

SUCCESS STORIES

Steel



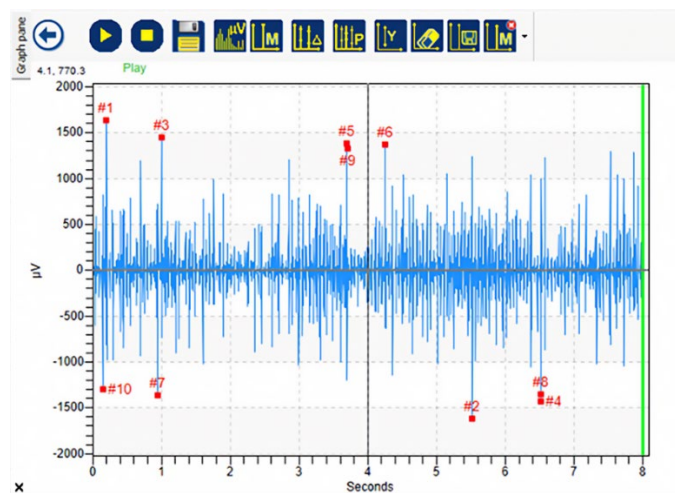
John Garrison Main Hoist Input Shaft Bearing on Crane

Authors: Tristan Rienstra and John Garrison

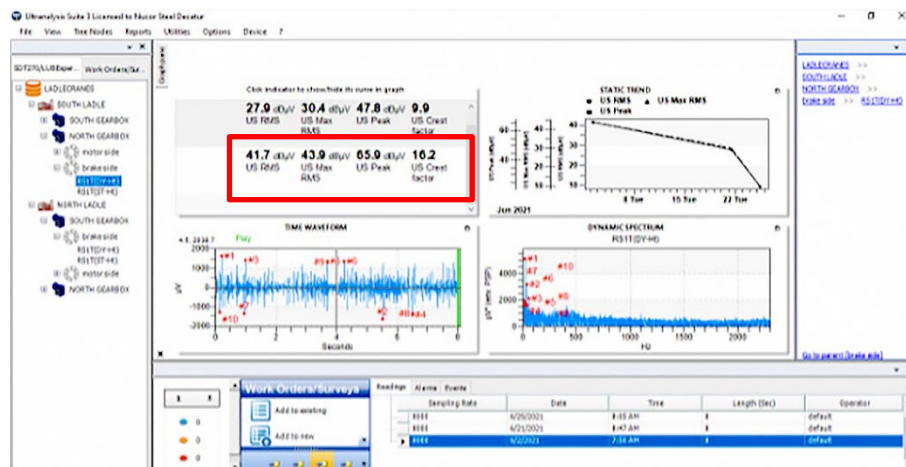
Email address: tristan.rienstra@sdtultrasound.com

On June 2, 2021, John Garrison was asked to check a main hoist input shaft bearing on a crane. Vibration analysis is not very useful for this application because of the amount of vibration and movement the crane makes. We knew ultrasound was the way to go.

Upon arrival to the crane, he began listening to the bearings on the input shaft and the brake drum side of the gear box. Immediately, John recognized something didn't sound right. He made it known to the crane technicians and went to upload the data to UAS3 so he could perform an analysis. John immediately recognized very high peaks in the wave form as well as an audio signal full of impacts.



He immediately went back to the crane technicians to review with them the data he had found. John briefed them on the 4 condition indicators (41.7 dBµV rms, 43.9 dBµV max rms, 65.9 dBµV peak, and 16.2 crest factor).





The crane crew technicians had two reservations... One that John hasn't been doing ultrasound analysis long, and the other was that this was the newest bearing on the crane being installed less than a month ago. The resulting action was that the bearings weren't changed even though the following week was a down day and the repair could have been planned.

Unfortunately, it wasn't and two weeks later the bearing failed. The unplanned downtime to repair the damaged input shaft and replace the bearing took approximately 6 hours. The loss of production was expensive enough, not to mention the cost of parts and labor.

Since the repair was made, the crane technicians have much more belief in ultrasound technology, and we have been routinely monitoring the bearings on the crane.

Below is the input shaft bearing right after being pulled out of the gearbox. As you can see all the rollers are gone and had to be fished out of the bottom of the gearbox. Fortunately, they didn't get caught in the gears causing further problems.



Predicting and preventing transformer outages in a steel mill

Author: Allan Rienstra

Email address: allan.rienstra@sdtultrasound.com

Skip Young, a maintenance technician, has decreased untimely production shutdown by combining ultrasound inspection and infrared inspection at Gerdau Ameristeel's Calvert City, Kentucky Facility.

