DynaPredict - Web Platform
DESCRIPTIVE MANUAL

Summary

1. Introduction

This document deals with the operation of the DynaPredict Web Platform, whose purpose is to make the DynaLoggers data collected by the App or Gateway available in the cloud, and to facilitate fault interpretation and diagnosis.

Throughout this manual will be presented and explained in detail the user interaction screens.
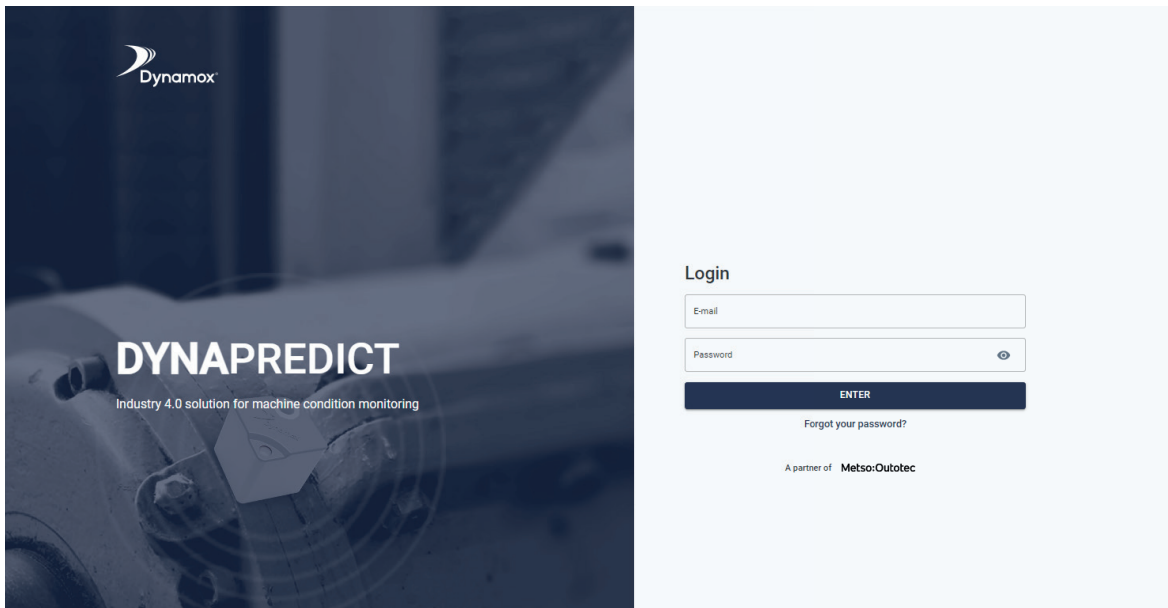
2. Platform Access

The access to the Web Platform is performed through the URL: https://dyp.dynamox.solutions.

Initially, the login screen will be displayed and the user must enter their access credentials to enter the Platform.

If you do not have access credentials, you can contact Dynamox directly, through the e-mail support@dynamox.net. If the user forgets his/her password, it is possible to reset it through the option "Forgot your password?" generating a link that will be sent to the registered e-mail.

Picture: User Authentication

After logging into the Web Platform, you must choose the workspace you want to access, based on the permissions assigned to the user.
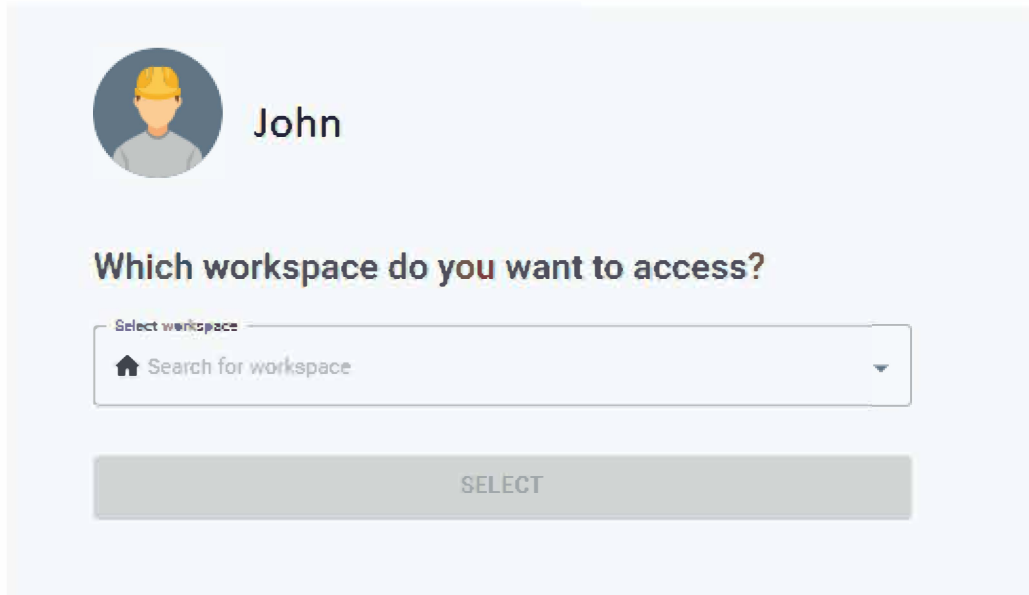
Picture: Workspace Selection

After selecting the workspace, the user will have access to the Web Platform and all its functionalities.

2.1 Home Screen and Main Menu

Immediately after logging in, at the top of all screens you will be able to view/hide the side menu, as well as the print commands, help, and language.

Picture: Available Options in all screens.

Currently, the Web Platform is available in Portuguese, English, Spanish, French and Korean.

When logging in, the first screen to be shown is the DMA Dashboard, which will be discussed in detail in the following sections.

Picture: Platform Home Screen - DMA Dashboard

The side menu, shown in the picture beside, can be accessed at any time after the user login.

From there, you can access the Integrated, Predictive, and Sensitive sections (available to customers who have purchased this module).

Picture: Side Menu

Integrated

In the Integrated section, an overview of the data and assets that composes the workspace is presented, through the functions:

Dashboard: section that centralizes data obtained from predictive and sensitive data. It is divided into two parts:
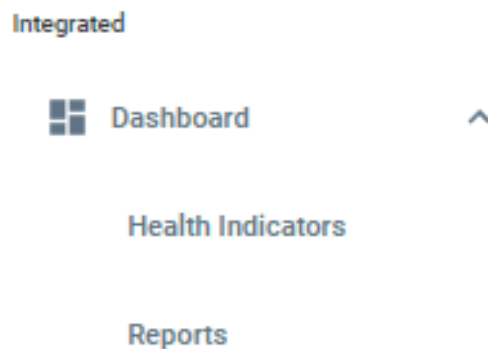
Picture: Integrated section in the side menu

- Health Indicators: presents the health of the assets by sectors, taking into account the predictive and sensitive modules (in case the company has acquired it).
- Reports: presents all the predictive and sensitive analyses performed by users in the client company.

2. Asset tree: enables the hierarchy of the company's units, sectors and machines, facilitating the organization and management of the available assets.

3. Machines: presents a view per machine, considering the predictive and sensitive module. By selecting a machine to visualize, it presents a grouped view of all Spots located on this specific machine, as well as anomalies detected by sensitive inspectors through the sensitive module.

Predictive

The Predictive section presents the main functions that support predictive monitoring, based on information from Dynamox's vibration and temperature sensors, the DynaLoggers. Among them are:

DMA Dashboard: decision support panel, which displays an indication of the assets' health, through the information of the sensed Spots and alarms configured for each point;

Spectral Analysis: list with all the spectral analyses performed by Spot and machine.

Spots: list with all the monitoring points (Spots) created, their respective machines and DynaLoggers.

Gateways: lists all registered Gateways (automated data collectors for Dynamox sensors) and their respective settings.

Sensitive (Optional)

In the Sensitive section, functions that support the creation and management of sensitive inspection routes are available:

Dashboard: six dashboards are available to assist decision making, regarding sensitive inspection routes and anomalies reported by field inspectors.

Adherence Groups: a panel that provide the list with the grouped user groups for route adherence accounting.

Route Management: a list with all the inspection routes and their respective information, as well as the option to create and manage new or existing routes.

Checklist Models: a list of all checklists created, and option to create new checklist templates.

More information regarding the use of these features is described in the Sensitive Inspection Manual.
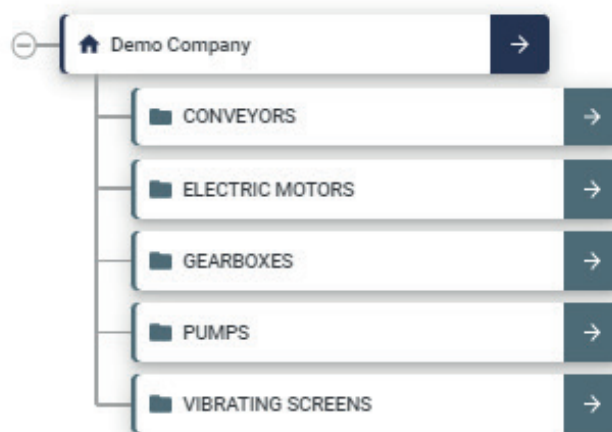
3. Asset Tree Creation

The first step in the process of initiating the deployment of Dynamox's monitoring system is the creation of the company's asset tree.

The Asset Tree is a visualization in the shape of a tree, with all the assets in which the system developed by Dynamox will be deployed. This functionality allows an overview of the organizational structure, facilitating the analysis and management of assets, through the hierarchy of units, sectors and machines of the company.

Through asset tree management you can create sub-areas to reflect your company's structure. To edit the tree, the user (with administrator permission) must access the "MANAGE" option, in the upper right corner.

The gear symbol, which will appear next to the name of each level will allow you to edit or delete levels. To add sub-levels, the user must click on the " + " icon, next to the desired entity.
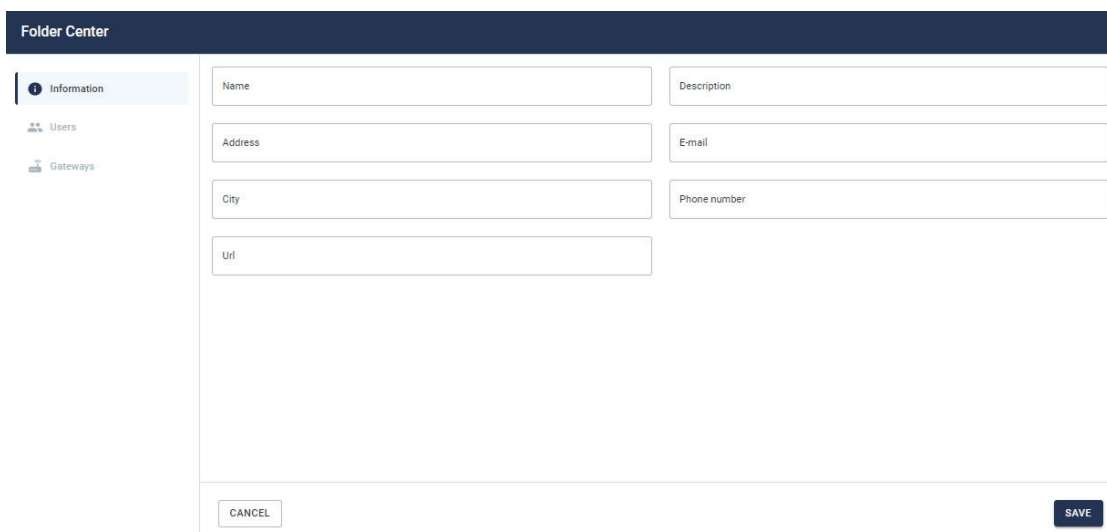

Picture: Asset tree creation

By selecting the + icon on a workspace, you can create a subarea "" or a machine ""
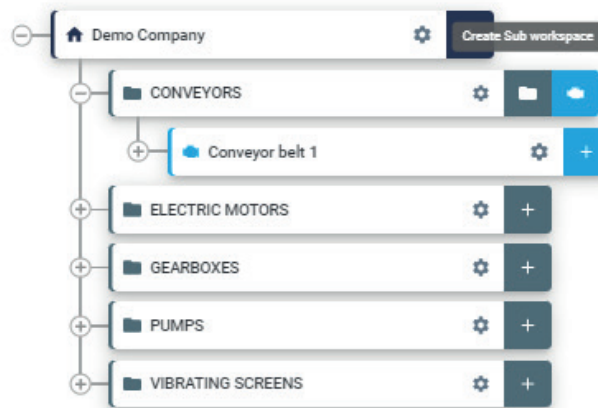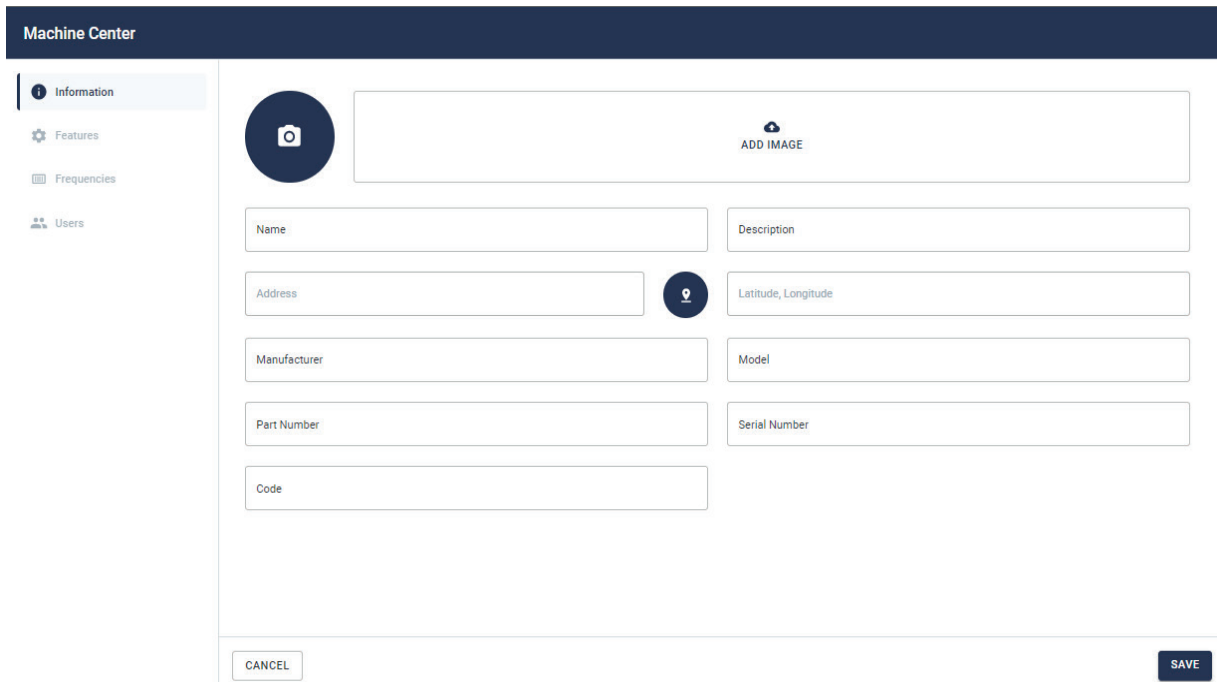

Picture: Adding sublevel or machine in the asset tree

By selecting the Create Subarea option, a new window will open, asking for information to create this subfolder. In addition, in the "users" tab, you can manage the users that will have access to this subfolder (for more information on user management, see the next section on user management). After saving, the subfolder will be created.

Picture: Sub-area configuration

When creating a machine, you must select the option in light blue. The following information will be requested:

Picture: New Machine Setup Tab

1) Information

Machine name (mandatory): used to identify the machine.
Machine description (optional): information regarding function, position, shape, etc.
Address (optional): Location where the machine is installed. It's possible to use geo-reference, via Google Maps.
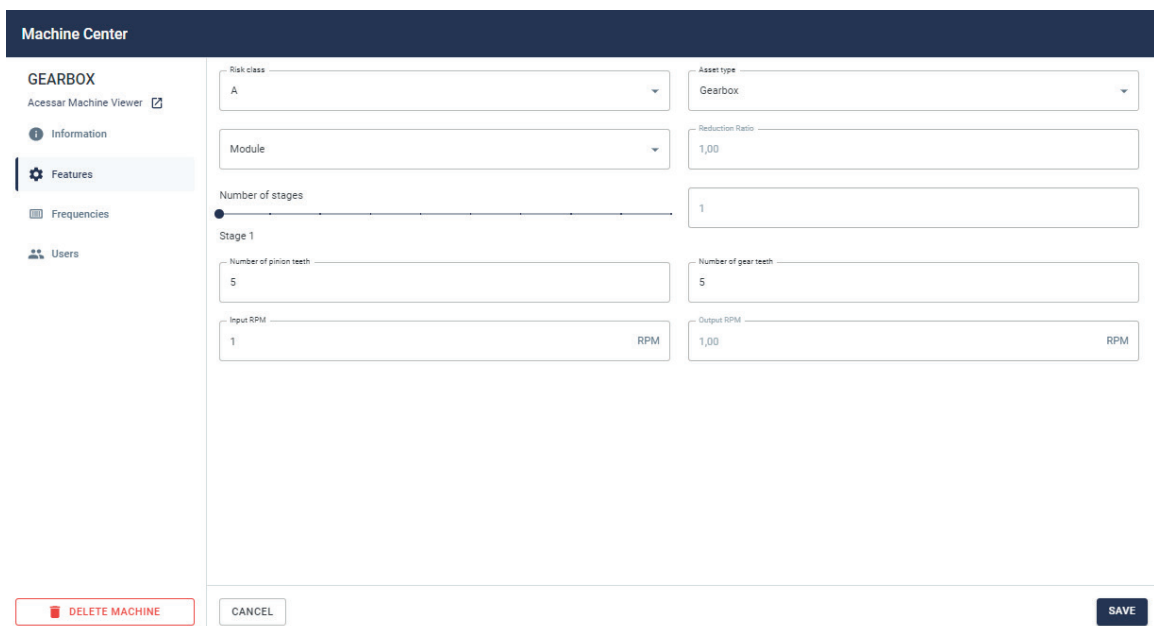Image (optional): it's possible to register a picture of the machine.
Other information: manufacturer, machine model and other items can be optionally entered.

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2) Characteristics

Risk class (optional): Criticality of the machine (Business Risk, A, B, C, D)

Type (optional): A choice list presents options with different asset types. Depending on the machine chosen, you will be asked for technical data regarding the referred asset model. Below, there is an example on how to fill in the information for a gearbox.

Picture: Filling in the characteristics of the monitored machine

3) Frequencies (optional)

Machine characteristic frequencies can be added in the "Frequencies" tab. Afterwards, the Spots created within that machine will inherit the frequencies created.

The process of inheriting the frequency from the in Spots is detailed in the section "Creating Spots".

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4) Users (optional)

It is possible to register users with machine-level subscriber permissions, so that they can receive notifications via e-mail if any configured alerts are triggered by one or more Spots.

Note: A user will not be able to access, edit or delete the machine to which he/she is subscribed unless he/she has the administrator or editor's permission at a higher level than the one in the asset tree.

After filling in the requested information and selecting SAVE, the machine will be created.

From this created machine level, you can create other new levels using the + icon next to the desired machine. These are: Sub-sets (and components), Spots and, for clients of the sensitive module, associate Checklists.
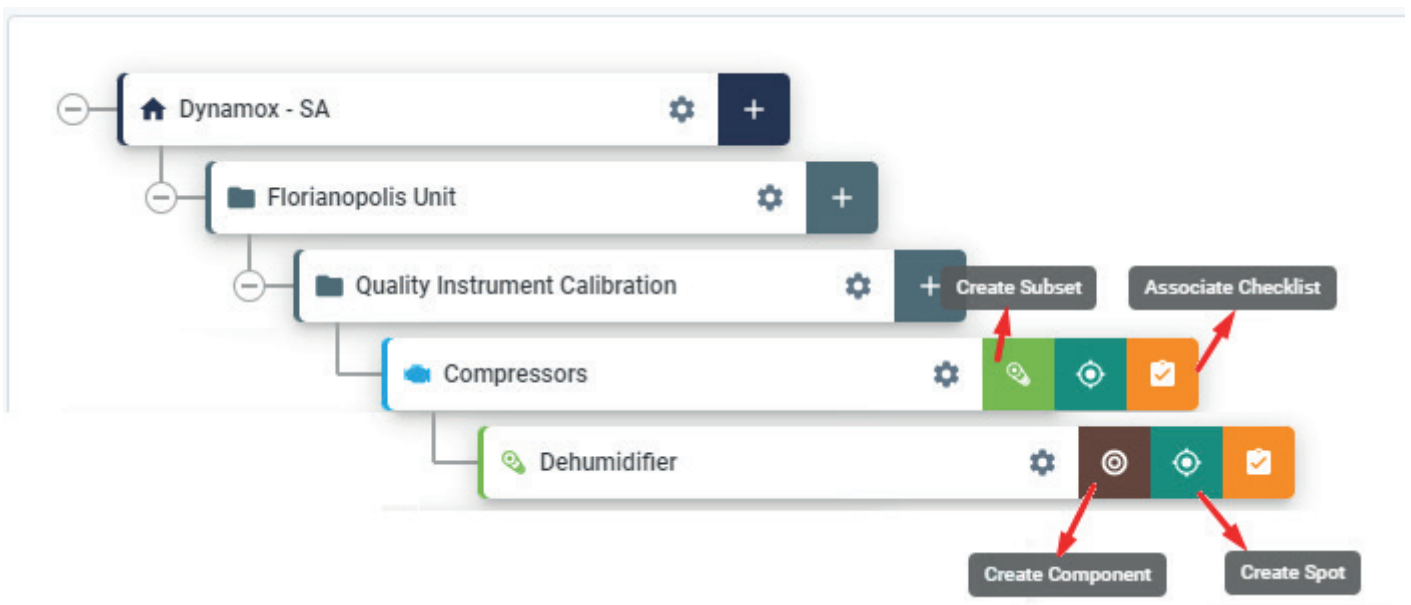
Picture: Options to create subset, component, Spot, and associate checklists

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Subset: indicated for large machines with several Spots. Its function is to allow a grouping of Spots or checklists within sub-levels of the machine, thus creating a better organization of itself.

Component: in subsets it is possible to even create another level, the component one. These allow one to create Spots and associate checklists separately. The creation process is similar to the procedure for machines/subassemblies.

Spot (monitoring points): these are the levels where the vibration and temperature sensors are associated. Within a machine it is possible to create as many Spots as necessary and in each one of them a history of vibration and temperature data will be generated.

Checklist: exclusive to customers of the sensitive module, allows the user to associate the sensitive inspection checklist templates with the referred machine.

Note: The functions described above are only available to users with.

3.1 Users Management

In order to allow a sustainable and organized management within the system, different profiles have been created for the users. In summary, there are 5 profiles: administrator, editor, collector, reader, and subscriber. Below we list the possible permissions for each profile type:

	Subscriber	Reader	Collector	Editor	Admin
Access data	X	✓	✓	✓	✓
Collect data	X	X	✓	✓	✓
Edit Spots e Gateways	X	X	X	✓	✓
Delete machine, Spots e Gateways	X	X	X	X	✓
Edit Working Areas areas and users permissions	X	X	X	X	✓
Realize predictive analysis	X	✓	✓	✓	✓
Create templates of Checklists	X	X	X	✓	✓
Create and edit inspection routes Sensitive	X	X	X	X	✓
Receive notifications of alerts via e-mail	✓	X	X	X	X

Picture: Permissions per user type

*Note: Users with the 'subscriber' permission can also have the Reader / Collector / Editor / Administrator permission, because this profile only enables receiving alarms by email.

Users with "Administrator" permission can add or remove other users, as well as edit permission levels. This is achieved through the MANAGE, option at the top right of the Asset Tree screen, followed by the option " ⚙ ", next to the desired level within the asset tree.

In the "Users" tab a quick search field and a list of all users associated with the given workspace will be displayed. For each user listed you can edit permissions or remove them
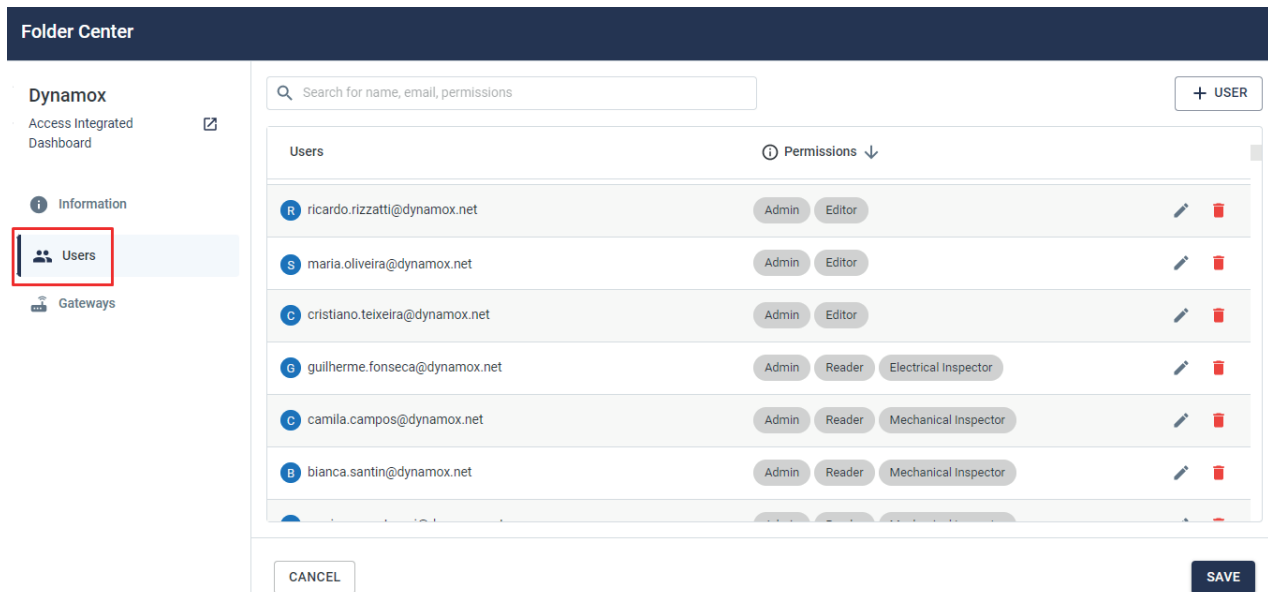

Picture: Configuring User Permissions

For an administrator to add a new user to the workspace, simply click on "+ User", define the permission level, and save. An e-mail invitation will be sent to the new user's e-mail address, through which they can create a password to use the system.

Note: for the Sensitive module, it will also be possible to add, in addition to the permissions shown above, another three (3) permissions: Electrical Inspector, Mechanical Inspector and Lubricator. These three profiles give the respective user permission to perform sensitive inspections in the field, that is, to answer checklists of registered machines within their inspection routes. There is no level difference between these 3 permissions. Therefore they should be assigned according to the nature of the user's work.

