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ERL MAINTENANCE SUPPORT SDN BHD

(Company No. 498574-T)

E-MAS

Your Railway Operations & Maintenance Specialist

ROLLING STOCK DEPARTMENT

IN-HOUSE TECHNICAL INSTRUCTION

VIBRATION ANALYSIS APPLICATION NOTES

Doc. No. R00.OMR.M90000.CZ.1001.B

Release

	Name	Dept./Position	Date	Signature
Released:	Mohd Jamil	RST HoD	06.03.2012	
Checked:	Mohamad	RST QMR	06.03.12	
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Amendments or additions to this procedure must be indicated with a vertical black line in the adjacent left margin.

Change Record and Configuration Control

Revision	Date	Modification	Name
B	9.02.2012	Changes of Measurement points	Ham
A	01.12.2009	NEW	Ham

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1 Purpose

The procedure addresses the application of vibration spectral analysis in the maintenance of rolling stock.

2 Scope, Distribution & Access

This procedure covers the settings used for specific rolling stock parts both in service and during overhaul.

It does not provide a guide on how to use both hardware and software associated with the analysis.

This procedure is be distributed and made accessible to the author and those listed under the mailing group "RST MGT".

3 Application

The analysis is considered as a tool for condition monitoring used to aid optimization of the maintenance interval of rotating parts.

As no historical data is available within the system and therefore in the initial phase, the analysis will rely on:

- Available references with regard to the parameter setting s as well as alarm thresholds
- Trial runs to collect minimum reference data

Once sufficient database has been collected, these parameters and thresholds should be reviewed and adjusted accordingly.

Currently, the following items are monitored using this application:

- Gearboxes
- Traction motors
- Axle bearings
- Compressors

and when deemed necessary and beneficial, additional items may be added.

3.1 Equipment

The equipment comprises of a portable spectrum analyzer from SKF, Microlog GX-M, with an accompanying software @pitude and sensors.

Within the sensor group, there are 2 types of sensors available for use.

They are made by SKF (Wilcoxon) and CTC Sensor. SKF sensors are of the nominal 100mV/g group while CTC Sensor group has a mixture of 100mV/g and 500mV/g sensors.

For route application, which includes readings to be taken on board of trains, sensors are not to be mixed as each has its own response characteristics and the points set in the Microlog are programmed according to each and every individual sensor's response. The response characteristics information can be found from the individual calibration certificates that are kept by the department calibration committee.

For identification purpose, each sensor is marked with a number. They correspond to the numbering found in the route of the Microlog as well as the switch box numbering and the numbering of the sensor locations as shown in the appendix.

For non-route application it is best to use SKF sensors since they are very close to the nominal value of 100mV/g.

3.2 Readings and their Storage

Reading may be taken on train borne equipment without removal from trains (hereafter referred as on-train measurements). For this a train has to be purposely called in or when it is in the workshop in conjunction with other scheduled maintenance (overhaul excluded)

Reading can also be taken from equipment removed from train for overhaul purposes. Currently, only traction motors and compressors are included in this class of measurement.

Readings taken will be saved in the hardidsk of the Dell Latittude E5500 laptop, serial. No. CHZ222S for storage and further action.

3.3 Indication of Alarm

Alarm thresholds are built on the following parameters:

1. Overall value
2. Envelope
3. Band Alarm

All thresholds are set based on the first 3 sets of reading obtained. The actual setting of these values are based on experience and feeling of the analyst. They will be reviewed when sufficient data are collected.

3.3.1 Overall

The overall alert value is determined based on the average values across the readings with a 2 or 3 times standard deviation added. Danger level is set at 1.5, 2 or 3 times the alert.

3.3.2 Envelope

The envelopes for the points are generated and manually adjusted based on the spectra obtained. They are aimed to capture the high 0.5x, 1x, 2x and 3x, as well as other peaks at frequencies that are characteristics of the equipment.

3.3.3 Band Alarm

Band alarms are set to monitor narrow bearing frequencies and generally, only the ball pass frequency of inner and outer rings are monitored.

The alert and danger level for second multiples of bearing frequencies are generally set lower than the fundamental bearing frequencies to increase the sensitivity of the band alarm.

3.4 Indication from Microlog

After a reading has been taken, Microlog normally would compare previous value with the current one and indicate via one of its LED:

A green indicator next to the item being monitored in the route tree indicates that all alarm thresholds defined for the item have not been reached.

A yellow indicator shows that one or more alert thresholds have been reached.

A red indicator indicates that one or more danger thresholds have been reached.

In addition, it will also indicate the percentage difference of these 2 readings. Whenever possible, review the % difference on site. If there is a sudden increase/decrease between the readings, it is recommended to retake the points involved.

3.5 Follow-up Action

Trending will be used as an approach to track the changes between readings of the same equipment. Trending may involve the comparison of overall and band alarms of consecutive readings of a same point or across similar points in the route.

It should be noted that there are factors that should be taken into consideration when using trending to set the right alert and danger level, as each train has different load condition at different time (different size of wheel, stiffness of dampers etc.)

In general, until such time when a more meaningful threshold is obtained, the alert level does not normally warrant immediate action but is for the analyst to note to have a closer look at the spectra.

Danger level, if any, shall be explained to the possible extent. Where necessary, either a more frequent or detail measurement should be taken to determine if any physical action is needed.

Danger thresholds should be acknowledged in the system.

4 Notes on taking measurements on-train

4.1 Evaluation by Trending

The on-train measurements are meant for condition monitoring where reading are taken on a periodic basis and the trend is under observation.

It should be noted that there is no direct comparison between the readings taken during overhaul and those taken on board of train, since the operating conditions as well as the mounting arrangement of the machinery under these circumstances are not similar.

Because of these reasons, more focus is given to find bearing defect frequencies while other usual signatures such as unbalance, misalignment are for reference only.

4.2 Repeatability of Measurement

It is important to achieve repeatability of the test condition during first and every subsequent reading. Changes may be made to the test condition without the knowledge of the tester and may result in erroneous interpretation and incorrect follow-up action.

