

SUCCESS STORIES

Chemical & Petrochemical



Time-Based greasing? Sure?

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It makes sense to be reminded, from time to time, that calendar is not always the best decision-making tool. Actually, it rarely is.

Because, if it was, you would have been dragged out of your 65th birthday party and taken to a hospital for a hip replacement, since statistics say that hip failures happen from that age on, and if your hip is just fine... bad luck, they will “repair” it anyway.

Personally, I somehow prefer it to be done based on REAL CONDITION of MY hip, not statistics and calculations. And, luckily for all of us, that’s exactly how medicine does it.

Unfortunately, bearings do not always have the luxury we have, the luxury to be examined before someone injects something into our bloodstream or replaces some of our “parts”.

Fortunately, more and more “doctors and nurses”, in Maintenance and Reliability, care enough and know enough to question the calendar and actually ask the patient (bearing) three simple and effective questions:

- Do you need grease?
- How much?
- Do you feel better now?

You just need to speak the bearing language, and you’ll get your answers loud and clear.

Recently, Mr. Alican Gozuacik and I spent 4 days in training with high performing Jotun team in Turkey, led by Mr. Bahadir Buyukeren, with Hakta Zeren and Kamil Okcu.

It is also important to mention Mr. Serdar who was not involved in training until the very end but played a highly important role in greasing bearings right.

So, let’s see what we had on the menu:

Two fans with the same specs (not using word identical as I do not believe in it, but “same” fans), operating in the same conditions (according to how the process is supposed to work) and treated with copy/paste time-based lubrication plan.

- Direct drive, 55 kW motors, with 6 313 and 6 315 bearings.
- Lubrication plan based on recommendations:
 - 13 grams every 4 000 hours, both DE and NDE on both motors.
- No Ultrasound history data available – no alarms applied at this point.

As assuming seems to be the keyword in many lubrication programs, let me join the club and assume something myself.

I assume that the recommendation is wrong.

As it was time to replenish the grease in both motors (according to those 4 000 hours), we used the opportunity to do it. But this time with LUBExpert.

After a couple of minutes of basic instructions to Mr. Serdar, he was on his way to replenish grease based on real condition and real bearings’ needs. We did nothing, we simply enjoyed the scene.

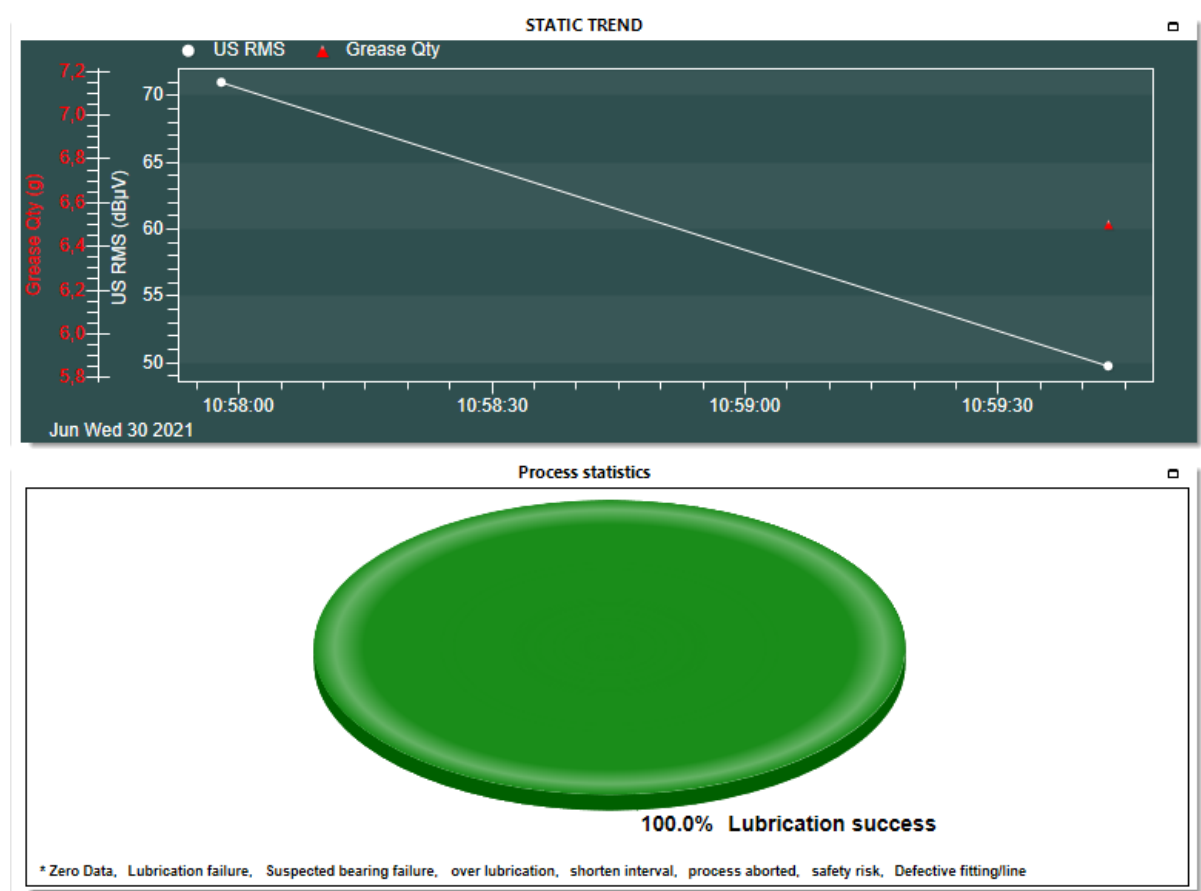
And, surprise, surprise... what happened during grease replenishment was not even close to what time-based recommendations were directing Mr. Serdar to do.

Fan 2 Motor NDE:

Planned quantity: 13 grams / proven wrong

Applied: 6.5 grams

Outcome: Lubrication success



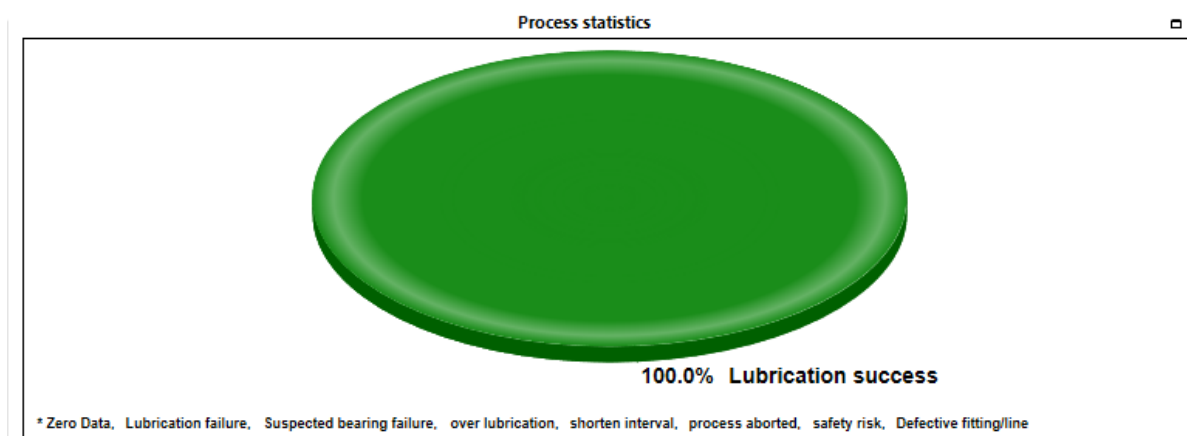
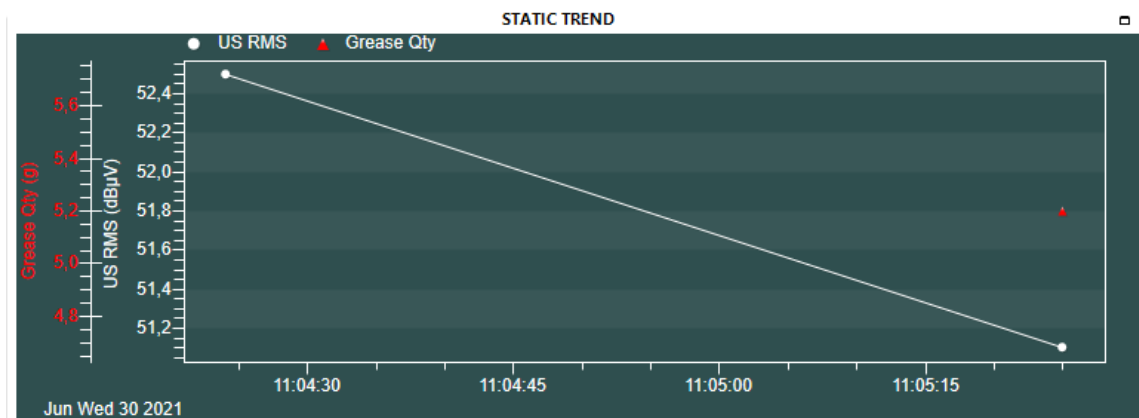
Readings Alarms Events									
Jotun Lube/Line 2 FAN Direct Drive/Motor Nde/LUBEsense1(ST-Ht)									
RMS	Lube Alarm	Lube Alarm Level	Grease Name	Nb. Grease Shot	Grease Qty	Sensor Name	Length (Sec)	Operator	
49,7	▲	Lubrication success	LGHP	5	6.5	LUBEsense1	4	default	
71		initial reading	LGHP	0	0	LUBEsense1	4	default	

Fan 2 Motor DE:

Planned quantity: 13 grams / proven wrong

Applied: 5.2 grams

Outcome: Lubrication success



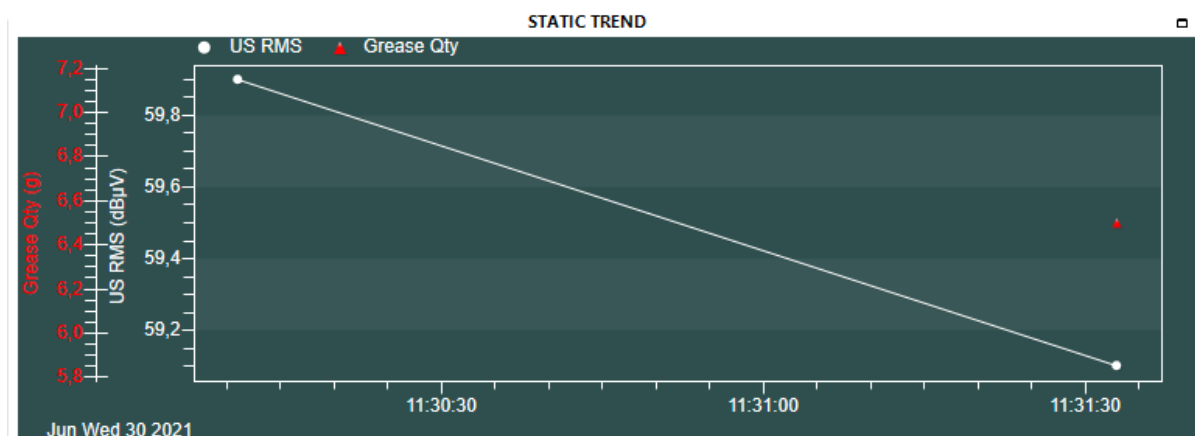
Readings Alarms Events									
Jotun Lube/Line 2 FAN Direct Drive/Motor DE/LUBEsense1(ST-Ht)									
RMS	Lube Alarm	Lube Alarm Level	Grease Name	Nb. Grease Shot	Grease Qty	Sensor Name	Length (Sec)	Operator	
51,1		Lubricationsuccess	LGHP	4	5.2	LUBEsense1	4	default	
52,5		initial reading	LGHP	0	0	LUBEsense1	4	default	

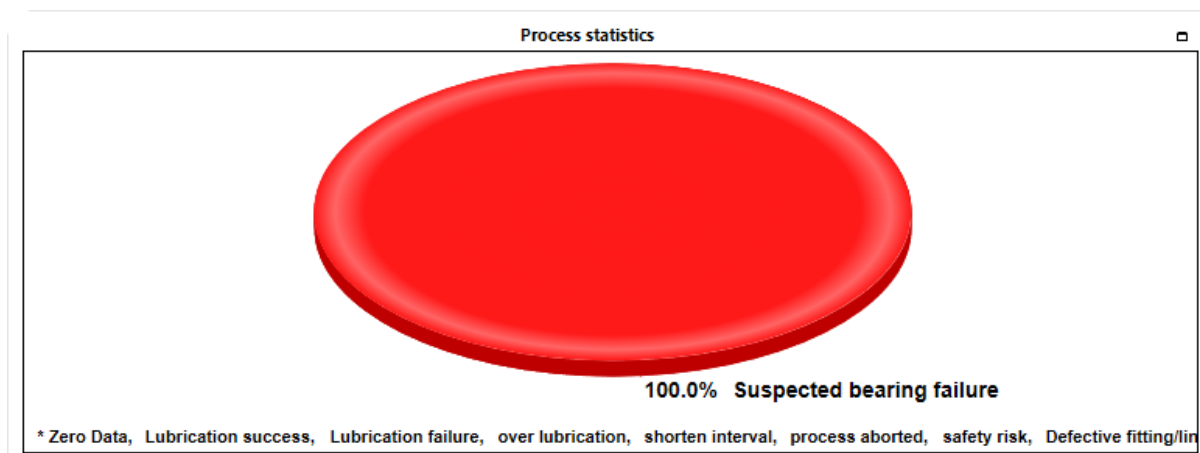
Fan 1 Motor NDE:

Planned quantity: 13 grams / proven wrong

Applied: 6.5 grams

Outcome: Suspected bearing failure – Data reported to CM team





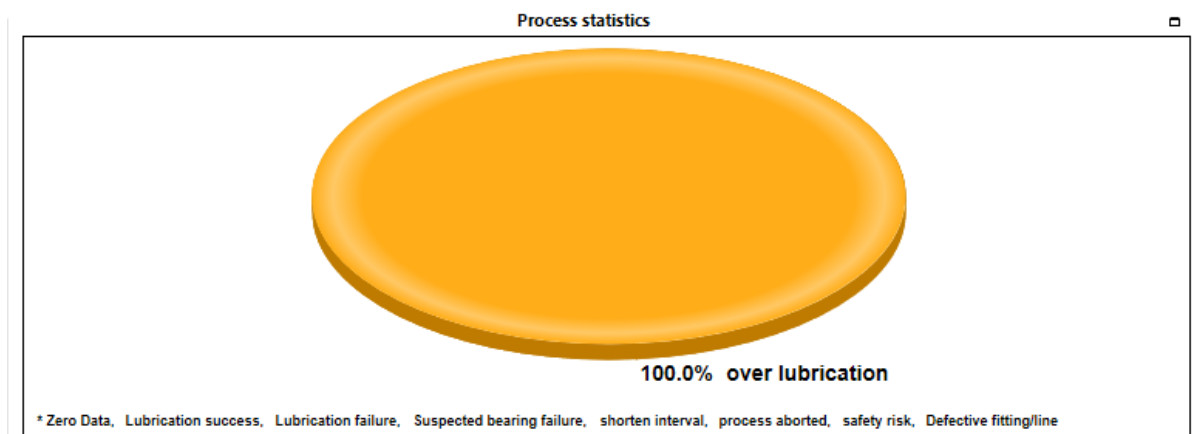
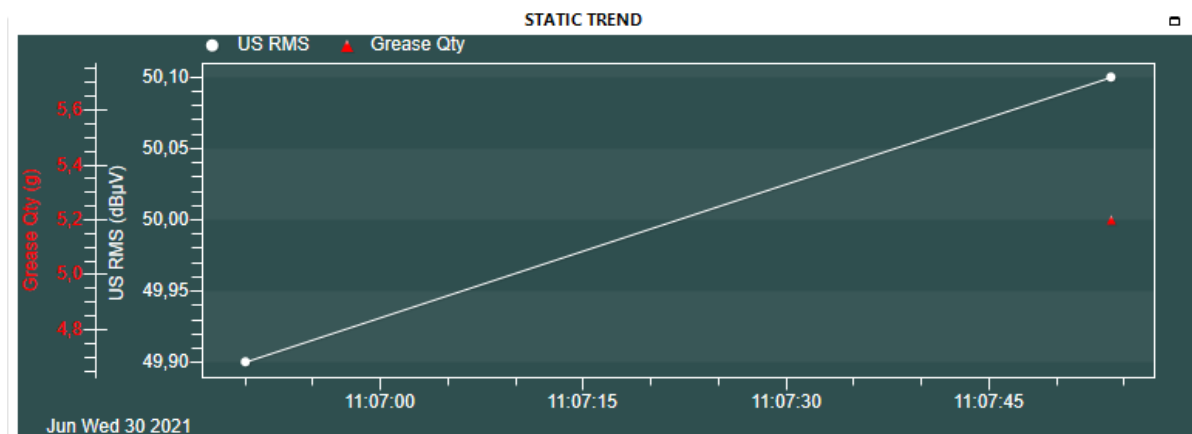
Readings Alarms Events									
Jotun Lube/Line 1 FAN Direct Drive/Motor NdE/LUBEsense1(ST-Ht)									
RMS	Lube Alarm	Lube Alarm Level	Grease Name	Nb. Grease Shot	Grease Qty	Sensor Name	Length (Sec)	Operator	
59,1	▲	Suspected bearing failure	LGHP	5	6.5	LUBEsense1	4	default	
59,9		initial reading	LGHP	0	0	LUBEsense1	4	default	

Fan 1 Motor DE:

Planned quantity: 13 grams / proven wrong

Applied: 5.2 grams

Outcome: Over Lubrication – Bearing didn't need any grease



Readings Alarms Events									
Jotun Lube/Line 1 FAN Direct Drive/Motor DE/LUBEsense1(ST-Ht)									
RMS	Lube Alarm	Lube Alarm Level	Grease Name	Nb. Grease Shot	Grease Qty	Sensor Name	Length (Sec)	Operator	
50,1		over lubrication	LGHP	4	5.2	LUBEsense1	4	default	
49,9		initial reading	LGHP	0	0	LUBEsense1	4	default	

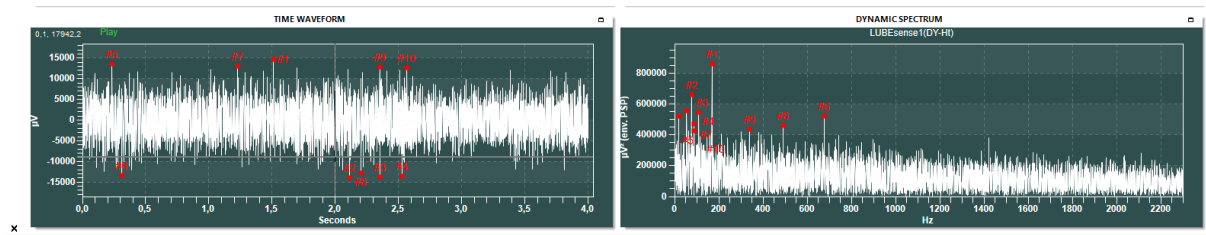
Worth mentioning:

Mr. Serdar performed the task perfectly and with no assistance from our side.

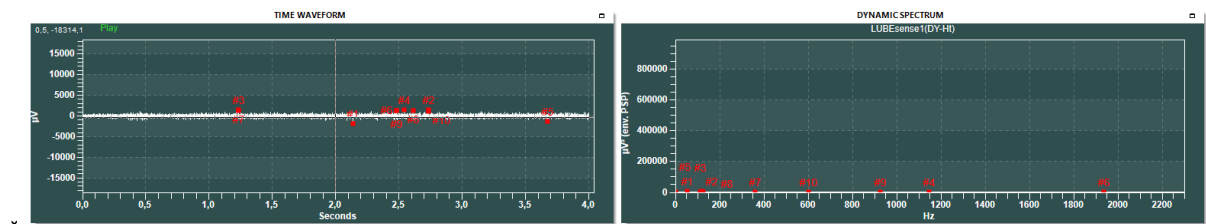
In addition, LUBExpert collected the Dynamic data (TWF and Spectrum) for each bearing before and after the grease replenishment process.

That makes Mr. Serdar a member of the Condition Monitoring team, providing highly valuable data.

Before:



After:



Let us conclude this interesting and clear case:

- The needs of each bearing were different, opposite to what was assumed;
- None of those needs matched the Time-Based plan;
- Following the Time-Based plan would have actually hurt the bearings;
- The job was done easily, correctly, fast, and effectively.

Obviously, there is a good way and a bad way to replenish grease.

Your bearings – your choice.

On-Condition or Time-Based?

Author: Allan Rienstra

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Maintaining plant assets in an optimal state of lubrication is a topic receiving lots of attention. Maintenance and Reliability practitioners dedicate teams to the task but not every organization achieves world-class results. As much as 80% of all bearing failures are attributed to poor lubrication practices including:

- Using the wrong lubricant
- Lubricant deterioration
- Lack of lubricant
- Too much lubricant
- Contamination
- Mixing grease types
- Using sealed bearings but still providing a grease nipple access point on the motor (whoops!)



Figure 1 - Collecting ultrasound data with SDT270 while replenishing lubricant.

“During the training, we performed measurement practice on several machines (Figure 1). One of the machines was a fan, scheduled for re-lubrication in a few days” recalls Haris. “The customer’s standard greasing practice is to follow manufacturer’s recommendations for both interval and amount. In other words, they grease on a time-based schedule and trust the motor manufacturer to guide on quantity.”

Haris Trobradovic used the opportunity and performed re-greasing exactly as

One glaring mistake that contributes to early bearing failure is over/under lubrication. Over and under lubrication is the product of scheduling grease replenishment on a time-based instead of a condition-based schedule, and not knowing how much grease to inject.

Too often bearings are being fed new grease before it’s required. Other times the grease gun comes out too late. Some lubrication technicians guess the quantity of grease to inject and don’t even know how much grease is dispensed with a stroke of their grease gun. Bearing manufacturers provide formulae for calculating a theoretical grease capacity for each bearing but not everyone knows how to use them. Still others simply follow guidelines given by the motor manufacturer. Often this “bad advice” is stamped directly on the motor.

To drive home this point, Haris Trobradovic, one of SDT’s many globe-trotting corporate trainers recently delivered training to a petrochemical facility in the Middle East.



Figure 2 - Two fan bearings with different load. Why do they share the same grease replenishment protocol?

recommended by the OEM, even though the Condition Monitoring team had a different opinion. Their ultrasound data did not indicate any need for grease replenishment, after having added a small amount of lubricant followed by a measurement. The CM team members are strong advocates for on-condition lubrication and doing away with time-based.

Following the facility's lubrication procedure raised several red flags. Figure 2 shows two bearings driving the fan. Why would two identical bearings, but with different loads, have the exact same grease replenishment protocols? Maybe it's purely out of convenience; since the lubricator is there to grease the drive end bearing, might just as well pump a few strokes into the non-drive end.

Another issue that disturbed the SDT trainer was the instructions stamped on the motor plate. See Figure 3 – Maintenance of the bearings with grease quantity regulator". This stamp instructs the owner of the motor to add 32.7 grams of grease (grease type not identified) every 3 068 operating hours. Haris wondered if the OEM took into consideration the installation of the motor in a climate that is

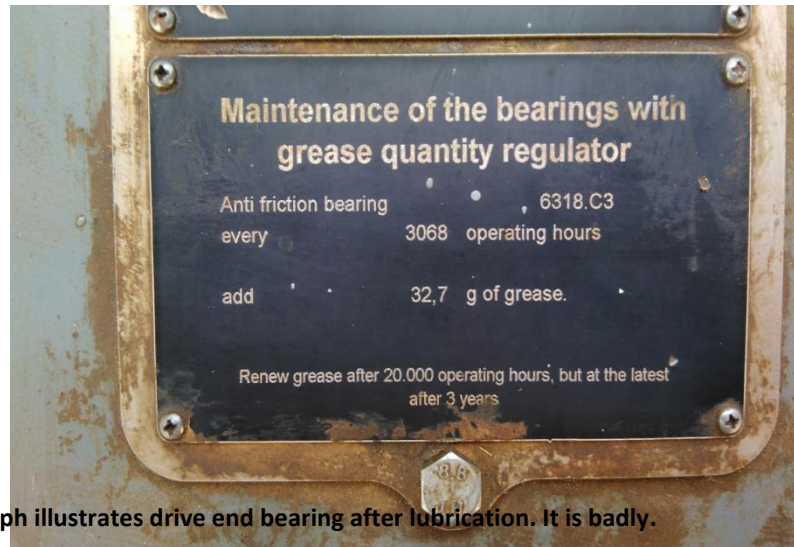
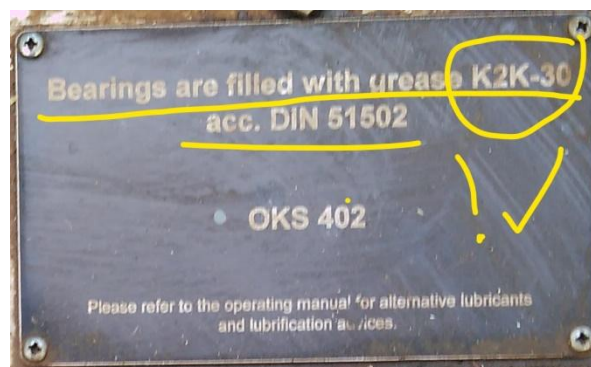


Figure 3 - Top trend graph illustrates drive end bearing after lubrication. It is badly. very hot and humid in the summertime, but cold, snowy, and dry in the winter.

One refreshing fact was an additional plate (Figure 4) with details about the grease type used in the bearing. Mixing incompatible grease types is an often-cited cause of premature bearing failure. This same reminder is provided by the SDT LUBExpert Ultrasound Tool. Prior to beginning a lubrication task LUBExpert reminds the operator of the correct grease type to use.

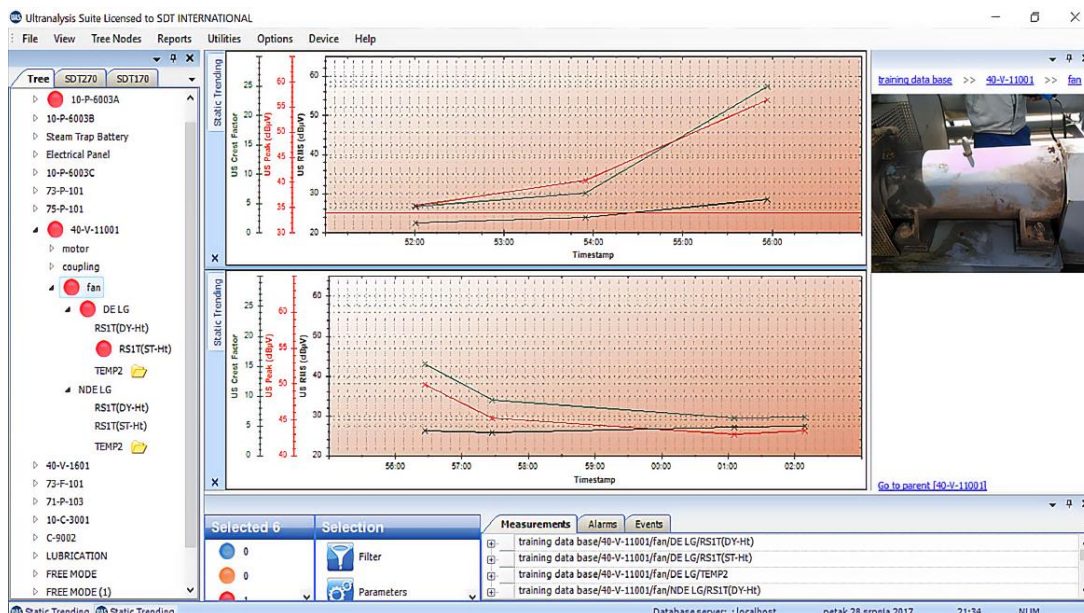
Figure 4 - This motor had a secondary plate reminding lube-techs which grease type to use.



Continuing with the experiment, Haris and the CM team attached the grease gun to the SDT equipment and greased the drive end bearing following OEM recommendations. Figure 5 is a screen

Figure 4 - OEM instructs the owner to grease on a time-based schedule without considering the operating environment.