A specific background

Processing steel requires continuous electric power supply. The maintenance team must therefore prevent the untimely failure of electrical components. Such failures are often due to the presence of partial discharges and will result in untimely production shutdowns. However, decreasing the failure rate is not enough. Anomalies must be detected as early as possible. The later the detection, the higher the repair costs for the component or the longer its replacement or production restart will be delayed. An efficient solution consists in detecting anomalies, as early as possible, by combining ultrasound analysis and infrared imaging of electrical systems, such as substations, transformers, etc.

Gerdau is one of the world's leading steel producers. Gerdau Ameristeel, the American arm of Gerdau, operates 19 mills in North America. Ultrasound and infrared inspections are used to prevent electrical outages in the group's mills. The example of how ultrasound technology prevented a transformer outage was provided for this paper by Skip Young, a technician with the facility in Calvert City, Kentucky.

Partial discharge is the root of all evil

Most high-voltage electrical faults are the result of partial discharges. But partial discharges also affect low-voltage switch gears.

Standard IEC 60270 defines partial discharge as a localized electrical discharge that partially shorts out the insulating void between the conducting parts. It is called "partial" because it only affects part of the insulator. It is a destructive phenomenon due to the damage to the insulator, which in turn can result in its total destruction.

An insidious enemy

From the first occurrence of the defect to sudden breakdown, partial discharge is not easy to detect, at least in the absence of suitable means: equipment is running as new and partial discharge has no incidence on its performance. Furthermore, the residual lifetime of a component exposed to partial discharges is not easily predictable. Indeed, it depends on other factors that are impossible to assess and can vary in time. The main factors are operating voltage, ambient temperature, humidity, and pollution, which is often found in steel mills.

So, here is the issue: no breakdown resulting from partial discharges – and this is often a major breakdown – is acceptable from an economic standpoint. The best way to prevent such a breakdown is to perform inspections on a regular basis. Now, what technology should we use?

Ultrasound AND infrared: the winning pair

These are not competitive, but complementary technologies.

For example, arcing generates a strong heat release. On the contrary, corona and tracking discharges do not feature any heat build-up, except at a very advanced stage. We will see hereafter that early detection is also essential. Therefore, the response is clear: the best strategy consists in combining ultrasound and infrared inspections.

Early detection for simple and low-cost maintenance

If the partial discharge is detected early, the maintenance team has more time ahead before repairs are required. They can then confidently plan a maintenance operation during the next scheduled production shutdown. But that's not all. Early detection of anomalies has a financial impact too. Required maintenance will remain simple, hence inexpensive. It will consist in cleaning, dusting, and tightening all connections. No comparison with long and expensive maintenance operations, such as full overhaul or replacement of subsystems.

Required diagnosis

Detecting partial discharges is not enough. The maintenance department will have to issue a precise diagnosis in order to assess the defect severity. That is, reliably decide on the level of urgency of the operation.

However, partial discharges are a specific application where defect severity does not depend on the measurement amplitude. The signal shape and content, which are not easily identified by listening, are used to detect the presence of corona and/or tracking and/or arcing discharges. This is the reason why SDT offers several technical solutions to address this specific issue. The 4 condition indicators – RMS, Max RMS, Peak and Peak factor – are the first line of defense. The second tool available to the operator is an audible rendering in real time via heterodyne. Finally, time and frequency signal analysis using the Ultranalysis Suite software is the final piece in the jigsaw puzzle that allows issuing a reliable diagnosis. The case study presented below is a perfect example of the usefulness of these different tools.



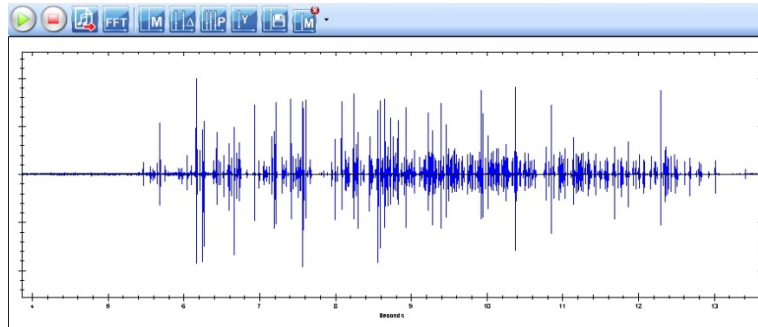
The Gerdau case study

During an inspection, Skip Young detected the existence of a partial discharge on a phase of a transformer head using his SDT270 collector. By comparing the 4 condition indicators obtained after collecting static measurements, he was able to conclude that this was not a minor defect like nuisance corona. The thermogram showed no hot spot. Skip concluded that it was not a resistive defect of the arcing type.

Time signal analysis clearly shows the presence of tracking.

