FLUKE® Reliability

GAIN DEEP INSIGHTS INTO BEARING HEALTH WITH ULTRASOUND

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Accelix™
Webinar Series

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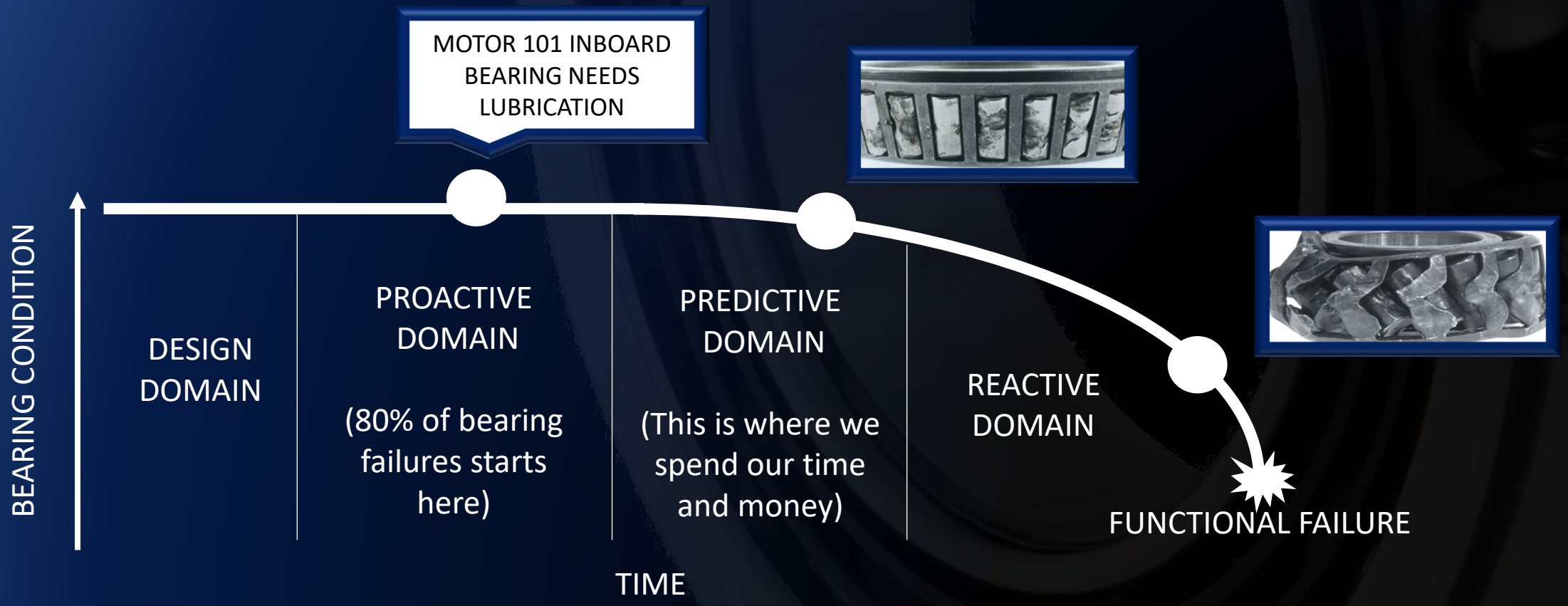
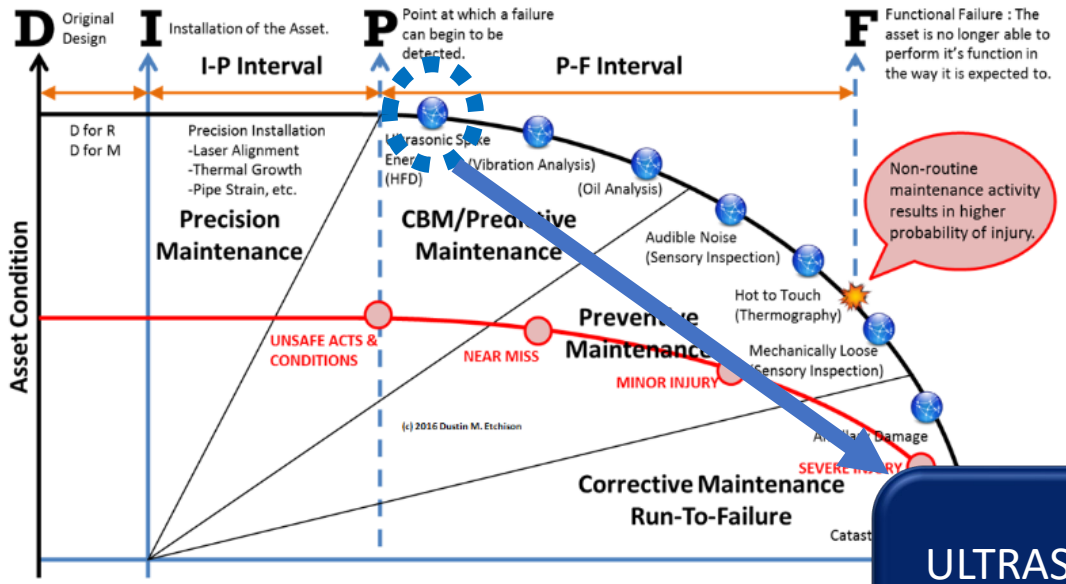
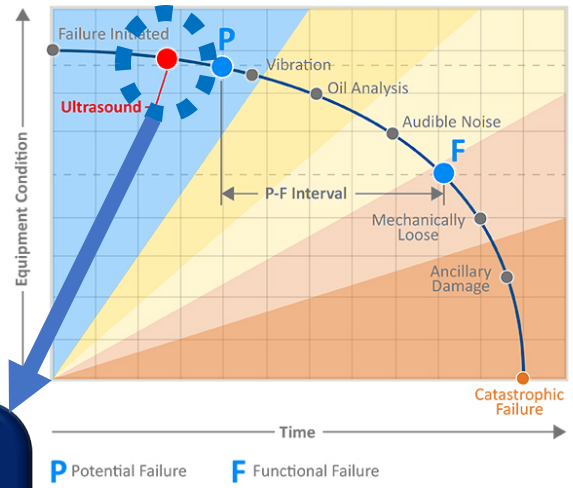
STOP MONITORING YOUR BEARINGS AND START MANAGING THEM!

