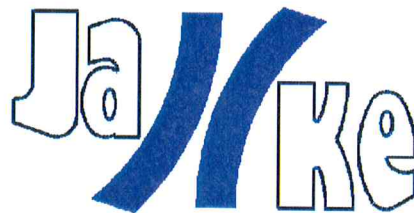


Technical report
of
inspection on gearbox PPSC1290-A115



Jahnel – Kestermann
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Technical Report
PPSC1290-A115 / 222881 03 01

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1. Project description

This document presents the results of the inspection on gearbox type PPSC1290-A115.

Gearbox Data

Gearbox Type	PPSC1290-A115
Ja)(Ke order	222811
Ja)(Ke serial no.	222811 03 01
Rated Power	1775 kW
Licensee	Templeton Municipal Light and Water Plant
Location	Baldwinville, MA, USA
Date of inspection	March 15. 2013

2. Description of findings

In gearbox PPSC1290-A115 the planetary stages are only accessible with the use of borescope. All pictures presented in the inspection report [1] are taken with a borescope.

3. Inspection of Exxon Mobil

A service engineer of Exxon Mobil inspected the gearbox on February 6. 2013. The pictures indicate a loose mesh between planet and ring gear of the intermediate planetary stage, see Picture 1. Dark lines in radial direction on the tooth flank are presented in Picture 2. These lines are visible on the ring gear of the main planetary stage and the intermediate planetary stage.

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Picture 1: Intermediate gear mesh, planet- ring gear



Picture 2: Intermediate gear mesh, ring gear

On the ring gear of the main stage a grey area on the flank is visible, see Picture 3.



Picture 3: Main gear mesh, ring gear

4. Evaluation of findings

All accessible gear stages and bearings are in a good condition. Additional to the visual examination a vibration measurement was performed. The evaluation of the measurement, see [2], confirms the result of the visual examination.

The gear mesh of planet and ring gear of the intermediate planetary stage is slight loose, but the function of the mesh is not restricted.

Dark lines in radial direction on the tooth flank are a typical result of the machining process of the ring gear. The machining process of the ring gear only includes milling. No surface hardening or grinding is applied.

The grey area on the flank of the ring gear of the main planetary stage seems to be a reflection caused by the lubricant.

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PPSC1290-A115 / 222881 03 01

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5. Conclusions / Recommendations

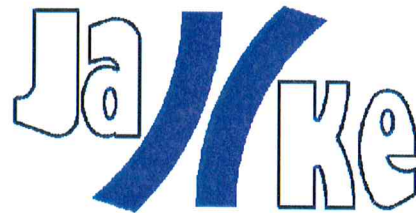
The visual inspection as well as the vibration measurement indicates a good condition of the gearbox. For the whole gearbox no special action is recommended.

6. References

- [1] Servicebericht für PPSC1290-A115 222811.03.01, 08.04.2013, Jahnel-Kestermann
- [2] Technical report of vibration measurement on gearbox PPSC1290-A115, 08.04.2013, Jahnel-Kestermann

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Technical report
of
vibration measurement on gearbox PPSC1290-A115



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Technical Report PPSC1290-A115

Jahnel-Ke

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D - 44789 Bochum

1. Project description

This document presents the results of the vibration measurement on gearbox type PPSC1290-A115.

Gearbox Data

Gearbox Type	PPSC1290-A115
Ja)(Ke order	222811
Ja)(Ke serial no.	2228110301
Rated Power	1775 kW
Licensee	Templeton Municipal Light and Water Plant
Location	Baldwinville, MA, USA
Date of measurement	March 15. 2013

Measurement equipment

Measurement system	Schenck VIBRO Test 60
Accelerometer	Schenck AS-060
Software	Brüel&Kjaer Vibro, Vibro Report

2. Description of measurements

The Vibrations of the gearbox were measured while the turbine was in power production. During the measurement the power and the rotational speed varied.

The measurements are stored as effective vibration level. Additional spectra of the vibration velocity in a range of 1 Hz to 2000 Hz are recorded.

The accelerometer was connected by magnetic clamps at the positions listed in Table 1. Additional pictures of the measurement positions are presented in Appendix A.

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Welle / shaft	Position / position	x- Richtung (axial)	y- Richtung (horiz.)	z- Richtung (vertik.)
Getriebeabstützung gear support	rotorseitig 3 Uhr rotorside 3 o'clock	V1x	V1y	V1z
Antriebswelle input shaft	Deckel cover	V2x	V2y	V2z
Abtriebswelle output shaft	generatorseitig generator side	V3x	V3y	V3z

Table 1: Positions of the accelerometer

2.1. Measurement results

2.2. Vibration level measurement

The measured effective vibration levels as well as the average power during the measurement are presented in Table 2.