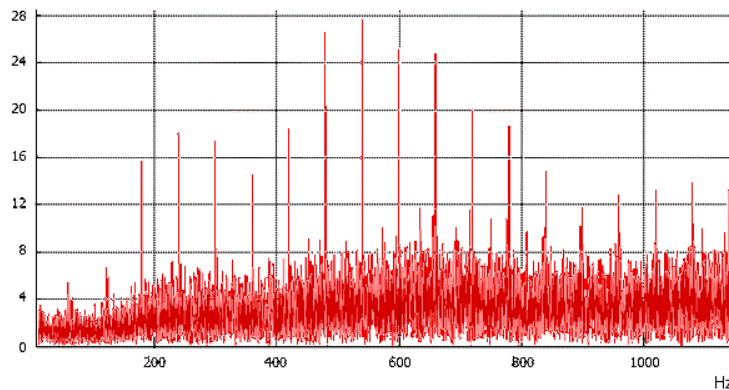


The thermogram showed no hot spot.



The time signal shows the presence of short-lived successive flashovers that are not repetitive and are typical of tracking.

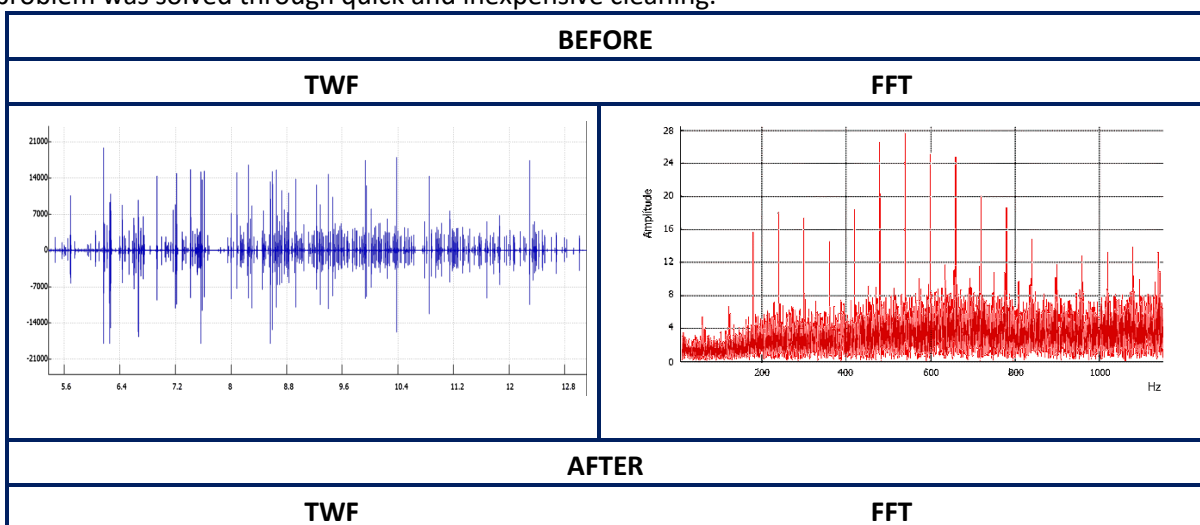
Tracking was confirmed by analyzing the spectrogram. However, it also revealed the presence of a destructive corona.

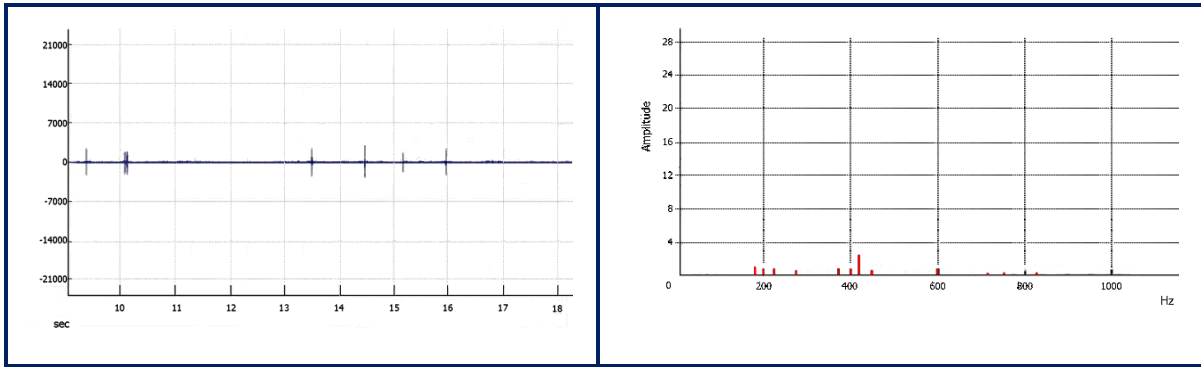


The frequency signal shows peaks at the fundamental frequency (60 Hz) and at its harmonics, which is typical of a destructive corona. It also shows noise between the peaks, which is typical of tracking.

After analyzing the data originating from the static measurements and time and frequency representations, the company decided upon scheduling a maintenance operation during the next shutdown planned for the transformer. It simply consisted in cleaning the transformer head.

