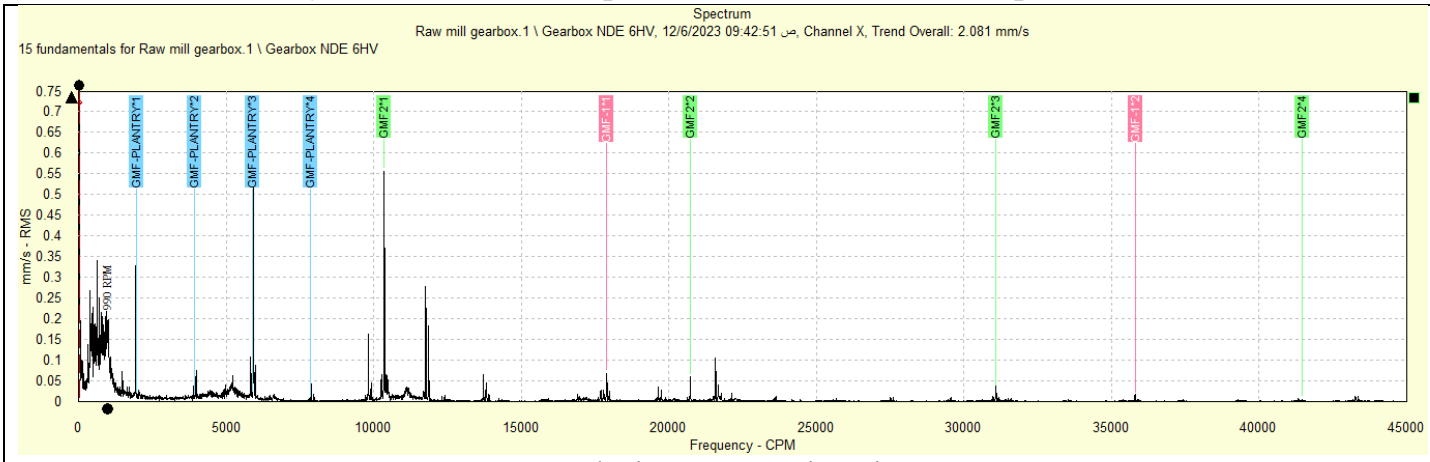


Acceleration Spectrum in Point 5

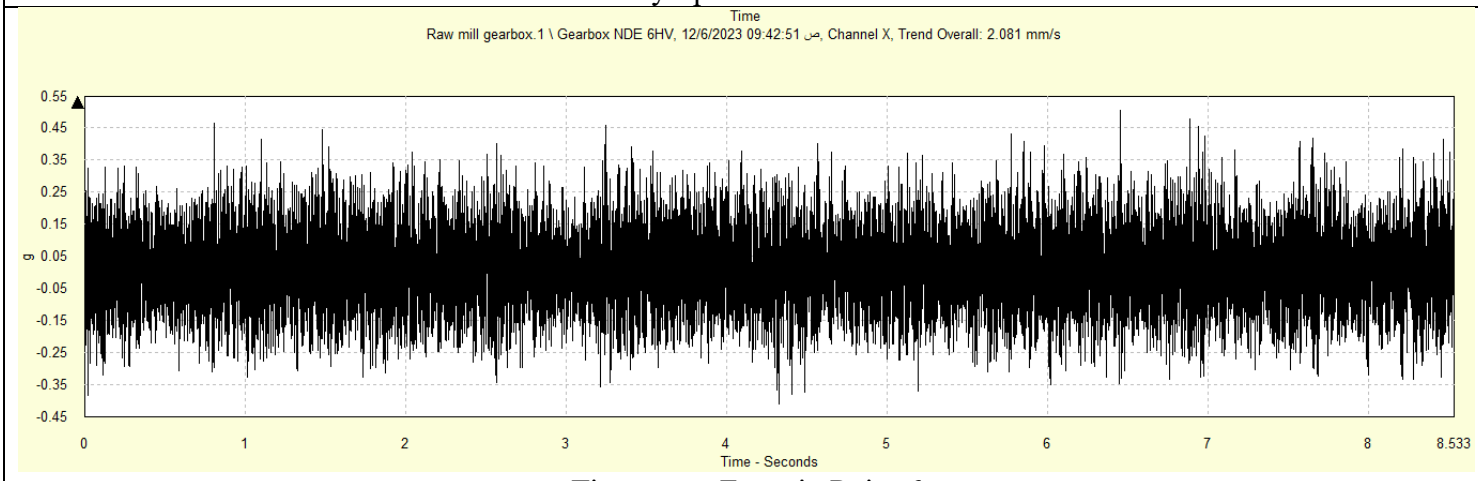