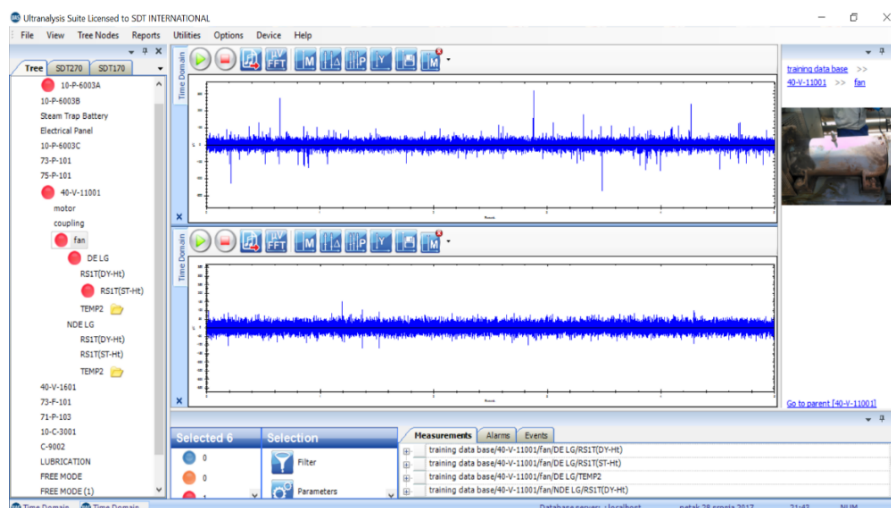
shot captured from UAS, the companion software to LUBExpert. The top trend is the drive end bearing. Within four minutes, the overall RMS increased by 7 dBμV while the Crest Factor and Peak spiked sharply.



The bottom trend is from the non-drive end bearing. Adding the requisite amount of grease had no positive outcome for the Overall RMS which stayed stable at 26 dB μ V. The drop in Crest Factor and Peak readings, however, indicates the bearing may be entering a failed state. More frequent condition monitoring with complimentary technologies such as vibration analysis will ensure any machine downtime is scheduled on the client's terms, not the machine's.

For those unfamiliar with these data formats, Overall RMS, Max RMS, Peak, and Crest Factor are used to bring synthetic meaning to ultrasound STATIC data. Sadly, following OEM procedure resulted in over lubrication of the DE bearing.

To drive home the point, Haris also captured DYNAMIC signals from the drive end bearing. As seen in Figure 6 the time signal before (bottom) and after (top) reveals new peaks and impacts forming. Over lubrication causes pressure to build inside the bearing. Ideally, the lubricant wants to feed from the



thickener to form a thin film between the rolling elements and the race. It can't do this if there's too much grease and pressure. The result is increased friction and impacting, two phenomena easily detected with ultrasound specialty tools like SDT's LUBExpert.

Finally, Haris collected DYNAMIC time signals on the non-drive end bearing. In Figure 7 the bottom time signal shows dominant peaks that are clearly random impacts. After lubrication those peaks are

Figure 6 - Dynamic data from drive end shows the emergence of defects (top) after bearing was over-greased following OEM recommendations.

gone, as you can see in the top time signal, Figure 7. It appears that replenishing the grease in the non-drive end had some positive benefits, and those benefits are clearly illustrated in UAS.

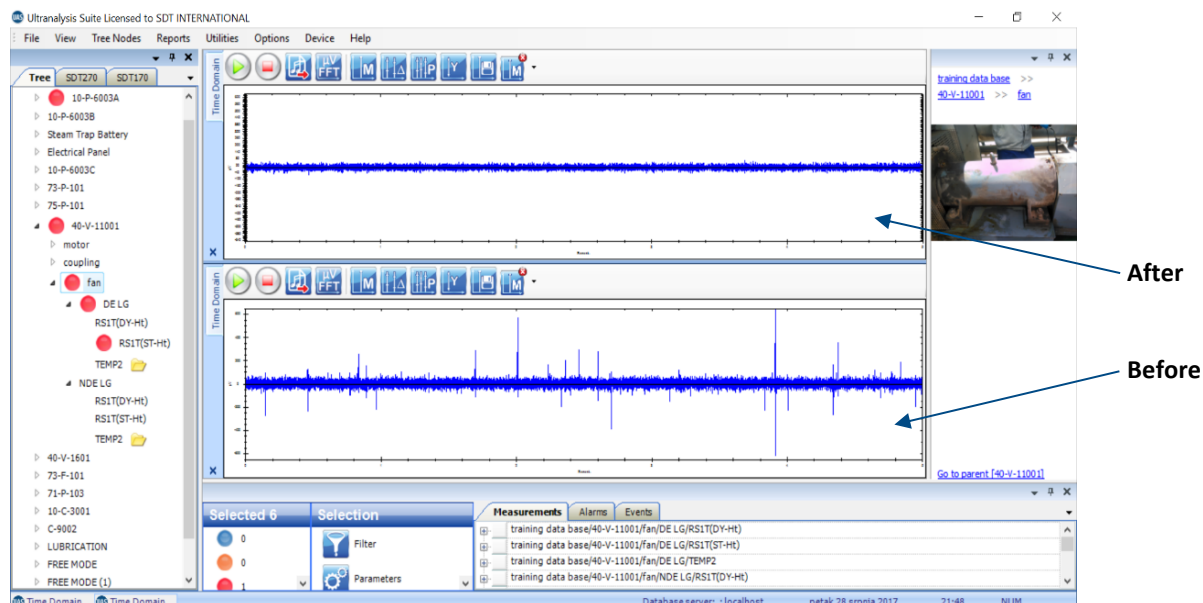


Figure 7 - The non-drive end bearing has defects as shown by this dynamic time signal. Ultrasound assisted lubrication with SDT allowed the CM team to identify this potential fault.

The bottom line is that following OEM recommendations to replenish lubrication on a time-based or time-in-service protocol are proven wrong time and again. Following the greasing instructions stamped on the motor plate led to the drive end bearing being over greased and reducing life expectancy.

Another interesting takeaway here is that while an ultrasound lubrication solution – LUBExpert – was used to monitor the effects of adding grease, the added benefit for the CM team is the indication that a failure state may exist. There was a day not too long ago when the lubricator was counted on for keeping his finger on the pulse of the plant. Solutions like SDT's LUBExpert are restoring important responsibilities to a task that recently has been given to "lower-skilled" tradespeople.

It's past time that lube-techs be recognized for the important role they can play contributing to plant reliability.

In the past, we used ultrasound only for air leak detection and for lubrication routes without exporting data to a software. Now, with the help of the Ultranalysis suite software, our use of ultrasound is getting closer to common vibration techniques. We began by measuring several pieces of equipment with our SDT270 and its dedicated ultrasound sensors to familiarize ourselves with the equipment and software.

Since our vibration program is important in the plant, I wanted to integrate ultrasound into our existing predictive maintenance practices. That's when we came up with the idea of using it on our CB-1310 conveyor. At first, in 2016, we built a route only at the level of the return rollers. A reading on the roll frame gave us good signal quality for the application.



At this time, the previously established preventive maintenance route was still performed. We used these latest inspections to establish a basic level of alarm based on the provided ultrasound indicators. By comparing the two routes for a few months, we arrived at similar results. Subsequently, we refined our alarms to make sure we could see the problems in advance. Following the satisfactory results obtained, we applied the same method on the carrier rollers without even opening the covers.



After a dozen collections, we can say today that the results are very promising. One year ago, since implementing this new ultrasonic strategy, we no longer need to do the preventive maintenance route.

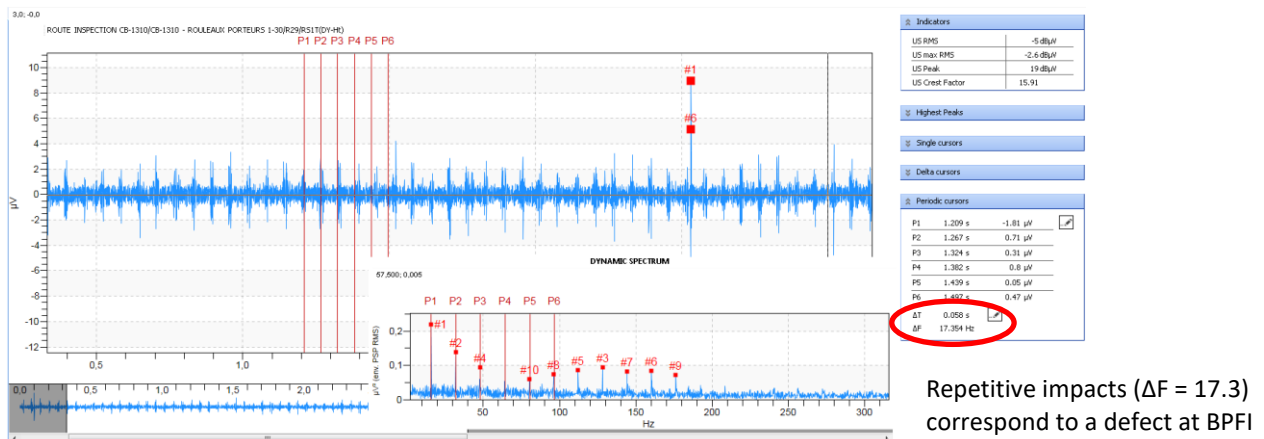
Since I am a vibration analysis technician, I use ultrasound by applying the same techniques I use in vibration. In both cases, I analyze the time waveform and / or spectral (FFT) except that I am measuring ultrasound instead of displacement (vibration).

Here are some examples of defects found on our rolls. Unfortunately, for our carrier rollers, I check three rolls at a single reading point, and I can not say precisely which one is in fault. These rolls are manufactured with two bearings 6304-2RS / C3 and it is the outer ring of the bearing that rotates at a speed of 238 RPM.

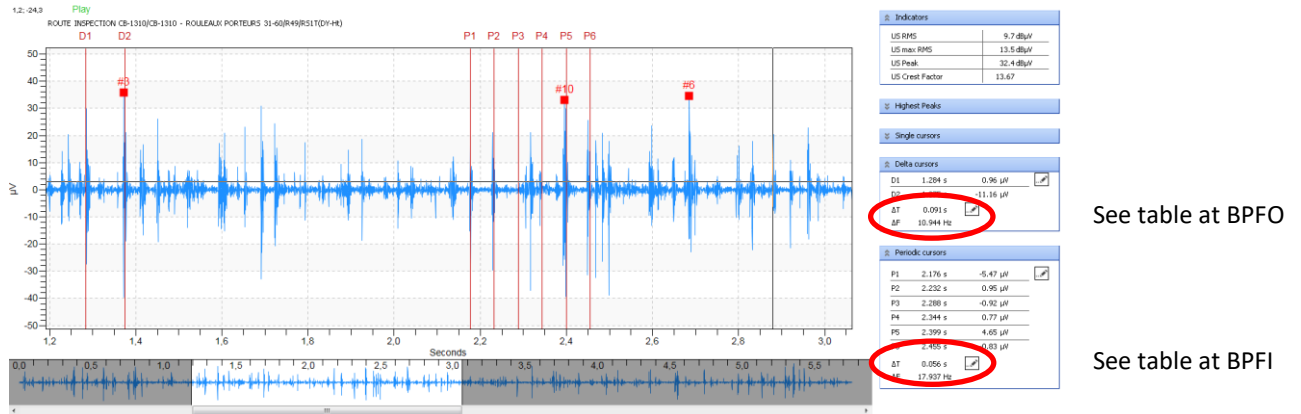
These are the default frequencies for a SKF 6304 bearing

	f_e Rotational frequency of outer ring	3.97 Hz	
FTF	f_c Rotational frequency of the rolling element and cage assembly	2.51 Hz	
BSF	f_r Rotational frequency of a rolling element about its own axis	6.97 Hz	linked to August 20
BPFI	f_{ip} Over-rolling frequency of one point on the inner ring	17.6 Hz	linked to January 3 & 25
BPFO	f_{ep} Over-rolling frequency of one point on the outer ring	10.2 Hz	linked to January 25
2 x BSF	f_{rp} Over-rolling frequency of one point on a rolling element	13.9 Hz	linked to August 20

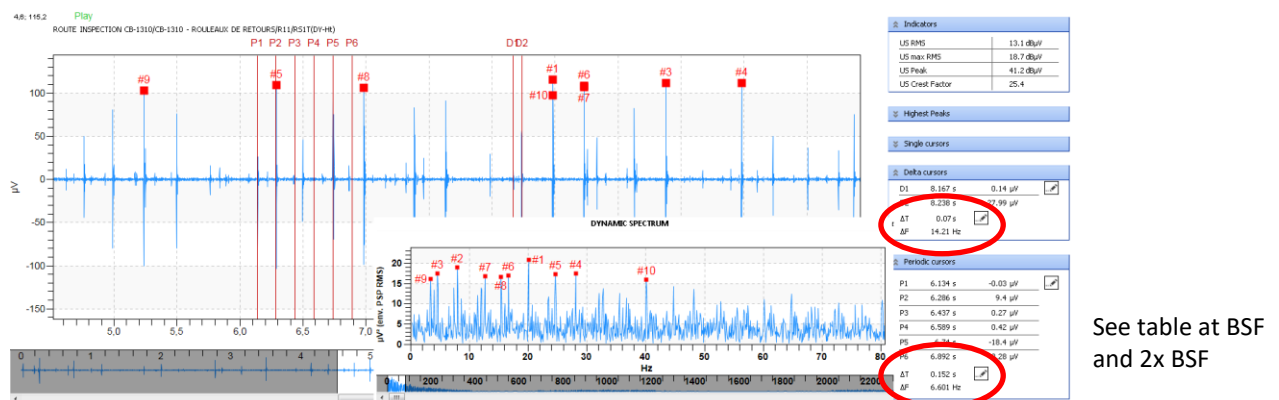
January 3, 2018: Roller Bearing R29 Internal Rolling Cage Failure (BPFI)



January 25, 2017: Roller bearing R49 presence of internal and external bearing failure (BPFI and BPFO) may be that it was on two different rolls.



August 20, 2018: Roller back R11 bearing ball bearing frequency (BSF)



During the analysis, we see on neighboring readings the presence of the roll in fault but at lower amplitude. This helps us confirm the faulty roll section. Of course, there are many other parameters to consider, such as dirty rolls and the like. Listening to the time wave also helps to confirm a potential problem.

In conclusion, the program is working very well, and the alarm level currently set allows us to identify each time there is an appearance of a defect on a roll. We do not really need to identify the specific fault of the bearing each time because the rolls are not expensive enough to spend so much time.

In our study case, the typical defects are identified at low rotating speed, where in practice, vibration technics reach their sensitive limits.