This includes the method of suspension and point of suspension of bogies, mounting method and the mounting location of sensors.

4.3 Frequency

The measurement should be taken at a 6-month interval.

4.4 Measurement Track

The measurement shall be taken with the train on body stand at track 12.

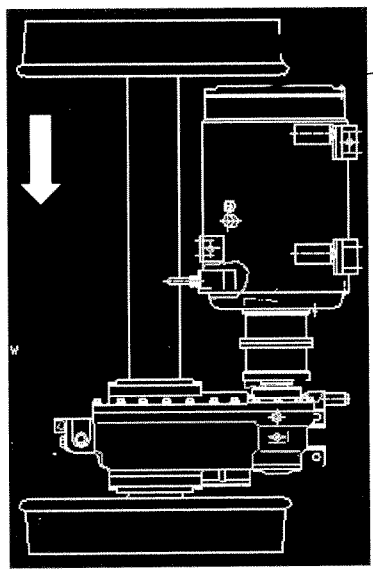
The bogie stand shall be lowered sufficiently to ensure the wheels cannot come in contact with it when they are rotating

No rotating parts shall come in contact with any wires, piping or fittings unless it is so intended for the sake of taking measurement.

4.5 Direction of Rotation

The rotating direction of the traction motor and the wheel set shall be determined from the non-driving end of the traction motor. The motor shall turn in *clockwise* direction when viewed from the non-driving end as shown in the figure below.

Traction motor shall rotate in clockwise direction when view from the indicated arrow / direction



Non-driving end of traction motor

From the same viewing direction, the wheel next to the gearbox will also rotate in the same direction – i.e. clockwise.

4.6 Speed

The rotating speed of the wheel has to be set to 327rpm.

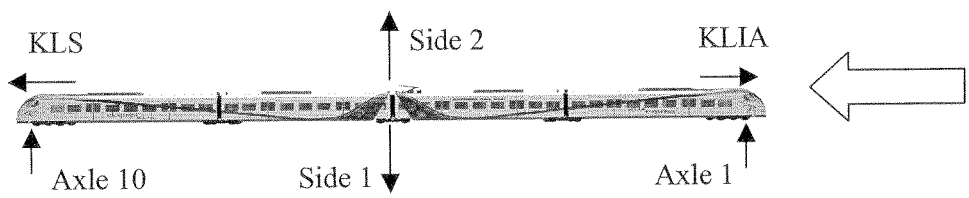
This speed is set at the 22kW inverter that comes with an operator console.

In the console, select manual mode in order to get access to the manual page

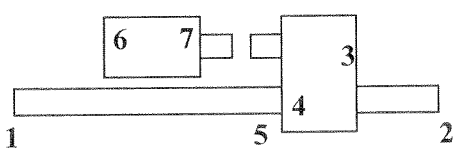
For motor speed, enter 3600rpm (the operator console is programmed for 2 pole motor whereas the traction motor is a 4 pole motor).

It is necessary to confirm the speed of the wheel is maintained at this speed throughout the entire measurement session. A speed reference can be made by attaching a 10x10mm reflective tape on the either one of the wheels of the axle under test.

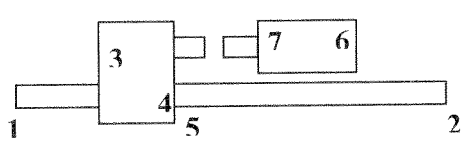
4.7 Orientation of Train



Sensors Locations at wheelsets no. 1, 3, 7 and 9 as seen from the block arrow direction above



Sensors Locations at wheelsets no. 2, 4, 8 and 10 as seen from the block arrow direction above



where

Points 1 and 2 – Axle bearing boxes, 1 for Side 1, and 2 for Side 2

Points 3 to 5 – Gearboxes

Points 6 and 7 – Traction motor

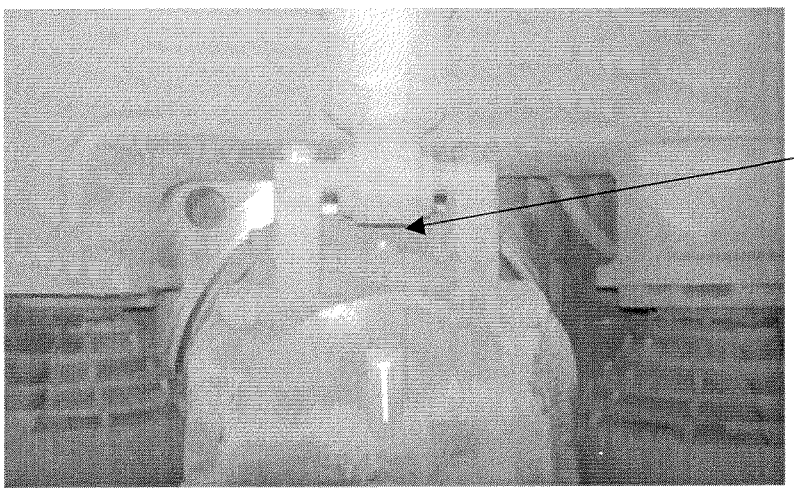
Refer to respective section in this document for further description of these points.

No measurements are taken on axle 5 and 6 since they are not powered.