Envelope Acceleration Spectrum in Point 5

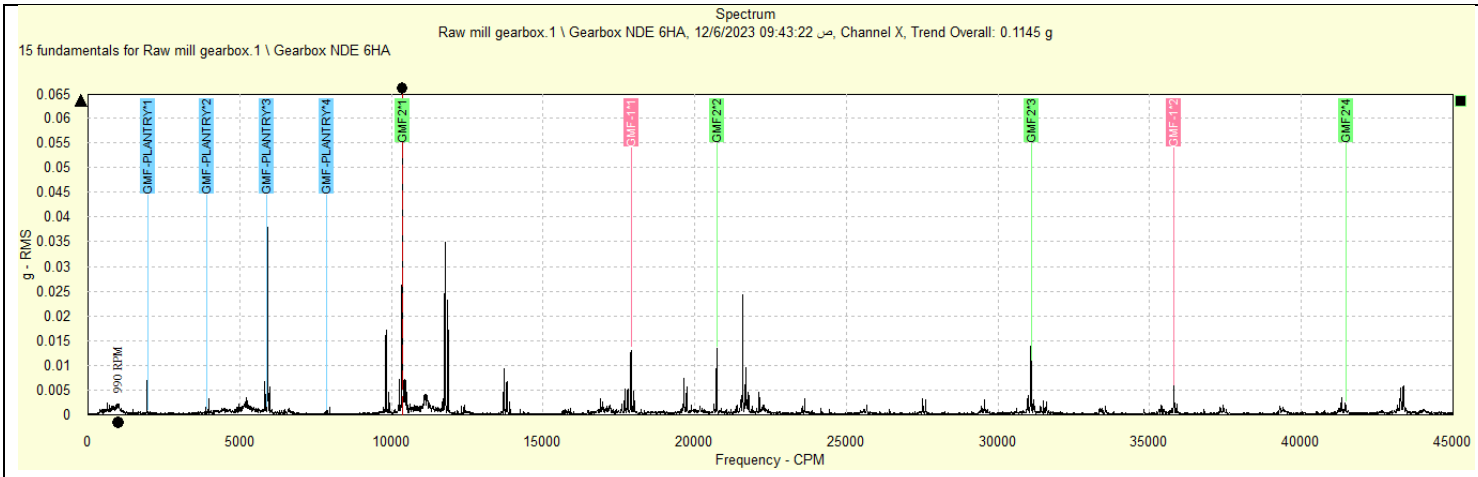
5.3.4 Velocity and acceleration spectrums and time wave in point 6