Position	Power [kW]	Vibration level [mm/s]
V1x	113	0.22
V1y	113	0.25
V1z	113	0.42
V2x	450	0.25
V2y	450	0.36
V2z	450	0.79
V3x	450	0.40
V3y	450	0.80
V3z	450	0.44

Table 2: Vibration level

Limits for the vibration level of gearboxes in wind turbines are given in VDI 3834 [1]. The upper limit for a gearbox in a good condition, which is suitable to run in continuous production, is 3.5 mm/s.

All vibration levels are below the limit given in VDI3834.

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2.3. Vibration spectra

The spectra of the vibration measured at the positions listed in Table 1 are presented in Appendix B. Vibrations which are caused by the measurement system are excluded from the evaluation. The vibration velocity which is related to the gearbox is small. The highest peak is about 0.32 mm/s at 1703Hz, measured at the output shaft in vertical direction.

3. Conclusions

According to the vibration measurement the gearbox is in good condition. At every position the vibration level are below the limit given in VDI3834. The vibration spectra not give any indication for a defect.

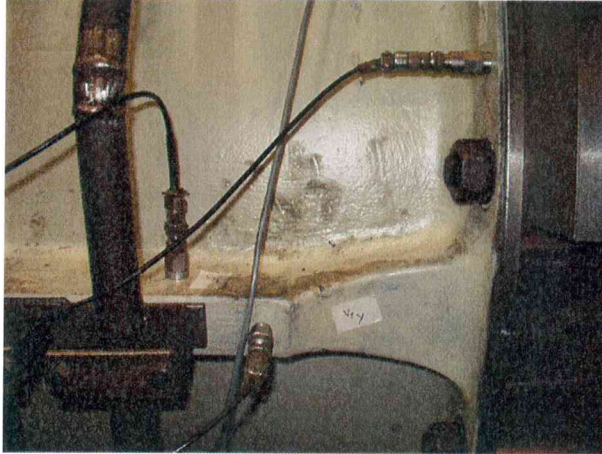
4. References

- [1] VDI3834, Measurement and evaluation of the mechanical vibration of wind energy turbines and their components, March 2009, Beuth Verlag GmbH

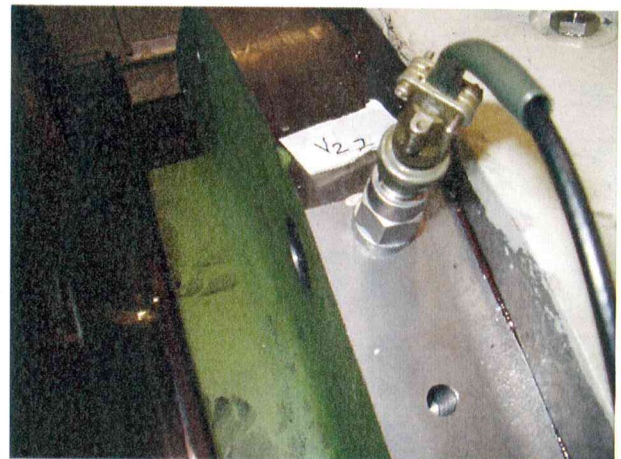
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5. Appendix A

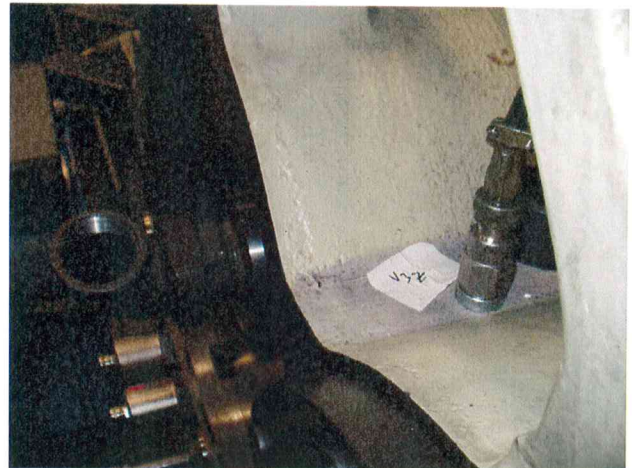
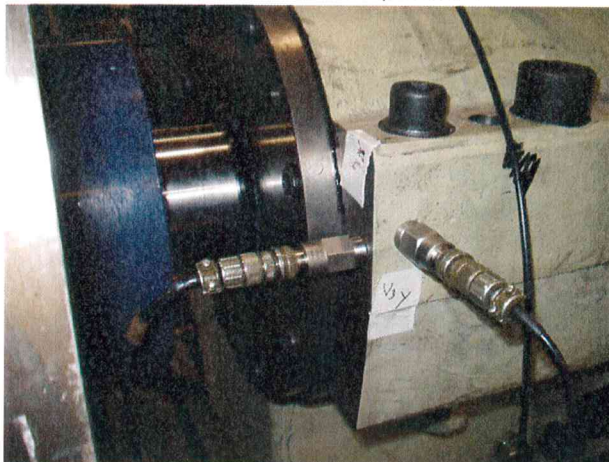
Measurement positions at the gear support