Finally, a new data collection was carried out after restarting the system. The curves below show the results obtained before and after the maintenance operation. They clearly demonstrate that the problem was solved through quick and inexpensive cleaning.





Top: measurements prior to maintenance. Bottom: after maintenance. Please note that time and frequency representations are on the same scale.

Conclusion

Damages caused by partial discharges are admittedly not a common occurrence. However, they are not acceptable because of their disastrous financial consequences. Also, their occurrence and their evolution are not easily predictable. The best option consists in inspecting the facilities on a regular basis and using appropriate means. Optimum efficiency is attained by combining ultrasound measurements and infrared thermography. The Gerdau example is a perfect illustration thereof.

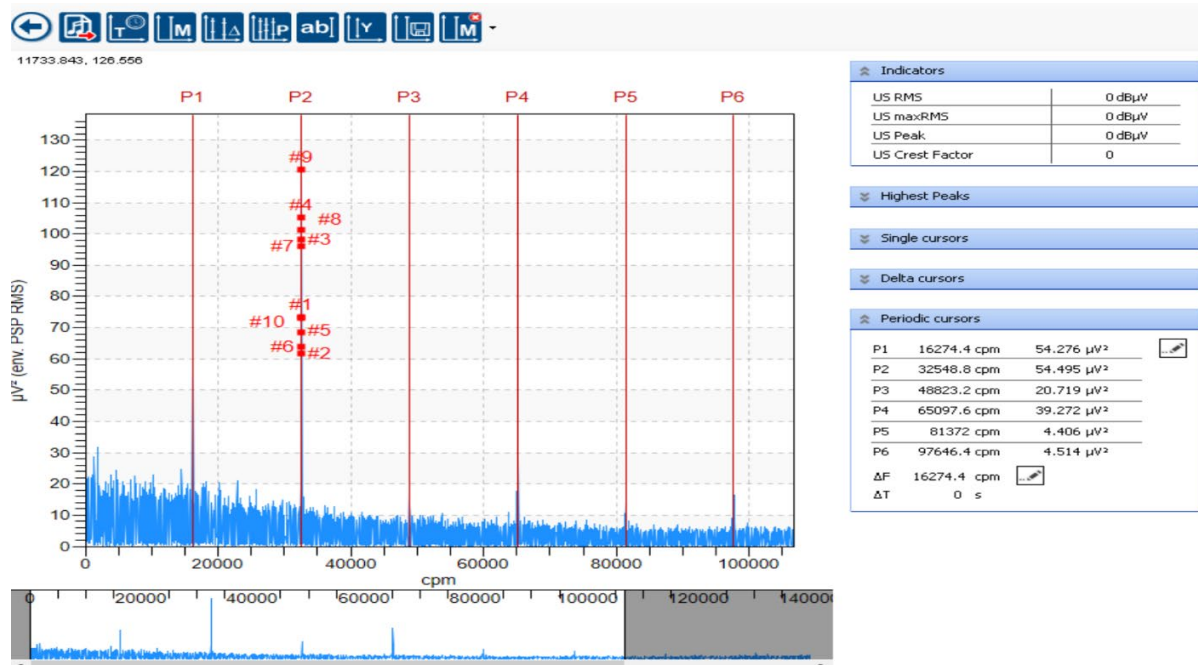
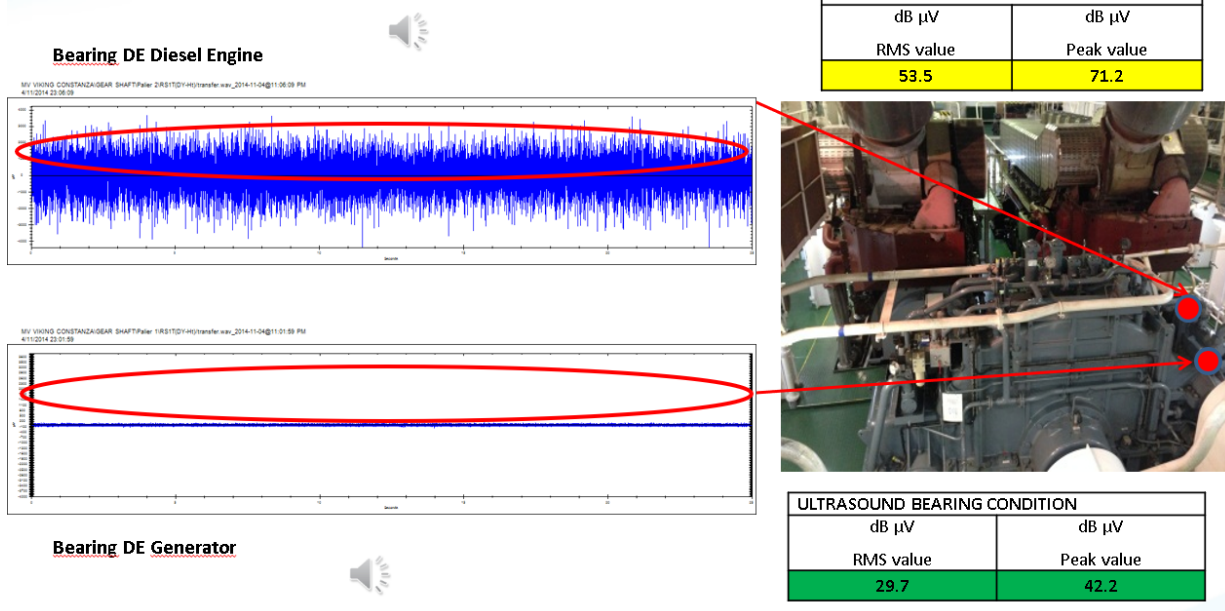
A low-end camera will not be suitable to search for this type of defect. Neither will a low-end ultrasound measuring instrument. A listen-only “detector” is also to be avoided. It is imperative that the user issue a reliable diagnosis and answer the following question: “How much time do we have before the facility is affected by irreversible damage?” The user will need overall condition indicators, signal acquisition, and time and frequency representations.