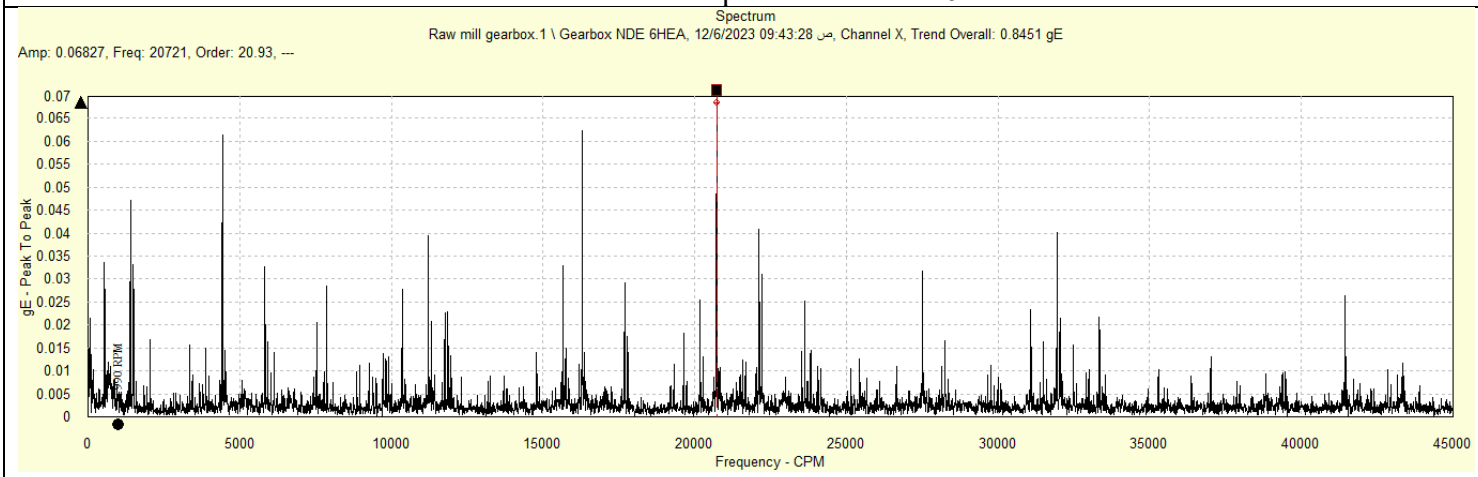
Velocity Spectrum in Point 6



Time wave Form in Point 6

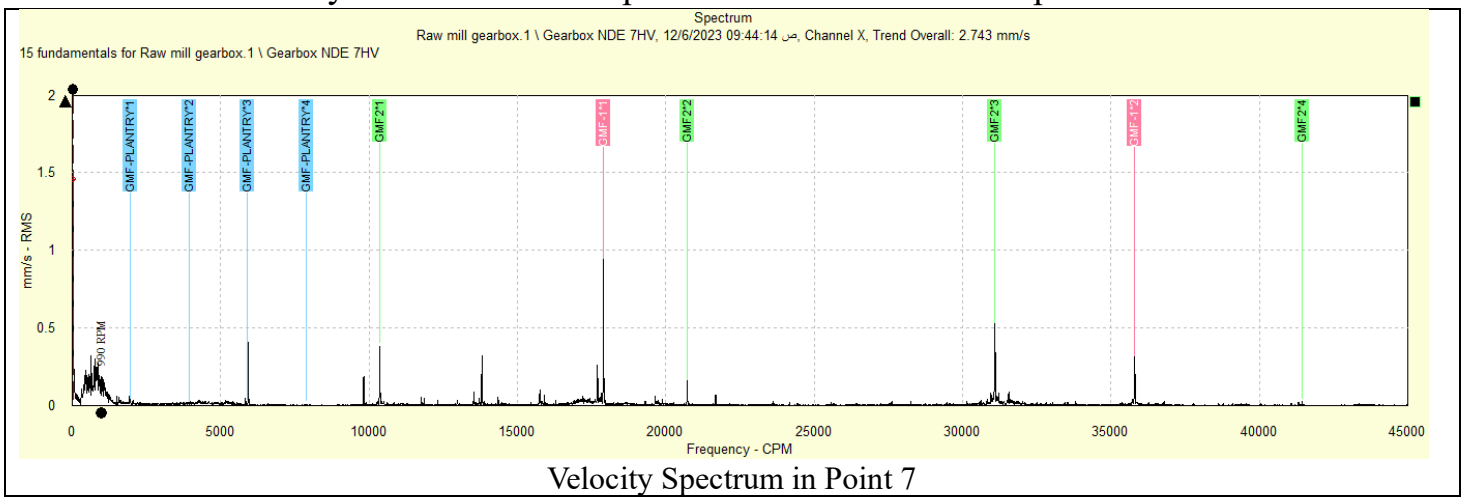


Acceleration Spectrum in Point 6