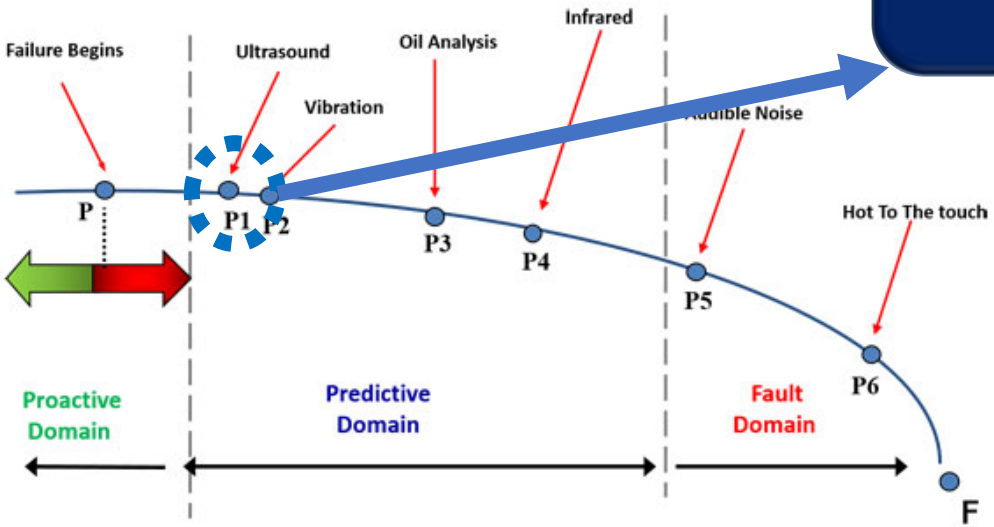


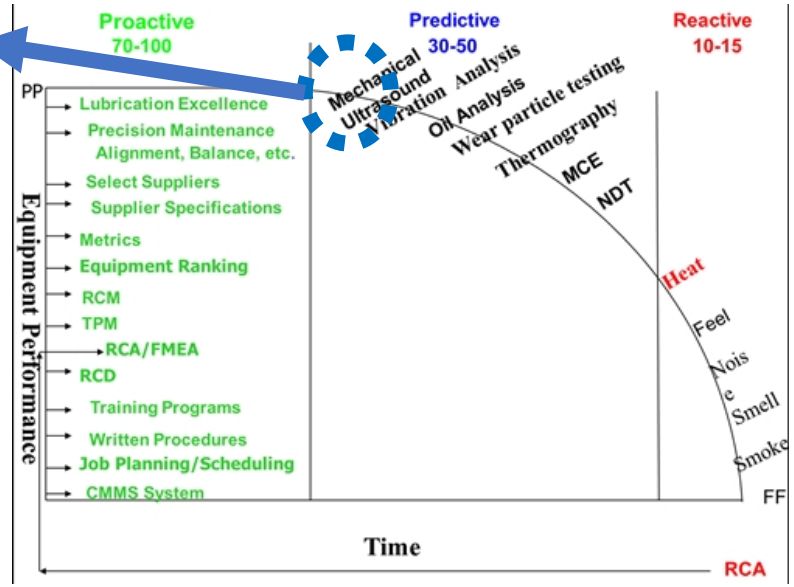


Ultrasound Is The First Line of Defence

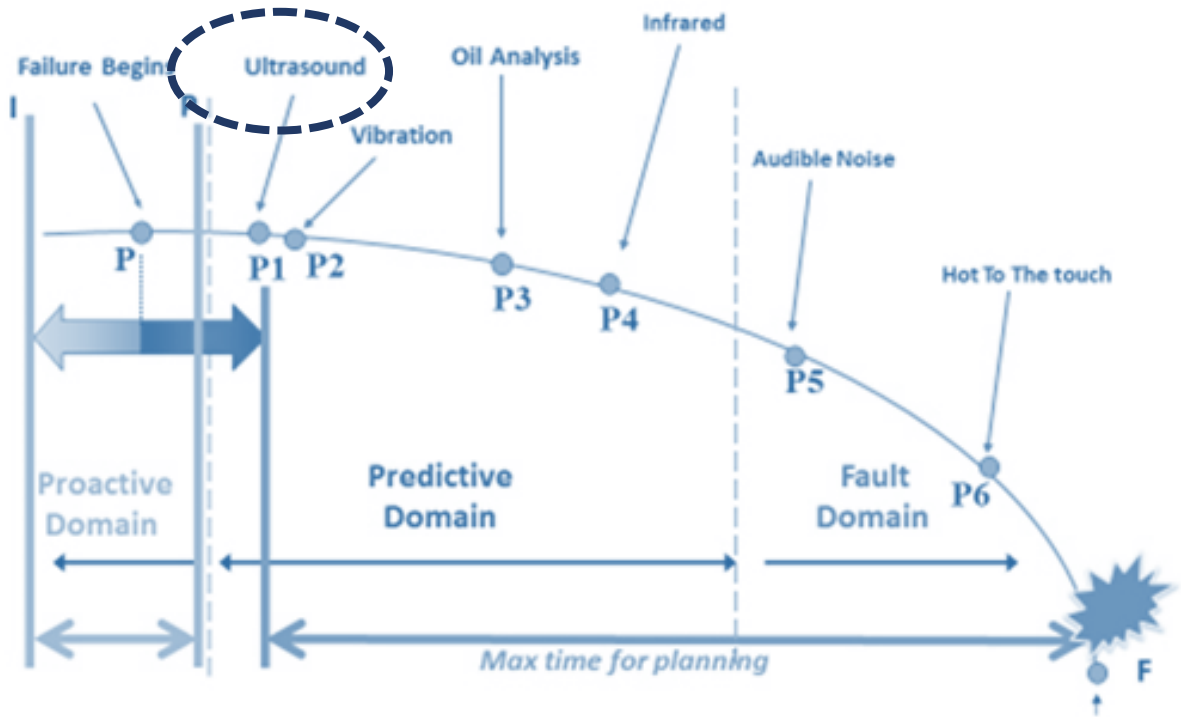


ULTRASOUND OWN THE APEX OF THE P-F CURVE FOR BEARINGS



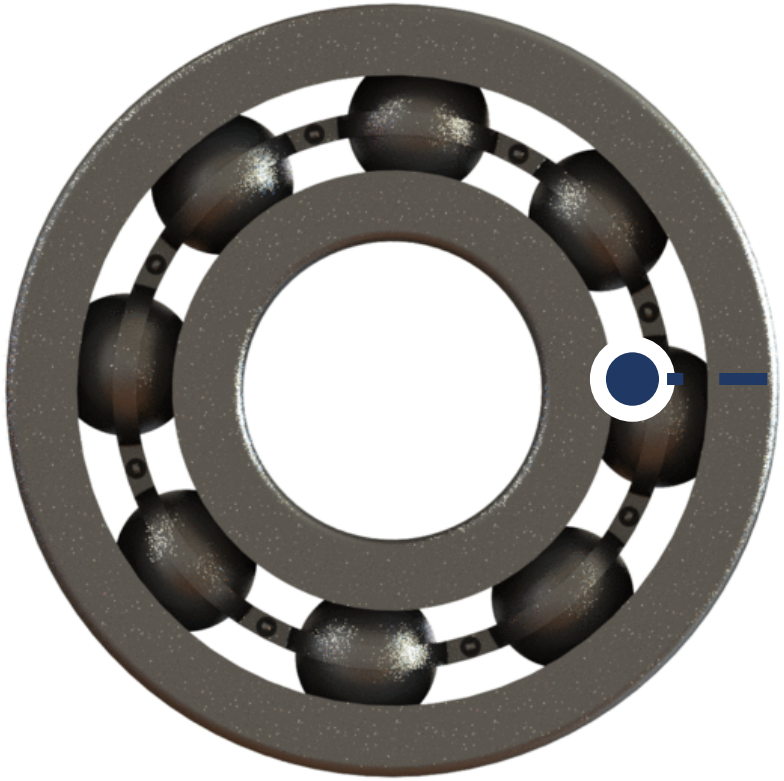


THE POWER OF ULTRASOUND



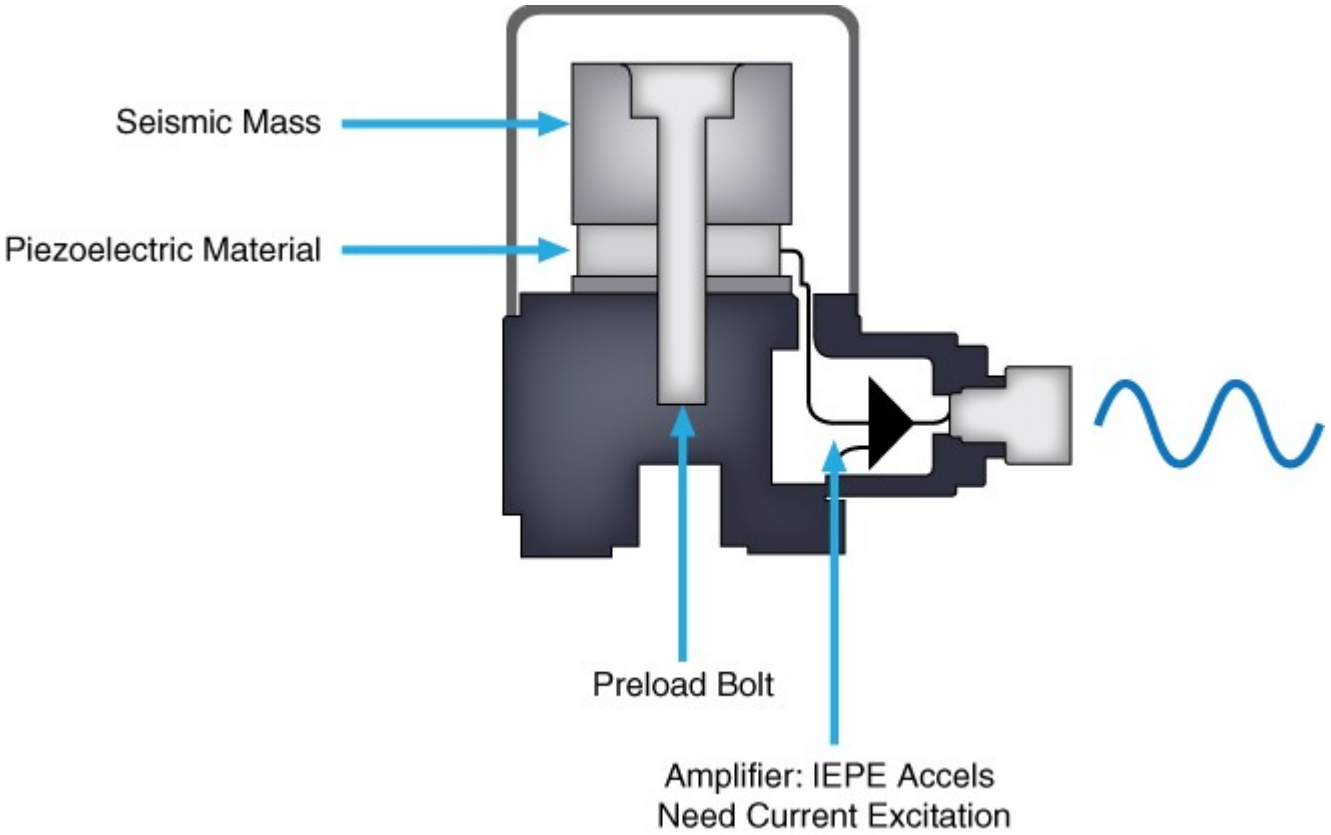
"Ultrasonic monitoring of bearings provides the earliest warning of bearing failure. An increase in amplitude of a monitored ultrasonic frequency of 12 decibels over baseline would indicate the initial (incipient) stages of bearing failure. This change is ***detected long before it is indicated by changes in vibration or temperature."***

THE POWER OF ULTRASOUND



*ULTRASOUND SENSORS DETECT FRICTION. BY FOCUSING ON A NARROW BAND OF HIGH FREQUENCIES, IT DETECTS SUBTLE CHANGES IN AMPLITUDE AND SOUND QUALITY PRODUCED BY **FRICTION***

THE VALUE OF VIBRATION



BEARING MUST "MOVE" BEFORE IT WILL DETECT A FAILURE.

QUESTION…

DO YOU AGREE?

Even without identifying the exact cause of a fault, there is great value in simply identifying that maintenance is required, therefore avoiding catastrophic failure and the potential for secondary damage, injured personnel and excessive downtime.

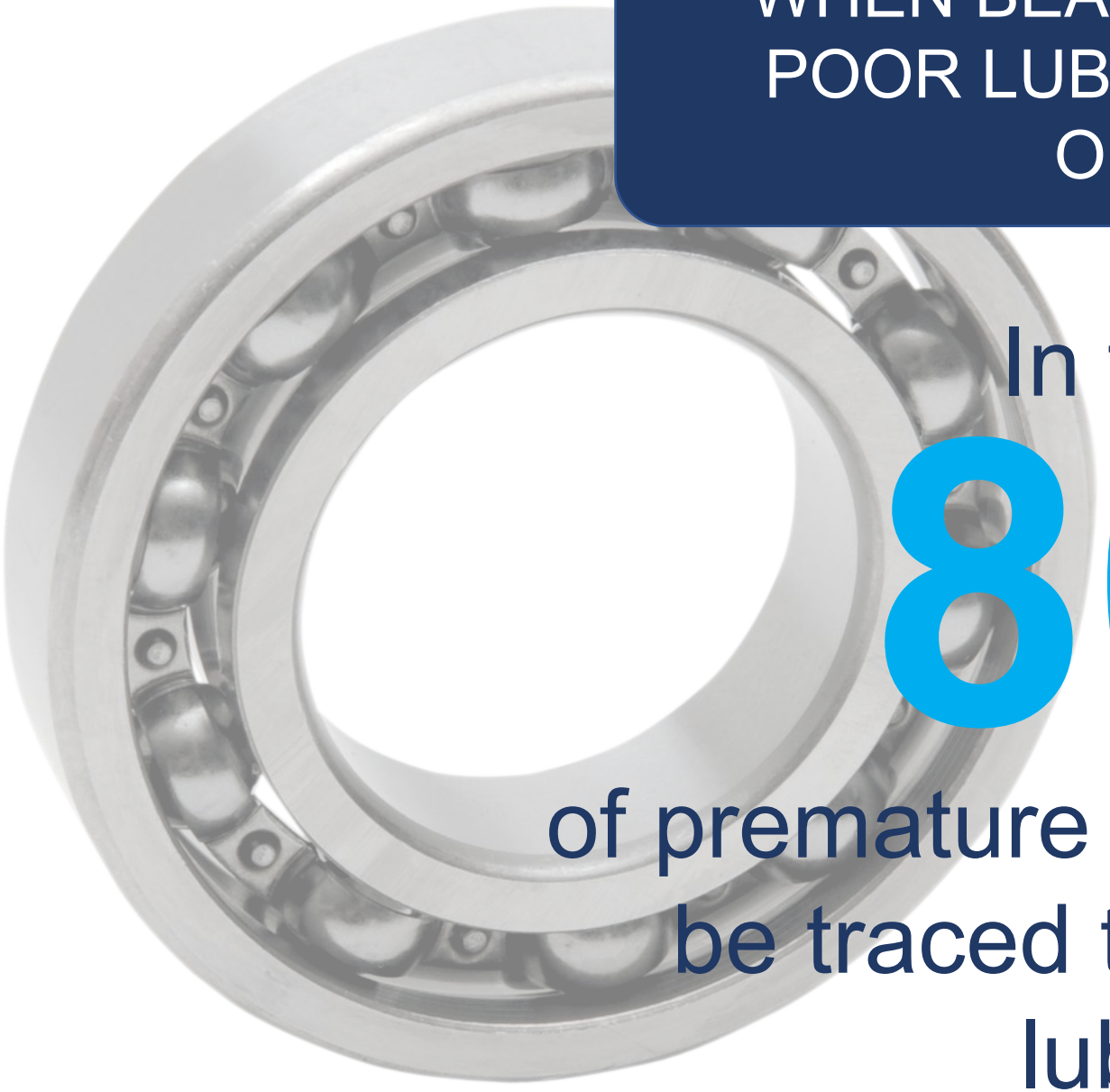
PUT AN END TO ANALYZING HEALTHY BEARINGS!

ON AVERAGE

80-90%

OF MACHINES RUN WITHOUT ANY IMPENDING ISSUE. IN FACT, THE CONDITION MEASUREMENTS DO NOT PROVIDE ANY INDICATION OF AN UPCOMING MECHANICAL PROBLEM; THEY JUST CONFIRM THAT THE MACHINE CONDITION IS FINE.

