NDS
User Manuals

Dashboard

Date	**2023/08/28**
Version	**v1**
Author	**Dries Van Loon**
Verified	**Abhinandan Jain**

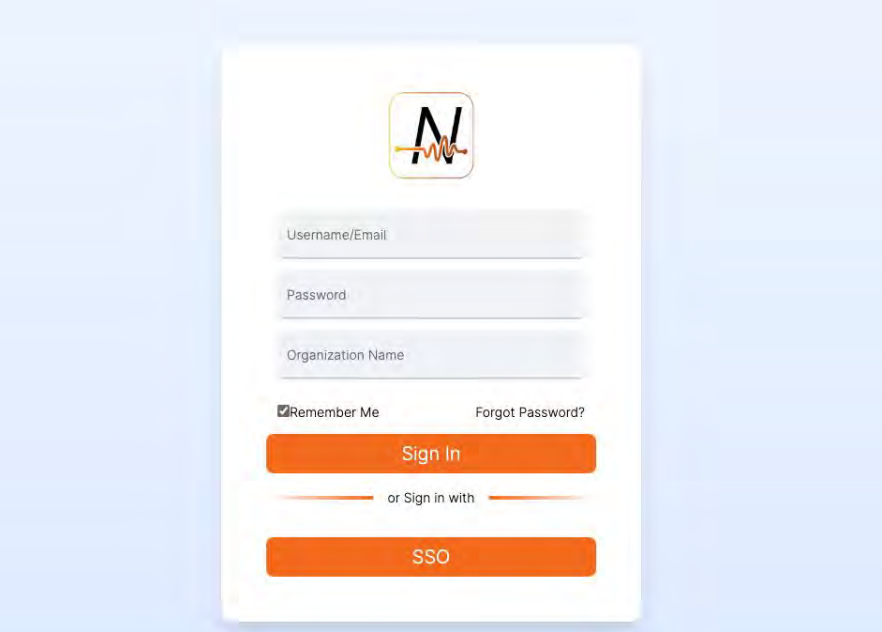
Table of Contents

1. Login Page

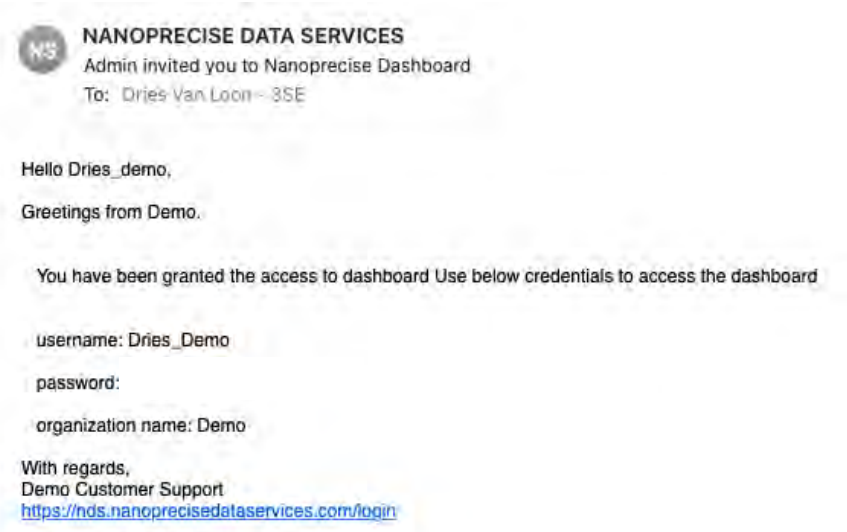
Website: https://nds.nanoprecisedataservices.com/login

1.1. Nanoprecise Users

Enter the provided Username & Password & Organization Name, which should be received by email from notifications@nanoprecisesc.com, and select “Sign In”

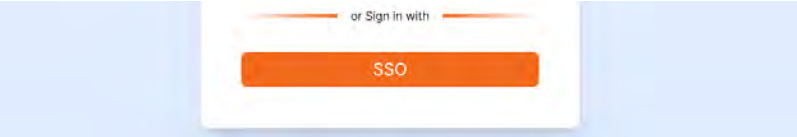


Example email with credentials



1.2. SSO users

Select Sign in with Single Sign On

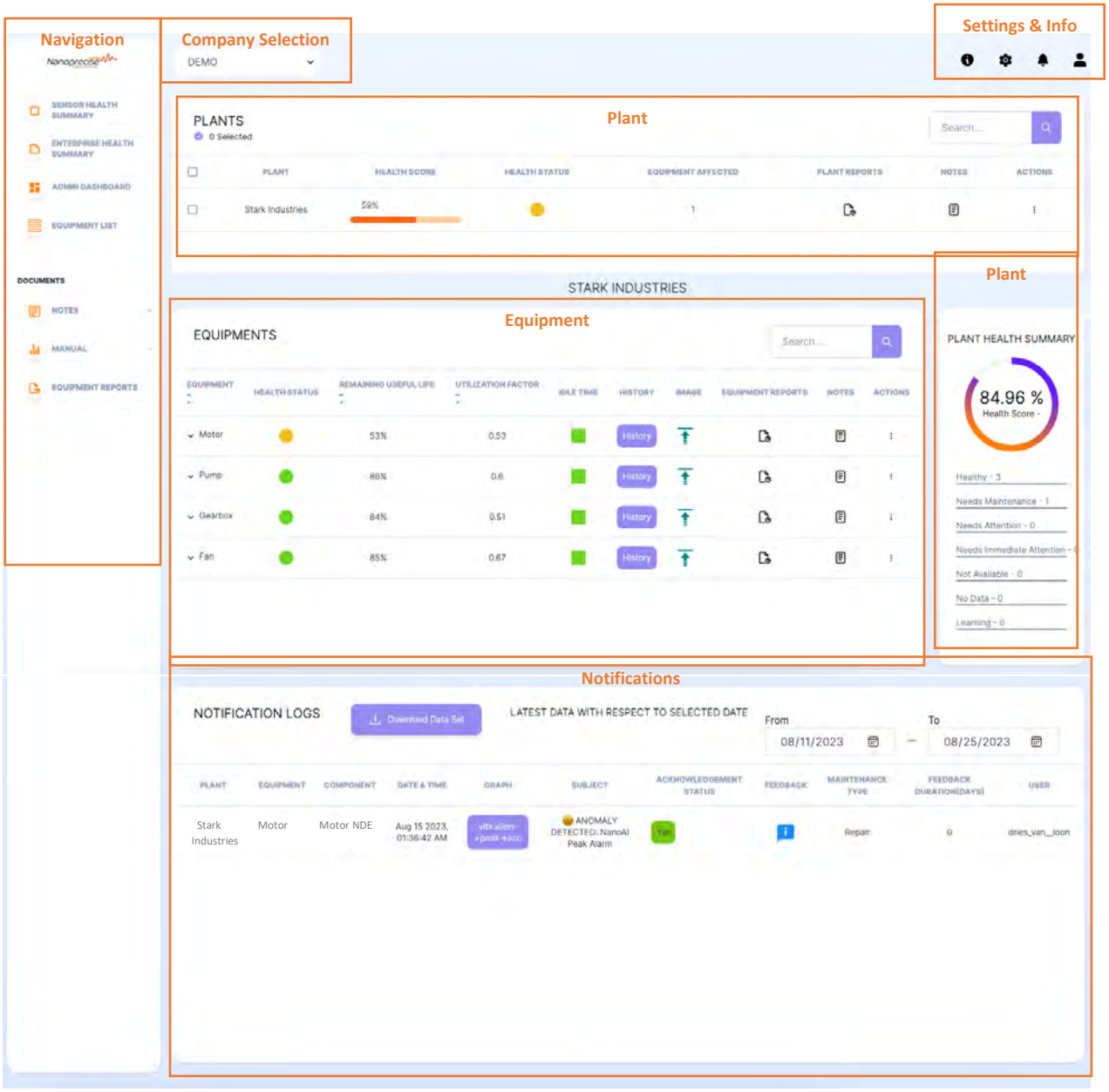


Enter the “Organization Name” of the Company you are trying to access.
If Organization is setup for SSO, it will redirect you to the “Sign In” page of your company SSO.

Once sign in is successful you will be automatically redirected to the Nanoprecise Main Page.

If you would like to setup SSO for your company, please contact your Nanoprecise representative or customer-success@nanoprecise.io .

2. Main Page



2.1. Main parts, Plant, Equipment, Notifications.

Main Page: Consists of 3 main parts, **Plant, Equipment, Notifications,** showing current health status and insights, ordered on highest priority (lowest health score) Main goal is to drive the user towards the highest priority insights first.

PLANT: Provides an overall health score & health status for each plant under the company, organized by health score (worst first). The selected plant (default 1st one in list, but multiple can be selected) will populate the machine/equipment tab below as well as the "Plant Health Summary" on the right-hand.