3.2 Detailed Navigation in the Asset Tree

On the main screen of the Platform, by clicking on the button next to the workspace , the user can load different levels of the asset tree, just as in the DynaPredict application.
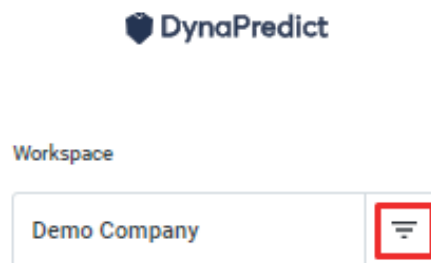
Picture: Selecting work area/subarea from the side menu

The alternative tree will appear on the right part of the screen, where you can select the desired subarea.
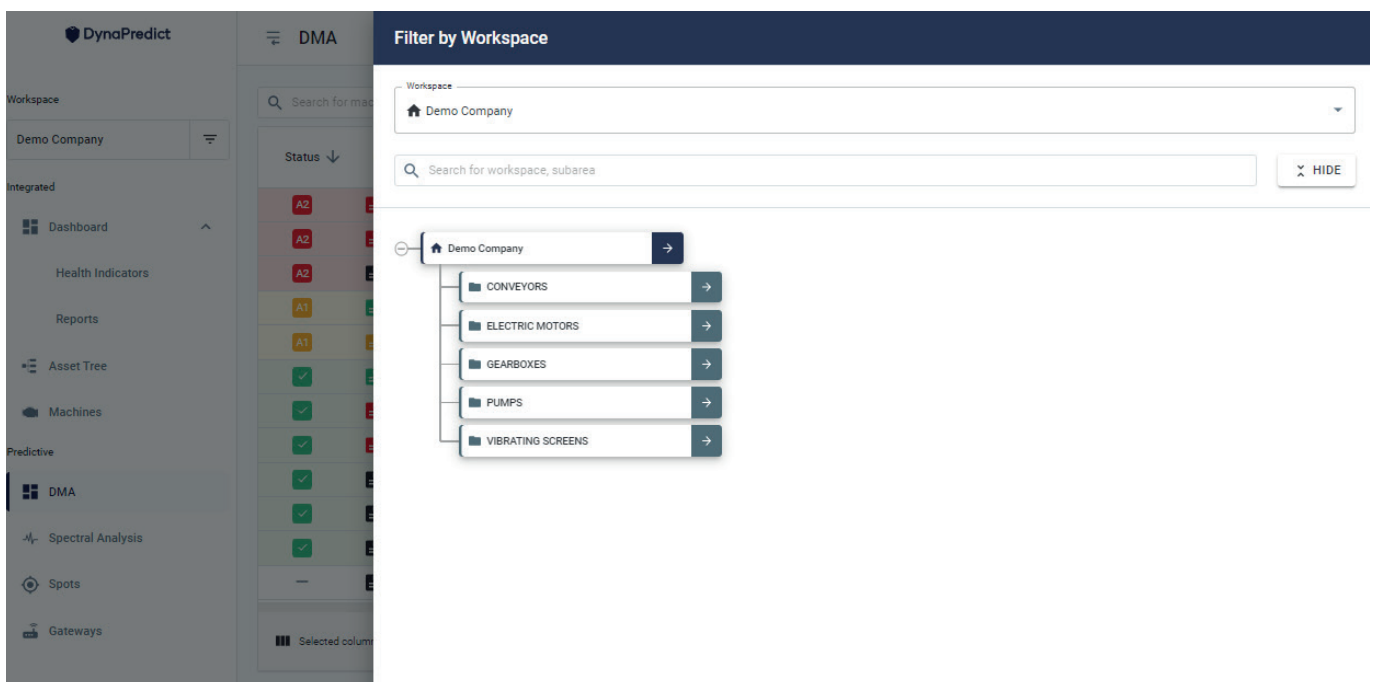
Picture: Entry-level selection from the asset tree

This option allows a granularization of what is seen by the user, as it allows them to only access information from a specific area, without having to see information from all the other levels that they can access.

This option also contributes to a better experience for users who have access to companies with a high number of sensors, because the Web Platform will load only the data from the selected level, which will facilitate, for example, the visualization of the DMA Dashboard, with more targeted information and fast loading.

4. Spots creation and Configuration

A Spot (monitoring point) can be created directly within a machine, subarea or component.

To start creating, simply select the MANAGE option in the Asset Tree, followed by the "create" button, represented by the + icon, at the desired level.

Finally, you must select the option to create Spot through the " ⊙ " icon.
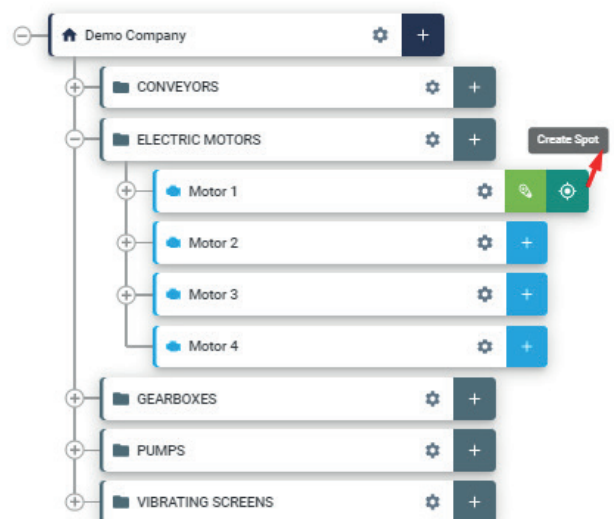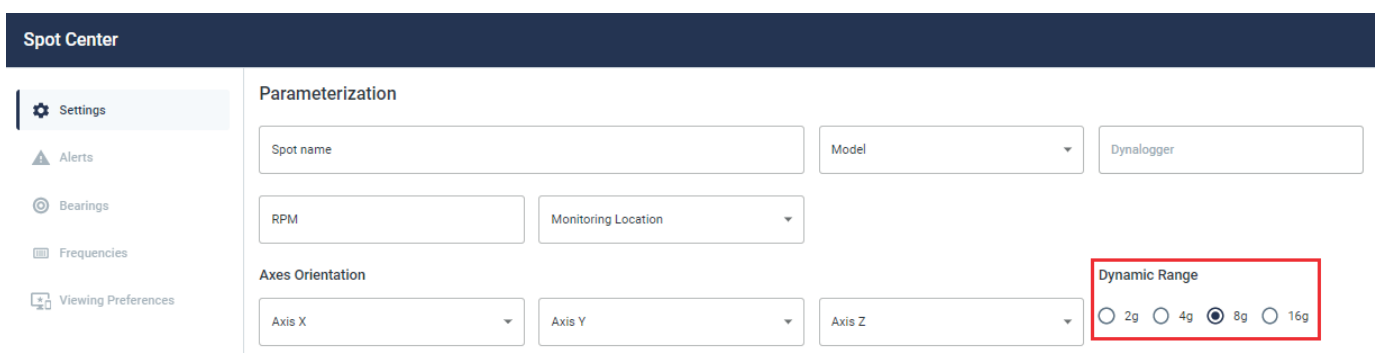

Picture: Spot Criation

After the creation, a new registration screen, with configuration configuration steps will be presented.

First, it is necessary to add the Spot identification, that is, the name that will be given to the monitoring point. Then you must choose the sensor model that you want to register in this point: TcA+, TcA, AS, HF, RE, HF+, TcAg and TcAs. (Information available in the body or label of the DynaLogger to be added).

*Note: To effectively associate a DynaLogger to the Spot in question, it is necessary to access the mobile application since the sensor communicates via Bluetooth. For further information about associating a sensor to a Spot, please refer to the DynaPredict Application Manual, Predictive module.

Picture: Spot Information Tab

Following the required settings:

RPM: rotations per minute of the closest rotating component to the installation site of the chosen sensor.
MONITORING LOCATION: Type of component/equipment to which the DynaLogger will be attached.

AXIS ORIENTATION: defines the positioning orientation of the DynaLogger that will be installed. The fixed orientation of the DynaLoggers is displayed on the body or label of the devices. Based on this orientation, the user must select the actual positioning given to the DynaLogger installed in the machine.

DYNAMIC RANGE: parameter that delimits the maximum vibration level that can be measured by the DynaLogger. The 4 options are ±2g, ±4g, ±8g and ±16g. This item is important for quality measurement. An incorrectly chosen dynamic range may result in saturation of the signal or loss of resolution and measurement quality. We recommend selecting the lowest value that comprises the normal vibration of the machine, and leaving a certain margin in case the values evolve. For example, the appearance of a defect in the monitored component. More information in "How to choose the dynamic range"

CONTINUOUS MONITORING: the sample interval parameter is the value that defines how often will the DynaLogger turn itself on and collect vibration and temperature measurements from the point where it is installed. These measurements will be stored in the DynaLogger's internal memory and will be waiting for collection via application or gateway.

This will later generate a data history that is accessible on the Web Platform.

The complementary item "Metrics" defines which magnitudes will be collected at each sample interval configured above.

Note: any value from 1 to 60 min is available for selection in the sample interval field.

SPOT OPERATION LEVELS: This setting is optional and serves to register the machine's hour meter in operation or under stress, that is, based on the machine's vibration levels, the system counts the operation time in each situation. To use this option, simply activate the symbol and, in metrics, choose between speed and acceleration. Then you must select the axis that you want to monitor (or all axes) and enter minimum operating thresholds, i.e. below this the machine will be considered off. One must also define a maximum stress threshold, above which machine will be considered in stress operation.
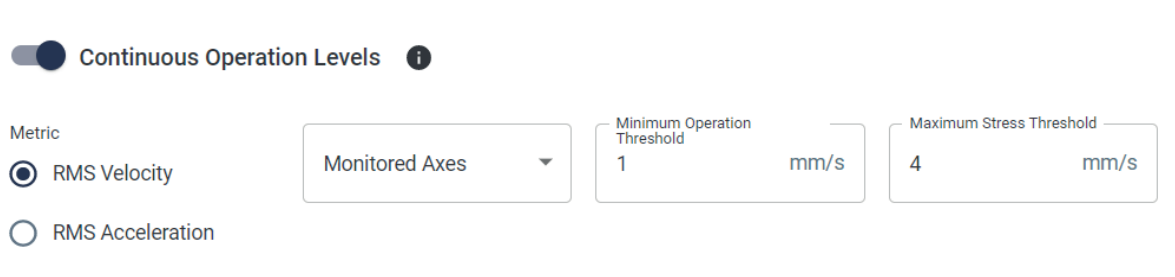

Figure: Stressed and stopped machine configuration levels

SPECTRAL MONITORING: this setting is mandatory and defines the duration and maximum frequency characteristics of the standard spectrum.

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This is important for Spots that will be collected later by gateways or Spots that will be collected by different inspectors via App, because a collection pattern will be generated. This pattern makes the analysis more assertive and afterwards vibration analysts will make the predictive reports.

In "Monitored Axes" one determines the axes to be collected. It's possible to select the unixial or triaxial collection option, as shown in the image below.
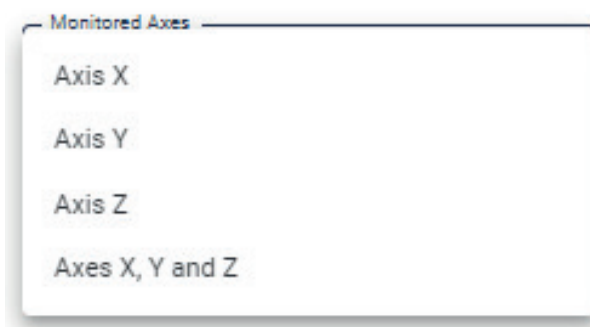
Next you must choose the maximum collection frequency:
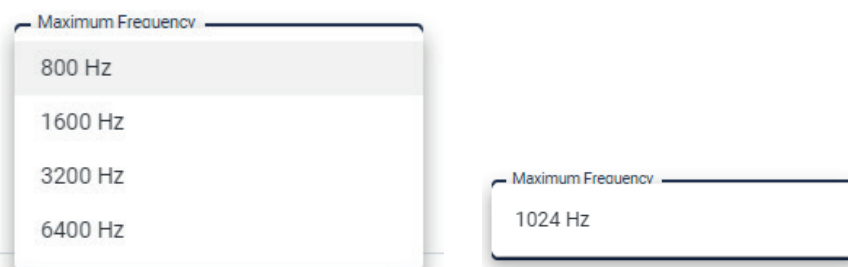
Picture: Max. frequency options for DynaLogger HF (left) and for DynaLogger TcA+ (right)

The collection duration field corresponds to the signal acquisition time, that is, the time of the waveform. The options vary according to the selected maximum frequency. Therefore pay attention to the trade-off between maximum frequency and desired duration.

The number of turns and the number of lines will change according to the choices in the fields above, and the rpm determined at the point. Below there's an example for the case of RPM = 1800.

Spectral Monitoring

Monitored Axes	Maximum Frequency	Collection Duration	Number of turns
Axes X, Y and Z	6400 Hz	1.28 seconds	0 turns

Number of lines
8192 lines

Picture: No. of turns and no. of turns with the chosen 6400 Hz, 1.28s, 1800 RPM configuration.

When finishing and saving the desired settings, the monitoring point will be created.
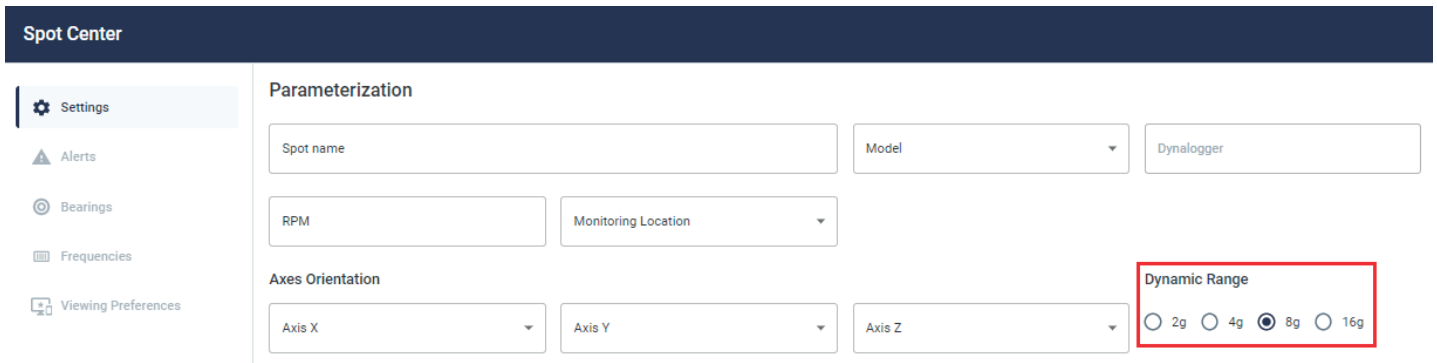
Remember that this process only creates the monitoring point (Spot). To actually start getting vibration and temperature data from this location, you must perform the physical installation of the DynaLogger and associate the corresponding serial number via mobile app.

Note: the only mandatory tab to be filled in when creating spots is precisely the one described in this article. The others (Alerts, Bearings, Frequencies, and Display Preferences) are important, but are optional and can be done in a second moment, that is, they do not require pre-installation of the sensor in the field.

4.1 How to choose the dynamic range.

When setting up a spot, one of the settings to be made is the "Dynamic Range" setting.

The dynamic range is a parameter that delimits the maximum vibration level that can be measured by the DynaLogger sensor. There are 4 options: ±2g, ±4g, ±8g and ±16g, as shown in the Picture below.

Picture: Dynamic range interface selection.

When installing the DynaLogger on the machine, taking the precautions described in the Getting Started section, the user should choose a dynamic range suitable for the machinery. It is recommended to choose a range that contains the maximum vibration levels that the machine is capable of generating in its typical operating condition, and also to consider a margin. This margin will ensure that in the event of a machine fault developing, which in turn will most likely increase the vibration levels, the DynaLogger will be able to measure these values and the signal saturation does not occur.

If there is no previous knowledge of the vibration levels under normal operating conditions of the machinery or a history that helps in defining the dynamic range, the following procedure can be chosen:

1. At first you can set the dynamic range to a higher value, for example 8g, which is the system's default setting.
2. Next, you should perform a spectral analysis of the machine in full operation.
3. The waveform (signal in time) should be analyzed, as it will help in the decision-making for correct definition of the dynamic range. Typical cases are dealt with below and come with a respective decision making to fit the dynamic range.

Case 1 - Saturated Measurement

In this case, the measurement taken will have amplitude values equal or greater than theselected dynamic range. The picture below shows a saturated measurement, where the chosen dynamic range was ±2g.
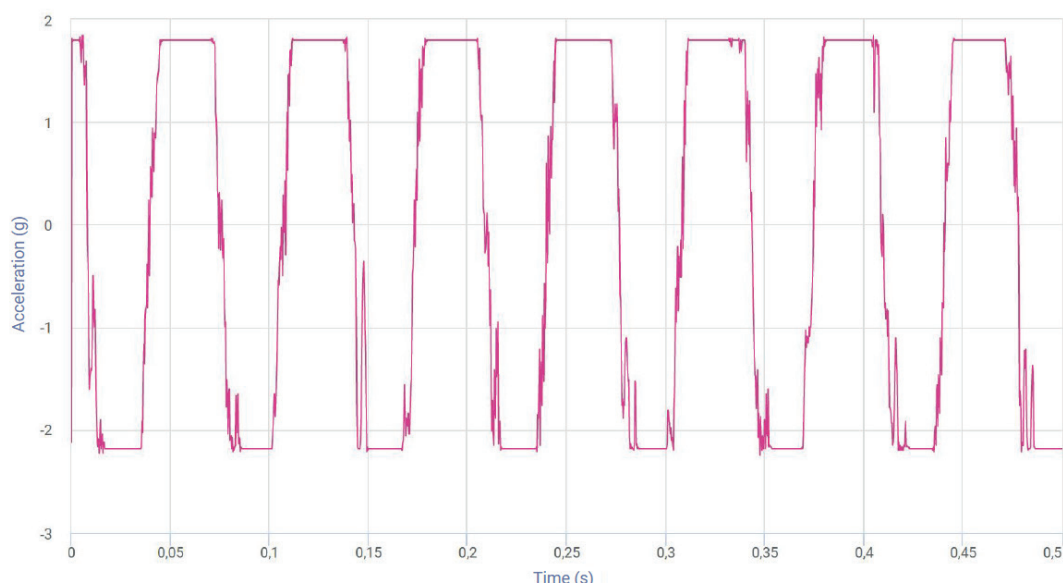
Picture: Saturated measurement: chosen dynamic range of ±2g and measured waveform with peak levels of ±2g or greater. Low frequency dominant signal.

In this case you should increase the dynamic range to a higher value. When increasing the dynamic range it is necessary to take a new measurement, obtain a spectrum and check the waveform again. If the levels are within the new dynamic range with a certain amplitude margin, this range can be admitted.

Case 2 - Unsaturated measurement, but with low margin

In this case the amplitude of the measurement is within the dynamic range, but the captured amplitude values are very close to the set value. If the machinery develops a problem, it is likely that the vibration levels will tend to increase and may exceed the set dynamic range, again saturating the measurement (see case 1). In this case it is only recommended that the user increases the dynamic range to the next level, so that the vibration evolution of the machinery can be observed without saturation.

The Figure below shows the case of an unsaturated measurement, but with low margin. It was ±2g.

RMS	0.1589	2.2976	2.3275
PP	1.2500	7.1250	7.8750
CF	4.5133	1.5810	1.6931
KURT	3.0387	1.5127	1.5258
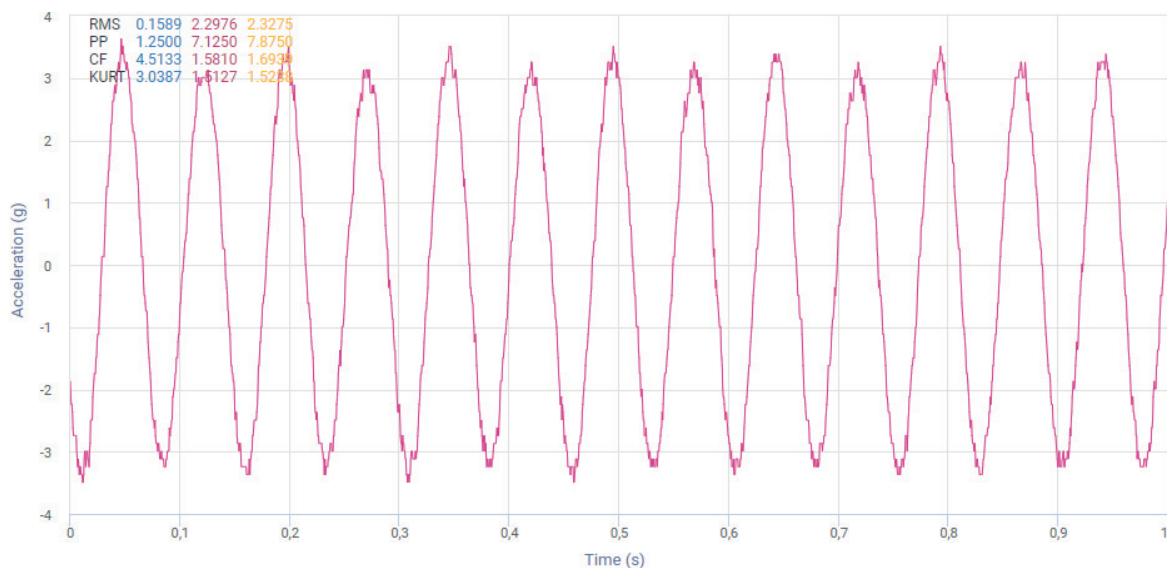
Picture: Unsaturated measurement with low margin: chosen dynamic range of ±4g and measured waveform with peak levels at or below approximately ±3.5g.

Case 3 - Unsaturated measurement with margin (ideal case)

In this type of measurement, the amplitude levels collected are within the selected dynamic range and still have room for increase. This is the case where the dynamic range is ideal for monitoring machinery. The picture below shows the case of a correctly chosen dynamic range of the sensor.
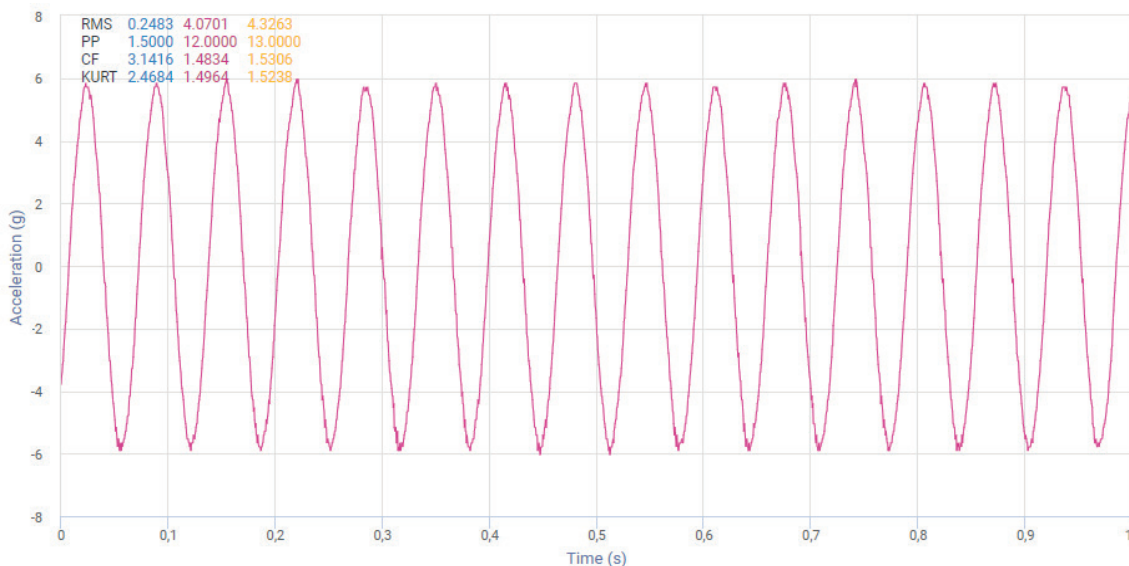
Picture: Unsaturated measurement with margin: chosen dynamic range of ±8g and measured waveform waveform with peak levels of ±6g or less.

Case 4 - Unsaturated measurement, but with a lot of margin

A common mistake is to select a too high dynamic range, i.e. with too much margin between the actual vibration amplitudes of the asset and the dynamic range limit. This type of setting allows the monitoring of the machine without any saturation, however it loses in terms of resolution, i.e. signal quality. The dynamic range options available and their respective resolutions are presented in the following table.

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Dynamic Range	
g	Resolution (g)
±2,00	0,0156
±4,00	0,0312
±8,00	0,0625
±16,00	0,125

Table: Available dynamic range options and their respective resolution

In this case one should assess whether it is possible to decrease the selected dynamic range, improving the resolution according to the Table. After the change, take another measurement and check if the levels are within the dynamic range with some margin. The following figure shows an unsaturated measurement, but with a lot of margin.
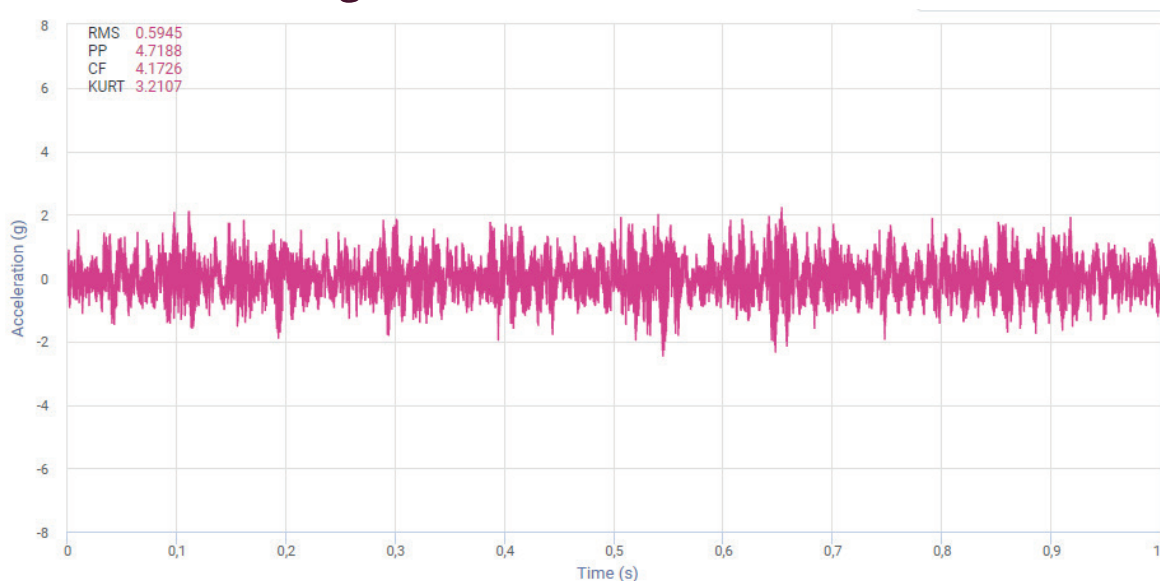
Picture: Unsaturated measurement with too much margin: dynamic range chosen of ±8g and measured waveform with levels equal or smaller than approximately ±2.5g. Suggestion: Change to ±4 g.

4.2 Maximum Frequency, Duration and Resolution

In DynaLoggers, when requesting a vibration spectrum (via Gateway or App), it is possible to set the duration of the collection time made by the sensor on the waveform and, in some models, it is also possible to choose the maximum frequency (max frequency).

The number of turns and the number of lines will change depending on the choices made in these fields. The relationship of number of lines and collection duration (per frequency) for each DynaLogger model is shown below:

Triaxial	Number of lines per axis			
Max. Frequency (Hz)	512	1024	2048	4096
800	0.64s	1.28s	2.56s	5.12s
1600	0.32s	0.64s	1.28s	2.56s

Uniaxial	Number of lines per axis					
Max. Frequency (Hz)	512	1024	2048	4096	8192	16384
800	0.64s	1.28s	2.56s	5.12s	10.24s	20.48s
1600	0.32s	0.64s	1.28s	2.56s	5.12s	10.24s
3200	0.16s	0.32s	0.64s	1.28s	2.56s	5.12s
6400	0.08s	0.16s	0.32s	0.64s	1.28s	2.56s

Picture: Settings for maximum frequency duration and respective number of lines. DynaLogger TcA+ above, DynaLogger HF below.