5 General Descriptions of Measuring Points

5.1 Axle Bearings

Point 1 and 2 are meant for axle bearings

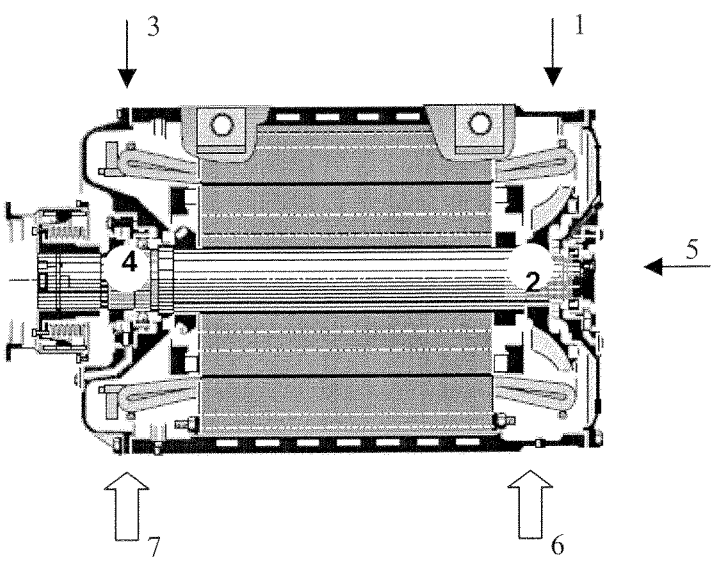


The points are located at the top of the axle box. They are identified via the target.

It has been found that the targets do not adhere well to the axle box. Therefore, subsequent readings on axle box should be done with the target removed, and replaced with rare earth magnet mount.

5.2 Traction Motor

Traction motors are monitored both on-train and during overhaul.



Points 1 to 5 are taken during overhaul, while points 6 and 7 are taken when the motor is mounted under the train.

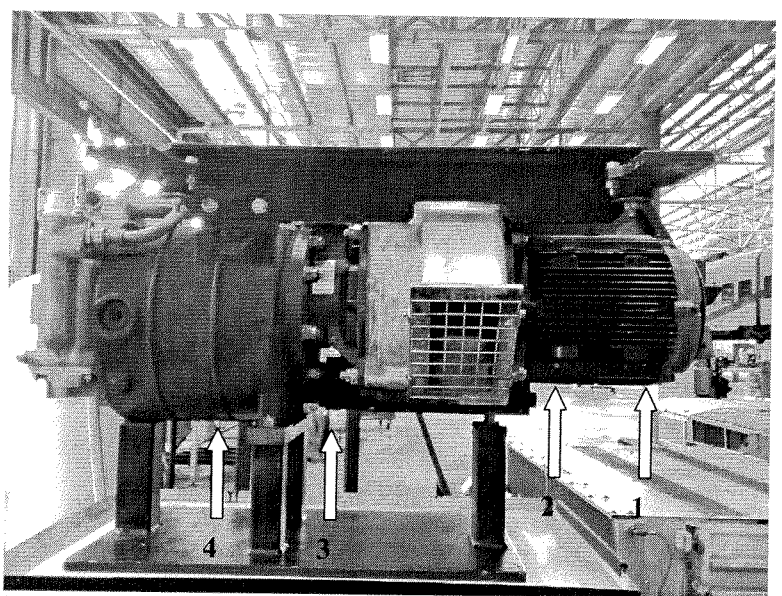
Targets are glued for points 6 and 7 for on board monitoring. If these are lost, alternative mounting method can be used with a remark made. Where possible, the glued points should be restored.

Appendix A provides the parameters for points 1 to 5 while Appendix E provides the same for points 6 and 7.

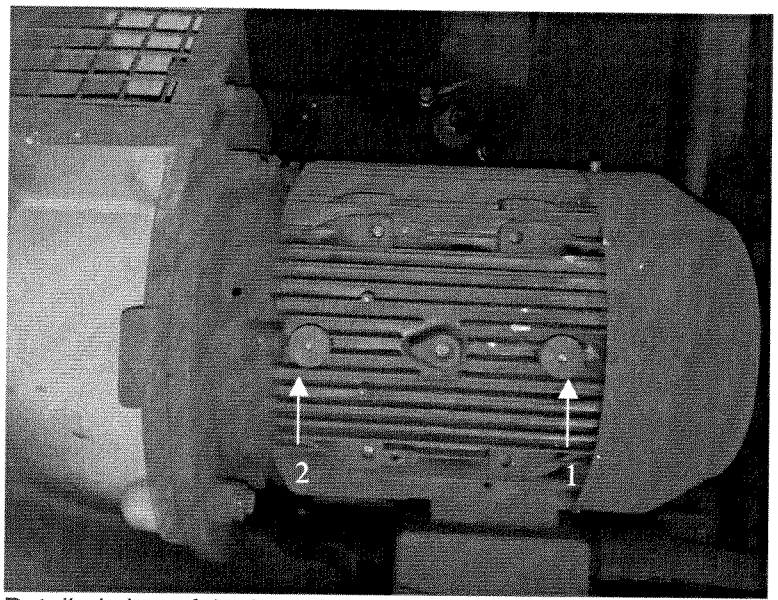
5.3 Compressors

Compressors are also monitored on-train as well as during overhaul.

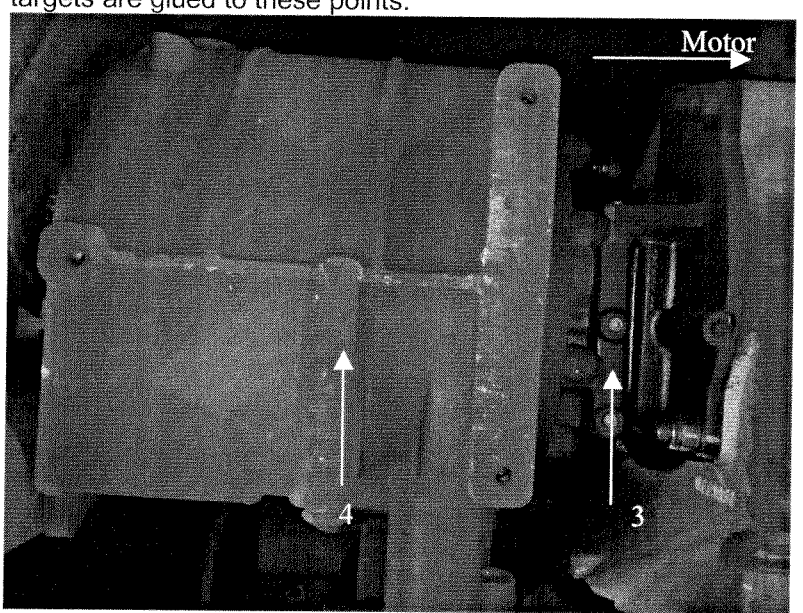
For on-train measurement, it will not be taken with the other on-train measurements since it can be powered independently by the train and therefore are more flexible with the location and timing. Furthermore, there are only 4 points per train and hence the reading can be taken in a much quicker manner.