- Plant list has all different plants under the company and has a checkbox in the front to select for which plant(s) you want to populate the equipment list
- Health Score: is a calculated number representing the health of a plant based on the health status of the equipment under the plant (Refer to Appendix C for more info)
- Health Status: the health status of the worst equipment under the plant
- Equipment affected: how many equipment have increased health status
- Plant Report: central location to store additional finding reports on a plant level
- Notes: Notes can be added on different levels of the hierarchy
- Action: Allows users to re-name the equipment & plant name

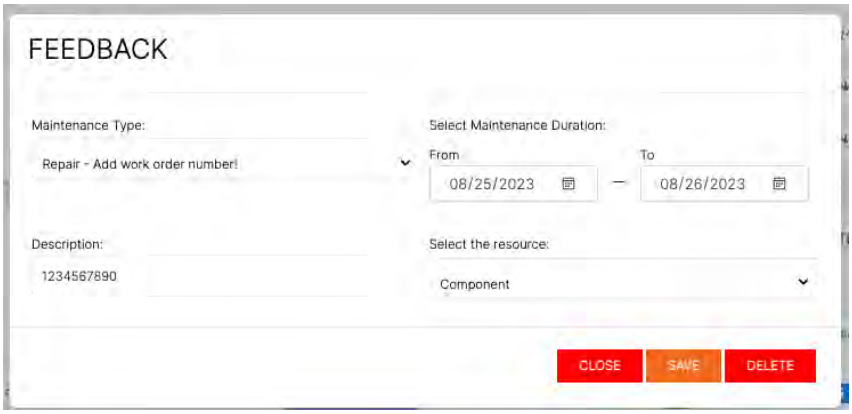
PLANT HEALTH SUMMARY: Total nr of equipment under each health status for the selected plant

EQUIPMENT: Based on the selected plants (can be multiple) the equipment will be listed organized based on the highest priority (lowest health score first)

- Equipment list is populated with all equipment from the corresponding selected plant in the Plant section
- Health Status: Defined by the active Fault Severity/stage (2/3/4) and Remaining Useful Life (Refer to Appendix C for more info)
- Remaining Useful Life (RUL): Remaining useful life of the most critical/degraded component in an equipment. Presented in percentage until 750 hours (+- 30 days), after which the RUL is shown is hours.
- Utilization Factor: Percentage number of running/total measurement points
- Idle time: Indication if equipment did not run in X-days (Refer to notifications settings)
- History: Summary of RUL and health status for the past 7 days, or per selected date
- Image: Equipment image
- Equipment Report: Analysis reports central location to store additional finding reports
- Notes: Notes can be added on different levels of the hierarchy
- Action: Allows users to re-name the equipment & plant name

NOTIFICATIONS: the notifications from the selected plant(s) (which the user has access too) will be displayed for the past 2 weeks with the latest available showing first

- Plant/equipment/component: where the notification was triggered.
- Data & Time: when the notification was triggered.
- Graph: Which graph triggered the notification (Hyperlink that bring you to component page)
- Subject: the subject of the notifications
- Acknowledgement status: Notifications can be acknowledge, indicating they have been reviewed (the mouse tip will show which user acknowledge it)
- Feedback: allows users to log follow-up actions that resulted of a notifications.
  User can select maintenance type (predefined), description, time range and resource, once saved it will show in the notification log making it possible to close the loop and keep track of actions taken and by who.



- The time range for which notifications are displayed can be changed with the “From and To” date selectors
- The notification list can be downloaded by using “Download Data Set” option which will generated a csv file containing all the info displayed.

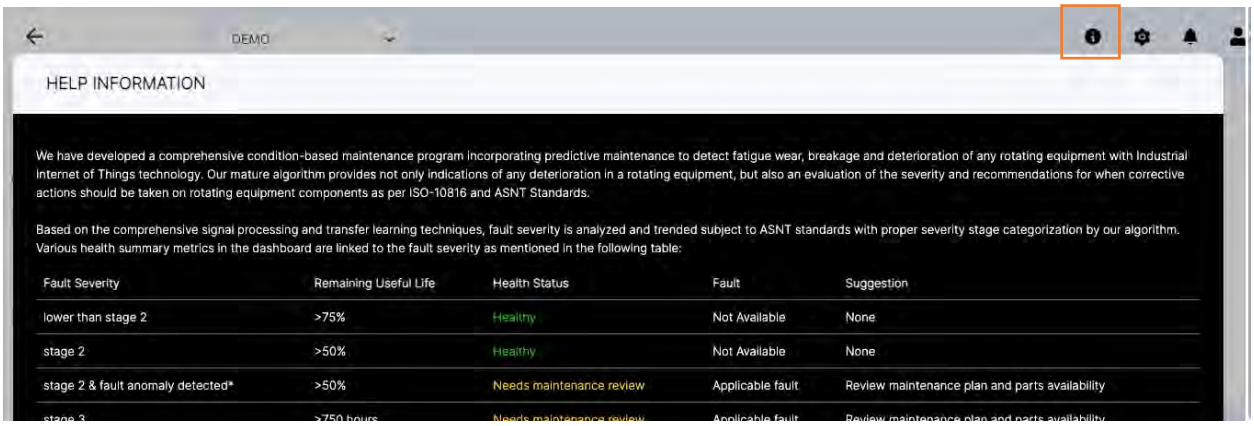
2.2. Navigation, Setting and Info

Navigation: Allows quick access to different sections of the dashboard (options available depend on user rights and activated functionality)

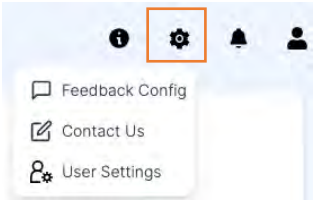
Company Selector: If user has access to multiple companies, they can be selected from dropdown.

Settings & info: Different user and company settings as well as information on health status and notification types

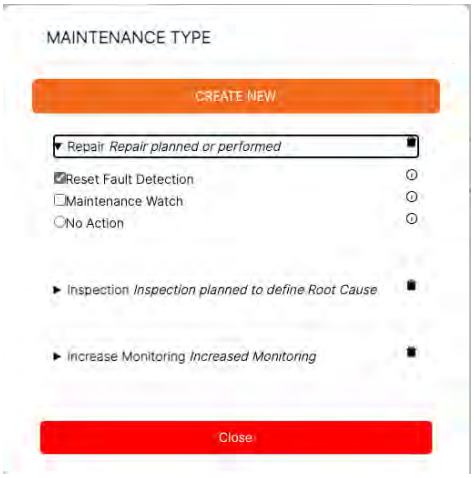
Info: Contains info on Health Status, Fault Severity and Notification Triggers and Topics



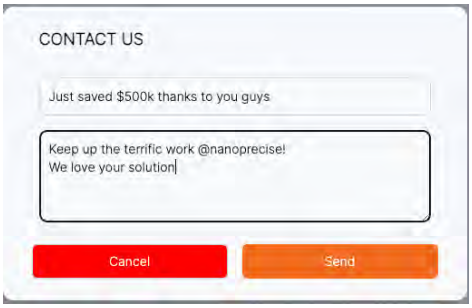
Settings:



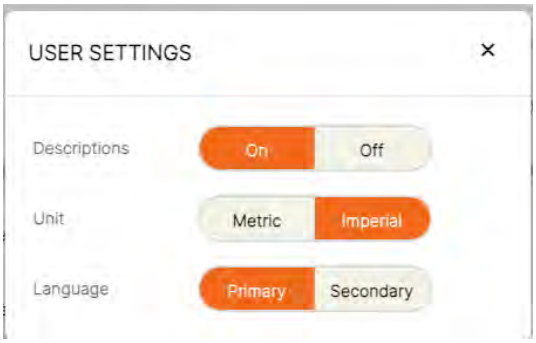
- Feedback Config to setup Maintenance types and actions



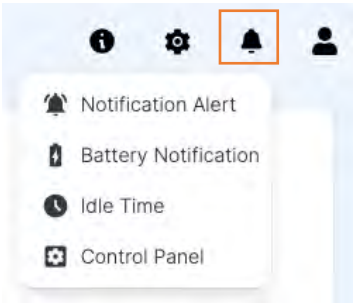
- Contact Us: Directly contact customer-success@nanoprecise.io



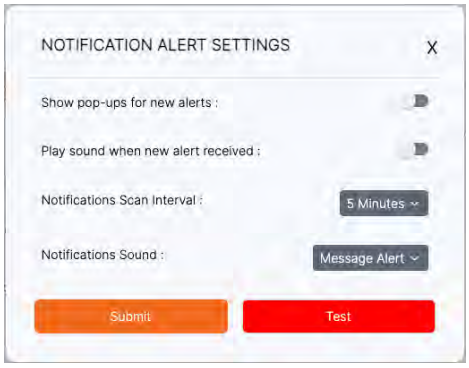
- User Settings: Turn on descriptions, set default units, set Language



Notification settings



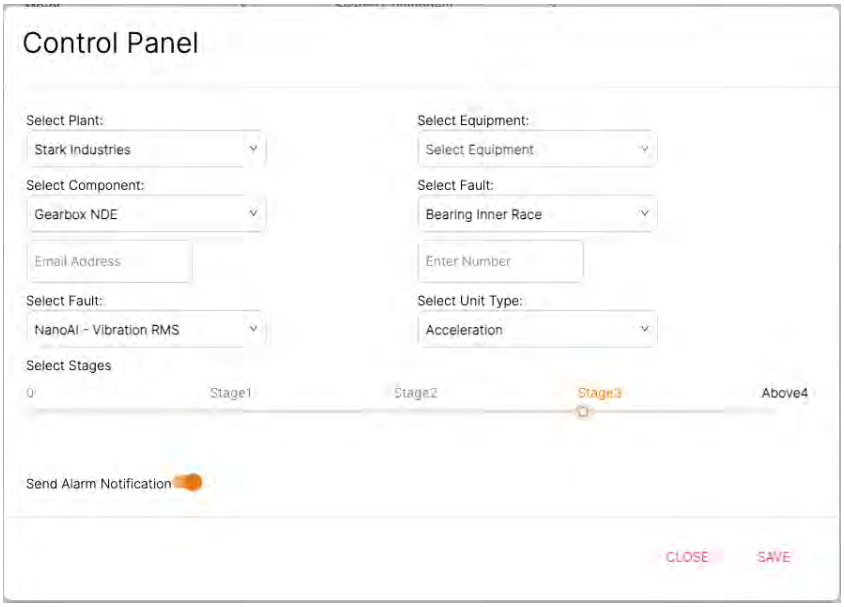
- Notification Alert: activate and manage Pop-up alerts



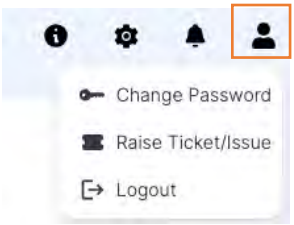
- Battery Notification: Setup notifications below certain battery level

- Idle Time: Setup for Idle time indication in equipment overview (X – days)

- Control Panel (DEMO Only): Simulate faults and trigger notifications.



