Nanoprecise

Prediction with Precision

User Manual

Notification

Nanoprecise
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Summary of Notification Types, Email Subjects and Priority

Source	Notification Type	Notification Email Subject	Notification → Priority → Action
Notifications from Cloud Computation	Notifications on Health Status Summary and Remaining Useful Life (RUL)	🔴 LATE-STAGE FAULT: Attention is required for your equipment Fault mode trend stage alarm	Action priority based on Health Status
	Notification by Condition intelligence	🔄 [CI Alert] "Equipment Name" – Shift Detected	Critical Multivariant Condition Intelligence - HIGH Review data and inspect equipment
	Notification by NanoAI Alarm	🟡EARLY-STAGE FAULT: NanoAI Amplitude Alarm	MEDIUM → Review data monitor
		🟡ANOMALY DETECTED: NanoAI RMS Alarm	LOW → Review data to validate changes
		🟡 ANOMALY DETECTED: NanoAI Peak Alarm	LOW → Review data to validate changes
		ANOMALY DETECTED: NanoAI Sound RMS Alarm	LOW → Review data to validate changes
	Notification by Email Alarm	🟡 CAUTION: Level Alarm - User Set Alarm threshold on different trends	Alarm → HIGH → User defined Warning → MEDIUM → User Defined Pre-warning → LOW → User Defined
	Grouped Notification	Daily Alarm Notification	LOW → Review data to validate changes
	Sensor Operational Status Notification	Please conduct connectivity/battery check for the following sensors	Sensor offline >4days → MEDIUM → Troubleshoot sensors
		Saturated Sensor Detected: Acc Peak within 5% of max level of sensor range	Sensor Saturated → MEDIUM → Troubleshoot sensors
		Last Running Difference > 24h	MEDIUM → Check sensors installation or running not running setup
Notification from Sensor Edge	Notification on Real-Time Anomaly Detection by Edge Computing	🟡 CAUTION: Sensor Notification	Anomaly from sensor edge → MEDIUM → Review data to validate changes

Late Stage Fault based on Health Status and Remaining Useful Life (RUL)

When any of the monitored fault stages are above stage 3, this type of notification will be triggered. The e-mail notification subject is "🔴 LATE-STAGE FAULT: Attention is required for your equipment" with the following information included in the email:

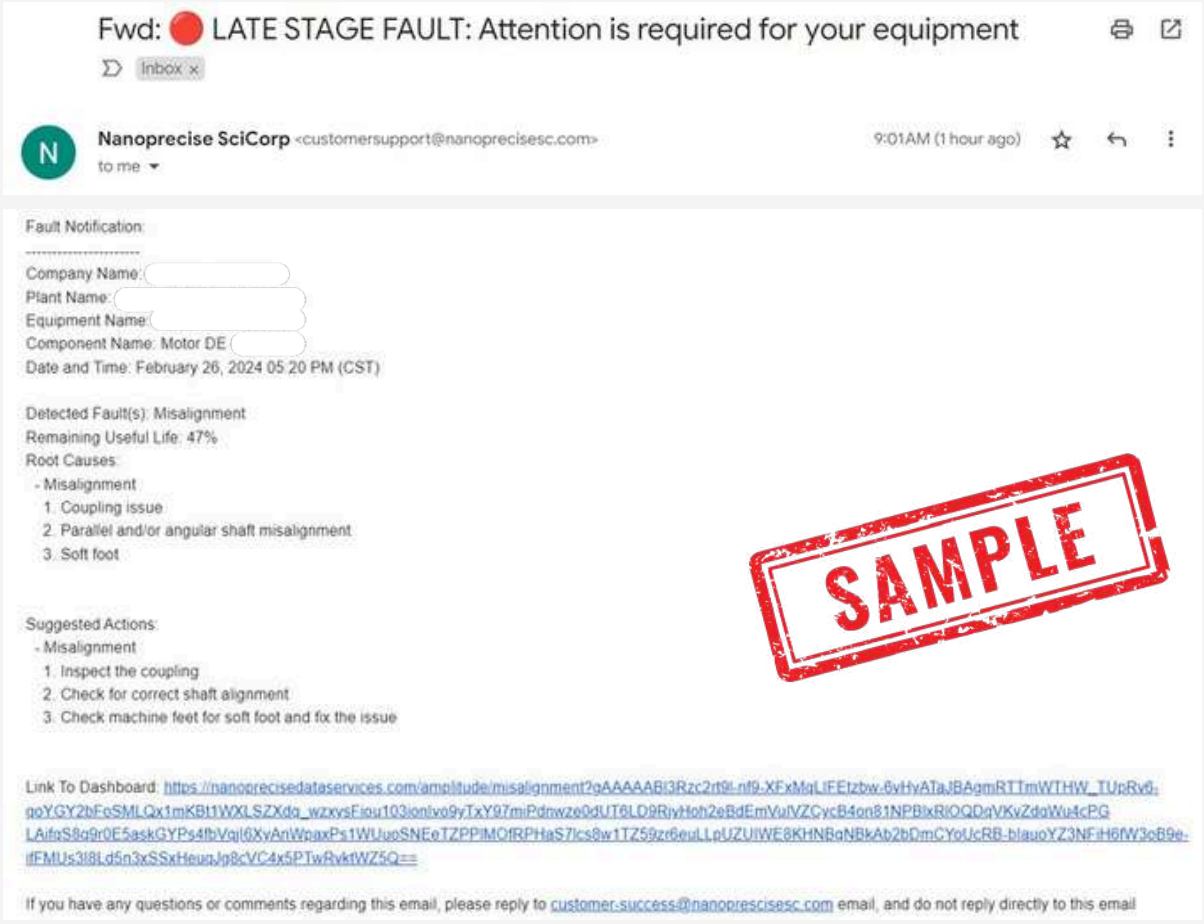
- Company Name, Plant Name, Machine Name (If it exists), Equipment Name, Component Name
- Date & Time
- Detected Fault(s)
- Remaining Useful Life
- Potential Root Causes
- Suggested Actions
- Link to Dashboard

The notification informs current Health Status and predicted RUL, subject to trend analysis on historical data. The notification is sent from our CDP (Core Data Processor) via cloud computing.

To achieve this type of notification, two relevant aspects are covered as below:

- Notification Strategy for timely notifications. Algorithm for Self-Adaptive
- Fault Stage 4 Threshold to avoid false positives

A sample of the email notification is shown below



Fwd: LATE STAGE FAULT: Attention is required for your equipment

Inbox ×

Nanoprecise SciCorp <customersupport@nanoprecisesc.com> 9:01AM (1 hour ago)

to me

Fault Notification:

Company Name:

Plant Name:

Equipment Name:

Component Name: Motor DE

Date and Time: February 26, 2024 05:20 PM (CST)

Detected Fault(s): Misalignment

Remaining Useful Life: 47%

Root Causes:

- Misalignment
  1. Coupling issue
  2. Parallel and/or angular shaft misalignment
  3. Soft foot

Suggested Actions:

- Misalignment
  1. Inspect the coupling
  2. Check for correct shaft alignment
  3. Check machine feet for soft foot and fix the issue

SAMPLE

Link To Dashboard: https://nanoprecisedataservices.com/amplitude/misalignment?gAAAAABi3Rzc2rt9l-nf9-XFxMqLIFEtzbw-6vHyATaJBAgmRTTmWTHW_TUpRv6-qoYGY2bFoSMLQx1mKBt1WXLSZXdg_wzxysFjou103ionlvo9yTxY97miPdnwze0dUT6LD9RjyHoh2eBdEmVuIVZCycB4on81NPBlxRlOQDqVKvZdqWu4cPG-LAifqS8g9r0E5askGYPs4fbVqjl6XyAnWpaxPs1WUuoSNEeTZPPIMOfRPHaS7lcs8w1TZ59zr6euLLpUZUlWE8KHNBqNBkAb2bDmCYoUcRB-blauoYZ3NFiH6fW3cB9e-fFMUs3l8Ld5n3xSSxHeuqJg8cVC4x5PTwRvktWZ5Q==

If you have any questions or comments regarding this email, please reply to customer-success@nanoprecisesc.com email, and do not reply directly to this email

Late-Stage Fault

- **Fault Amplitude Trends are individual component fault modes based on technical data**
- **→ Speed, Bearings, Vanes, Blades, Pistons, Gears, Rotor bars, ...**
- **Triggered by Fault Amplitude Trend Smooth AMP**
- **Threshold Initially based on ISO and ASNT**
- **Self-Adaptive Thresholds or User set**