Locations for Sensors on compressor (overview)



Detailed view of the locations for sensors underneath compressor motor. Do notice that sensor targets are glued to these points.



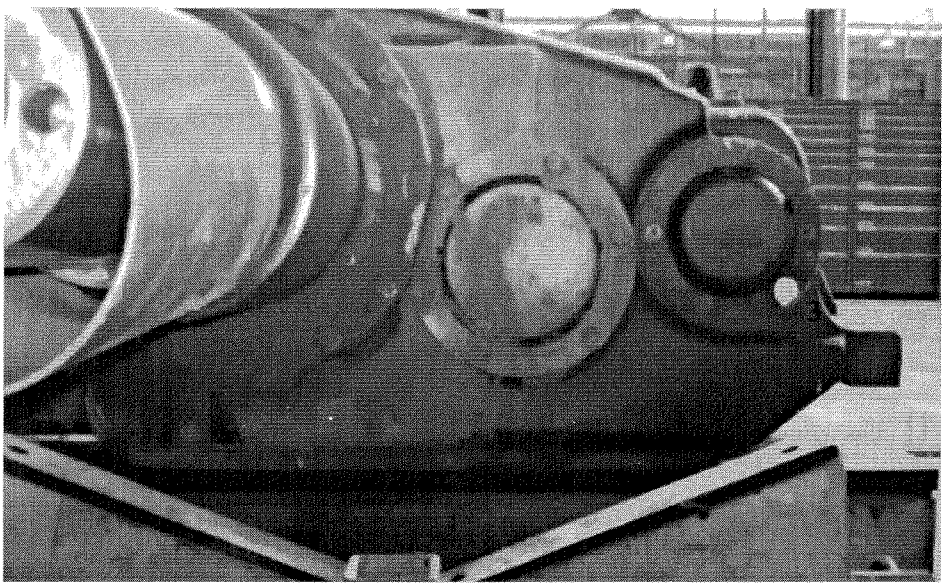
Detailed view of the locations for sensors mounting underneath air end

Parameters for points 1 to 4 for compressors are provided in Appendix B. These are applicable for both tests during overhaul as well as in service.

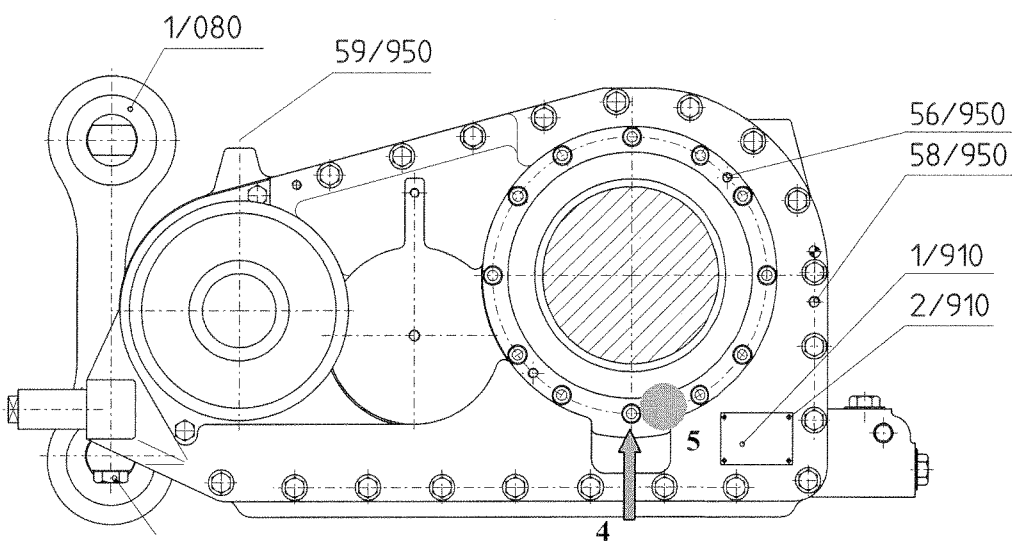
t is recommended to drain off the main reservoir before taking the measurement since the compressor has to be in running condition to have the reading taken.

5.4 Gearbox

Gearbox points are only to be taken during on-train measurement.



Point 3 – on the non-driven end of the input shaft of the gearbox, sensor to be placed axially on the bearing cover plate.



Point 4 – on the output shaft mounted vertically at the position indicated. Point 5 is mounted axially at the indication location.

5.5 Points Properties

All point properties can be found under the route named "**ET425M CM1800**" in @ptitude software and these are shortlisted in the appendices

These values are subject to changes and updates and therefore the values indicated in the appendices are only for information. The updated values are always kept in the @ptitude software.