User settings

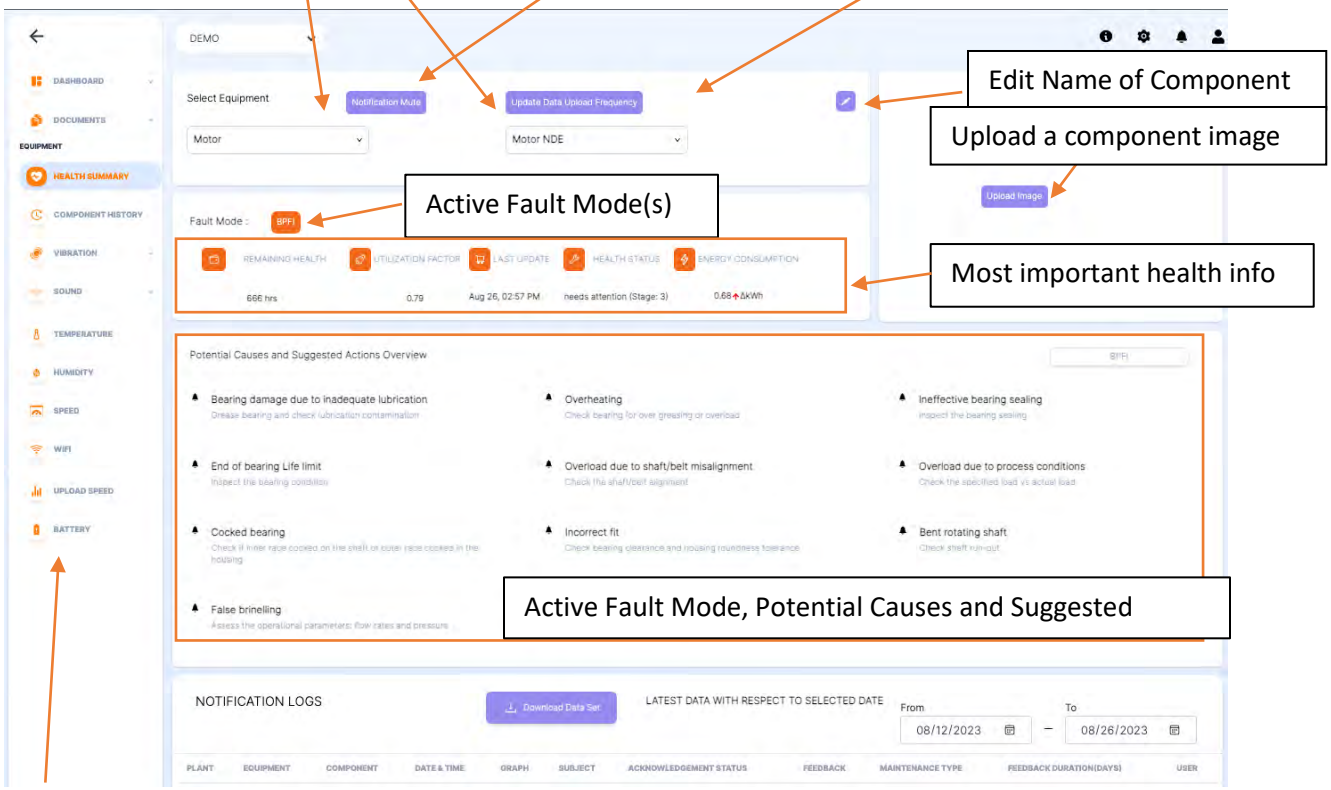


- Change Password
- Raise Ticket/Issue: Create a ticket with Nanoprecise Tech Support

- Logout

3. Component Health Summary Page

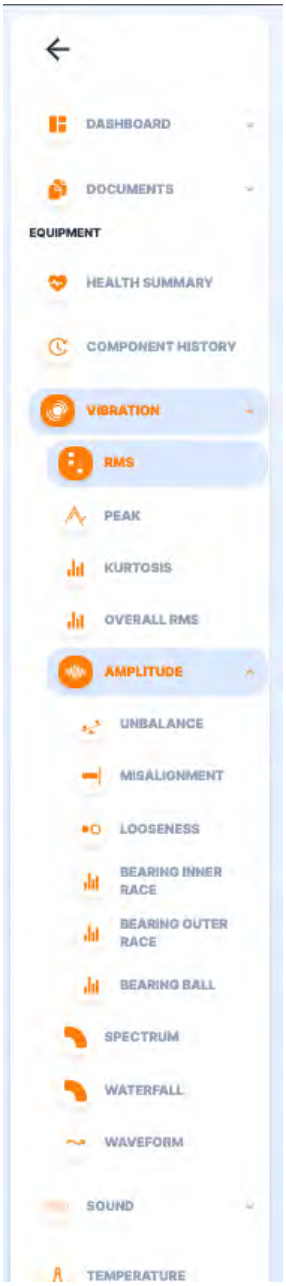
Can be accessed by clicking on any equipment name



4. Navigation and General functionality

4.1. Navigation

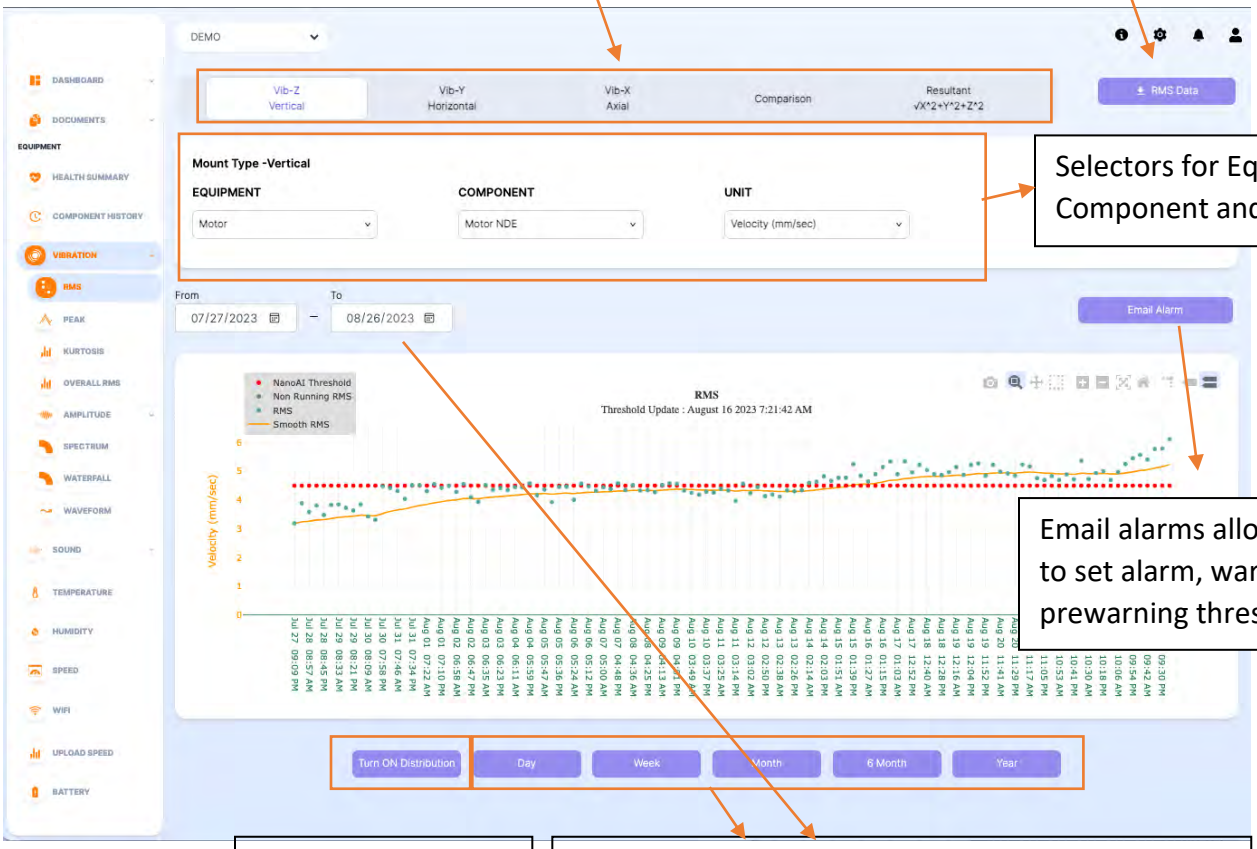
The different data sources can be selected individually, and the navigation tree will further expand to show all available options under that data type.



4.2. Trending Graph - Functionality

Select Direction (Z-Y-X), Comparison, Resultant

Download Data



Selectors for Equipment, Component and Units

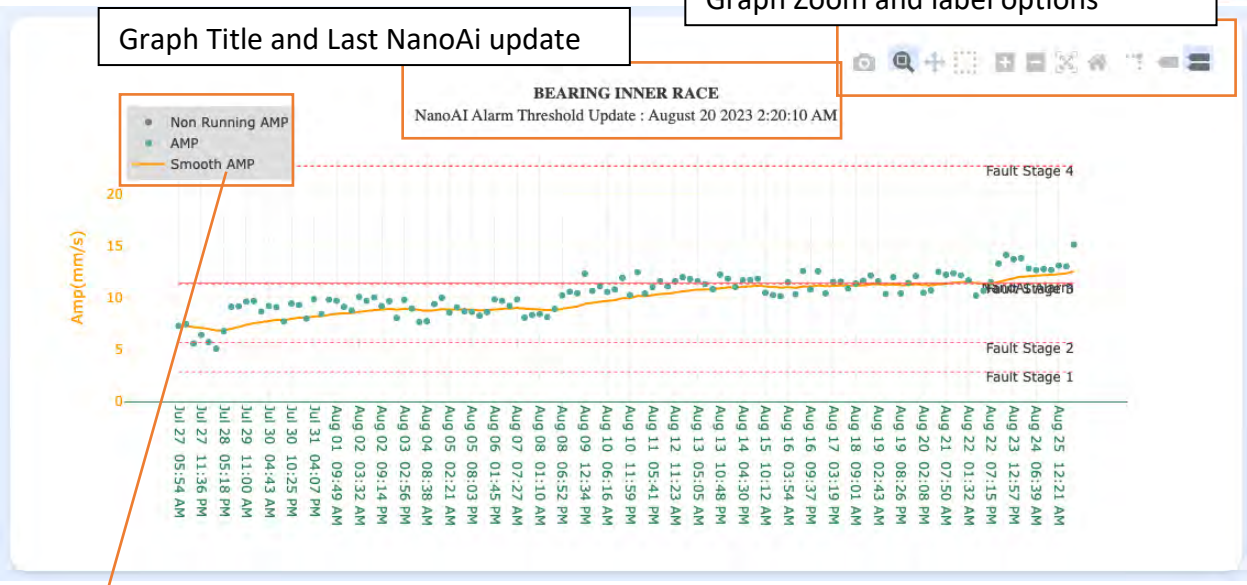
Email alarms allows users to set alarm, warning prewarning thresholds.