Different Health Status vs Priority

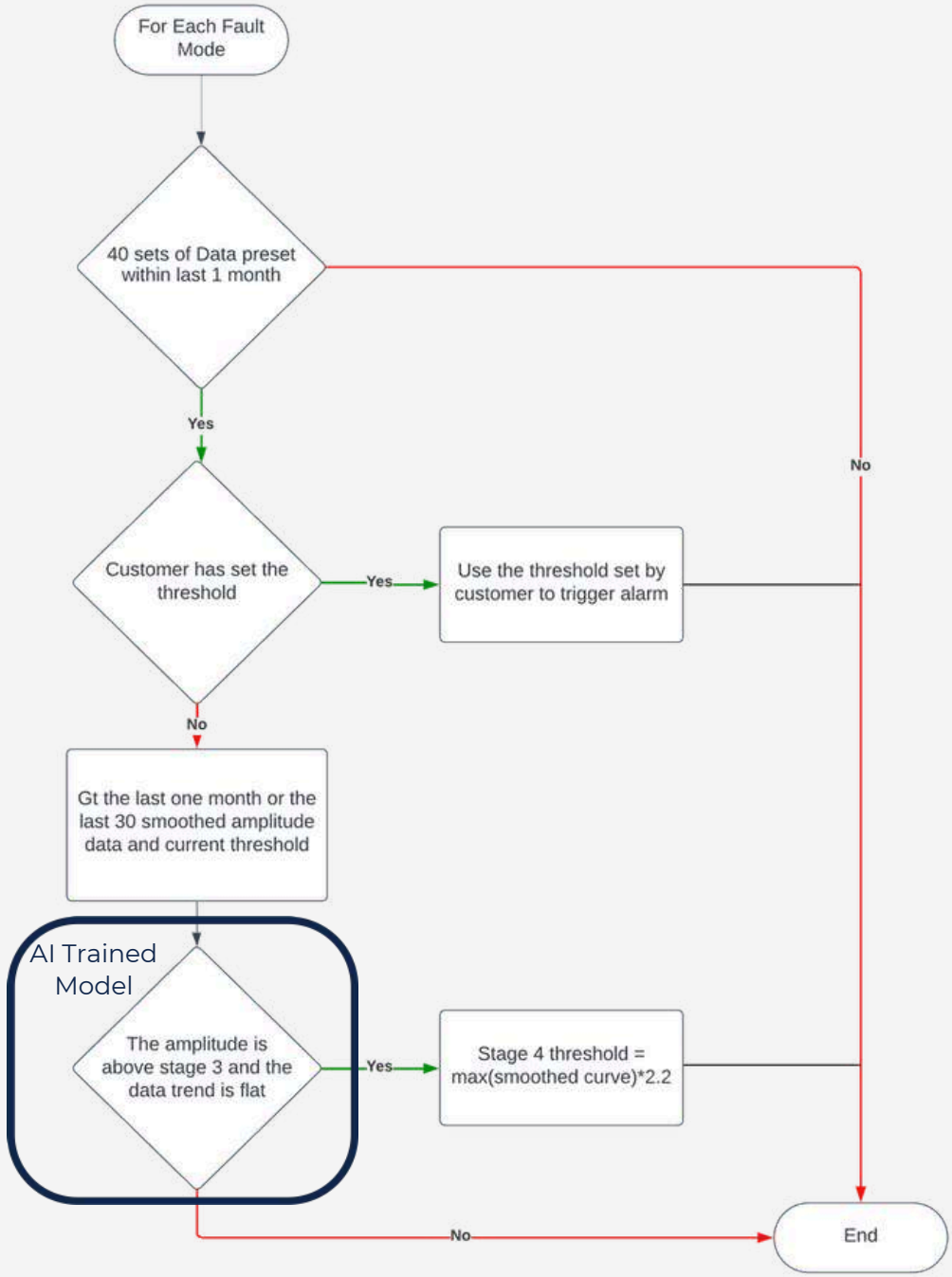
Fault Stage	RUL (Hours)	Health Status	Priority of Action	Alarm Frequency
Stage 4	RUL=0	Needs Immediate Attention	Review with HIGH Priority and Action Immediately	7 Days
Stage 3	RUL <750	Needs Attention	Review with MEDIUM Priority and Plan Maintenance activity	7 Days
	RUL >750	Needs Maintenance Review	Review with MEDIUM Priority and Plan Maintenance activity	7 Days

Note that this type of notification is sent when the fault amplitude trend is above stage 3 or stage 4.

The alarm will return to healthy once all the active fault stages are below stage 3

The RUL will be shown in percentage when RUL>750 hours.

Algorithm for Self-Adaptive Fault Stage 4 Threshold



No	Notes
1	The underlying logic behind the self-adaptive flowchart for adaptive fault amplitude stage 4 threshold: • Different equipment with different operational conditions may have different threshold values for fault stage 4. Threshold values based on • industrial standards/practices are only used as the initial threshold of fault stage 4. When the trend is flat while above stage 3, the equipment is • treated as running stable without a need for immediate attention. Thus, the stage 4 threshold value will be increased adaptively to avoid false positives.
2	The fault stage 4 threshold is re-evaluated by the algorithm every 3 days
3	With this adaptive threshold value, we can avoid false positives while not missing the increasing trend
4	Updated threshold will be used for fault detection and RUL calculation for the new data
5	When the fault stage is above stage 3 and the predicted RUL is smaller than 750Hours, the RUL is shown in hours. Otherwise, it is shown in percentage, i.e., the percentage of current fitted amplitude over the stage 4 threshold.

Representing Remaining Useful Life (RUL)

The Remaining Useful Life (RUL) in the notification is given either in percentage or in hours, by considering both the absolute amplitude values and the relative amplitude trend.

- **Absolute Amplitude Values: Determining whether it is above or below Stage 3 Relative Amplitude Trend: Determining whether it is increasing**
- **or not**
  - **If the trend is flat, even though its absolute value is beyond Stage 3, the predicted RUL to reach Stage 4 would still be very large**
  - **Otherwise, the increasing trend would lead to a short-predicted RUL to reach Stage 4.**

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	= 0	Hours

SL No	Notes
1	For Stage 1 and Stage 2, the RUL will be represented in percentage regardless of the value of predicted RUL in hours as the fault severity is very early stage.
2	750 hours is around one month, which is treated as the boundary to have RUL in percentage or hours.
3	When the RUL is represented in hours, immediate action with field check is needed as the increasing trend in detected fault amplitude would be significant
4	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.

Condition Intelligence (CI) Notifications

How it works:
CI uses a multivariate approach powered by AI. It monitors over 18+ vibration-related parameters simultaneously, learning what's normal for each asset and flagging only significant deviations. Key elements of CI:

- Multivariate Analysis: Detects correlated changes, not isolated spikes
- Adaptive Learning: Continuously refines baselines as machine behavior evolves
- Edge + Cloud Detection: Captures real-time anomalies and long-term trends
- Smart Notifications: Prioritized alerts based on severity and operational impact

This dual-layered system ensures that both gradual wear and sudden failures are detected with the right level of urgency.

From: NANOPRECISE DATA SERVICES <notifications@nanoprecisesc.com>
Subject: 🔄 [CI Alert] "Equipment Name" – Shift Detected

Condition Intelligence Notification – Immediate Review Needed for Pump XYZ
Company: MyCompanyABC
Plant: Houston Plant
Equipment: Pump XYZ
Component: Motor Alpha
Date & Time: April 27, 2025 08:43 PM (PST)

Detected Changes on Motor DE:
Velocity RMS resultant: Absolute Change 0.8 mm/sec (17.33%)
Acceleration RMS resultant: Absolute Change 1.73 g (135.07%)
Acceleration Peak resultant: Absolute Change 4.96 g (80.6%)

Link to Detected Changes Link to Dashboard
This change indicates a potential shift in machine health. Immediate action is recommended to prevent potential failures.

Next Steps:
Review the Equipment Health Link to Dashboard to assess the impact.
Access diagnostics for detailed trend analysis.

If you need further support, please reach out to your account team or contact customersuccess@nanoprecise.com.

NanoAI Notifications

The NanoAI Alarm system is engineered to meticulously monitor RMS/Peak/Amplitude/Sound levels across all sensors, activating notifications when these metrics surpass the NanoAI thresholds. This sophisticated algorithm scans the sensors continuously, with an option to adjust the system to accommodate for different scenarios (see Alert settings on Page 12 for more info). This flexibility aims to refine the notification process, ensuring users are alerted to significant changes while minimizing unnecessary alerts. Notifications are typically triggered under two principal scenarios:

- Equipment degradation, evidenced by an increasing trend in RMS/Peak/Amplitude/Sound levels.
- Anomalies characterized by sporadic instances of significantly high RMS/Peak/Amplitude/Sound values.