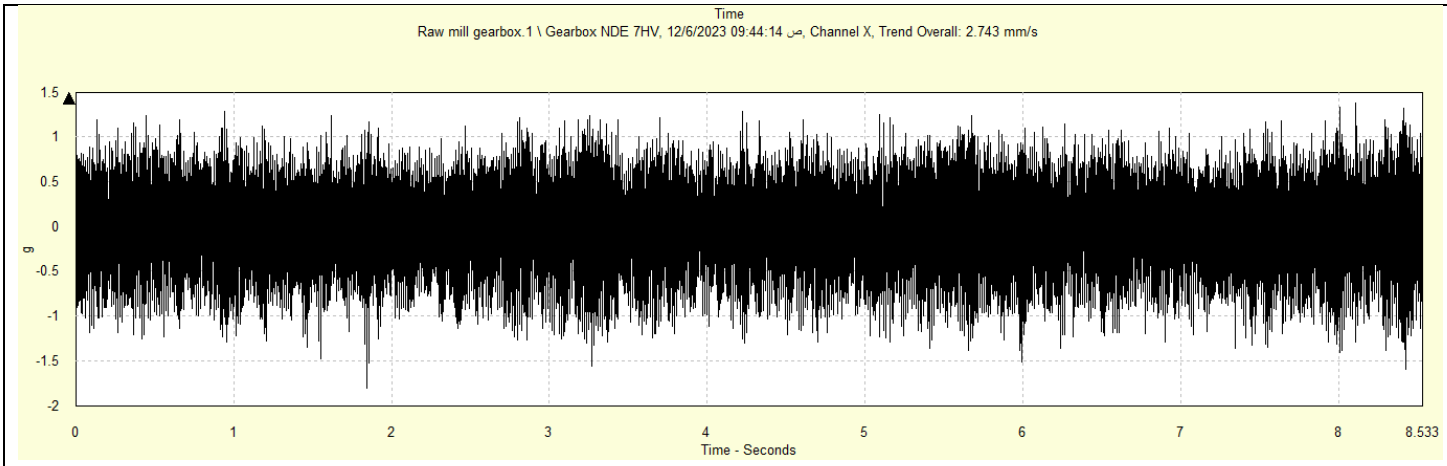


Envelope Acceleration Spectrum in Point 6

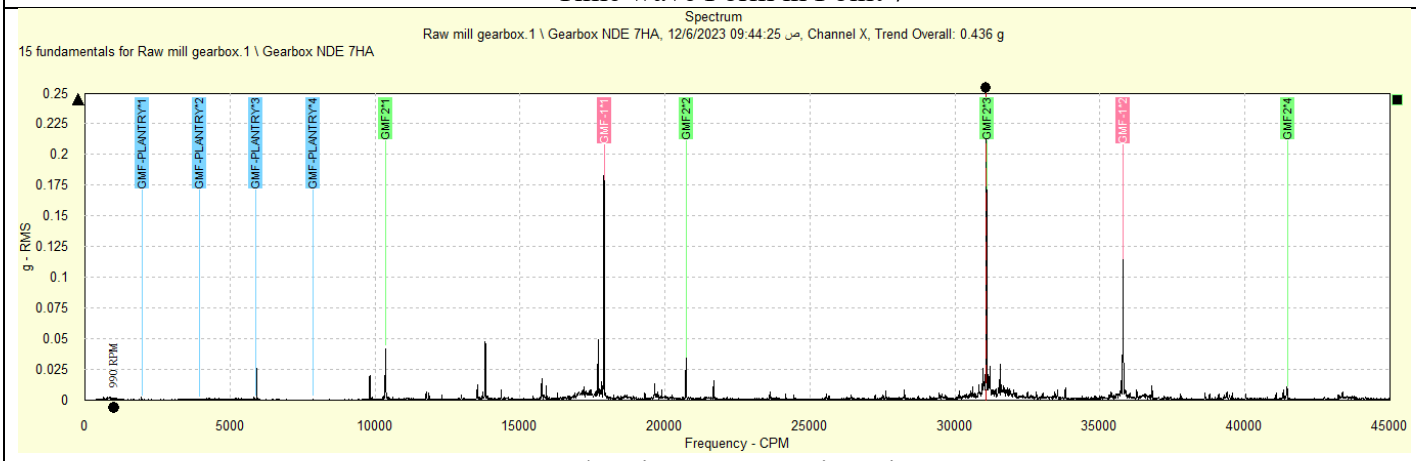
5.3.5 Velocity and acceleration spectrums and time wave in point 7