Turn On Distribution will plot the time axis on true scale

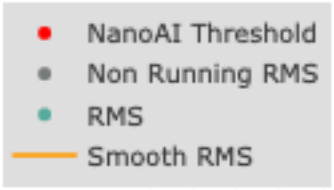
Quick Time Scaler to access data within a certain time period or dates can be selected to display coorepsonding data

Graph Zoom and label options

Graph Title and Last NanoAi update

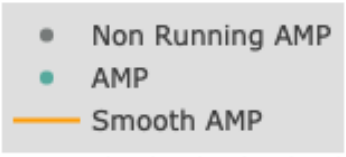


Legend for Vibration Graphs



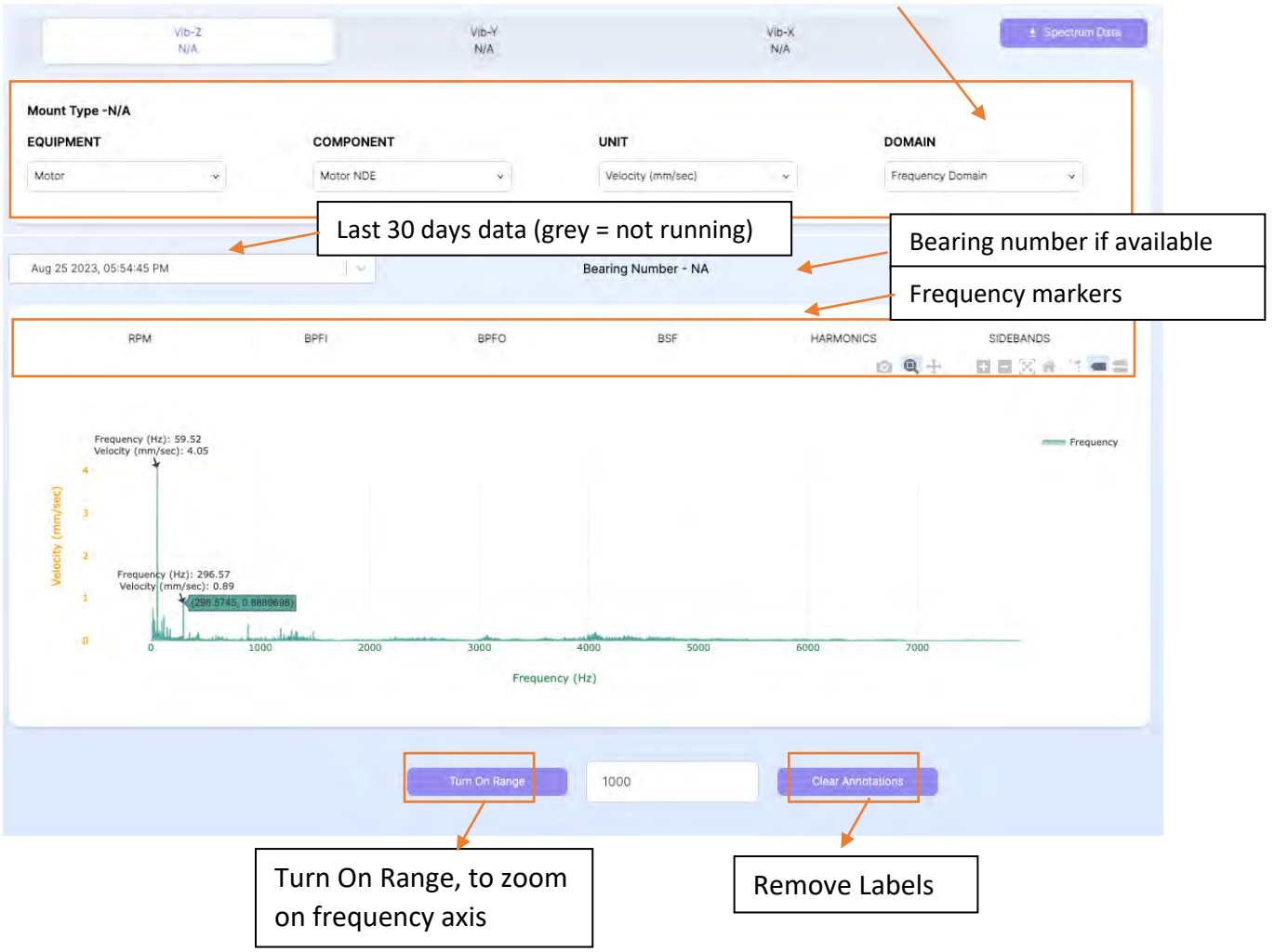
NanoAI - Self Adaptive Threshold (more info in Notification Manual)
Non Running Points (RNR threshold on ACC or Sound RMS or Flux)
Running Points (RNR threshold is self-adaptive based on clustering algo)
Smooth Trend using EMA

Legend for Amplitude Graphs

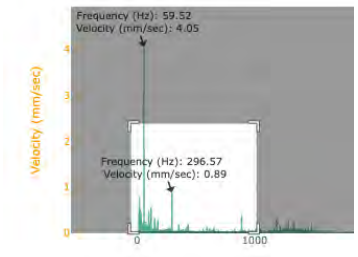


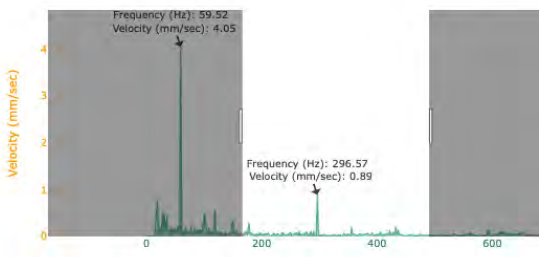
Non Running Points (RNR threshold on ACC or Sound RMS or Flux)
Running Points (RNR threshold is self-adaptive based on clustering algo)
Smooth Trend using EMA

4.3. Spectrum and time wave form Graph



Zoom by “drawing a box”, or horizontal or vertical “line” to keep the X or Y scaling fixed, “Double click” to zoom back out

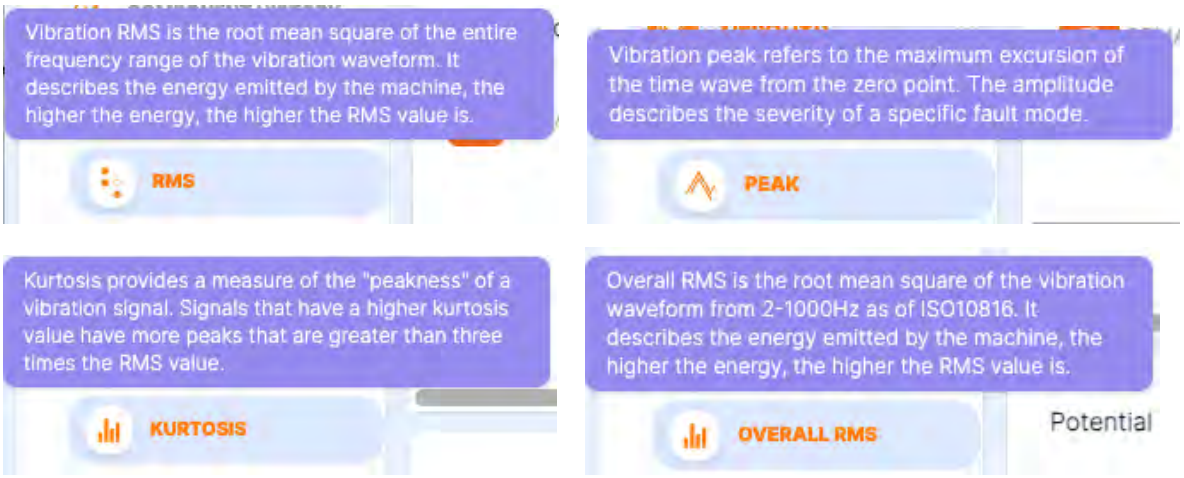




5. Vibration

5.1. RMS, Peak, Kurtosis, Overall RMS

Different statistics values are processed form the Vibration time signal and available for review.