The collection duration reflects the signal acquisition in time (waveform). The maximum frequency chosen will be the data range converted to the frequency domain (Hz or CPM). This configuration can be done via the Dyna-Predict mobile application or via the Web Platform in the "Settings" tab, as shown in the following pictures.
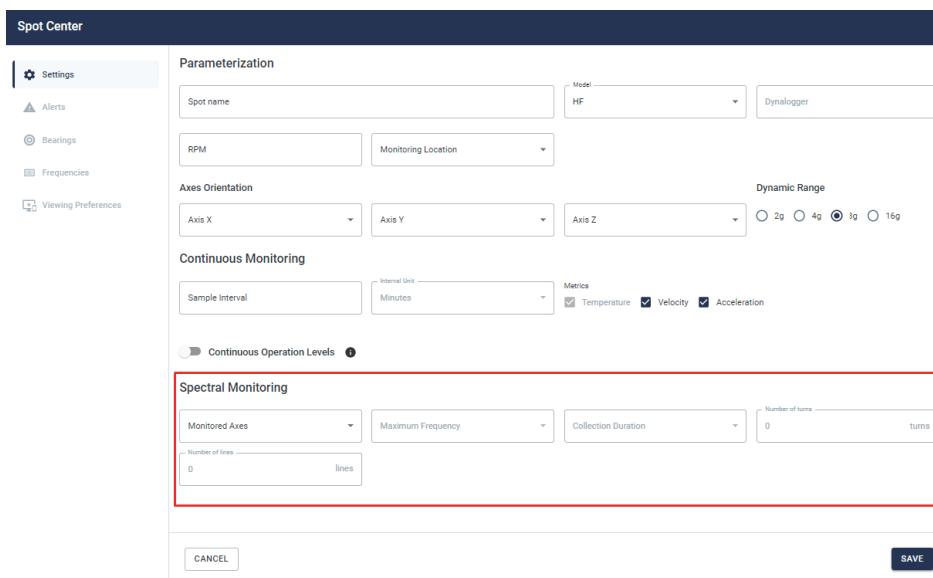
Picture: Web Platform Interface for Spectral Configuration
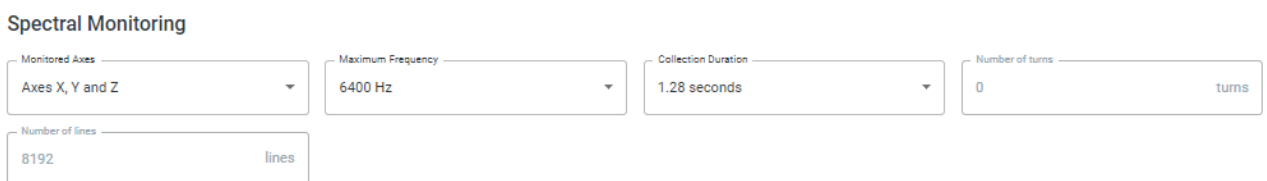
Picture: Spectral monitoring settings details

Note: The DynaLogger HF model allows for triaxial spectra with maximum frequencies of 800, 1600, 3200, and 6400Hz. For the first two options, data acquisition occurs simultaneously in all three axes. For 3200 and 6400Hz, data is collected sequentially, one axis after the other.

The user, when selecting the "collection duration" (Tcollection), is also changing the number of temporal samples that the sensor will collect, which in turn is 2x the Number of lines (shown in the image of the sensor models). The expected number of lines for the spectra, using only the maximum frequency information and the collection duration is given by:

$$N_{lines} = f_{max} \times T_{collection}$$

Both numbers (of samples and lines) affect the signal resolution, in waveform and vibration spectrum respectively. The spectral resolution can be calculated based on the maximum frequency or simply on the sampling duration

$$\Delta f = \frac{f_{max}}{N_{lines}} = \frac{1}{T_{collection}}$$

Example: suppose you choose a maximum frequency of 6400 Hz, with a duration of 2.56 seconds. The resolution in the spectrum will be:

$$\Delta f = \frac{1}{2.56s} = 0.39\ Hz$$

Whereas if a duration of only 0.08 second is chosen. The resolution will be:

$$\Delta f = \frac{1}{0.08s} = 12.5\ Hz$$

In summary, the spectrum resolution will be extremely impaired with such a low time duration, because the signal is collected with a lower level of detail.

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Visual Examples

Case 1 - Short time of collection

In this case the DynaLogger TcA+ was used for measurement with a maximum acquisition frequency of 1024 Hz and collection time duration of 0.5 s. Using the equations above one can expect a resolution at the frequency of 2 Hz and expect to get around 512 lines in the spectrum.
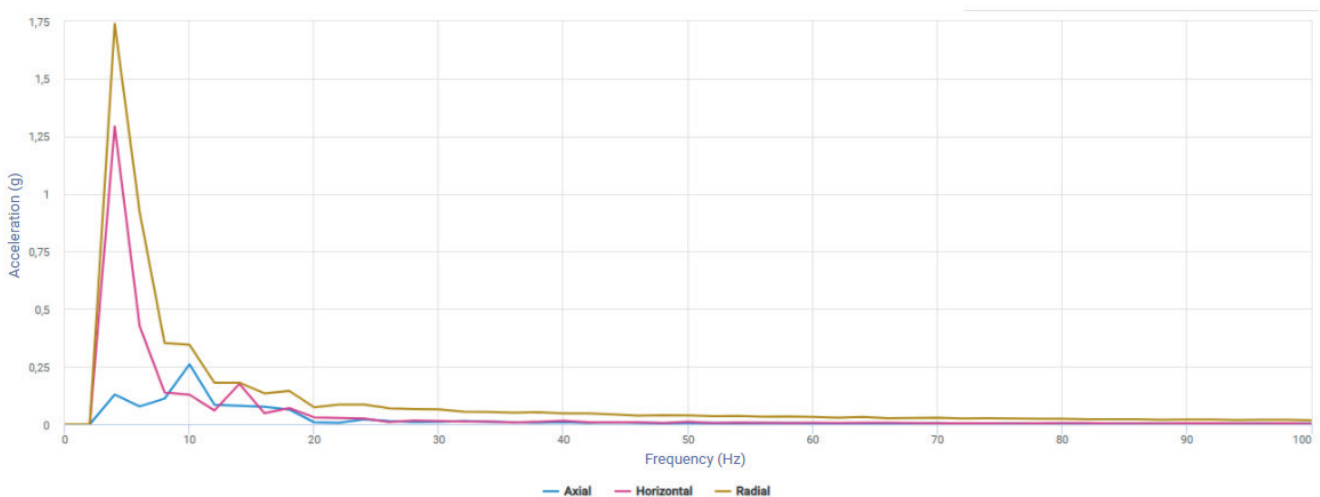
Picture: Vibration spectrum with 2 Hz resolution with zoom in the range 0 to 100 Hz.

As expected, the short duration of the collection time leads to low spectral resolution. It can be seen in the picture that the frequencies adjacent to the peak frequency have their amplitude recorded around this frequency, making the decay of the peak frequency slow, making analysis around the peak frequency difficult, or in some cases impossible.

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Case 2 - Long collection time

For this case the DynaLogger TcA+ was used again for measurement at the same maximum frequency of 1024 Hz, however the collection duration was increased to 4 s. Using the equations again, one can expect a resolution at a frequency of 0.25 Hz and around 4096 lines in the spectrum, an 8-fold increase in the number of spectral lines compared to the previous case.
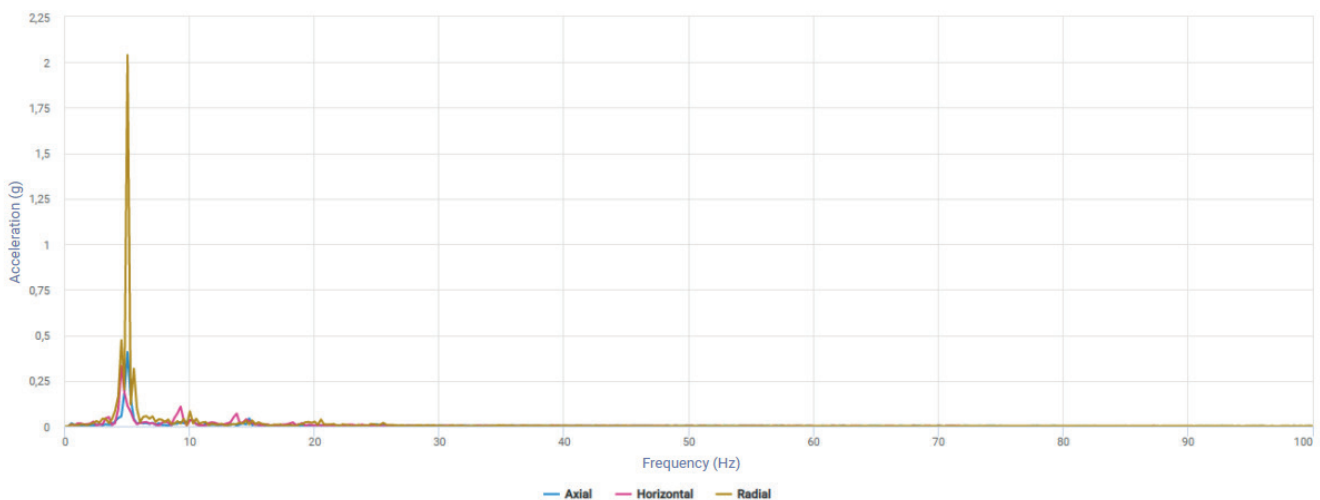
Picture: Vibration spectrum with 0.25 Hz resolution with zoom in the frequency range 0 to 100 Hz.

Comparing the cases it is noted that the acquisition done with a longer collection time duration allows a better definition of the peak frequency and that adjacent frequencies are better accounted for, which allows frequency analyses very close to the peak frequency.

It is worth noting that increasing the sample duration also leads to longer post-processing and data transfer time. However, whenever possible, the user should opt for a longer collection time in order to increase their spectral discretization.

5. Alerts

The Spot Center, the screen that displays the settings saved in each monitoring point, is accessible from several locations within the Web Platform, such as from the asset tree

When accessing the second tab of the Spot Center, the "Alerts" option will allow you to add alarm levels for continuous monitoring and also for spectral monitoring.
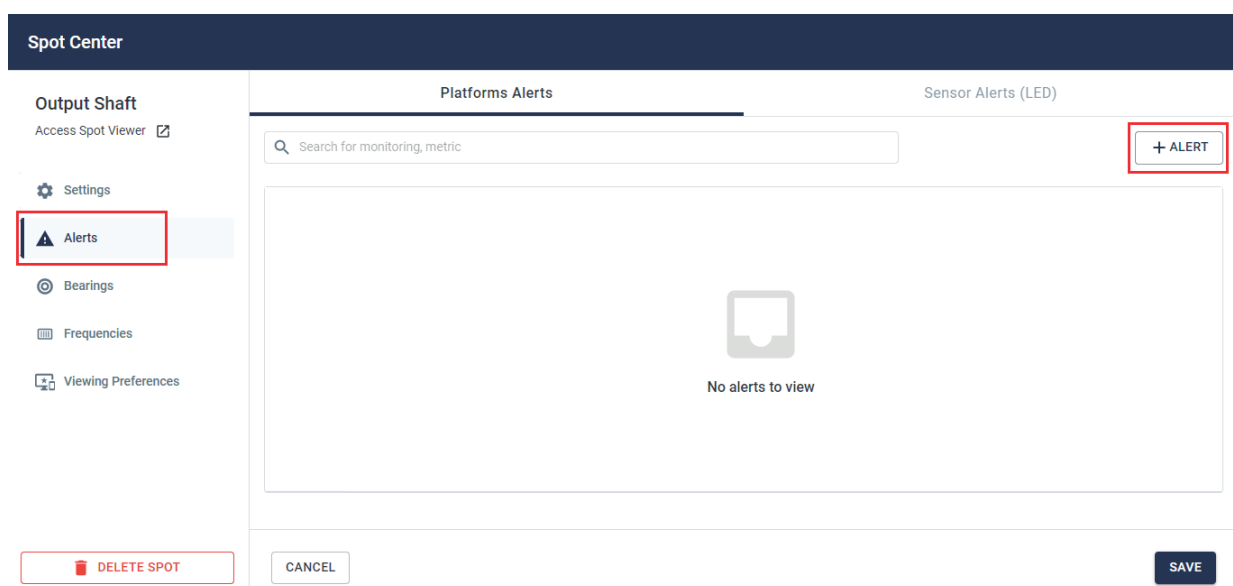
Picture: Alerts tab

Note: one does not necessarily have to configure the alert levels when creating the Spot, since it is interesting, at first, to know the standard vibration and temperature levels, and only then register these alarms. Once a history of data collected by the sensor installed in the monitoring point is generated, it is easier to define these values.
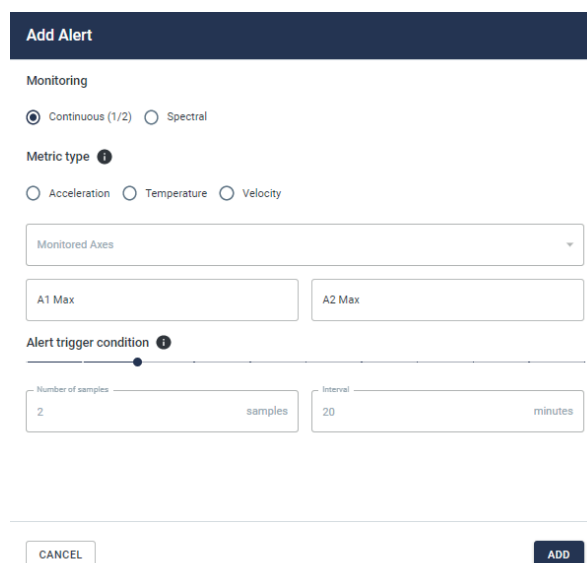
There are two types of alerts that can be set: 1) Platform Alert and 2) Sensor Alert (LED).

1) Platform Alerts

The alerts in the Platform are thresholds that will be used as a comparison with the data from the sensors in the field, obtained through collection via Gateway or mobile application. The objective is to evaluate if the data is transgressing the values considered ideal for the equipment's operation. The alarm violation evaluation is performed as soon as the collected data reaches the Web Platform. Within this type of alert there are two further subdivisions: continuous monitoring alarms and band alarms.

- Continuous monitoring alarms.

This type of alert is based on the evaluation of the continuous monitoring data shown in the continuous data history screen (Spot Viewer). These alarms can be set for temperature, RMS speed, or RMS acceleration.

Picture: Adding continuous alarm

It is currently possible to set up to two alert options. When one activates an option under "Metric Type", one must select the metric and, in the case of velocity and acceleration, configure the axis (or axes) that will be monitored with alarm levels. 7

There are two possible alarm levels, A1 and A2, with A2 being the most critical level. The maximum values, respectively, of alarms A1 and A2 are then determined.

Below, the alert trigger condition must be selected. This option works as a trigger, i.e., a rule for triggering A1 and A2 alerts from the data collected by the sensors and received by the Web Platform. This setting aims to avoid false alarms and ensure greater control over the monitored Spots. The trigger of any Spot, by default, is 2 (two) measurements, i.e., two consecutive transgressed points are required to trigger any of the alarms (A1 and A2). The number of consecutive samples can be customized by the user.
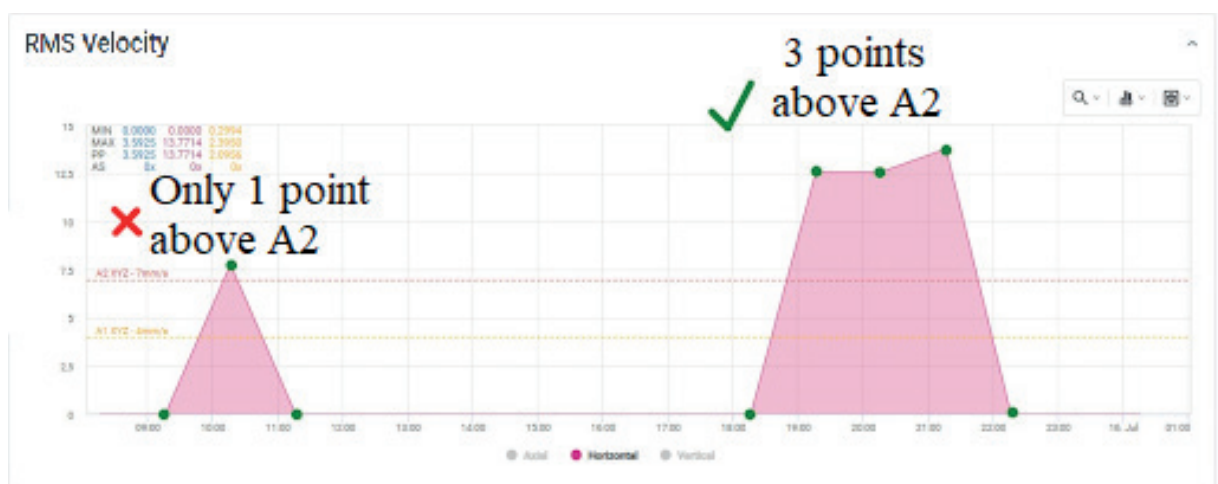
Picture: Alerts A1 and A2 trigger function
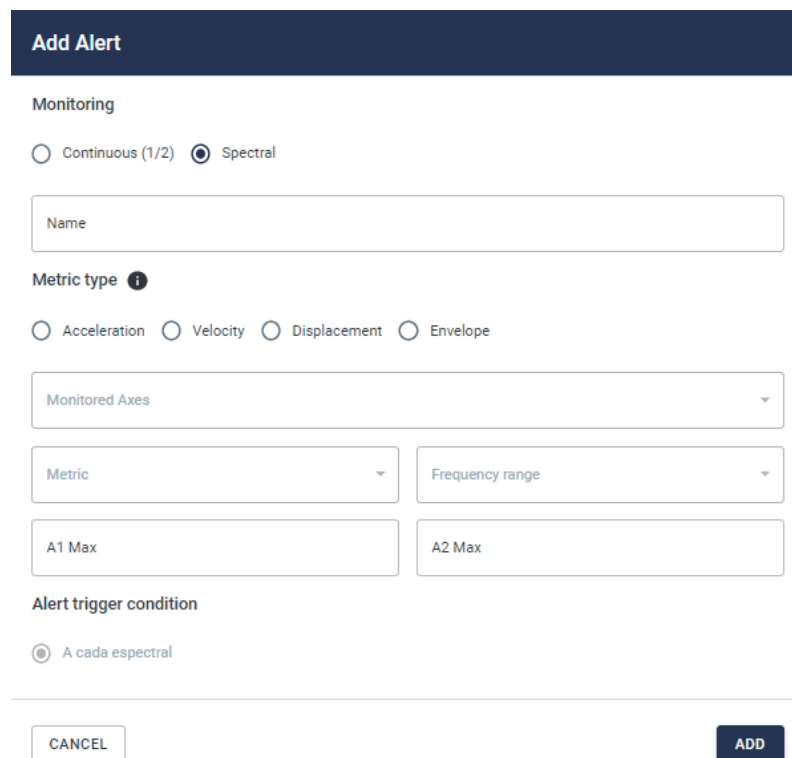
In the example above, where the yellow dotted line represents the A1 alert and the red line the A2 alert, if the trigger is set to 2, only the rightmost points on the chart would trigger the A2 alert.

- Spectral Monitoring Alarms

This type of alarm is intended to evaluate the vibration levels of the spectra collected for each monitoring point. The history of this type of measurement is accessed in the Spectral Trend screen.

From this screen it's possible to visualize, for different bands and magnitudes, the energy levels of each generated spectrum.

In order to set a spectral alarm, you must select the "Spectral" option of alarm creation:

Picture: Spectral alarm addition

For this type of alarm, one needs to add:

- Alert Name.
- Metric type: acceleration, velocity, displacement, or envelope.
- Monitored Axes: to which axis the alarm will be applied. Review the spectral monitoring settings chosen, to ensure that the alarm is added to an axis that is actually being collected.
- Metric: Depending on the "metric type selected above", several options can be chosen, as shown below:
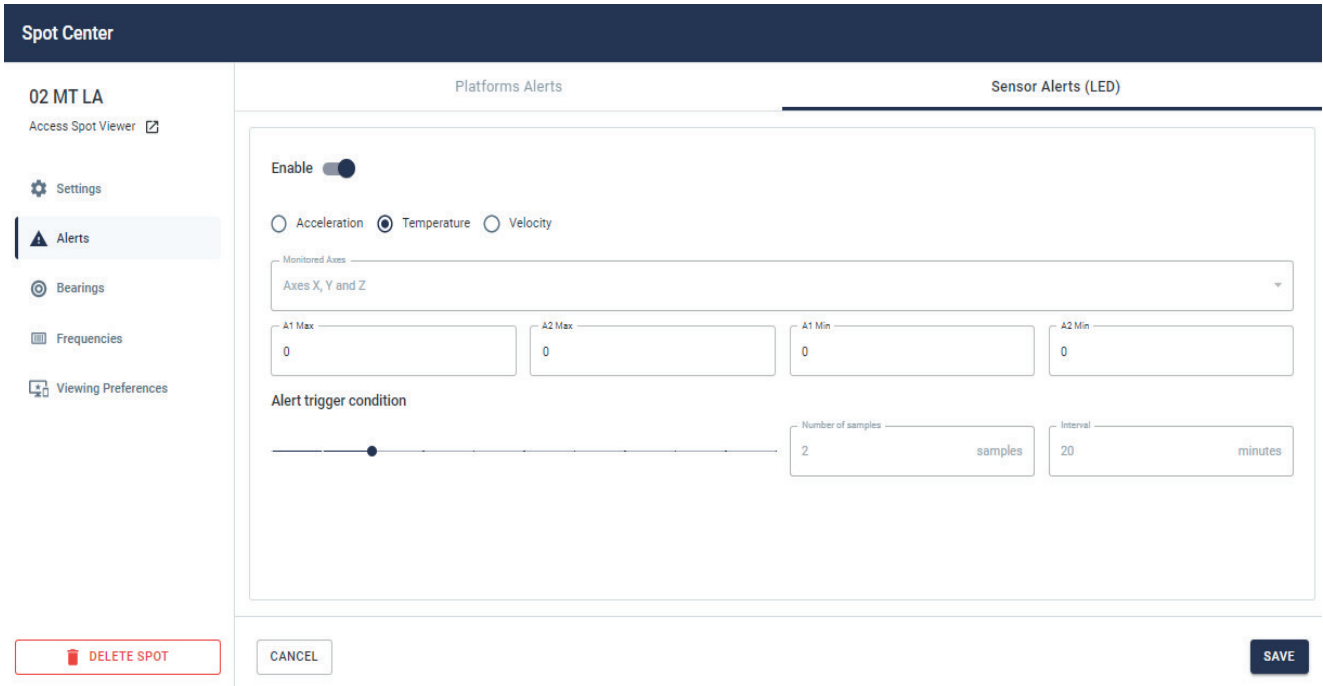
- Frequency band: band in which the alarm will be configured. Depending on the spectral monitoring configuration selected for the Spot, and also the "metric type" chosen above, several options will be available:

Up to 10 spectral alarms can be added to a Spot.

After setting continuous and spectral alarms (see example below), simply save and the alarms will take effect for the Spot in question.

Picture: Example of continuous and spectral alarms recorded at a Spot
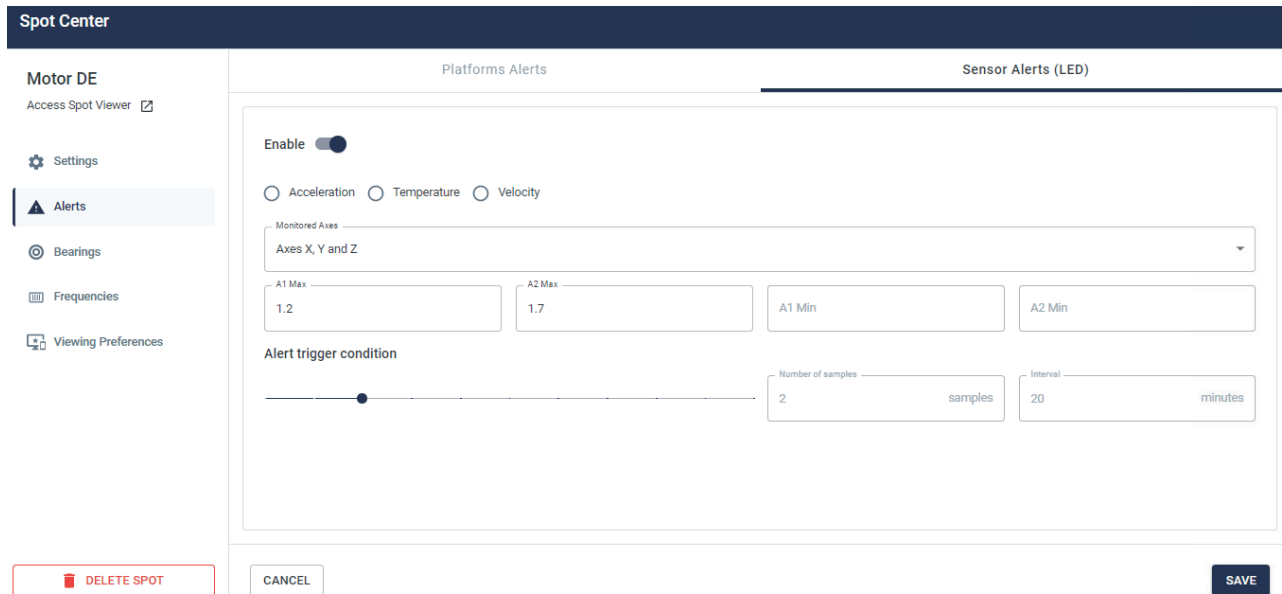
In the following sections, such as the "Dashboard DMA" section, we will show how the warnings to users work in case there is alarm transgression of the "Platform Alarm" type.

2) In-Sensor Alerts (LED)

It is also possible to set an LED alert. This alert can also be set for temperature, speed or acceleration.

Each DynaLogger has a LED that blinks green every 5s in case of full compliance, i.e. operation below A1 level. If alert level A1 is transgressed, the LED color changes to red. If level A2 is exceeded, the alert remains red, but blinks twice in a row, also every 5s.

This hardware visualization tool (DynaLogger) assists in verifying asset operation levels in the field.

Picture: Alert configuration in DynaLogger (LED)

6. Bearing Registration

The Spot center, a screen that displays the settings saved in each monitoring point, is accessible from several locations within the Web Platform, such as from the asset tree.

When accessing the Spot Center, in the third tab "Bearings" it will be possible to add one or more bearing models to the Spot. This will be useful for later analysis of the measurements to be performed by vibration analysts.
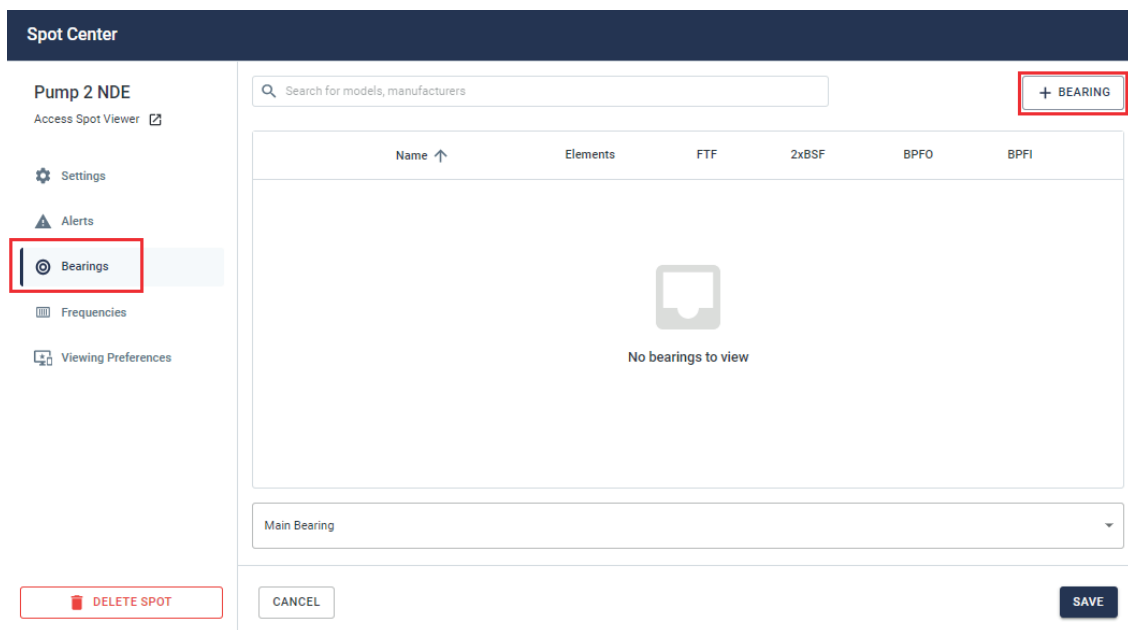
Picture: Bearings Tab

In the Web Platform there is a bank with approx. 70,000 bearing models already registered. In addition, it is possible to add more than one bearing and rename them conveniently.
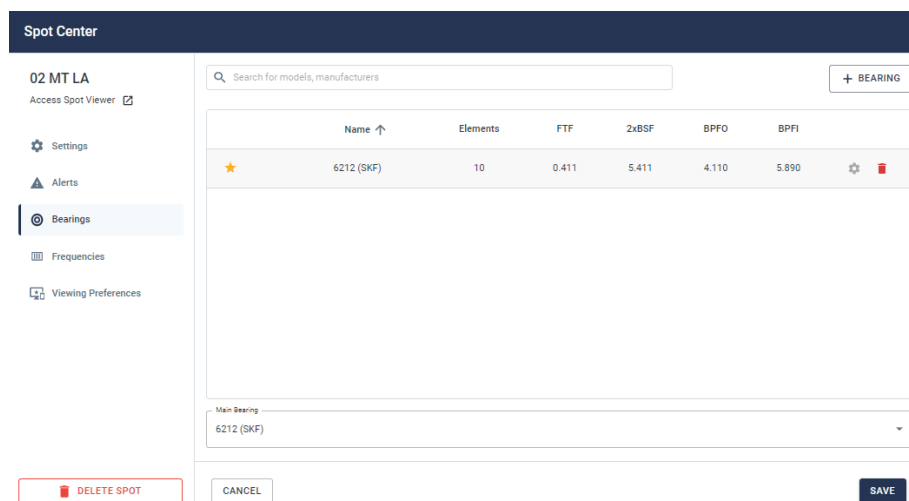
Picture: Registration of bearings with main bearing specification.

