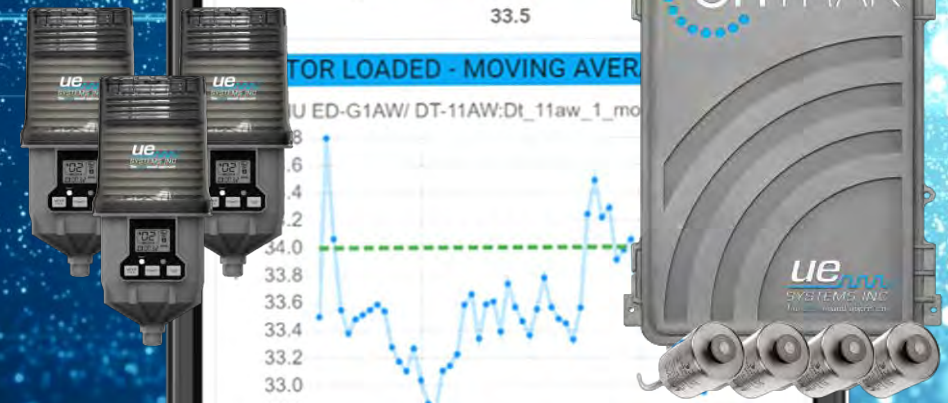
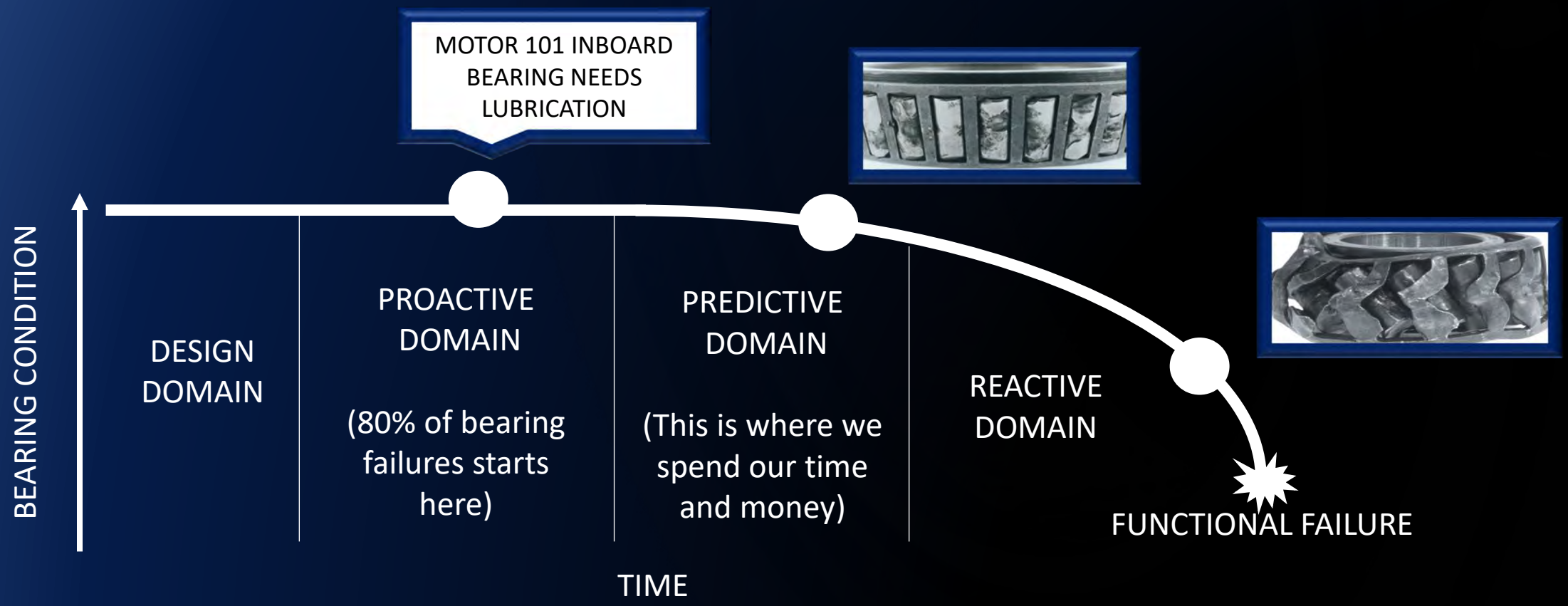


BEARING LUBRICATION *REIMAGINED*

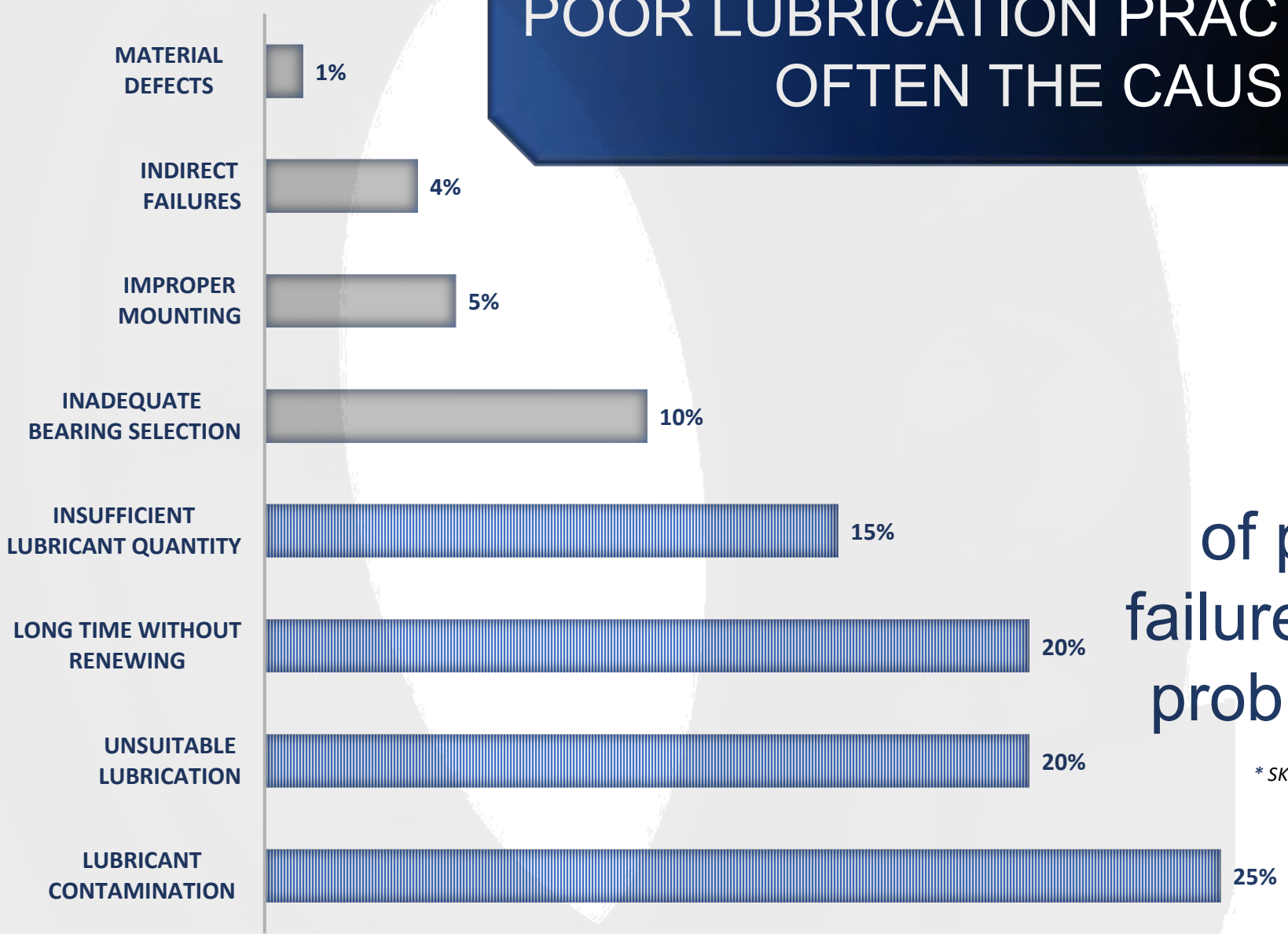
THE ONLY REAL-TIME BEARING REMOTE FRICTION MONITORING & LUBRICATION SYSTEM. YOU WILL NEVER LOOK AT BEARING LUBRICATION THE SAME AGAIN!



STOP MONITORING YOUR BEARINGS AND START MANAGING THEM!



