HI-SPEED INDUSTRIAL SERVICE QualiTest® Diagnostics

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June 19, 2020

Nucor Roll Mill
Jackson-Flowood, MS

Subject: June 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

## Defects

**Roll Stand 1A Planetary Gearbox**
Overall vibration amplitudes are varying with survey while gearbox data show signs of distress. We will continue to monitor this unit closely. Still rated as a **CLASS I** defect for now.

**Roll Stand 1 Motor**
There is a significant amount of 360 Hz. vibration especially at the drive end axial of the motor. There are also several rpm sidebands around the 360 Hz. peak. This indicates a drive problem such as SCR card fault. There could also be an issue with the armature. It is recommended to inspect the drive as soon as practical. This issue will be monitored closely. Because of the electrical vibration, this is rated as a **CLASS II** defect.

**Roll Stand 2 int. Gearbox**
Input rpm sidebands around the gear mesh frequencies indicate possible oscillation of the input gear set. This could be from an issue with the speed synch on the drives, drive line slop, or some other process issue. Gearbox may need an internal inspection in the future. Rated as a **CLASS I** defect.

**Roll Stand 4**
Int. gearbox vibration has varied from month to month. Data has been showing 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. We will continue to monitor this issue closely. Rated as a **CLASS I** defect.

**Roll Stand 5**
Vibration 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 still appears to be a vibration in this unit that may be due to imbalance of the fan wheel. Inspect, clean fan wheel as time allows. Ensure all bolts are tight. 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 decreased slightly from last month. 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**
Output side of the gearbox vibration increased this survey. We still suspect this to be possibly due to a resonant gear mesh frequency vibration. 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.

**Roll Stand 13 Cooling Fan Motor**
Fan appears to have vibration associated with fan imbalance. Resonance may also be a factor as this vibration does seem to vary slightly depending on the speed of the DC motor. We will monitor this closely. Rated as a **CLASS I** defect.

**Ejector Fan**
Motor axial vibration has increased to .45 ips-pk which is highest on record. Spectral data shows 2 and 3 x rpm vibrations at the inboard axial. This could be caused by a coupling issue, possible bent motor shaft, or rotor bar

issues. Fan bearings are also still showing some signs of possible looseness. Ensure bearing clearances are set properly. Couplings should also be checked. Check motor shaft with a dial indicator to confirm if shaft is bent. We will monitor this closely. Inspect as soon as time allows. Because of the high motor axial, this is rated as a **CLASS III** defect.

**Abbreviated Last Measurement Summary**

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**Database: nucorja9.rbm**
**Station: Roll Mill Rolls**
**Report Date: 19-Jun-20 13:51**

| MEASUREMENT POINT | OVERALL LEVEL | HFD / VHFD |
|---|---|---|
| **STD1A - Stand 1A** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .063 In/Sec | .012 G-s |
| MIH | .038 In/Sec | .014 G-s |
| MIA | .063 In/Sec | .122 G-s |
| COH | .285 In/Sec | .090 G-s |
| GIA | .022 In/Sec | .018 G-s |
| GIH | .043 In/Sec | .056 G-s |
| GI2 | .033 In/Sec | .030 G-s |
| GI3 | .029 In/Sec | .104 G-s |
| GI4 | .025 In/Sec | .113 G-s |
| GI5 | .014 In/Sec | .016 G-s |
| GI6 | .012 In/Sec | .032 G-s |
| GOH | .015 In/Sec | .013 G-s |
| **STD2A - Stand 2A** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .048 In/Sec | .0085 G-s |
| MIH | .069 In/Sec | .047 G-s |
| MIA | .109 In/Sec | .018 G-s |
| COH | .074 In/Sec | .083 G-s |
| **STD1 - Stand 1** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .077 In/Sec | .030 G-s |
| MIH | .081 In/Sec | .021 G-s |
| MIA | .226 In/Sec | .069 G-s |
| GIA | .084 In/Sec | .0056 G-s |
| GIH | .037 In/Sec | .014 G-s |
| COH | .114 In/Sec | .035 G-s |
| **STD2 - Stand 2** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .057 In/Sec | .039 G-s |
| MIH | .069 In/Sec | .045 G-s |
| MIA | .161 In/Sec | .127 G-s |
| GIA | .034 In/Sec | .014 G-s |
| GIH | .017 In/Sec | .022 G-s |
| COH | .115 In/Sec | .054 G-s |
| **STD3 - Stand 3** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .055 In/Sec | .094 G-s |
| MIH | .116 In/Sec | .054 G-s |
| MIA | .311 In/Sec | .177 G-s |
| GIA | .036 In/Sec | .038 G-s |
| GIH | .030 In/Sec | .029 G-s |
| COH | .122 In/Sec | .034 G-s |

