

7030 Ryburn Dr. Millington, TN

Phone: (901) 873-5300

Fax: (901) 873-5301

www.gohispeed.com

July 29, 2022

NUCOR Melt Shop Subject: July 2022 vibration survey

Below is a summary report for the Melt Shop monthly vibration survey that was performed on 7/27/22. 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.

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

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

<u>Class III</u>: 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.

<u>Class IV</u>; 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,

evin W. Marcuell

ISO Certified Vibration Analyst, Category III



Cell: 901-486-4565 Email: <u>kwilliam@gohispeed.com</u>

Defects

West Caster Mold Water Pump

Elevated 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 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

Pump was down this survey; however, the following still applies: 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 was recently replaced; however, data still shows high 1 x rpm axial vibration in the pump. Pump impeller/shaft could be out of balance or pump has cocked bearing or some other internal misalignment. Inspect as time allows. Rated as a **CLASS II** 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

Motor inboard vertical waveform data still shows an impacting or knock type vibration; however, amplitudes in motor are low at this time. We will continue to monitor this very closely. There was also an increase in overall amplitude of the fan drive end axial from .1 ips-pk to .5 ips-pk. The mill was down during testing so this might have influenced the vibration some if dampeners were closed off. If axial vibration persists during normal operation, then couplings and DE fan bearing should be visually inspected. Rated as a **CLASS II** 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.

Database: nucorja9.rbm Station: Melt Shop

	MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD
WCMWP	- WEST CASTER MOLD WATER PUMP	(28-Jul-22)	
		OVERALL LEVEL	1K-20KHz
МОН -	MOTOR OUTBOARD HORIZONTAL	.220 In/Sec	.397 G-s
MIH -	MOTOR INBOARD HORIZONTAL	.170 In/Sec	.763 G-s
MIA -	MOTOR INBOARD AXIAL	.216 In/Sec	.874 G-s
PIA -	PUMP INBOARD AXIAL	.165 In/Sec	1.618 G-s
PIH -	PUMP INBOARD HORIZONTAL	.161 In/Sec	1.736 G-s
РОН -	PUMP OUTBOARD HORIZONTAL	.201 In/Sec	1.948 G-s
ECMWP	- EAST CASTER MOLD WATER PUMP	(28-Jul-22)	
		OVERALL LEVEL	1K-20KHz
мон -	MOTOR OUTBOARD HORIZONTAL	.230 In/Sec	.162 G-s
MIH -	MOTOR INBOARD HORIZONTAL	.222 In/Sec	.188 G-s
MIA -	MOTOR INBOARD AXIAL	.125 In/Sec	.133 G-s
PIA -	PUMP INBOARD AXIAL	.484 In/Sec	.293 G-s
PIH -	PUMP INBOARD HORIZONTAL	.238 In/Sec	.901 G-s
POH -	PUMP OUTBOARD HORIZONTAL	.162 In/Sec	.958 G-s
WBOSTI	RP - WEST Booster PUMP	(28-Jul-22)	
		OVERALL LEVEL	1K-20KHz
мон -	MOTOR OUTBOARD HORIZONTAL	.058 In/Sec	.330 G-s
MIH -	MOTOR INBOARD HORIZONTAL	.069 In/Sec	.360 G-s
MIA -	MOTOR INBOARD AXIAL	.033 In/Sec	.195 G-s
PIA -	PUMP INBOARD AXIAL	.096 In/Sec	.516 G-s
PIH -	PUMP INBOARD HORIZONTAL	.124 In/Sec	.916 G-s
рон -	PUMP OUTBOARD HORIZONTAL	.230 In/Sec	1.983 G-s
ECSWP	1LFT - EAST CASTER SPRAY WP 1 LEFT	(28-Jul-22)	
		OVERALL LEVEL	1K-20KHz
мон -	MOTOR OUTBOARD HORIZONTAL	.109 In/Sec	.301 G-s
MIH -	MOTOR INBOARD HORIZONTAL	.069 In/Sec	.266 G-s
MIA -	MOTOR INBOARD AXIAL	.075 In/Sec	.183 G-s
PIA -	PUMP INBOARD AXIAL	.136 In/Sec	.208 G-s
MCSWP	2LFT - MID CASTER SPRAY WP 2 LEFT	(28-Jul-22)	
		OVERALL LEVEL	1K-20KHz
мон -	MOTOR OUTBOARD HORIZONTAL	.129 In/Sec	.198 G-s
MIH -	MOTOR INBOARD HORIZONTAL	.084 In/Sec	.600 G-s
MIA -	MOTOR INBOARD AXIAL	.113 In/Sec	.145 G-s
WCSWP	4RT - WEST CASTER SPRAY WP 4 RIGH	(28-Jul-22)	
		OVERALL LEVEL	1K-20KHz
мон -	MOTOR OUTBOARD HORIZONTAL	.203 In/Sec	.557 G-s
MIH -	MOTOR INBOARD HORIZONTAL	.147 In/Sec	.940 G-s
MIA -	MOTOR INBOARD AXIAL	.107 In/Sec	.421 G-s