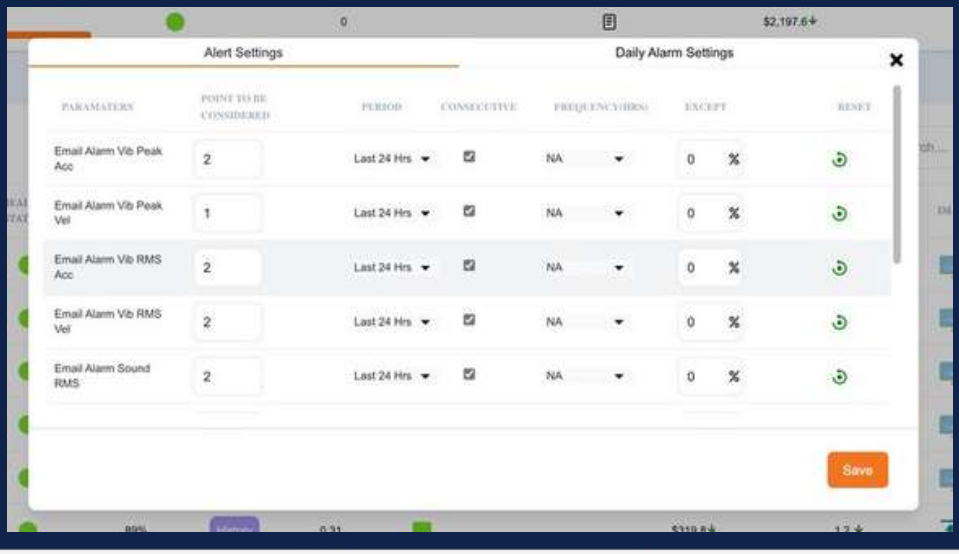
In such Notification email, the email subject is either "🟠 ANOMALY DETECTED: NanoAI RMS Alarm", "🟠ANOMALY DETECTED: NanoAI Peak Alarm", "🟠EARLY-STAGE FAULT: NanoAI Amplitude Alarm" & "🟠CAUTION: Level {Alarm type} - RMS reached threshold" (NanoAI Sound Alarm) with the following information included in the notification:

- Company Name, Plant Name, Machine Name (if used), Equipment Name, Component Name
- Current RMS/Peak/Amplitude/Sound value
- NanoAI RMS/Peak/Amplitude/Sound Alarm threshold value
- Date & Time
- Severity (for NanoAI amplitude alarm)
- Link to Dashboard

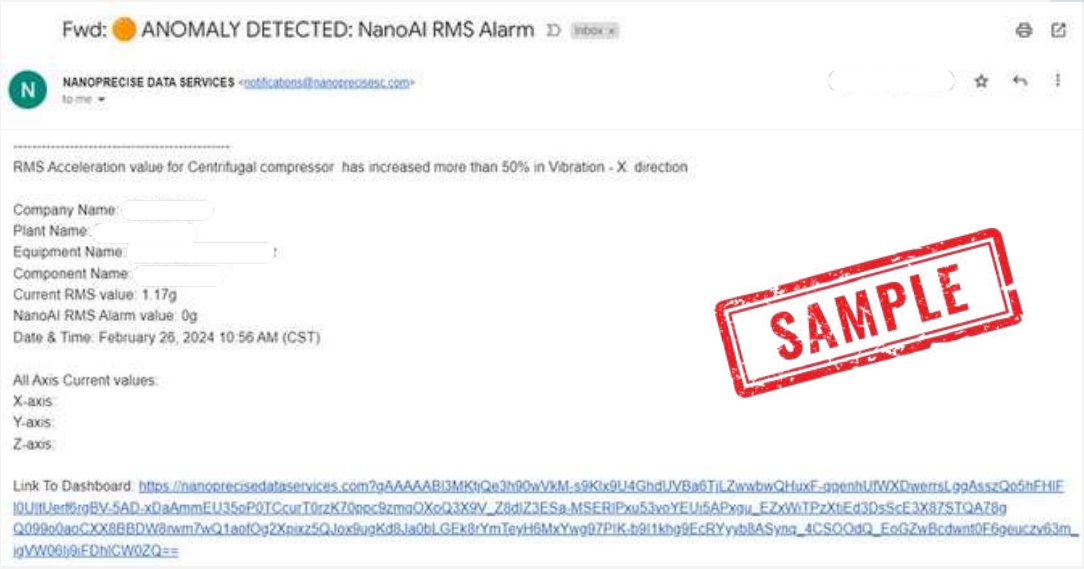
Alert settings

To further enhance this system, users can use the "Alert Setting" functionality. This feature allows users to customize the conditions under which NanoAI triggers an alert, offering granular control over the monitoring process. Below are Key components of this functionality:

- Users can specify a number of points (X), either consecutive or non-consecutive, that need to exceed the threshold within a given time frame to trigger an alert. This allows for tailored sensitivity settings, accommodating different monitoring needs.
- Users can define the period within which the X points should occur to be considered for an alert. This period could range from hours to days, offering flexibility in temporal monitoring resolution.
- The frequency setting allows users to determine how often (in days) the system re-evaluates conditions for triggering new alerts. This helps in managing the volume of notifications and focusing on the most relevant alerts.
- The except percentage setting defines the percentage with which the initial threshold will be increase to monitor for any changes after the initial notification is send and within the repeat time period. This to assure if the condition keeps worsening after first notification an additional notification will be send to alert user.



Samples of the email notifications are shown below:



Fwd: ANOMALY DETECTED: NanoAI RMS Alarm

NANOPRECISE DATA SERVICES <notifications@nanoprecisesc.com>

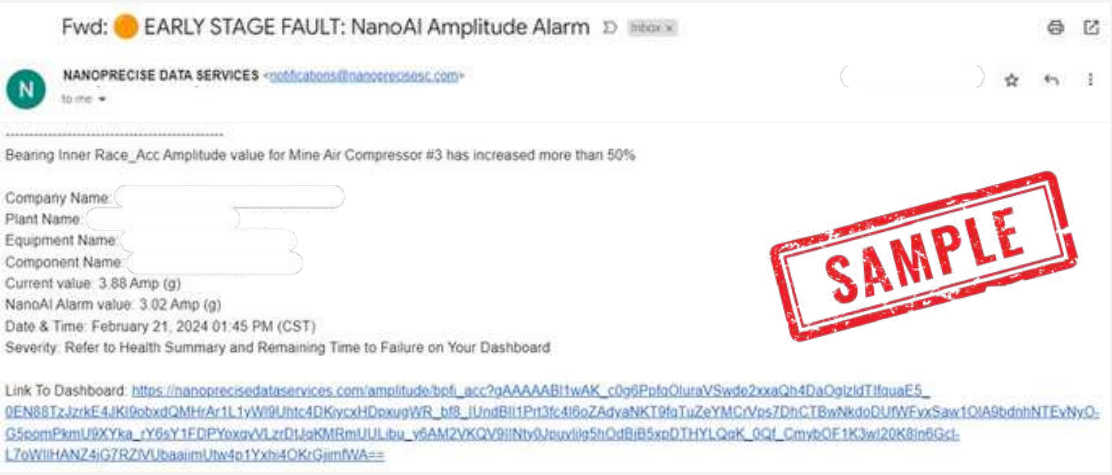
RMS Acceleration value for Centrifugal compressor has increased more than 50% in Vibration - X direction

Company Name:
Plant Name:
Equipment Name:
Component Name:
Current RMS value: 1.17g
NanoAI RMS Alarm value: 0g
Date & Time: February 26, 2024 10:56 AM (CST)

All Axis Current values:
X-axis:
Y-axis:
Z-axis:

Link To Dashboard: https://nanoprecisedataservices.com?gAAAAABl3MKtjQe3h90wVkM-s9Kix9U4GhdUVBa6TiLZwwbwQHuxF-qgenhUfWXDwerrsLggAsszQo5hFHIFl0UltUetf6rgBV-5AD-xDaAmmEU35oP0TCcurT0rzK70ppcBzmqOXoQ3X9V_Z8dlZ3ESa-MSERtPxu53voYEUi5APxgu_EZxWiTPzXtEd3DsScE3X87STQA78gQ099o0aoCXX8BBDW8rwm7wQ1aofOg2Xpixz5QJoxfugKd8Ja0bLGEk8rYmTeyH6MxYwg97PIK-b9l1khg9EcRYyvb8ASyng_4CSOOdQ_EoGZwBcdwnt0F6geuczv63m_igVW06lj9iFDhlCW0ZQ==