Appendices

Appendix A – Parameters and Alarm Threshold Tables for Traction Motor under Overhaul (appears as App A Trac Motor OVH)

Appendix B – Parameters and Alarm Threshold Tables for Compressors (appears as App B Compressor)

Appendix C – Parameters and Alarm Threshold Tables for Axle Bearings (appears as App C Axle BRGs)

Appendix D – Parameters and Alarm Threshold Tables for Gearboxes (appears as App D Gearbox)

Appendix E – Parameters and Alarm Threshold Tables for Traction Motor in Service (appears as App E Trac Motor Serv)

EQUIPMENT INFORMATION

Type of Equipment	Traction M
Test Under	Overhaul
Machine Speed (RPM)	2205

Fmax	Varies
Fmax Type	Ordered
Alert to Alarm Factor	1.5

SENSOR INFORMATION

Position	ALL		
Serial	SKF	Model	
Marking	None	Sensitivity	101
Position			
Serial		Model	
Marking		Sensitivity	

POINT PARAMETERS

Point	Name	Spectrum Type	Fmax	Averaging Type	No of Averages	Speed Tag Factor	Low Cut Off Freq.	Lines
1.1	ND.OA	Phase	54	Peak Hold	4	5.508	300	800
1.2	ND.OA.27x	Time	27	Peak Hold	2	5.508	300	3200
1.3	ND.gE (B3)	gE	54	Peak Hold	4	5.508	300	800
1.4	ND.gE.B1	gE	27	Peak Hold	4	5.508	300	400
1.5	ND.gE.B2	gE	27	Peak Hold	4	5.508	300	400
1.6	ND.gE.B3	gE	27	Peak Hold	4	5.508	300	400
1.7	ND.gE.B4	gE	27	Peak Hold	4	5.508	300	400
1.8	ND.gE.HFD	gHFD		Peak Hold	4	5.508	300	
2	ND.OA.Hor	Time	163	Peak Hold	4	5.508	300	1600
3.1	DE.OA	Phase	54	Peak Hold	4	5.508	300	800
3.2	DE.OA.27x	Time	27	Peak Hold	2	5.508	300	3200
3.3	DE.gE (B3)	gE	54	Peak Hold	4	5.508	300	800
3.4	DE.gE.B1	gE	27	Peak Hold	4	5.508	300	400
3.5	DE.gE.B2	gE	27	Peak Hold	4	5.508	300	400
3.6	DE.gE.B3	gE	27	Peak Hold	4	5.508	300	400
3.7	DE.gE.B4	gE	27	Peak Hold	4	5.508	300	400
3.8	DE.gE.HFD	gHFD		Peak Hold	4	5.508	300	
4	DE.OA.Hor	Time	10	Peak Hold	2	5.508	300	6400
5	Axial	Phase	27	Peak Hold	4	5.508	300	1600

ALARM PARAMETERS

Overalls

Type	Name	Points					Alert	Alarm
Velocity	TM.OA.OVH.2205RPM	1.1	1.2	3.1	3.2		1.16	1.74
gE	TM.gE.6016.OVH	3.6	3.7				1.98	5.94
gE	TM.gE.NU2012E.OVH	1.6	1.7				1.485	4.455
HFD	HFD General	1.8	3.8				1.5	5

Alarm Bands

						Peak		Overall	
Band for	Name	From	To	Limit mm/s	OA to Peak factor	Alarm	Alert	Alarm	Alert
1.1 / 1.2 /3.1 / 3.2	TM.OAR2K1	0.3	1.2		0.9	0.810	0.540	0.900	0.600
	TM.OAR2K2	1.2	2.2		0.85	0.701	0.468	0.825	0.550
	TM.OAR2K3	2.2	3.2		0.85	0.701	0.468	0.825	0.550
	TM.OAR2K4	3.2	12.2	1.4	0.7	0.525	0.350	0.750	0.500
	TM.OAR2K5	12.2	27	1	0.5	0.045	0.030	0.090	0.060
	TM.OAR2K6	27	54	0.9	0.5	0.090	0.060	0.180	0.120
5	TM.NDAX2k1	0.2	1.2		0.8	0.720	0.480	0.900	0.600
	TM.NDAX2K2	1.2	2.2		0.8	0.720	0.480	0.900	0.600
	TM.NDAX2k3	2.2	3.2		0.8	0.720	0.480	0.900	0.600
2	RBPF.OB2K1	30000	85000	0.35	0.6	0.315	0.210	0.525	0.350
	RBPF.OB2k2	85000	140000	0.35	0.6	0.315	0.210	0.525	0.350
	RBPF.OB2K3	140000	195000	0.3	0.6	0.270	0.180	0.450	0.300
	RBPF.OB2K4	195000	250000	0.25	0.6	0.225	0.150	0.375	0.250
	RBPF.OB2K5	250000	305000	0.18	0.6	0.162	0.108	0.270	0.180
	RBPF.OB2K6	305000	360000	0.18	0.6	0.162	0.108	0.270	0.180
4	RBPF.IB2K1	7992	9768	0.42	0.9	0.567	0.378	0.630	0.420
	RBPF.IB2k2	16872	18648	0.2	0.9	0.270	0.180	0.300	0.200

Enveloping - Bearing Frequencies

		Point		
No.	Envelope Name	1	2	3
1	TM.210E.2.2K.OVH	1.1	1.2	1.6
2	TM.6016.2.2K.OVH	3.1	3.2	3.6

Name TM.6016.2.2K.OVH
BRG 1 6016
BRG 2 NA
BRG 3 NA

Unsorted

Type	From	To
BSF	8,128	8,334
BPFO	13,234	13,570
BSF	16,257	16,668
BPFI	17,247	17,684
BPFO	26,469	27,139
BPFI	34,495	35,368

BRG 1 6016
BRG 2 NA
BRG 3 NA

Sorted

BSF	8,128	8,334
BPFO	13,234	13,570
BSF	16,257	16,668
BPFI	17,247	17,684
BPFO	26,469	27,139
BPFI	34,495	35,368

Name TM.210E.2.2K.OVH
BRG 1 NU210E
BRG 2 NA
BRG 3 NA

Unsorted

Type	From	To
BSF	6,807	6,979
BPFO	14,700	15,072
BSF	13,613	13,958
BPFI	20,137	20,647
BPFO	29,400	30,144
BPFI	40,274	41,293

BRG 1 NU210E
BRG 2 NA
BRG 3 NA

Sorted

BSF	6,807	6,979
BSF	13,613	13,958
BPFO	14,700	15,072
BPFI	20,137	20,647
BPFO	29,400	30,144
BPFI	40,274	41,293

Frequencies Set

		Frequency Group				
Set for	Name	1	2	3	4	5
1.1/1.2	TM.ND.OA	2xLF	NU210E	Rotor 40x		
3.1/3.2	TM.DE.OA	2xLF	6016	Rotor 40x		
1.3/3.3	TM.Bearings	NU210E	6016			