WHEN BEARINGS FAIL PREMATURELY, POOR LUBRICATION PRACTICES ARE OFTEN THE CAUSE.



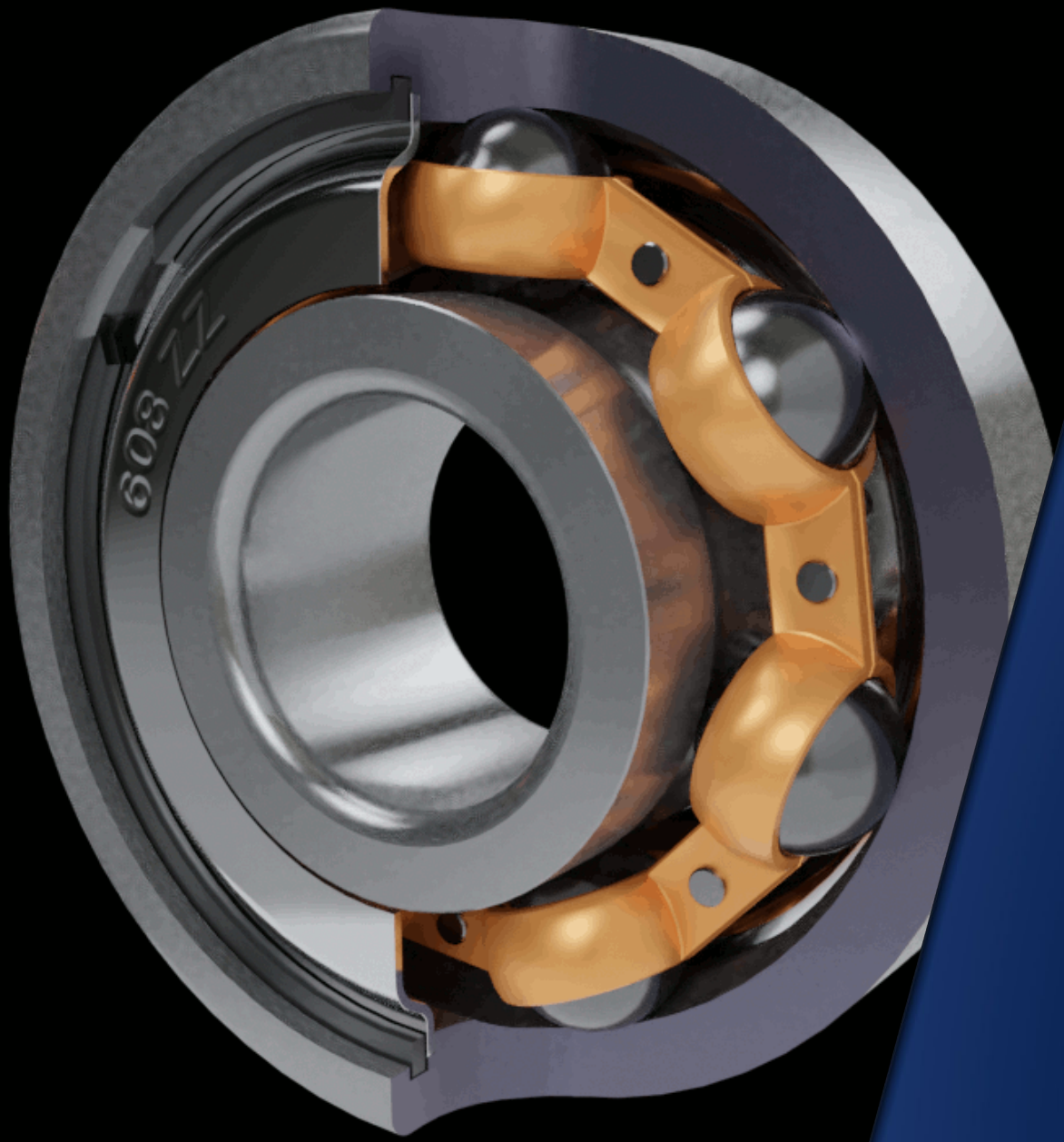
In fact, over

80%

of premature bearing failures can be traced to a problem with lubrication.

IF YOU COULD ASK A BEARING JUST ONE QUESTION, WHAT WOULD IT BE?

IF YOUR BEARING COULD ASK YOU ONE QUESTION, WHAT WOULD IT ASK YOU?

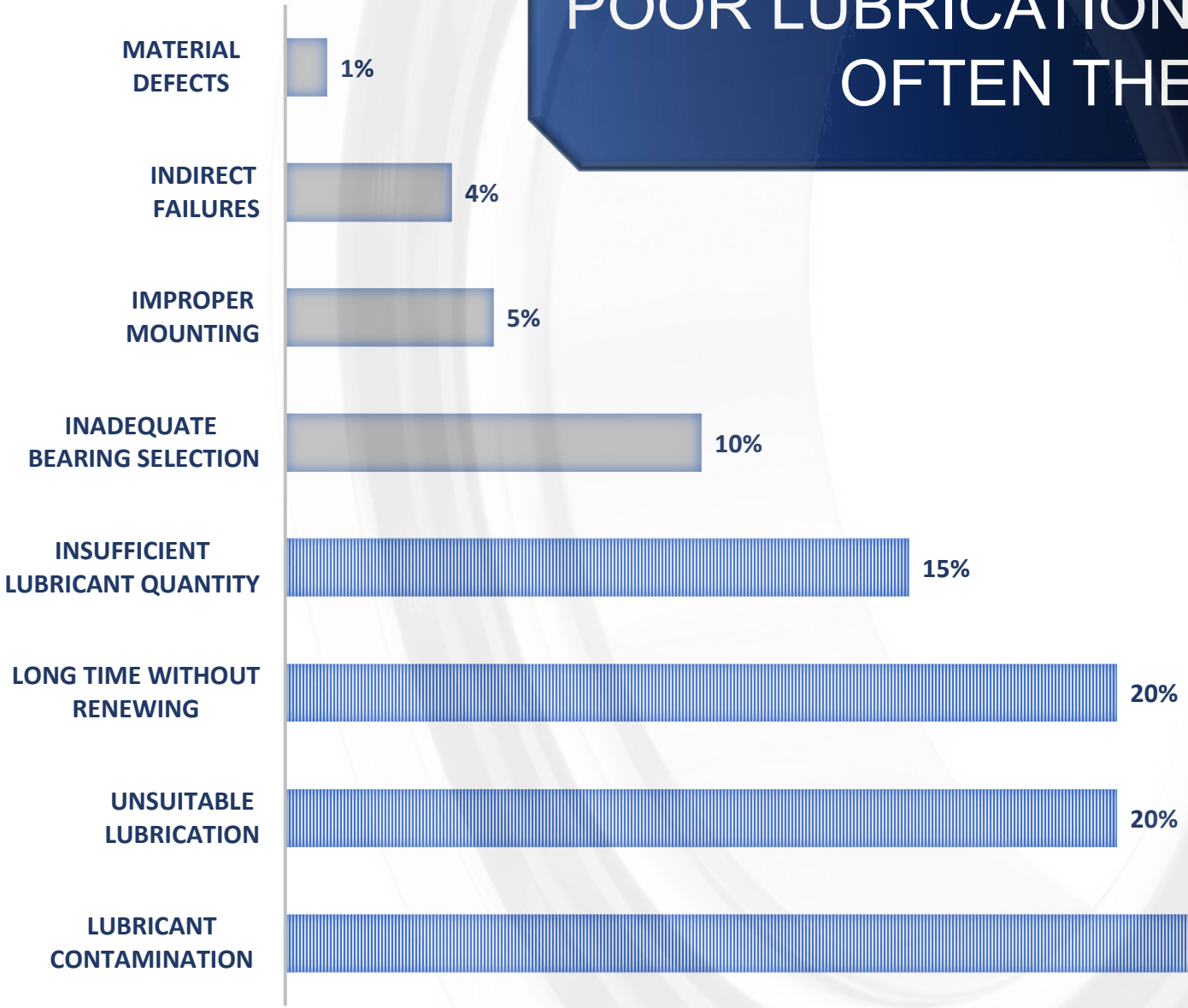


FRICTION

The entire point of an anti-friction bearing is to reduce friction. Let's think about friction and what it can tell us!

- **Poor lubrication**
- **Rubbing and skidding of rolling elements against the bearing raceway**
- **Impacting due to mechanical flaws**

WHEN BEARINGS FAIL PREMATURELY, POOR LUBRICATION PRACTICES ARE OFTEN THE CAUSE



In fact, over

80%

of premature bearing failures can be traced to a problem with lubrication.

** SKF Bearing Corporation, Bearing Failures and Their Causes*

COMPLEXITY IN TIME BASED LUBRICATION FREQUENCY

$$T = K \times \left[\left(\frac{14{,}000{,}000}{n \times (d^{0.5})} \right) - 4 \times d \right]$$

Where:

T = Time until next relubrication (hours)

K = Product of all correction factors
Ft x Fc x Fm x Fv x Fp x Fd
(see table)

n = Speed (RPM)

d = Bore diameter (mm)

Note:
ips = inches / second
0.2 inches / second = 5 mm / sec.

Grease Interval Correction Factors

Condition	Average Operating Range	Correction Factor
Temperature Ft	Housing below 150°F	1.0
	150 to 175°F	0.5
	175 to 200°F	0.2
	Above 200°F	0.1
Contamination Fc	Light, non-abrasive dust	1.0
	Heavy, nonabrasive dust	0.7
	Light, abrasive dust	0.4
	Heavy, abrasive dust	0.2
Moisture Fm	Humidity mostly below 80%	1.0
	Humidity between 80 and 90%	0.7
	Occasional condensation	0.4
	Occasional water on housing	0.1
Vibration Fv	Less than 0.2 ips velocity, peak	1.0
	0.2 to 0.4 ips	0.6
	Above 0.4 (see note)	0.3
Position Fp	Horizontal bore centerline	1.0
	45 degree bore centerline	0.5
	Vertical centerline	0.3
Bearing Design Fd	Ball bearings	10
	Cylindrical and needle roller bearings	5.0
	Tapered and spherical roller bearings	1.0

VARIABLES DO NOT OFTEN REFLECT CHANGING OPERATING AND ENVIRONMENTAL CONDITIONS

MONITOR AND TREND DECIBEL LEVELS
CAUSED BY FRICTION - ISO29821-1

ABOVE BASELINE INDICATES A LACK OF LUBRICATION.

ABOVE BASELINE INDICATES DAMAGE TO THE BEARING – A FAILURE MODE BEYOND LUBRICATION ALONE.

ABOVE BASELINE MEANS THE ASSET IS CRITICAL – IT IS CLOSE TO FAILURE.