Finally, the performance of the instruments used will ensure the early detection of partial discharges, which means simple and inexpensive asset condition monitoring.

Gearbox Example 1

Author: Patrice Dannepond

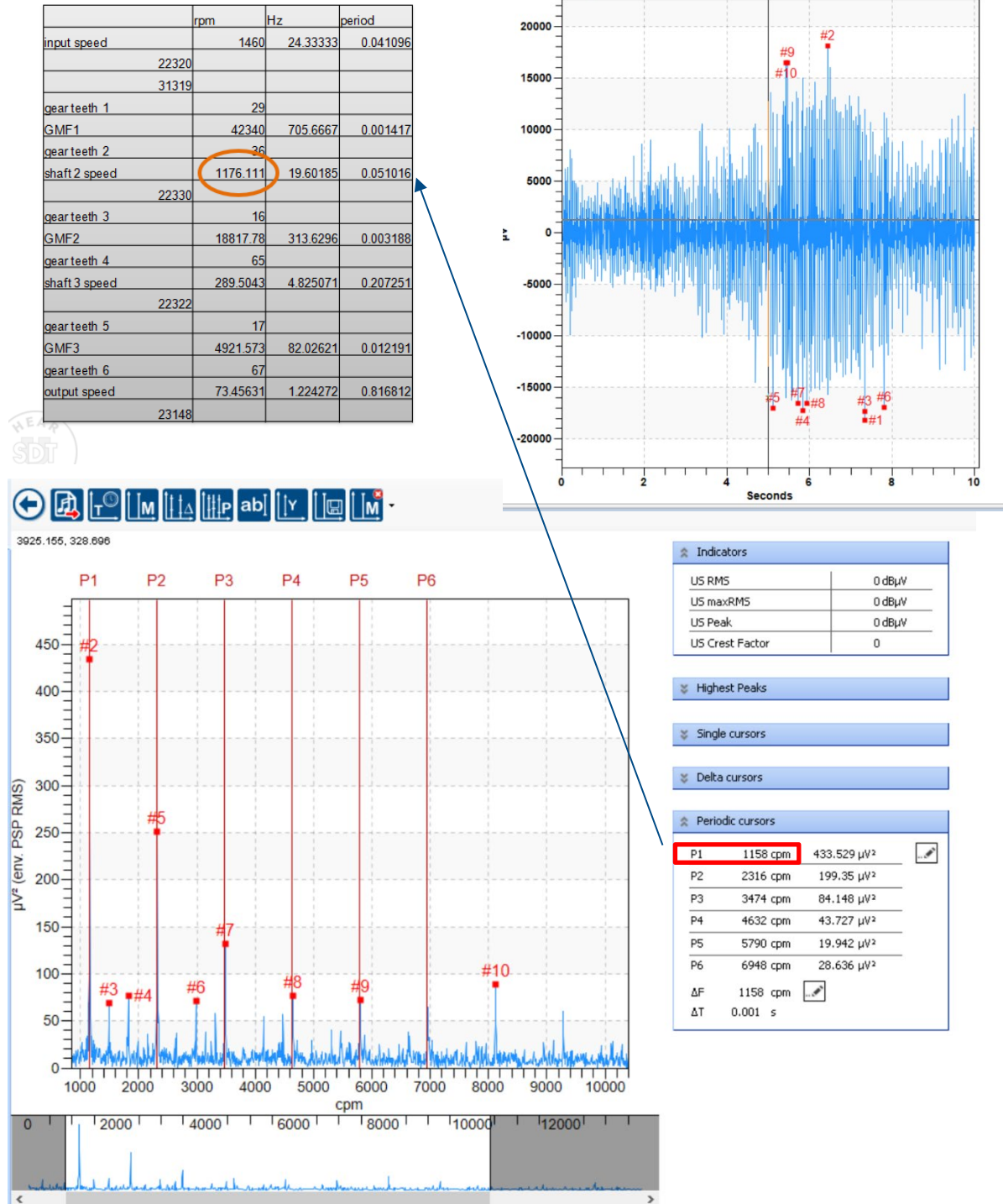
TIME WAVEFORM AND SOUND FILE – MAIN GEAR BOX :