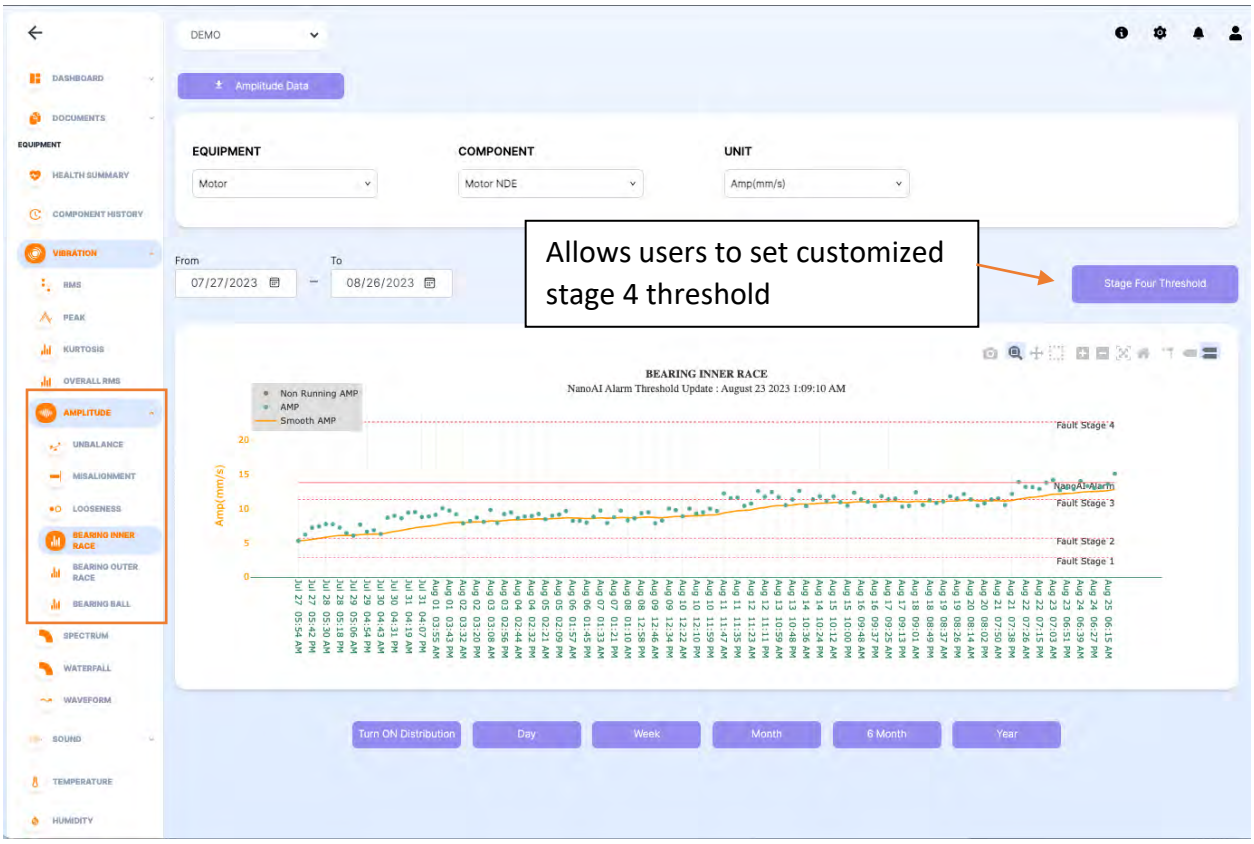


5.2. Amplitude

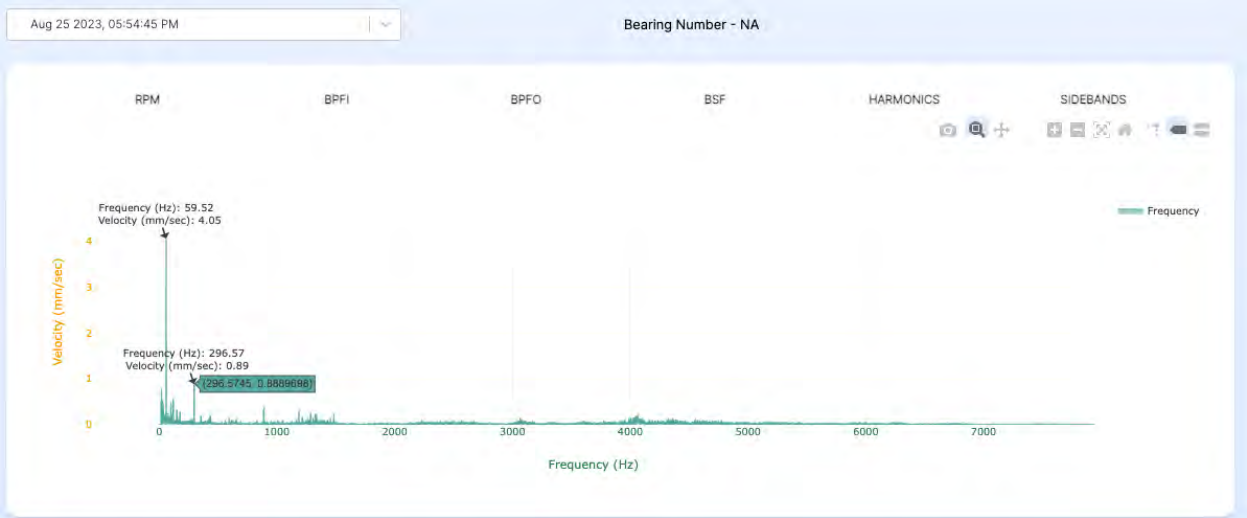
- The amplitude graphs are dependent on the component that the sensor is monitoring. Each sensor is configured based on its location to cover applicable fault modes. For example, to cover antifriction bearing faults, the amplitude tab will show graphs for Bearing Inner Race, Bearing Outer Race, and Bearing Ball; to cover shaft faults, options such as unbalance, misalignment and looseness will be present.

- The amplitude graphs are used to calculate the RUL of a component. There are four stages for each fault. The RUL is being calculated as the time it takes to reach a Fault Stage 4. The equipment reaches an unstable point if the graph crosses over the Fault Stage 4 line.

- More info on how the Stage 4 threshold is initially set (during learning) and how it becomes self-adaptive after can be found in appendix D

