HI-SPEED INDUSTRIAL SERVICE QualiTest® Diagnostics

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August 16, 2019

Nucor Roll Mill
Jackson-Flowood, MS

Subject: August vibration survey

Most of the machines surveyed were found to be in good condition with the exception of the following:

QualiTest® uses a four step rating system for defects.

Class I: Defect is present, but effect on reliability is not clear; no immediate action is required. Continue to normally monitor.

Class II: Defect (s) present that may cause problem in long term (2-6 months). Repair during normal maintenance scheduling. Continue to monitor.

Class III; Defect (s) present that may cause failure in short term (less than 2 months). This should be addressed as soon as practical, with a high maintenance priority. Increase monitoring frequency.

Class IV; Defect (s) present that makes continued reliability unpredictable, and possibility of secondary damage is high. Repairs should be made ASAP. An unscheduled shutdown should be considered for repairs

Hi-Speed **Industrial Service** tests and inspects industrial machinery and equipment and makes recommendations concerning maintenance and repairs based on its experience in the field of industrial repair and maintenance. The information contained herein is provided as an opinion only, not as a guaranty or warranty of the matters discussed herein.

Defects

Roll Stand 1A Planetary Gearbox
Overall vibration varies with each survey and may be influenced somewhat by speed and load. The vibrations in the planetary section still show signs of distress. We will continue to monitor this unit closely. Still rated as a **CLASS I** defect for now.

Roll Stand 2 MOTOR
Data of the motor indicates some signs of bearing issue possible in the motor. We will monitor this closely. Rated as a **CLASS I** defect for now.

Roll Stand 2 Cooling Fan Motor
Motor data suggests mechanical looseness of the motor fits and or fan hub. A rub can also cause this type of vibration. Vibration levels are not high levels as of now, but this issue will be monitored closely. Rated as a **CLASS II** defect.

Roll Stand 4
Gearbox is starting to show some signs of gear wear and or gear misalignment at the input to intermediate side. Speed and load may have some effect on the fluctuation of amplitude; however, signs of wear do exist. We will continue to monitor this issue closely. Rated as a **CLASS I** defect for now.

Roll Stand 5
Vibration has decreased slightly in the gearbox outboard side this survey. A dominant gear mesh vibration is present towards the output of the gearbox. The up and down amplitude of this peak from month to month is likely due to change in tooth load and machine speed. We will continue to monitor this very closely. Rated as a **CLASS I** defect for now.

Roll Stand 5 Cooling Fan Motor
There appears to be a vibration in this unit that may be due to imbalance of the fan wheel. There may also be a slight electrical issue in the motor as well, but the dominant vibration is due to the possible imbalance. We will monitor this closely. Rated as a **CLASS II** defect.

Roll Stand 6
A dominant gear mesh vibration is present towards the output of the gearbox. Overall vibration was lower this month; however, the up and down amplitude of this peak is likely due to change in tooth load and speed. This issue seems to have begun after gearbox was repaired. We will continue to monitor this very closely. Rated as a **CLASS I** defect.

Roll Stand 7
Gearbox vibration was lower this survey. Output side of the gearbox casing was .15 ips-pk this survey. Last survey it was .4 ips-pk. A dominant gear mesh vibration is present towards the output of the gearbox. The up and down amplitude of this peak from month to month is likely due to change in tooth load and machine speed. We will continue to monitor this very closely. Rated as a **CLASS II** defect.

Roll Stand 10
There are some gear related vibrations that are starting to trend upward slightly. We will monitor this closely for now. Rated as a **CLASS I** defect.

Roll Stand 10 Cooling Fan Motor
Motor data suggests that the motor fits or fan fits are loose. Inspect motor mounting plate/structure for looseness as well as the motor fits. Rated as a **CLASS II** defect.

Roll Stand 13 Cooling Fan Motor
Cooling fan motor data is showing vibrations associated with rotor issues such as loose or broken rotor bars. This is causing a higher than normal 1 x rpm vibration. We will monitor this closely. Rated as a **CLASS I** defect for now.

West Reheat hydraulic pump
Equipment was not in service this survey; however, the following most likely still applies: The pump has a much higher vibration this survey. Increase from .3 to .6 ips-pk. Spectrum shows high vibration at 2 x pump vane pass frequency with rpm sidebands. This could be due to clogged filter if equipped or other issue such as pump wear. Inspect pump soon. Rated as a **CLASS III** defect.