SAMPLE



Fwd: EARLY STAGE FAULT: NanoAI Amplitude Alarm

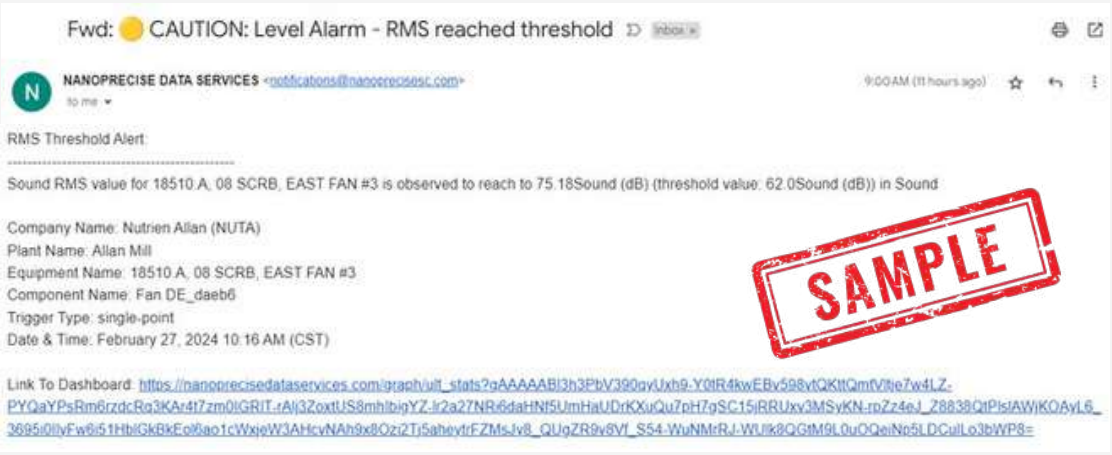
NANOPRECISE DATA SERVICES <notifications@nanoprecisesc.com>

Bearing Inner Race_Acc Amplitude value for Mine Air Compressor #3 has increased more than 50%

Company Name:
Plant Name:
Equipment Name:
Component Name:
Current value: 3.88 Amp (g)
NanoAI Alarm value: 3.02 Amp (g)
Date & Time: February 21, 2024 01:45 PM (CST)
Severity: Refer to Health Summary and Remaining Time to Failure on Your Dashboard

Link To Dashboard: https://nanoprecisedataservices.com/amplitude/bpfi_acc?gAAAAABl1wAK_c0g6PpfqOluraVSwde2xxaQh4DaOgIzIdTIfquaE5_0EN88TzJzrkE4JKl9obxdQMHrAr1L1yWl9lUhtc4DKiycxHDpxugWR_bf8_fUndBll1Prt3fc4l6oZAdyaNKT9fqTuZeYMCrVps7DhCTBwNkdoDUfWFvxSaw1OlA9bdnhNTEvNyO-G5pomPkmU9XYka_rY6sY1EDPYoxgvVLzrDtJqKMRmUULibu_v6AM2VKQV9llNty0JpuvIig5hOdBiB5xpDTHYLQqK_0Qf_CmybOF1K3wI20K8in6Gcl-L7oWIlHANZ4jG7RZlVUbaajimUtw4p1Yxhi4OKrGjimfWA==

SAMPLE



Fwd: CAUTION: Level Alarm - RMS reached threshold

NANOPRECISE DATA SERVICES <notifications@nanoprecisesc.com> 9:00 AM (11 hours ago)

RMS Threshold Alert

Sound RMS value for 18510.A, 08 SCRB, EAST FAN #3 is observed to reach to 75.18Sound (dB) (threshold value: 62.0Sound (dB)) in Sound

Company Name: Nutrien Allan (NUTA)
Plant Name: Allan Mill
Equipment Name: 18510.A, 08 SCRB, EAST FAN #3
Component Name: Fan DE_daeb6
Trigger Type: single-point
Date & Time: February 27, 2024 10:16 AM (CST)

Link To Dashboard: https://nanoprecisedataservices.com/graph/ult_stats?gAAAAABl3h3PbV390gyUxh9-Y0tR4kwEBv598vtQKttQmfVtje7w4LZ-PYQaYPsRm6rzdcRq3KAr4t7zm0tGRiT-rAlj3ZoxtUS8mhlbigYZ-lr2a27NRi6daHNf5UmHaUDrKXuQu7pH7gSC15jRRUxv3MSyKN-rpZz4eJ_Z8838QtPlsIAWjKOAyL6_3695i0IlvFw6i51HbIGkBkEol6ao1cWxjeW3AHcvNAh9x8Ozi2Tj5aheytrFZMsJv8_QUgZR9v8Vf_S54-WuNMrRJ-WUlk8QGtM9L0uOQeiNp5LDCulLo3bWP8=