ESERVOHYDP - EAST SERVO Hyd PUMP (28-Jul-22) (28-Jul-22) OVERALL LEVEL 1K-20KHz .027 In/Sec .183 G-s .065 In/Sec .098 G-s .127 In/Sec .317 G-s MOH - MOTOR OUTBOARD HORIZONTAL MIH - MOTOR INBOARD HORIZONTAL PIV - PUMP INBOARD VERTICAL MSERVOHYDP - MIDDLE SERVO Hyd PUMP (28-Jul-22)
 OVERALL LEVEL
 1K-20KHz

 .163 In/Sec
 .307 G-s

 .064 In/Sec
 .483 G-s

 .11 In/Sec
 .256 G-s
MOH - MOTOR OUTBOARD HORIZONTAL MIH - MOTOR INBOARD HORIZONTAL PIV - PUMP INBOARD VERTICAL .356 G-s .211 In/Sec (28-Jul-22) SERVOHRECP - SERVO Hyd RECIRC PUMP
 OVERALL LEVEL
 1K-20KHz

 .135 In/Sec
 .094 G-s

 .096 In/Sec
 .421 G-s

 .217 In/Sec
 2.045 G-s
MOH - MOTOR OUTBOARD HORIZONTAL MIH - MOTOR INBOARD HORIZONTAL PIV - PUMP INBOARD VERTICAL 1SUPLYP - #1 Supply Pump (28-Jul-22)
 OVERALL LEVEL
 1K-20KHz

 .047 In/Sec
 .163 G-s

 .068 In/Sec
 .246 G-s
MOH - MOTOR OUTBOARD HORIZONTAL.047 In/Sec.163 G-sMIH - MOTOR INBOARD HORIZONTAL.068 In/Sec.246 G-sMIA - MOTOR INBOARD AXIAL.078 In/Sec.134 G-sPIA - PUMP INBOARD AXIAL.224 In/Sec.598 G-sPIH - PUMP INBOARD HORIZONTAL.189 In/Sec.735 G-sPOH - PUMP OUTBOARD HORIZONTAL.170 In/Sec.810 G-s 4SUPLYP - #4 Supply Pump (28-Jul-22) ASOFLIF- #4 Supply Pump(28-Jul-22)OVERALL LEVEL1K-20KHzMOH - MOTOR OUTBOARD HORIZONTAL.057 In/SecMIH - MOTOR INBOARD HORIZONTAL.053 In/SecMIA - MOTOR INBOARD AXIAL.075 In/SecPIA - PUMP INBOARD AXIAL.183 In/SecPIH - PUMP INBOARD HORIZONTAL.178 In/SecPOH - PUMP OUTBOARD HORIZONTAL.173 In/Sec (28-Jul-22) 5SUPLYP - #5 Supply Pump Stormer+*5 Supply Pump(28-Jul-22)
OVERALL LEVEL1K-20KHzMOH - MOTOR OUTBOARD HORIZONTAL.052 In/Sec.784 G-sMIH - MOTOR INBOARD HORIZONTAL.060 In/Sec.773 G-sMIA - MOTOR INBOARD AXIAL.078 In/Sec.254 G-sPIA - PUMP INBOARD AXIAL.374 In/Sec.610 G-sPIH - PUMP INBOARD HORIZONTAL.179 In/Sec.683 G-sPOH - PUMP OUTBOARD HORIZONTAL.328 In/Sec1.385 G-s (28-Jul-22) 6SUPLYP - #6 Supply Pump
 OVERALL LEVEL
 1K-20KHz