Note: If more than one bearing model is added, it is mandatory to indicate which is the main bearing, that is, the one closest to the sensor on site. This will receive a star symbol indicating that it is the main bearing.

7. Frequency Registration
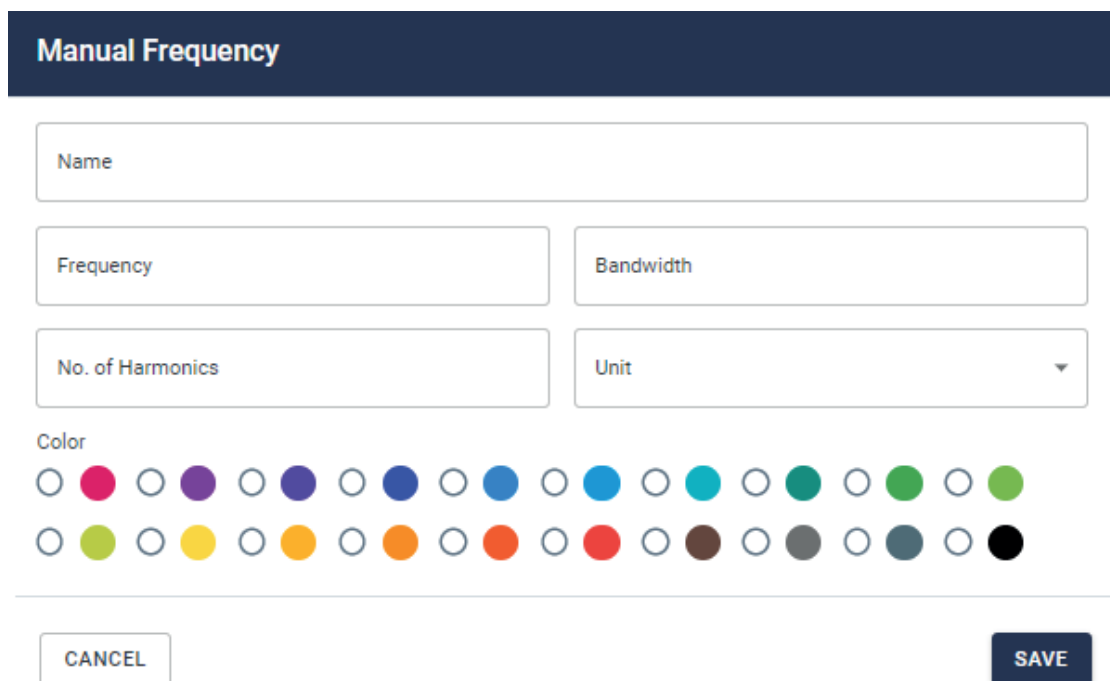
In the "Frequencies" tab of the Spot Center it will be possible to register specific frequencies for each Spot. These markers can be used in all spectra of this spot, as well as the markers of the machine where it is registered.
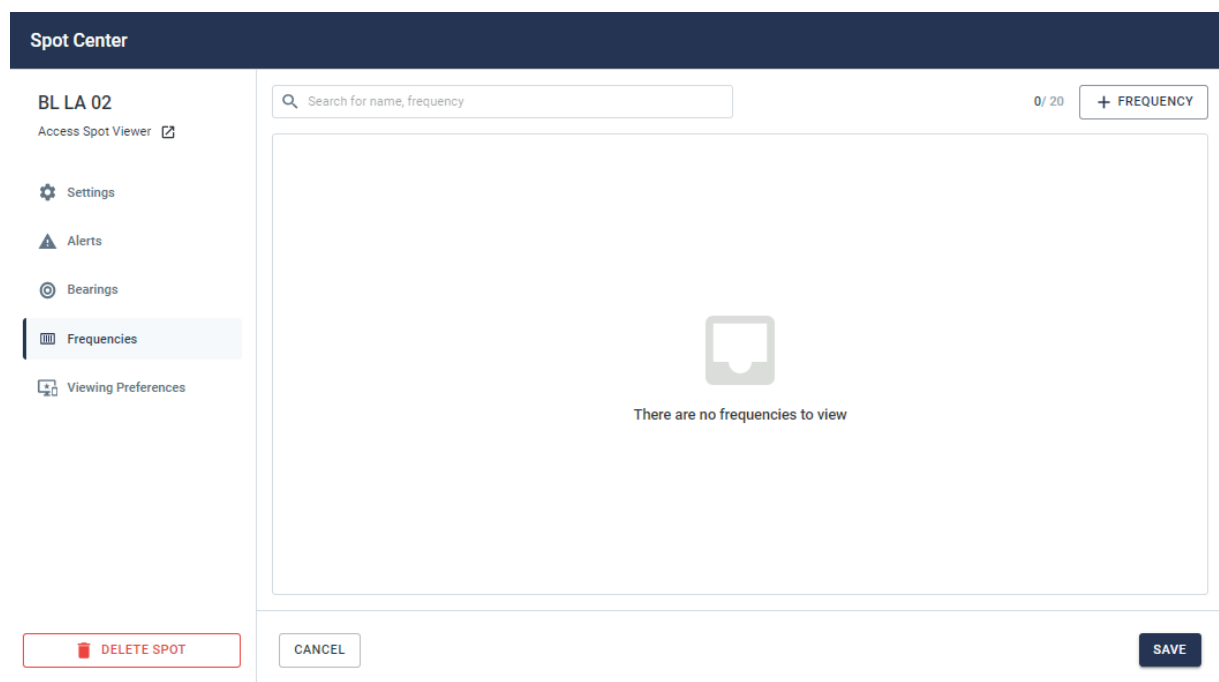
Picture: Frequency registration

If a marker has already been registered on the machine where the Spot is located, the marker will previously appear in the list. Otherwise, the list of markers will be empty. To add a new marker, click on + FREQUENCY in the upper right corner.

In the window that opens, you need to enter the name of the marker, the unit, the specific frequency where it will be inserted, bandwidth (thickness of the line created), number of harmonics and color of the marker.

Picture: Registration of customized frequencies in Spot

The Platform allows, per Spot, the registration of up to 20 customized frequency markers. The registration will be saved, as per the example below.
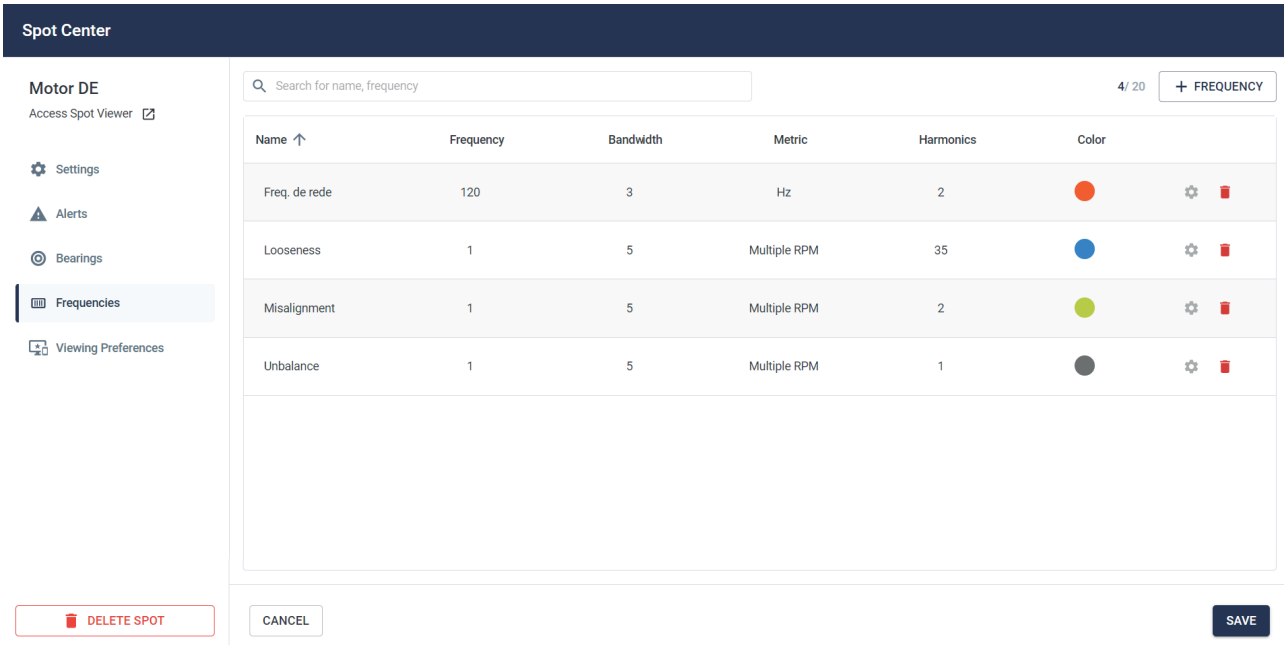
Picture: Example of registering custom frequencies in Spot
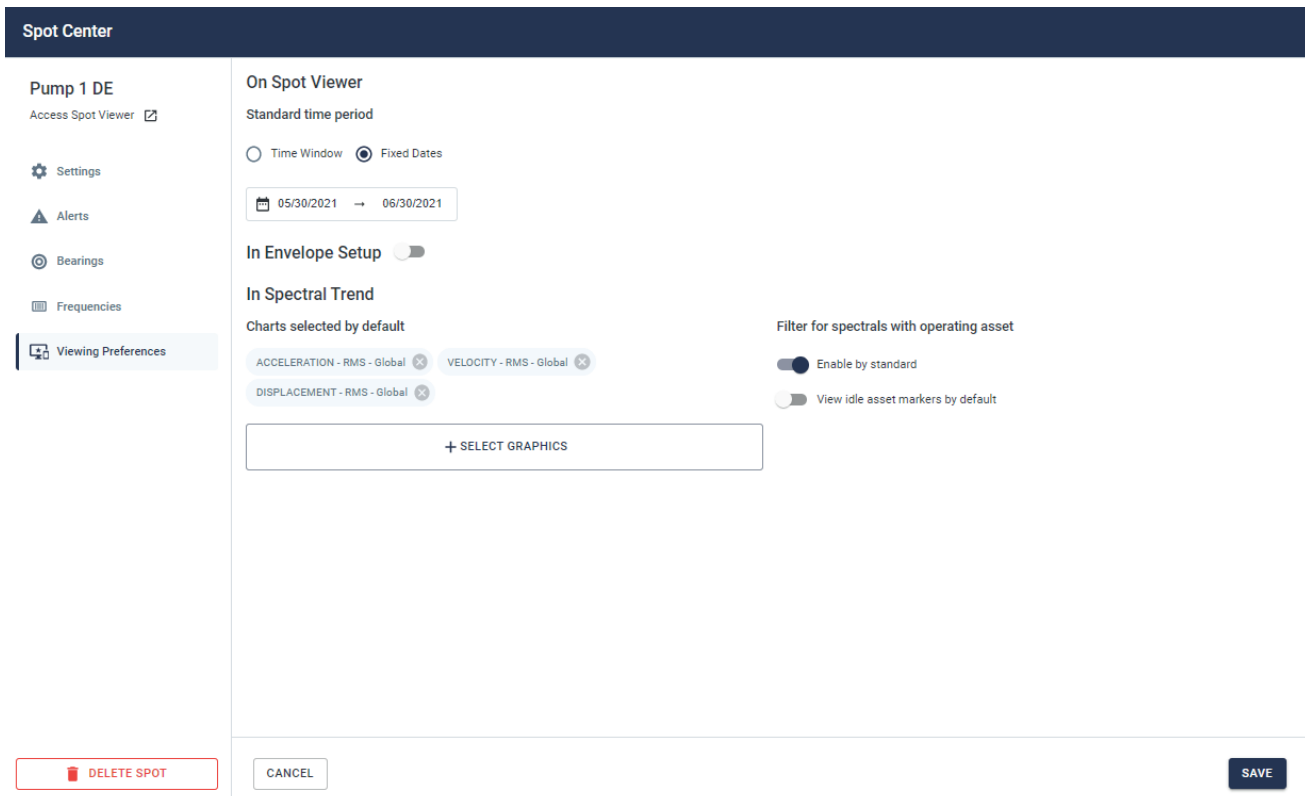
The display of these markers will be available for triggering in the spectral screen of each of the spectra obtained for the Spot, as can be seen in the example below.
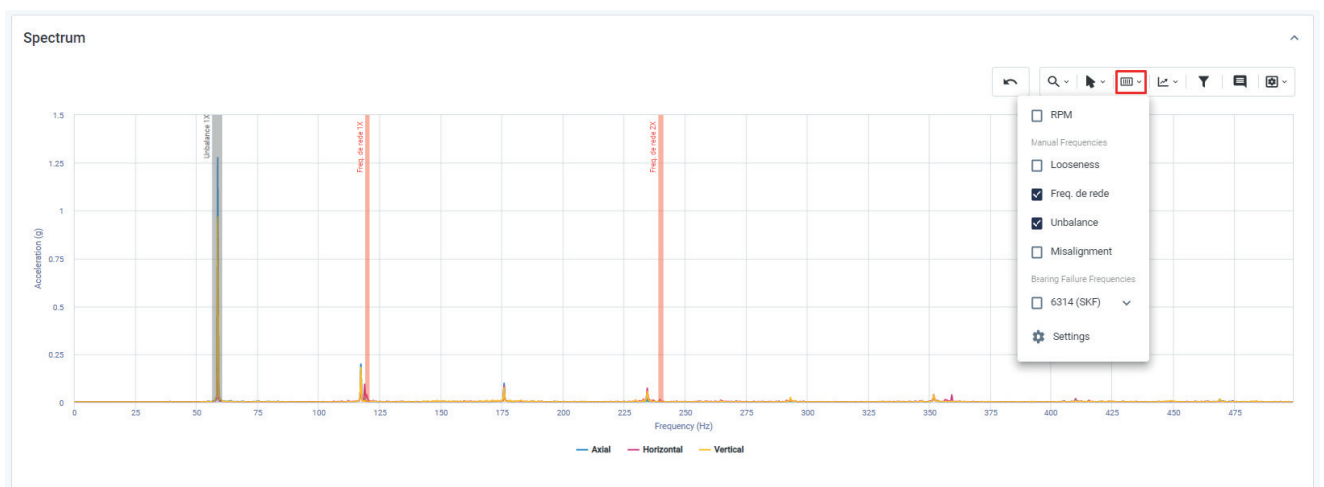
Picture: Frequency markers in vibration spectrum

8. Viewing Preferences

Also within the Spot Center, it is possible to define standardized visualization parameters for different screens of the Web Platform. The objective is to save viewing preferences for the referred Spot, in order to make navigation faster and, consequently, gain productivity in analysis.

Picture: Viewing preference settings

Spot Viewer: On this screen you can pre-set the default time period displayed when the user accesses the Spot continuous data history. The functionality impacts the way information in other fields is displayed, such as the timeline, charts, events, and predictive analytics. You can select time ranges or even a fixed date.

Envelope Settings: in the Envelope Settings option it is possible to customize and define filters so that when the user selects the option in the spectrum analysis, it is already previously set, as can be seen in the picture below. Likewise, it is also possible to define the maximum display frequency, whose value is customizable or even automatically defined by the Platform according to the main registered bearing model, taking into account the 4xBPFI reference (passage of rolling elements on the internal race) and the defined RPM.
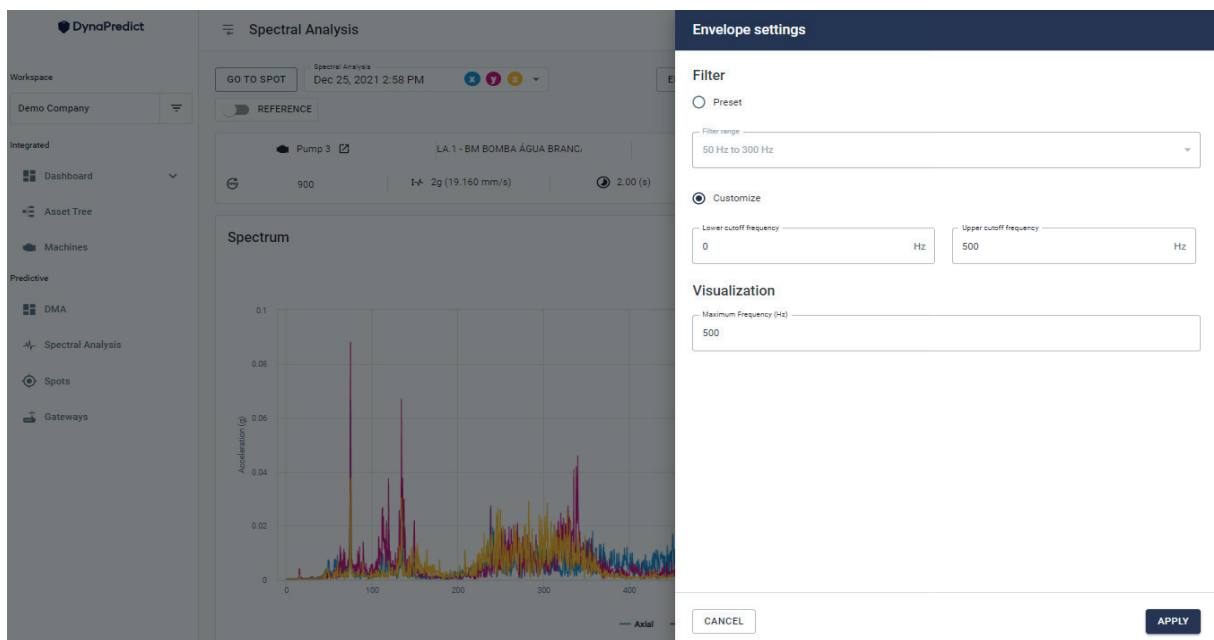
Picture: Envelope filter already customized based on viewing preferences

Spectral Trend: Similar to the Spot Viewer preferences, the Spectral Trend screen can be configured to define the standard graphs to be viewed by all users for that Spot. By default, the active graphs are always "RMS Acceleration - Global, RMS Velocity - Global and RMS Displacement - Global", as can be seen in the picture below. However, there are many other graphs available that may be even more useful in visualizing faults for the different types of assets monitored by Dynamox sensors.
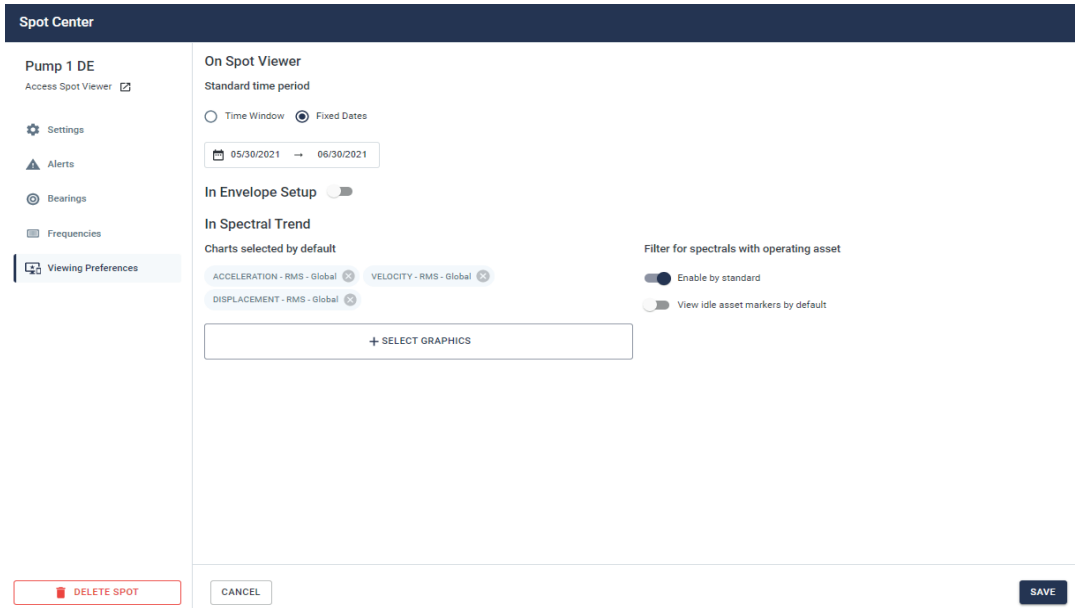
Picture: Spectral Trend Graph Viewing Preferences

To select other graph types, simply click on "+ SELECT GRAPH-ICS" and a new screen with options will be shown:
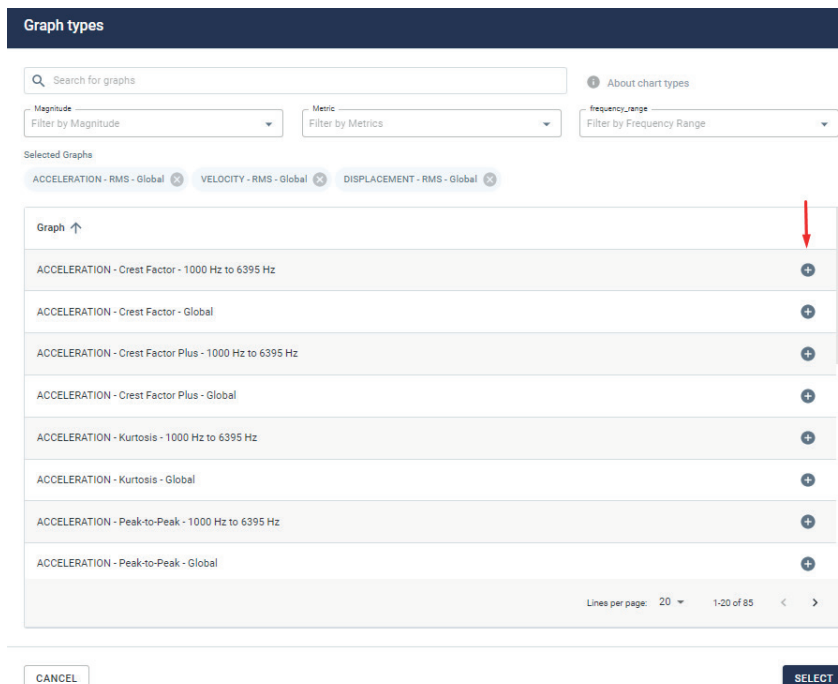
Picture: Spectral trend options

The graphs chosen in this viewing preference feature will be shown on the spectral trend screen, as per the example below.
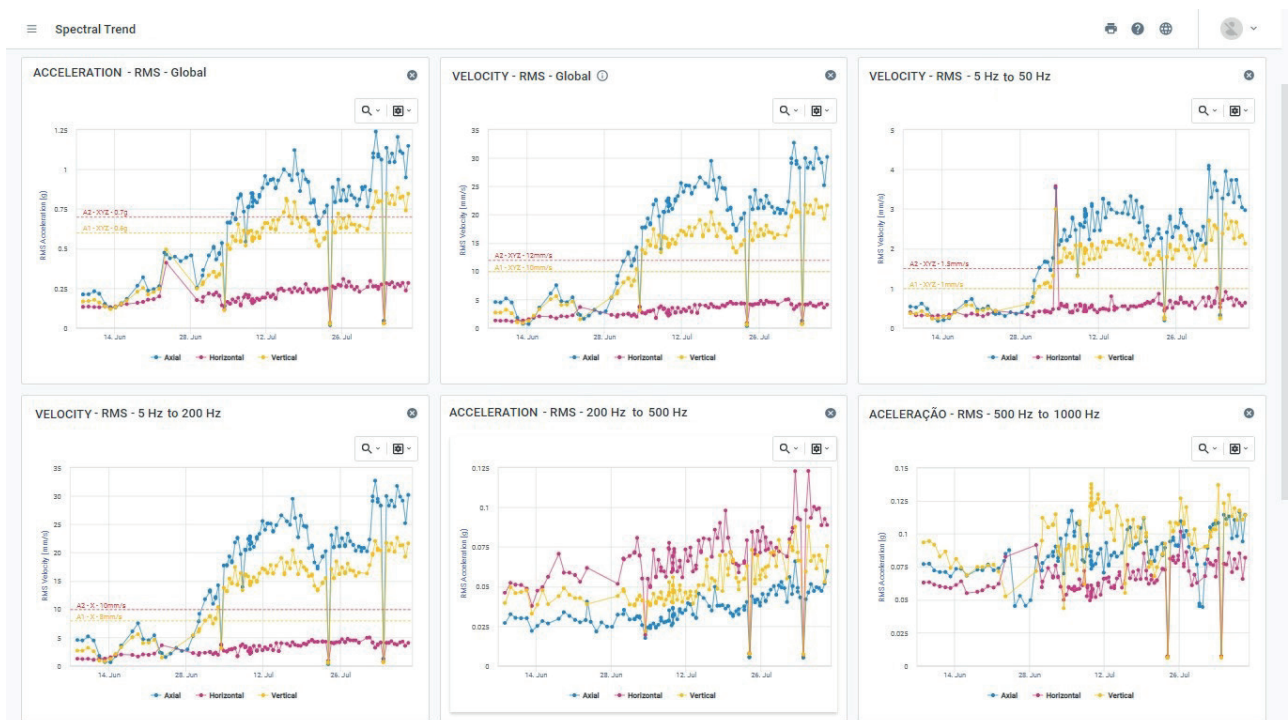
Picture: Spectral Trend with Saved Graphics via Viewing Preference.

9. Spot Edition

After creating a Spot, it may be necessary to do some parameter editing.
In the case of Web Platform editing, there are different paths that lead to the same editing screen.

1)) Through the "Spots" option in the Side Menu (image below): this screen shows all the Spots already created within the Web Platform for the chosen "Workspace" level.

At the top of the screen you can search for a specific Spot and access its editing screen through the "gear" icon highlighted in red on the picture.
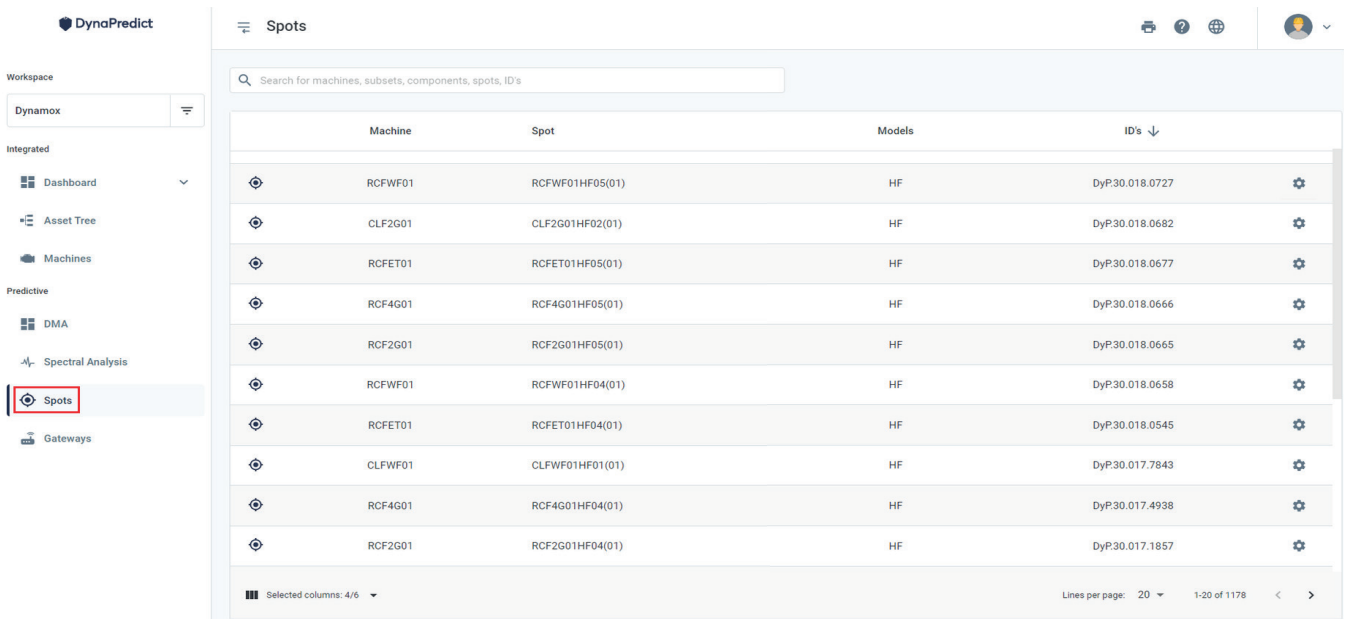
Picture: Editing Spots via the side menu, "Spots" tab.