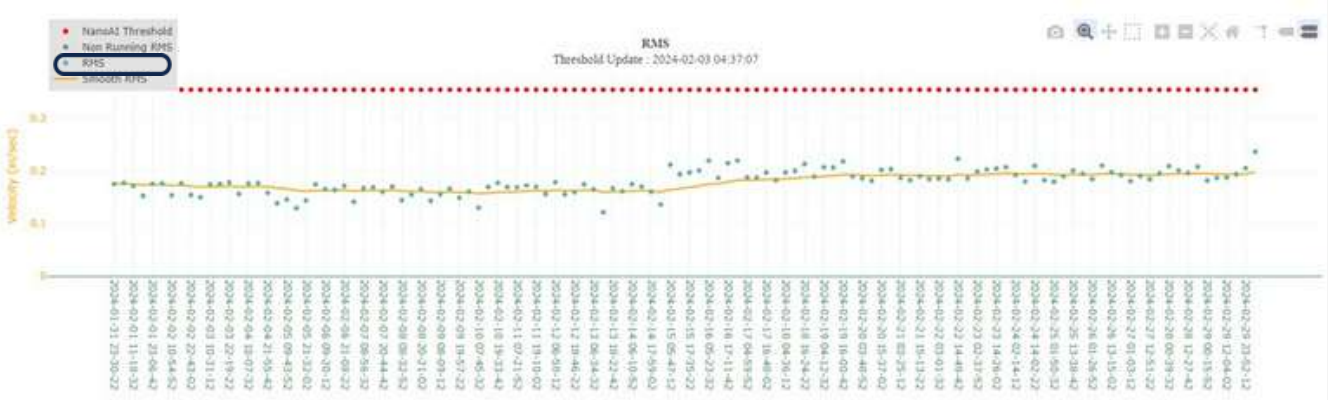
SAMPLE

Nano AI Trigger

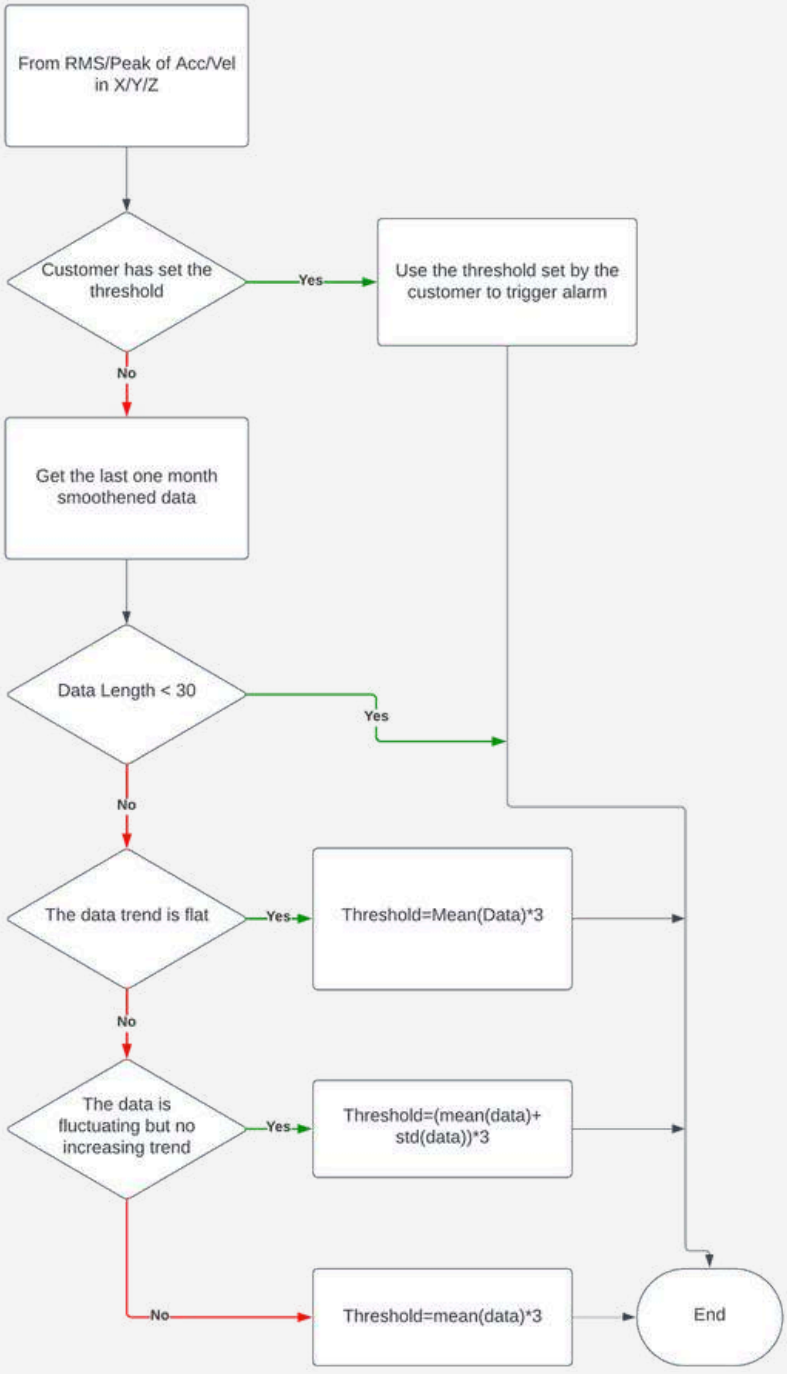
Anomaly Detected

- **RMS/Peak Or Sound Trends are Overall trends from entire Freq range**
- **Triggered by individual measurement points (example: RMS)**
  (possible logic: X > threshold in Y time, consecutive or not)
- **NanoAI = Self-Adaptive Threshold**

Priority → LOW, review data to validate changes

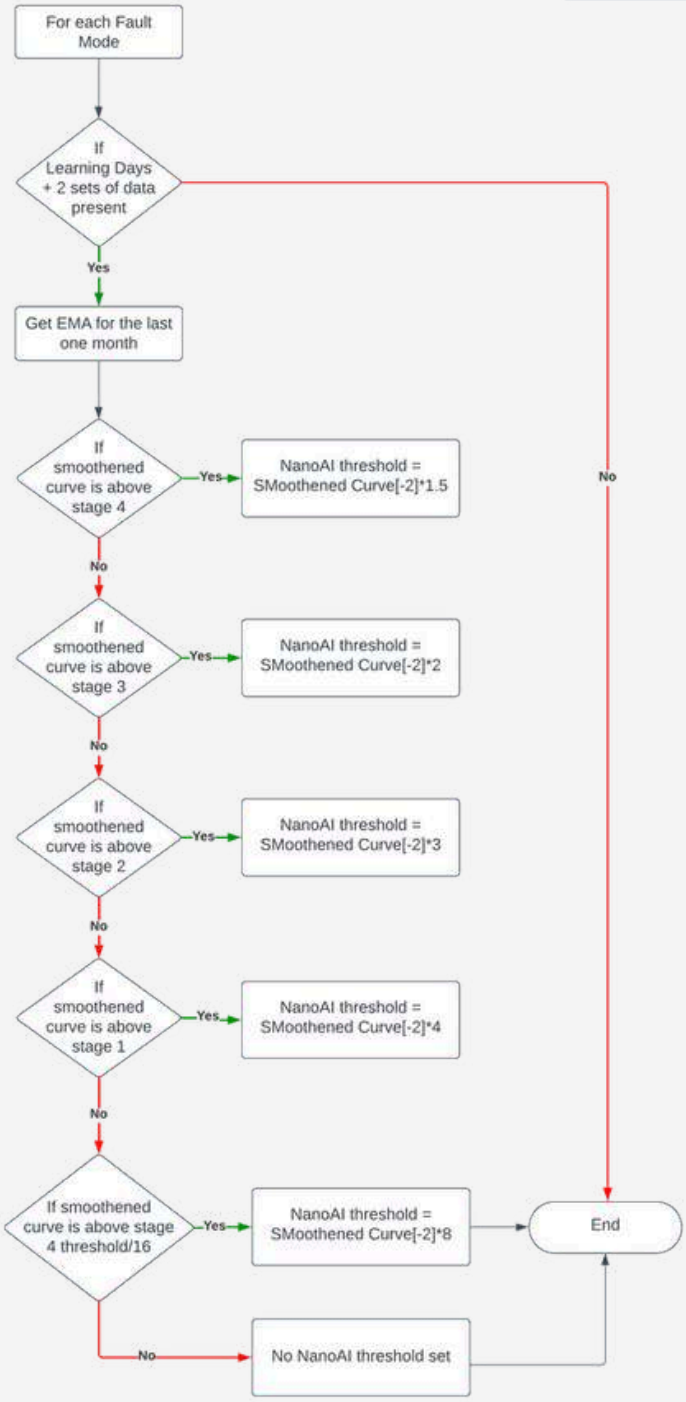


NanoAI RMS Alarm and NanoAI Peak Alarm



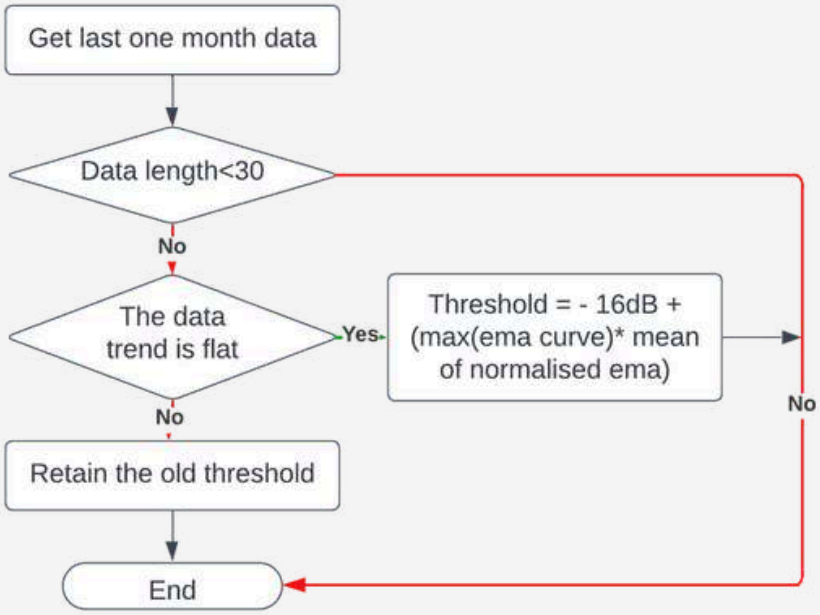
SL No	Notes
1	The NanoAI alarm threshold applies to vibration RMS/ peak in Acceleration and vibration RMS in Velocity.
2	The threshold is automatically updated based on one-month historic data by the AI-trained model.
3	No pre-knowledge is required from the customer.
4	Alarms will be automatically sent to the customer if the latest RMS/Peak passes the threshold during the scan.
5	For each sensor, the number of notifications on the NanoAI alarm RMS/Peak would be one per week.
6	If feedback is provided to a notification indicating a repair was made, the adaptive threshold will only consider data after the timestamp of the repair
7	For RPM<300, the threshold multiplication factor is 2
8	For NanoAI RMS alarm to be applied for the components with RPM>300, the system assumes that the vibration g rms over the past 30 days has a mean value greater than 1g/3 in at least 2 directions. Otherwise, the threshold will not be applied.