Measurement positions at the input shaft

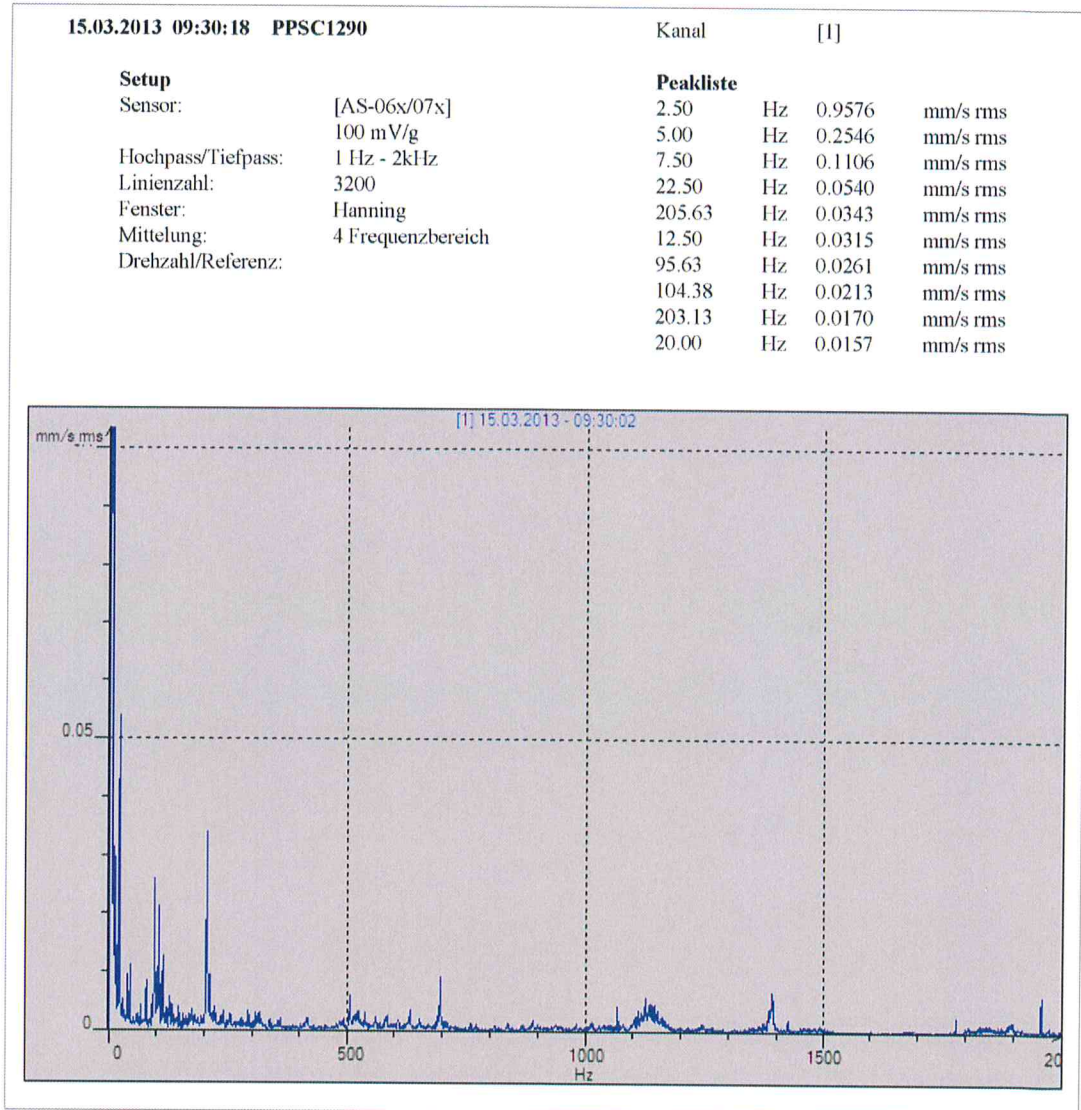


Measurement positions at the output shaft



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6. Appendix B



Position V1x: gear support, axial

15.03.2013 09:40:17 PPSC1290

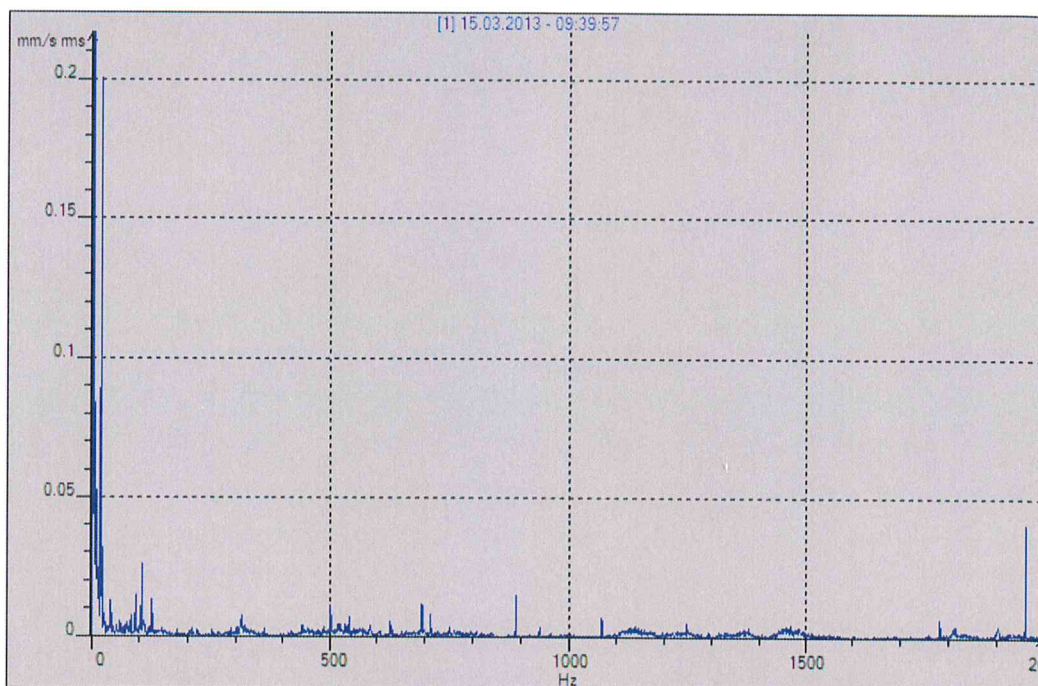
Kanal [1]

Setup

 Sensor: [AS-06x/07x]
 100 mV/g
 Hochpass/Tiefpass: 1 Hz - 2kHz
 Linienzahl: 3200
 Fenster: Hanning
 Mittelung: 4 Frequenzbereich