PRESCRIPTIVE

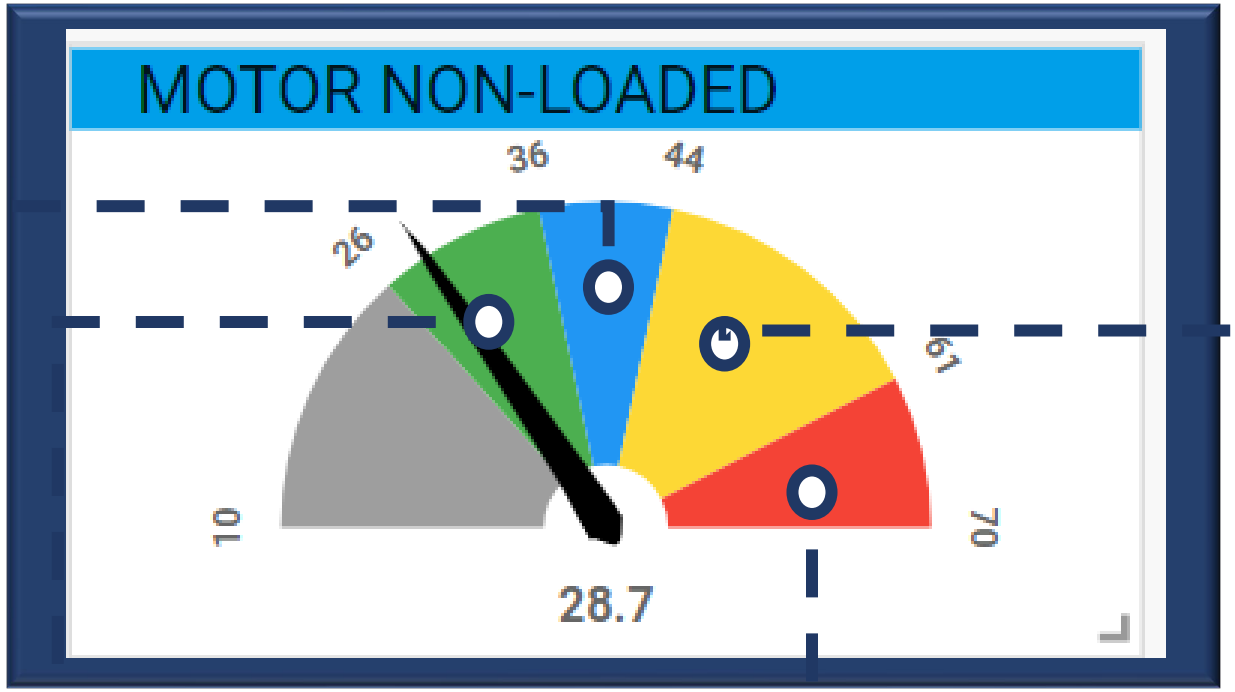
LUBRICATION AND HEALTH INSIGHTS

LUBRICATION REQUIRED

8dB above baseline indicates a **lack of lubrication**.

BEGINNING OF FAILURE

16dB above baseline indicates damage to the bearing – **a failure mode beyond lubrication alone.**



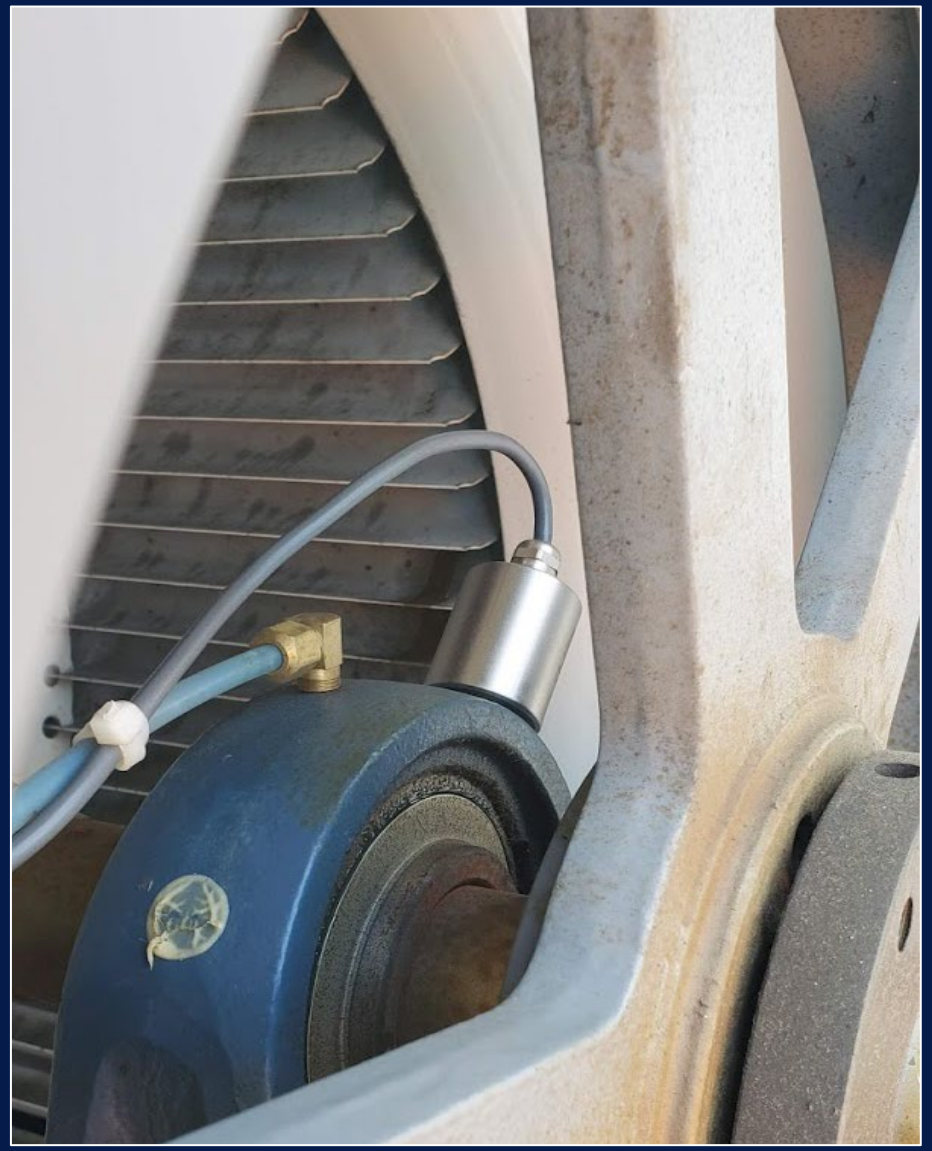
HEALTHY BEARING

Do Nothing!

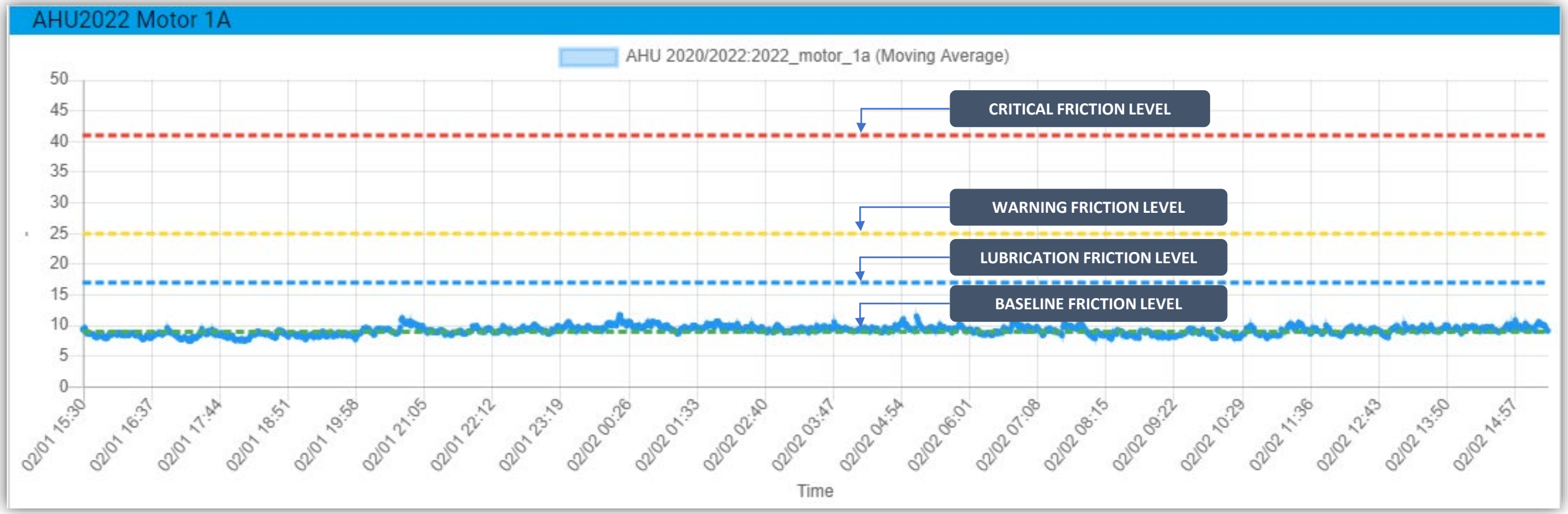
CLOSE TO FAILURE

35dB above baseline means the asset is critical – **it is close to failure.**

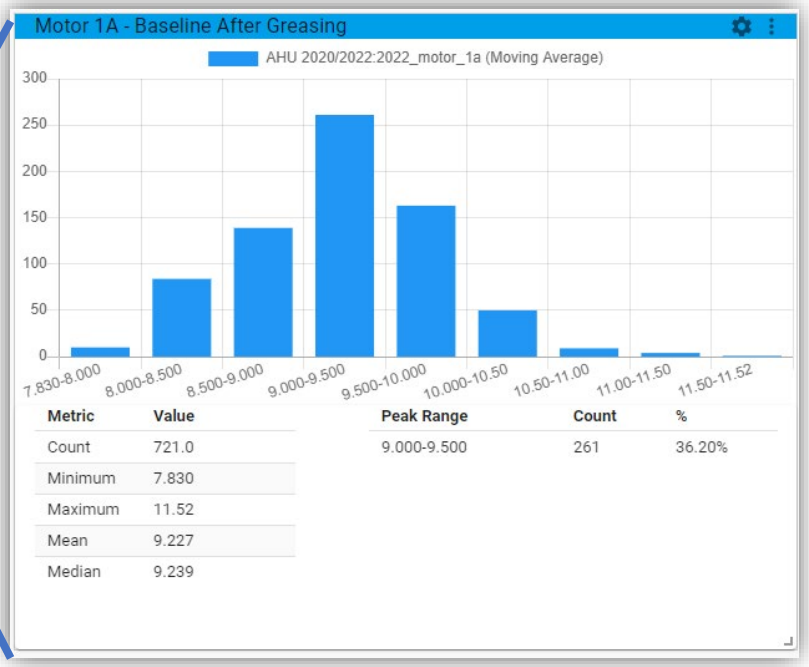
HOW SIMPLE IT IS TO SEE BEARING INSIGHTS FROM FRICTION