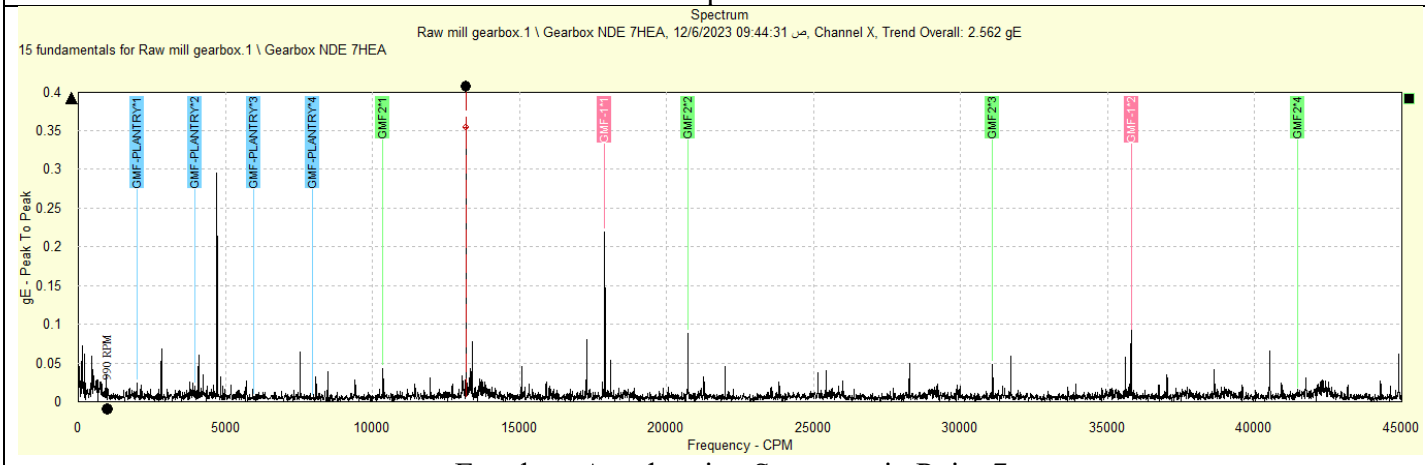
Velocity Spectrum in Point 7



Time wave Form in Point 7

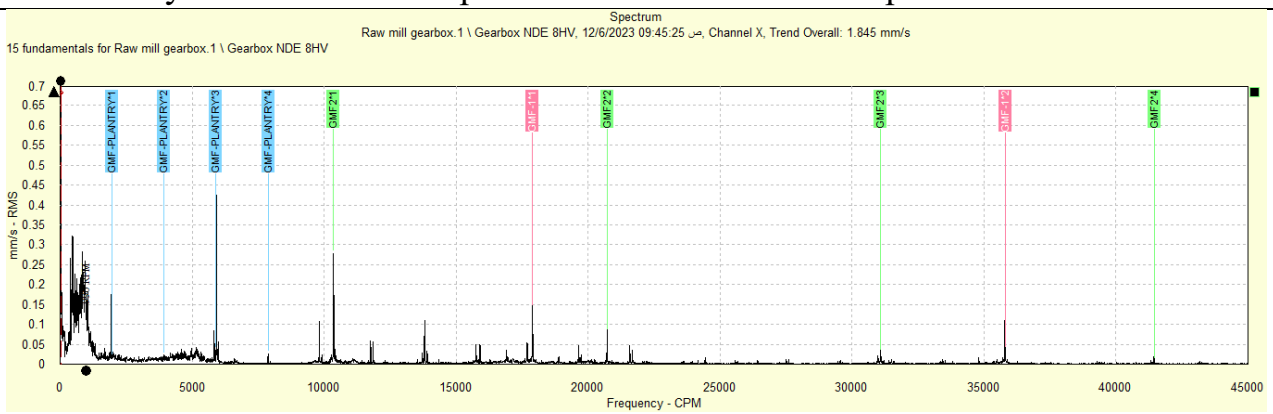


Acceleration Spectrum in Point 7