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



In fact, over

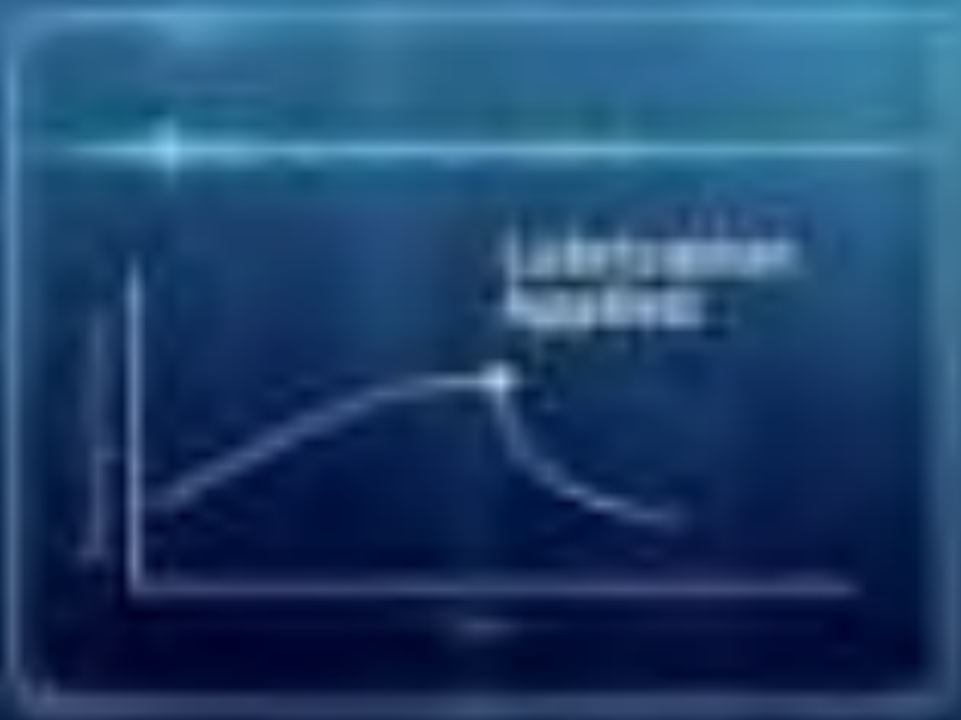
80%

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

* SKF Bearing Corporation, Bearing Failures and Their Causes

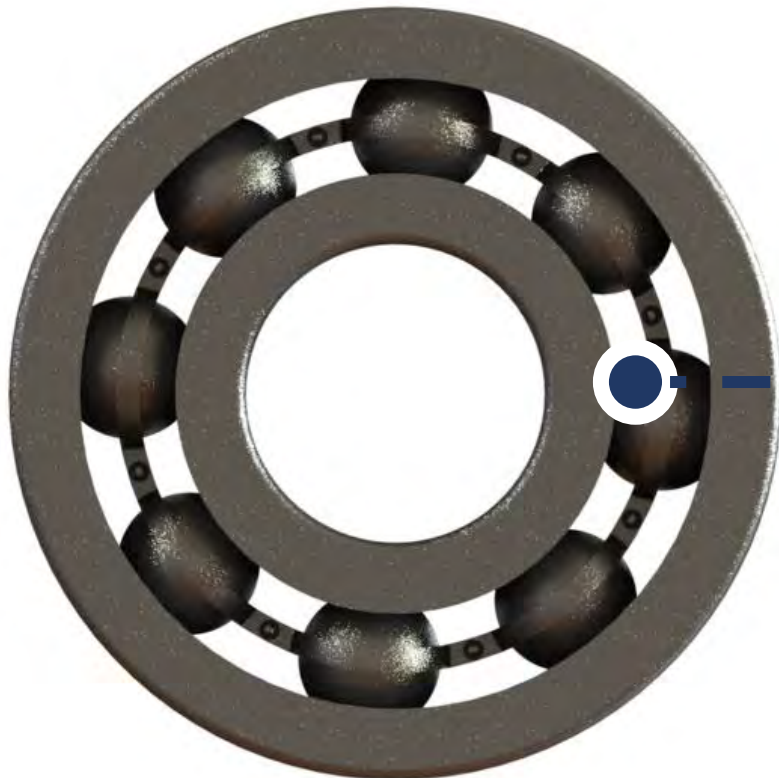
ONTRAK SMARTLUBE OVERVIEW



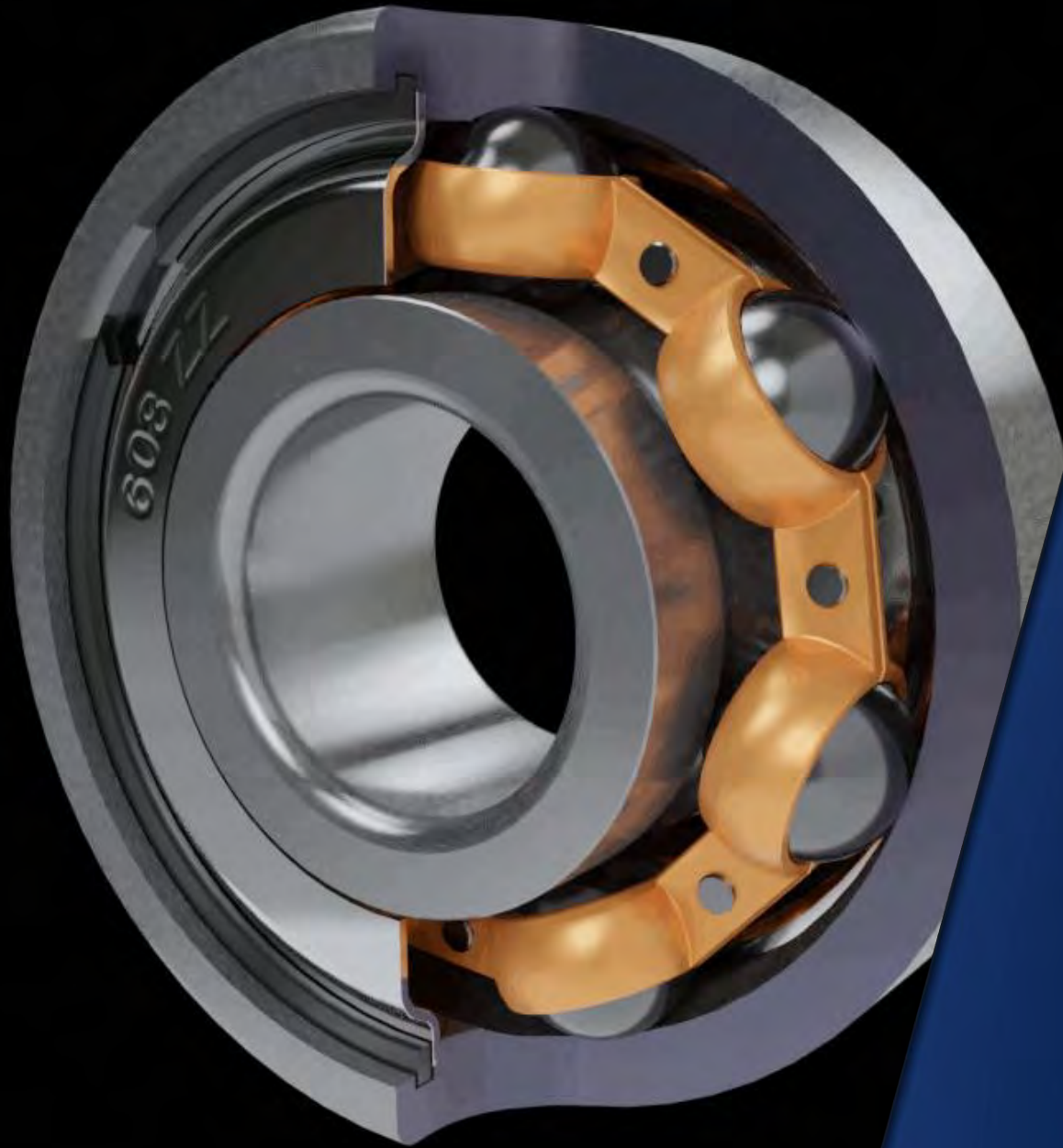


THE

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*

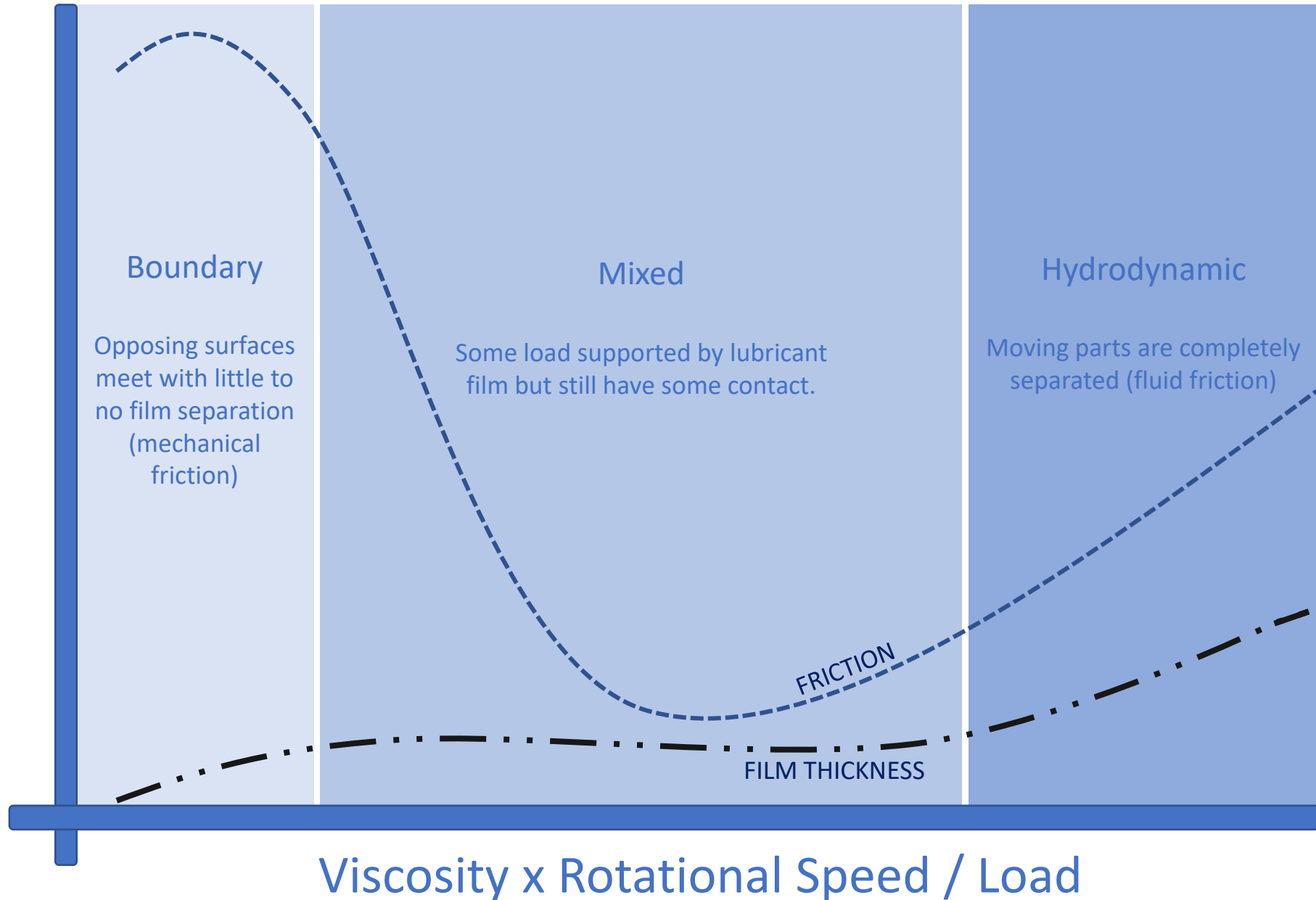


FRICITION

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**

Coefficient of
FRICTION



Viscosity x Rotational Speed / Load

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:

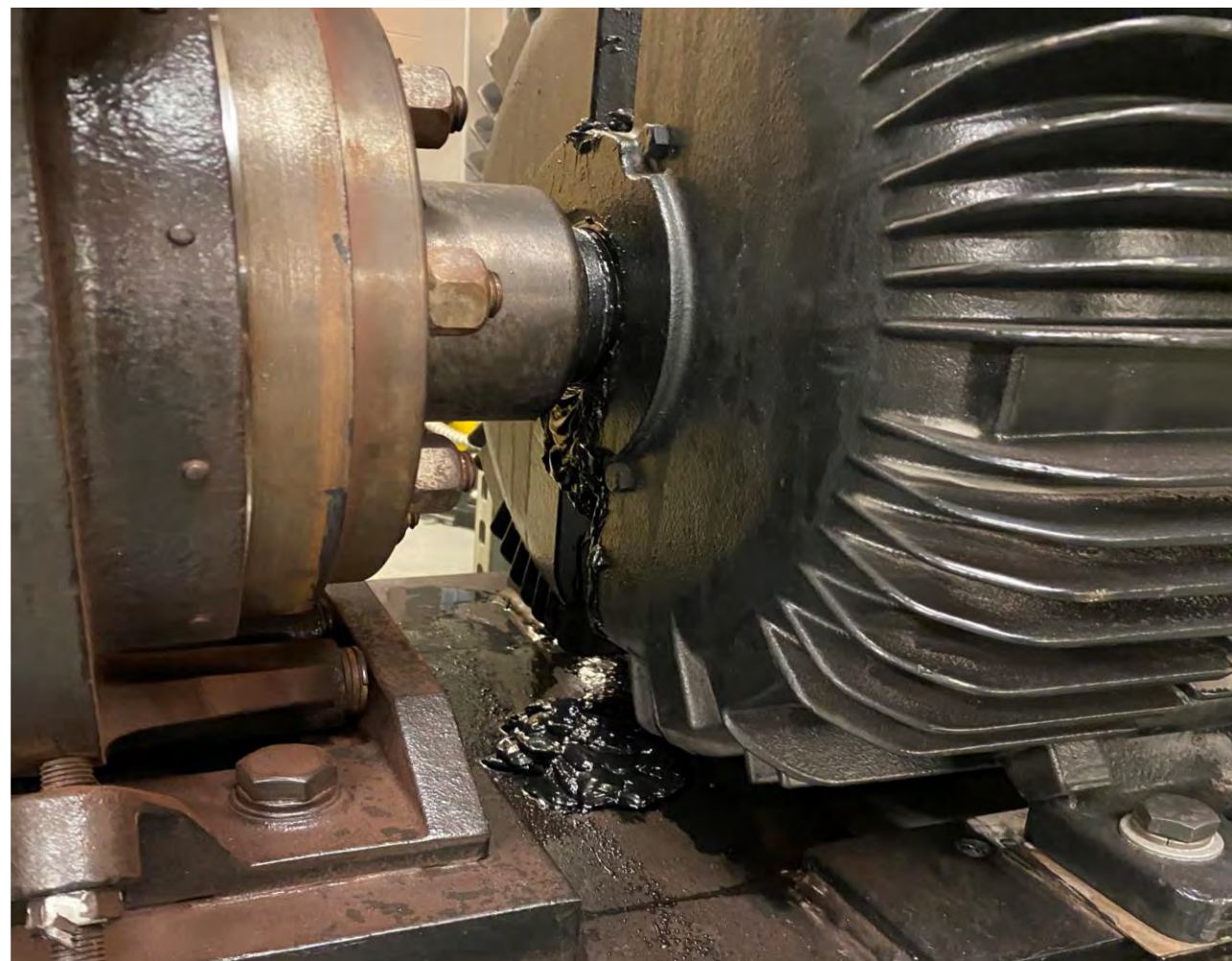
ips = inches / second
0.2 inches / second = 5 mm / sec.

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**

WHICH OFTEN LEADS TO OVER LUBRICATION



**WHEN IT COMES TO
REGREASING BEARINGS,
MORE IS NOT ALWAYS
THE BETTER OPTION AND
ACTUALLY CAN BE A