EQUIPMENT INFORMATION

Type of Equipment	Comp M
Test Under	Serv / OVH
Machine Speed (RPM)	1468

Fmax	Varies
Fmax Type	Ordered
Alert to Alarm Factor	1.5

SENSOR INFORMATION

Position	ALL		
Serial	SKF	Model	
Marking	None	Sensitivity	101
Position			
Serial		Model	
Marking		Sensitivity	

POINT PARAMETERS

Point	Name	Spectrum Type	Fmax	Averaging Type	No of Averages	Speed Tag Factor	Low Cut Off Freq.	Lines
1.1	CM.ND.RB.ph	Phase	245	Peak Hold	4	1	300	1600
1.2	CM.ND.OA.BP	Time	50	Peak Hold	4	1	300	1600
1.3	CM.ND.gE.B1	gE	50	Peak Hold	4	1	300	400
1.4	CM.ND.gE.B2	gE	50	Peak Hold	4	1	300	400
1.5	CM.ND.gE.B3	gE	50	Peak Hold	4	1	300	400
1.6	CM.ND.gE.B4	gE	50	Peak Hold	4	1	300	400
1.7	CM.ND.gHFD	gHFD		Peak Hold	4	1	300	
2.1	CM.DE.OA.ph	Phase	50	Peak Hold	4	1	300	1600
2.2	CM.DE.OA.EL	Time	16	Peak Hold	2	1	300	6400
2.3	CM.DE.gE.B1	gE	50	Peak Hold	4	1	300	400
2.4	CM.DE.gE.B2	gE	50	Peak Hold	4	1	300	400
2.5	CM.DE.gE.B3	gE	50	Peak Hold	4	1	300	400
2.6	CM.DE.gE.B4	gE	50	Peak Hold	4	1	300	400
2.7	CM.DE.gHFD	gHFD		Peak Hold	4	1	300	

ALARM PARAMETERS

Overalls

Type	Name	Points					Alert	Alarm
Velocity	CM.Westghse.6.5kW	1.1	1.2	2.1			5.5	8
gE	CM.ND.6305	1.5	1.6				0.98	2.94
gE	CM.DE.6208	2.5	2.6				1.21	3.63
HFD	HFD General	1.7	2.7				1.5	5

Alarm Bands

						Peak		Overall	
Band for	Name	From	To	Limit mm/s	OA to Peak factor	Alarm	Alert	Alarm	Alert
1.2	CM.ND.OA.B1	0.2	1.2		0.8	5.940	3.960	7.425	4.950
	CM.ND.OA.B2	1.2	2.2		0.8	1.980	1.320	2.475	1.650
	CM.ND.OA.B3	2.2	3.2		0.8	1.656	1.104	2.070	1.380
	CM.ND.OA.B4	3.2	12.2	1.4	0.7	1.155	0.770	1.650	1.100
	CM.ND.OA.B5	12.2	25	1	0.6	0.747	0.498	1.245	0.830
	CM.ND.OA.B6	25	50	0.9	0.6	0.495	0.330	0.825	0.550
	CM.ND.BP.B1	3.8	6.2	4.3	0.8	3.960	2.640	4.950	3.300
1.1	CM.ND.RB.B1	20.4	57.9	1	1	1.500	1.000	1.500	1.000
	CM.ND.RB.B2	57.9	95.4	1	1	1.500	1.000	1.500	1.000
	CM.ND.RB.B3	95.4	132.8	0.6	0.6	0.540	0.360	0.900	0.600
	CM.ND.RB.B4	132.8	170.3	0.7	0.7	0.735	0.490	1.050	0.700
	CM.ND.RB.B5	170.3	207.8	0.55	0.55	0.454	0.303	0.825	0.550
	CM.ND.RB.B6	207.8	249.2	0.55	0.55	0.454	0.303	0.825	0.550
2.1	CM.DE.OA.B1	0.2	1.2		0.8	5.940	3.960	7.425	4.950
	CM.DE.OA.B2	1.2	2.2		8	19.800	13.200	2.475	1.650
	CM.DE.OA.B3	2.2	3.2		0.8	1.656	1.104	2.070	1.380
	CM.DE.OA.B4	3.2	12.2	1.4	0.7	1.155	0.770	1.650	1.100
	CM.DE.OA.B5	12.2	25	1	0.6	0.747	0.498	1.245	0.830
	CM.DE.OA.B6	25	50	0.9	0.6	0.495	0.330	0.825	0.550
2.2	CM.DE.EL.B1	3.68	4.5	1.25	0.8	1.500	1.000	1.875	1.250
	CM.DE.EL.B2	7.76	8.58	0.6	0.8	0.720	0.480	0.900	0.600

EQUIPMENT INFORMATION

Type of Equipment	Air End
Test Under	Serv / OVH
Machine Speed (RPM)	1468

Fmax	Varies
Fmax Type	Ordered
Alert to Alarm Factor	1.5

SENSOR INFORMATION

Position	ALL		
Serial	SKF	Model	
Marking	None	Sensitivity	101
Position			
Serial		Model	
Marking		Sensitivity	

POINT PARAMETERS

Point	Name	Spectrum Type	Fmax	Averaging Type	No of Averages	Speed Tag Factor	Low Cut Off Freq.	Lines
1.1	AE.D.OA	Time	50	Peak Hold	4	1	300	3200
1.2	AE.D.OA.ph	Phase	50	Peak Hold	4	1	300	400
1.3	AE.D.gE.B1	gE	50	Peak Hold	4	1	300	400
1.4	AE.D.gE.B2	gE	50	Peak Hold	4	1	300	400
1.5	AE.D.gE.B3	gE	50	Peak Hold	4	1	300	1600
1.6	AE.D.gE.B4	gE	50	Peak Hold	4	1	300	400
1.7	AE.D.gHFD	gHFD		Peak Hold	4	1	300	
2.1	AE.ND.OA	Time	50	Peak Hold	4	1	300	3200
2.2	AE.ND.OA.ph	Phase	50	Peak Hold	4	1	300	400
2.3	AE.ND.gE.B1	gE	50	Peak Hold	4	1	300	400
2.4	AE.ND.gE.B2	gE	50	Peak Hold	4	1	300	400
2.5	AE.ND.gE.B3	gE	50	Peak Hold	4	1	300	1600
2.6	AE.ND.gE.B4	gE	50	Peak Hold	4	1	300	400
2.7	AE.ND.gHFD	gHFD		Peak Hold	4	1	300	