Ejector Fan
The motor appears to be thrusting slightly again this month. Overall vibration levels are within acceptable limits this survey. This issue will continue to be monitored closely.

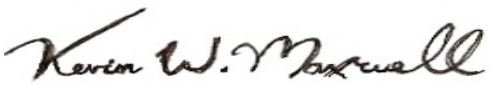
Furnace CT Drive North
Large increase in 1 x rpm vibration in the motor outboard. This may be due to coupling issue, shaft run-out, loose base. Inspect the unit for these issues soon. Rated as a **CLASS II** defect.

Scale Pit NORTH Pump
There is a high 1 x rpm vibration that may be due to an issue with the pump. For now, ensure that the pump is operating at the proper flow parameters. Pump may also have some imbalance which could cause this type of vibration. For now, this is a **CLASS II** defect.

South Quincy Air Compressor
Motor vibration has decreased this survey. Data has shown (in the past) high frequency electrical type vibration such as 2 x line frequency, stator slot pass, and or rotor bar pass frequency vibrations. This usually indicates an electrical issue is present such as winding issue, rotor issue, etc. We will monitor this issue closely. Rated as a **CLASS I** defect.

As always, it has been a pleasure to NUCOR Steel Flowood, MS. If there are any comments or questions, do not hesitate to contact us.

Sincerely,



ISO Certified Vibration Analyst, Category III

HI-SPEED INDUSTRIAL SERVICE

QualiTest® Diagnostics

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Abbreviated Last Measurement Summary

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Database: nucorja9.rbm
Station: Roll Mill Rolls

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD
STD1A - Stand 1A	(12-Aug-19)	
	OVERALL LEVEL	1K-20KHz
MOH	.049 In/Sec	.014 G-s
MIH	.045 In/Sec	.029 G-s
MIA	.106 In/Sec	.065 G-s
COH	.226 In/Sec	.050 G-s
GIA	.046 In/Sec	.108 G-s
GIH	.078 In/Sec	.095 G-s
GI2	.059 In/Sec	.050 G-s
GI3	.051 In/Sec	.205 G-s
GI4	.041 In/Sec	.087 G-s
GI5	.031 In/Sec	.047 G-s
GI6	.023 In/Sec	.074 G-s
GOH	.022 In/Sec	.015 G-s
STD2A - Stand 2A	(12-Aug-19)	
	OVERALL LEVEL	1K-20KHz
MOH	.030 In/Sec	.013 G-s
MIH	.067 In/Sec	.111 G-s
MIA	.106 In/Sec	.018 G-s
COH	.150 In/Sec	.038 G-s
STD1 - Stand 1	(12-Aug-19)	
	OVERALL LEVEL	1K-20KHz
MOH	.084 In/Sec	.056 G-s
MIH	.112 In/Sec	.167 G-s
MIA	.192 In/Sec	.075 G-s
GIA	.060 In/Sec	.016 G-s
GIH	.069 In/Sec	.0075 G-s
COH	.083 In/Sec	.069 G-s
STD2 - Stand 2	(12-Aug-19)	
	OVERALL LEVEL	1K-20KHz
MOH	.100 In/Sec	.086 G-s
MIH	.080 In/Sec	.097 G-s
MIA	.201 In/Sec	.169 G-s
GIA	.110 In/Sec	.026 G-s
GIH	.047 In/Sec	.052 G-s
COH	.411 In/Sec	.558 G-s
STD3 - Stand 3	(12-Aug-19)	
	OVERALL LEVEL	1K-20KHz
MOH	.064 In/Sec	.107 G-s
MIH	.087 In/Sec	.030 G-s
MIA	.168 In/Sec	.254 G-s
GIA	.031 In/Sec	.130 G-s
GIH	.042 In/Sec	.059 G-s
COH	.303 In/Sec	.045 G-s
STD4 - Stand 4	(12-Aug-19)	
	OVERALL LEVEL	1K-20KHz
MOH	.073 In/Sec	.330 G-s
MIH	.074 In/Sec	.125 G-s
MIA	.154 In/Sec	.129 G-s
GIA	.075 In/Sec	.168 G-s
GIH	.072 In/Sec	.145 G-s
COH	.257 In/Sec	.027 G-s