2) Through the DMA Dashboard: in the row of each registered Spot, there is a gear symbol that allows access to the editing screen of the spot in question.
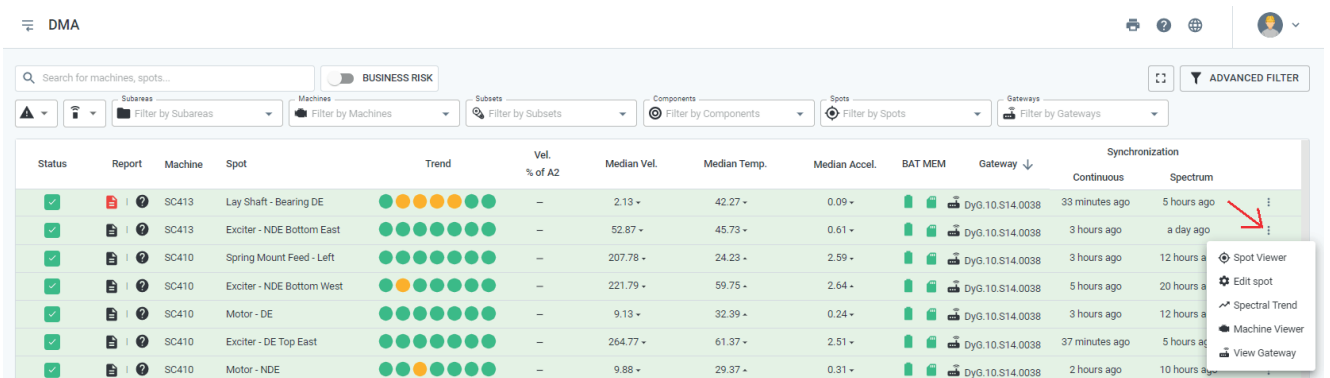
Picture: Editing Spots via the DMA Dashboard

3) From the Spot Viewer (data history) screen of each Spot: the option is available at the top of the screen under "Edit Spot".
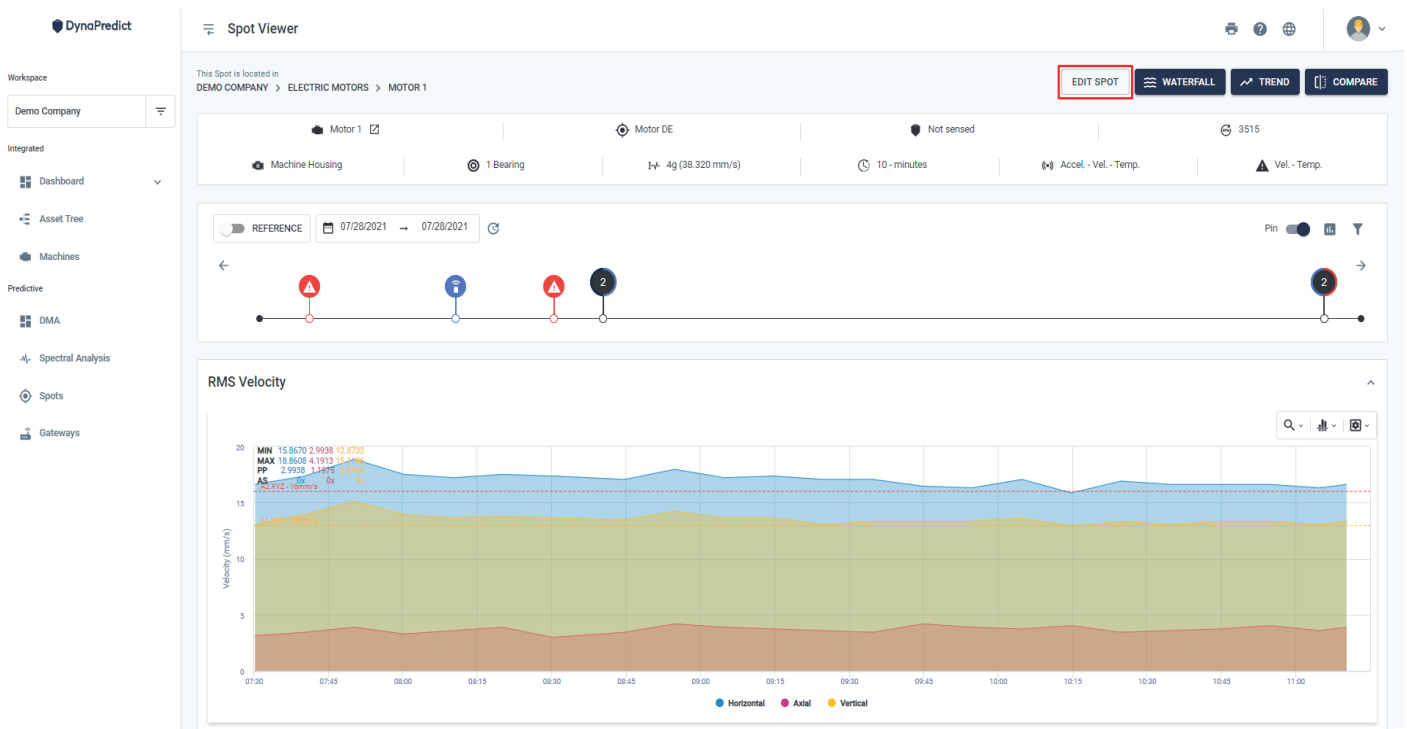
Picture: Editing a Spot using the "Spot Viewer" screen

4) Through the Asset Tree: after accessing the "MANAGE" mode, the user simply clicks on the gear symbol " ⚙ " of the Spot that he wishes to edit.
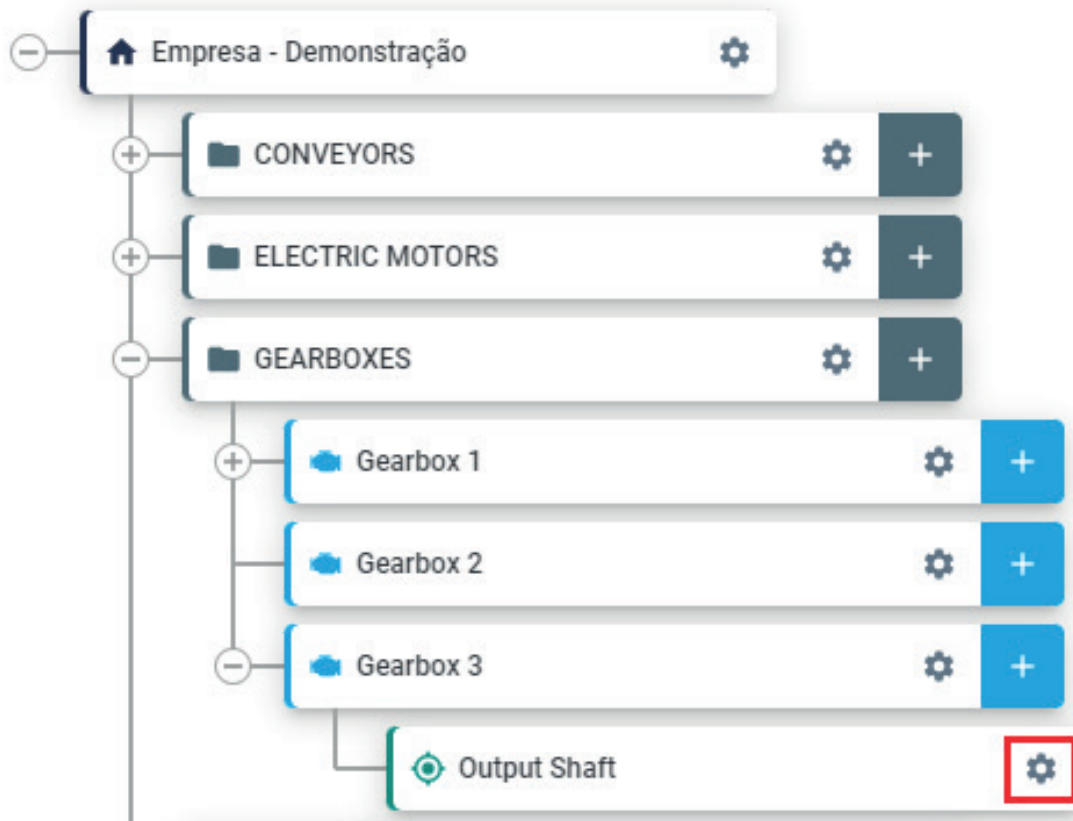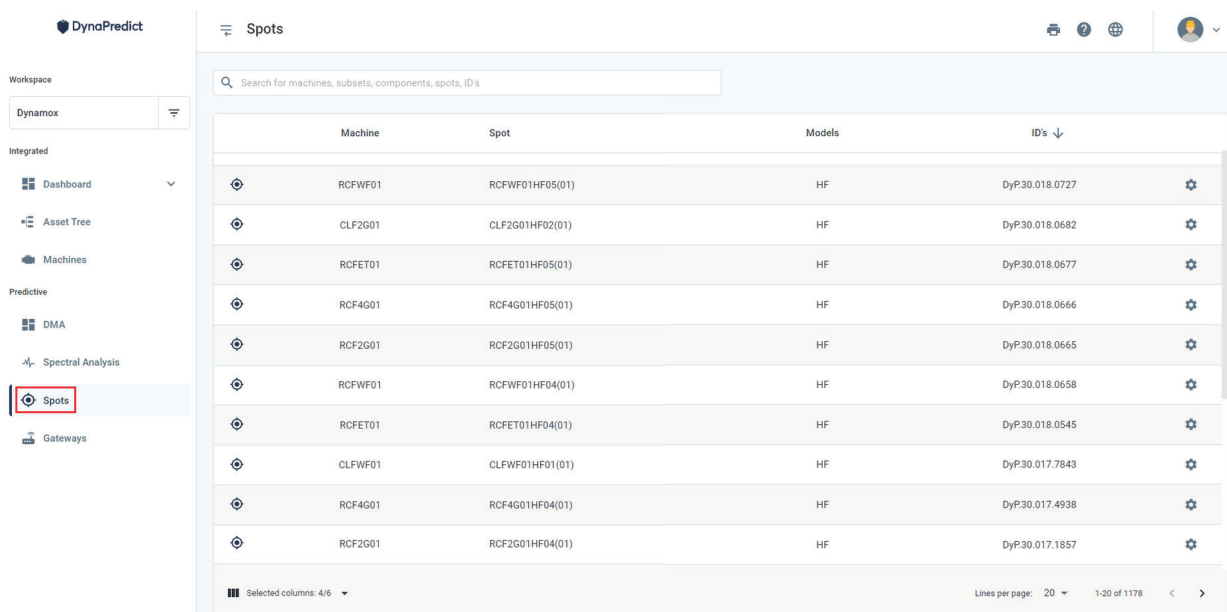
Picture: Spot Editing via the Asset Tree.

The 4 options listed above will allow the same edits to be made to the Spots. These edits are essentially the same as those that were previously registered in the Spot setup, described in the previous "Creating Spots" sections.

10. Spot List

The Spots screen, accessed through the side menu, brings information regarding all the monitoring points registered below or at the level accessed by the user, respecting the hierarchy of the asset tree. It also brings information about which machine the spot belongs to, if there is (or not) a DynaLogger associated, its model and serial number.
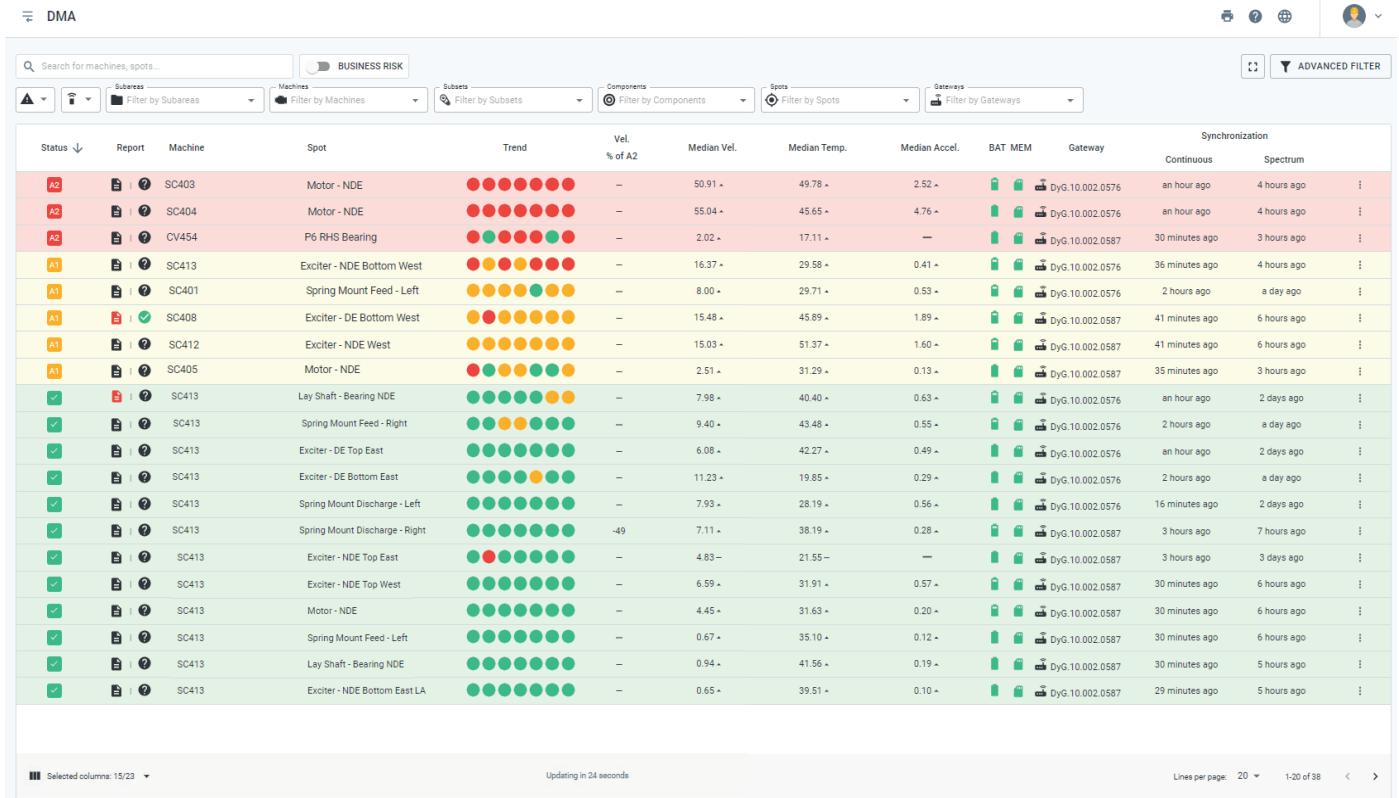
Picture: Spot List

Using the pencil symbol, the Web Platform allows users (editors and administrators) to make changes to the spots they want. After clicking on it, the "Spots Creation / Configuration" screen will be displayed.

11. DMA Dashboard

The goal of the DMA Dashboard is to support maintenance decision making and interventions by providing an overview of the Spots condition, based on previous measurements and user-defined alerts (A1 and A2).

Picture: DMA Dashboard

The Dashboard consists of the following columns:

Status: shows the current state of the spot, informing whether it has exceeded the A1 and A2 alert limits, of continuous level or by band, defined in the spot's registration. The status is updated at each new collection performed by the application or by the Gateway.

Report : status of the last "predictive analysis" performed, as well as the status of progress (open, in progress, resolved). By clicking on any of the report icons, the respective predictive report previously performed by the analyst will be opened.

Machine: Name of the machine to which the Spot is registered.

Subset : subdivision of a machine, according to the asset tree.

Component : subdivision of a subarea, according to the asset tree.

Spot : name of the monitoring point.

Trend: analyzes the Spot's variation over time. Each circle represents the worst alert level (A1 and A2) exceeded for each of the last seven days prior to the last collection date. By hovering the cursor over the circles, it is possible to view the date, the alert violated, and the estimated time that this Spot was on alert.

Median Velocity: median value of the RMS velocity on the day of the last collection. The arrow next to the value indicates the variation from the day before the last collection.

Median Temperature: median value of the temperature, in ºC, on the day of the last collection. The arrow next to the value indicates the variation in relation to the day before the last collection.

Median Acceleration: median value of the RMS acceleration on the day of the last collection. The arrow next to the value indicates the variation in relation to the day before the last collection.

Vel % of A2: Displays the percentage difference between the median value in RMS speed and the A2 alarm level, in relation to the last collection day. To learn how to configurate these levels, read "Spots Creation / Configuration".

Temp % of A2: Presents the percentage difference between the median value in temperature and the A2 alarm level, in relation to the last collection day. This indicator considers the configuration of "Spot operating levels" in order to disregard downtime values.

Accel % of A2: Presents the percentage difference between the median value in RMS acceleration and the A2 alarm level, in relation to the last collection day. This indicator takes into account the configuration of "Spot operating levels" in order to disregard downtime values.

BAT: Estimation of the remaining battery of the DynaLogger associated with the Spot.

MEM: indicates the remaining storage capacity of the DynaLogger memory. The memory length depends on the sampling interval, i.e. how often the DynaLogger collects and stores data. This interval can be queried by hovering the mouse over the memory card icon of the desired spot. They are divided into 4 colors:

  More than 40% free memory.

  Between 20% and 40% free memory.

🟥 Less than 20% free memory;

⬜ Memory full. When this happens, the DynaLogger stops collecting data, keeping the already collected data.

Note: Whenever data from a DynaLogger is collected, either by the Application or by the Gateway, the internal memory of the device is erased.

Gateway: If the Spot is associated with a gateway, for automated collection, the gateway's serial number will be shown. If the user wants to access information about a specific gateway, just click on the serial number.

Last General Synchronization: Shows the date of the last synchronization, that is, the date of the last measurement point collected for this Spot.

Last Continuous Synchronization: Shows the date of the last continuous synchronization, that is, the date of the last continuous data collection point collected for this Spot.

Last Spectral Synchronization: mostra a data da última sincronização espectral, ou seja, data do último espectro para esse spot;

Filter Columns in Tables: through the " ▥ Selected columns: 16/23 ▾ " option located in the lower left corner of the DMA screen, a window opens listing all columns that can be displayed/hidden. This allows the user to determine which columns will be shown in the tables, in order to display only the relevant items to the analy-
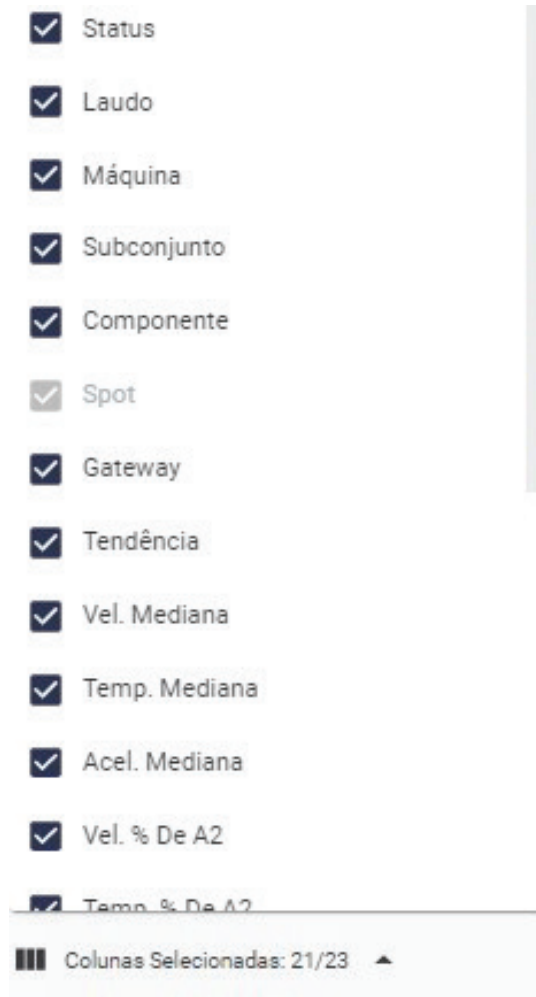
Picture: Selectable columns in the DMA

In addition, in the upper left corner of the page there is a search bar and an advanced filter, which allows you to search by various options, such as by a machine, Spot, or serial number of a specific DynaLogger.
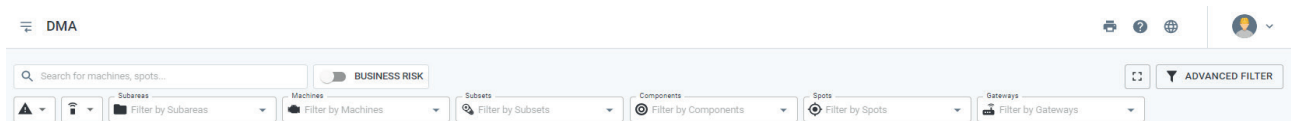
Picture: Advanced filters and search bar

In addition, by selecting the " ⋮ " option at the end of each of the Dashboard lines, quick shortcuts are shown so that the user can continue navigating the Platform and obtain specific informations from the spots.

◉ Spot Viewer

⚙ Edit spot

↗ Spectral Trend

🗖 Machine Viewer

📶 View Gateway

📄 Analysis Report
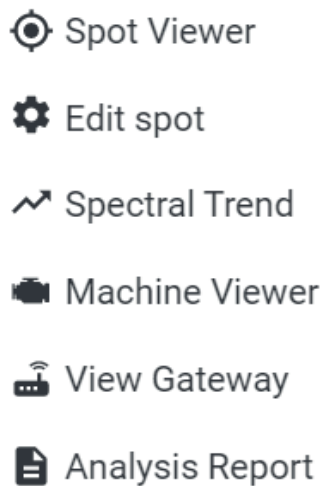
Picture: Navigation shortcuts

12. Alert visualization in the Asset Tree

Another possible page for viewing alerts, in addition to the DMA screen, is the asset tree screen.

Before getting into the detail of the alerts, at the top of the page is the search field to search by subwork areas, machines, subsets, components and Spots.

Note: If the search is for a component, subset or Spot, it is necessary to expand the machine where these are located so that the Platform can search the items within it.
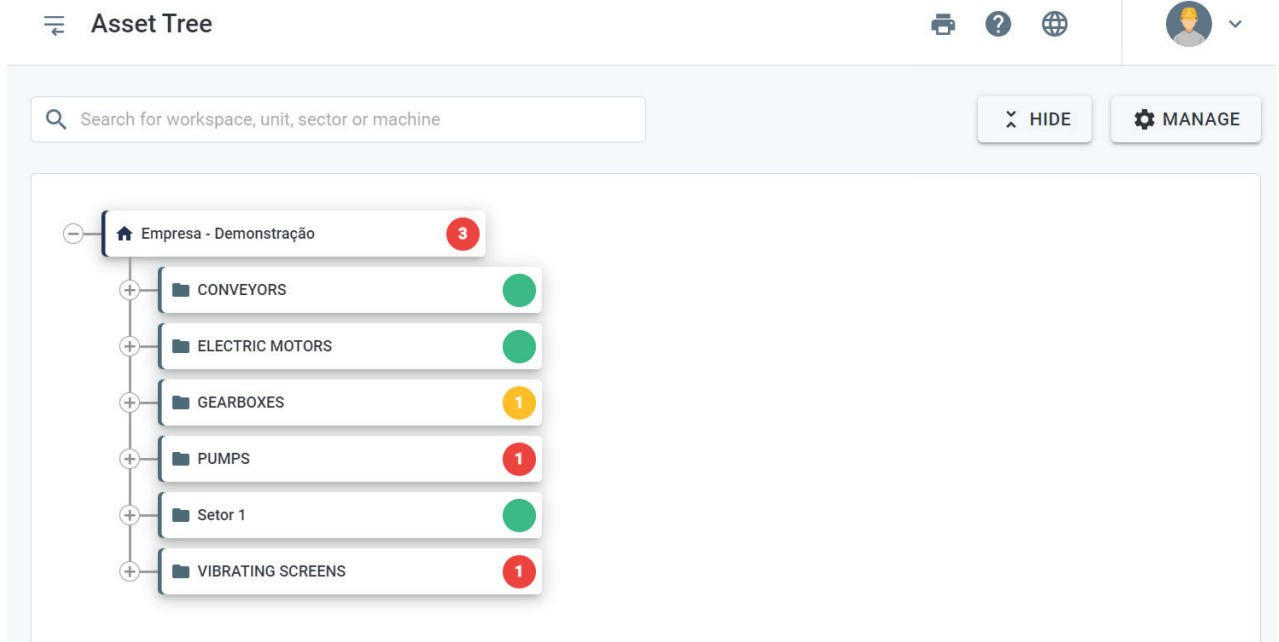
Figura: Árvore de Ativos e barra de pesquisa

Next to the name of each workspace, folder and machine is a circle indicating the number of monitored points that have or have not triggered one of the alerts (A1/A2). The arrangement of the alert icons is as follows:

🔴 Alert A2: Next to the name of each workspace, folder and machine is a circle indicating the number of monitored points that have or have not triggered one of the alerts (A1/A2). The arrangement of the alert icons is as follows:

🟡 Alert A1: When you hover the mouse over the yellow icon, the number of triggered A1 alerts will be displayed. The number in the center of the circle refers only to alerts of type A1 (yellow).

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● No alerts: The condition of the selected level is within the normal range defined by alerts in the platform, with no alerts triggered. This icon will also be displayed in cases where no alert has been registered.

Note: If the selected level is a folder, machine, subset or component, i.e, that can have more than one Spot associated, when you hover the mouse over the alerts icon in the asset tree, the number of each of the aforementioned status types will be displayed, as follows:
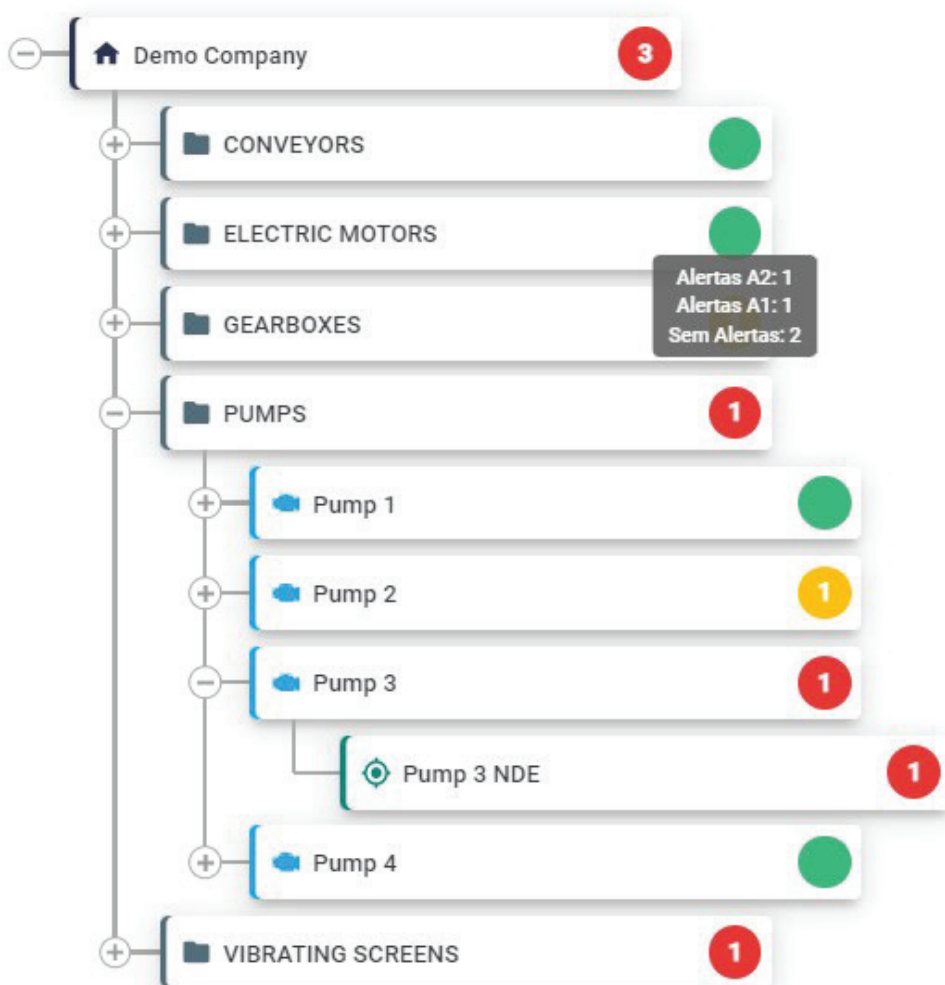
Picture: Alerts tab

13. Spot Viewer - RMS Velocity, Temperature and RMS Acceleration History

The telemetry data (continuous data) of vibration and temperature are obtained based on the sample interval configured for each sensor within its respective spot. This interval is configurable in "Spots Creation / Configuration" and is visible in the vibration and temperature data history screen, called the Spot Viewer.