FRICTION TREND IN A HEALTHY BEARING



FRICTION TREND IN A HEALTHY BEARING

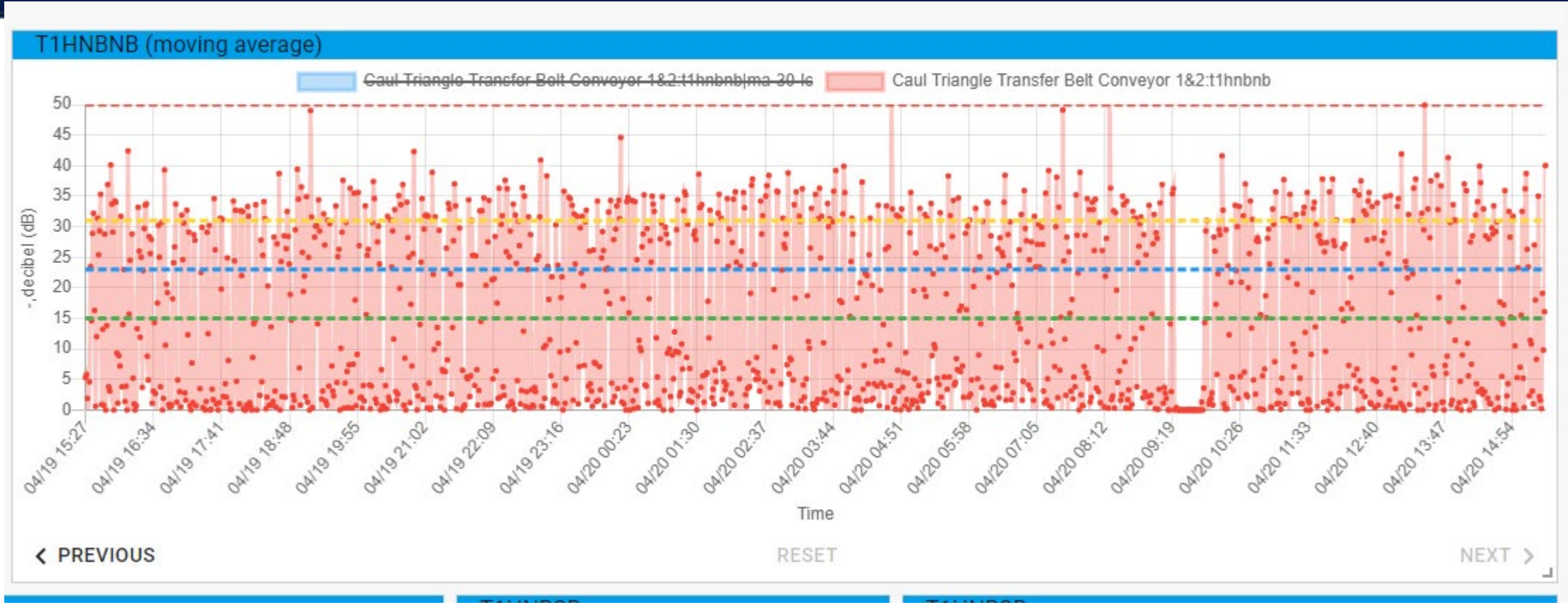


- TRENDING NEAR THE BASELINE
- THROUGH ALL VARYING SPEEDS, THE FRICTION HAS A CONSISTENT CENTER POINT (AVERAGE)
- VALUES ARE NOT BOUNCING AROUND. (PEAK-TO-PEAK VALUES)

WAIT…
DOESN'T THE FRICTION CHANGE BASED ON VARYING SPEED CONDITIONS?

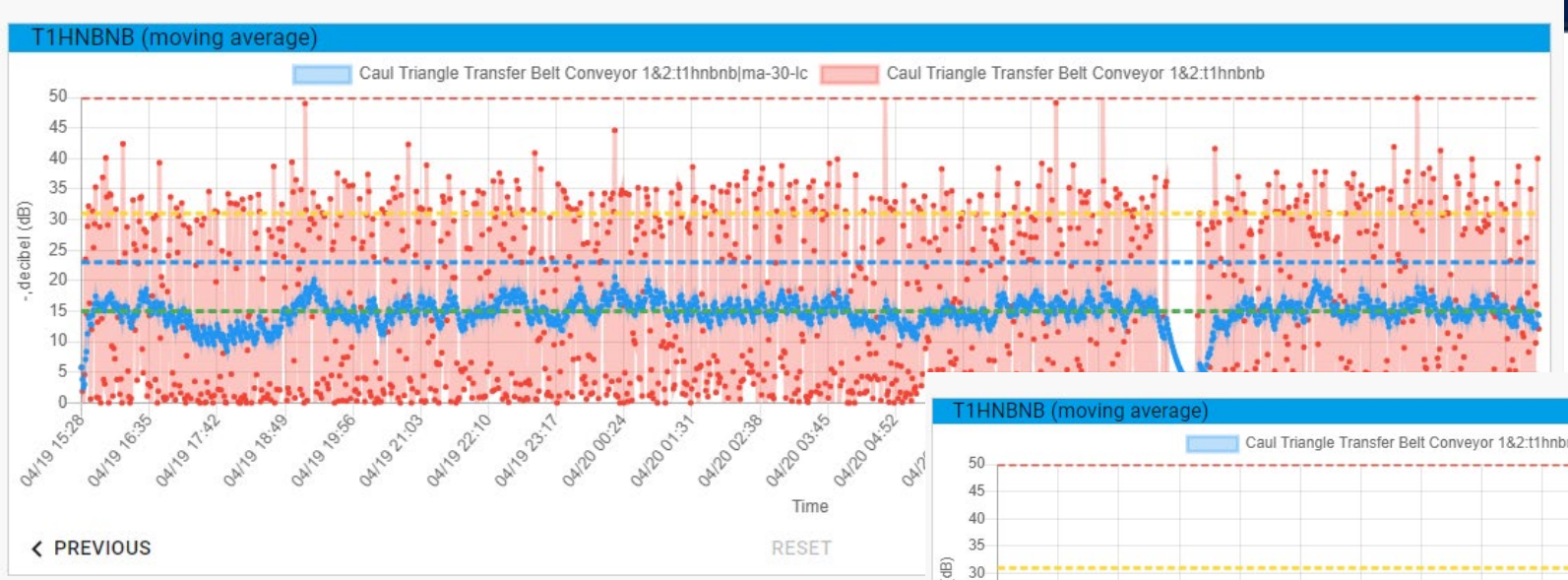
NO, AND THIS IS WHAT IS GREAT ABOUT ULTRASOUND AND MONITORING FRICTION. IN A HEALTHY, PROPERLY LUBRICATED BEARING THE FRICTION SHOULD NOT CHANGE DRAMATICALLY. A SLIGHT INCREASE OF 2-3DB MAY BE SEEN DEPENDING ON THE SPEED CHANGE.

FRICTION TREND IN A
EXTREME LOAD & DUTY BEARING



RAW FRICTION VALES TAKEN EVERY ONE MINUTE

FRICTION TREND IN A EXTREME LOAD & DUTY BEARING



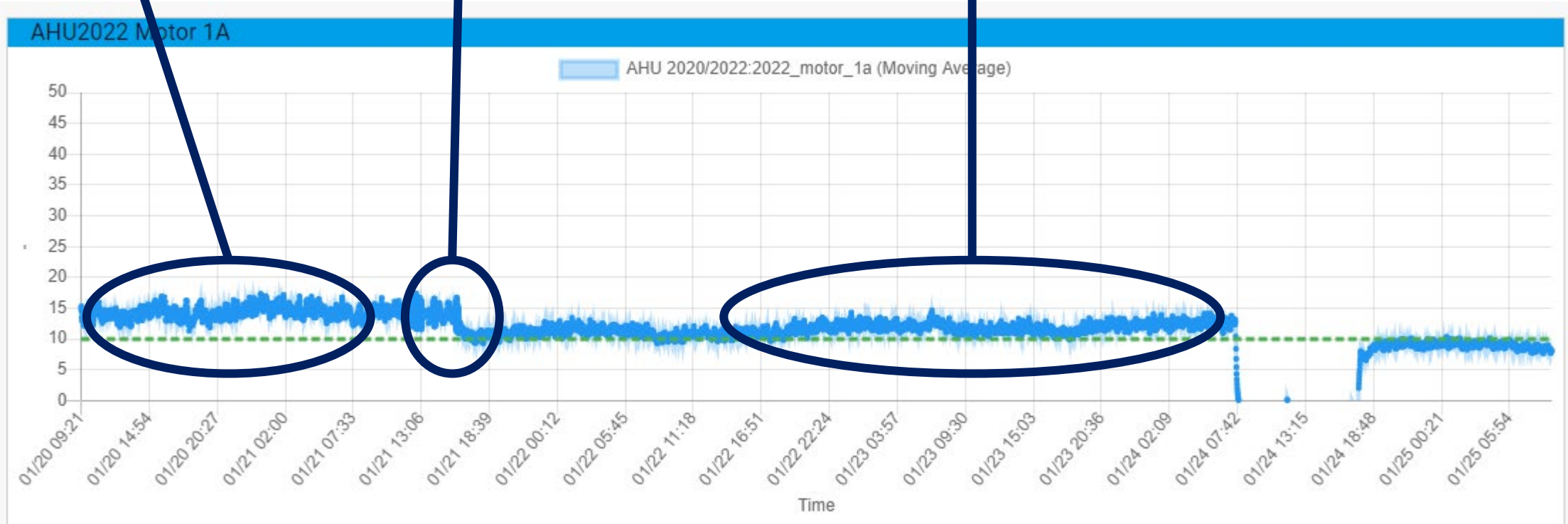
- **RAW & MOVING AVERAGE FRICTION VALES TAKEN EVERY ONE MINUTE.**

FRICTION TREND IN A UNDER LUBRICATED BEARING

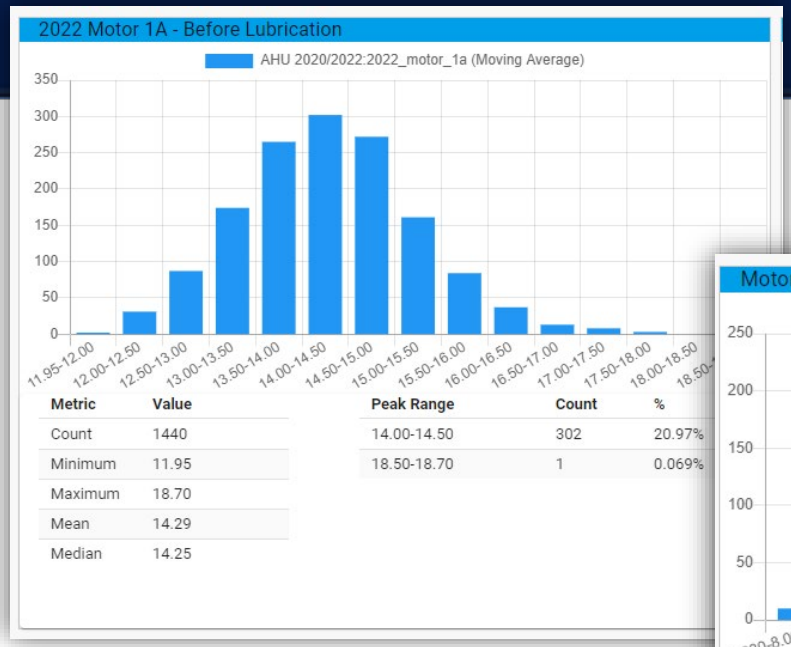
Initial Friction:
Baseline = 14dB
Peak-to-Peak = 6.75db