STD5 - Stand 5 (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.046 In/Sec	.049 G-s
MIH	.057 In/Sec	.076 G-s
MIA	.081 In/Sec	.085 G-s
GIA	.036 In/Sec	.0018 G-s
GIH	.035 In/Sec	.030 G-s
GOH	.092 In/Sec	.096 G-s
COH	.409 In/Sec	.032 G-s

STD6 - Stand 6 (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.045 In/Sec	.063 G-s
MIH	.037 In/Sec	.061 G-s
MIA	.074 In/Sec	.052 G-s
GIA	.067 In/Sec	.010 G-s
GIH	.042 In/Sec	.031 G-s
GOH	.241 In/Sec	.070 G-s
COH	.257 In/Sec	.079 G-s

STD7 - Stand 7 (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.034 In/Sec	.044 G-s
MIH	.059 In/Sec	.085 G-s
MIA	.041 In/Sec	.043 G-s
GIA	.061 In/Sec	.0063 G-s
GIH	.033 In/Sec	.016 G-s
GOH	.149 In/Sec	.071 G-s
COH	.285 In/Sec	.088 G-s

STD8 - Stand 8 (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.031 In/Sec	.041 G-s
MIH	.052 In/Sec	.075 G-s
MIA	.059 In/Sec	.020 G-s
GIA	.047 In/Sec	.0094 G-s
GIH	.041 In/Sec	.075 G-s
COH	.118 In/Sec	.028 G-s

STD9 - Stand 9 (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.043 In/Sec	.077 G-s
MIH	.115 In/Sec	.103 G-s
MIA	.058 In/Sec	.060 G-s
GIA	.135 In/Sec	.111 G-s
GIH	.094 In/Sec	.948 G-s
COH	.167 In/Sec	.060 G-s

STD10 - Stand 10 (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.047 In/Sec	.038 G-s
MIH	.043 In/Sec	.123 G-s
MIA	.077 In/Sec	.074 G-s
GIA	.130 In/Sec	.322 G-s
GIH	.094 In/Sec	.523 G-s
COH	.107 In/Sec	.072 G-s

STD11 - Stand 11 (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.028 In/Sec	.011 G-s
MIH	.023 In/Sec	.028 G-s
MIA	.054 In/Sec	.031 G-s
GIA	.043 In/Sec	.015 G-s
GIH	.048 In/Sec	.074 G-s
GOH	.033 In/Sec	.093 G-s
COH	.129 In/Sec	.042 G-s

STD12 - Stand 12 (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.029 In/Sec	.076 G-s

	MIH	.027 In/Sec	.108 G-s
	MIA	.048 In/Sec	.062 G-s
	COH	.105 In/Sec	.029 G-s

STD13 - Stand 13 (12-Aug-19)

		OVERALL LEVEL	1K-20KHz
	MOH	.126 In/Sec	.129 G-s
	MIH	.069 In/Sec	.077 G-s
	MIA	.191 In/Sec	.173 G-s
	GIA	.025 In/Sec	.0036 G-s
	GIH	.034 In/Sec	.151 G-s
	GOH	.029 In/Sec	.277 G-s
	COH	.454 In/Sec	.488 G-s

STD14 - Stand 14 (12-Aug-19)

		OVERALL LEVEL	1K-20KHz
	MOH	.092 In/Sec	.227 G-s
	MIH	.070 In/Sec	.094 G-s
	MIA	.103 In/Sec	.130 G-s
	GIA	.090 In/Sec	.112 G-s
	GIH	.063 In/Sec	.167 G-s
	GOH	.045 In/Sec	.092 G-s
	COH	.576 In/Sec	.083 G-s

STD15 - Stand 15 (12-Aug-19)

		OVERALL LEVEL	1K-20KHz
	MOH	.062 In/Sec	.492 G-s
	MIH	.069 In/Sec	.239 G-s
	MIA	.060 In/Sec	.233 G-s
	GIA	.037 In/Sec	.313 G-s
	GIH	.056 In/Sec	.409 G-s
	COH	.092 In/Sec	.168 G-s

NORTH AC - NORTH AIR COMPRESSOR QUINCY (12-Aug-19)