 Drehzahl/Referenz:

Peakliste

Peak	Hz	Amplitude	Unit
2.50	Hz	0.7865	mm/s rms
20.00	Hz	0.2003	mm/s rms
7.50	Hz	0.0840	mm/s rms
11.88	Hz	0.0527	mm/s rms
1960.00	Hz	0.0403	mm/s rms
22.50	Hz	0.0313	mm/s rms
104.38	Hz	0.0257	mm/s rms
14.38	Hz	0.0243	mm/s rms
890.63	Hz	0.0149	mm/s rms
91.88	Hz	0.0144	mm/s rms



Position V1y: gear support, horizontal

15.03.2013 09:50:53 PPSC1290

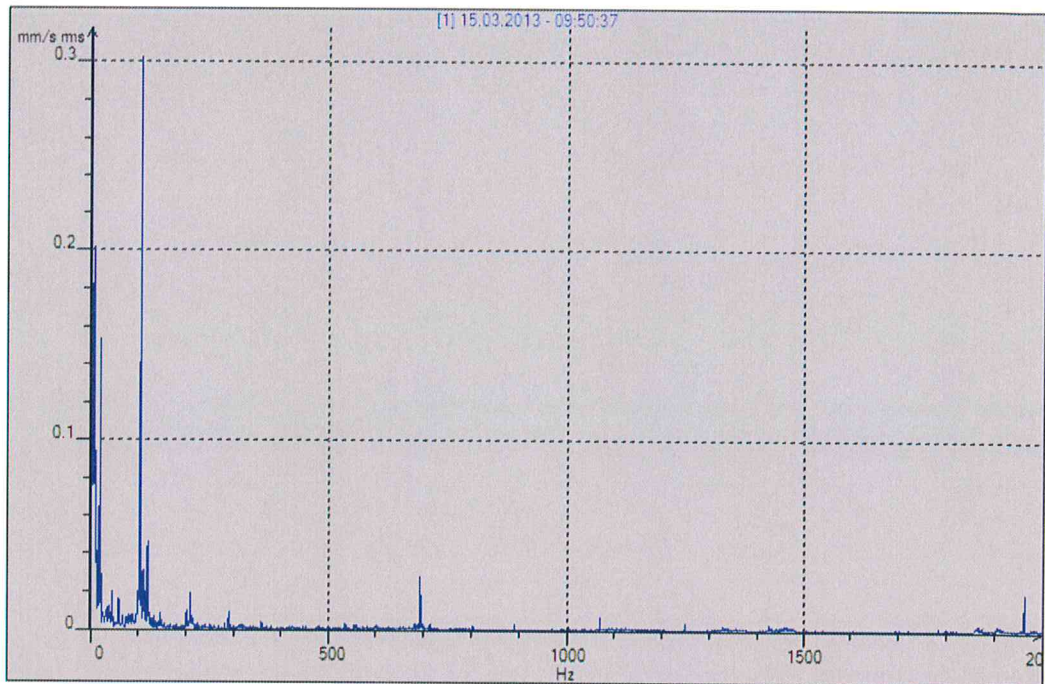
Kanal [1]