Bearing Fault Detection in a Biomass Conversion Facility

Authors: Allan Rienstra and Patrice Dannepond

Email address: allan.rienstra@sdtultrasound.com

Today I want to share with you a story of how SDT helped one client identify failure conditions on large, low speed spherical roller bearings. It is an interesting tale about a facility that serves a dual purpose, reducing greenhouse gas and fossil fuel emissions while producing energy and resources through the conversion of household waste.

Energy from Waste

The power grid is fed from many sources. Coal, nuclear, and gas fired generation plants, solar and wind, just to name a few. And then there is Biogas, a methane-rich product originating from the decomposition of organic waste. Biogas conversion has gained traction in Europe. However global acceptance of biogas as a legitimate fuel is held back by the abundance of and low price demanded for natural gas. Reliability through ultrasound is one way biogas conversion facilities can avoid cost escalation and remain an attractive alternative fuel.

Biomass energy technologies extract energy resources from virgin and waste biomass. Biomass is non-fossil, energy-containing forms of carbon. Virgin forms include plants and vegetation. Waste forms include municipal solid wastes, residual by-products from forestry and agriculture, as well as non-hazardous industrial wastes.

Biomass energy is used for the production of heat, steam, and electricity. It also creates fuels that can serve as suitable alternatives for fossil fuels, most common being methane gas. Extracting the chemical energy content inherent in non-fossil organic materials is the job of a biomass conversion facility.

Converting Household Waste to Methanol and Fertilizer

Anaerobic digestion is a biological process that decomposes organic matter by means of microbial flora. It is a natural process occurring in the absence of oxygen within a closed containment. It is an innovative process for treating household waste.



Located in Montpellier, France, AMETYST is the largest biomass conversion facility in the region. It has the capacity to convert 203,000 tonnes of household and bio-waste each year. By diverting this waste away from landfill sites, AMETYST is capturing greenhouse gases and putting them to work. In a normal year 14.4 million cubic metres of methane biogas is converted and used for the production of electricity and heat, equivalent to 30,000 megawatts of electricity. 24,000 tonnes of compost go back to the community for use in landscaping, and 4000 tonnes of organic waste compost is used for natural soil amendments for agriculture.

Methane Ovens

After sorting and pre-composting, the organic matter moves through anaerobic digestion units converting household waste to biogas and compost. Basically, these are large ovens rotating slowly around two large outer rings on each end. Each ring is supported by four massive spherical roller bearings.

Recently, the bearing on Oven 2 had failed and was replaced. SDT's field specialist for the French region, Patrice Dannepond, was called to site to collect ultrasound data on oven 1 and oven 2 to confirm their condition and help plan for similar failures. Ultrasound technology was chosen because of its ability to monitor and assess the condition of bearings rotating at such low speeds.

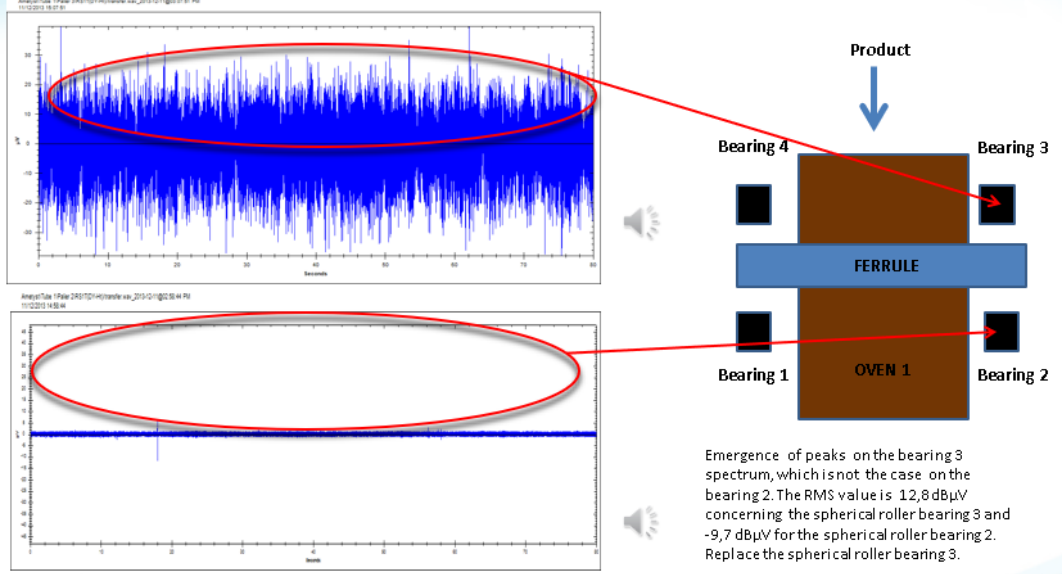
Oven 1

By capturing static and dynamic ultrasound data using an SDT270DU and a resonant contact ultrasound sensor, Patrice measured, listened, and analyzed the eight ring support bearings. Bearings 1 through 4 support the Product Entry side on Oven 1. High static RMS values were detected on bearings 3 and 4. Bearing 1 and 2 measured minus 9 dBrms while 3 and 4 were 12.8 and 14.2 dBrms.

	dB uV (RMS)	dB uV (Max RMS)	dB uV (Peak)	dB uV (Crest Factor)
Bearing 1	-9.6	-7.2	11.2	11
Bearing 2	-9.7	-5.6	15.8	18.7
Bearing 3	12.8	17.5	32.1	9.2
Bearing 4	14.2	19	32	7.76
Bearing 5	-9.9	3.9	21.7	38
Bearing 6	-10	-7.2	7.5	7.41
Bearing 7	-10.3	-8.4	13	14.12
Bearing 8	-6.8	12.7	30.5	72.83



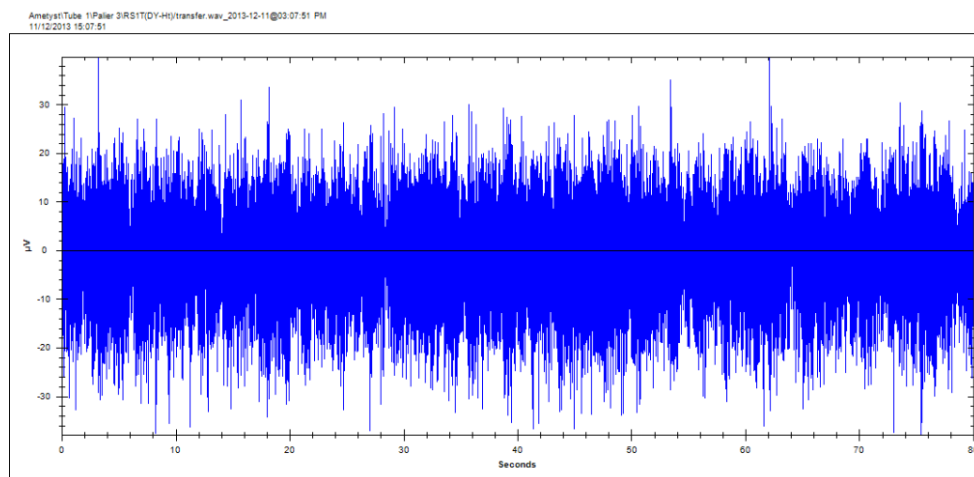
TIME WAVEFORM AND SOUND FILE – OVEN 1 :

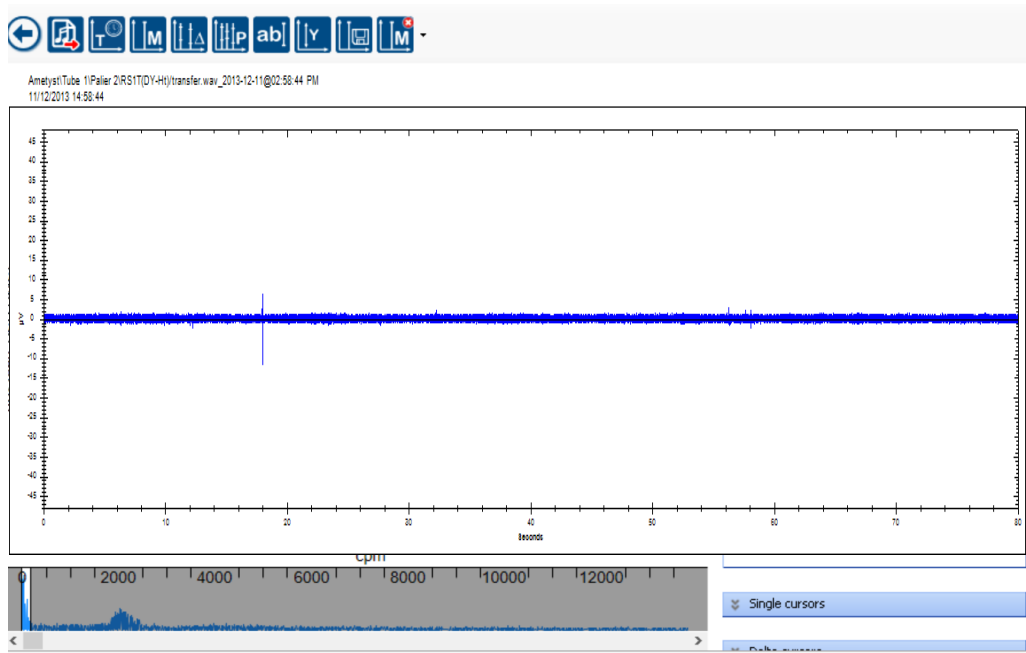


We noted earlier that the rotational speed of the oven is 1 RPM, and the bearing is 4 RPM. For a good analysis of low-speed bearings at least 3 to 4 full rotations are desired. To be safe, Patrice set his SDT270DU to capture an 80 second dynamic signal. Looking at the dynamic data in the time trace the emergence of peaks on bearing 3 and 4 are consistent with the static RMS values. Looking at the time waveform of bearing 4 Patrice notes the presence of impulses each 14.48 seconds. This is consistent with the running speed of the bearing.

The conclusion was to replace both #3 and #4 bearings. Bearings 5 through 8 on the Product Exit side of the oven returned low dB RMS values and no impulses were detected in the time trace. All four bearings were given a pass.