NanoAI Amplitude Alarm



Notification Subject	First Notification Time	Second notification time if the fault/anomaly is still detected for the same equipment/component
ANOMALY DETECTED: NanoAI RMS Alarm	Within 15 mins after receiving the data	The repeat frequencies are based on alert setting manageable on dashboard by super admin
ANOMALY DETECTED: NanoAI Peak Alarm	Within 15 mins after receiving the data	The repeat frequencies are based on alert setting manageable on dashboard by super admin
EARLY-STAGE FAULT: NanoAI Amplitude Alarm	Within 15 mins after receiving the data	The repeat frequencies are based on alert setting manageable on dashboard by super admin

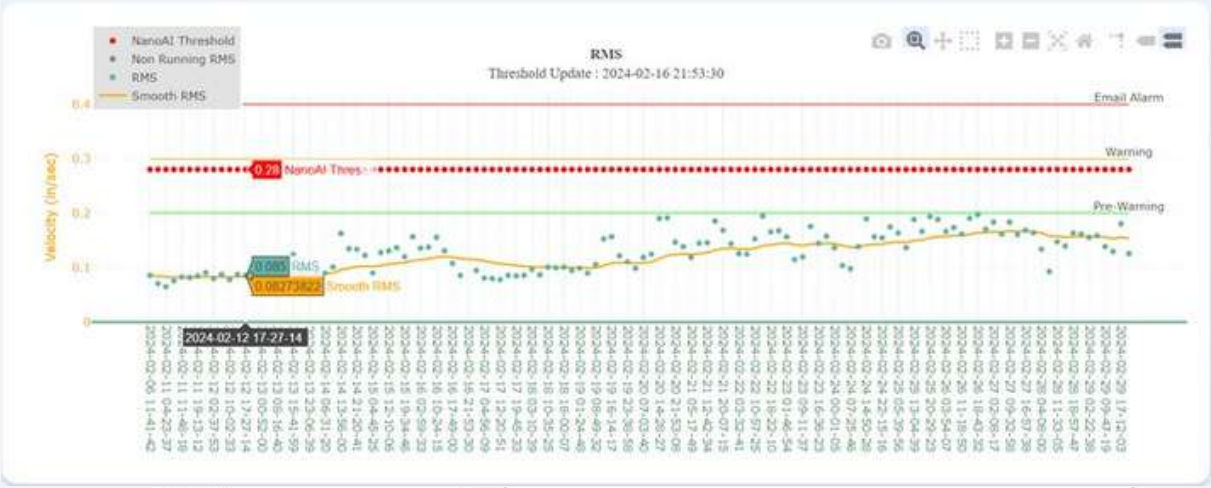
NanoAI Sound Alarm

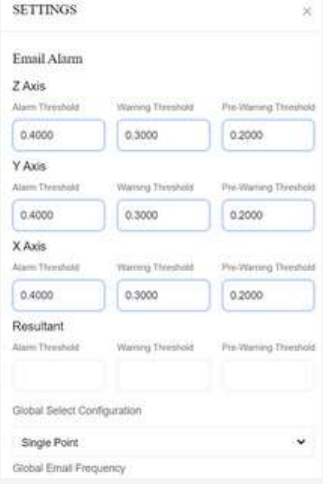


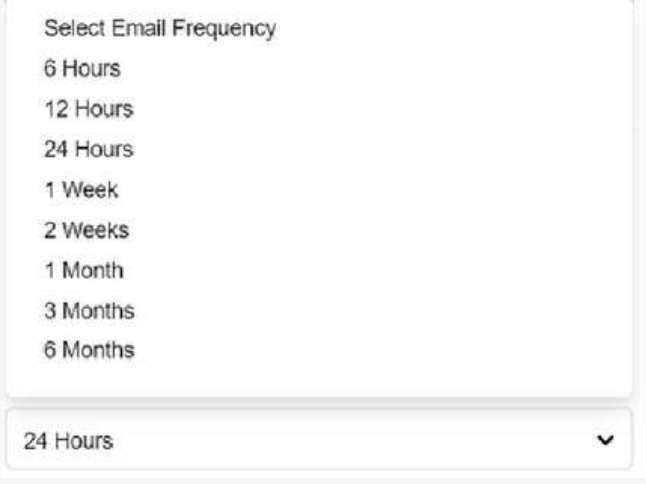
Notification Subject	First Notification Time	Second notification time if the fault/anomaly is still detected for the same equipment/component
ANOMALY DETECTED: NanoAI Sound RMS Alarm	Within 15 mins after receiving the data	The repeat frequencies are based on alert setting manageable on dashboard by super admin

Notification by Email Alarm

The Email Alarm on the dashboard allows customers to set customized threshold values on Vibration RMS, Vibration Peak (in acceleration, velocity, and displacement), Sound RMS, Humidity and Temperature. Customers can easily set the Email Alarm by clicking "EMAIL ALARM" and entering threshold value & Email Frequency, as demonstrated in the second screenshot below. Additionally, it is important to note that the alert settings (Page 12) will also apply to the Email Alarm, ensuring a seamless integration of preferences across the platform.







The notification is triggered once the latest RMS/Peak/Temperature value is above email threshold based on alert settings.

In such Notification email, the email subject is either "🟠 CAUTION: Level {Alarm type} - Peak /RMS reached threshold" or "🟠 CAUTION: Level {Alarm type} - Temperature reached the threshold". For Vibration Peak/RMS, Sound RMS, and temperature, the Alarm type has three levels: -

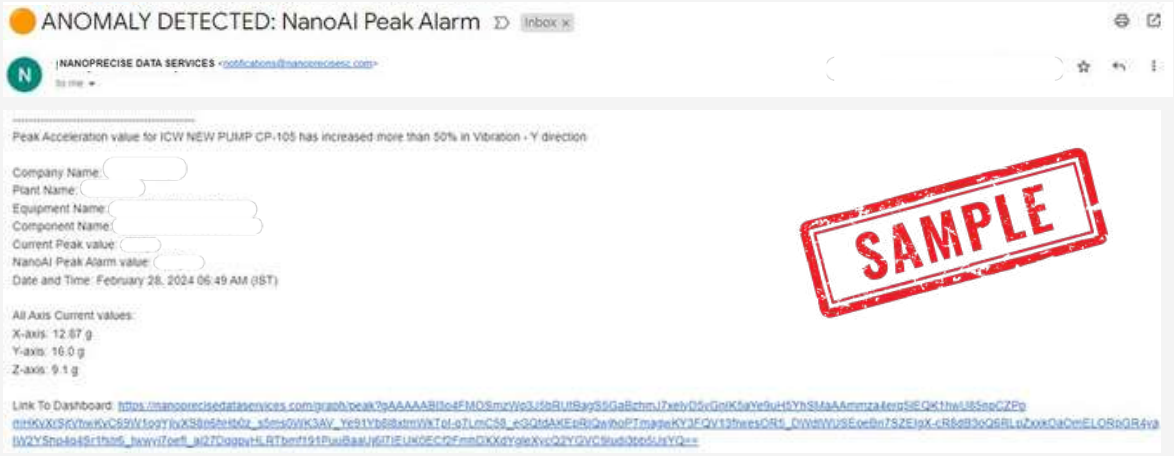
- Alarm (High priority)
- Warning (Moderate priority)
- Pre-warning (Low priority)
- The order is Alarm > Warning > Pre-warning

The notification email with the above-mentioned subjects will include the following information:

- (RMS (or Peak) (Acceleration/Velocity/Displacement) value for (Equipment) is observed to reach to (latest value) in Vibration direction
- Company Name; Plant Name; Equipment Name; Component Name
- Date & Time
- Link to Dashboard

The notification email with "🟠 CAUTION: Level {Alarm type} - Temperature reached the threshold" includes the same information except the first item would be "Temperature value for (Equipment) is observed to reach to (latest value)".

Samples of the email notifications are shown below:



Notification Subject	First Notification Time	Second notification time if the fault/anomaly is still detected for the same equipment/component
CAUTION: Level Alarm - Peak reached threshold	Within 15 mins after receiving the data	These repeat frequencies are based on the individual email setting
CAUTION: Level Pre-warning - Peak reached threshold		
CAUTION: Level Warning - Peak reached threshold		
CAUTION: Level Alarm - RMS reached threshold		
CAUTION: Level Pre-warning - RMS reached threshold		
CAUTION: Level Warning - RMS reached threshold		
CAUTION: Level Alarm - Temperature reached threshold		
CAUTION: Level Pre-warning - Temperature reached threshold		
CAUTION: Level Warning - Temperature reached threshold		

Sensor Notification

Nanoprecise provides an automatic sensor status check by verifying the saturated sensor, last running difference notification, and sensor uploading status, which includes battery voltage and connectivity parameters.