STD4 - Stand 4 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .035 In/Sec | .027 G-s |
| MIH | .056 In/Sec | .0078 G-s |
| MIA | .073 In/Sec | .059 G-s |
| GIA | .032 In/Sec | .011 G-s |
| GIH | .052 In/Sec | .015 G-s |
| COH | .114 In/Sec | .028 G-s |

STD5 - Stand 5 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .036 In/Sec | .079 G-s |
| MIH | .094 In/Sec | .029 G-s |
| MIA | .079 In/Sec | .035 G-s |
| GIA | .042 In/Sec | .0044 G-s |
| GIH | .034 In/Sec | .0034 G-s |
| GOH | .059 In/Sec | .054 G-s |
| COH | .582 In/Sec | .023 G-s |

STD6 - Stand 6 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .039 In/Sec | .058 G-s |
| MIH | .035 In/Sec | .068 G-s |
| MIA | .091 In/Sec | .054 G-s |
| GIA | .031 In/Sec | .0069 G-s |
| GIH | .025 In/Sec | .0076 G-s |
| GOH | .065 In/Sec | .063 G-s |
| COH | .085 In/Sec | .081 G-s |

STD7 - Stand 7 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .046 In/Sec | .052 G-s |
| MIH | .062 In/Sec | .078 G-s |
| MIA | .052 In/Sec | .217 G-s |
| GIA | .039 In/Sec | .0071 G-s |
| GIH | .029 In/Sec | .023 G-s |
| GOH | .103 In/Sec | .032 G-s |
| COH | .377 In/Sec | .063 G-s |

STD8 - Stand 8 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .033 In/Sec | .023 G-s |
| MIH | .041 In/Sec | .054 G-s |
| MIA | .049 In/Sec | .048 G-s |
| GIA | .035 In/Sec | .023 G-s |
| GIH | .024 In/Sec | .014 G-s |
| COH | .116 In/Sec | .077 G-s |

STD9 - Stand 9 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .033 In/Sec | .070 G-s |
| MIH | .129 In/Sec | .105 G-s |
| MIA | .055 In/Sec | .067 G-s |
| GIA | .105 In/Sec | .0085 G-s |
| GIH | .053 In/Sec | .148 G-s |
| COH | .172 In/Sec | .358 G-s |

STD10 - Stand 10 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .036 In/Sec | .034 G-s |
| MIH | .048 In/Sec | .045 G-s |
| MIA | .058 In/Sec | .028 G-s |
| GIA | .039 In/Sec | .149 G-s |
| GIH | .039 In/Sec | .077 G-s |
| COH | .129 In/Sec | .039 G-s |

STD11 - Stand 11 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .021 In/Sec | .039 G-s |
| MIH | .027 In/Sec | .029 G-s |

| | | | |
|---|---|---|---|
| MIA | .050 In/Sec | .088 G-s | |
| GIA | .076 In/Sec | .038 G-s | |
| GIH | .055 In/Sec | .228 G-s | |
| GOH | .039 In/Sec | .114 G-s | |
| COH | .129 In/Sec | .026 G-s | |

STD12 - Stand 12 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .027 In/Sec | .074 G-s |
| MIH | .025 In/Sec | .121 G-s |
| MIA | .053 In/Sec | .194 G-s |
| COH | .124 In/Sec | .052 G-s |

STD13 - Stand 13 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .060 In/Sec | .149 G-s |
| MIH | .100 In/Sec | .082 G-s |
| MIA | .097 In/Sec | .102 G-s |
| GIA | .042 In/Sec | .044 G-s |
| GIH | .028 In/Sec | .052 G-s |
| GOH | .048 In/Sec | .017 G-s |
| COH | .369 In/Sec | .402 G-s |

STD14 - Stand 14 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .117 In/Sec | .286 G-s |
| MIH | .103 In/Sec | .152 G-s |
| MIA | .099 In/Sec | .050 G-s |
| GIA | .044 In/Sec | .055 G-s |
| GIH | .031 In/Sec | .019 G-s |
| GOH | .029 In/Sec | .064 G-s |
| COH | .423 In/Sec | .158 G-s |

STD15 - Stand 15 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .058 In/Sec | .252 G-s |
| MIH | .076 In/Sec | .501 G-s |
| MIA | .051 In/Sec | .166 G-s |
| GIA | .035 In/Sec | .071 G-s |
| GIH | .052 In/Sec | .366 G-s |

STD16 - Stand 16 (18-Jun-20)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .043 In/Sec | .119 G-s |
| MIH | .045 In/Sec | .257 G-s |
| MIA | .050 In/Sec | .147 G-s |
| GIA | .085 In/Sec | .017 G-s |
| GIH | .049 In/Sec | .023 G-s |
| GOH | .039 In/Sec | .019 G-s |
| COH | .190 In/Sec | .102 G-s |