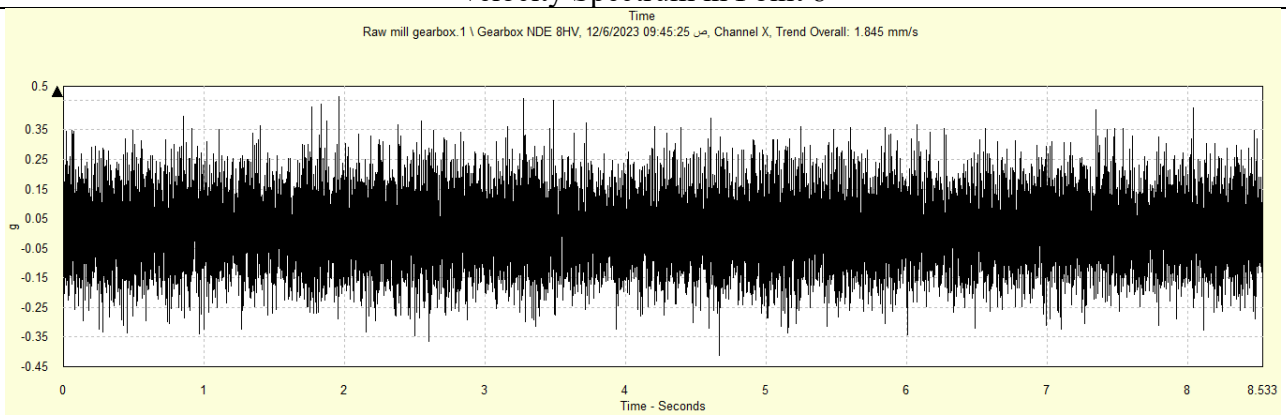


Envelope Acceleration Spectrum in Point 7

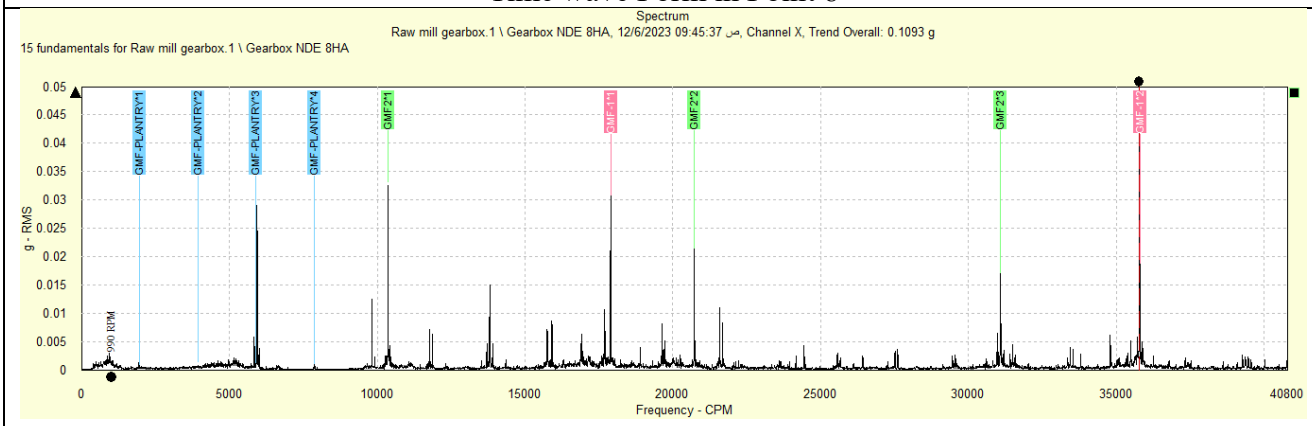
5.3.6 Velocity and acceleration spectrums and time waves in point 8