ALARM PARAMETERS

Overalls

Type	Name	Points					Alert	Alarm
Velocity	AE.Tamrotor	1.1	1.2	2.1	2.2		5.5	8
gE	AE.gE.DE (Pos 3)	1.5	1.6				1.37	4.12
gE	AE.gE.ND (Pos 4)	2.5	2.6				1.65	4.96
HFD	HFD General	1.7	2.7				1.5	5

Alarm Bands

						Peak		Overall	
Band for	Name	From	To	Limit mm/s	OA to Peak factor	Alarm	Alert	Alarm	Alert
1.1/1.2 /2.1/2.2	AE.B1	0.4	1.2		0.8	5.940	3.960	7.425	4.950
	AE.B2	1.2	2.2		0.8	1.980	1.320	2.475	1.650
	AE.B3	2.2	2.8	2.2	0.8	2.316	1.544	2.895	1.930
	AE.B4	2.8	5.2	4.3	0.8	3.960	2.640	4.950	3.300
	AE.B5	5.2	25	2.2	0.8	2.316	1.544	2.895	1.930
	AE.B6	25	50	1.25	0.8	1.320	0.880	1.650	1.100

EQUIPMENT INFORMATION

Type of Equipment	Axle BRG
Test Under	Service
Machine Speed (RPM)	327

Fmax	Varies
Fmax Type	Ordered

SENSOR INFORMATION

Position	1		
Serial	2746	Model	CTC AC136-1A
Marking	1	Sensitivity	493.13
Position	2		
Serial	2745	Model	CTC AC136-1A
Marking	2	Sensitivity	507.93

POINT PARAMETERS

Point	Name	Spectrum Type	Fmax	Averaging Type	No of Averages	Speed Tag Factor	Low Cut Off Freq.	Lines
1.1	AX.OA.S1	Time	36	Average	4	1	30	1600
1.2	AX.gE.S1.B1	gE	183	Average	8	1	30	400
1.3	AX.gE.S1.B2	gE	183	Average	8	1	30	400
1.4	AX.gE.S1.B3	gE	183	Average	8	1	30	400
1.5	AX.gE.S1.B4	gE	183	Average	8	1	30	400
2.1	AX.OA.S2	Time	36	Average	4	1	30	1600
2.2	AX.gE.S2.B1	gE	183	Average	8	1	30	400
2.3	AX.gE.S2.B2	gE	183	Average	8	1	30	400
2.4	AX.gE.S2.B3	gE	183	Average	8	1	30	400
2.5	AX.gE.S2.B4	gE	183	Average	8	1	30	400

ALARM PARAMETERS

Overalls

Type	Name	Points					Alert	Danger
Velocity	AX.OA.2	1.1	2.1				3.69	4.549
gE	AX.gE.B1 - B4	1.2/2.2	1.3/2.3	1.4/2.4	1.5/2.5		0.95	2.86

Alarm Bands

						Peak		Overall	
Band for	Name	From	To			Danger	Alert	Danger	Alert
1.1 /2.1	AX.OA.B1	6.58	6.84			0.600	0.300	1.000	0.500
	Ax.OA.B2	9.1	9.48			0.600	0.300	1.000	0.500
	AX.OA.B3	13.15	13.69			0.400	0.200	1.000	0.500
	AX.OA.B4	18.21	18.95			0.400	0.200	1.000	0.500

Enveloping - Bearing Frequencies

		Point		
No.	Envelope Name	1	2	3
1	AX.OA.2	1.1	2.1	-

EQUIPMENT INFORMATION

Type of Equipment	Gearbox
Test Under	Service
Machine Speed (RPM)	327

Fmax	Varies
Fmax Type	Ordered

SENSOR INFORMATION

Position	3		
Serial	3721	Model	CTC AC135-1A
Marking	3	Sensitivity	505.6
Position	4		
Serial	3720	Model	CTC AC135-1A
Marking	4	Sensitivity	490.7
Position	5		
Serial	3722	Model	CTC AC135-1A
Marking	5	Sensitivity	497.19

POINT PARAMETERS

Point	Name	Spectrum Type	Fmax	Averaging Type	No of Averages	Speed Tag Factor	Low Cut Off Freq.	Lines
3.1	GB.IP.OA.Ax	Time	30	Average	6	5.508	300	1600
3.2	GB.IP.OA.Ax.B1	gE	50	Average	6	5.508	300	400
3.3	GB.IP.OA.Ax.B2	gE	50	Average	6	5.508	300	400
3.4	GB.IP.OA.Ax.B3	gE	50	Average	6	5.508	300	400
3.5	GB.IP.OA.Ax.B4	gE	50	Average	6	5.508	300	400
4.1	GB.OP.OA.Vt	Time	120	Average	6	1	100	1600
4.2	GB.OP.OA.Vt.B1	gE	120	Average	6	1	100	400
4.3	GB.OP.OA.Vt.B2	gE	120	Average	6	1	100	400
4.4	GB.OP.OA.Vt.B3	gE	120	Average	6	1	100	400
4.5	GB.OP.OA.Vt.B4	gE	120	Average	6	1	100	400
5.1	GB.OP.OA.Ax	Time	120	Average	6	1	100	1600
5.2	GB.OP.OA.Ax.B1	gE	120	Average	6	1	100	400
5.3	GB.OP.OA.Ax.B2	gE	120	Average	6	1	100	400
5.4	GB.OP.OA.Ax.B3	gE	120	Average	6	1	100	400
5.5	GB.OP.OA.Ax.B4	gE	120	Average	6	1	100	400