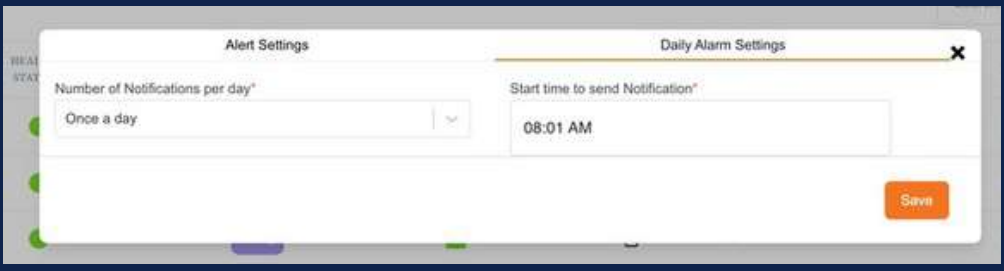
In case the sensor misses multiple uploads, a notification on Sensor Operational Status will be sent automatically with the following information:

- **Email subject**
- **Plant**
- **Equipment**
- **Component**
- **Link to Dashboard**

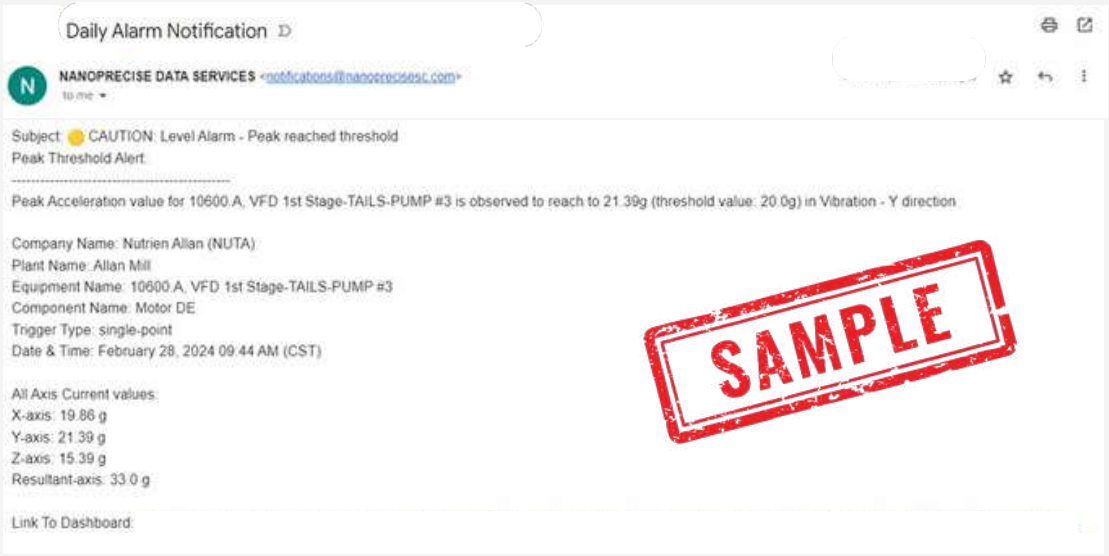
Detailed information is provided in the following Table:

Daily Alarm Notification

All notification also get summarized in a Daily Alarm Notification. The subject of this type of notification is "Daily Alarm Notification". This approach allows all notifications to be summarized into one comprehensive summary email, streamlining the flow of information. This consolidated format ensures that users are kept informed without the clutter of numerous individual alerts. Additionally, we offer the ability to manage the volume of daily alarm emails and the specific times they are dispatched, thanks to the alert settings options. This level of flexibility ensures that users receive pertinent information in a consolidated and timely manner, facilitating a streamlined and efficient monitoring process.



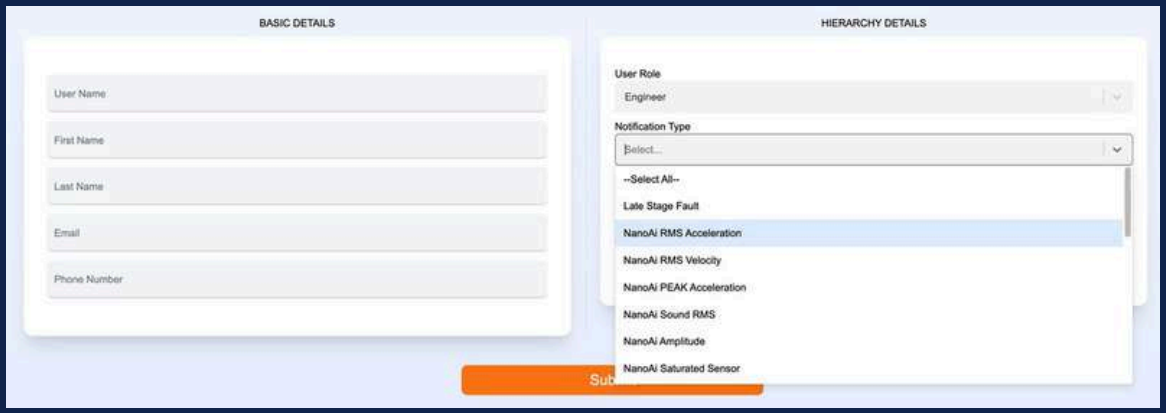
A sample of the email notification is shown below:

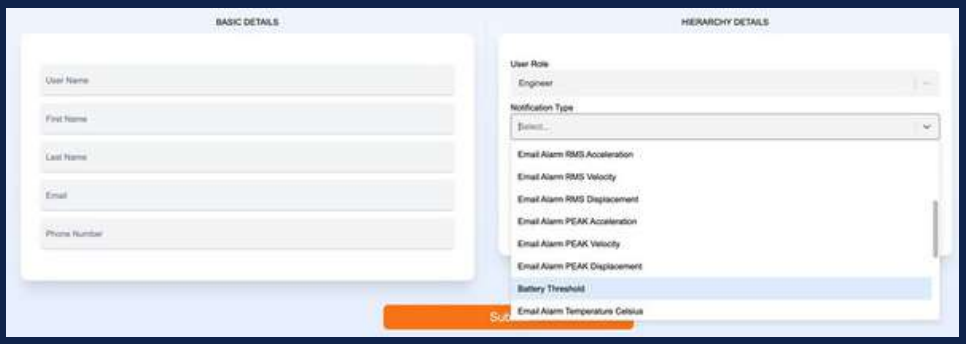


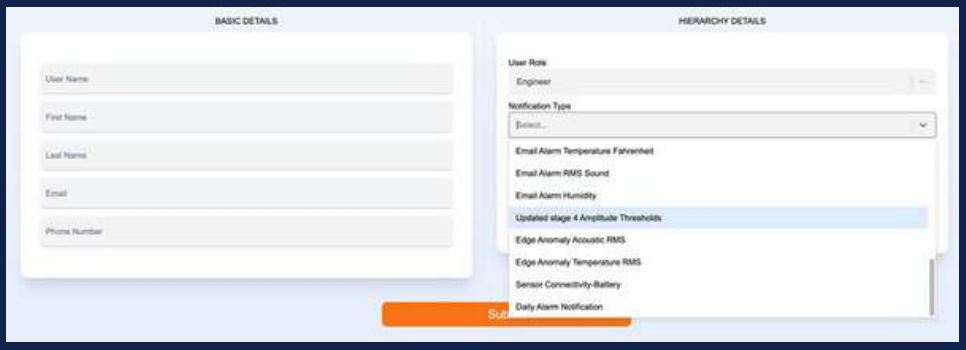
User Notification Management

Our system introduces advanced management capabilities specifically designed for user admins. This powerful feature set allows super-admins to curate the notification experience on a per-user basis, ensuring that each user receives only the most relevant information. Key aspects of this functionality include:

- **User-Specific Notification Management: With granular control over notification types, super-admins can ensure that every user receives notifications that are pertinent to their role, interests, or responsibilities. This customization capability ensures that notifications are not only timely but also relevant to each recipient, enhancing the overall efficiency and effectiveness of the monitoring process.**







This feature reinforces our commitment to providing a flexible and user-friendly experience. By empowering super-admins with the tools to manage notification preferences, we ensure that our system adapts to the unique needs of each organization, delivering relevant, timely information that drives informed decision-making and streamlined operations.

Notification from Real-Time Anomaly Detection by Edge Computing

Besides notifications sent from the RotationLF cloud on “long-term” historical data, Nanoprecise also provides real-time notifications from Sensor Edge. Sensor Edge takes measurements with a short time interval, e.g., 15 mins, and will perform anomaly detection on the edge to detect any sudden changes in the overall data.