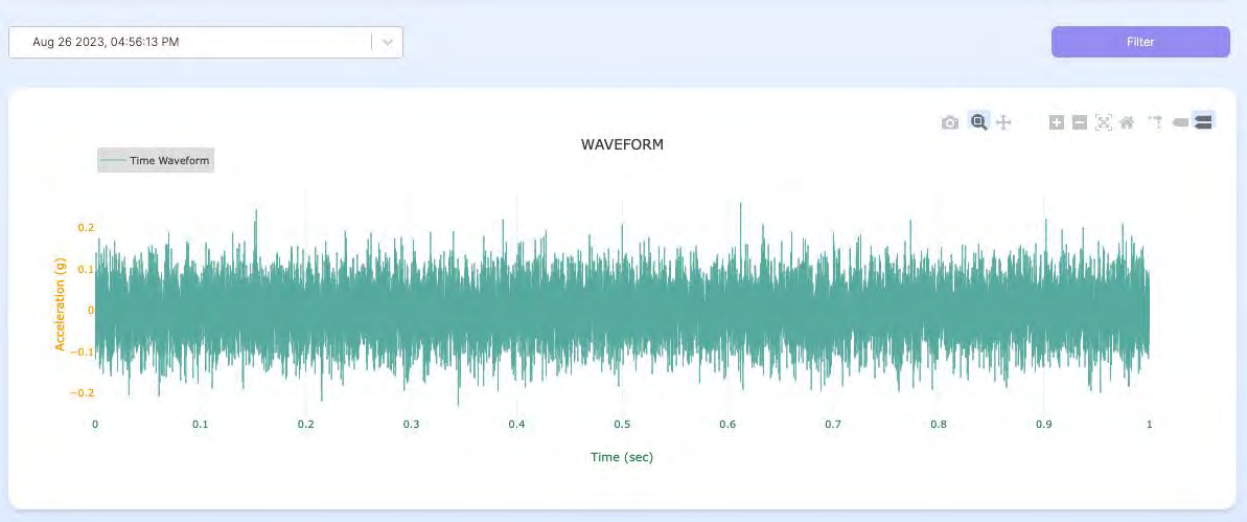


5.3. Spectrum



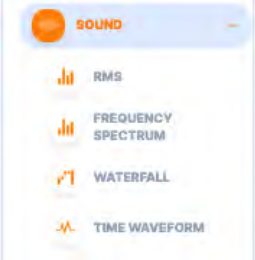
5.4. Waterfall Spectrum

5.5. Waveform

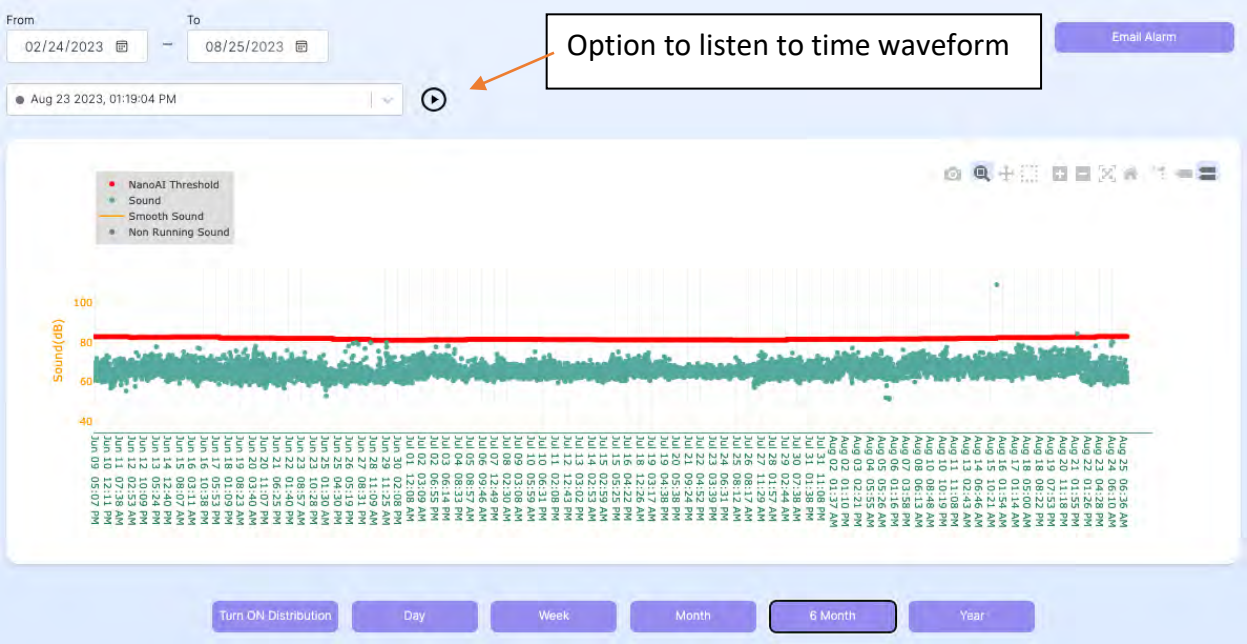


6. Sound

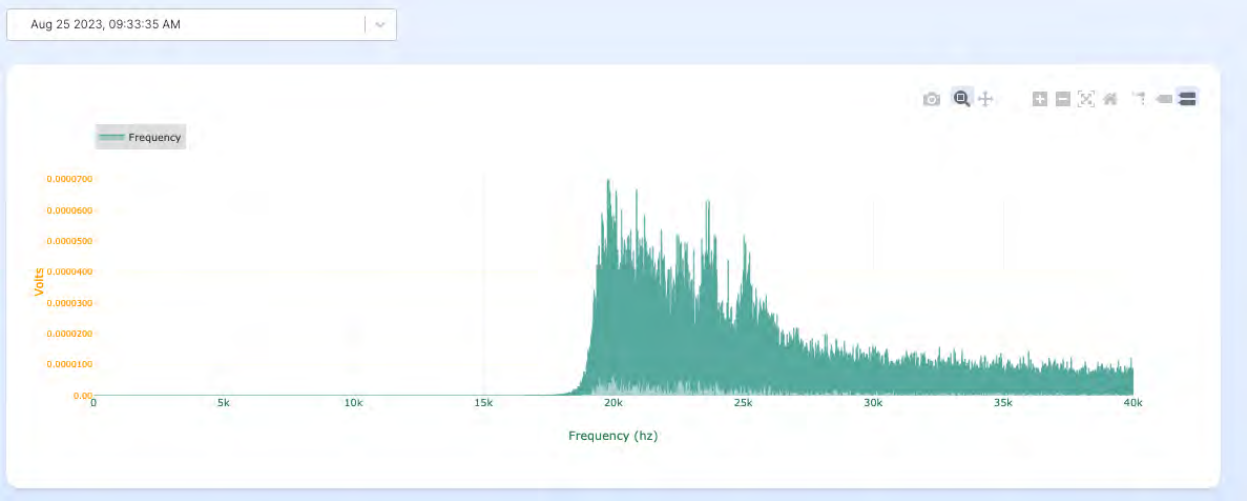
The acoustic emission data has a set frequency range of 20kHz – 40 or 80 kHz to capture the maximum amount of useful data, which is beyond human hearing range.



