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December 22, 2021

NUCOR Melt Shop

Subject: December 2021 vibration survey

Below is a summary report for the Melt Shop monthly vibration survey that was performed on 12/21/21. Most of the machines surveyed were found to be in good condition except for 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.

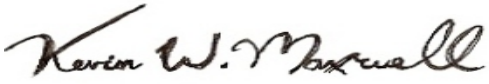
**Class III;** Defect (s) present that may cause failure in short term (less than 2 months). This should be addressed as soon as practical, with a high maintenance priority. Increase monitoring frequency.

**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.

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

Sincerely,



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## *Defects*

**West Caster Mold Water Pump**

High 2 x rpm vibration is present in in motor and pump. This indicates angular misalignment. Motor and pump may also have some internal wear. Perform a precision alignment with less than .003" offset and angularity (rim and face). Ensure there is no soft foot present in the motor. Rated as a **CLASS II** defect.

**East Caster Mold Water Pump**

***Pump was down this survey; however, the following still applies:*** Pump is still showing some signs of internal wear. Coupling is also showing signs of wear likely due to misalignment. Perform a precision alignment with less than .002" offset and angularity. Ensure there is no soft foot present. Rated as a **CLASS II** defect.

**Cooling Tower #2 Supply Pump**

Motor data is showing signs of motor bearing issues. The pump appears to have cavitation which is causing a high noise floor in the spectrum. This is also making the ODE pump bearing have high acceleration. This could also be a bearing issues, but the noise floor is masking the data somewhat. Pump impeller or other pump internals may also be worn which could be causing this vibration. Pump needs to be inspected as time allows. Rated as a **CLASS II** defect.

**Cooling Tower #3 Supply Pump**

***Pump was down this survey; however, the following still applies:*** The pump appears to have cavitation which is causing a high noise floor in the spectrum. This is also making the ODE pump bearing have high acceleration. This could also be a bearing issues, but the noise floor is masking the data somewhat. Pump impeller or other pump internals could also be worn which could be causing this vibration. Pump needs to be inspected as time allows. Rated as a **CLASS II** defect.

**Cooling Tower Pump #5**

Pump vibration has increased significantly since last month's survey. Pump has a high amplitude 1 x rpm vibration with a 2 x rpm vibration present as well. This could be coupling related or issue with impeller causing an imbalance. For now, it is recommended to inspect the pump coupling. If all looks good, then the issue may be with the impeller or pump shaft could be bent. Rated as a **CLASS III** defect.

**Cooling Tower #6 Supply Pump**

The pump vibration data is still indicating that there is bearing wear, and possibly cavitation in the pump. Inspect ODE pump bearing SOON. Ensure the pump has no inlet restrictions and is operating in the correct part of the curve. Rated as a **CLASS II** defect.

**Caster ID Baghouse Fan**

The bearing peaks and sidebands previously seen appear to have subsided for the most part, Previous data showed fan inboard axial spectrum to have several sidebands peaks around 2 x outer race defect frequency. We are monitoring this closely. Rated as a **CLASS I** defect for now.

**Furnace Reverse Air Fan**

The thrusting and impacting that was seen last survey was not present this month. It is unclear if any actions had been taken since or if the process flow was influencing this. Rated as a **CLASS I** defect for now.

**Spray Chamber Exhaust Fan**

Motor and fan have high fan speed vibration. Outboard fan bearing is showing signs of defects/wear. Inspect fan bearings especially the ODE fan bearing for defects and proper lubrication as soon as practical. This unit is very likely operating near a critical speed and is resonant which is likely influencing the high vibration in the motor and fan. Fan also has some imbalance likely caused by build-up. Because of the high vibration amplitudes, this is rated as a **CLASS III** defect.

**South Caster Oscillator**

***Caster was down this survey; however, the following still applies:*** This unit has visible axial movement of the input of the gear drive. You can see the movement at the coupling gap. Data of the gear drive does show some gear noise and this unit seems to be knocking worse than the other two drives. Inspect unit as scheduling allows. Rated as a **CLASS II** defect.