COSTLY MISTAKE.**

THE

POWER OF ULTRASOUND FOR LUBRICATION

- *KNOWN PRECISELY **WHEN** LUBRICATION IS REQUIRED*
- *KNOWN PRECISELY HOW **MUCH** GREASE IS REQUIRED*

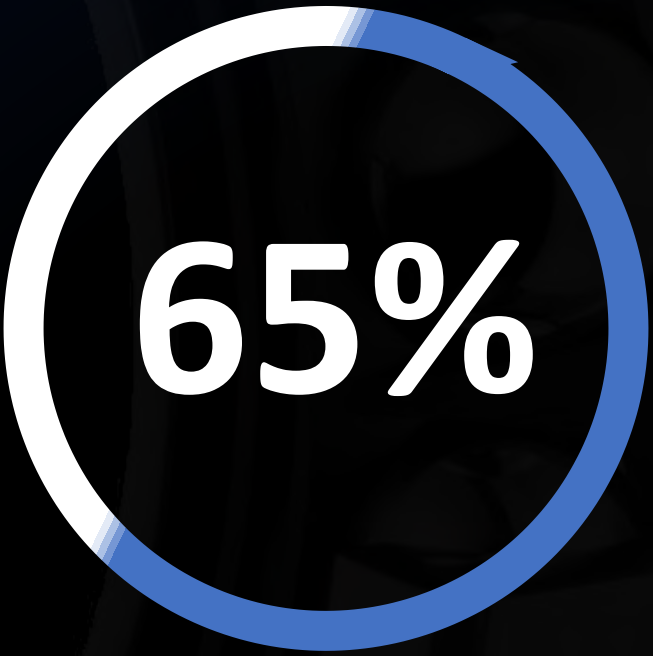
VALUE



DECREASE IN GREASE CONSUMPTION







DECREASE IN TIME REQUIRED FOR OPTIMAL BEARING LUBRICATION



DECREASE IN PREMATURE BEARING FAILURE

LUBRICATION FAILURE MODES VS. LUBRICATION PRACTICES

LUBRICATION ISSUES CAUSING 80% OF PREMATURE BEARING FAILURES	TIME BASED <i>LUBRICATION IS PERFORMED ON TIME INTERVALS WITH A SPECIFIC AMOUNT OF GREASE BASED ON COMPLEX THEORETICAL CALCULATIONS AND ESTIMATIONS</i>		CONDITION BASED <i>LUBRICATION IS PERFORMED BASED ON THE CONDITION OF BEARING (FRICTION) USING ULTRASOUND.</i>	
	 GREASE GUN	 AUTO-LUBER	 GREASE CADDY	 ONTRAK SMARTLUBE
LUBRICANT CONTAMINATION	✗	✓	✗	✓
UNSUITABLE LUBRICATION	✗	✓	✗	✓
LONG TIME WITHOUT RENEWING	✗	✗	✓	✓
INSUFFICIENT LUBRICANT QUANTITY	✗	✗	✓	✓