Lubrication Added:
Amount of Grease = 15cc

Friction After Lubrication
Baseline = 11dB
Peak-to-Peak = 3db

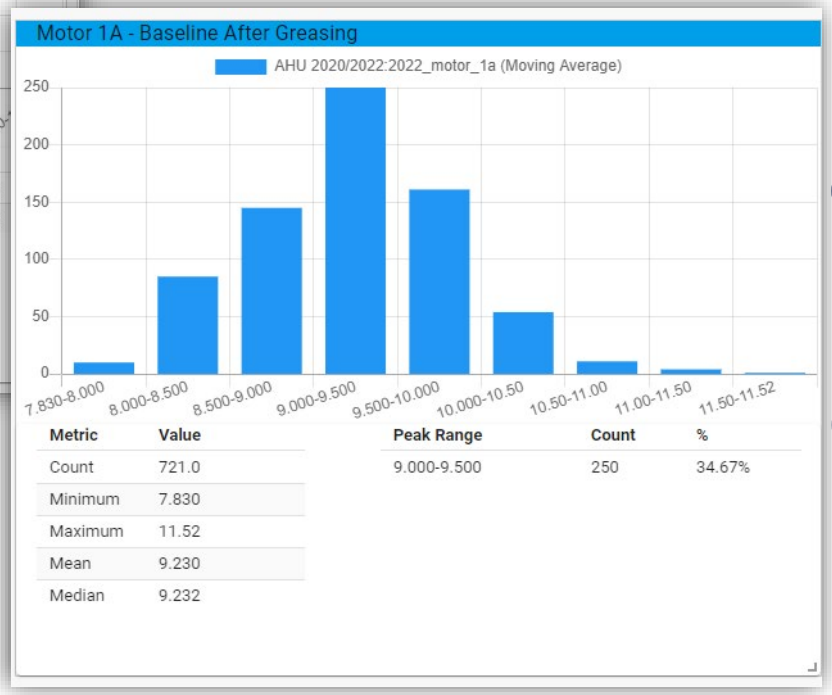


FRICTION TREND IN A UNDER LUBRICATED BEARING



Metric	Value
Count	1440
Minimum	11.95
Maximum	18.70
Mean	14.29
Median	14.25

Peak Range	Count	%
14.00-14.50	302	20.97%
18.50-18.70	1	0.069%

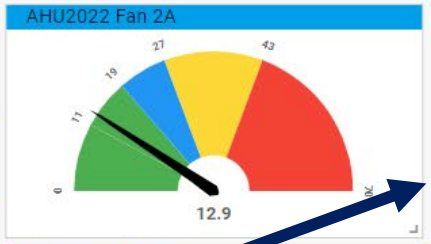


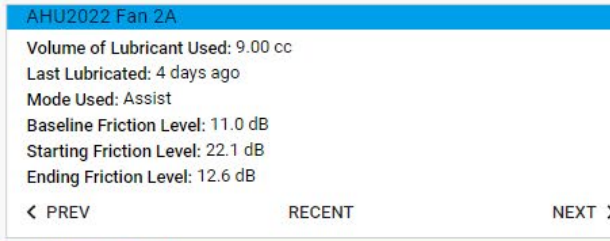
Metric	Value
Count	721.0
Minimum	7.830
Maximum	11.52
Mean	9.230
Median	9.232

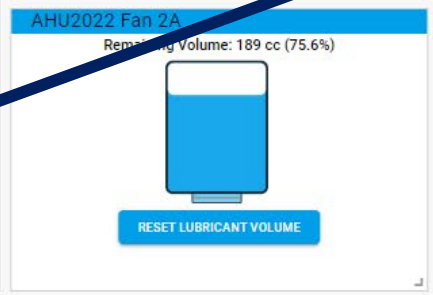
Peak Range	Count	%
9.000-9.500	250	34.67%

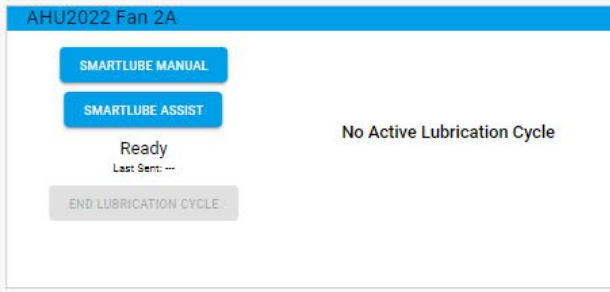
- **NOTICEABLE DECREASE IN FRICTION AFTER LUBRICATION**
- **NOTICEABLE DECREASE IN THE PEAK-TO-PEAK VALUES.**
- **NOTICEABLE CENTER POINT ON THE HISTOGRAM**

FRICTION TREND IN A UNDER LUBRICATED BEARING



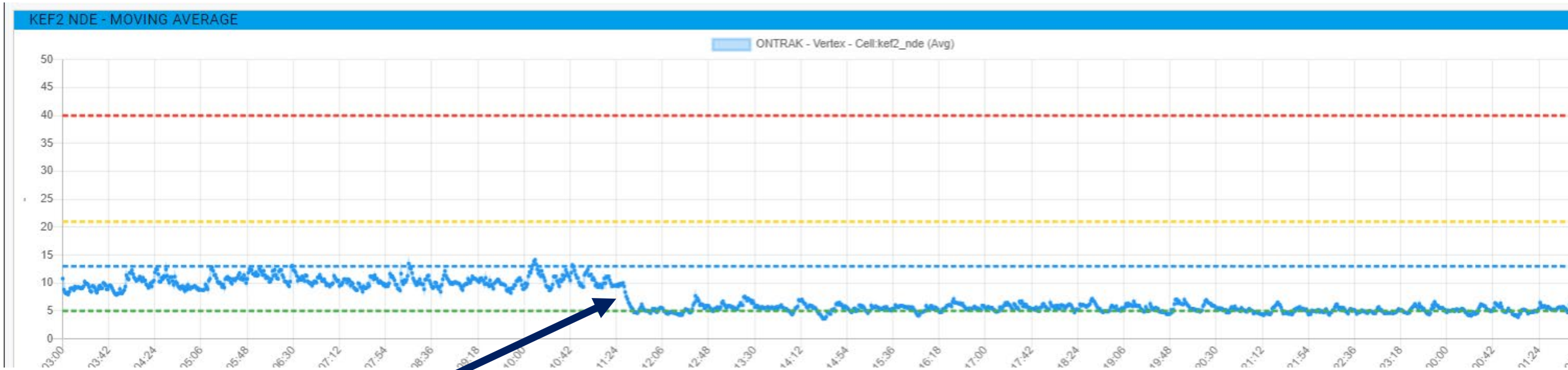






NOTICEABLE DECREASE IN FRICTION AFTER LUBRICATION

FRICTION TREND IN A UNDER LUBRICATED BEARING



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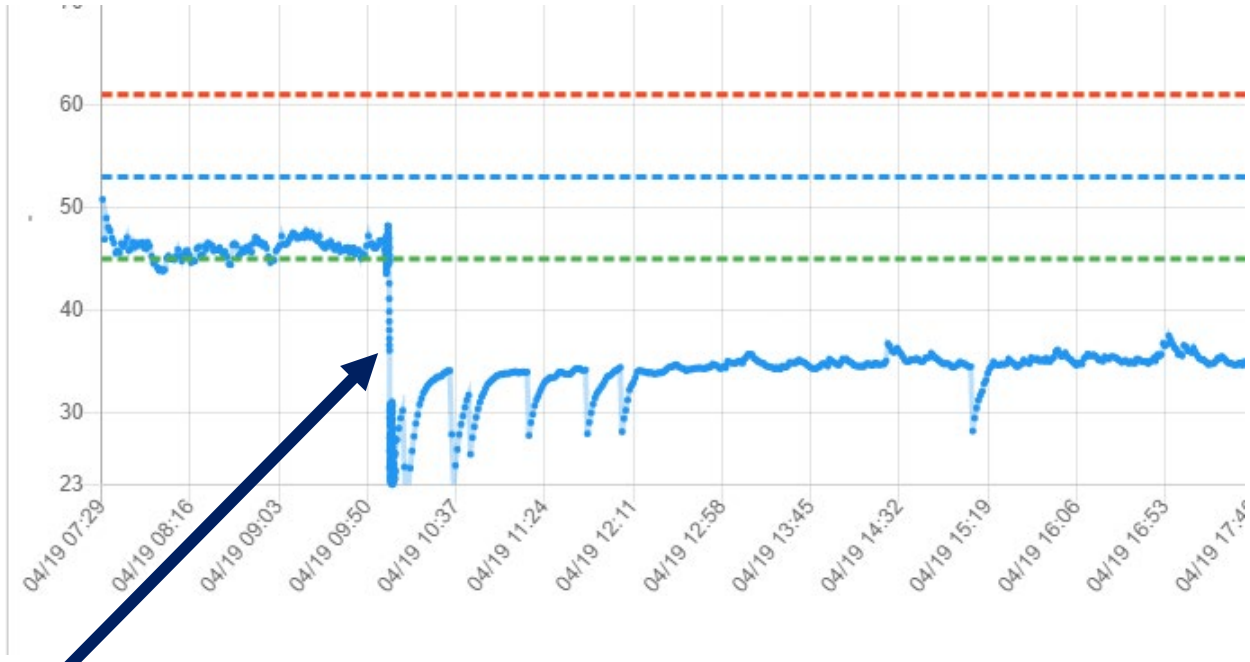

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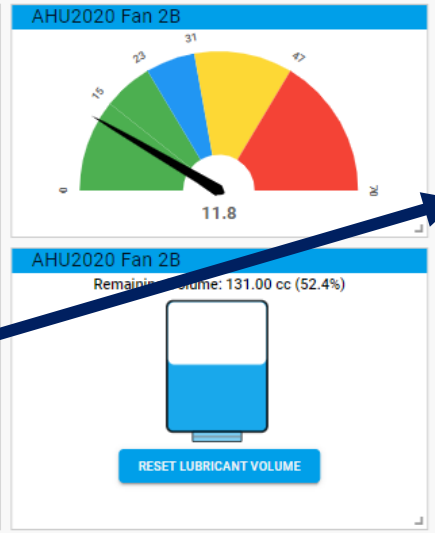
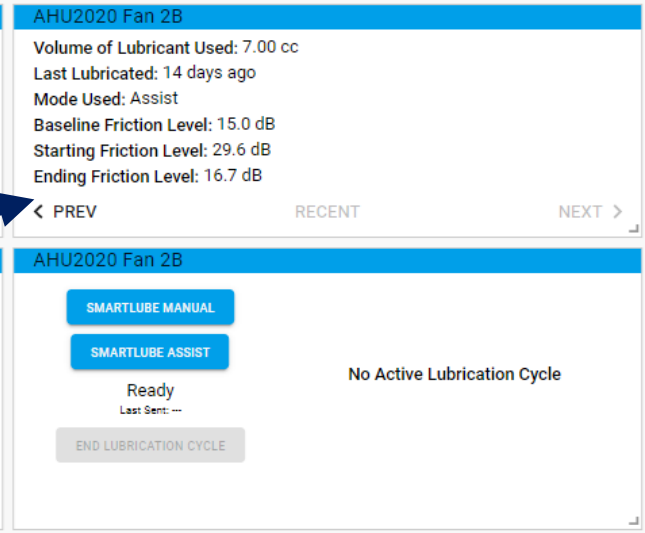
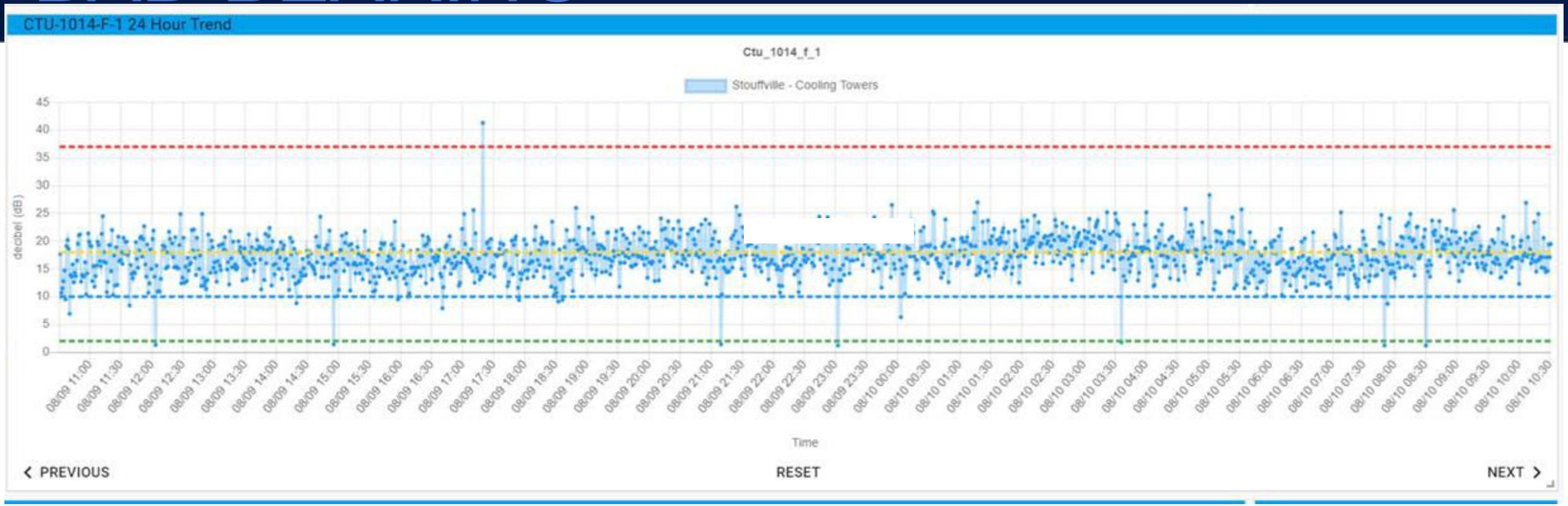