Gearbox Example 2

Author: Patrice Dannepond

Bad gear on shaft 2

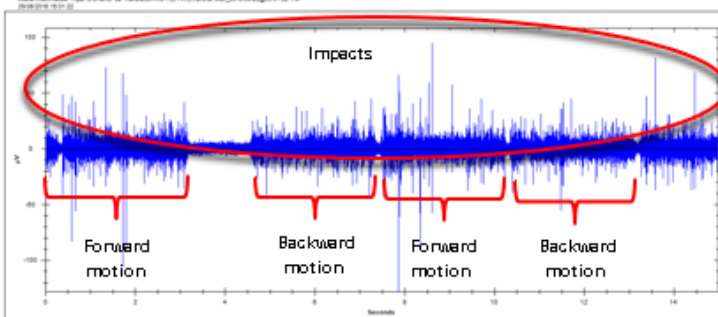
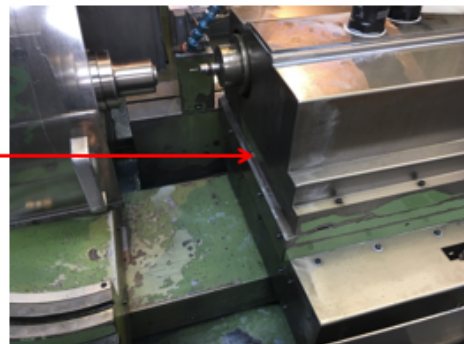


Detecting defective bearing during sliding motion of translation trolley

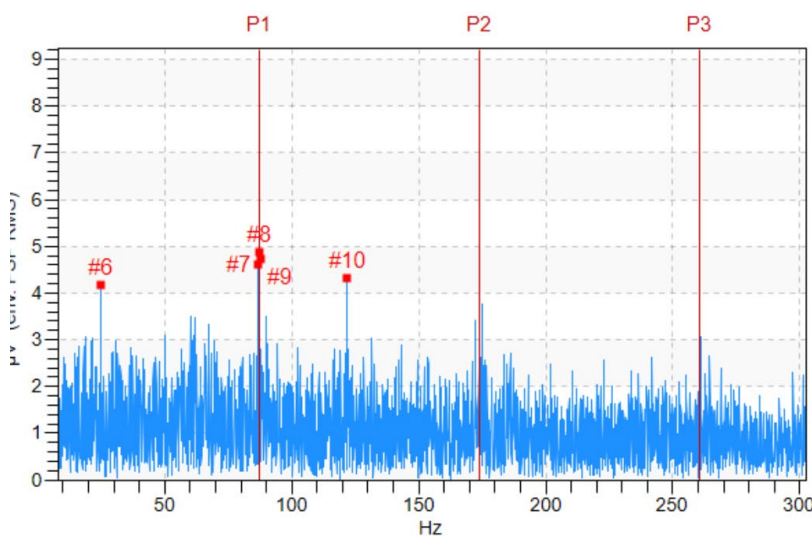
Author: Patrice Dannepond

RECTIFIER TRIPET 2 - Translation trolley:

US	dB μ V (RMS)	dB μ V (Peak)	dB μ V (Crest Factor)
Bearing 1	13,4	39,4	19,94



30.589, 5.711



Indicators	
US RMS	0 dB μ V
US maxRMS	0 dB μ V
US Peak	0 dB μ V
US Crest Factor	0

Highest Peaks

Single cursors

Delta cursors

Periodic cursors		
P1	87.273 Hz	1.079 μ V ²
P2	173.945 Hz	1.092 μ V ²
P3	260.617 Hz	3.722 μ V ²
P4	347.289 Hz	1.692 μ V ²
P5	433.961 Hz	0.16 μ V ²
P6	520.633 Hz	0.358 μ V ²
ΔF	86.672 Hz	
ΔT	0.012 s	

Possible bearing problem. Harmonics of 86 Hz.