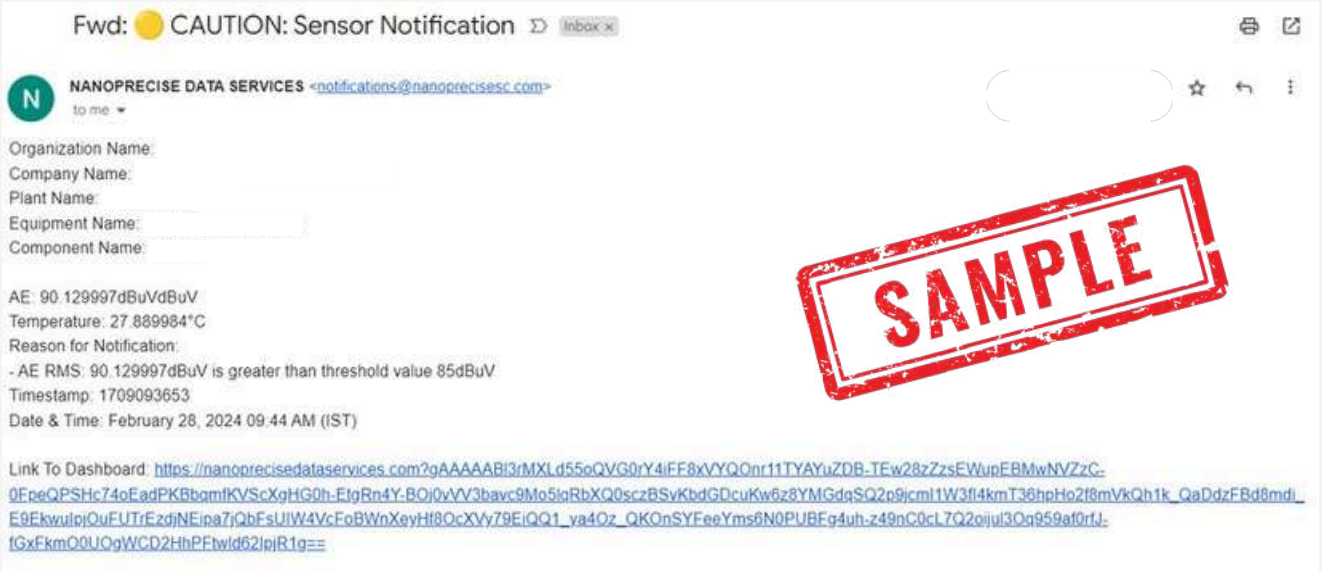
Sensor Edge Notification

- Sensor will perform Anomaly detection on ACC RMS, Sound RMS, or Temperature*
    - ACC RMS (*Only when activated)
    - Sound RMS Default threshold 85dB (*self adaptive based on >42dB running data)
    - Temperature Default Threshold 75C/167F (can be updated)
    - “under devop”: use NanoAI thresholds from dashboard on edge
- At the wake up interval of the sensors (between 30sec & 1 hour, default 15min)
- If Anomaly detected on edge
    - RAW data is captured
    - Upload is done
    - Notification triggered
    - If no anomaly data is stored and uploaded with regular upload

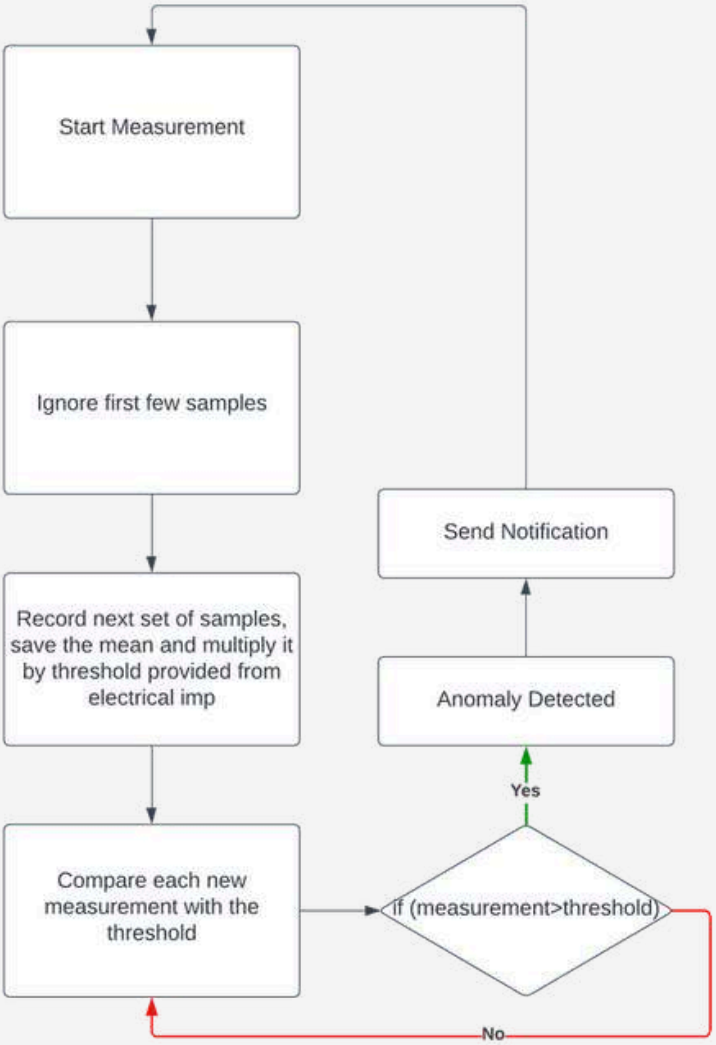
Priority → MEDIUM, Review data to validate changes

In the notification email shown below, the email subject is "🟠 CAUTION: Sensor Notification" Vibration, Acoustic Emission, and Temperature are covered by edge computing for real-time anomaly detection. Edge computing means the computation is done on the edge of the microprocessor of the Machine Doctor sensor.

Priority → MEDIUM, Review data to validate changes

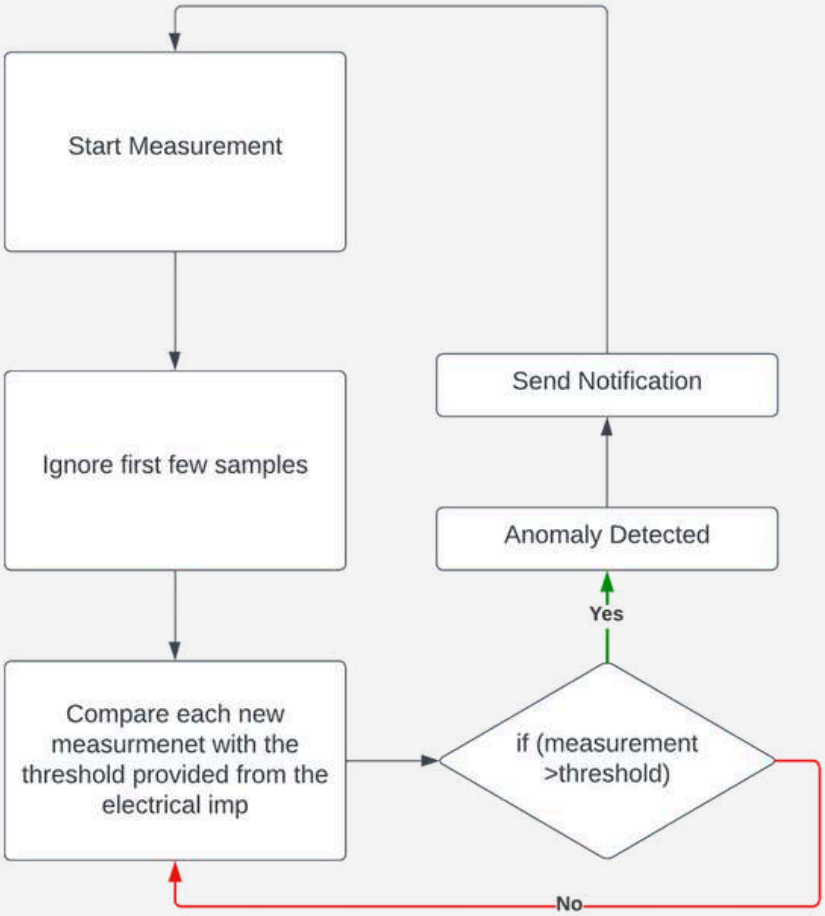


Anomaly Detection by Acoustic Emission on Edge



SL No	Notes
1	The threshold is automatically updated based on real data by algorithm
2	No pre-knowledge is required from the customer.

Anomaly Detection by Temperature on Edge



SL No	Notes
1	The default threshold value is 75 degrees Celsius or 167 degrees Fahrenheit
2	The default threshold value can be customized subject to the customer's request.