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Abbreviated Last Measurement Summary
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            Database:  nucorja9.rbm
            Station:   Melt Shop
            Route No.  1:  MELT SHOP
            Report Date:  22-Dec-21   09:38

    MEASUREMENT POINT            OVERALL LEVEL       HFD / VHFD
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    WCMWP      - WEST CASTER MOLD WATER PUMP   (21-Dec-21)
                                 OVERALL LEVEL     1K-20KHz
           MOH                    .299 In/Sec       .586 G-s
           MIH                    .237 In/Sec      1.164 G-s
           MIA                    .180 In/Sec       .691 G-s
           PIA                    .151 In/Sec      1.435 G-s
           PIH                    .121 In/Sec      1.181 G-s
           POH                    .174 In/Sec      1.128 G-s

    MCMWP      - MID CASTER MOLD WATER PUMP    (21-Dec-21)
                                 OVERALL LEVEL     1K-20KHz
           MOH                    .106 In/Sec       .698 G-s
           MIH                    .126 In/Sec       .828 G-s
           MIA                    .206 In/Sec       .589 G-s
           PIA                    .161 In/Sec       .800 G-s
           PIH                    .180 In/Sec      1.026 G-s
           POH                    .138 In/Sec      1.031 G-s

    EBOSTRP    - EAST Booster PUMP             (21-Dec-21)
                                 OVERALL LEVEL     1K-20KHz
           MOH                    .118 In/Sec       .095 G-s
           MIH                    .080 In/Sec       .187 G-s
           MIA                    .042 In/Sec       .112 G-s
           PIA                    .086 In/Sec       .061 G-s
           PIH                    .091 In/Sec       .108 G-s
           POH                    .069 In/Sec       .215 G-s

    ECSWP 1LFT - EAST CASTER SPRAY WP 1 LEFT   (21-Dec-21)
                                 OVERALL LEVEL     1K-20KHz
           MOH                    .240 In/Sec       .602 G-s
           MIH                    .100 In/Sec       .489 G-s
           MIA                    .102 In/Sec       .690 G-s

    MCSWP 2LFT - MID CASTER SPRAY WP 2 LEFT    (21-Dec-21)
                                 OVERALL LEVEL     1K-20KHz
           MOH                    .085 In/Sec       .316 G-s
           MIH                    .094 In/Sec       .671 G-s
           MIA                    .101 In/Sec       .471 G-s

    MCSWP 3RT  - MID CASTER SPRAY WP 3 RIGHT   (21-Dec-21)
                                 OVERALL LEVEL     1K-20KHz
           MOH                    .206 In/Sec       .589 G-s
           MIH                    .143 In/Sec       .608 G-s
           MIA                    .096 In/Sec       .440 G-s

    ESERVOHYDP - EAST SERVO Hyd PUMP           (21-Dec-21)
                                 OVERALL LEVEL     1K-20KHz
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| | | | |
|---|---|---|---|
| MOH | .033 In/Sec | .189 G-s | |
| MIH | .074 In/Sec | .135 G-s | |
| PIV | .162 In/Sec | 1.085 G-s | |

MSERVOHYDP - MIDDLE SERVO Hyd PUMP (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .210 In/Sec | .293 G-s |
| MIH | .162 In/Sec | .429 G-s |
| PIV | .210 In/Sec | .994 G-s |

SERVOHRECP - SERVO Hyd RECIRC PUMP (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .060 In/Sec | .123 G-s |
| MIH | .091 In/Sec | .459 G-s |
| PIV | .163 In/Sec | .965 G-s |

N2DECKHYDP - North 2ND DECK Hyd PUMP (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .070 In/Sec | .877 G-s |
| MIH | .137 In/Sec | .825 G-s |
| PIV | .424 In/Sec | 6.418 G-s |

2DEKRECIP - 2ND DECK L&S Hyd RECIRC PUM (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .102 In/Sec | .355 G-s |
| MIH | .122 In/Sec | .449 G-s |
| PIV | .369 In/Sec | 1.261 G-s |

S2DECKHYDP - SOUTH 2ND DECK Hyd PUMP (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .108 In/Sec | .627 G-s |
| MIH | .080 In/Sec | .872 G-s |
| PIV | .203 In/Sec | 2.269 G-s |

1SUPLYP - #1 Supply Pump (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .061 In/Sec | .214 G-s |
| MIH | .061 In/Sec | .184 G-s |
| MIA | .096 In/Sec | .114 G-s |
| PIA | .225 In/Sec | .974 G-s |
| PIH | .183 In/Sec | .752 G-s |
| POH | .192 In/Sec | .964 G-s |