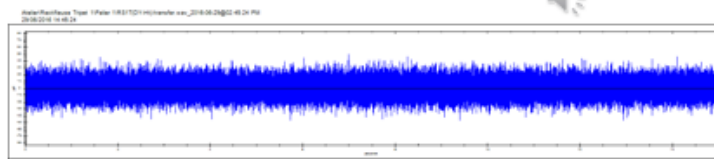
Lathe

Author: SDT Ultrasound Solutions

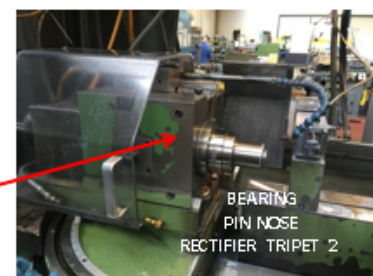
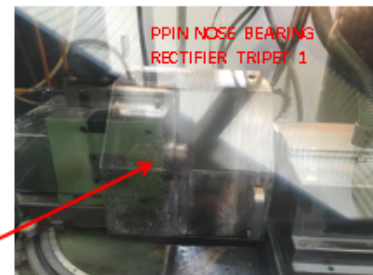
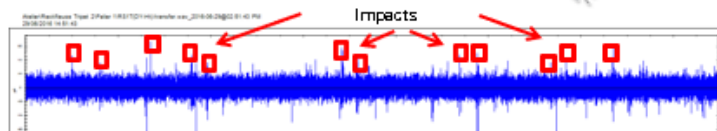
TRIPET RECTIFIERS - Bearing Spindle nose - speed = 1360 rpm:

US	dB μ V (RMS)	dB μ V (Peak)	dB μ V (Crest Factor)
Bearing - T1	21	33,7	4,32
Bearing - T2	17	36,4	9,13

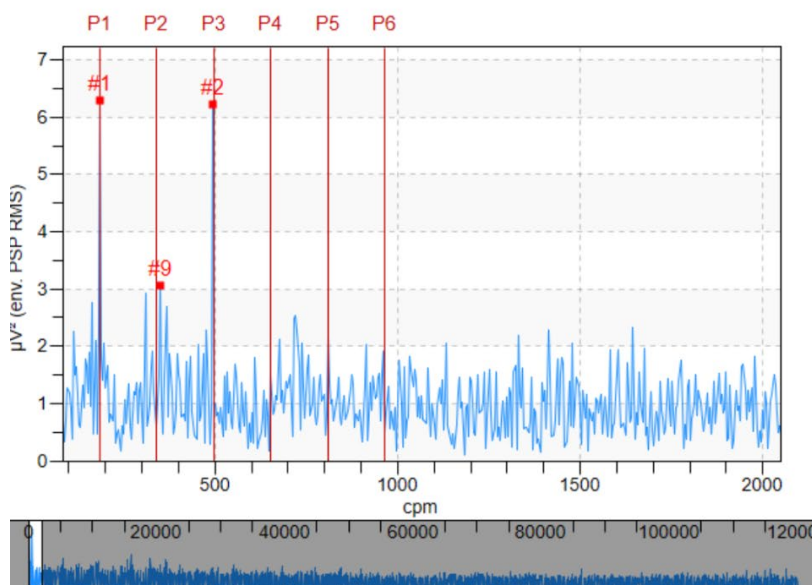
PIN NOSE BEARING - TRIPET 1



PIN NOSE BEARING - TRIPET 2



459.373, 3.645



Indicators	
US RMS	0 dB μ V
US maxRMS	0 dB μ V
US Peak	0 dB μ V
US Crest Factor	0

Highest Peaks

Single cursors

Delta cursors

Periodic cursors

P1	184.295 cpm	2.224 μ V ²
P2	340.545 cpm	1.191 μ V ²
P3	496.795 cpm	6.219 μ V ²
P4	653.045 cpm	0.175 μ V ²
P5	809.295 cpm	0.796 μ V ²
P6	965.545 cpm	1.904 μ V ²
ΔF	156.25 cpm	
ΔT	0.006 s	

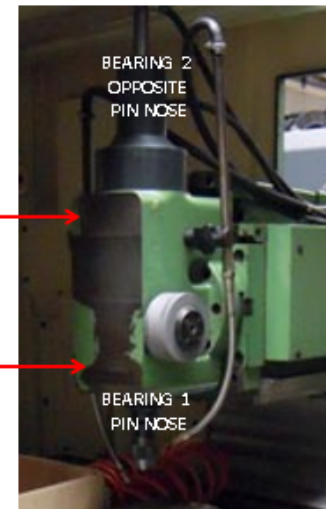
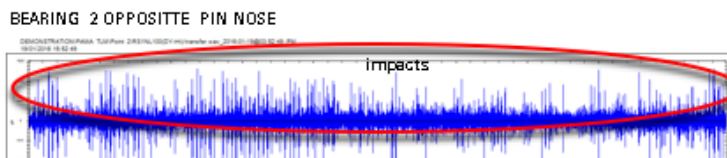
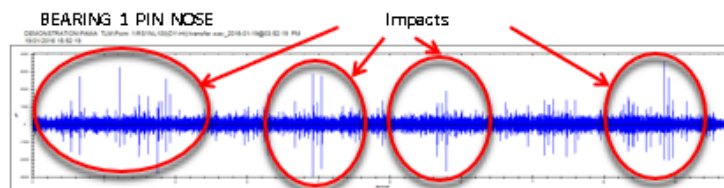
Random impacts. No exact multiple harmonics. Lubrication issue.