NORTH AC - NORTH AIR COMPRESSOR QUINCY (18-Jun-20)

| | OVERALL LEVEL | 1 - 20 KHz |
|---|---|---|
| MOH | .143 In/Sec | .167 G-s |
| MIH | .138 In/Sec | .400 G-s |
| MIA | .263 In/Sec | .017 G-s |
| | OVERALL LEVEL | 1K-20KHz |
| CIA | .243 In/Sec | .550 G-s |
| CIH | .218 In/Sec | .413 G-s |
| COH | .196 In/Sec | .523 G-s |

SOUTH AC - SOUTH AIR COMPRESSOR QUINCY (18-Jun-20)

| | OVERALL LEVEL | 1 - 20 KHz |
|---|---|---|
| MOH | .073 In/Sec | .960 G-s |
| MIH | .158 In/Sec | .383 G-s |
| MIA | .102 In/Sec | .362 G-s |
| | OVERALL LEVEL | 1K-20KHz |
| CIA | .192 In/Sec | .458 G-s |
| CIH | .183 In/Sec | .373 G-s |
| COH | .235 In/Sec | .649 G-s |

Database: nucorja9.rbm
Station: Roll Mill Utilities

| MEASUREMENT POINT | OVERALL LEVEL | HFD / VHFD |
|---|---|---|
| **HYDPMP1 - Hydraulic Pump East** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .176 In/Sec | .147 G-s |
| MIH | .433 In/Sec | .169 G-s |
| PIV | .240 In/Sec | 1.103 G-s |
| **HYDPMP3 - Hydraulic Pump West** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .119 In/Sec | .345 G-s |
| MIH | .292 In/Sec | .335 G-s |
| PIV | .305 In/Sec | 3.535 G-s |
| **DESFAN - Desolution Fan** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .018 In/Sec | .081 G-s |
| MIH | .027 In/Sec | .040 G-s |
| **COMFAN - Combustion Air Fan** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .149 In/Sec | .171 G-s |
| MIH | .115 In/Sec | .268 G-s |
| MIA | .074 In/Sec | .161 G-s |
| FIH | .083 In/Sec | .131 G-s |
| FOH | .109 In/Sec | 1.169 G-s |
| **EJCFAN - Ejector Air Fan** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .088 In/Sec | .617 G-s |
| MIH | .085 In/Sec | 1.421 G-s |
| MIA | .454 In/Sec | 1.175 G-s |
| FIH | .065 In/Sec | 1.925 G-s |
| FOH | .062 In/Sec | 1.064 G-s |
| **COLPMP2 - Furnace Cooling Pump center** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .256 In/Sec | .331 G-s |
| MIH | .152 In/Sec | .481 G-s |
| MIA | .132 In/Sec | .110 G-s |
| **FCTSOUTH - Furnace CT Drive South** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .350 In/Sec | .081 G-s |
| MIH | .204 In/Sec | .157 G-s |
| MIA | .180 In/Sec | .015 G-s |
| **FCTNORTH - Furnace CT Drive North** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .278 In/Sec | .103 G-s |
| MIH | .143 In/Sec | .065 G-s |
| MIA | .154 In/Sec | .0060 G-s |
| **SCLPMP1 - Scale Pit Pump South** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .104 In/Sec | .312 G-s |
| MOV | .096 In/Sec | .428 G-s |
| MIV | .055 In/Sec | .106 G-s |
| MIH | .078 In/Sec | .122 G-s |
| MIA | .064 In/Sec | .058 G-s |
| **CTWTR1 - CT Pump East/Middle Pump** | (18-Jun-20) | |
| | OVERALL LEVEL | 1K-20KHz |
| MOH | .084 In/Sec | .487 G-s |
| MIH | .117 In/Sec | .260 G-s |

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            MIA                        .054 In/Sec        .112 G-s

      MILWTR3     - Mill Water Pump West           (18-Jun-20)
                                      OVERALL LEVEL      1K-20KHz
            MOH                        .070 In/Sec        .335 G-s
            MIH                        .049 In/Sec        .676 G-s
            MIA                        .029 In/Sec        .357 G-s

      MILWTR1     - Mill Water Pump East           (18-Jun-20)
                                      OVERALL LEVEL      1K-20KHz
            MOH                        .100 In/Sec        .223 G-s
            MIH                        .050 In/Sec        .323 G-s
            MIA                        .039 In/Sec        .100 G-s

      EASTBOOST   - East Booster Pump Small        (18-Jun-20)
                                      OVERALL LEVEL      1K-20KHz
            MOH                        .217 In/Sec       .0010 G-s
            MIH                        .200 In/Sec       .0043 G-s
            MIA                        .135 In/Sec       .0023 G-s

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   Clarification Of Vibration Units:
      Acc       -->  G-s       RMS
      Vel       -->  In/Sec    PK
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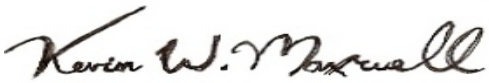
As always, it has been a pleasure to NUCOR Steel Flowood, MS. If there are any comments or questions, do not hesitate to contact us.

Sincerely,




**ISO Certified Vibration Analyst, Category III**

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