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

+8dB

**ABOVE BASELINE
INDICATES A LACK OF
LUBRICATION.**

+16dB

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

+35dB

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

PRESCRIPTIVE

LUBRICATION AND HEALTH INSIGHTS

LUBRICATION REQUIRED

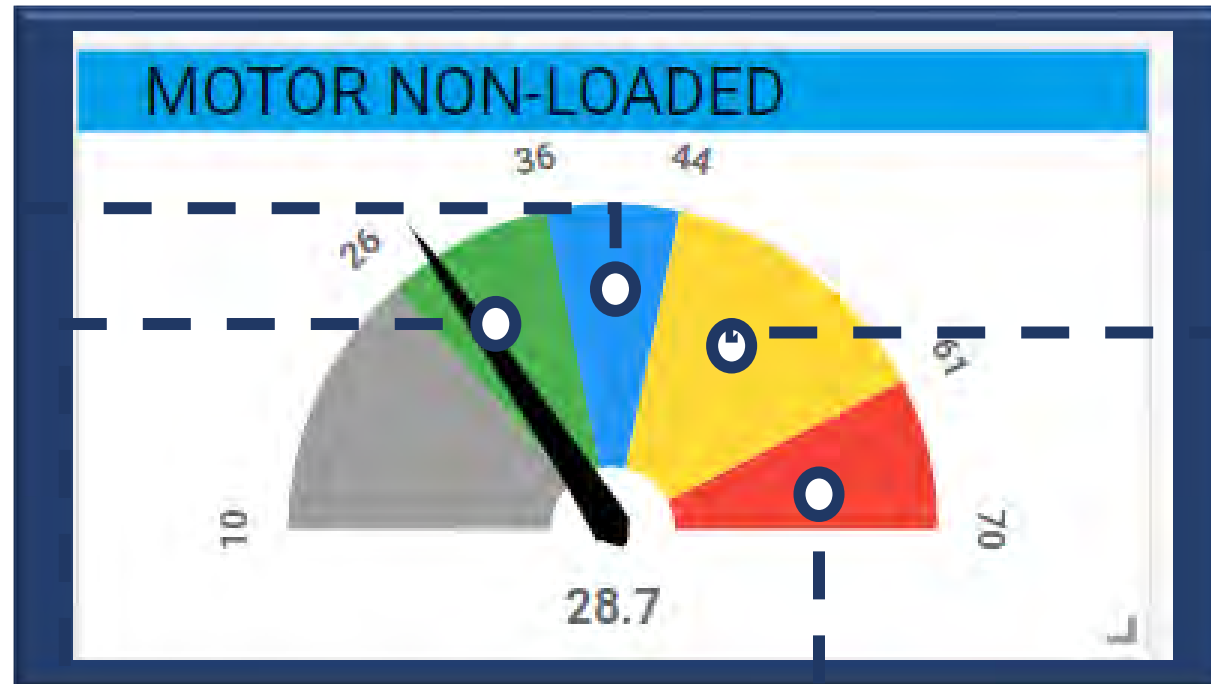
8dB above baseline
indicates a **lack of
lubrication.**

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 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

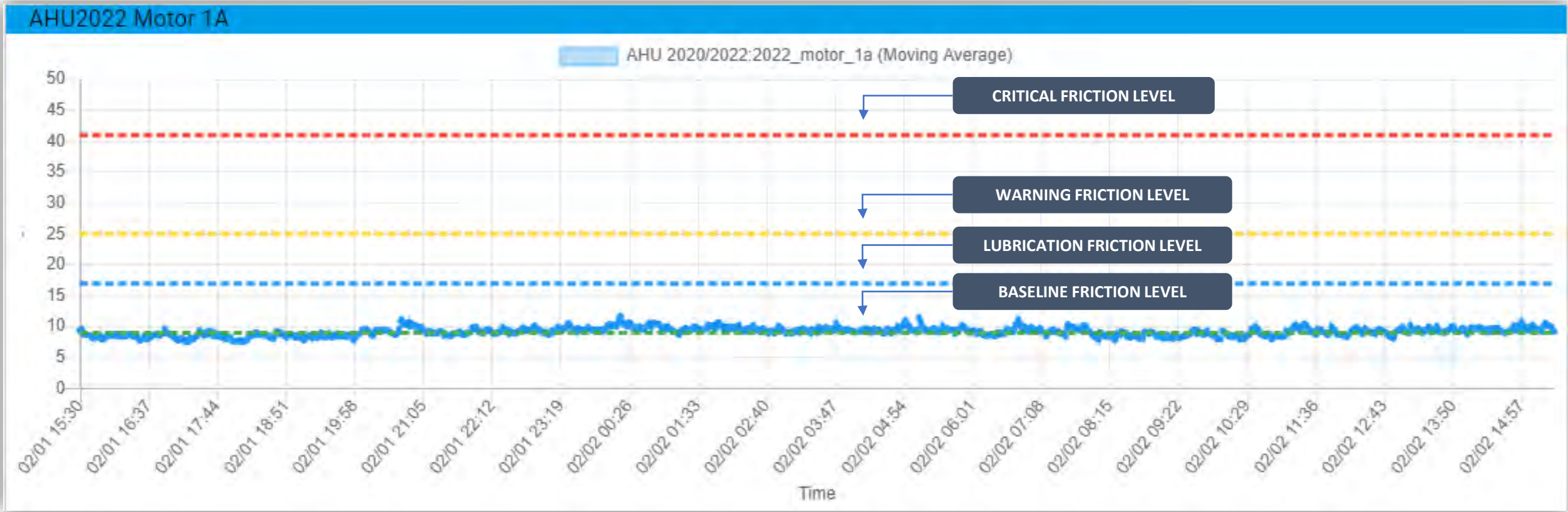
HISTORICAL

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.



FRICITION TREND IN A HEALTHY BEARING



WAIT...

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

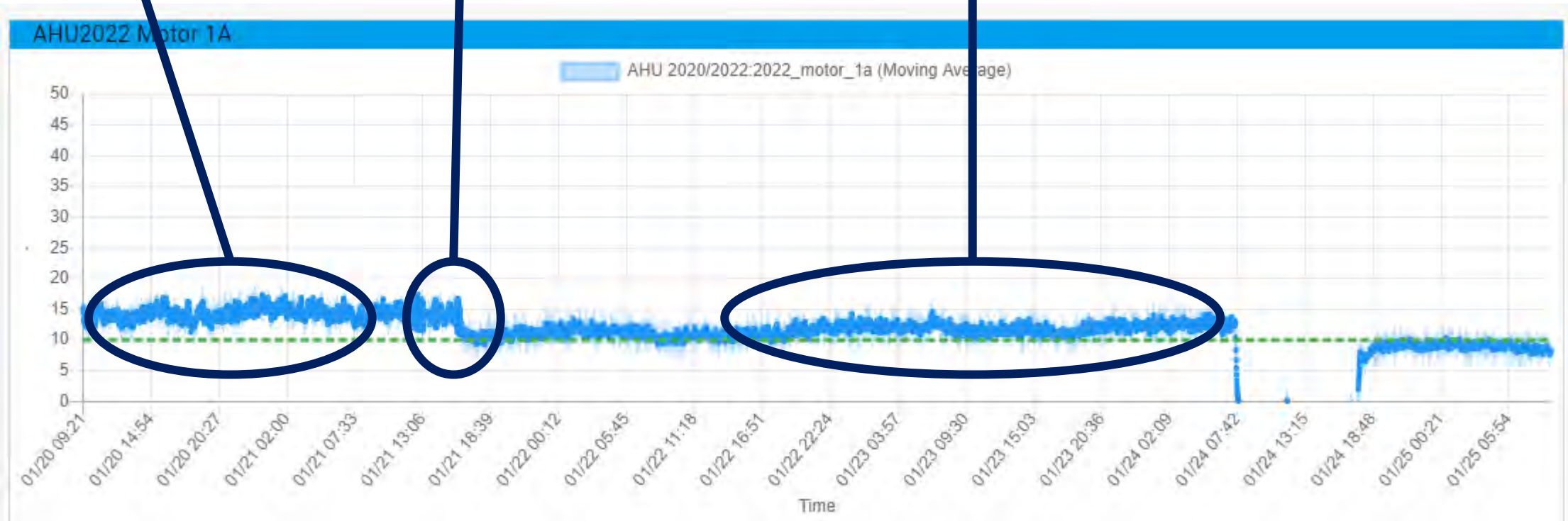
**YES, BUT ONLY A LITTLE.... AND THIS IS WHAT IS
GREAT ABOUT ULTRASOUND AND MONITORING
FRICTION. IN A HEALTHY, PROPERLY LUBRICATED
BEARING THE FRICTION SHOULD NOT CHANGE
DRAMATICALLY. A SLIGHT INCREASE OF 2-3DB MAY BE
SEEN DEPENDING ON THE SPEED CHANGE.**