 .051 In/Sec
 .206 G-s

 .062 In/Sec
 .157 G-s
MOH - MOTOR OUTBOARD HORIZONTAL .206 G-s MIH - MOTOR INBOARD HORIZONTAL .157 G-s MIA - MOTOR INBOARD AXIAL .069 In/Sec .093 G-s .189 In/Sec .537 G-s .176 In/Sec .666 G-s .314 In/Sec 2.675 G-s PIA - PUMP INBOARD AXIAL PIA - PUMP INBOARD AATAL PIH - PUMP INBOARD HORIZONTAL POH - PUMP OUTBOARD HORIZONTAL CBRA - CASTER BAGHOUSE REVERSE AIR (28-Jul-22) CERACASTER BAGHOUSE REVERSE AIR(28-501-22)OVERALL LEVEL1K-20KHzMOH - MOTOR OUTBOARD HORIZONTAL.041 In/Sec.033 In/Sec.443 G-sMIA - MOTOR INBOARD HORIZONTAL.030 In/SecFIH - FAN INBOARD HORIZONTAL.023 In/SecFOH - FAN OUTBOARD HORIZONTAL.039 In/Sec.039 In/Sec.095 G-s CBID- CASTER BAGHOUSE ID FAN(28-Jul-22)
OVERALL LEVEL1K-20KHzMOH - MOTOR OUTBOARD HORIZONTAL.071 In/Sec.072 G-sMOV - MOTOR OUTBOARD VERTICAL.049 In/Sec.093 G-sMIH - MOTOR INBOARD HORIZONTAL.077 In/Sec.218 G-sMIV - MOTOR INBOARD VERTICAL.090 In/Sec.431 G-sMIA - MOTOR INBOARD AXIAL.066 In/Sec.354 G-sFIA - FAN INBOARD AXIAL.501 In/Sec1.700 G-s

FIH - FAN INBOARD HORIZONTAL	.209 In/Sec	2.102 G-s
FIV - FAN INBOARD VERTICAL	.158 In/Sec	1.215 G-s
FOH - FAN OUTBOARD HORIZONTAL	.170 In/Sec	.351 G-s
FOV - FAN OUTBOARD VERTICAL	.045 In/Sec	.390 G-s
FOA - FAN OUTBOARD AXIAL	.182 In/Sec	.446 G-s
FRAF - Furnace REVERSE AIR Fan	(28-Jul-22)	
	OVERALL LEVEL	1K-20KHz
MOH - MOTOR OUTBOARD HORIZONTAL	.046 In/Sec	.148 G-s
MIH - MOTOR INBOARD HORIZONTAL	.044 In/Sec	.381 G-s
MIA - MOTOR INBOARD AXIAL	.029 In/Sec	.132 G-s
FIA - FAN INBOARD AXIAL	.044 In/Sec	.311 G-s
FIH - FAN INBOARD HORIZONTAL	.039 In/Sec	.746 G-s
FOH - FAN OUTBOARD HORIZONTAL	.026 In/Sec	.193 G-s
EFBHF - East Furnace Bag House Fan	(28-Jul-22)	
-	OVERALL LEVEL	1K-20KHz
MOH - MOTOR OUTBOARD HORIZONTAL	.049 In/Sec	.270 G-s
MIH - MOTOR INBOARD HORIZONTAL	.064 In/Sec	.591 G-s
MIA - MOTOR INBOARD AXIAL	.040 In/Sec	.380 G-s
FIA - FAN INBOARD AXIAL	.071 In/Sec	.522 G-s
FIH - FAN INBOARD HORIZONTAL	.073 In/Sec	1.028 G-s
FOH - FAN OUTBOARD HORIZONTAL	.099 In/Sec	1.445 G-s
WERDE - WECT FURDACO RAG HOUSO FAD	(28111-22)	
WIDH - WEST FULLACE Day house Fail	(20-DUI-22)	18-2088
	085 TR/Soc	580 C-c
MUL - MOTOR TUBOARD HORIZONTAL	112 In/Sec	.503 G-s
MIN MOTOR INBOARD NORIZONIAL	105 In/Sec	.555 G S
FIA - FAN INBOARD AXIAL	.105 IN/Sec	.070 G-S
FIN - FAN INDOARD AAIAD	145 In/Sec	1 729 G-S
FIII - FAN INDOARD HORIZONIAL	139 In/Sec	1.729 G-S
FON - FAN OUTBOARD NORTZONTAL	.139 11/360	.009 G-S
SCEXFAN - SPRAY CHAMBER EXHAUST Fan	(28-Jul-22)	
	OVERALL LEVEL	1K-20KHz
MOH - MOTOR OUTBOARD HORIZONTAL	.483 In/Sec	.305 G-s
MIH - MOTOR INBOARD HORIZONTAL	.517 In/Sec	.261 G-s
MIA - MOTOR INBOARD AXIAL	.250 In/Sec	.153 G-s
FIH - FAN INBOARD HORIZONTAL	.396 In/Sec	.211 G-s
FOH - FAN OUTBOARD HORIZONTAL	.459 In/Sec	.208 G-s
ENARCOHYDD - EAST NARCO Hyd DIMP	(28111-22)	
	OVERALI. LEVEL	1K-20KHz
MOH - MOTOR OUTBOARD HORTZONTAL	.035 In/Sec	.207 G-s
MTH - MOTOR INBOARD HORIZONTAL	031 Tn/Sec	372 6-9
PTV - PIMP INBOARD VERTICAL	062 In/Sec	746 G-s
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Clarification Of Vibration Units: Acc --> G-s RMS Vel --> In/Sec PK