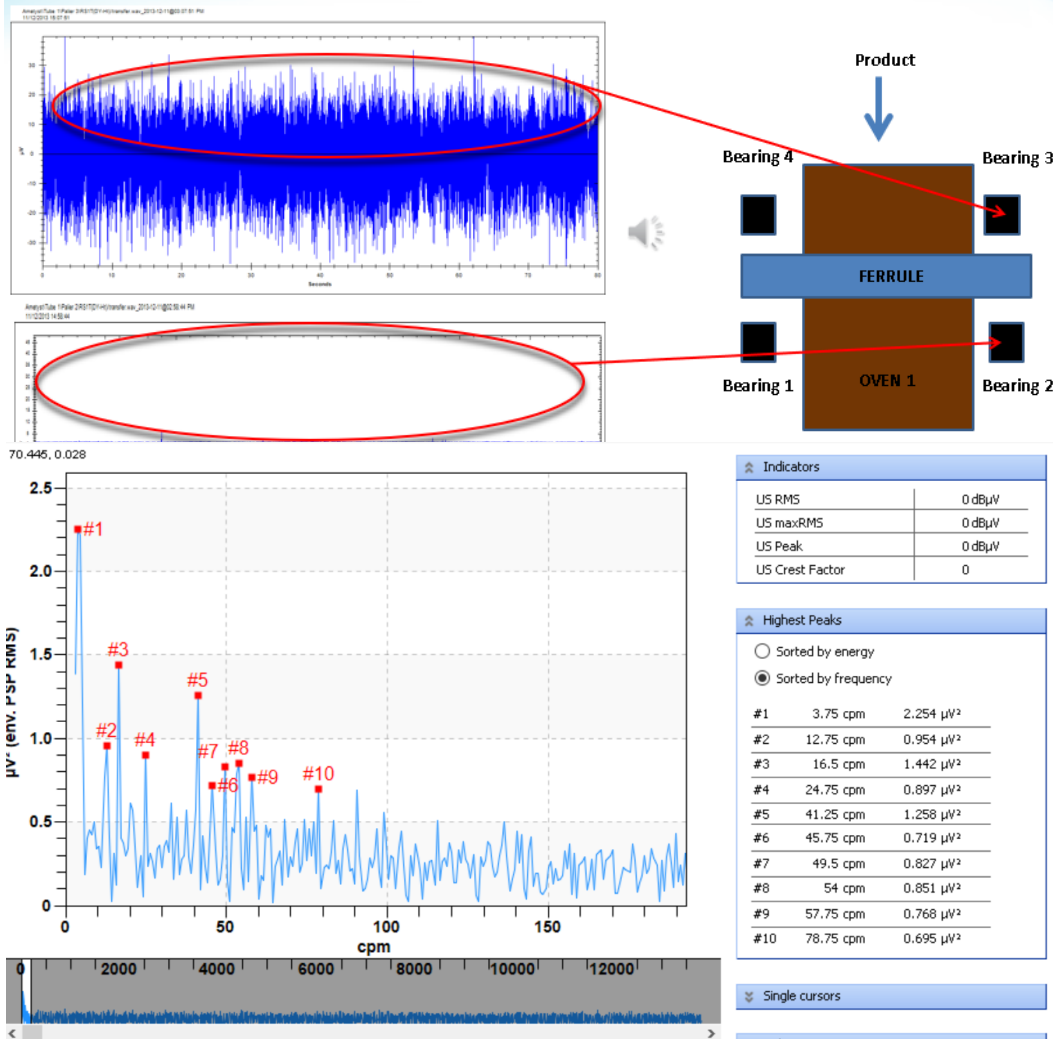
Bearing #3



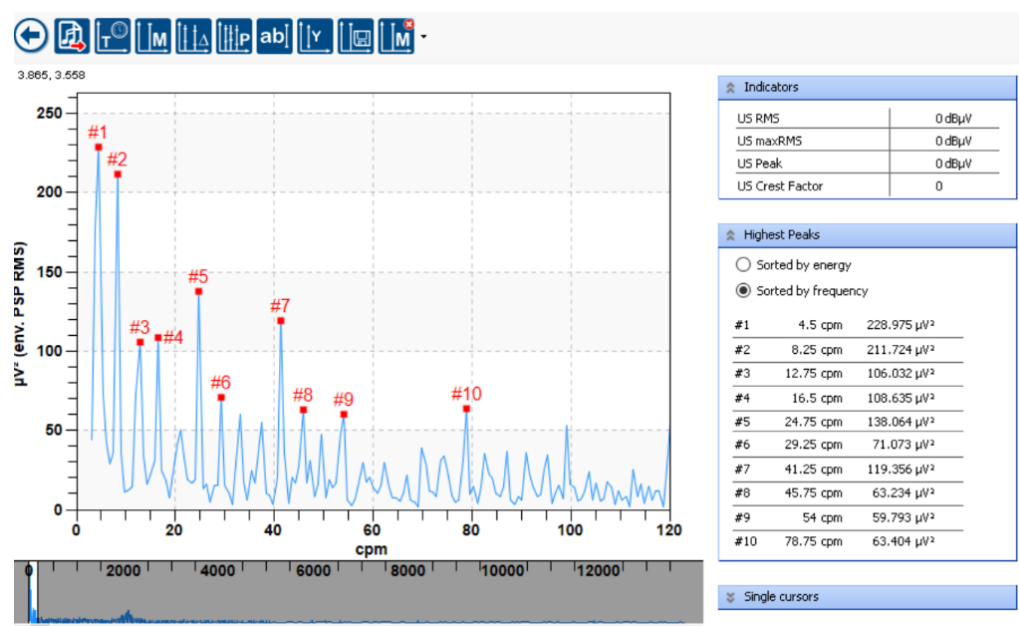
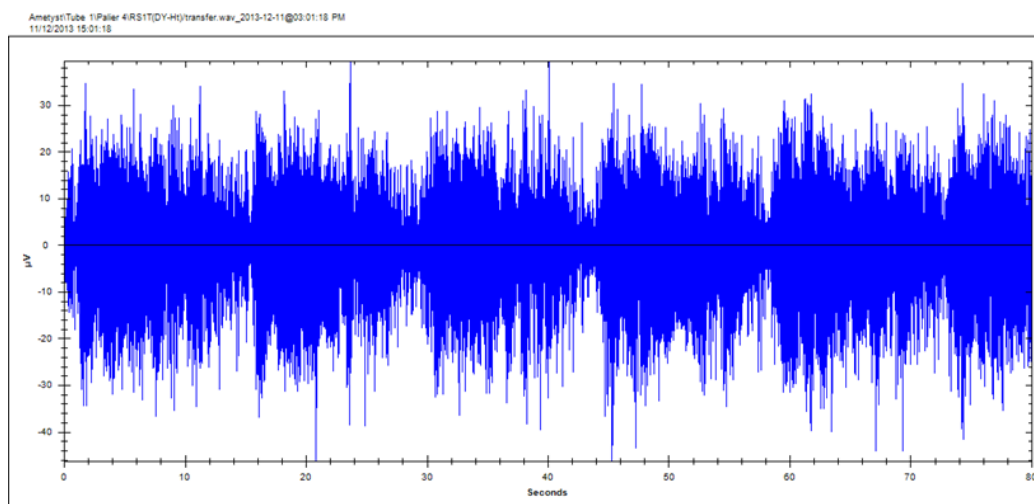


Bearing #2

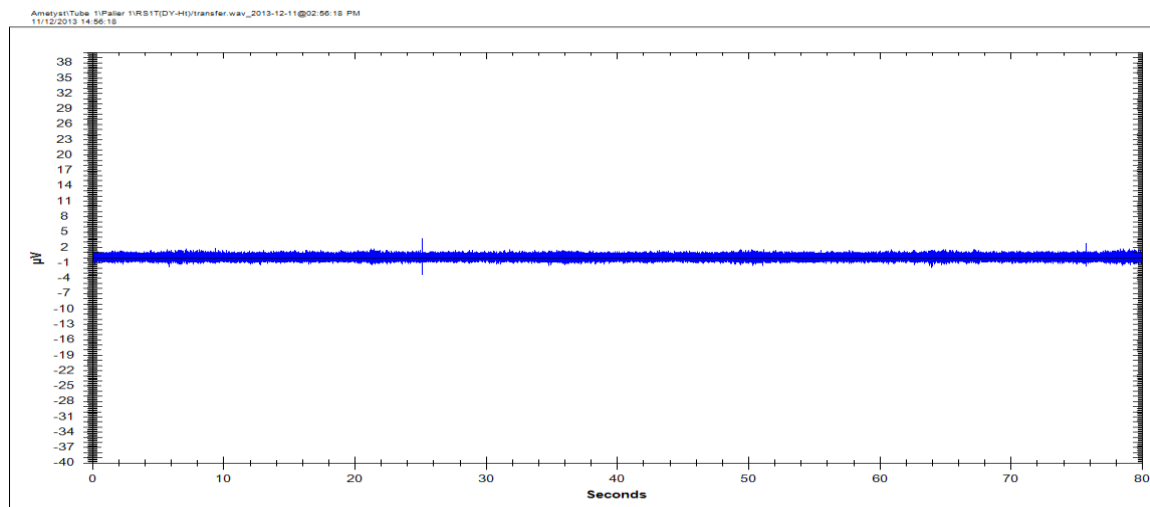
TIME WAVEFORM AND SOUND FILE – OVEN 1 :



Bearing #4



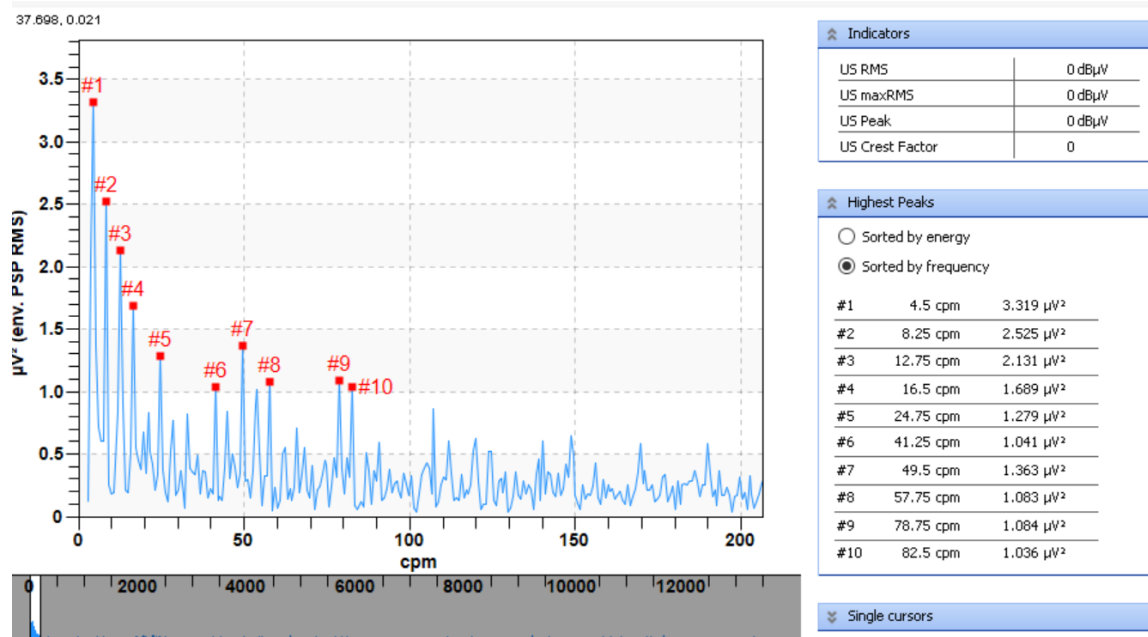
Bearing #1



Oven 3

Looking first at the Product Entry side of Oven 3 it was noted that all four bearings exhibited a higher level of ultrasound than the peer bearings on Oven 1 (3.5/-5/2.4/-1/3 Oven 3) Vs (-9.6/-9.7/12.8/14.2 Oven 1). Bearing 2 and 4 are quieter than bearing 1 and 3. The time signals do not show any dominant peaks to suggest bearing wear. This is confirmed by the consistency and low values seen in the Crest Factor results. A ninth dynamic measurement taken on the body of the oven for 5 seconds helped confirm the assessment that an alignment issue exists between the support ring and the oven.

Evaluating the Product Exit side of Oven 3 it was noted that all four bearings returned acceptable and low dB RMS values. The only data that triggered an alarm from Patrice was the high Crest Factor and



Max RMS values returned by Bearing 8. Taking the dynamic signal into the Time Trace Patrice saw the emergence of peaks at the rotational speed of the bearing 4.4 RPM.

Compared to bearings 3 and 4 on Oven 1, Bearing 8 on Oven 3 is in a less advanced state of failure. As bearing 8 is just beginning to demonstrate early warning signs it was recommended to increase the frequency of monitoring.

Conclusions

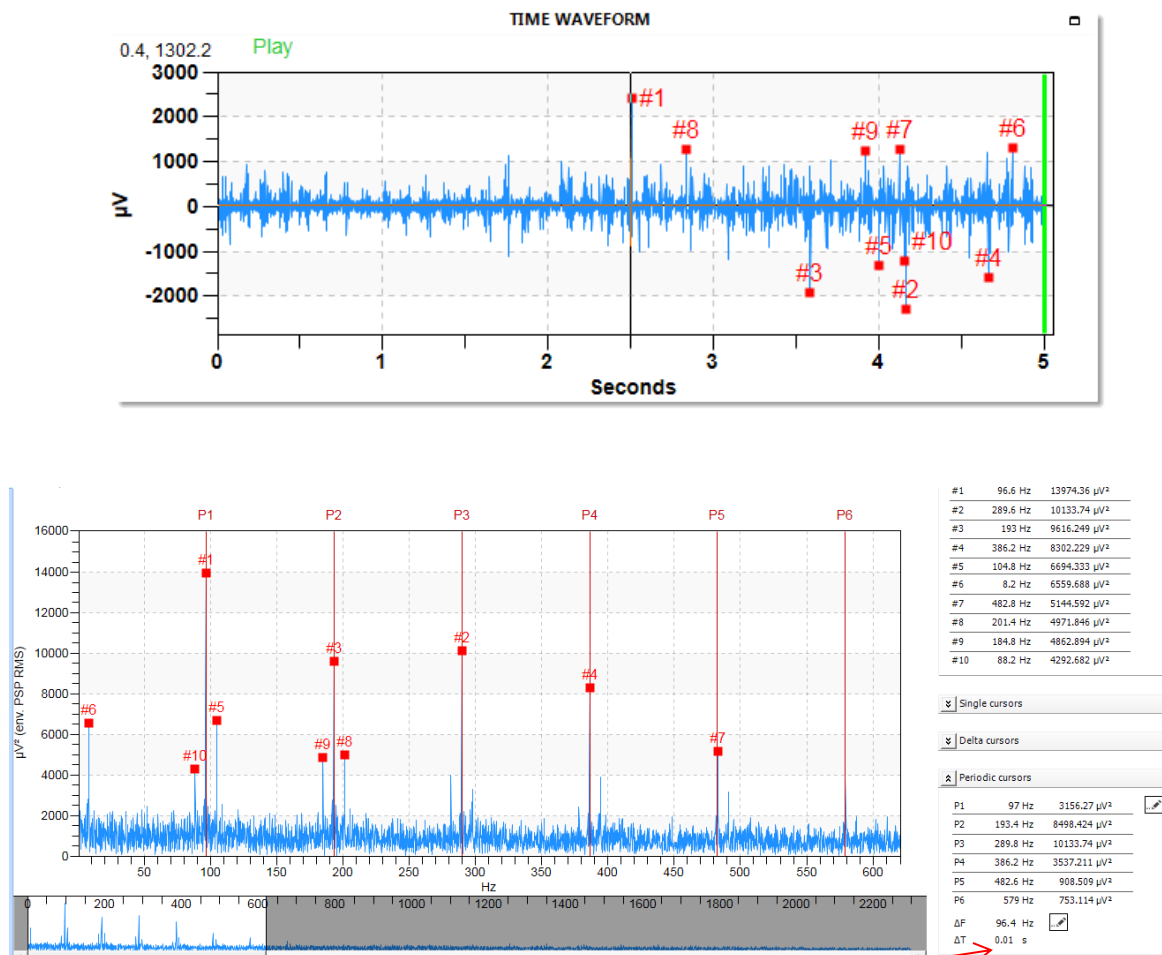
Biogas conversion facilities such as the one featured in Montpellier, France are being built all over Europe and North America. They represent tremendous opportunities to recover energy and fuel from waste that would otherwise sit in piles at a landfill. Reaping non-fossil energy is one reward. Reducing greenhouse gas emissions is the second. The low price of natural gas is still a big factor keeping these facilities from going mainstream.

In this presentation we have identified the potential to run these biogas conversion facilities in a more cost-effective manner by putting Ultrasound condition monitoring to work. We all must recognize that the path to efficiency and profitability is paved by Reliability. SDT's field service team has demonstrated just how easy and effective it is to employ simple ultrasound analysis to predict high-cost failures well in advance. By increasing reliability and decreasing unplanned expenditures ultrasound is helping make biogas conversion an economically viable alternative fuel source.

Horizontal Mixer Jack Shaft

Author: SDT Ultrasound Solutions

On July 18, 2019, during Cody's SDT routes he recorded a repeating ticking in the drive side bearing on the intermittent shaft for the horizontal mixer.



The ticks were found to repeat at 96.4 Hz.

Below you will find the data collected and calculated.

13						
14	FPM	Roll Diameter (in)	RPM	UAS Frequency		Frequency Factor
15	413	3.1875	494.9157007	96.4		0.194780646

Using a tachometer, we found the shaft to spin at roughly

Shaft Diameter

$RPM = (FPM * 12) / (D * \pi)$

Obtained from above

$FF = UASF / RPM$

Bearing being used is a Sealmaster RPM-303-2. Sealmaster provides their vibration geometry.