FRICITION TREND IN A UNDER LUBRICATED BEARING

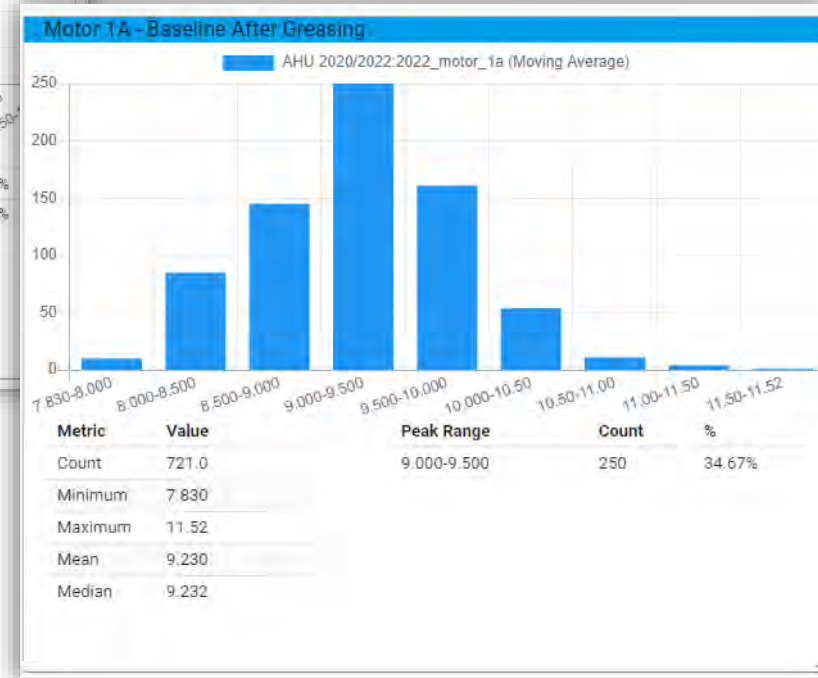
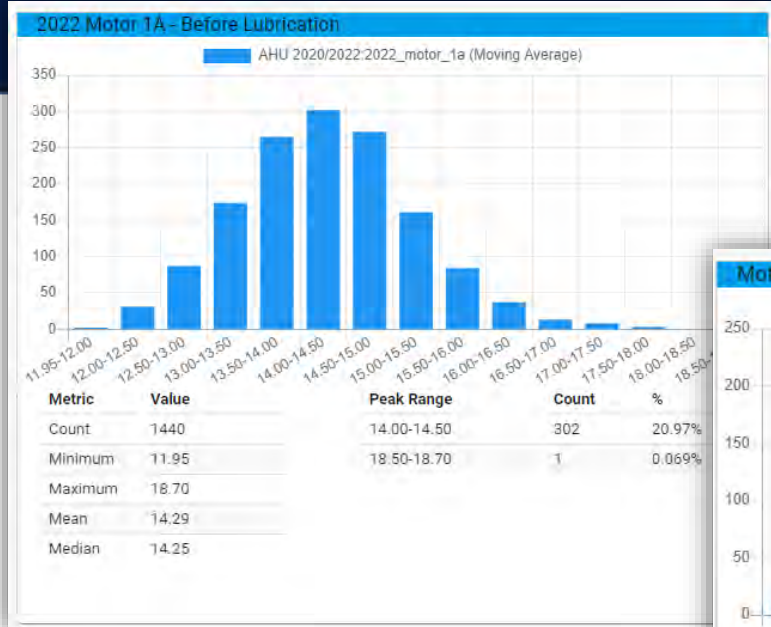
Initial Friction:
Baseline = 14dB
Peak-to-Peak = 6.75db

Lubrication Added:
Amount of Grease = 15cc

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

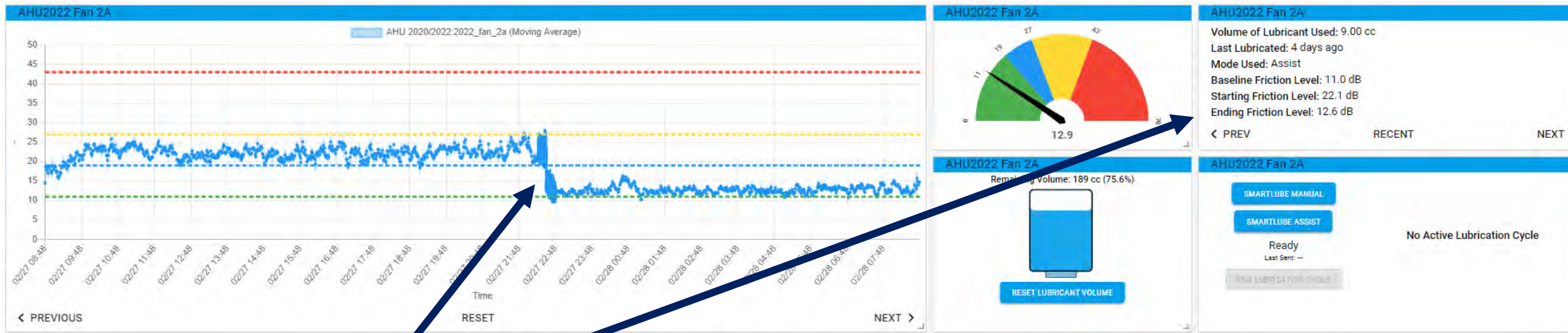


FRICITION TREND IN A UNDER LUBRICATED BEARING



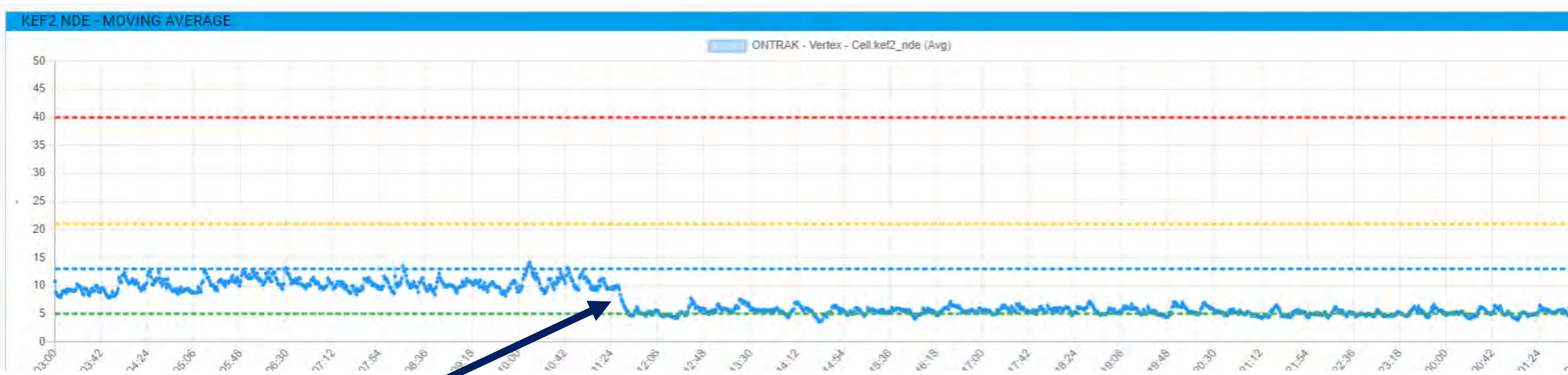
- NOTICEABLE DECREASE IN FRICTION AFTER LUBRICATION
- NOTICEABLE DECREASE IN THE PEAK-TO-PEAK VALUES.
- NOTICEABLE CENTER POINT ON THE HISTOGRAM