Setup

 Sensor: [AS-06x/07x]
 100 mV/g
 Hochpass/Tiefpass: 1 Hz - 2kHz
 Linienzahl: 3200
 Fenster: Hanning
 Mittelung: 4 Frequenzbereich
 Drehzahl/Referenz:

Peakliste

Peak	Hz	mm/s rms
1.88	Hz	0.3915
104.38	Hz	0.3025
6.88	Hz	0.2020
20.00	Hz	0.1538
8.75	Hz	0.1212
11.88	Hz	0.0943
120.00	Hz	0.0461
101.25	Hz	0.0435
15.63	Hz	0.0411
106.88	Hz	0.0346



Position V1z: gear support, vertical

15.03.2013 18:04:04 PPSC1290

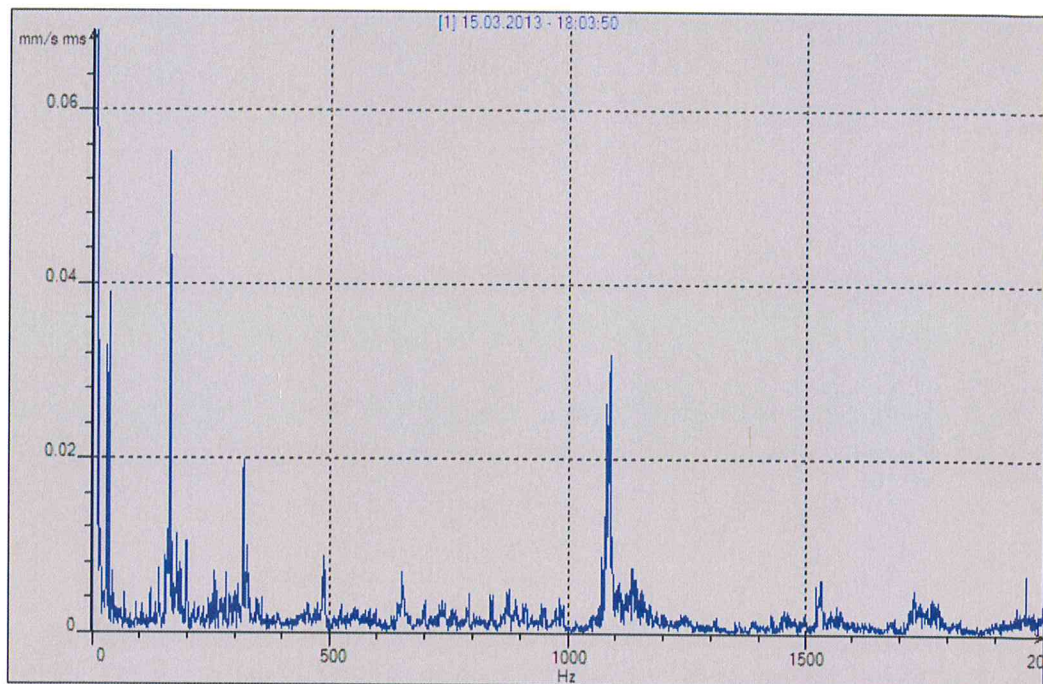
Kanal [1]

Setup

 Sensor: [AS-06x/07x]
 100 mV/g
 Hochpass/Tiefpass: 1 Hz - 2kHz
 Linienzahl: 3200
 Fenster: Hanning
 Mittelung: 4 Frequenzbereich
 Drehzahl/Referenz:

Peakliste

Peak	Frequency (Hz)	Amplitude (mm/s rms)
1	2.50	1.3653
2	5.00	0.2625
3	8.75	0.1131
4	163.13	0.0552
5	12.50	0.0397
6	35.00	0.0390
7	31.25	0.0329
8	1088.13	0.0320
9	1079.38	0.0264
10	1083.13	0.0239