2SUPLYP - #2 Supply Pump (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .078 In/Sec | 1.347 G-s |
| MIH | .090 In/Sec | 1.718 G-s |
| MIA | .070 In/Sec | .687 G-s |
| PIA | .207 In/Sec | .814 G-s |
| PIH | .217 In/Sec | .771 G-s |
| POH | .256 In/Sec | 1.452 G-s |

5SUPLYP - #5 Supply Pump (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .087 In/Sec | .609 G-s |
| MIH | .156 In/Sec | 1.190 G-s |
| MIA | .131 In/Sec | .449 G-s |
| PIA | .816 In/Sec | 1.489 G-s |
| PIH | .614 In/Sec | 1.069 G-s |
| POH | .306 In/Sec | 1.251 G-s |

6SUPLYP - #6 Supply Pump (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .059 In/Sec | .238 G-s |
| MIH | .080 In/Sec | .219 G-s |
| MIA | .083 In/Sec | .168 G-s |
| PIA | .172 In/Sec | .833 G-s |
| PIH | .193 In/Sec | .575 G-s |
| POH | .230 In/Sec | 1.884 G-s |

CBRA - CASTER BAGHOUSE REVERSE AIR (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .041 In/Sec | .451 G-s |
| MIH | .033 In/Sec | .197 G-s |
| MIA | .021 In/Sec | .093 G-s |
| FIH | .020 In/Sec | .195 G-s |
| FOH | .040 In/Sec | .138 G-s |

CBID - CASTER BAGHOUSE ID FAN (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .077 In/Sec | .105 G-s |
| MOV | .042 In/Sec | .155 G-s |
| MIH | .083 In/Sec | .211 G-s |
| MIV | .047 In/Sec | .163 G-s |
| MIA | .033 In/Sec | .204 G-s |
| FIA | .094 In/Sec | 1.702 G-s |
| FIH | .109 In/Sec | 2.249 G-s |
| FIV | .069 In/Sec | .967 G-s |
| FOH | .111 In/Sec | .677 G-s |
| FOV | .033 In/Sec | .697 G-s |
| FOA | .055 In/Sec | .399 G-s |

FRAF - Furnace REVERSE AIR Fan (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .050 In/Sec | 1.040 G-s |
| MIH | .054 In/Sec | .346 G-s |
| MIA | .044 In/Sec | .203 G-s |
| FIA | .040 In/Sec | .367 G-s |
| FIH | .041 In/Sec | .431 G-s |
| FOH | .037 In/Sec | .268 G-s |

EFBHF - East Furnace Bag House Fan (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .073 In/Sec | 1.015 G-s |
| MIH | .069 In/Sec | .675 G-s |
| MIA | .066 In/Sec | 1.035 G-s |
| FIA | .067 In/Sec | .588 G-s |
| FIH | .067 In/Sec | .995 G-s |
| FOH | .096 In/Sec | 1.116 G-s |

WFBHF - WEST Furnace Bag House Fan (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .082 In/Sec | .803 G-s |
| MIH | .085 In/Sec | .543 G-s |
| MIA | .083 In/Sec | .389 G-s |
| FIA | .100 In/Sec | 1.342 G-s |
| FIH | .089 In/Sec | 1.139 G-s |
| FOH | .101 In/Sec | 1.017 G-s |

SCEXFAN - SPRAY CHAMBER EXHAUST Fan (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | 1.918 In/Sec | .336 G-s |
| MIH | 2.111 In/Sec | .323 G-s |
| MIA | .935 In/Sec | .182 G-s |
| FIH | .673 In/Sec | .284 G-s |
| FOH | .834 In/Sec | .753 G-s |

ENARCOHYDP - EAST NARCO Hyd PUMP (21-Dec-21)

| | OVERALL LEVEL | 1K-20KHz |
|---|---|---|
| MOH | .055 In/Sec | .289 G-s |
| MIH | .057 In/Sec | .287 G-s |
| PIV | .137 In/Sec | .678 G-s |

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Clarification Of Vibration Units:

Acc --> G-s RMS

Vel --> In/Sec PK