Table No. 17 Vibration Geometry Information			BSF	BPFI	BPFO	FTF 1	FTF 2	
SHAFT SIZE	UNIT NO.	INSERT NO.	FACTOR FOR ROLLER SPIN O	FACTOR FOR INNER ROLLER PASS I	FACTOR FOR OUTER ROLLER PASS B	FACTOR FOR FUND. TRAIN (SHAFT ROT.) F	FACTOR FOR FUND. TRAIN (HSG. ROT.) G	NUMBER OF ROLLERS/ROW Z
1 3/16	103	RCI-103	0.12580	0.17823	0.13844	0.00729	0.00938	19
1 1/4	104	RCI-104	0.12580	0.17823	0.13844	0.00729	0.00938	19
1 3/8	106	RCI-106	0.11732	0.18917	0.14416	0.00721	0.00946	20
1 7/16	107	RCI-107	0.11732	0.18917	0.14416	0.00721	0.00946	20
1 1/2	108	RCI-108	0.11320	0.17101	0.12899	0.00717	0.00950	18
1 5/8	110	RCI-110	0.11320	0.17101	0.12899	0.00717	0.00950	18
1 11/16	111	RCI-111	0.11320	0.17101	0.12899	0.00717	0.00950	18
1 3/4	112	RCI-112	0.10828	0.16264	0.12069	0.00710	0.00957	17
1 15/16	115	RCI-115	0.10828	0.16264	0.12069	0.00710	0.00957	17
2	200	RCI-200	0.10828	0.16264	0.12069	0.00710	0.00957	17
2 3/16	203	RCI-203	0.10828	0.17921	0.13745	0.00724	0.00943	19
2 1/4	204	RCI-204	0.12160	0.19584	0.15416	0.00734	0.00933	21
2 7/16	207	RCI-207	0.13446	0.19584	0.15416	0.00734	0.00933	21
2 1/2	208	RCI-208	0.13446	0.19584	0.15416	0.00734	0.00933	21
2 11/16	211	RCI-211	0.15781	0.22018	0.17982	0.00749	0.00917	24
2 3/4	212	RCI-212	0.15781	0.22018	0.17982	0.00749	0.00917	24
2 15/16	215	RCI-215	0.15781	0.22018	0.17982	0.00749	0.00917	24
3	300	RCI-300	0.15781	0.22018	0.17982	0.00749	0.00917	24
3 3/16	303	RCI-303	0.17061	0.23678	0.19656	0.00756	0.00911	26
3 7/16	307	RCI-307	0.17061	0.23678	0.19656	0.00756	0.00911	26
3 1/2	308	RCI-308	0.17061	0.23678	0.19656	0.00756	0.00911	26
3 15/16	315	RCI-315	0.16448	0.23758	0.19576	0.00753	0.00914	26
4	400	RCI-400	0.16448	0.23758	0.19576	0.00753	0.00914	26
4 7/16	407	RCI-407	0.16005	0.22885	0.18781	0.00751	0.00915	25
4 1/2	408	RCI-408	0.16005	0.22885	0.18781	0.00751	0.00915	25
4 15/16	415	RCI-415	0.15868	0.22922	0.18745	0.0075	0.00917	25
5	500	RCI-500	0.15868	0.22922	0.18745	0.0075	0.00917	25

13							
14	FPM	Roll Diameter (in)		RPM	UAS Frequency		Frequency Factor
15	413	3.1875		494.9157007	96.4		0.194780646

Due to uncertainty in the tac, it was determined there was an issue within the out race of the bearing.

Below is a picture of the outer race of the bearing when taken out and inspected.



Grooves are worn into the outer race, and this is what the ultrasound was detecting as each rolling element contacted it. Eventually this would lead to a failure of the bearing.

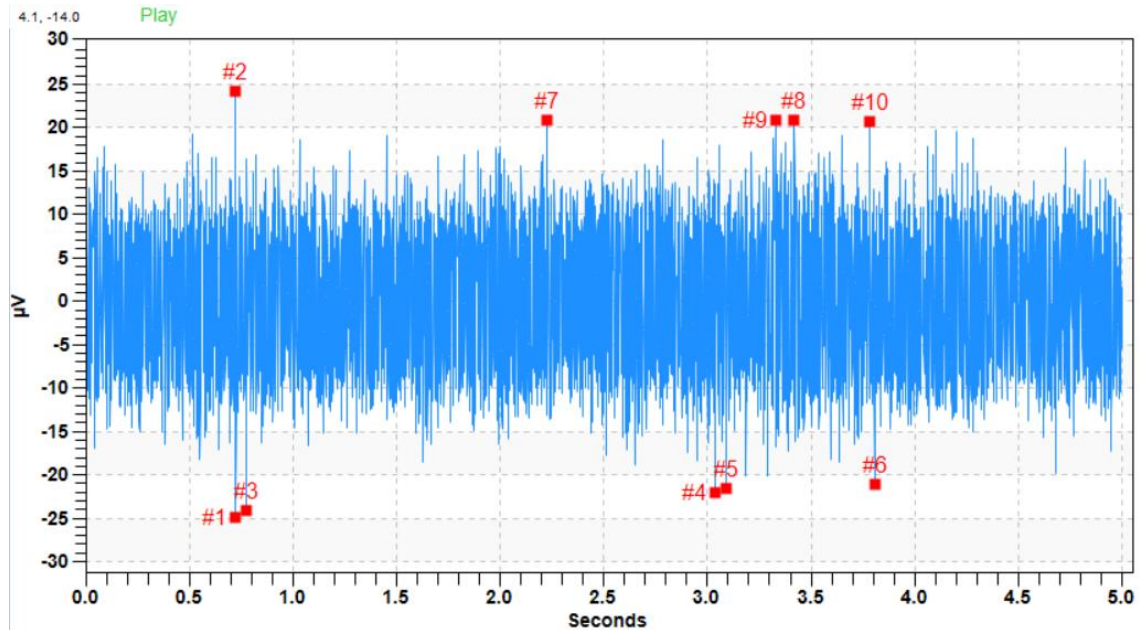
Grid Couplings

Author: Robert Dent

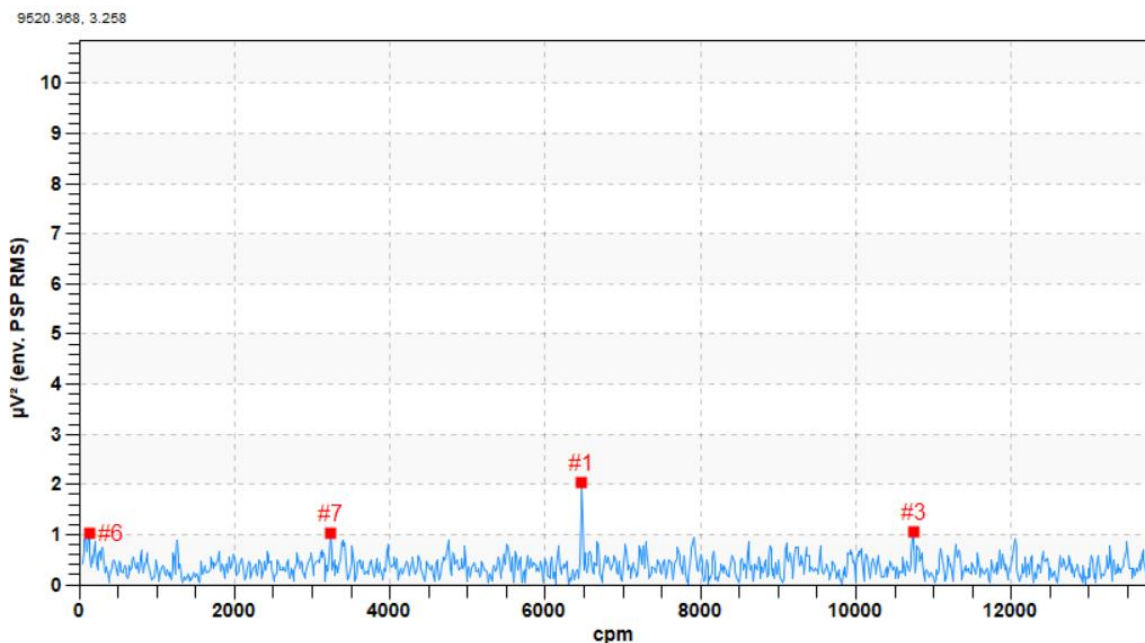
Email address: robert.dent@sdtultrasound.com

Canroof Canada uses airborne ultrasound to check the health of their couplings every month. A 5 second reading provides enough data to identify lubrication and functional issues.

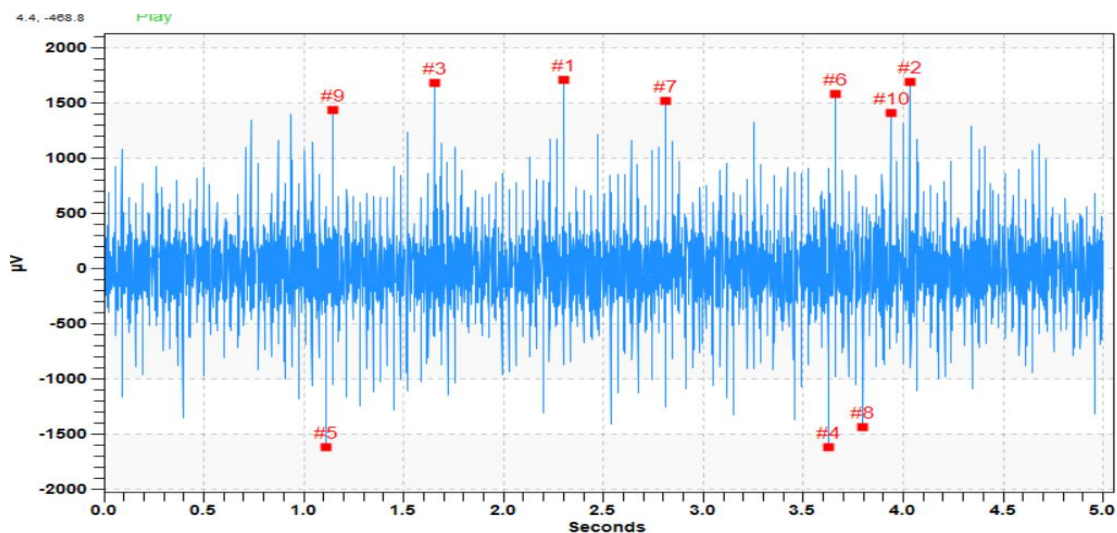
Grid coupling with no problems



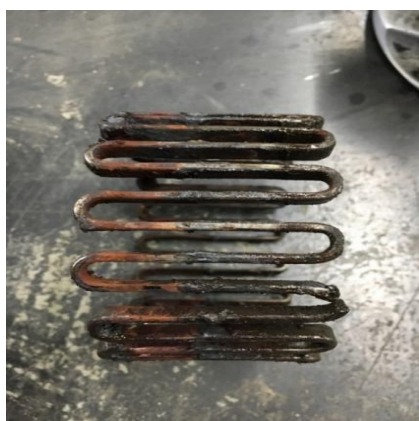
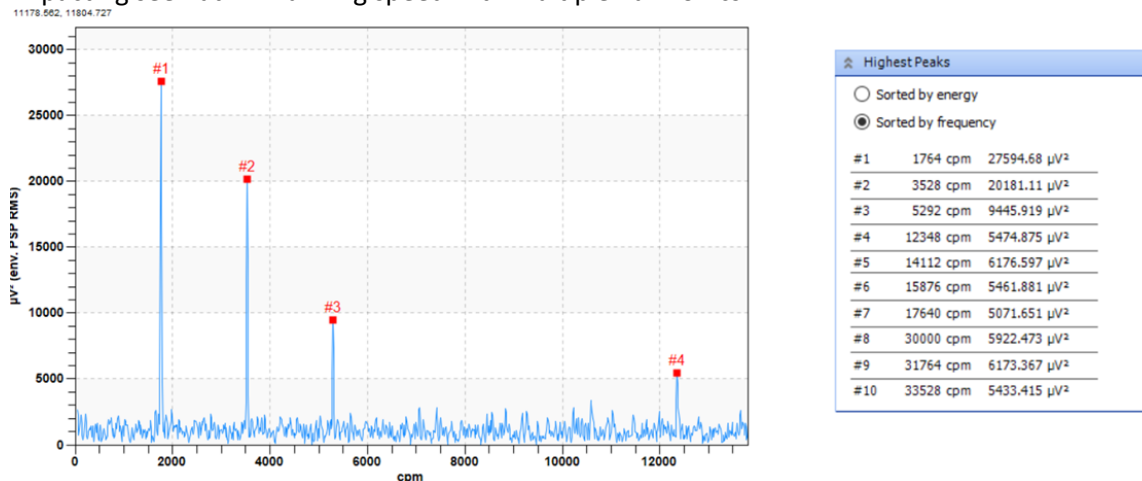
No real impacting – very low energy being generated.



Grid coupling (Lack of lubrication and worn-out grid)

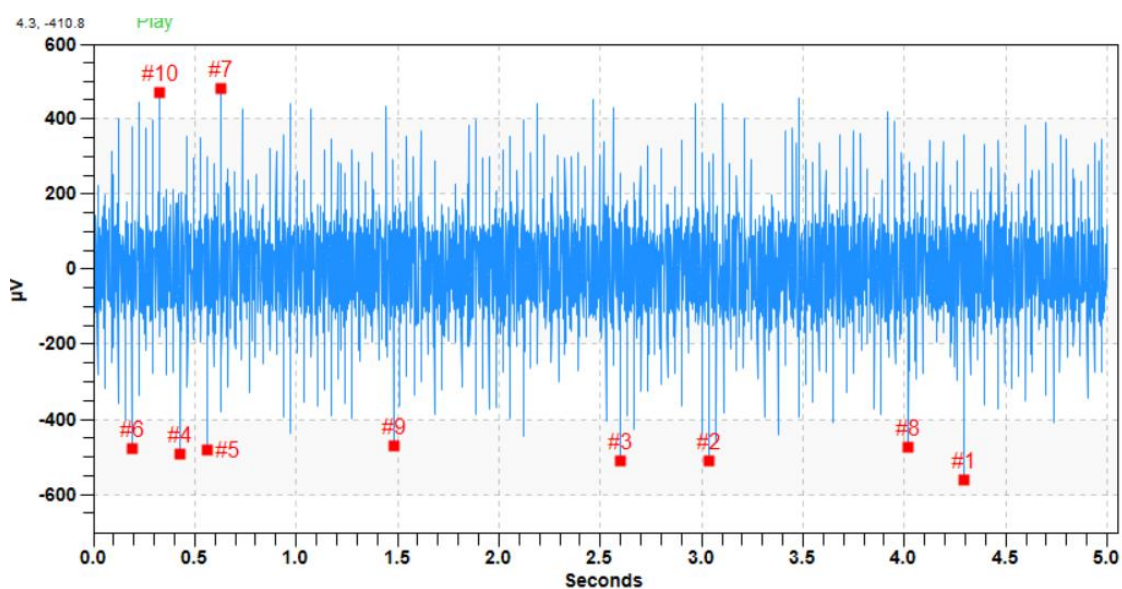
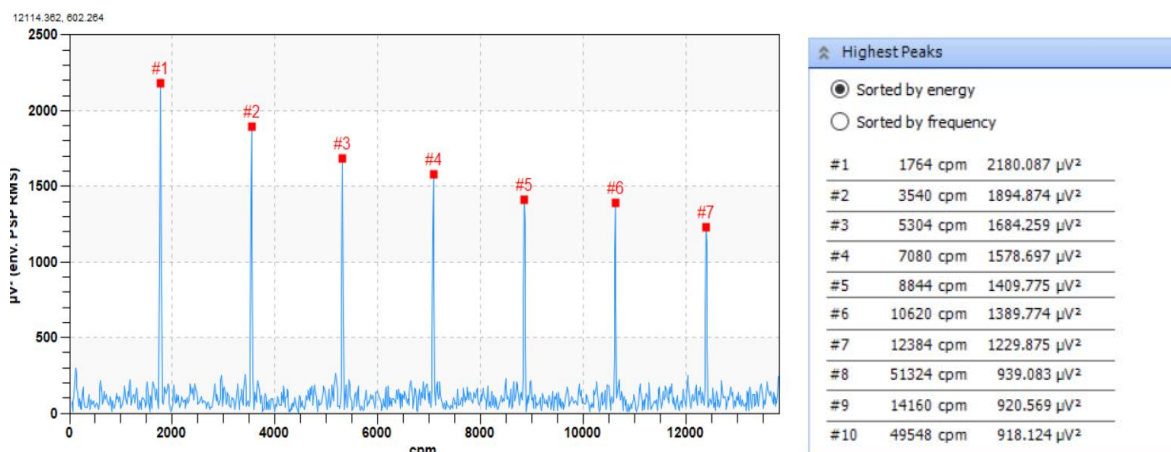


Impacting seen at 1 x Running speed with multiple harmonics.