ALARM PARAMETERS

Overalls

Type	Name	Points					Alert	Danger
Velocity	GB.IP.OA.Ax.2	3.1					4.336	5.23
gE	GB.IP.gE.Ax.B1 to B4	3.2	3.3	3.4	3.5		0.91	2.72
Velocity	GB.OP.OA.Vt.2	4.1					3.56	4.327
gE	GB.OP.gE.Vt.B1 to B4	4.2	4.3	4.4	4.5		0.62	1.87
Velocity	GB.OP.gE.Ax.2	5.1					3.761	4.465
gE	GB.OP.gE.Ax.B1 to B4	5.2	5.3	5.4	5.5		0.69	2.08

Alarm Bands

						Peak		Overall	
Band for	Name	From	To			Danger	Alert	Danger	Alert
3.1	GB.QJ212.1	5.846	5994			0.400	0.250	1.000	0.750
	GB.QJ212.2	7.969	8.171			0.400	0.250	1.000	0.750
	GB.QJ212.3	11.692	11.988			0.300	0.200	1.000	0.750
	GB.QJ212.4	15.938	16.342			0.300	0.200	1.000	0.750
	GB.NJ215.1	7.542	7.85			0.500	0.250	1.000	0.750
	GB.NJ215.2	10.098	10.51			0.500	0.250	1.000	0.750
	GB.NJ215.3	15.084	15.7			0.400	0.200	1.000	0.750
	GB.NJ215.4	20.196	21.02			0.400	0.200	1.000	0.750
	GB.NU212.1	6.614	6.782			0.500	0.250	1.000	0.750
	GB.NU212.2	9.186	9.418			0.500	0.250	1.000	0.750
	GB.NU212.3	13.229	13.563			0.400	0.200	1.000	0.750
	GB.NU212.4	18.371	18.837			0.400	0.200	1.000	0.750
3.1 / 4.1 / 5.1	GB.N2313.1	5.116	5.246			0.500	0.250	1.000	0.750
	GB.N2313.2	7.721	7.917			0.500	0.250	1.000	0.750
	GB.N2313.3	10.232	10.492			0.400	0.200	1.000	0.750
	GB.N2313.4	15.443	15.833			0.400	0.200	1.000	0.750
4.1 / 5.1	GB.TRB.1	21.593	22.139			0.700	0.350	1.000	0.750
	GB.TRB.2	23.832	24.436			0.700	0.350	1.000	0.750
	GB.TRB.3	43.185	44.279			0.400	0.200	1.000	0.750
	GB.TRB.4	47.665	48.871			0.400	0.200	1.000	0.750

Enveloping

		Point		
No.	Envelope Name	1	2	3
1	GB.IP.OA.Ax.2	3.1		
2	GB.OP.OA.Vt.2	4.1		
3	GB.OP.OA.Ax.2	5.1		

EQUIPMENT INFORMATION

Type of Equipment	Traction M
Test Under	Service
Machine Speed (RPM)	1800

Fmax	Varies
Fmax Type	Ordered

SENSOR INFORMATION

Position	6		
Serial	83671	Model	CTC AC102-1A
Marking	6	Sensitivity	96.65
Position	7		
Serial	83672	Model	CTC AC102-1A
Marking	7	Sensitivity	96.67

POINT PARAMETERS

Point	Name	Spectrum Type	Fmax	Averaging Type	No of Averages	Speed Tag Factor	Low Cut Off Freq.	Lines
6.1	TM.ND.OA	Time	25	Average	6	5.508	550	6400
6.2	TM.ND.gE.B1	gE	33	Average	6	5.508	300	400
6.3	TM.ND.gE.B2	gE	33	Average	6	5.508	300	400
6.4	TM.ND.gE.B3	gE	33	Average	6	5.508	300	400
6.5	TM.ND.gE.B4	gE	33	Average	6	5.508	300	400
7.1	TM.DE.OA	Time	25	Average	6	5.508	550	6400
7.2	TM.DE.gE.B1	gE	33	Average	6	5.508	300	400
7.3	TM.DE.gE.B2	gE	33	Average	6	5.508	300	400
7.4	TM.DE.gE.B3	gE	33	Average	6	5.508	300	400
7.5	TM.DE.gE.B4	gE	33	Average	6	5.508	300	400

ALARM PARAMETERS

Overalls

Type	Name	Points					Alert	Danger
Velocity	TM.ND.OA.Vt.2	6.1					4.336	5.23
gE	TM.ND.gE.Vt.B1 to B4	6.2	6.3	6.4	6.5		0.91	2.72
Velocity	TM.DE.OA.Vt.2	7.1					3.56	4.327
gE	TM.DE.gE.Vt.B1 to B4	7.2	7.3	7.4	7.5		0.62	1.87

Alarm Bands

						Peak		Overall	
Band for	Name	From	To			Danger	Alert	Danger	Alert
6.1 / 7.1	TM.BRGS.1	5.956	6.200			0.500	0.250	1.000	0.500
	TM.BRGS.2	7.763	8.079			0.500	0.250	1.000	0.500
	TM.BRGS.3	11.913	12.399			0.400	0.200	1.000	0.500
	TM.BRGS.4	15.525	16.159			0.400	0.200	1.000	0.500
	TM.BRGS.5	6.616	6.886			0.500	0.250	1.000	0.500
	TM.BRGS.6	9.063	9.433			0.500	0.250	1.000	0.500
	TM.BRGS.7	13.232	13.772			0.400	0.200	1.000	0.500
	TM.BRGS.8	15.525	16.159			0.400	0.200	1.000	0.500

Enveloping - Bearing Frequencies

		Point		
No.	Envelope Name	1	2	3
1	TM.ND.OA.Vt.2	6.1		
2	TM.DE.OA.Vt.2	7.1		