FRICITION TREND IN A UNDER LUBRICATED BEARING



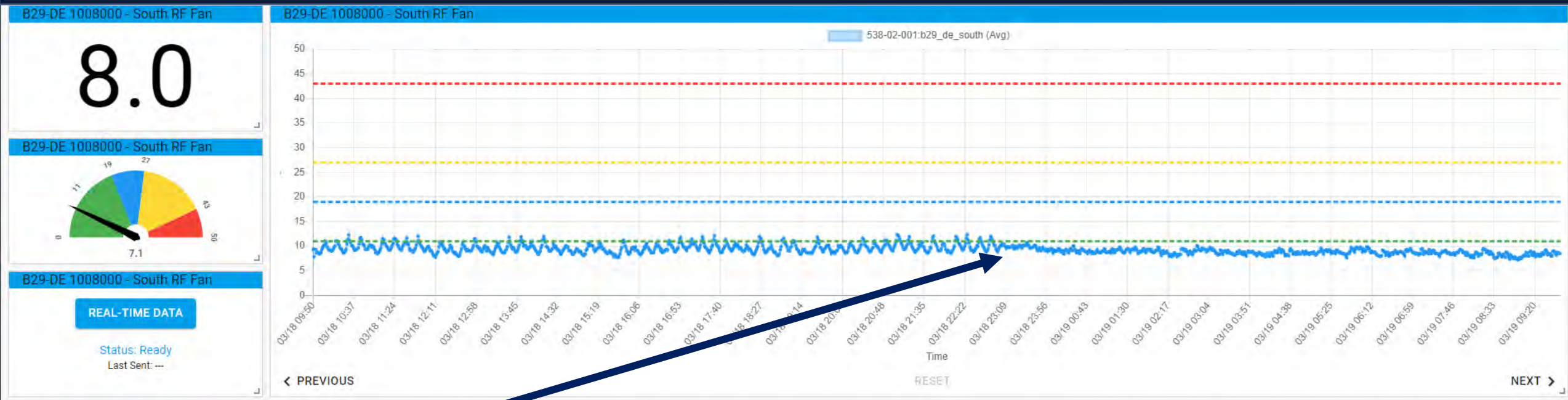
NOTICEABLE DECREASE IN FRICTION AFTER LUBRICATION

FRICITION TREND IN A UNDER LUBRICATED BEARING



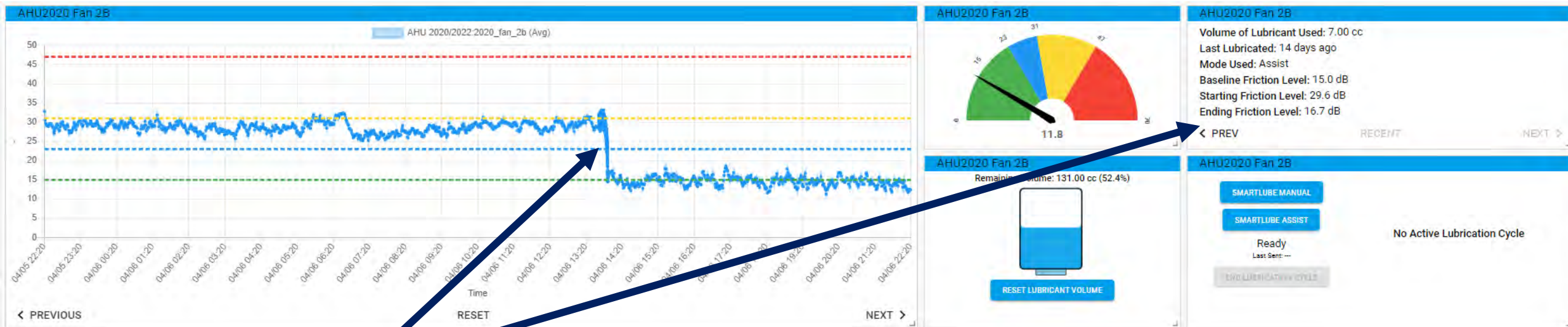
NOTICEABLE DECREASE IN FRICTION AFTER LUBRICATION

FRICITION TREND IN A UNDER LUBRICATED BEARING



NOTICEABLE DECREASE IN IMPACTING AFTER LUBRICATION

FRICTION TREND IN A UNDER LUBRICATED BEARING



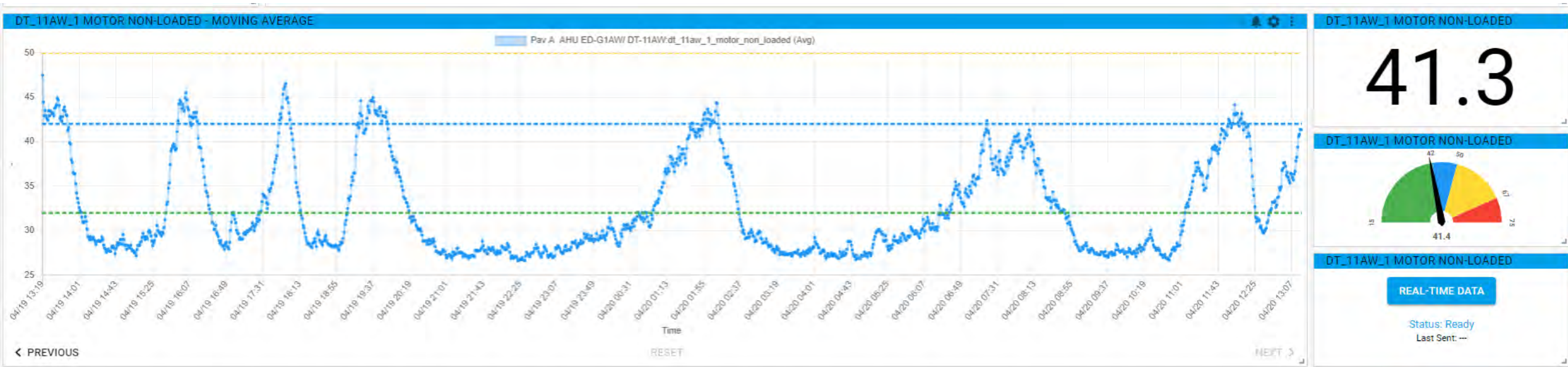
NOTICEABLE DECREASE IN FRICTION AFTER LUBRICATION