Grid coupling (broken grid)

Impacting seen at 1 x Running speed with multiple harmonics



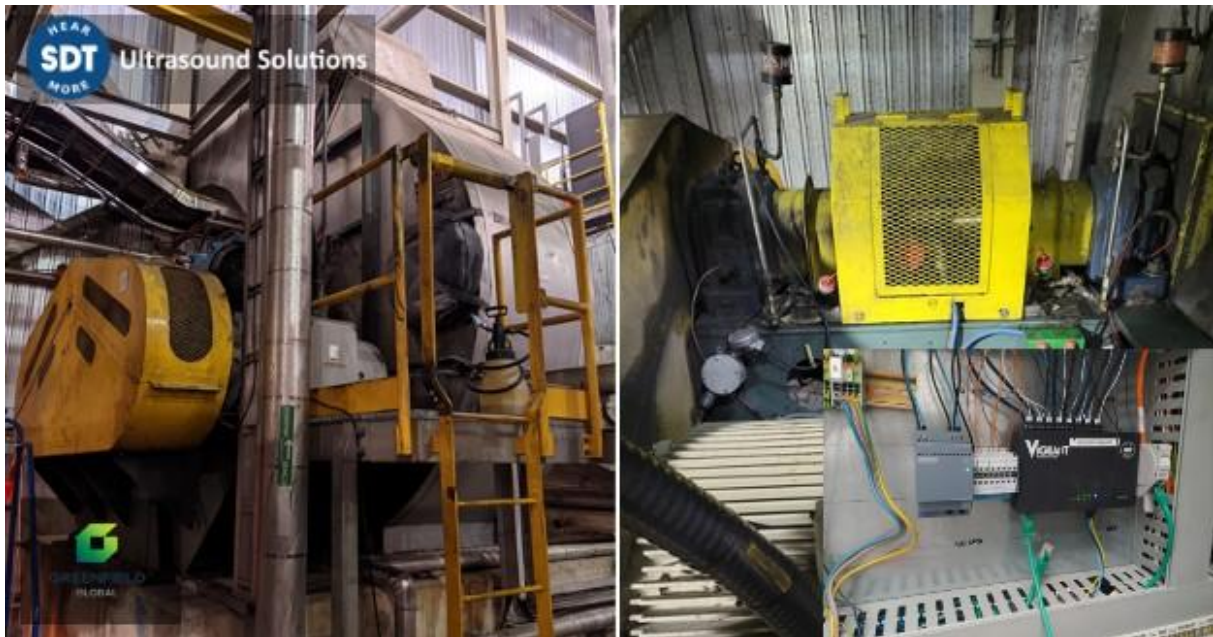
Greenfield Ethanol Failure Cause Analysis

Authors: Tristan Rienstra and Jonathan D.

Email address: tristan.rienstra@sdtultrasound.com

Continuously Monitored using Vibration & Ultrasound Analysis

This BF-9401 Area Pulling Fan plays an integral role in Greenfield Ethanol's manufacturing process. It is a critical component to their Thermal Oxidizer Equipment. If this fan goes down, production is severely hindered, and possibly even stopped all together.



Vigilant System Permanent Install on Critical Fan Bearing

Understanding the Asset

The asset is a New York Blower with a 250hp motor that rotates 1780 rpm. The fan rotates at 1168 rpm 24/7, all day, every day. The fan shaft is mounted with two SKF 22232 bearings, they're lubricated with oil.

The last time the fans bearings were replaced was October 22, 2012.

Vibration & Ultrasound Analysis, September 2022

Lead Vibration Analyst, Jonathan Dion takes routine vibration measurements on this plant's critical equipment. Back in 2018, a defect was detected on the pulley side of the fan (SKF 22232). It has since been evolving. Using the acceleration envelope filter in Peakvue, it can be seen clearly.



Figure 2 – Ultrasound Readings (UAS3)

Vibration & Ultrasound Analysis, November 2022, Vigilant System

With no plan to replace the bearings until the large-scale planned shutdown in September 2023, the best course of action decided by the reliability team was to install a Vigilant System to continuously monitor the condition of the fans bearings, and hopefully see the assets life extended until the planned shutdown.

The Vigilant System is an 8-Channel Online Condition Monitoring Solution that combines the versatility of ultrasound and the analytics of vibration. Vigilant comes standard with its own embedded software that any member of the reliability team can access using the correct network credentials.

The Vigilant provides reliability teams with a means to continuously monitor critical assets that are heavily guarded, or in this case as they near their end of life.



Vigilant System

See how the Vigilant was configured below:

- M2H horizontal drive motor
- F1H : fan side drive Horizontal
- F1A : fan side Axial drive
- F2H : fan opposite drive side Horizontal

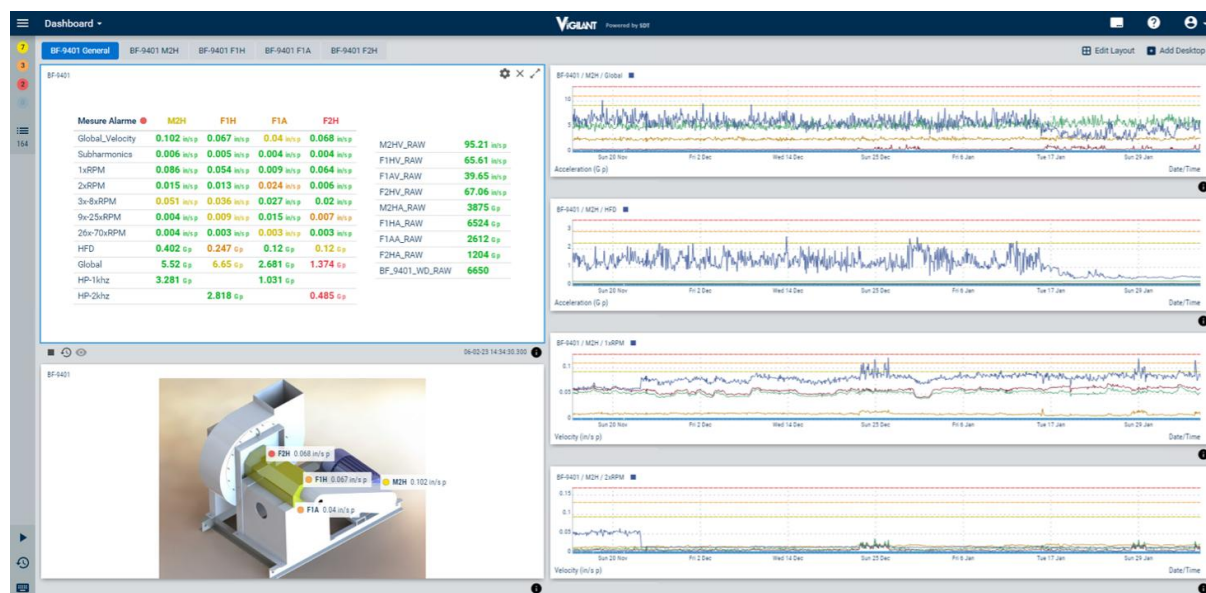


Figure 3 – Vibration Sensor Configuration & Dashboard (Vigilant Embedded Software)

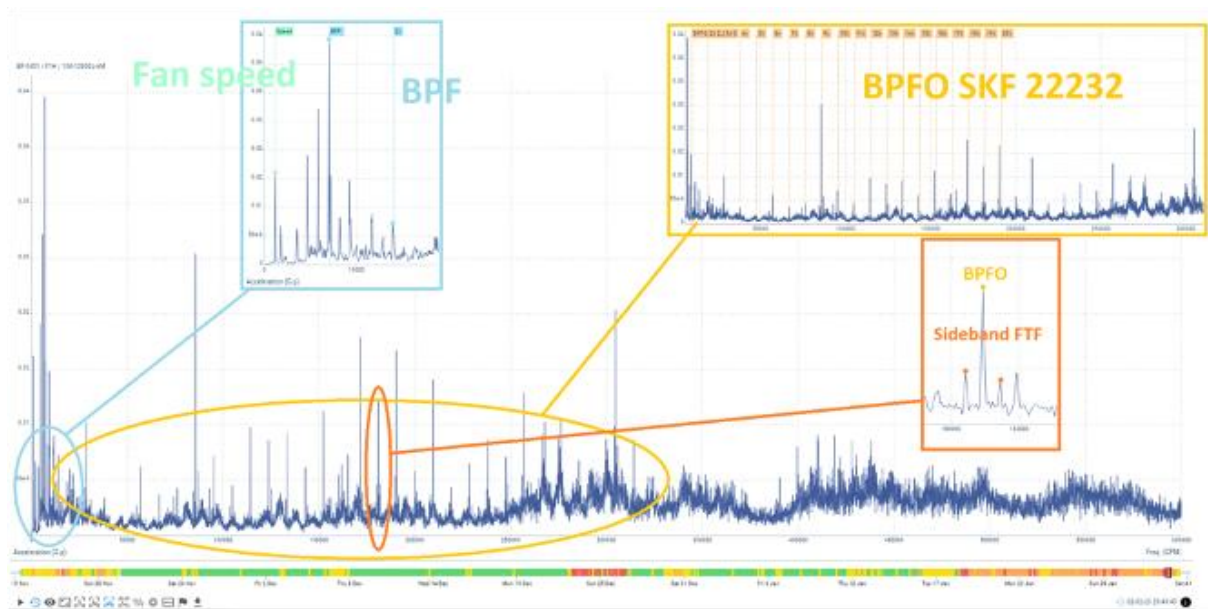
Vibration & Ultrasound Analysis, February 2023, Vigilant System

The reliability team's focus was monitoring data collected by the F1H Accelerometer. Monitoring technicians split their windows into 4, all with different lines of resolution as to see rapid changes as well as changes over a long period of time.