Note: the most common way to access this screen is via the "Dashboard DMA".
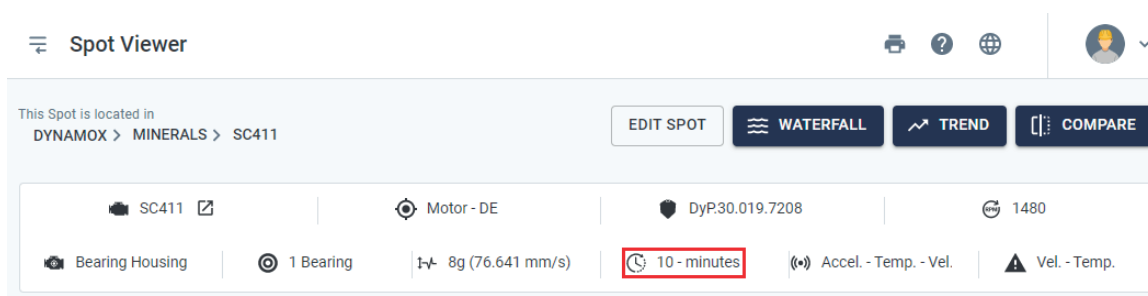
Picture: Spot Viewer screen with selected sample interval information

Based on this interval, vibration graphs (RMS velocity and/or RMS acceleration) and contact temperature will be presented, where each measurement point was obtained precisely according to the time set in the interval.

As will be shown below, this type of chart allows for basic monitoring of a machine's operating levels, quickly pointing out any deviation from the expected standard.

RMS Velocity

Just below the header shown in the image above, the first vibration graph is displayed: the RMS velocity graph, presented in triaxial form, i.e. in the three axes. In the footer, by clicking on the name of the axis, you can activate or deactivate the displayed axes by clicking on each text
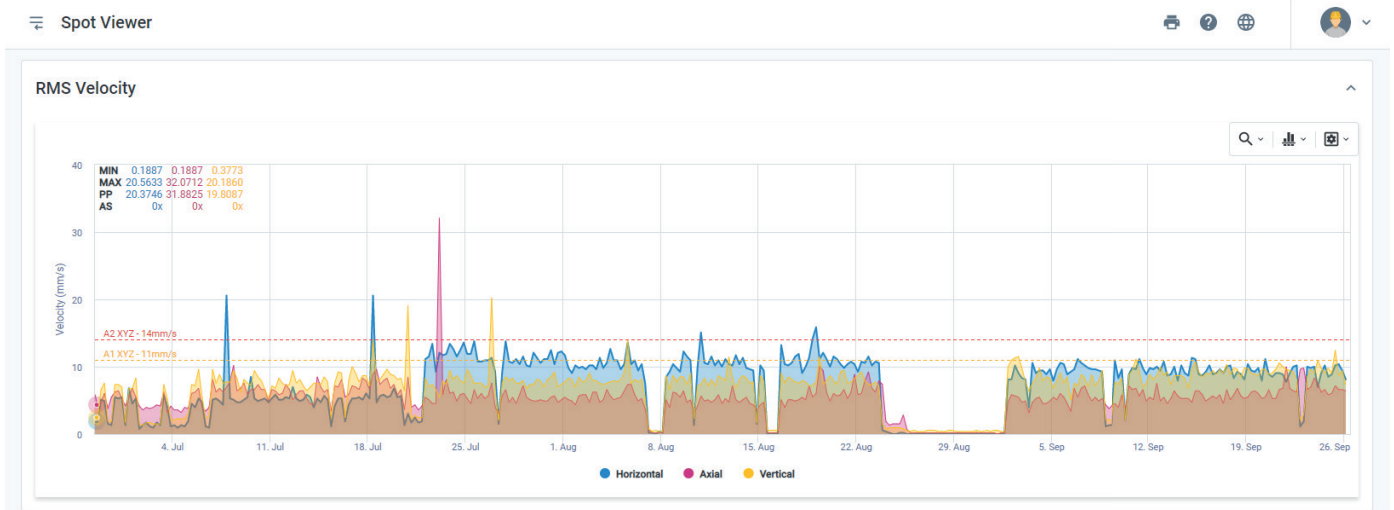
Picture: Graph of velocity over time per axis

Note: the yellow and red dotted lines correspond to the alerts configured for this point. For more details, see the link.

Temperature

Below the RMS velocity graph the temperature graph is exhibited with values also measured based on the sample interval.

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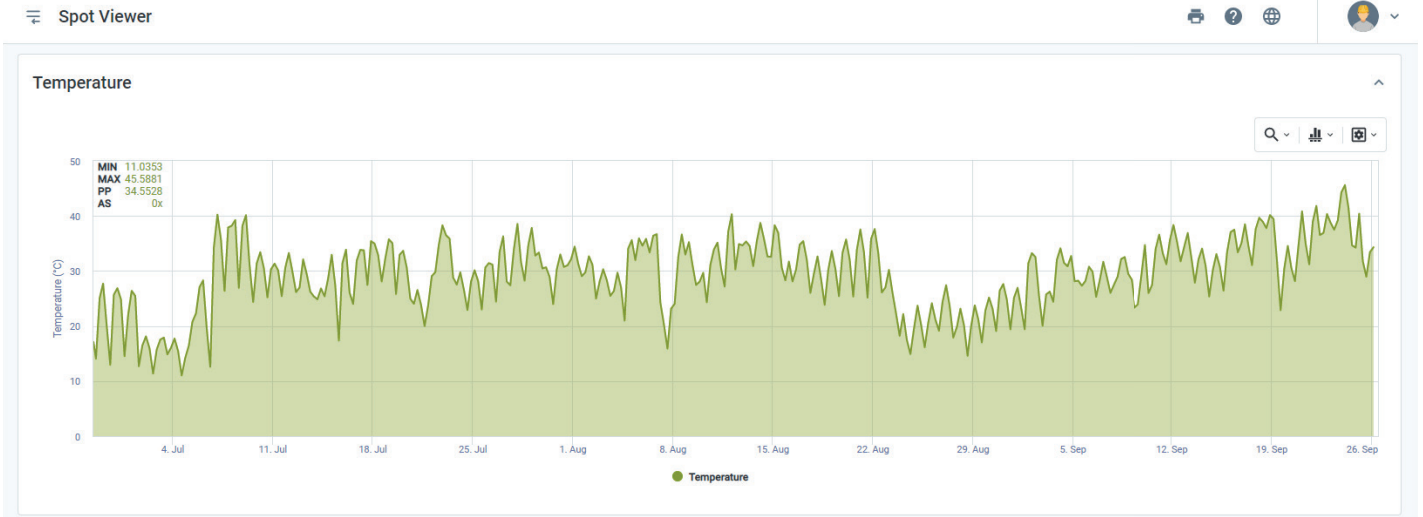
Picture: Temperature graph over time

RMS Acceleration

Finally, at the bottom of the page, the RMS acceleration graph is displayed. This is another way to track the vibration levels of the monitored asset.
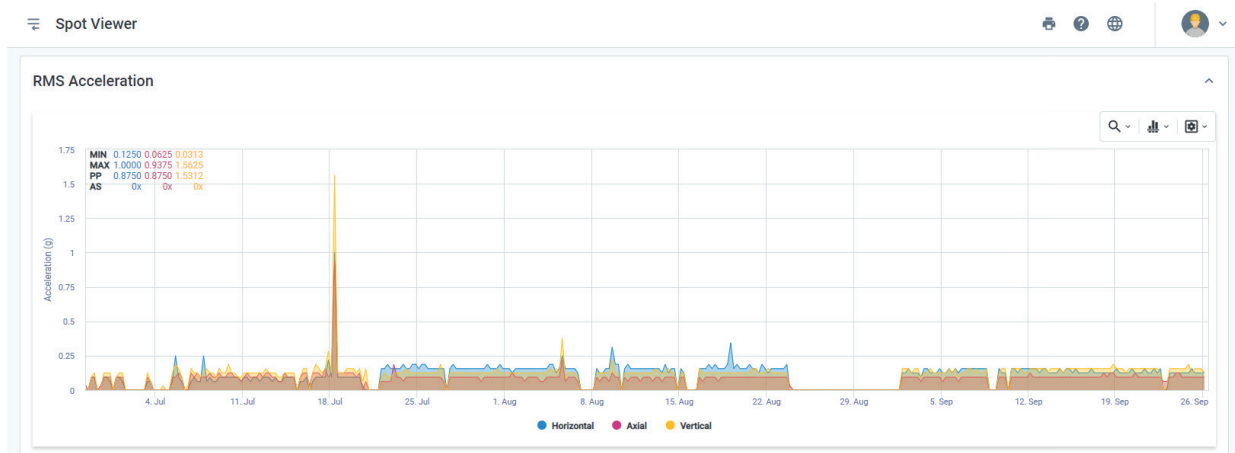
Picture: Graph of acceleration over time per axis

Note: once again, the alert levels configured in the yellow and red dotted worksheets can be seen. Note that in this case, the monitored machine presents a strong evolution of vibration levels, even passing the configured alarm levels.

Using the function box, present in the upper right corner of the chart, you can access the following tools:

1) Zoom Tools
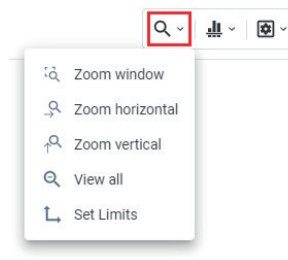
Picture: Alerts Tab

The zoom tools can be used to view a specific part of the graph. Zooming can be done directly on the axis (horizontal X/Vertical Y) or both at the same time (XY window). The default zoom is set to 'horizontal'. To set axis limits for zooming, select 'Set Limits'. To return to the original view, select 'View All'.

2) Analysis Tools
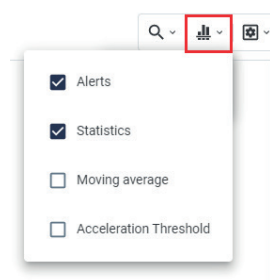
Picture: Analysis Tools

The analysis tools have four functionalities:

Alerts - Plots alert levels A1 and A2 on the chart. This option will only be available in Spots that have previously defined alerts.

Statistics - Displays the maximum, minimum, and peak-to-peak RMS speed values for the selected period;

Moving Average - Used to smooth out short fluctuations and highlight long-term trends. Below is an example of an RMS velocity graph with moving average enabled for the axial axis.
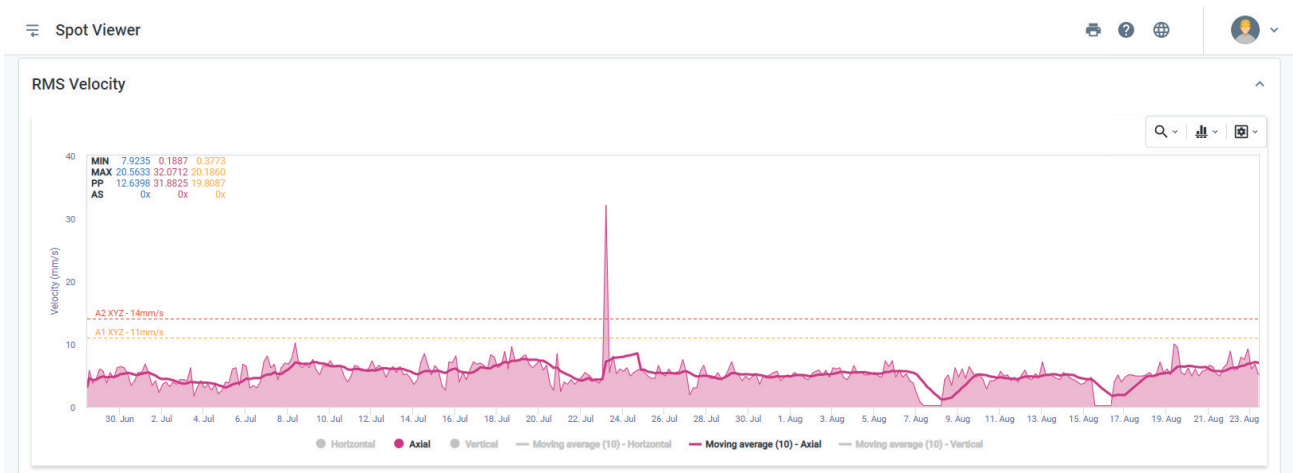
Picture: RMS velocity graph with moving average enabled

Acceleration Threshold - allows you to plot the minimum and maximum acceleration thresholds configured in Spot creation, to check the instants when the machine is operating under stress or moments of stopped machinery.

3) Viewing Options
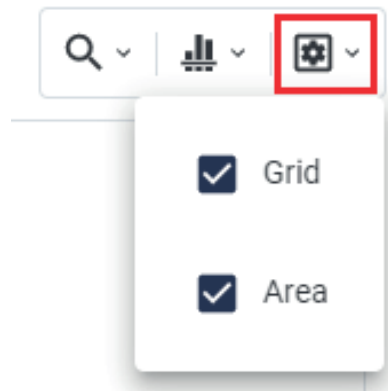
Picture: Viewing Options

The viewing options have two features:

Grid - Plots the grid lines at significant intervals on the graph;

Area - Adds or removes the color filling below each line of the graph.

13.1 Timeline in the Spot Viewer

After the Spot's header registration, the Timeline is displayed, which chronologically presents the events that occurred in the Spot in question during the selected period.

To navigate through the calendar, you can click on it, just above the timeline, to set the start and end of the displayed data.

By default, the Platform shows the period referring to the last 7 days. For a better usability of the user, by clicking on the "   ⟳   " icon, to the right of the calendar, it is possible to select pre-selected periods, among them: last 24 hours, last 7, 15, 30, 60, or 90 days.
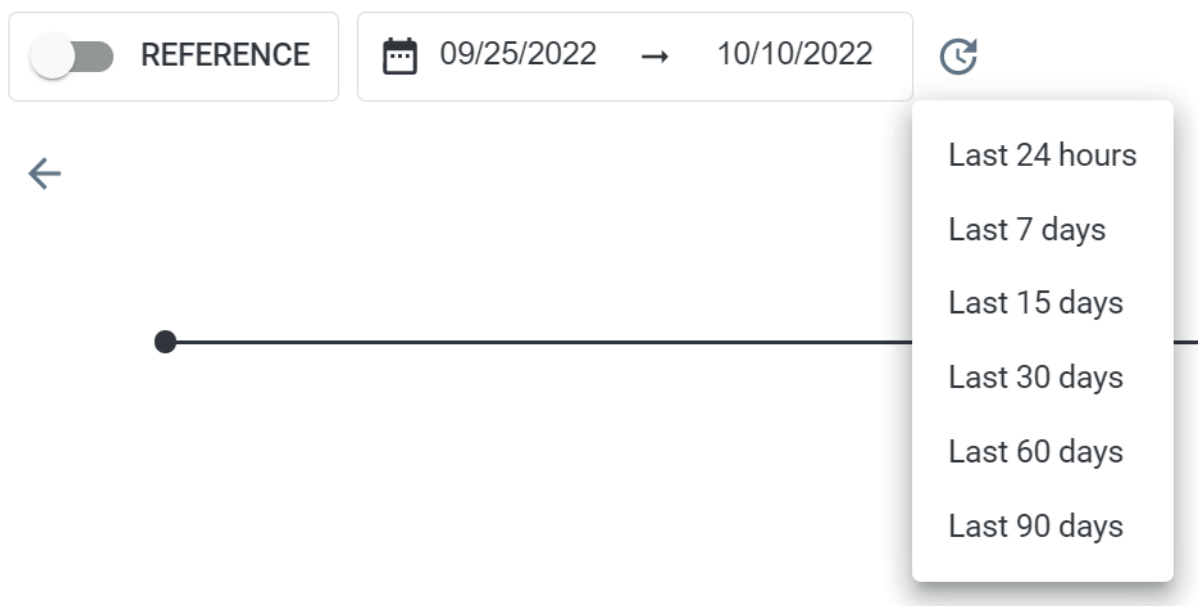
Picture: Calendar of the spot viewer screen

Currently there are several types of events: continuous data collection, spectral analysis collection, report emission (predictive analysis), Spot parameterization, Spot created/deleted, A2 Alert, and commented events only.

Picture: Timeline and events related to the Spot

The icons displayed on the timeline follow the pattern below:

Spectral Analysis: through this icon the user can access a spectral analysis performed in Spot. After clicking on the icon, a tab will be displayed with information such as creation date, defined axes, the person responsible and the event agent, the synchronization date, preview of the graph for user viewing, among others.

Collection: Collection available data from the sensor memory based on the sample interval chosen for the Spot. This event, as well as the Spectral Analysis, can be generated by Gateway or by an inspector collecting via field application. By clicking on the icon it is possible to know the source of the collection as well as its time information.

Parameterization Event: editing event performed by a user. By clicking on the event it is possible to see which change was made, who was responsible for it, and at what moment (on the timeline) it was made.

Predictive Analysis: issuing predictive analysis report, based on data from vibration and temperature sensors. By clicking on the icon, the information of the user who performed the analysis and the shortcut for the report will be displayed. This icon has color interactivity, that is, its color is displayed according to the criticality assigned by the analyst when making the report. By default, there are: green, yellow and red, which relate, respectively, to normal, alert and intervention levels.

A2 Alert: Alert type A2 triggered on the Spot. Clicking on the icon will display information such as: agent (Gateway or application collection), metric (speed, acceleration, or temperature), time that the Spot was above specified levels and the configured value of alerts across all metrics.

⊚ Spot Created/Deleted: Spot creation event visualized. Clicking on the icon will display information about the user who created the spot, the settings made and through which way (application or platform) the monitoring point was created. In the case of a Spot deletion event, the icon will appear in red.

All icons can be accessed by selecting their respective functionality in the alternatives menu of the event filter.
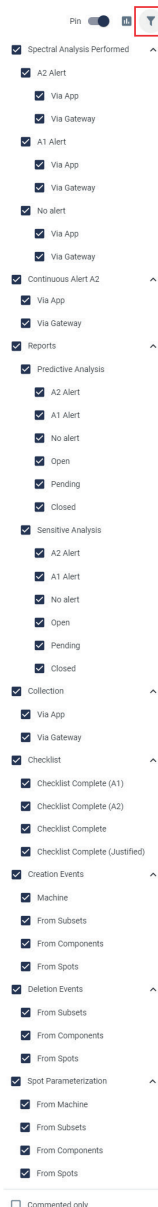
Picture: Timeline events filter

There is also the option to pin or unpin the timeline from the top of the page, using " Pin ⬤ ". Next to this is the " 📊 " icon, which takes the user to a tabular view of the machine timeline, entitled Event Report. This type of data visualization follows the same pattern of icons used in the timeline, described above. Similarly, information about the user who performed the action and which Spot was involved in the event is displayed.

Users are also able to leave comments on a timeline event (collection, spectral, parameterization) that can be answered by other colleagues in the form of a "conversation". Each comment has date/time information and it will be possible for users to edit or delete their own comments. Events that have comments appear on the timeline highlighted with a red circle, shown in the example below:
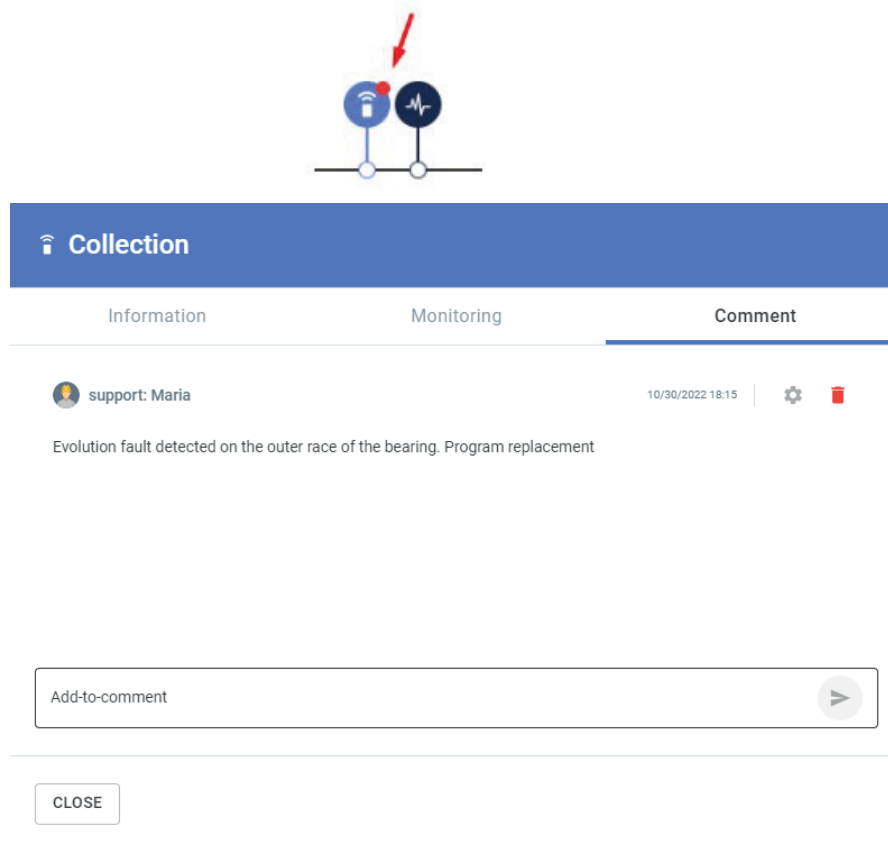
Picture: Comments tab for an event that occurred on the Spot timeline

13.2 Temporal Reference

One of the features available in the Spot Viewer screen is to select a continuous collection period as a reference for future analysis.

For example, after implementing a maintenance action and knowing that the asset is functioning properly, the post-implementation period can be used as a time reference. This way, at any time in the future, the reference can be accessed to make a comparison with the current vibration and temperature data.

To configure the reference period, just click on the REFERENCE option, paying attention to choose the correct period through the start and end dates.
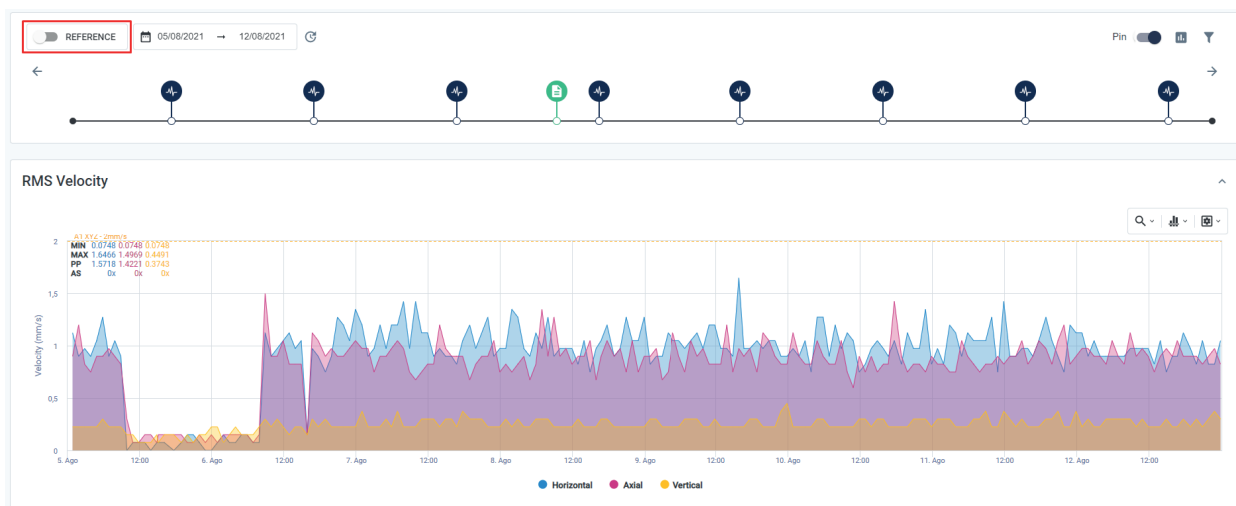
Picture: Enable period as reference in the "Spot Viewer"

In any future analysis, to view the chosen reference, simply click on the clock button, which is next to the date options, and select "View Reference".
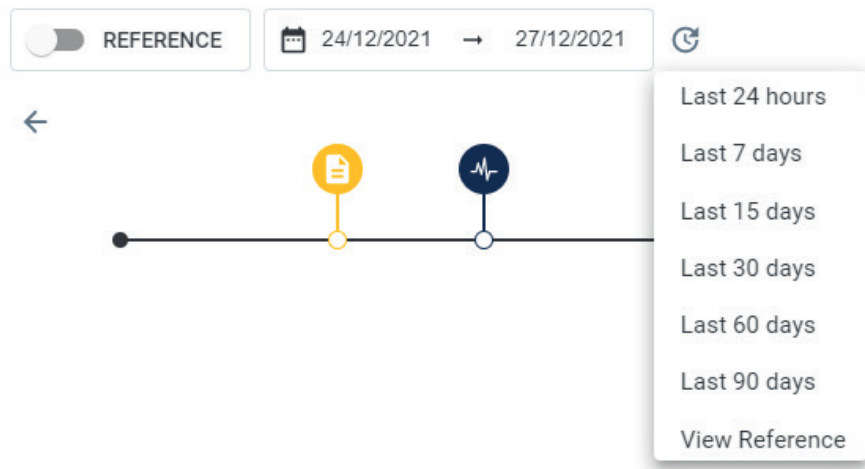
Picture: Viewing the selected reference

13.3 Compare Tool

The Compare tool makes it possible to compare continuous data from different time periods side by side.