Position V2x: input shaft, axial

15.03.2013 18:09:36 PPSC1290

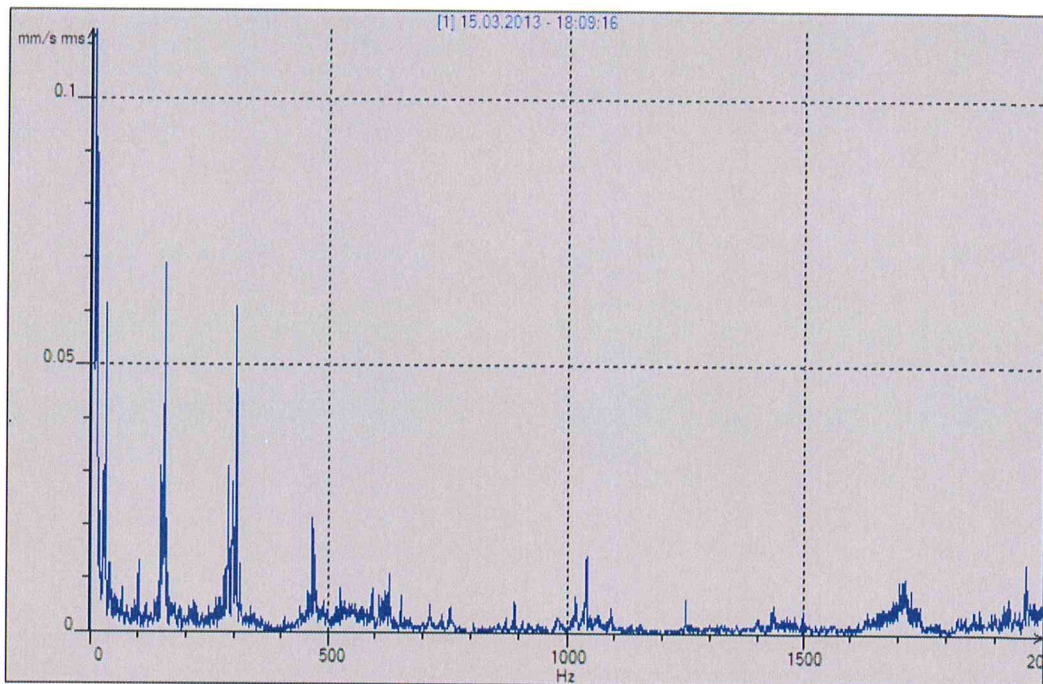
Kanal [1]

Setup

 Sensor: [AS-06x/07x]
 100 mV/g
 Hochpass/Tiefpass: 1 Hz - 2kHz
 Linienzahl: 3200
 Fenster: Hanning
 Mittelung: 4 Frequenzbereich
 Drehzahl/Referenz:

Peakliste

Peak	Hz	mm/s rms
1.88	Hz	1.6808
6.25	Hz	0.5019
11.88	Hz	0.0927
13.13	Hz	0.0898
156.25	Hz	0.0691
33.13	Hz	0.0616
304.38	Hz	0.0610
10.00	Hz	0.0553
152.50	Hz	0.0426
15.63	Hz	0.0363



Position V2y: input shaft, horizontal

15.03.2013 18:13:06 PPSC1290

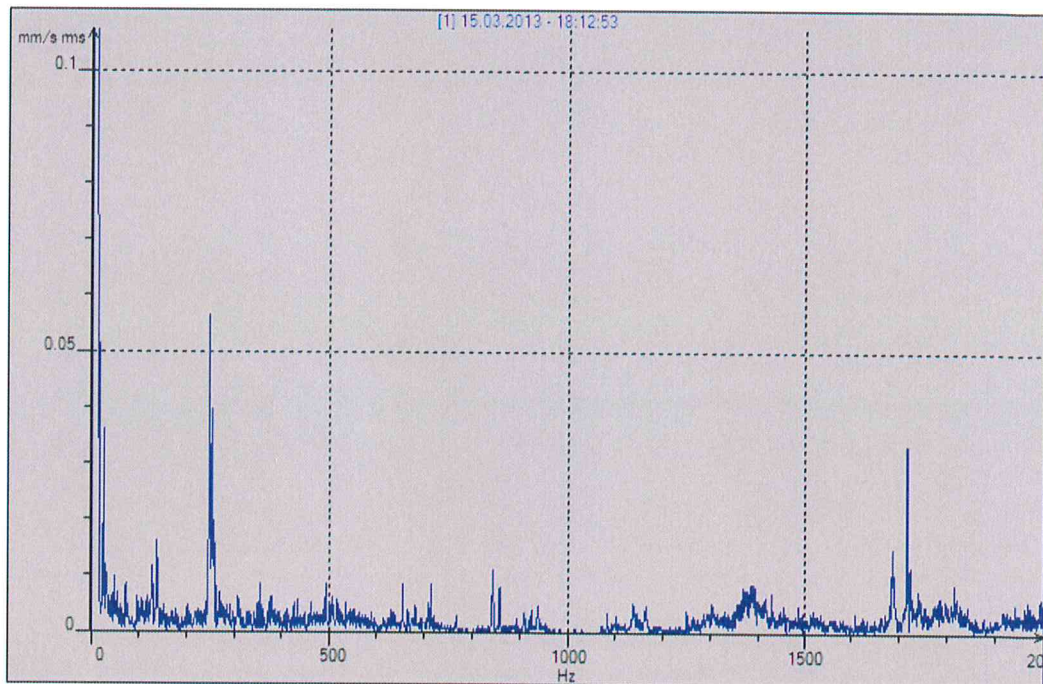
Kanal [1]

Setup

 Sensor: [AS-06x/07x]
 100 mV/g
 Hochpass/Tiefpass: 1 Hz - 2kHz
 Linienzahl: 3200
 Fenster: Hanning
 Mittelung: 4 Frequenzbereich
 Drehzahl/Referenz:

Peakliste

Frequency (Hz)	Amplitude (mm/s rms)
1.88	1.4039
6.25	0.5192
9.38	0.1491
15.63	0.0616
247.50	0.0564
253.13	0.0397
27.50	0.0363
251.25	0.0334
257.50	0.0196
24.38	0.0190



Position V2z: input shaft, vertical

15.03.2013 18:16:49 PPSC1290

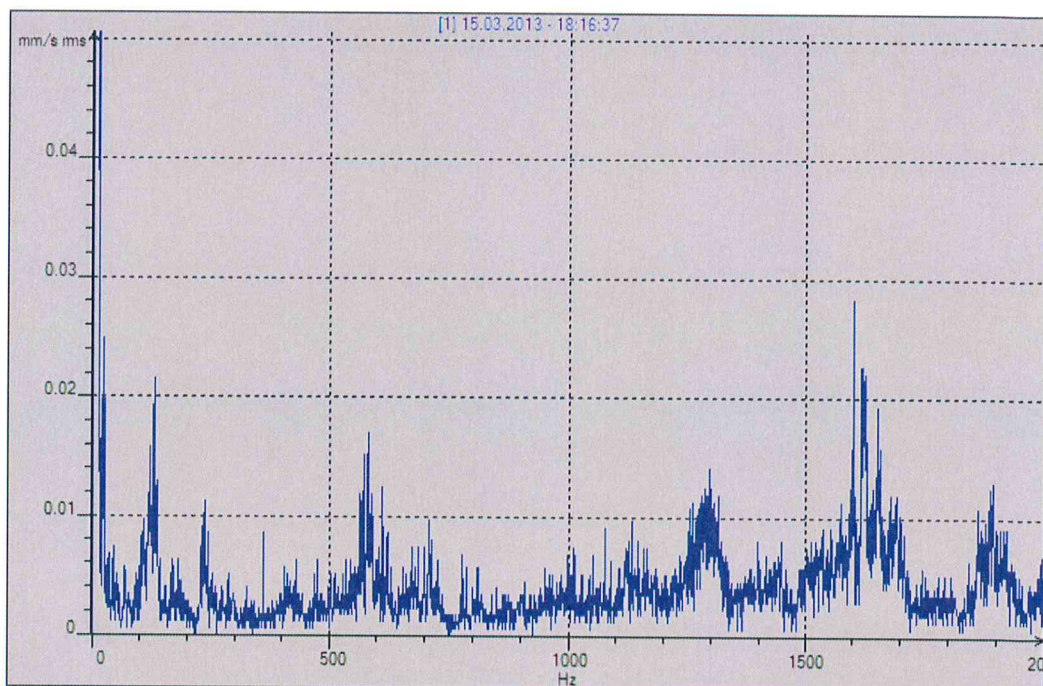
Kanal [1]

Setup

 Sensor: [AS-06x/07x]
 100 mV/g
 Hochpass/Tiefpass: 1 Hz - 2kHz
 Linienzahl: 3200
 Fenster: Hanning
 Mittelung: 4 Frequenzbereich
 Drehzahl/Referenz:

Peakliste

Peak	Hz	mm/s rms
2.50	Hz	1.1404
4.38	Hz	0.4546
7.50	Hz	0.1298
6.25	Hz	0.1054
12.50	Hz	0.0697
1601.25	Hz	0.0283
15.00	Hz	0.0249
22.50	Hz	0.0249
1626.88	Hz	0.0221
129.38	Hz	0.0215



Position V3x: output shaft, axial

15.03.2013 18:21:10 PPSC1290

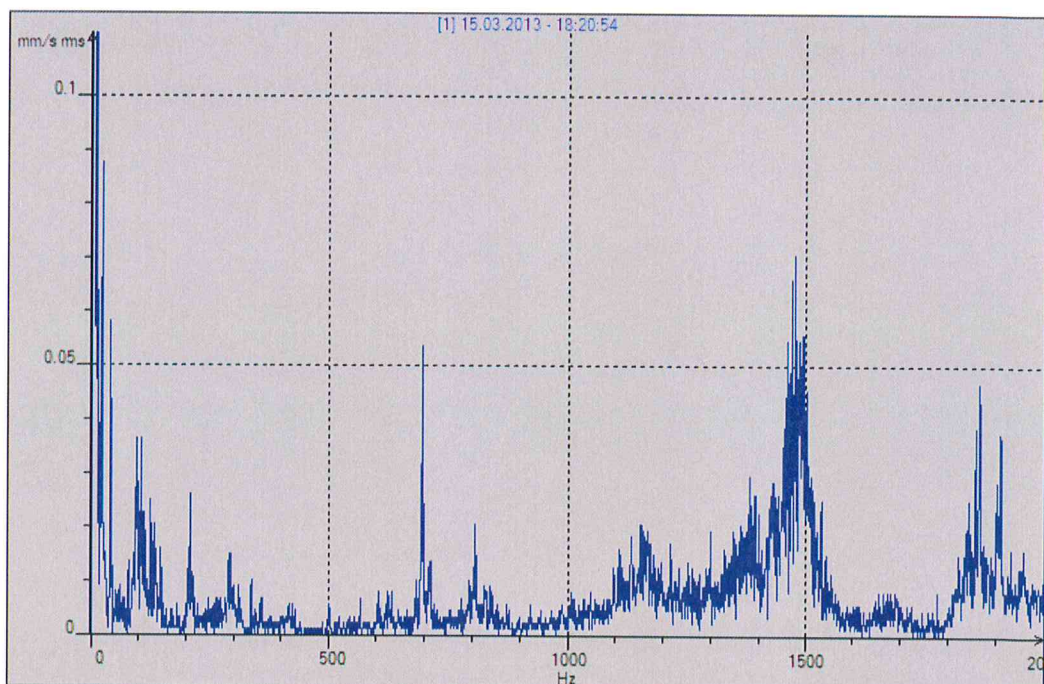
Kanal [1]