Milling machine

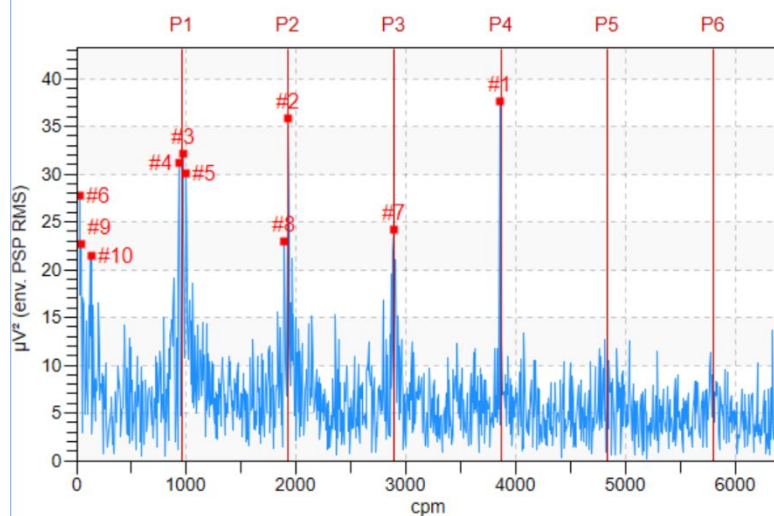
Author: SDT Ultrasound Solutions

PAMA TLM MACHINING CENTER - speed = 1000 rpm:

US	dB μ V (RMS)	dB μ V (Peak)	dB μ V (Crest factor)
Bearing 1	45,8	70,9	17,99
Bearing 2	42,3	62,3	9,23



1264.332, 25.898



Indicators	
US RMS	0 dB μ V
US maxRMS	0 dB μ V
US Peak	0 dB μ V
US Crest Factor	0

Highest Peaks

Single cursors

Delta cursors

Periodic cursors

P1	962.01 cpm	29.402 μV^2
P2	1930.147 cpm	26.103 μV^2
P3	2898.284 cpm	24.149 μV^2
P4	3866.421 cpm	3.823 μV^2
P5	4834.559 cpm	3.173 μV^2
P6	5802.695 cpm	8.964 μV^2

ΔF 968.137 cpm

ΔT 0.001 s

1 X RPM harmonics in ultrasound spectrum from bearing shows looseness. Bearing fit tolerances are out.

Energy Savings 4.0

Author: Benoît Degraeve

Email address: benoit.degraeve@sdtultrasound.com

In the industry, one of the most common applications when using ultrasonic detectors is to search for leaks to achieve energy savings. For both service providers and maintenance engineers, the hardest task is not to localize the leaks, which is child's play if you have the appropriate tool, but to generate a report, organize the required repairs and communicate on the resulting savings within the company.

In 2018, we worked with a company located in the North of Manchester, which, for many years, has used measuring instruments to detect leaks. However, no energy savings have been observed nor measured. As a result, the team was experiencing a loss of motivation and had given up on its cost reduction strategy. Thus, our customer's request was simple: give new life to their projects. The first steps consisted in clearly redefining everyone's role. The second step was to train the team to the use of newly available tools: leak detector and mobile applications. The third step was to set up a "think tank" inviting all stakeholders to reflect on the best approach to adopt to manage and organize a leak detection campaign before, during and after our intervention (see diagram below). Finally, the fourth step was to celebrate our results with all the people involved in the project. After two days on site, everyone precisely knew what was expected of him/her. 17 leaks were localized, representing potential yearly savings of 3 934 GBP (4 481 EUR) and, after the quick repair of 7 leaks, actual savings of 1 648 GBP (1 877 EUR).

As a result, the inspector has a better control of his/her network and of compressed air losses and actual needs; the purchasing officer can calculate the return on investment; the technician feels valued by the savings generated by his/her work; and finally, everyone is thankful to the sponsor for (re)establishing communication between the different departments.

Summary of the inspection :	
Number of leaks found :	17
Potential savings* (m³/h) :	27.7
Potential savings* (£/year)	3934
Actual savings** (m³/h) :	11.6
Actual savings** (£/year) :	1648

Electric cost (£/kWh) : 0.081

Energy needed to generate compressed air (kW/1000cfm) : 0.2

Hours of compressors operation per year : 8760.0

Automatic savings sheet generated by the mobile application

Leak details N°	1	Severity :	
Location	Sensor		
Felt Line	Flexible Sensor		
Distance	RMS value (dBμV)		
20.00	45.0		
LEAK ESTIMATION			
Loss (m³/h)	Loss (£/year)		
1.5	218		
Comments			



Automatic work order generated by the application