The option is available in the upper right corner of the Spot Viewer screen.
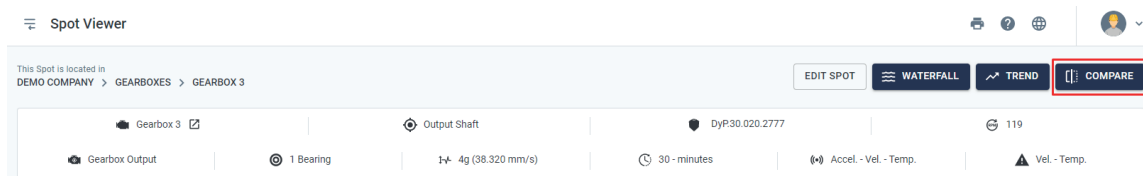
Picture: Compare tool

After selecting the desired Spot, the data will appear side by side. You can change the desired period on each side.
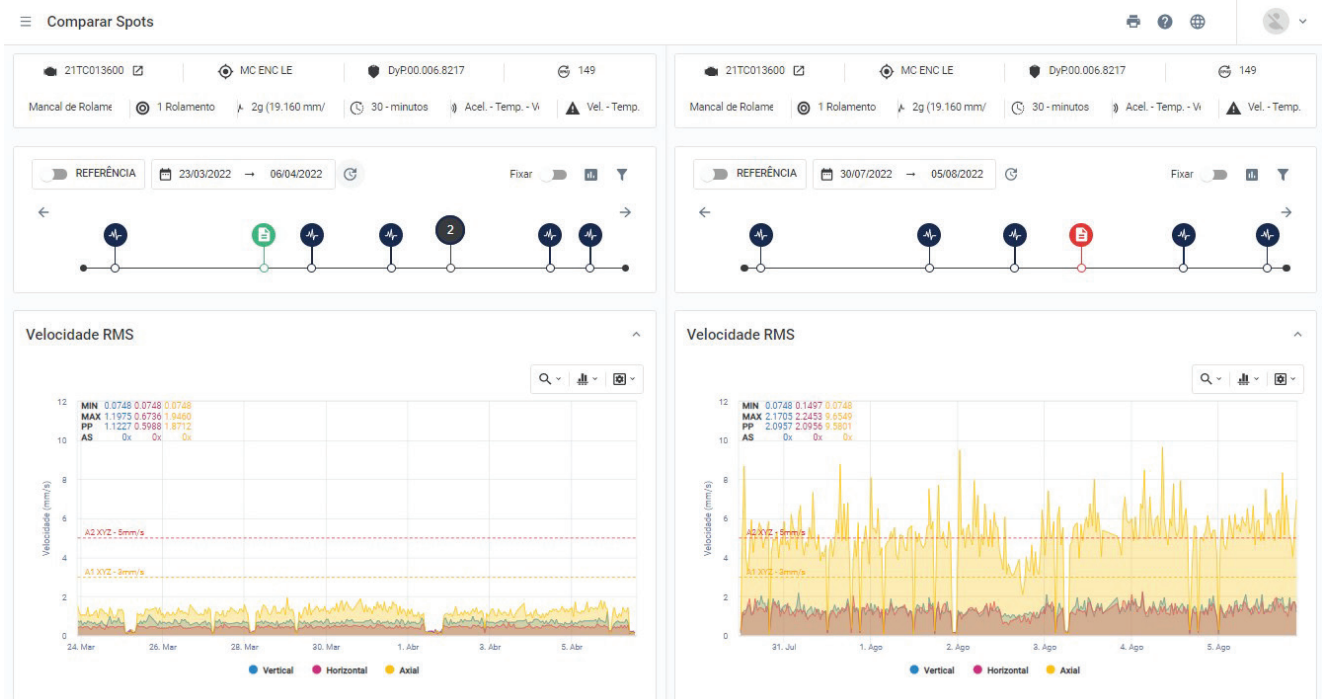
**Picture: Comparison of continuous data from a conveyor belt bearing.
Left side: post-maintenance levels. Right side: high levels, intervention report already issued.**

This tool can be relevant for adding comparison images to the reports / predictive analyses, thus making the reports richer and more visual.

Note: It is possible to compare two different Spots in different time periods. The customization and choice is under the user's control. It is worth mentioning that all analysis tools, markers and the tools alike are also available in the comparison view.

14. Accessing the Vibration Spectral Screen

Vibration Spectra is useful for failure mode analysis in industrial machinery. Through them, it is possible to identify what

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type of defect is evolving or appearing in the asset, in order to schedule maintenance and avoid corrective stops in the production line.

Access to the spectral analysis screen occurs in several ways within the Web Platform. Below we will mention the main ones:

1) Through the timeline of each Spot or machine

The spectra are accessible via the spectral analysis icon ⏺ on the timeline in the data history screen, present in the Machine Viewer and Spot Viewer screens. When you select the icon, a summary window with details of the spectra will be displayed. In the summary window you can access general information, a simplified version of the graph, and insert or view any comments entered by users.

Picture: Event Report - Spectral Analysis

The complete chart, with all the tools, can be accessed by clicking on the "Open Graph" button on the screen above or directly on the icon, as shown below:
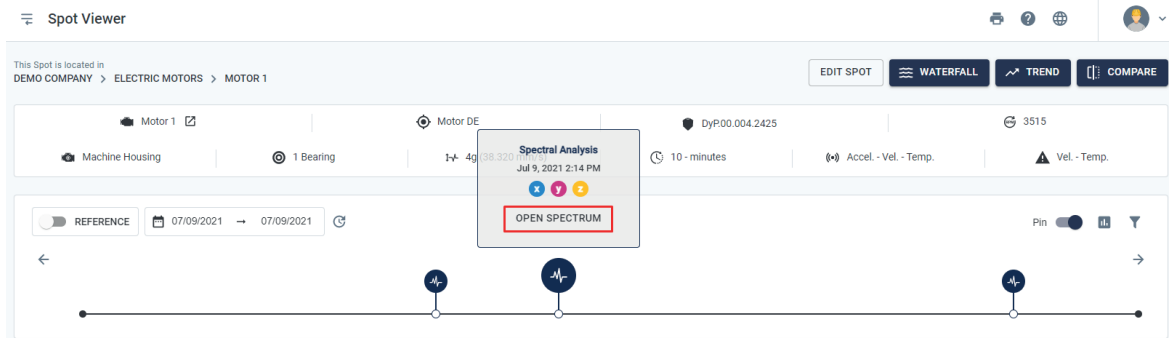
Picture: Spectra access via timeline

2) Access via spectral trend

This is done by clicking on the Spectral Trend graph point. As discussed in this link, each point of the spectral trend represents a spectrum, with its respective date and time of realization. When selecting one of the points on the graph, the spectrum of that moment is opened on a new screen.
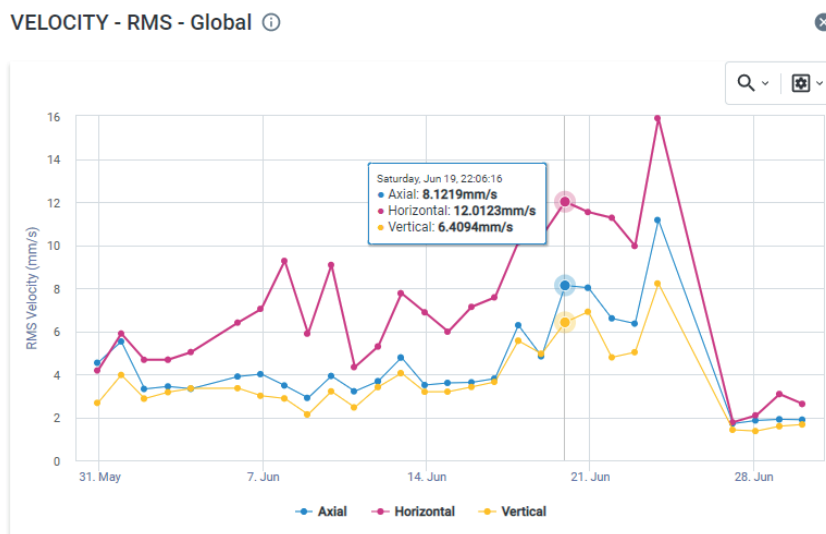
Picture: Spectral Trend - accessing the spectral at a desired point

3) Through the "Spectral Analysis" screen in the side menu

The user can access a list of all the spectra performed in the sector or plant to which he is logged in through "Spectral Analysis" in the side menu.
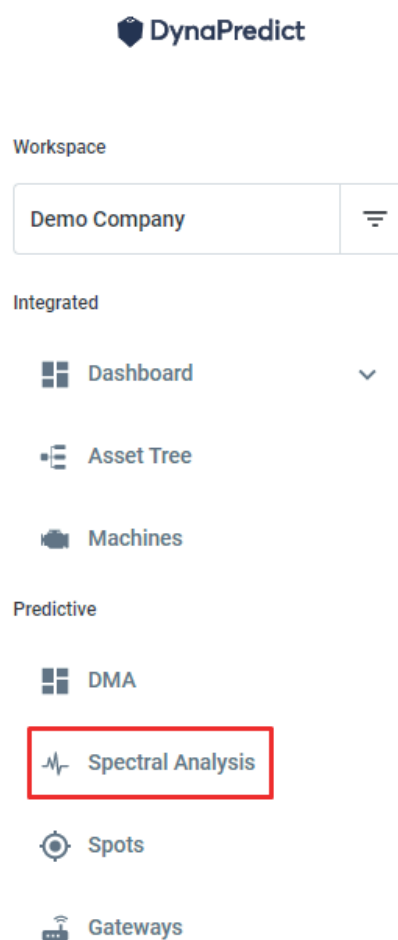
Picture: Spectral Analysis option in the side menu

When accessing this screen, the user can filter by various items, such as machine, Spot, or serial number of a DynaLogger.
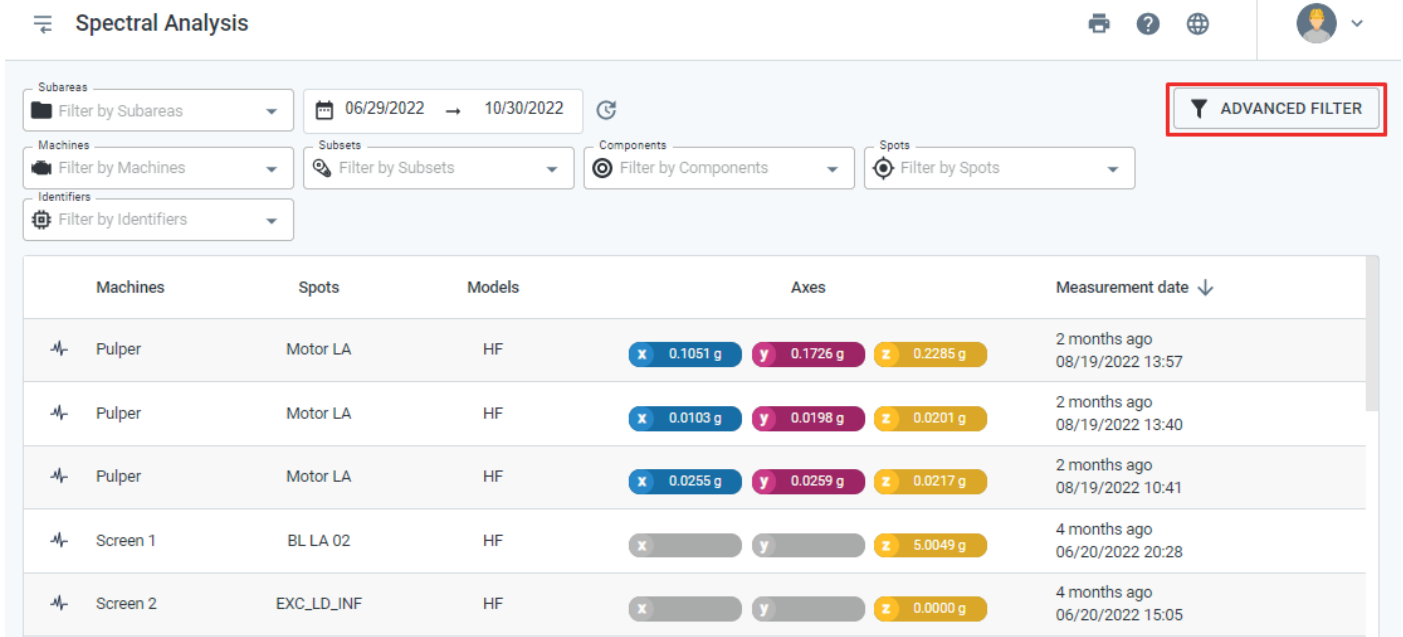
Picture: Spectral list with selectable filters

When using any of the three ways mentioned above, the spectral screen will open, displaying the spectrum in the frequency domain and the waveform in the time domain. The screens and functionality of the spectral analysis will be detailed in subsequent sections.

15. Spectral Trend Graphs

The user can follow the trend of the data from his spectral collections, i.e., graphs with the energy present in each spectral collection performed. The tool is available via the "TREND" button in the upper right corner of the Spot

By clicking this button, the user will be taken to the "Spectral Trend" screen and will find by default the global RMS level trends for acceleration, velocity, and displacement.

With this tool, it will be possible to view the spectral measurements history in a very visual way, thus highlighting possible evolutions in the vibration levels of the machinery.
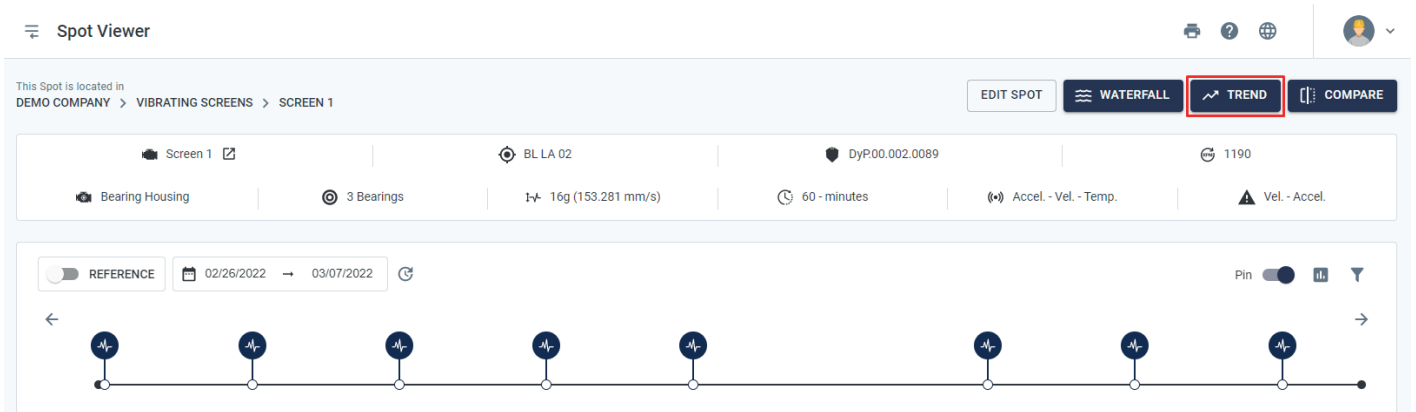
Picture: Accessing the spectral trend screen via spot viewer
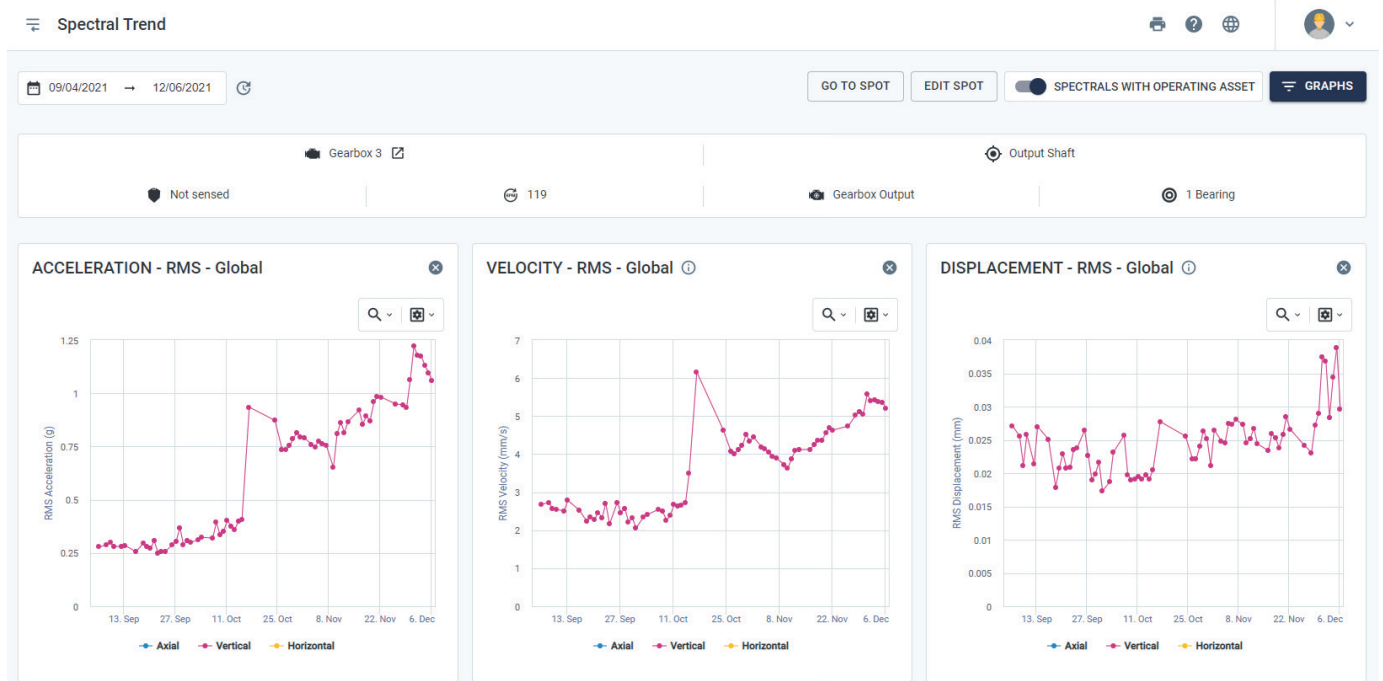
Picture: Standard spectral trend with plots of acceleration, velocity and displacement

Clicking on one of the graph points takes you to the spectral analysis screen for the time at which the spectrum was recorded. The arrangement of the graph data takes into account the time period selected in the header at the top of the screen.

This tool also allows the user to select metrics by frequency bands, highlighting evolutions in the vibration pattern of different machine components. For this, the Platform makes available more than 80 types of graphics, through the GRAPHS button in the upper right corner.

The available graphs provide global metrics by frequency range and several others. In addition, you can add multiple graphs side by side to compare data trends. Some chart options are described in the picture:
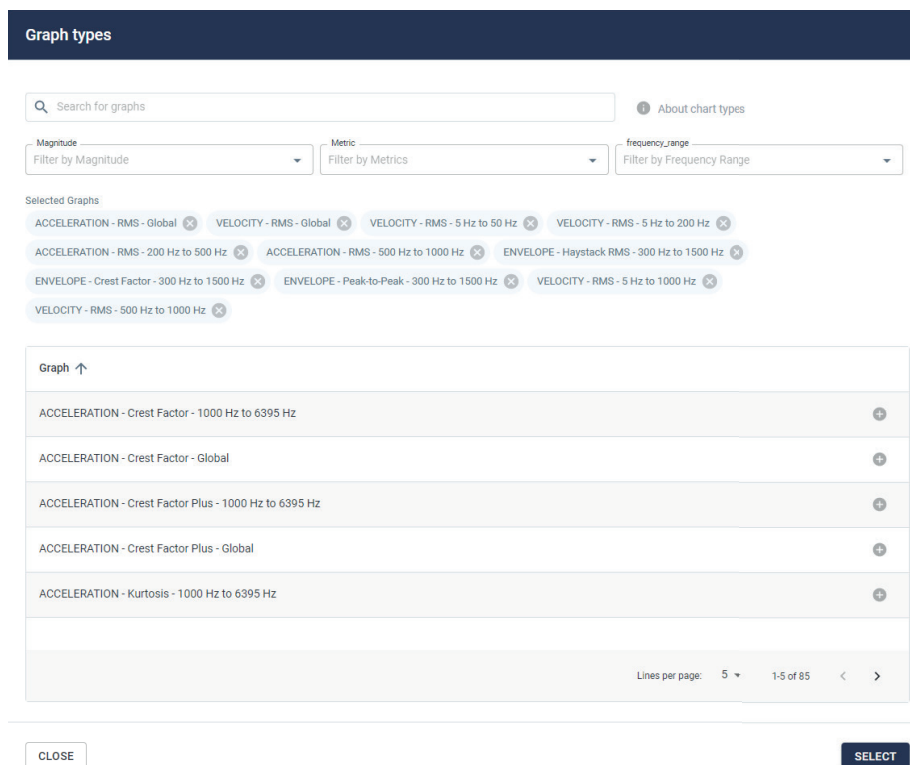
Picture: Selection of Spectral Trend Graph Types

After selecting the desired graphs and reloading the page, the new charts will be shown, as in an example below. In this case the RMS - Global displacement graph was removed and graphs per band were added, like the third one shown below, for "Velocity - RMS - 5 Hz to 50 Hz".

Picture: Spectral trend graphs in different bands and metrics

The "GRAPHICS" option momentarily saves the visualization of the chosen graphics. To save permanently for the Spot in question, the user must save the graphics via the viewing preferences tool.V

16. Vibration Spectrum Analysis

When accessing a spectrum in the Web Platform, first the spectral in the frequency domain is displayed for the active, accelerating axes. Information is also available for the velocity and displacement quantities (see Metrics section).
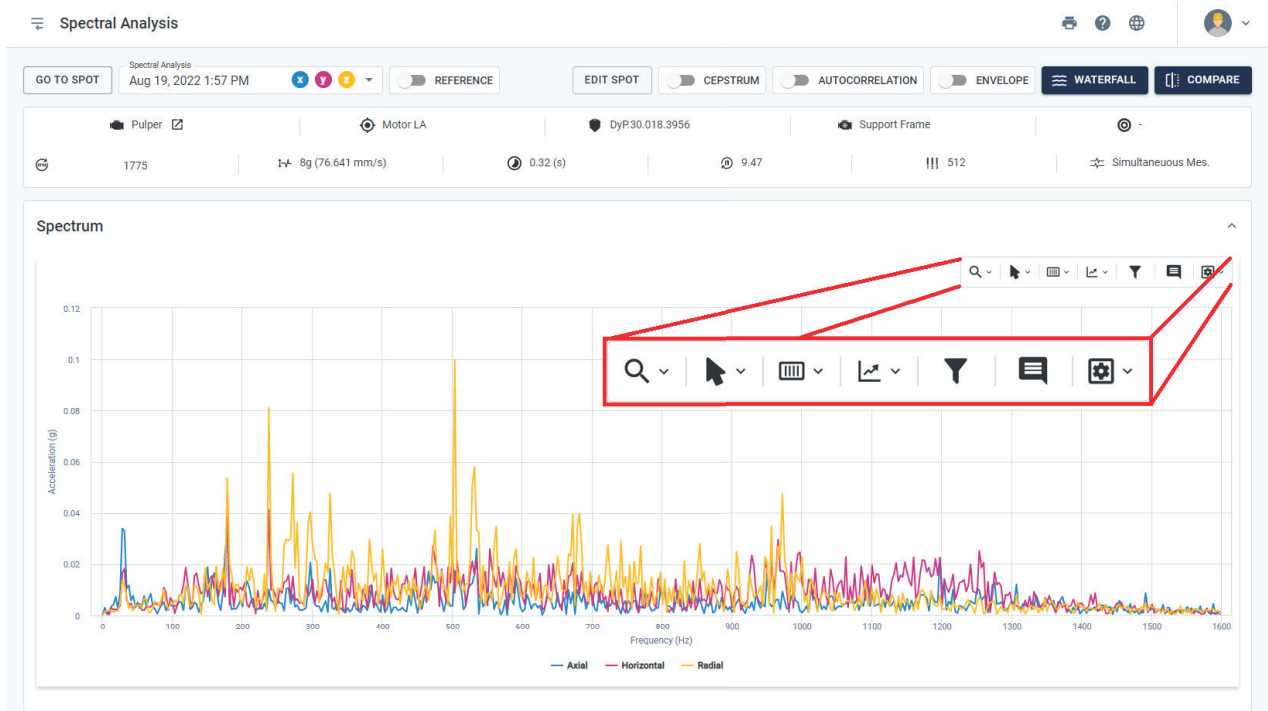
Picture: Spectral analysis and available tools

At the top of the page, information is displayed about which time period the viwed spectral refers to and which axes were collected. By clicking on the rectangle with the date, you can also browse spectra in nearby time periods for a quick visualization.

The objective of the DMA Dashboard is to support maintenance decision making and interventions by providing an overview of the Spots condition, based on previous measurements and user-defined alarms (A1 and A2).
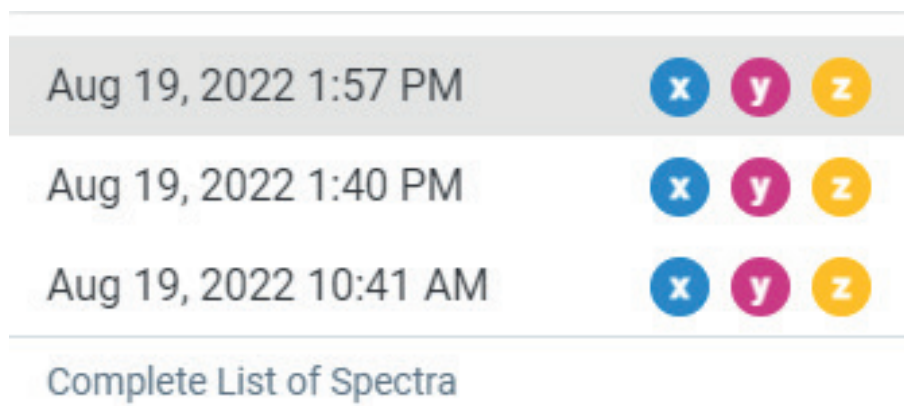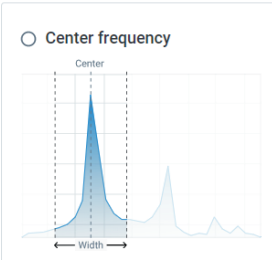

Picture: Spectral Analysis Selection

The following section explains each of the tools in the role framework:

Zoom Tools

Several of the functionalities are analogous to the zoom tool of the Spot Viewer, detailed in previous sections. On the other hand, the Spectral Analysis zoom tools have differentiating features, such as keyboard shortcuts, with the objective of boost the way the user relates to the Platform.

In addition, when zooming in on the graph a return zoom button appears, as it can be seen in the picture below, allowing the user to undo the last zoom command.
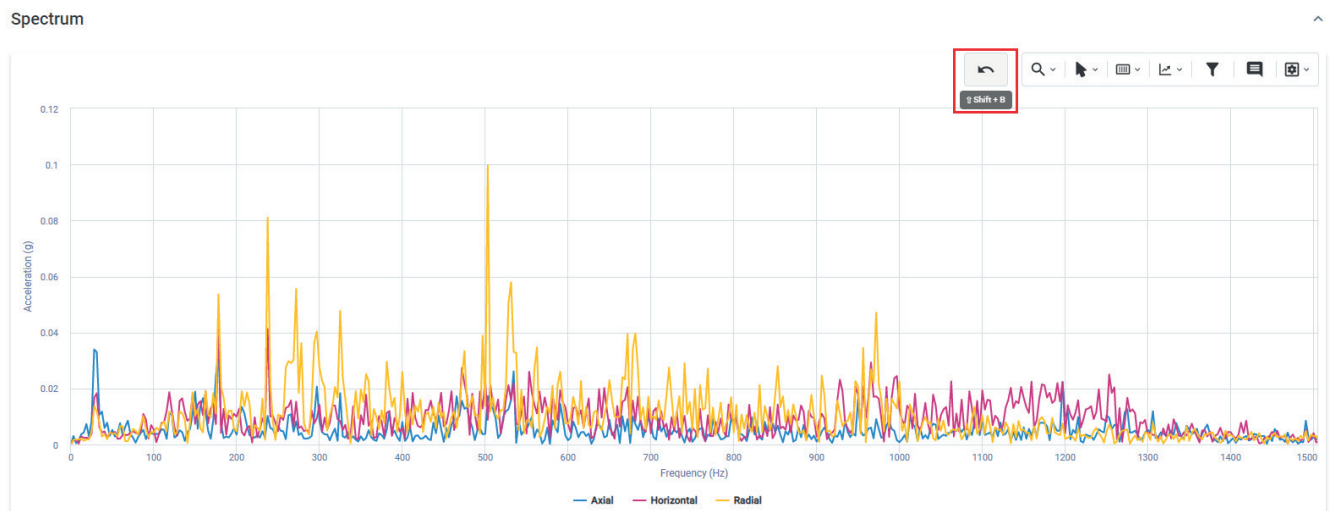
Picture: Zoom return button

Cursor Tools

It is possible to highlight specific frequencies, their harmonics and their sidebands on the graphs. To highlight a specific frequency, simply select the cursor type, place the mouse on the graph and mark. The points corresponding to the selected frequencies will be displayed on the graph, as well as a window with their amplitudes. The cursors are important to analyze, in detail, the frequencies that are being excited in the spectrum, as well as their sources.

The single cursor, as its name suggests, will mark a specific frequency in the spectrum.