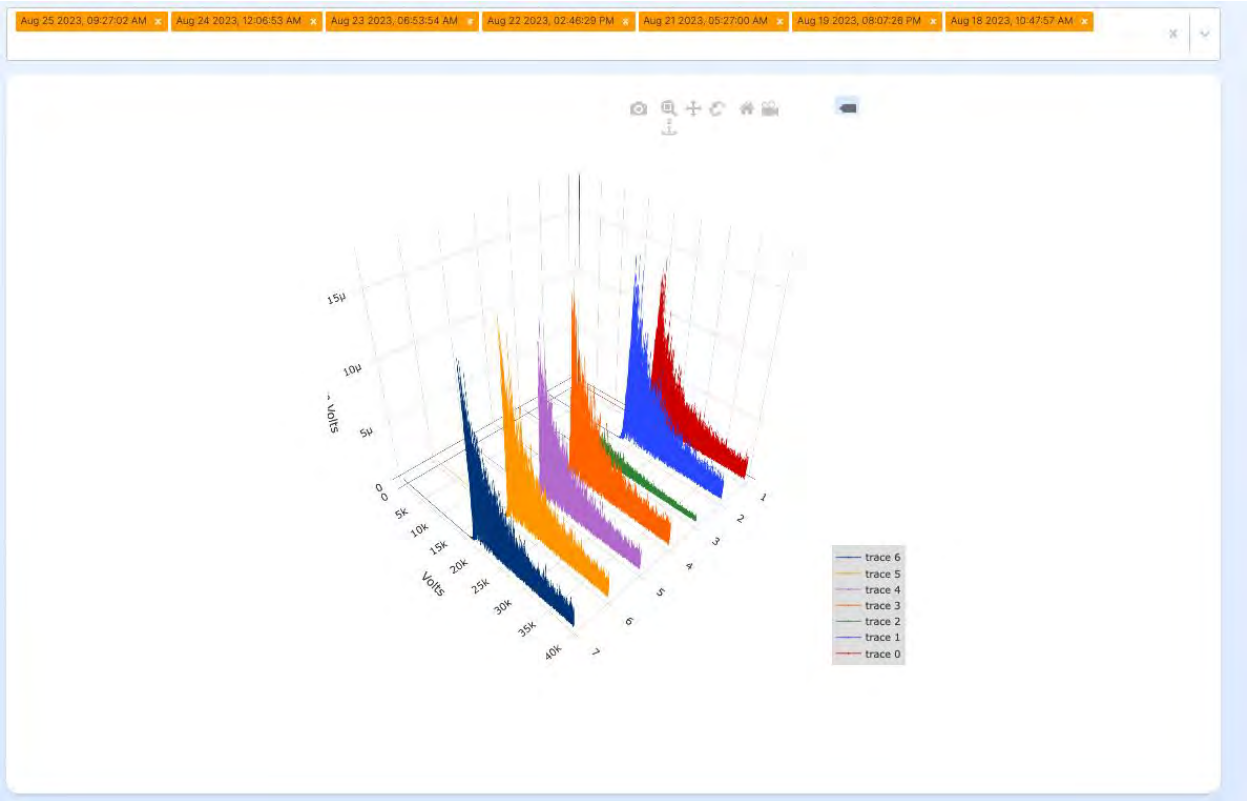
6.1. RMS



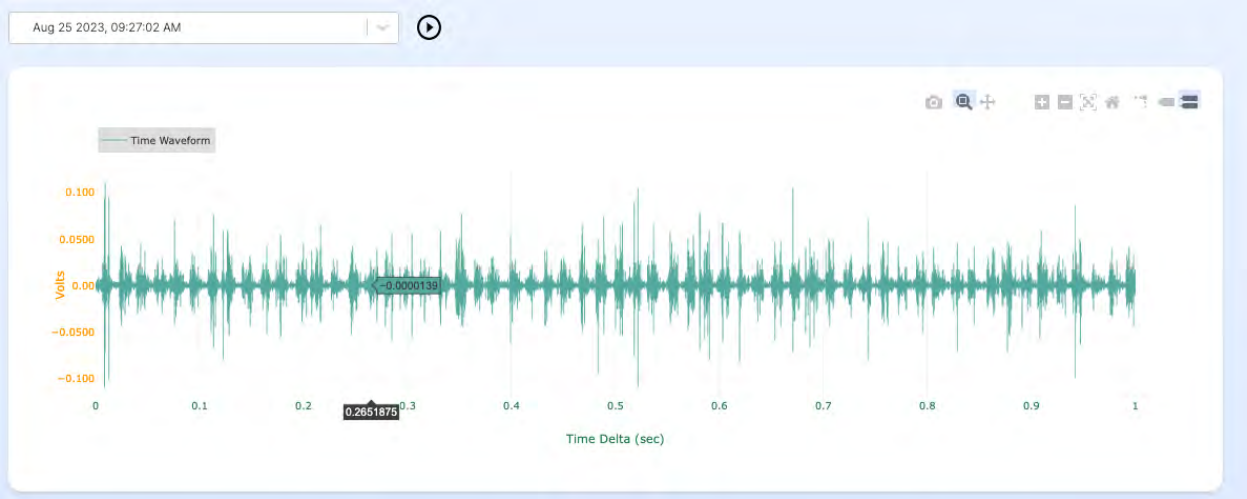
6.2. Spectrum



6.3. Waterfall Spectrum



6.4. Time Wave Form



7. Flux

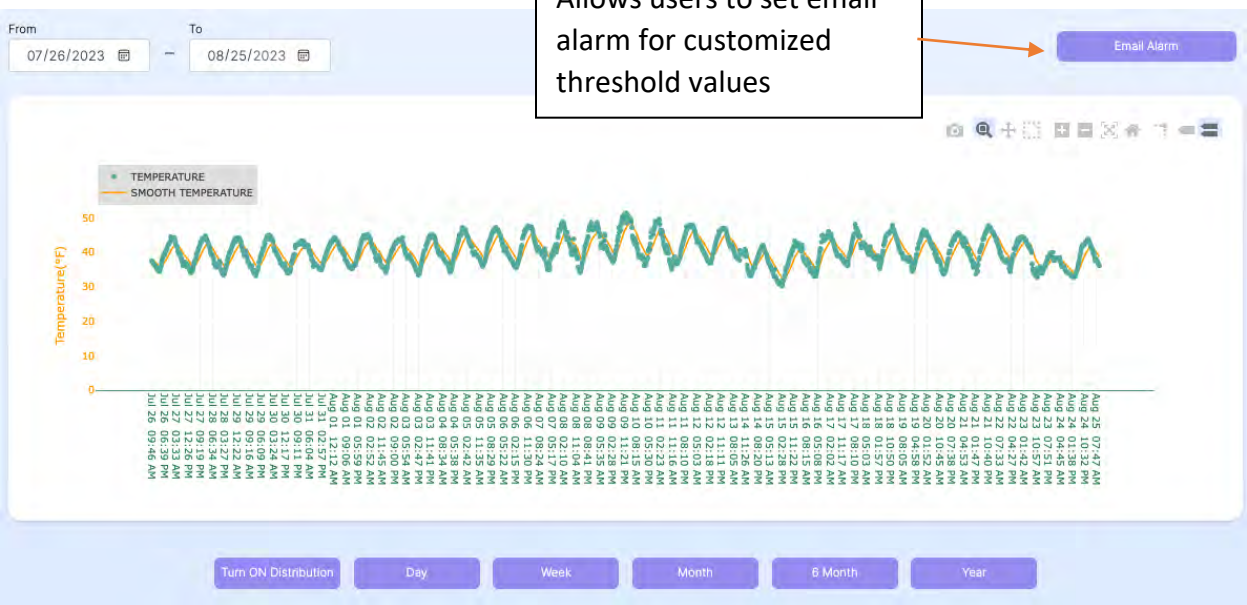
7.1. RMS

7.2. Spectrum

7.3. Time waveform

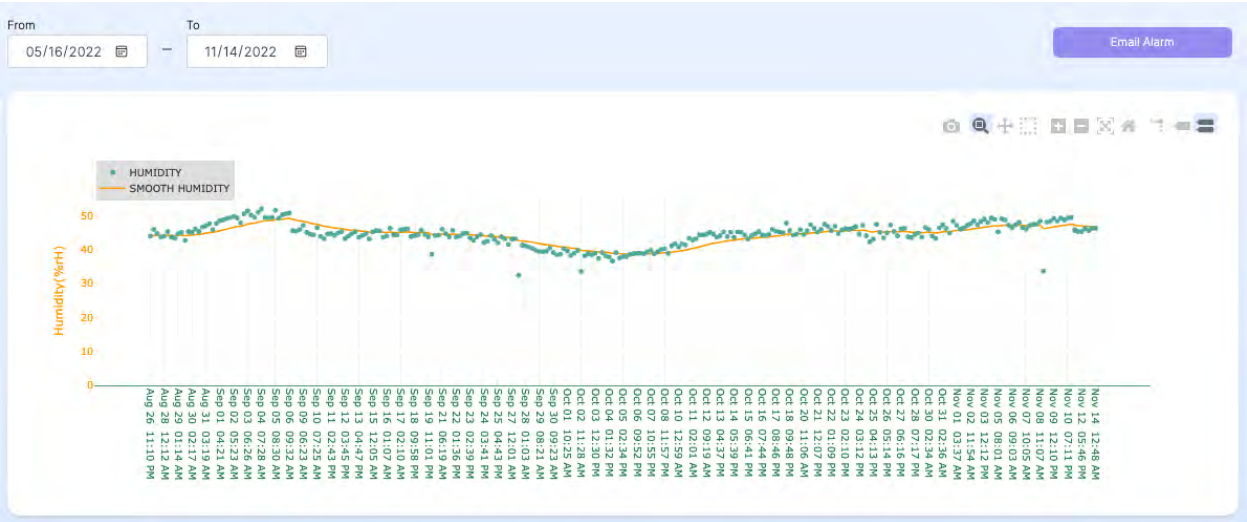
8. Temperature

Temperature graph represents surface temperature of each location on which the sensor is mounted.



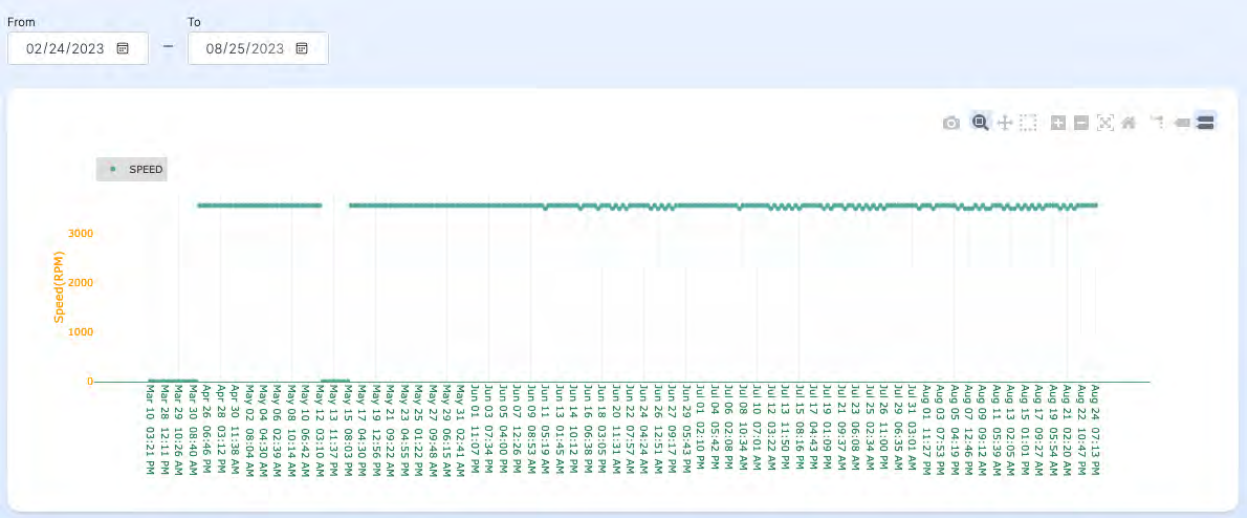
9. Humidity

The humidity graph represents the atmospheric humidity value near the sensor.



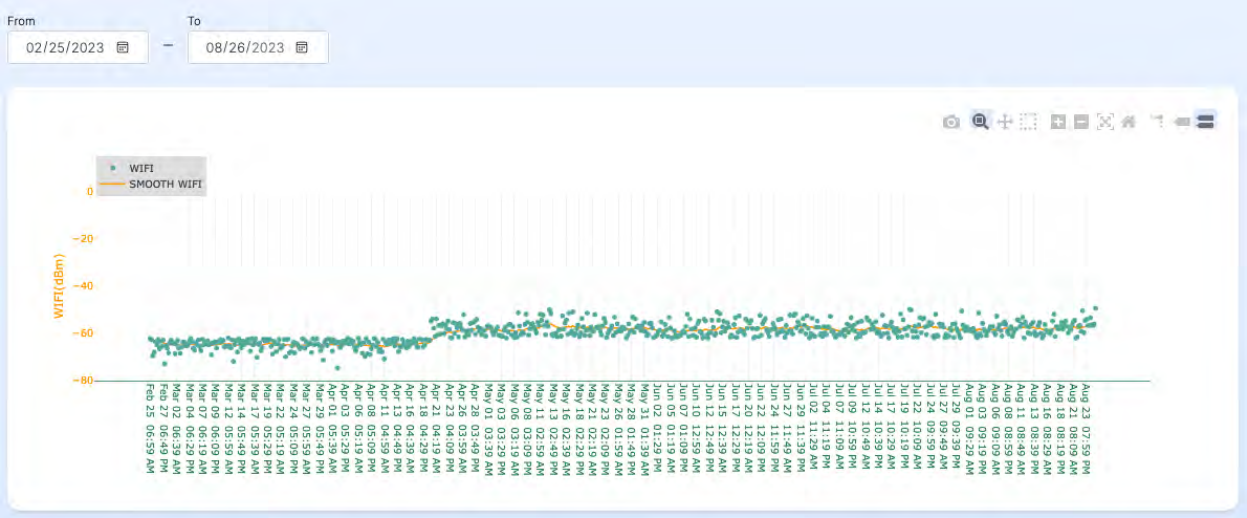
10. Speed

The speed graph provides RPM of the equipment, which can be extracted from the vibration or flux signal



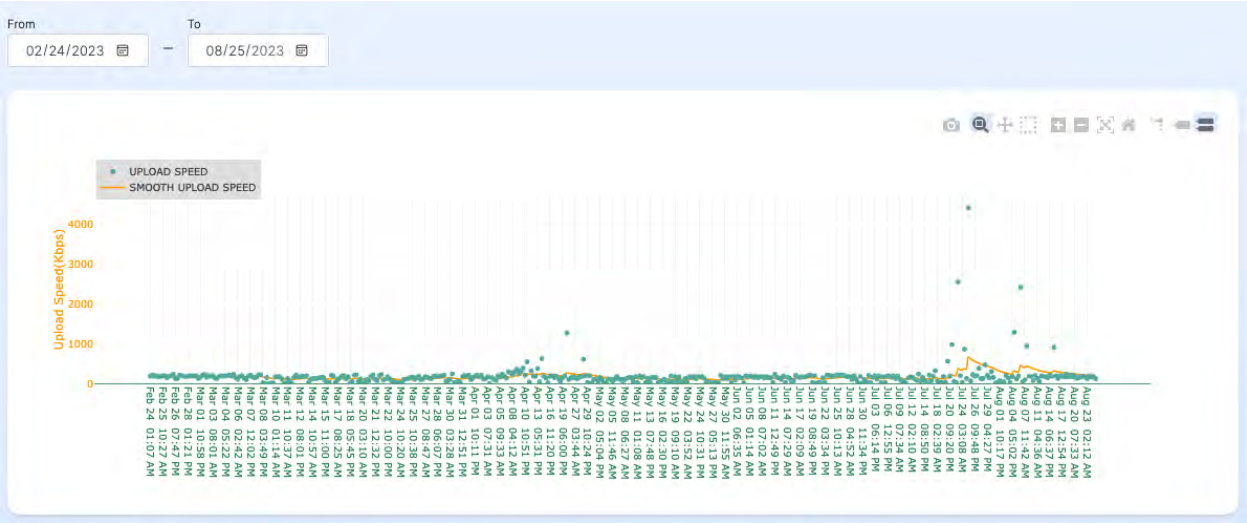
11. Wi-Fi

The Wi-Fi graph provides the strength of the network. Higher values (greater than -70dBm) represent good connectivity.