Setup

 Sensor: [AS-06x/07x]
 100 mV/g
 Hochpass/Tiefpass: 1 Hz - 2kHz
 Linienzahl: 3200
 Fenster: Hanning
 Mittelung: 4 Frequenzbereich
 Drehzahl/Referenz:

Peakliste

Peak	Hz	mm/s rms
1.88	Hz	3.7226
3.75	Hz	0.6703
5.63	Hz	0.2683
10.00	Hz	0.1439
7.50	Hz	0.1427
22.50	Hz	0.0879
1479.38	Hz	0.0708
1473.75	Hz	0.0662
15.00	Hz	0.0639
40.00	Hz	0.0582



Position V3y: output shaft, horizontal

15.03.2013 18:36:10 PPSC1290

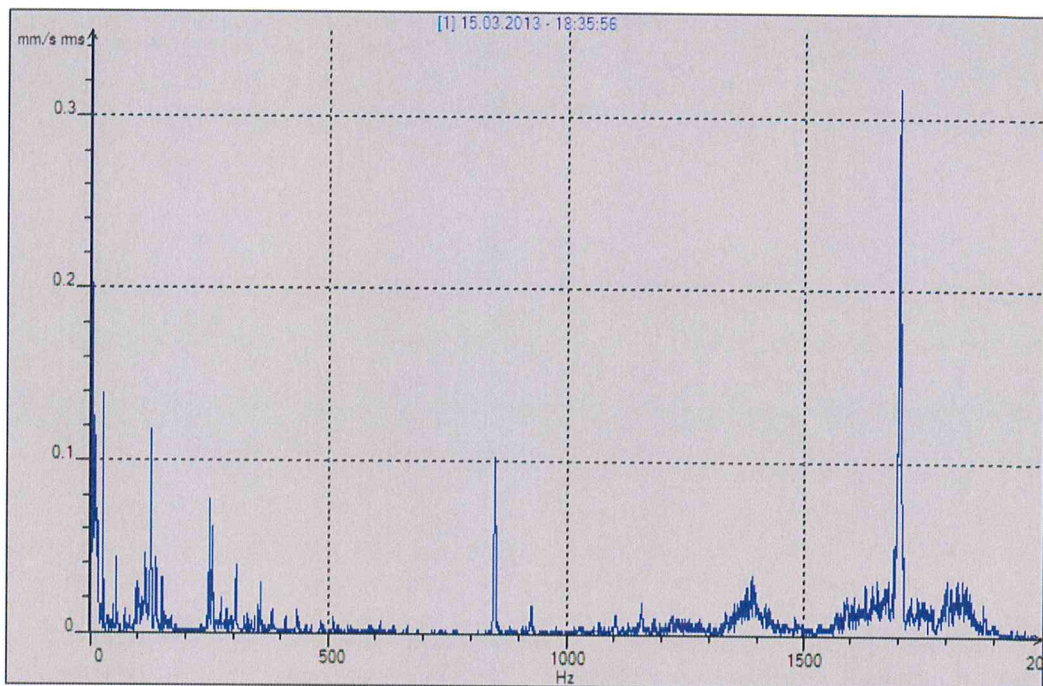
Kanal [1]

Setup

 Sensor: [AS-06x/07x]
 100 mV/g
 Hochpass/Tiefpass: 1 Hz - 2kHz
 Linienzahl: 3200
 Fenster: Hanning
 Mittelung: 4 Frequenzbereich
 Drehzahl/Referenz:

Peakliste

Peak	Frequency (Hz)	Amplitude (mm/s rms)
2.50	2.50	0.3882
1703.13	1703.13	0.3174
1700.00	1700.00	0.2923
4.38	4.38	0.1804
27.50	27.50	0.1393
9.38	9.38	0.1256
127.50	127.50	0.1188
11.25	11.25	0.1142
1697.50	1697.50	0.1073
1696.25	1696.25	0.1073



Position V3z: output shaft, vertical