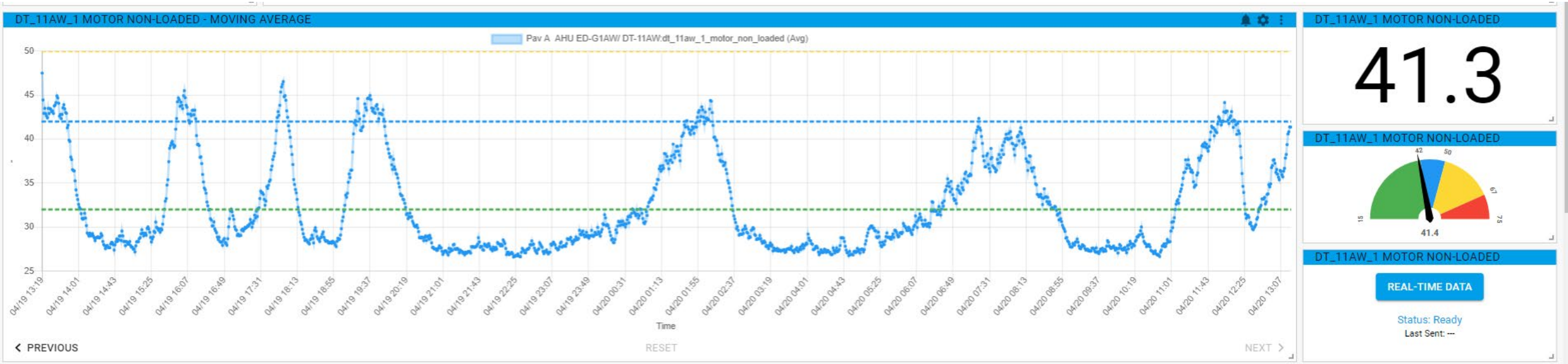
NOTICEABLE DECREASE IN FRICTION AFTER LUBRICATION

FRICTION TREND IN A BAD BEARING



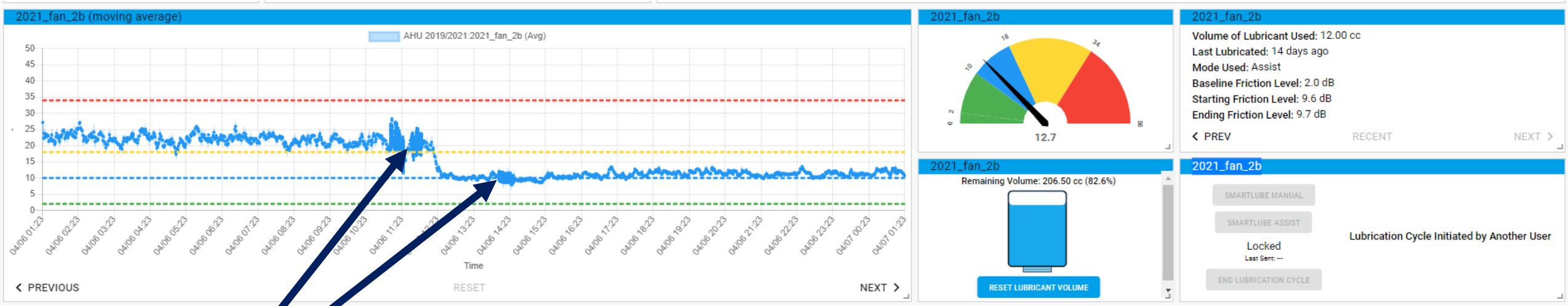
NOTICEABLE IMPACTING IN THE BEARING

FRICTION TREND IN A BAD BEARING



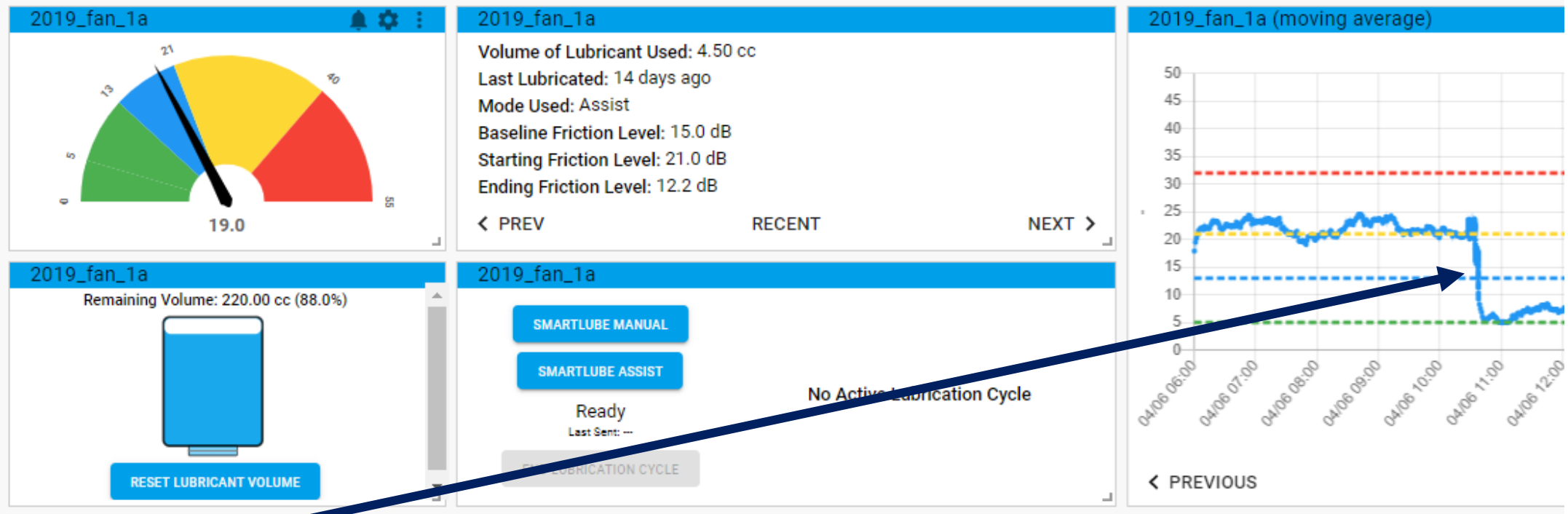
- **FRICTION TRACKING WITH THE VFD. INDICATION OF ANOMALY IN THE BEARING**

FRICTION TREND IN A BAD BEARING



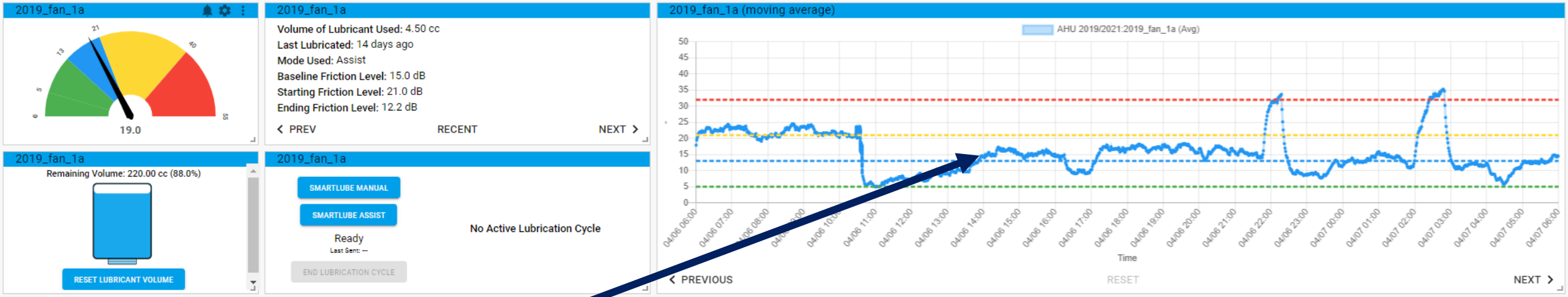
WHILE THE FRICTION WAS REDUCED, IT COULD NOT BE RESTORED TO BASELINE. EITHER IMPROPER BASELINE OR DEFECT IN THE BEARING

FRICTION TREND IN A BAD BEARING



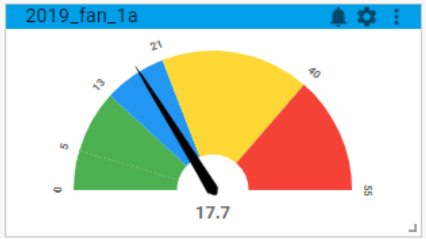
THIS LOOKS LIKE A SUCCESSFUL LUBRICATION…BUT IS IT?

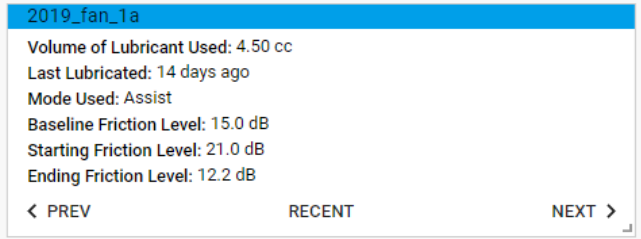
FRICTION TREND IN A BAD BEARING

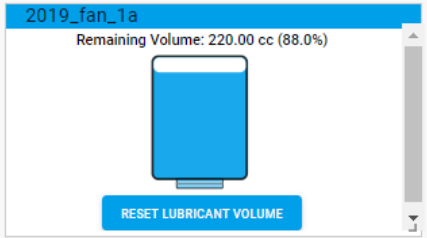


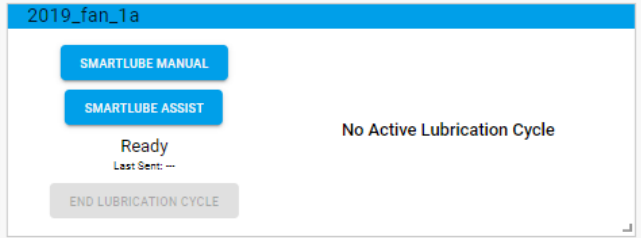
WITHIN A FEW HOURS OF LUBRICATION, THE FRICTION WAS BACK UP!