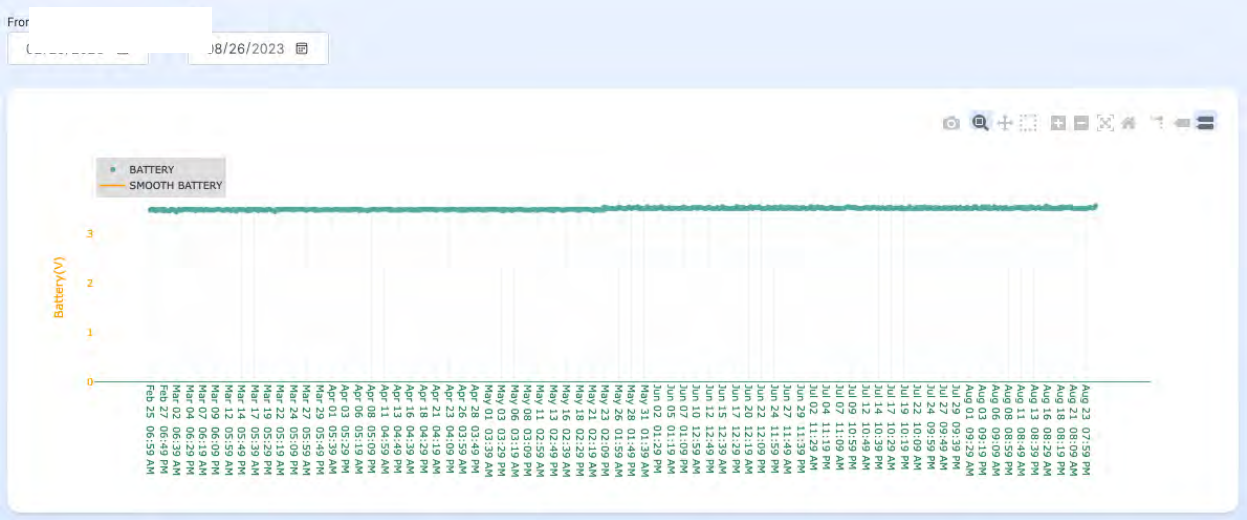
12. Upload speed

Every data upload the upload speed is measured and displayed in trend.



13. Battery

The battery graph provides the status of battery life.



14. Appendix A: NanoAI Alarm & Adaptive fault amplitude threshold

NanoAI Alarm

- Threshold is automatically updated every 30 days based on the data of the last 30 days
- Al trained model is used to capture the features of data
- Threshold is set/modified to adapt to the features
- No prior knowledge is required from customer
- Alarms will be automatically sent to customer if RMS/Peak hits the threshold
- Applies to RMS/Peak of vibration signals (acceleration & velocity) and RMS of ultrasonic signals

15. Appendix B: Dashboard Terminologies

Vibration

Waveform: A plot of amplitude versus time. The waveform illustrates how the vibration signal (i.e., acc., vel., and dis.) appears when graphed as amplitude over time.

Spectrum: A plot of amplitude versus frequency.

- The Spectrum is obtained by applying a Fast Fourier Transform (FFT) on Waveform, which breaks the signal down into specific amplitudes at various component frequencies.
- If a machinery problem exists, FFT Spectrum provides information to help determine the location of the problem, the cause of the problem, and, with trending, how long until the problem becomes critical.
- Because we know that certain machinery problems occur at certain frequencies, we analyze the FFT spectrum by looking for amplitude changes in certain frequency ranges.

Frequency Spectrum Waterfall: A three-dimensional plot in which multiple vibration spectra curves are displayed simultaneously.

- On the Nanoprecise Dashboard, vibration frequency spectrum waterfall plot covers multiple spectra for the last 7 days
- By using the frequency spectrum waterfall plot, it can show how the frequency spectral structure changes over time

RMS: Root Mean Square is the square root of the average of the squared values of the vibration waveform. RMS describes the vibration energy in the machine. The higher the vibration energy, the higher the vibration RMS is.

Peak: Peak value in time domain. The maximum excursion of the time wave from the zero or equilibrium point in the time domain.

Kurtosis: Kurtosis is a statistical parameter used to characterize a signal. Kurtosis provides a measure of the "peakness" of a vibration signal. Signals that have a higher kurtosis value have more peaks that are greater than three times the RMS value, which are, for mechanical vibration signals, the impulses introduced by the mechanical impacts, indicating the potential mechanical fault.

Amplitude: The maximum amplitude for the fault characteristic frequencies and its harmonics up to 10th order. This amplitude describes the severity of a specific fault mode. Nanoprecise uses such amplitudes for RUL calculation.

Sound

Time Waveform: The Acoustic Emission (AE) waveform illustrates how the AE signal appears when graphed as amplitude over time.

Frequency Spectrum: A plot of amplitude in micro voltage versus frequency. The AE spectrum describes the amplitude at each frequency component.

Frequency Spectrum Waterfall: A three-dimensional plot in which multiple AE spectra curves are displayed simultaneously.

- On Nanoprecise Dashboard, AE frequency spectrum waterfall plot covers multiple spectra for the last 7 days
- By using the frequency spectrum waterfall plot, it can show how the frequency spectral structure changes over time

RMS: Root Mean Square is the square root of the averaged of the squared values of the AE waveform. RMS describes the AE energy emitted by the machine. The higher the AE energy, the higher the AE RMS is.

16. Appendix C: Health Status & Health Score & RUL Calculation

Health Status:

Based on the comprehensive signal processing and transfer learning techniques, fault severity is analyzed and trended subject to ASNT standards with proper severity stage categorization by our algorithm. Various health summary metrics in the dashboard are linked to the fault severity as mentioned in the following table:

Fault Severity	Remaining Useful Life	Health Status	Fault	Suggestion
lower than stage 2	>75%	Healthy	Not Available	None
stage 2	>50%	Healthy	Not Available	None
stage 2 & fault anomaly detected*	>50%	Needs maintenance review	Applicable fault	Review maintenance plan and parts availability
stage 3	>750 hours	Needs maintenance review	Applicable fault	Review maintenance plan and parts availability
stage 3	251-750 hours	Needs attention	Applicable fault	Schedule maintenance activity
stage 3	<250 hours	Needs immediate attention	Applicable fault	Repair immediately
stage 4	0	Needs immediate attention	Applicable fault	Repair immediately

*fault anomaly detected: fault amplitude data exceeds NanoAI Amplitude threshold

Health Score:

Health score on Plant level is the average rating of each equipment health status under the plant.

Assuming Plant A has 4 different equipment in it. Each equipment has 4 health modes with following health modes and associated score of ranking.

- **Healthy - 3**
- **Needs maintenance review - 2**
- **Needs attention - 1**
- **Needs immediate attention - 0**

If two equipment are in the healthy mode, 1 is in Needs maintenance review mode and 1 is in Needs attention mode then he health score will be calculated by averaging the total score.

In this case = 3 + 3 + 2 + 1 / 12 = 0.75 = **75 is the health score**

Remaining Useful Life:

Table C.1 RUL Representation on Dashboard

Fault Stage	Predicted RUL in hours	RUL Representation on Dashboard
Stage 1	NA	Percentage
Stage 2	NA	Percentage
Stage 3	>750	Percentage
	<750	Hours
Stage 4	>750	Percentage
	<750	Hours
Note 1	By NA for Stage 1 and Stage 2, it means the RUL will be represented in percentage regardless of the value of predicted RUL in hours.	
Note 2	Two factors are taken into consideration for RUL calculation: Absolute Amplitude and Relative Amplitude Increasing Trend.	
Note 3	750 hours is around one month, being treated as the boundary to have RUL in percentage or in hours.	
Note 4	When the RUL is represented in hours, immediate action with a field check is needed as the increasing trend in detected fault amplitude would be significant.	
Note 5	When the RUL is represented in percentage, continuous monitoring is needed without immediate action with field check as the detected fault amplitude would be relatively flat.	
Note 6	Variance in RUL is only applicable to RUL representation in *hours*, indicating the variance/accuracy of predicted RUL. RUL in *percentage* has no variance because of the straightforward calculation of (current Amp)/(Stage 4 Amp Threshold)	

17. Appendix D: Fault Amplitude Stage Thresholds

Below info is also available on dashboard under the “info” button 

We have developed a comprehensive condition-based maintenance program incorporating predictive maintenance to detect fatigue wear, breakage and deterioration of any rotating equipment with Industrial Internet of Things technology. Our mature algorithm provides not only indications of any deterioration in a rotating equipment, but also an evaluation of the severity and recommendations for when corrective actions should be taken on rotating equipment components as per ISO-10816 and ASNT Standards.

Based on the comprehensive signal processing and transfer learning techniques, fault severity is analyzed and trended subject to ASNT standards with proper severity stage categorization by our algorithm. Various health summary metrics in the dashboard are linked to the fault severity as mentioned in the following table:

Fault Severity	Remaining Useful Life	Health Status	Fault	Suggestion
lower than stage 2	>75%	Healthy	Not Available	None
stage 2	>50%	Healthy	Not Available	None
stage 2 & fault anomaly detected*	>50%	Needs maintenance review	Applicable fault	Review maintenance plan and parts availability
stage 3	>750 hours	Needs maintenance review	Applicable fault	Review maintenance plan and parts availability
stage 3	251-750 hours	Needs attention	Applicable fault	Schedule maintenance activity
stage 3	<250 hours	Needs immediate attention	Applicable fault	Repair immediately
stage 4	0	Needs immediate attention	Applicable fault	Repair immediately

*fault anomaly detected: fault amplitude data exceeds NanoAI Amplitude threshold

The following quotes from ASNT standards are used to categorize fault severity stages: Bearing wear stage for single highest bearing fault frequency harmonic amplitude (mm/s peak) vs shaft rotational speed

Note: If feedback is provided to the specific notification through the notification log and the selected maintenance type has “Reset Fault Detection” activated, then all data till that time will be discarded and learning will be restarted.

RPM	Stage 1	Stage 2	Stage 3	Stage 4
900	0.826	1.651	3.429	6.858
1200	0.889	1.778	3.556	7.112
1800	1.016	2.032	4.064	8.128
3600	1.27	2.54	5.08	10.16

We extract a wide range of features such as rms and kurtosis from raw data, amplitudes of fault-related frequencies from FFT and Hilbert transform, and RPM extraction algorithm with satisfactory accuracy to determine the current severity and to predict the remaining time to maintenance so as to better serve our clients. Available historical data and run to failure test data are also employed to further improve the performance of our algorithm. Our condition monitoring industry experts are working together with our algorithms to provide tailor-made solutions to our clients.

For further help and clarification,Contact us

Adaptive fault amplitude threshold

- Threshold is automatically updated based on the real data
- Al trained model is used to capture the features of data
- Threshold will be lifted if fault is above stage 3, yet amplitude is flat (to avoid false positives)
- Updated threshold will be used for fault detection & RUL calculation with new data