FRICION TREND IN A BAD BEARING



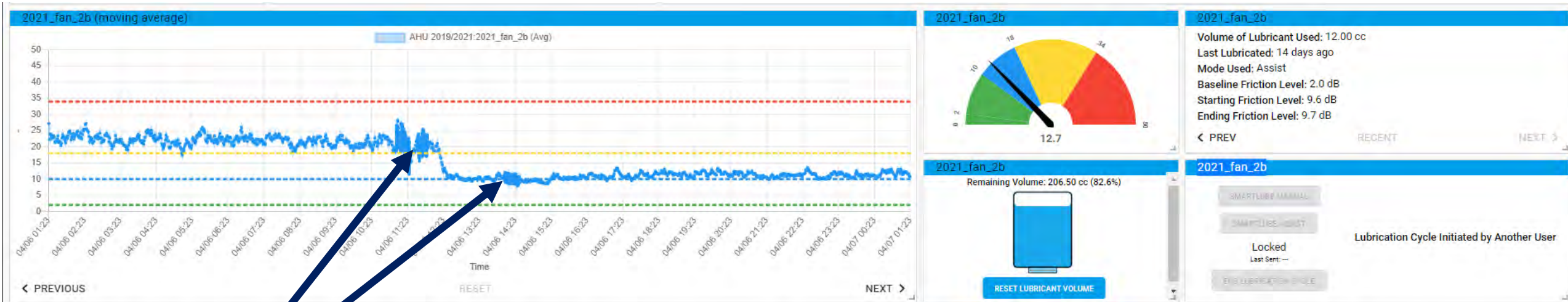
○ NOTICEABLE IMPACTING IN THE BEARING

FRICION TREND IN A BAD BEARING



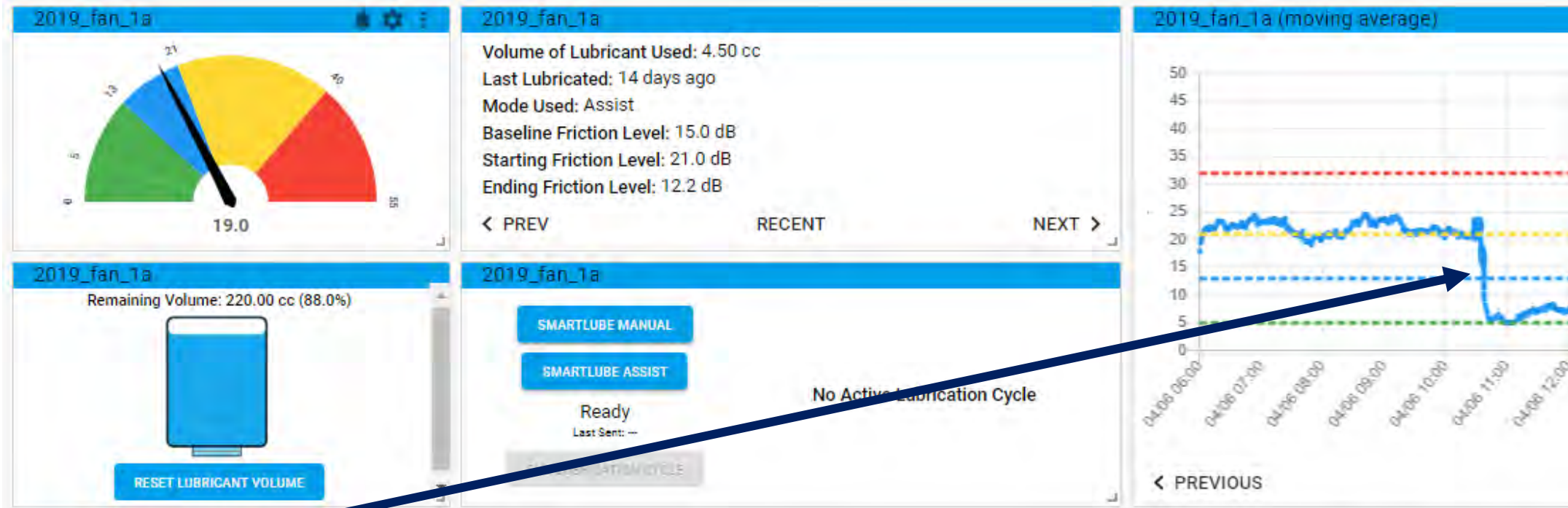
FRICION TRACKING WITH THE VFD. INDICATION OF ANOMALY IN THE BEARING

FRICITION TREND IN A BAD BEARING



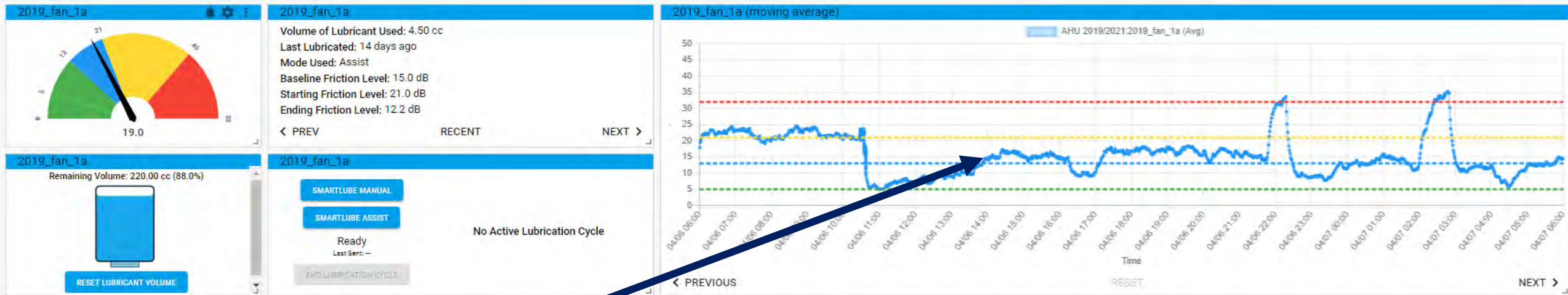
WHILE THE FRICTION WAS REDUCED, IT COULD NOT BE RESTORED TO BASELINE. EITHER IMPROPER BASELINE OR DEFECT IN THE BEARING

FRICTION TREND IN A BAD BEARING



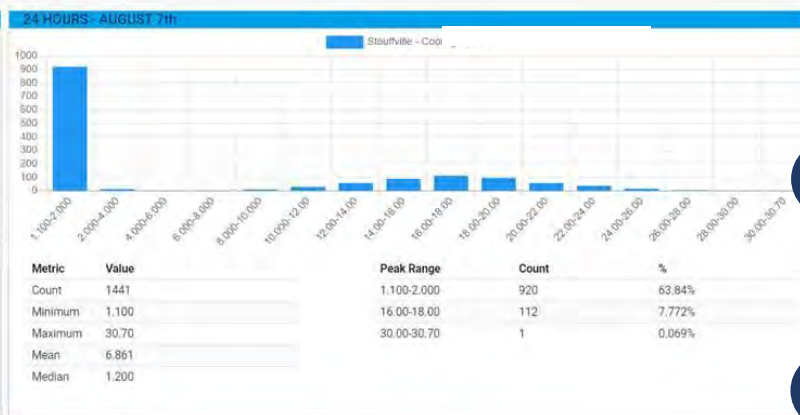
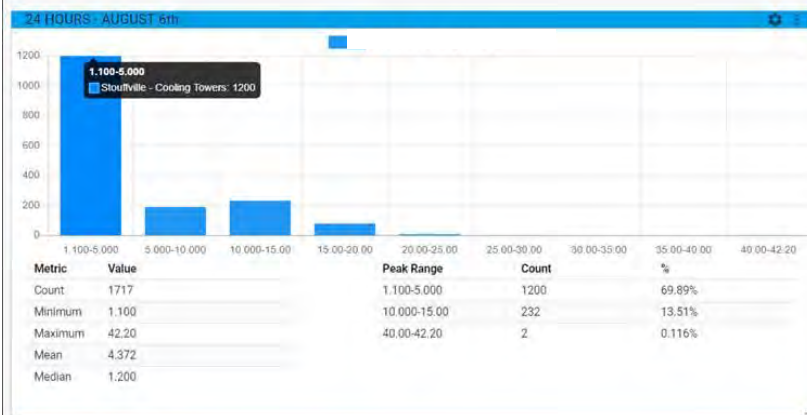
THIS LOOKS LIKE A SUCCESSFUL LUBRICATION...BUT IS IT?

FRICITION TREND IN A BAD BEARING



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

FRICITION TREND IN A BAD BEARING



NOTICEABLE INCREASE IN FRICTION OVER 4 DAYS



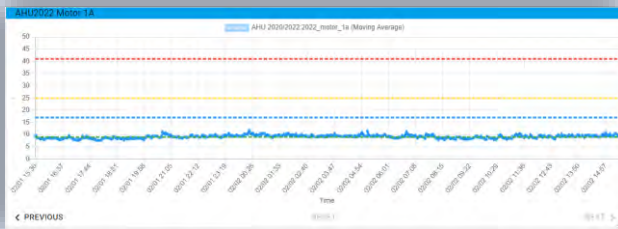
NOTICEABLE INCREASE IN THE PEAK-TO-PEAK VALUES.

NO SINGLE POINT OF FRICTION LEVEL. BEARING IS BOUNCING AROUND

BEARING LUBRICATION AND HEALTH MONITORING MADE EASY WITH FRICTION

1

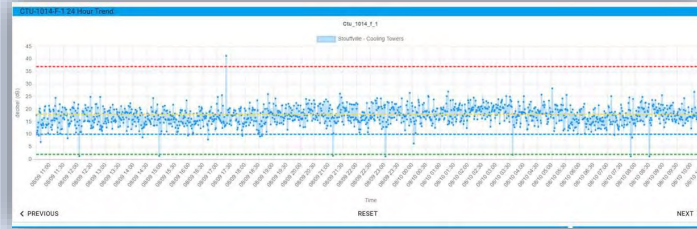
**LOOK FOR A
CONSISTENT AVERAGE
TREND VALUE**



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

2

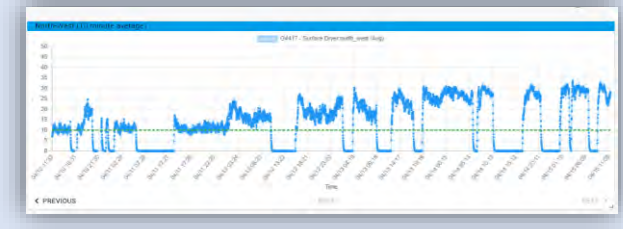
**LOOK FOR PEAKS AND
VALLEYS LESS THAN 4
DB IN AMPLITUDE**



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

3

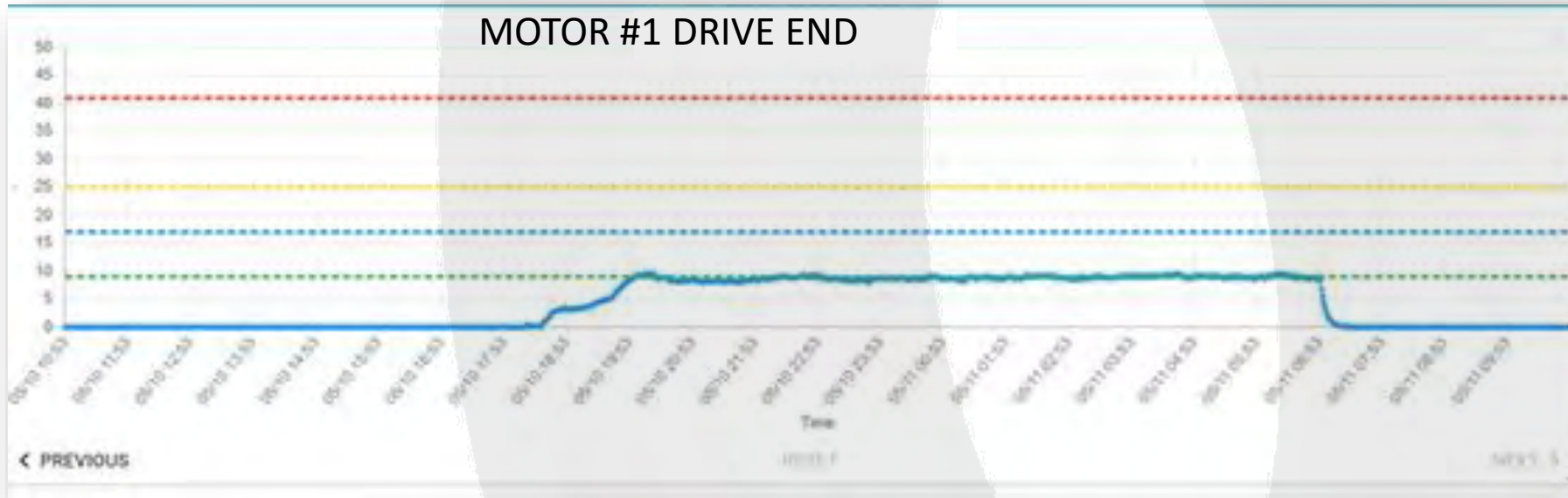
**LOOK FOR INCREASE IN
FRICTION OVER 30
DAYS**