		OVERALL LEVEL	1 - 20 KHz
	MOH	.144 In/Sec	.173 G-s
	MIH	.158 In/Sec	.389 G-s
	MIA	.244 In/Sec	.021 G-s
		OVERALL LEVEL	1K-20KHz
	CIA	.196 In/Sec	.425 G-s
	CIH	.200 In/Sec	.468 G-s
	COH	.141 In/Sec	.427 G-s

SOUTH AC - SOUTH AIR COMPRESSOR QUINCY (12-Aug-19)

		OVERALL LEVEL	1 - 20 KHz
	MOH	.226 In/Sec	.390 G-s
	MIH	.241 In/Sec	.404 G-s
	MIA	.113 In/Sec	.014 G-s
		OVERALL LEVEL	1K-20KHz
	CIA	.345 In/Sec	.607 G-s
	CIH	.386 In/Sec	.899 G-s
	COH	.284 In/Sec	.665 G-s

WEST AC - WEST AIR COMPRESSOR QUINCY (12-Aug-19)

		OVERALL LEVEL	1 - 20 KHz
	MOH	.221 In/Sec	.358 G-s
	MIH	.161 In/Sec	.330 G-s
	MIA	.274 In/Sec	.253 G-s
		OVERALL LEVEL	1K-20KHz
	CIA	.229 In/Sec	.786 G-s
	CIH	.260 In/Sec	.562 G-s
	COH	.227 In/Sec	.614 G-s

Database: nucorja9.rbm
Station: Roll Mill Utilities

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD
HYDPMP1	- Hydraulic Pump East	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.151 In/Sec	.218 G-s
MIH		.324 In/Sec	.196 G-s
PIV		.248 In/Sec	1.078 G-s
HYDPMP2	- Hydraulic Pump Center	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.109 In/Sec	.269 G-s
MIH		.318 In/Sec	.178 G-s
PIV		.229 In/Sec	1.533 G-s
DESFAN	- Desolution Fan	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.052 In/Sec	.040 G-s
MIH		.032 In/Sec	.031 G-s
COMFAN	- Combustion Air Fan	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.262 In/Sec	.275 G-s
MIH		.224 In/Sec	.282 G-s
MIA		.232 In/Sec	.186 G-s
FIH		.164 In/Sec	.584 G-s
FOH		.234 In/Sec	.766 G-s
EJCFAN	- Ejector Air Fan	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.078 In/Sec	.558 G-s
MIH		.074 In/Sec	.439 G-s
MIA		.075 In/Sec	.780 G-s
FIH		.040 In/Sec	.530 G-s
FOH		.089 In/Sec	.528 G-s
COLPMP2	- Furnace Cooling Pump center	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.282 In/Sec	.356 G-s
MIH		.196 In/Sec	.218 G-s
MIA		.074 In/Sec	.159 G-s
FCTSOUTH	- Furnace CT Drive South	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.082 In/Sec	.073 G-s
MIH		.068 In/Sec	.087 G-s
MIA		.079 In/Sec	.047 G-s
FCTNORTH	- Furnace CT Drive North	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.501 In/Sec	.051 G-s
MIH		.372 In/Sec	.107 G-s
MIA		.160 In/Sec	.097 G-s
SCLPMP2	- Scale Pit Pump North	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.578 In/Sec	.193 G-s
MIH		.199 In/Sec	.598 G-s
MIA		.155 In/Sec	.225 G-s
PIH		.177 In/Sec	.051 G-s
CTWTR2	- CT Pump West	(12-Aug-19)	
		OVERALL LEVEL	1K-20KHz
MOH		.064 In/Sec	.306 G-s
MIH		.087 In/Sec	.410 G-s
MIA		.200 In/Sec	.125 G-s

MILWTR3 - Mill Water Pump West (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.086 In/Sec	.328 G-s
MIH	.052 In/Sec	.201 G-s
MIA	.090 In/Sec	.119 G-s

MILWTR2 - Mill Water Pump Center (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.092 In/Sec	.383 G-s
MIH	.044 In/Sec	1.383 G-s
MIA	.047 In/Sec	.701 G-s

EASTBOOST - East Booster Pump Small (12-Aug-19)

	OVERALL LEVEL	1K-20KHz
MOH	.443 In/Sec	.126 G-s
MIH	.258 In/Sec	.097 G-s
MIA	.336 In/Sec	.126 G-s

Clarification Of Vibration Units:

Acc --> G-s RMS

Vel --> In/Sec PK