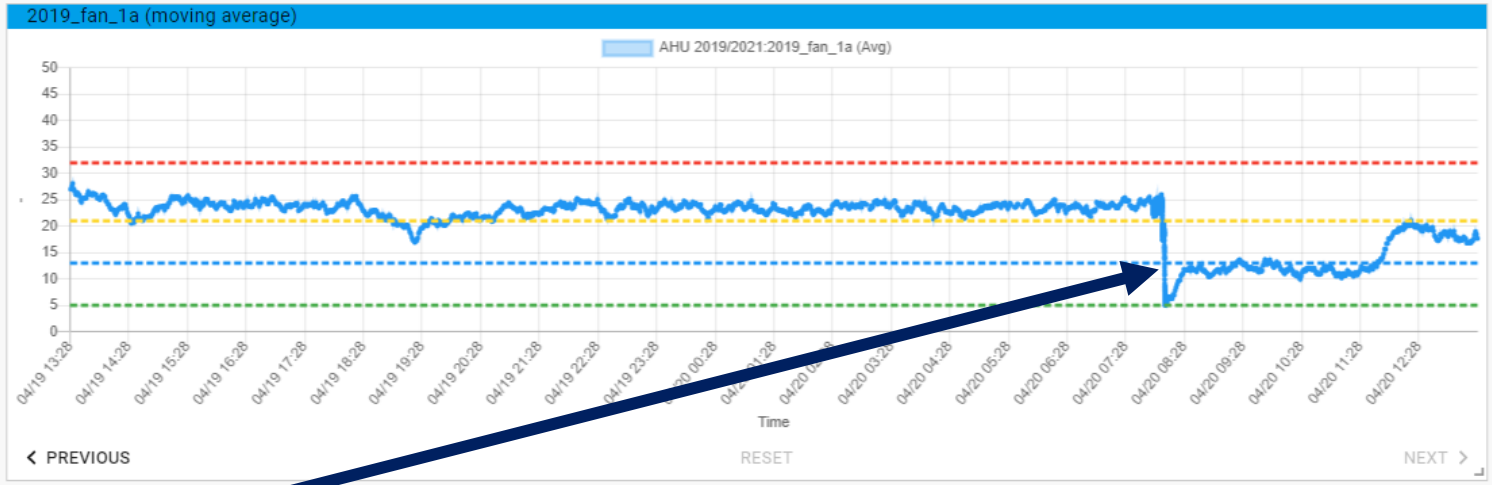
FRICTION TREND IN A BAD BEARING





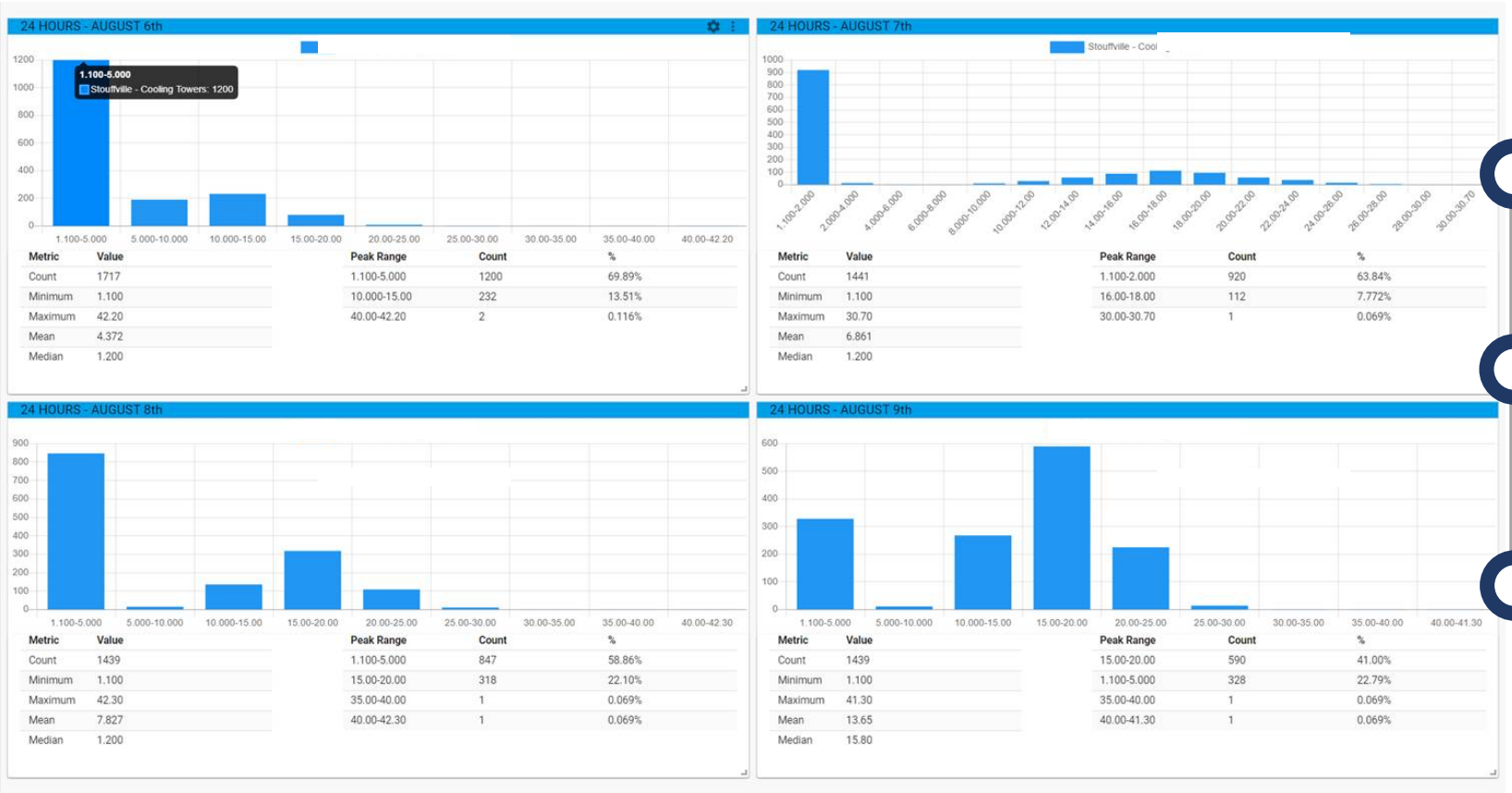






EVEN AFTER MULTIPLE LUBRICATION CYCLES DAYS APART

FRICTION TREND IN A BAD BEARING



- **NOTICEABLE INCREASE IN FRICTION OVER 4 DAYS**
- **NOTICEABLE INCREASE IN THE PEAK-TO-PEAK VALUES.**
- **NO SINGLE POINT OF FRICTION LEVEL. BEARING IS BOUNCING AROUND**

HOW TO SET A FRICTION BASELINE

COMPARISON

WHEN THERE IS MORE THAN ONE BEARING OF THE SAME TYPE, LOAD AND RPM, MULTIPLE BEARINGS CAN BE COMPARED.

EACH BEARING IS TRENDED AT THE SAME TEST POINT. THE DECIBEL LEVELS ARE COMPARED. IF THERE ARE NO SUBSTANTIAL DIFFERENCES (LESS THAN EIGHT DB), A BASELINE DB LEVEL IS SET FOR EACH BEARING.

SET WHILE LUBRICATING:

- APPLY A SMALL AMOUNT OF GREASE
  - IF FRICTION IS **REDUCED**, CONTINUE LUBRICATING UNTIL FRICTION BEGINS TO RISE AND SET BASELINE
  - IF FRICTION IS **INCREASED**, DISCONTINUE LUBRICATING. THE BEARING IS OVER GREASED AND THE BASELINE SHOULD BE SET LOWER THAN CURRENT READING
  - IF FRICTION REMAINS **CONSTANT**, AND THERE ARE NO SIGNS OF IMPACTING, SET BASELINE AS IS

HISTORICAL

BEARING DB LEVELS ARE OBTAINED FROM AN INITIAL SURVEY AND COMPARED 30 DAYS LATER.

IF THERE IS LITTLE (LESS THAN EIGHT DB) TO NO CHANGE IN DB, THEN THE BASELINE LEVELS ARE SET AND WILL BE USED FOR COMPARISON FOR SUBSEQUENT INSPECTIONS.

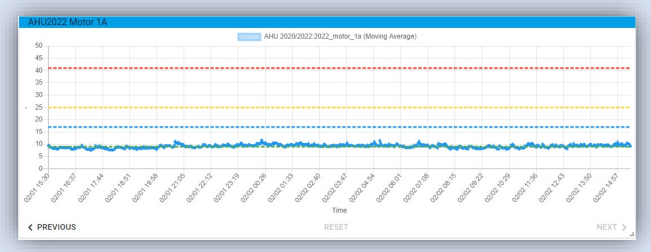
BEARING LUBRICATION AND HEALTH MONITORING

MADE EASY WITH FRICTION

UE SYSTEMS INC
The ultrasound approach

1

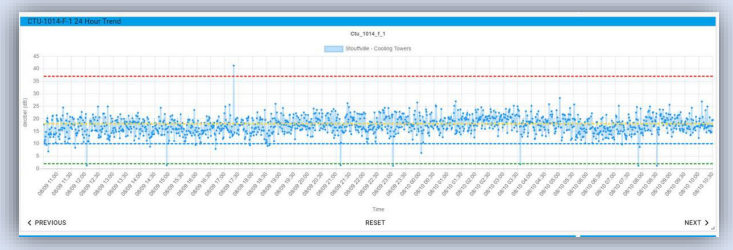
LOOK FOR A CONSISTENT AVERAGE TREND VALUE



FRICTION IS NOT IMPACTED BY SPEED. A HEALTHY WELL LUBRICATED BEARING WILL HAVE A STEADY FRICTION TREND.

2

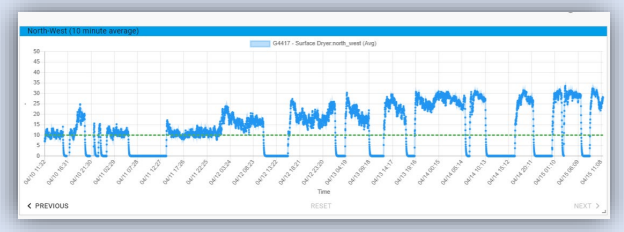
LOOK FOR PEAKS AND VALLEYS LESS THAN 4 DB IN AMPLITUDE



AN UNHEALTHY BEARING WILL HAVE FRICTION "BOUNCING" AROUND CAUSING LARGER PEAKS AND VALLEYS CAUSED BY IMPACTING

3

LOOK FOR INCREASE IN FRICTION OVER 30 DAYS



AN INCREASE IN FRICTION OVER TIME INDICATES THE BEARING IS NOT HEALTHY

FLUKE Reliability

QUESTIONS?

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Subject-matter expert Craig Haase provides a primer on thermography in maintenance and reliability and how it can powerfully unearth details surrounding your machines' condition and health. Haase will detail customer scenarios and use cases, highlighting how thermal imaging solutions can record, provide alarm notifications, and monitor assets 24/7 regardless of location. He will also discuss the turnkey options available as solutions to common but complicated plant applications.

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