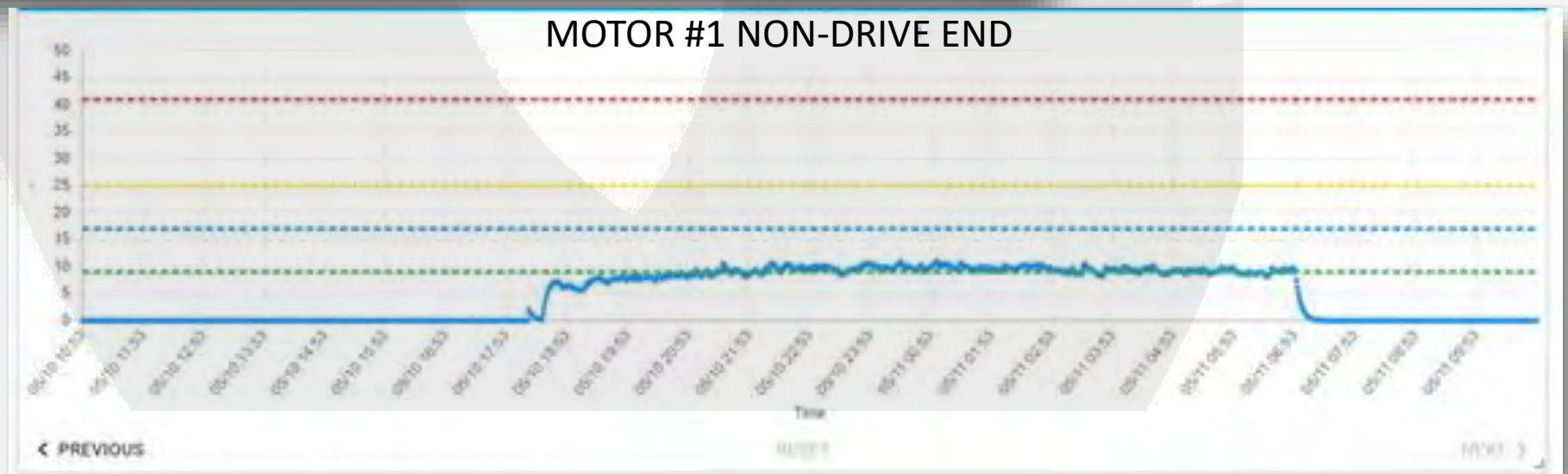
**AN INCREASE IN FRICTION OVER
TIME INDICATES THE BEARING IS
NOT HEALTHY**

IDENTICAL MOTORS WITH DIFFERENT FRICTION TRENDS

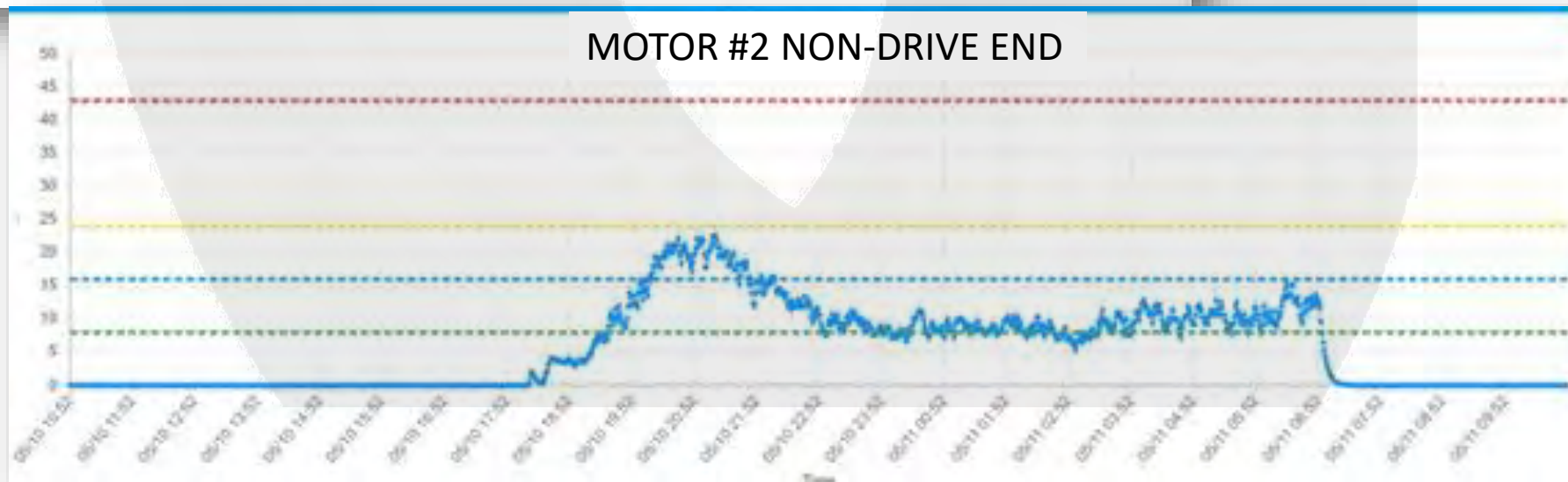
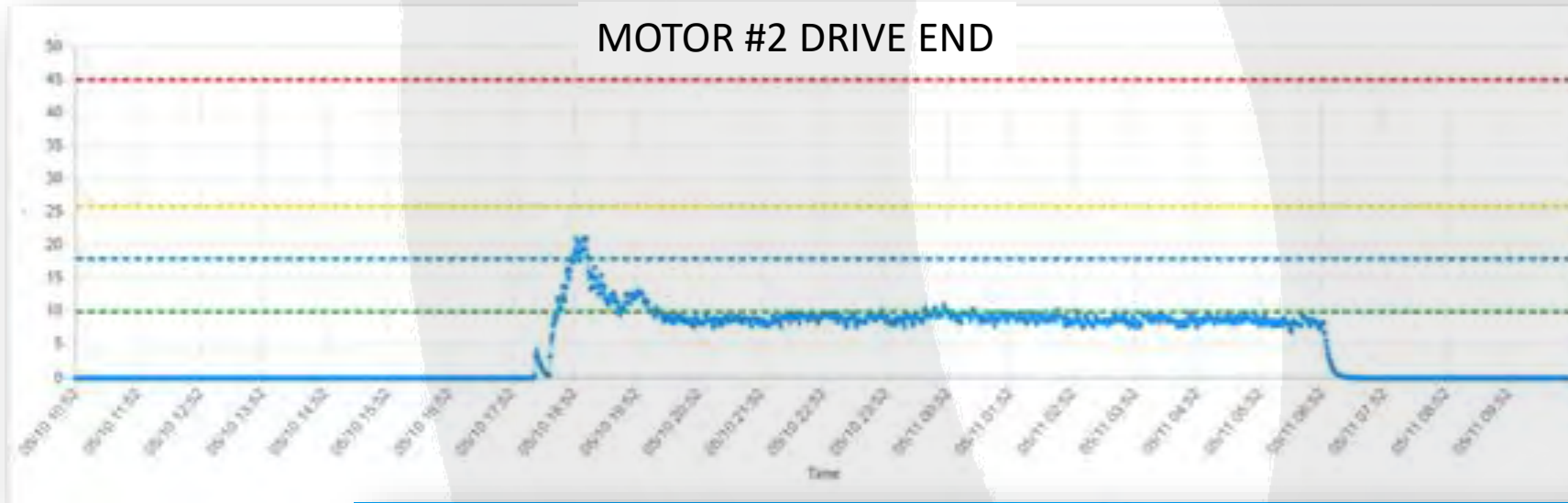
MOTOR #1 DRIVE END



MOTOR #1 NON-DRIVE END



IDENTICAL MOTORS WITH DIFFERENT FRICTION TRENDS



CAUSE: THERMAL EXPANSION FROM IMBALANCE

Work Order #:

Assessment Comment: An imbalance condition continues to exist on the fan.

Analysis Comment: The imbalance condition on the fan continues to be an issue. The overall amplitude in the Spectrum has increased going from 0.148 ips (inches per second) on May 2 to 0.259 ips (inches per second) on May 6. This has been reported prior and is probably the cause of looseness observed in the envelope spectrum.

Repair Recommendation: I recommend checking the runout of the motor shaft and fan hub where they mate. Inspect the blades for damages from impacts with the shroud. Inspect the shroud for impacts and clean any buildup that might be present. If the runout is less than 0.002", perform a precision balance, if greater, consider replacing the motor shaft. Consider looking at the bore of the fan hub and ensure it is centered.

QUESTIONS?

blairf@UESystems.com