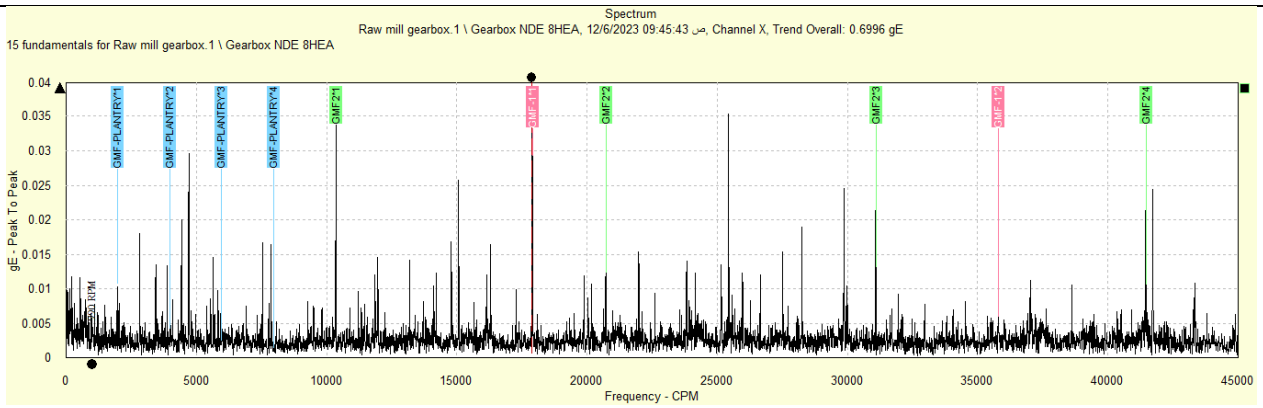
Velocity Spectrum in Point 8



Time wave Form in Point 8



Acceleration Spectrum in Point 8



Envelope Acceleration Spectrum in Point 8

6. Infrared Thermography Images

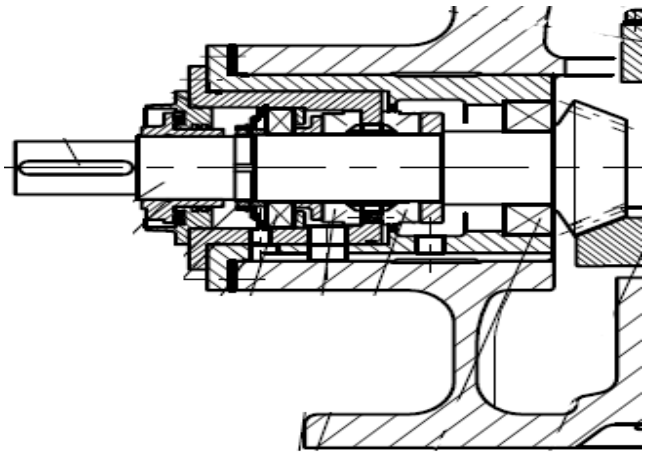
Infrared thermography images collected by FLUKE Tis 20+ Thermal imager.

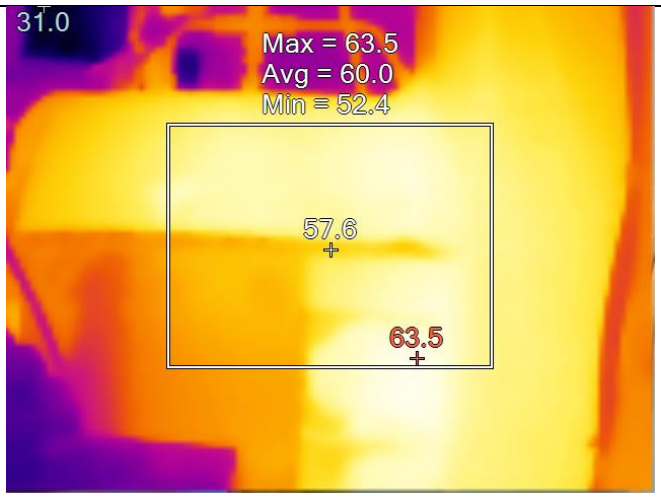
- **Desirable**: Component is 10-24°C (18-75°F) above ambient (normal)
- Important: Component is 25-39°C (77-102°F) above ambient (normal)
- Mandatory: Component is 40-69°C (104-156°F) above ambient (normal)
- **Immediate**: Component is 70°C (158°F) or more above ambient (normal)

Severity Criteria for Temperature Ranges

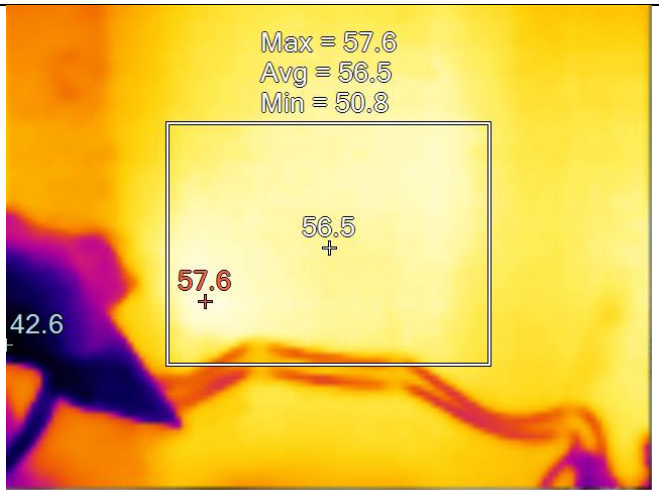
In our condition the ambient temperature is 30 ° C the difference in second range 25-39 ° C.