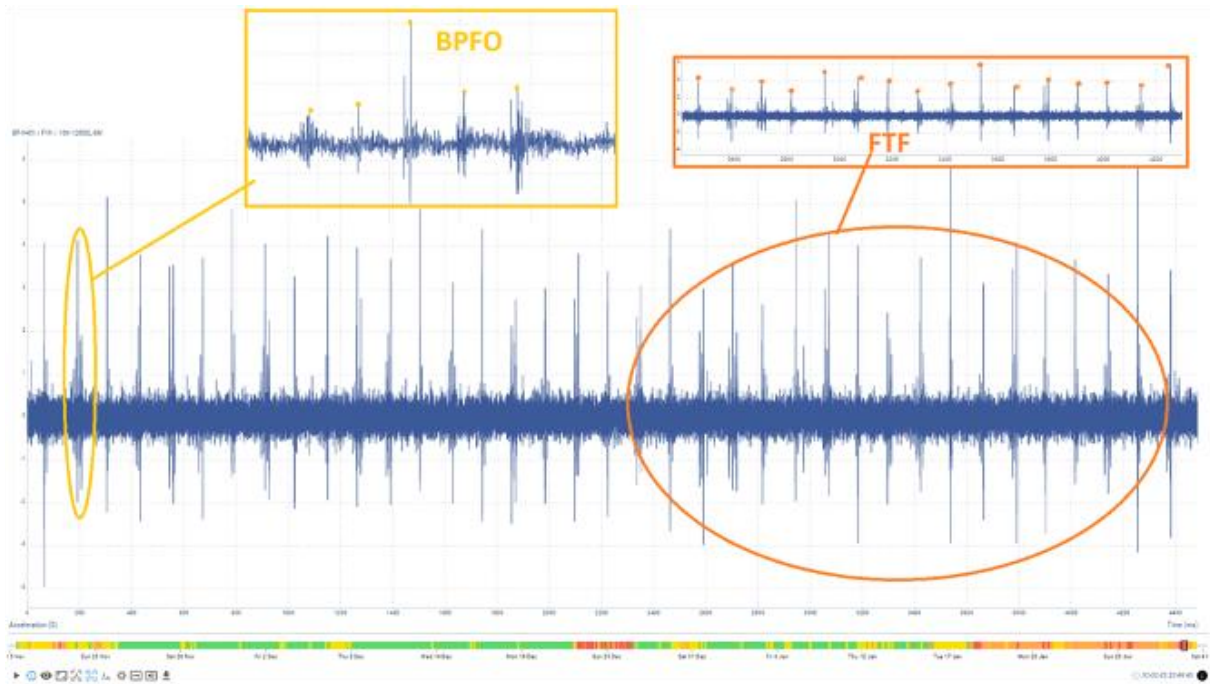


Figure 4 – Vigilant Window Configuration

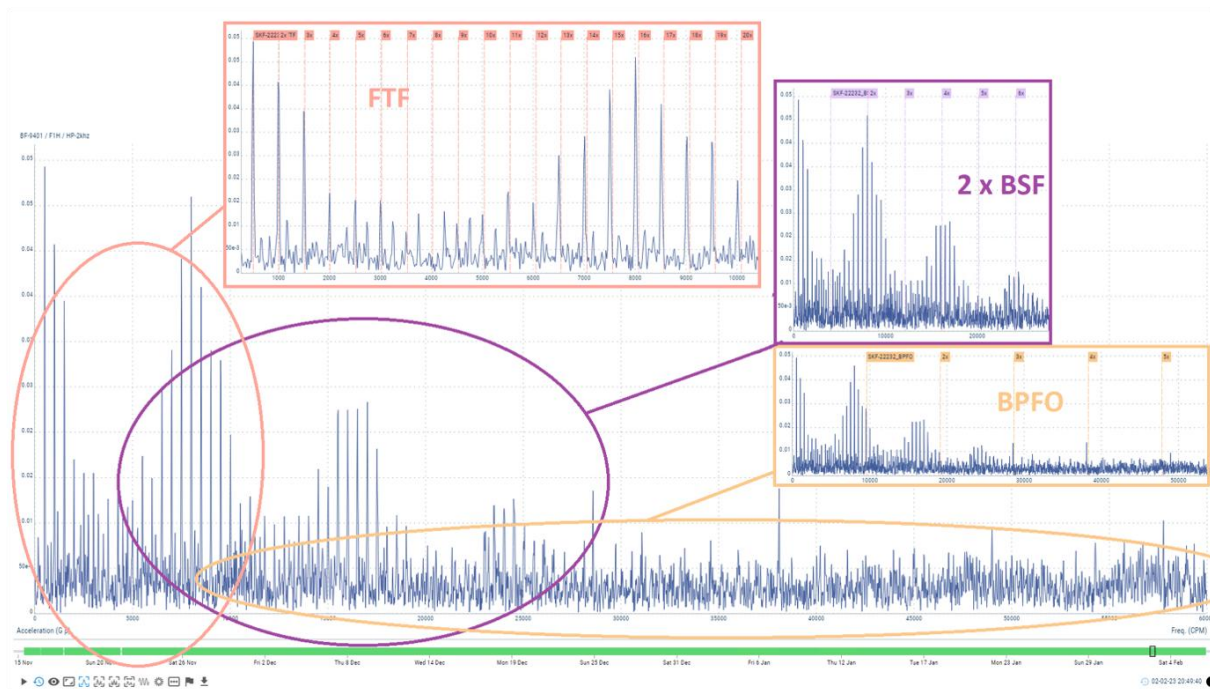
A Closer Look at Each of the 4 Windows



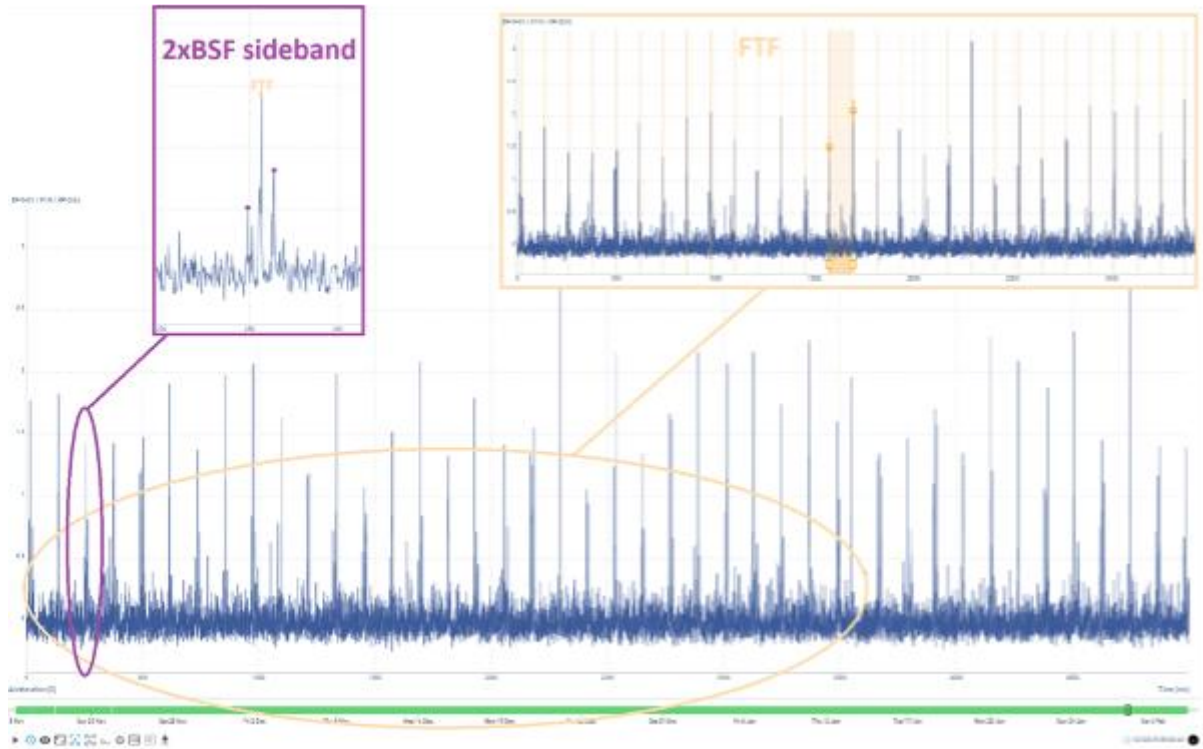
Window 1 - Max. Frequency 10000hz, Lines 12800, Averages 6 – February 2, 2023



Window 2 – Time Waveform – Duration: 4.485 seconds – Points: 114817 – February 2, 2023



Window 3 – Envelope Spectrum – High-Pass Freq. 2000hz, Max. Freq. 1000hz, Lines 3200, 1 Average – February 2, 2023



Window 4 – Envelope Time Waveform – High-Pass Freq. 2000hz, Duration: 5.05 seconds – Points: 12800 – February 2, 2023

Concluding Thoughts

With the Vigilant system in place, constantly monitoring the condition of the fans faulty bearing, the maintenance and reliability team at Greenfield Ethanol can safely extend the life of this fan, possibly even until the next scheduled shutdown in September 2023.

But just in case, alarm management was set up with the plants DCS to trigger email alerts if the condition of the fans bearings decreases to dangerous levels.

Critical Centrifuge Bearing Monitoring

Author: Tristan Rienstra

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A centrifuge uses centrifugal forces, generated at high RPMs to separate solids and liquids. At Greenfield Ethanol, they use centrifuges in their manufacturing processes. They are critical to their operations.

This centrifuge in question rotates at 5250RPM, and it has a suspected bad bearing. The following Figure 1 & 2 depicts the bearing & the asset.



Figure 1 - Centrifuge - Greenfield Ethanol

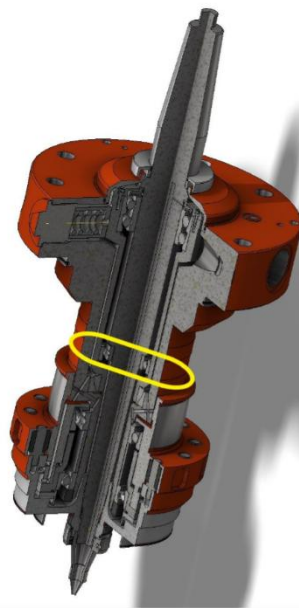


Figure 2 - Centrifuge Diagram - Bad Bearing in Question

Jonathan Dion, of Greenfield Ethanol previously reported monitoring a critical fan with a bad bearing up until his plants next scheduled shutdown.

He successfully managed to extend that fans lifespan for a full calendar year by keeping it under a watchful eye with his Vigilant System: an 8-Channel permanent condition monitoring solution, capable of both ultrasound and vibration analysis.

A similar situation arose at his plant. He discovered a bad bearing on a centrifuge using his SDT Ultrasound Data Collector. The fault was not yet visible with his vibration analysis tools. No cause for concern yet, the bearing had a lot of life left, but it was in the early stages of failure. Still, no reason to use unplanned downtime to replace the bearing. The plan is to replace the bearing during the next scheduled shutdown. Please see the DIPF curve in Figure 3.

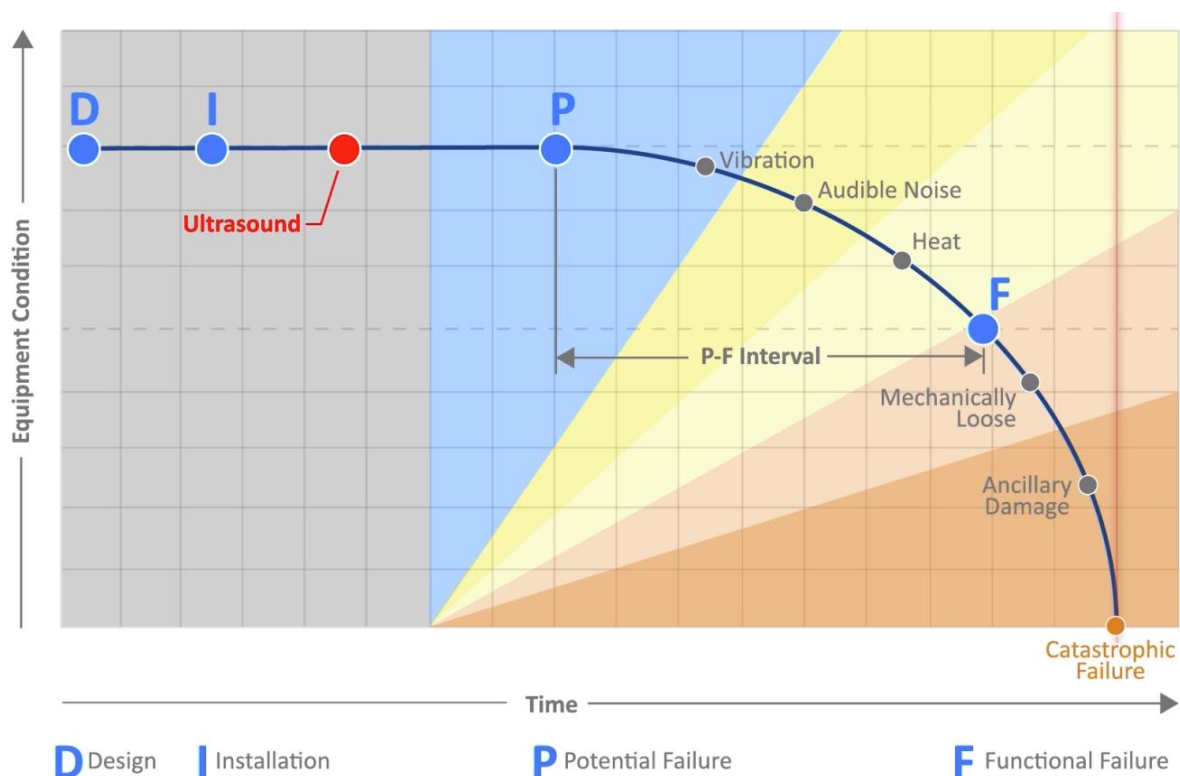


Figure 3 - DIPF Curve

So, Jonathan did what any savvy reliability engineer would; used his Vigilant System (as per figure below) to establish permanent monitoring on this critical bearing, as operations and production continued. Jonathan used both ultrasound and vibration to monitor its condition.



For the next few months, the bearings condition continued to slowly deteriorate in the ultrasound spectra. It was eventually visible and well defined in the vibration spectra and demodulated spectrum, as seen in the data in Figure 4 & 5.

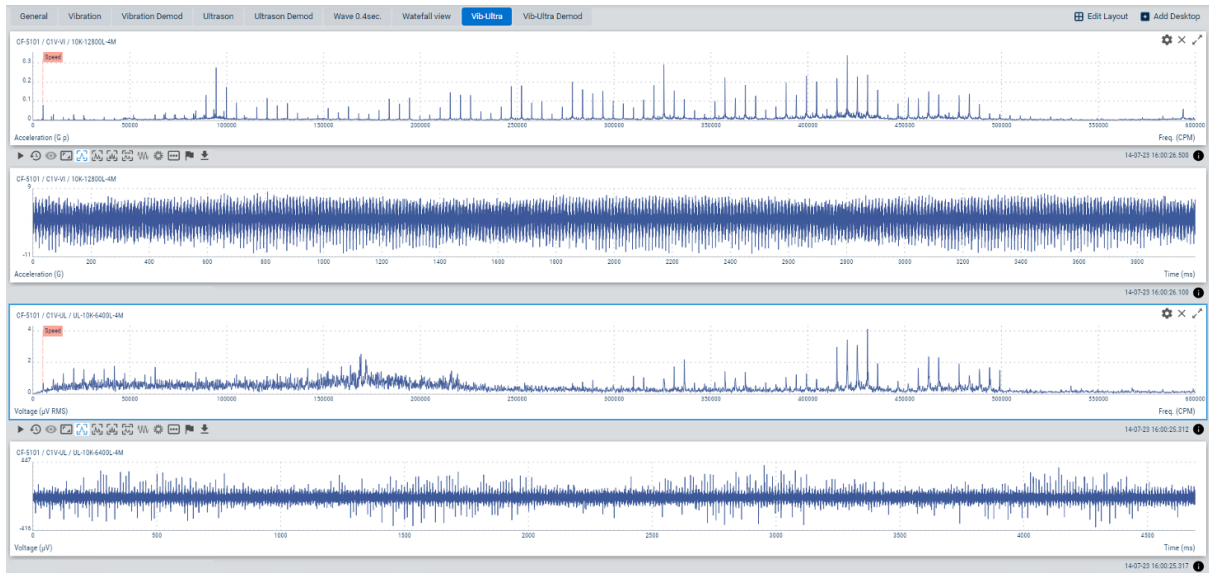


Figure 4 - Vigilant Dashboard - Ultrasound & Vibration Spectra



Figure 5 - Vigilant Dashboard - Ultrasound & Vibration Spectra Demodulated

The severity of the problem has clearly increased since it was first discovered with ultrasound. It is now visible in the vibration spectra, showing a ball pass frequency outer race defect with 1x rpm sidebands.