Cross section in Gearbox	Thermal Image

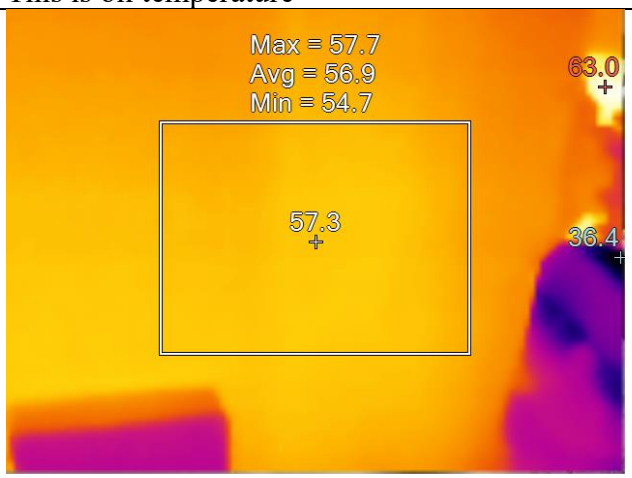




The difference temperature in bearings area less than 5 °C.



This is oil temperature



7. Oil Analysis

The oil sample taken from return pipe after oil filter and by Ferro check 2200 the ferrous counter is **13 ppm**

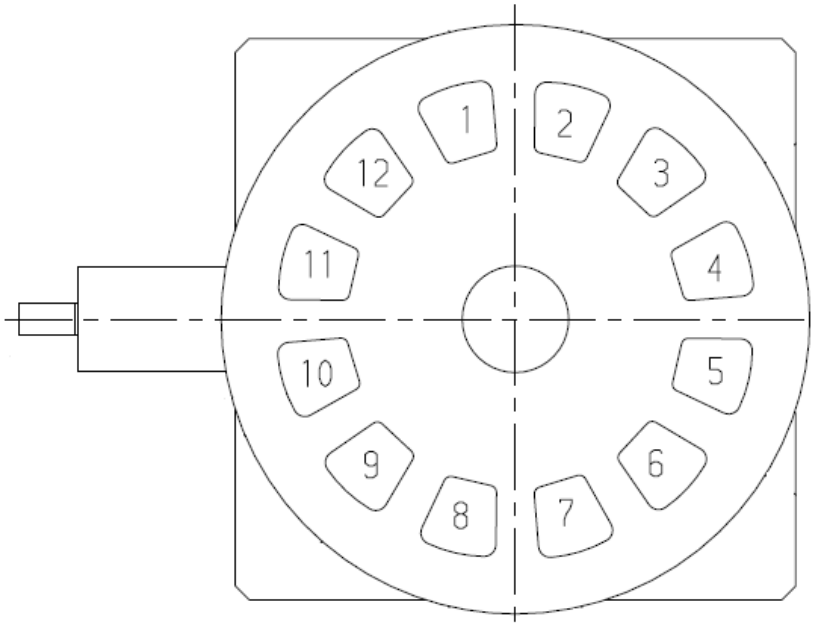
8. Axial Tilting-pad Thrust Bearings

An axial tilting-pad thrust bearing is fitted in the upper section of the housing to absorb the high axial load from the grinding process. The axial tilting-pad thrust bearing is designed for hydrostatic lubrication and has a low specific surface load. All the pads of the axial tilting-pad thrust bearings are mounted on spherical members to enable free adjustability at any level. This compensates for manufacturing tolerances and housing deformation. The tilting pads have an optimum length-to-width ratio and a support displaced in the direction of rotation.

Alarms pressure for these pads as manual

Mill stop

1. If 4 pressure transmitter < 15 bar
2. If 2 pressure transmitter placed side by side < 15 bar



Tilting- pad Thrust Bearings

The Pressure of Tilting Pads in CCR	
Position Tilting Pads	Pressure, bar
Tilting Pad No.01	55
Tilting Pad No.02	63
Tilting Pad No.03	68
Tilting Pad No.04	81
Tilting Pad No.05	40
Tilting Pad No.06	55
Tilting Pad No.07	20

Tilting Pad No.08	54
Tilting Pad No.09	52
Tilting Pad No.10	59
Tilting Pad No.11	64
Tilting Pad No.12	71

From above the pressure in pad 07 range to 17 bar and in pad 05 range to 29 bar.

9. Conclusion

From all above points we conclusion the following:

1- The Input shaft bearings and gear in good condition
2- The other internal gears and bearings need external helping to good assessment them due to difficult depend in vibration readings them only because bad mechanical transmission path of signal.
3- The tilting pads till now acceptable range but need also external helping to assessment them.