The harmonic cursor will mark multiples of the chosen frequency. Finally, the sidebands cursor will mark a central and side frequencies, as chosen by the user.
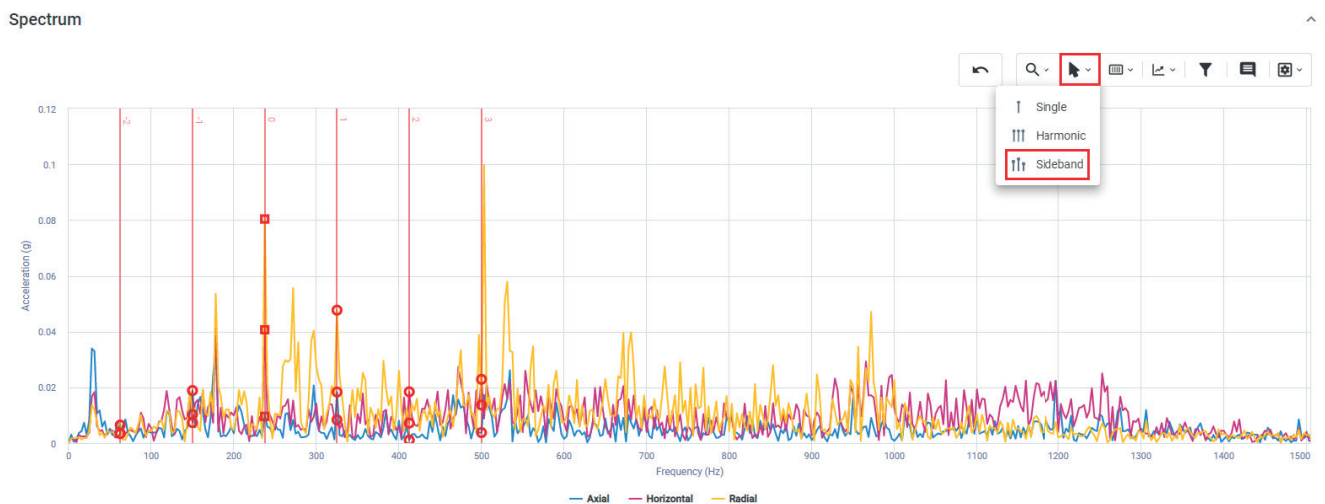
Picture: Cursor Tool

Similar to the Zoom tools, there are shortcuts for creating cursors quickly, which are also detailed in the Spectral graphs shortcuts section.

In the Waveform graph the periodic type cursor is available. Finally, to remove a cursor, simply double click on the text box that provides amplitude and frequency values at the highlighted points on the graph.

All cursors have a subtitle indicating the vibration values in each axis at the instant they are positioned. The values are displayed at the bottom of each graph.

Single Cursor ●					
Band	Frequency (Hz)	Axis X (g)	Axis Y (g)	Axis Z (g)	
1 X	237.5000	0.0102	0.0413	0.0810	

Sideband Cursor ●				
Sideband	Frequency (Hz)	Axis X (g)	Axis Y (g)	Axis Z (g)
-2	62.5000	0.0035	0.0034	0.0065
-1	150.0000	0.0189	0.0074	0.0102
0	237.5000 87.5 (Δf)	0.0102	0.0413	0.0810
1	325.0000	0.0183	0.0083	0.0477
2	412.5000	0.0011	0.0184	0.0072
3	500.0000	0.0038	0.0229	0.0137

Harmonic Cursor ●				
Harmonic	Frequency (Hz)	Axis X (g)	Axis Y (g)	Axis Z (g)
1 X	271.8750	0.0083	0.0153	0.0556
2 X	543.7500	0.0035	0.0113	0.0195
3 X	815.6250	0.0012	0.0026	0.0105
4 X	1087.5000	0.0034	0.0129	0.0095
5 X	1359.3750	0.0056	0.0027	0.0042

Picture: Point-to-point values of the cursors at the bottom of the graph

Automatic Frequency Markers

It is possible to highlight the rotational frequency of the machine, in addition to the characteristic failure frequencies of the bearing for cases where it has been registered in the bearing bank. The process of bearing inclusion is detailed in the Spot Creation section. The available options for automatic cursors on the Platform are:

RPM: Machine rotation frequency;
BPFI: Passing frequency of the rolling elements on the internal race;
BPFO: Passing frequency of the rolling elements on the outer race;
BSF: Rotation frequency of the rolling elements;
FTF: Rotation frequency of the cage.
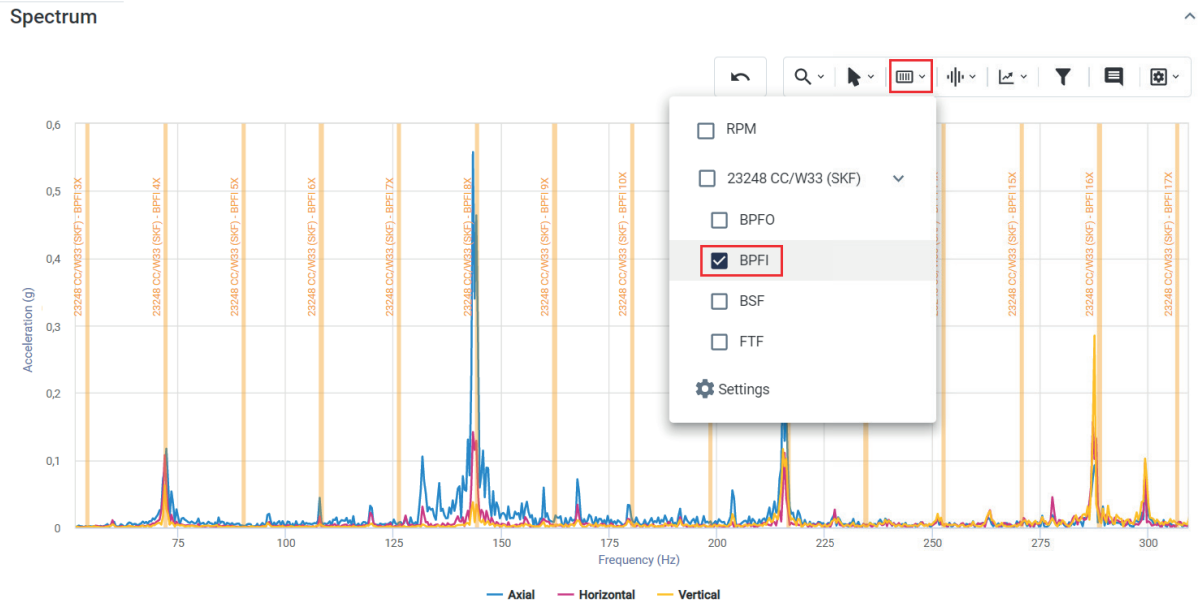
Picture: Tools highlighting rotational frequencies and bearing failures

Customized Frequency Markers

This tool allows the insertion of frequency markers for visualization on spectral graphs. In this way, it will be possible to register the different frequencies present in the machines (blade pass frequency, gearing frequency, electrical failure characteristic frequencies, among others). The process of setting up a custom marker is detailed in the Spot Creation section, on the "Frequencies" tab.
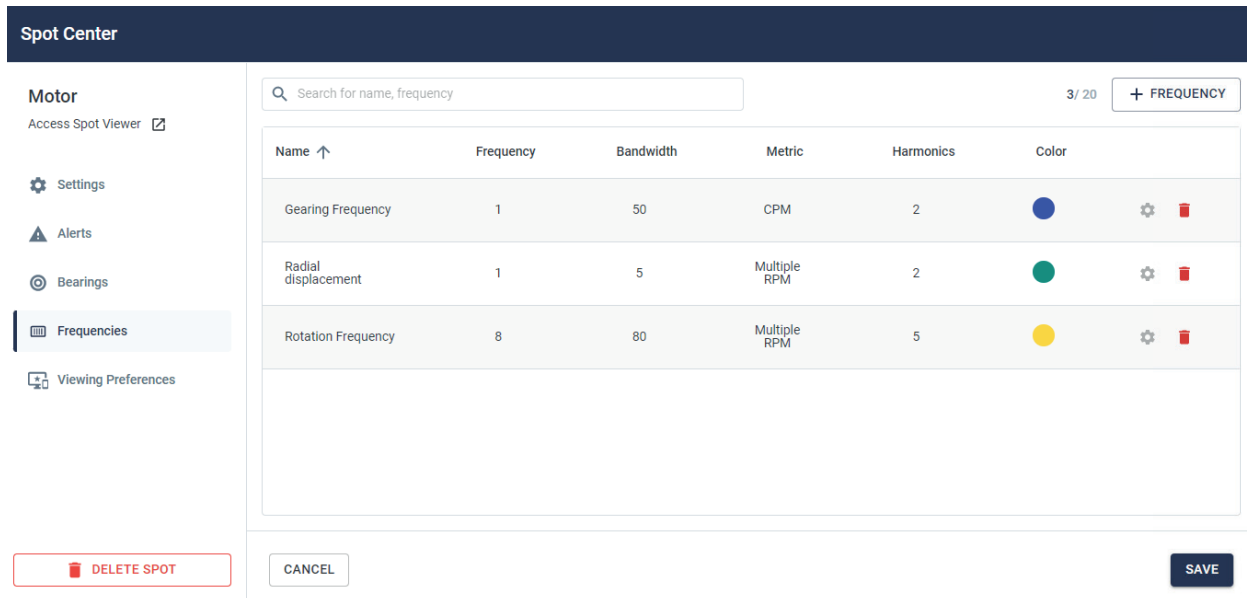
Picture: Customized Frequency Markers

Ao analisar uma espectral, o marcador estará disponível junto às outras ferramentas, através do símbolo de onda.
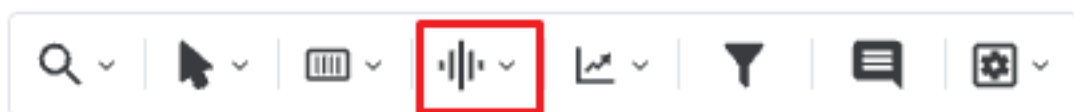
Picture: Accessing the custom bookmark tool

When the marker is activated, indicative lines will appear on the spectrum, as previously configured (color pattern, value on axis, origin).
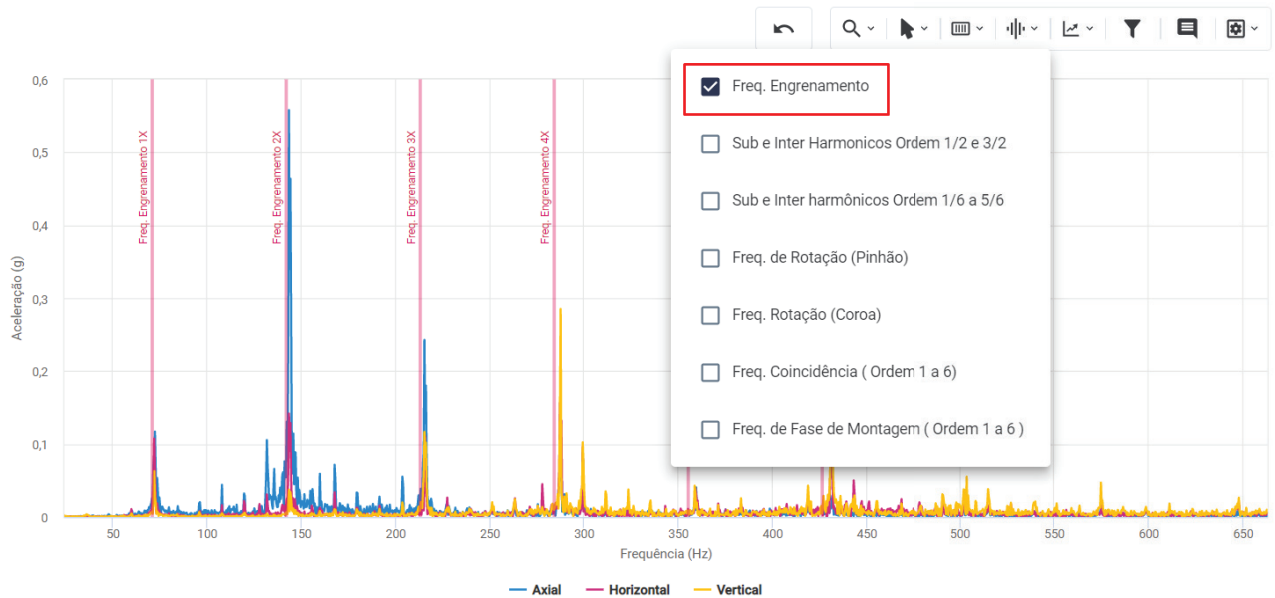
Picture: Cursor tool with customized frequency values

This tool helps the user to visually identify the frequency of interest and its harmonics, aiming to identify patterns to detect known failure modes.

Metrics

Allows you to change the spectral magnitude (acceleration, velocity, or displacement) and their respective units. It can be accessed through the toolbar above the spectral graphs shown.
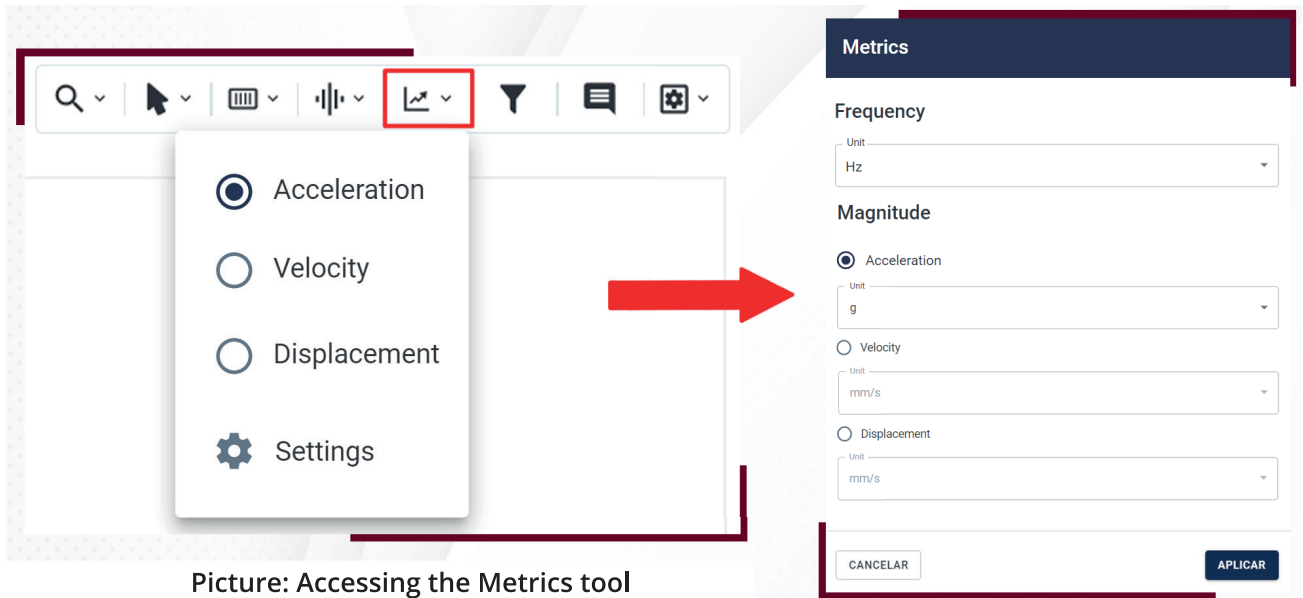
Picture: Accessing the Metrics tool

Picture: Metrics Tool

Filter Toots

It is possible to apply filters that help eliminate noise and highlight characteristics of the signal. When you select the option, a new window will open where you can choose the desired filter type and cutoff frequencies.
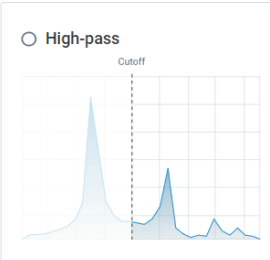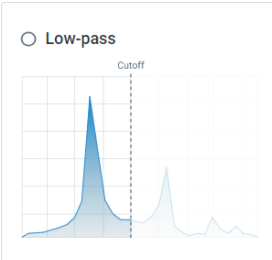
Pictiure: Accessing the filter tool
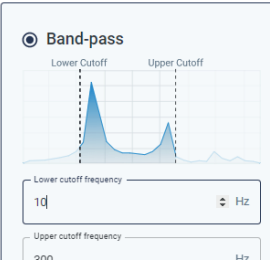
The options are: 'High Pass', 'Low Pass', 'Band-Pass', 'Center Frequency' filters.

The objective of the DMA Dashboard is to support maintenance decision making and interventions by providing an overview of the Spots condition, based on previous measurements and user-defined alarms (A1 and A2).

Picture: Filters tool

The shortcut for using filters on graphics is (Shift + F).
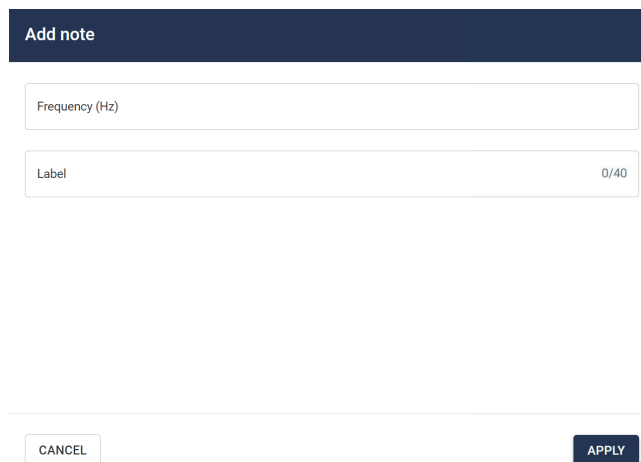
Notes

ÉIt is possible to add notes to custom frequencies. The annotations serve to assist the analyst in viewing the spectral analysis graph more clearly and efficiently.

Picture: Accessing the note tool

When you select the icon in the top toolbar of the spectral analysis graphs, a window will appear asking for two pieces of information: at what frequency the user wants to insert the note, and a subtitle box that will appear over the cursor on the graph.

Picture: Add notes on specific frequency

The keyboard shortcut for using the notes on the graph is (Shift + N).

Visualization Options

The series of visualization options, which can be accessed from the top right menu, encompasses a number of functionalities, including: plotting grid lines, viewing the graph in logarithmic scale

which can facilitate defect detection on slow rotating machines, or displaying the text boxes of cursors added via the "Cursor tooltip" option.
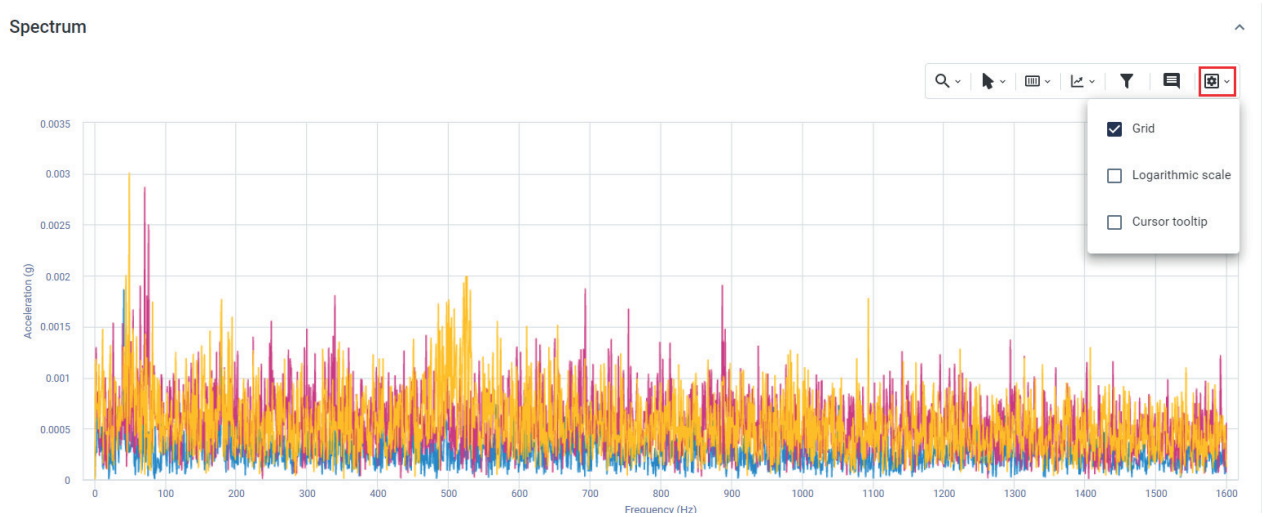
Picture: Display Options

Spectral Chart Shortcuts

Tool	Function	Shortcut
Zoom	Zoom Window	⬆ Shift + W
	Zoom Horizontal	⬆ Shift + H
	Zoom Vertical	⬆ Shift + V
	Back Zoom	⬆ Shift + B
	Setting Limits	⬆ Shift + D
	View All	⬆ Shift + A
	Set Limits	⬆ Shift + L
Cursor	Unique	⬆ Shift + U
	Harmonic	⬆ Shift + C
	Sideband	⬆ Shift + S
Filters	Add Filter	⬆ Shift + F
Notes	Add Note	⬆ Shift + N

Picture: Tool Shortcuts

Aiming at the dynamic use of the Platform, the Spectral Charts have several shortcuts that encompass the main tools for analyzing vibration spectra. The shortcuts are arranged as shown in the table.

16.1 Waveform (linear and circular)

The waveform is the arrangement of the data coming from the DynaLoggers in graphical form in the time domain. It represents all possible variations in the set of values obtained in acceleration from the point where the sensor is installed, for the time the data set was acquired (by App or Gateway).

The waveform can be important for visualizing repeating patterns in the signal, such as beating or impacts, as well as modulations. The data can also be converted from acceleration to velocity and displacement.

To get to this screen see the section "Accessing the Vibration Spectral Screen", which shows the various ways to view the waveform and spectra for each Spot. Below there is an example of a tri-axial waveform obtained from a conveyor belt bearing.
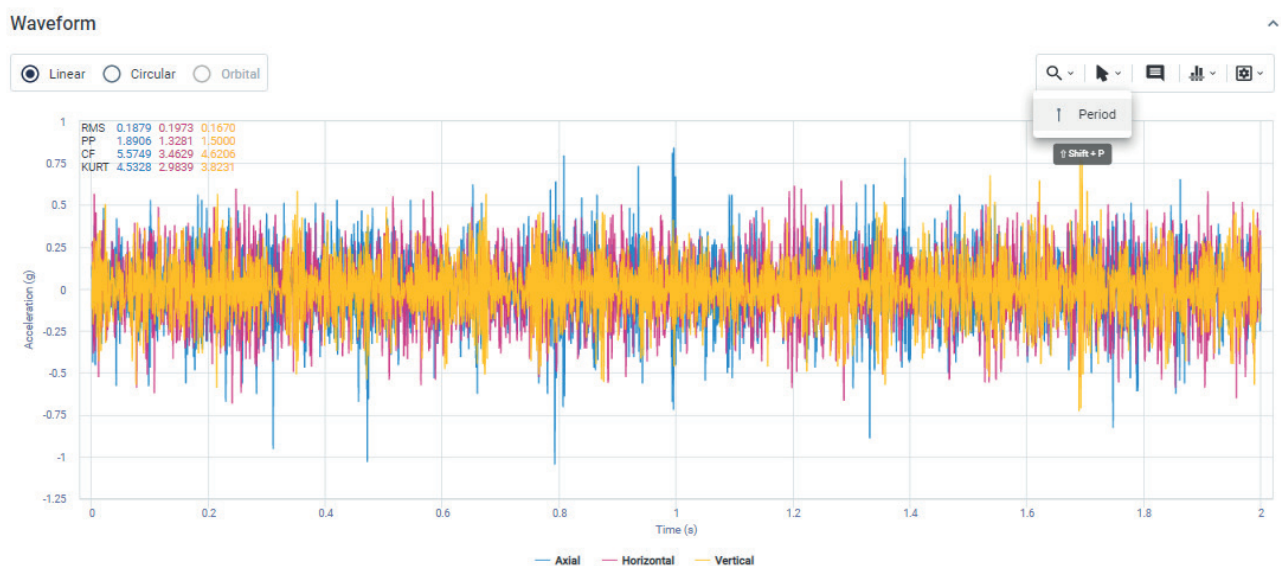
Picture: Viewing the waveform and period cursors

In the same graph, instantaneous values, per axis, of: RMS, peak-to-peak, crest factor and kurtosis are available in the upper left corner. In addition, using the period cursors you can see the time difference between two distinct peaks, as well as the resulting frequency in Hz.

Circular waveform

The circular waveform is another way to analyze the same data, but plotted in polar coordinates.

To activate this form of visualization, simply, on the desired waveform, activate the "CIRCULAR" option at the top right of the screen.

One must also define the starting instant and the number of revolutions displayed on the graph.
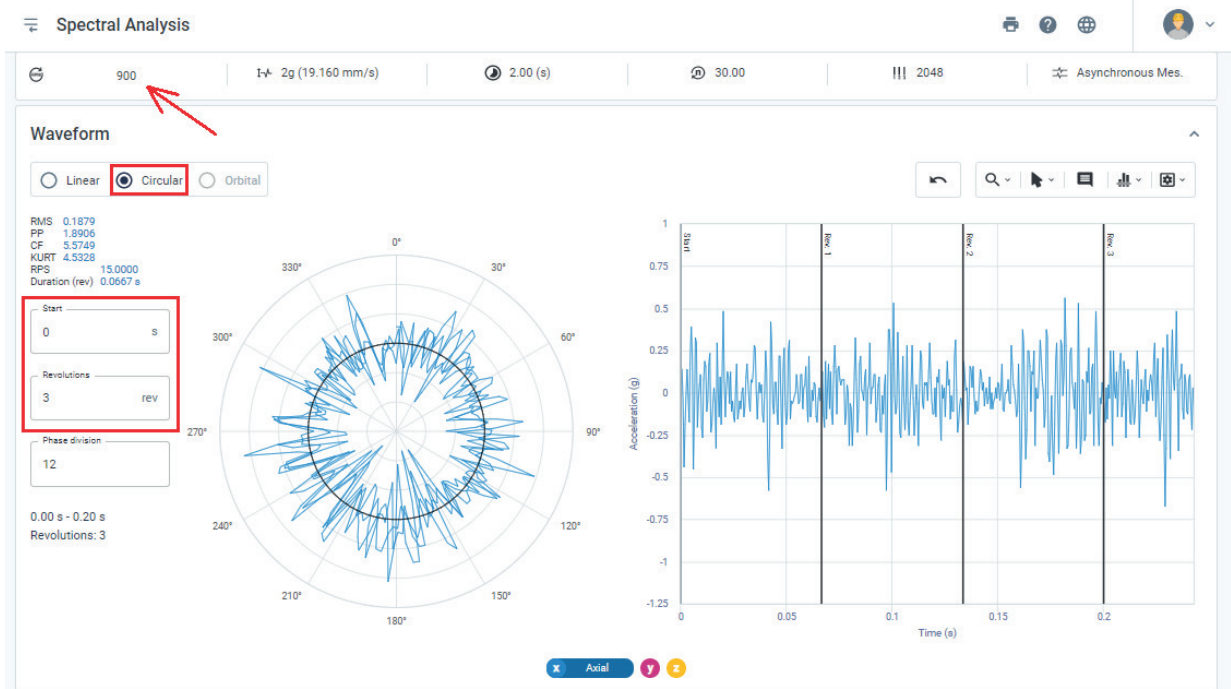
Picture: Viewing the circular waveform

For satisfactory results, it is recommended that the RPM of the location closest to the monitored point is correctly scaled. This can be changed momentarily at the top of the page for a real-time update of the waveform.
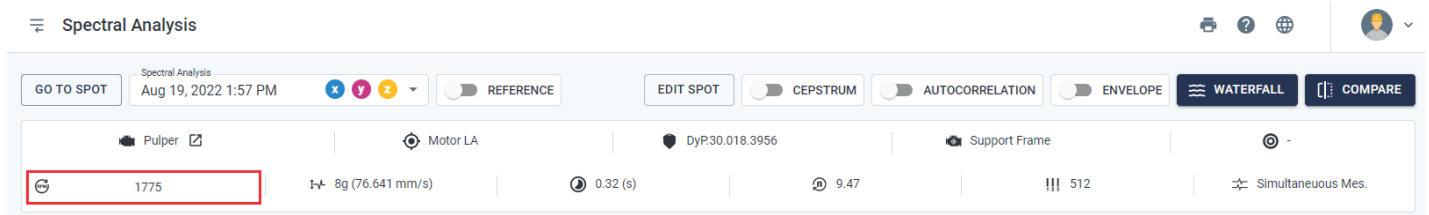
Picture: Timely edition of RPM

16.2 Spectral Envelope

Vibration analysts can use several tools for fault analysis within the Web Platform. One of the main ones is the Spectral Envelope, useful for identifying high frequency faults through signal demodulation.

When accessing a spectrum in the Web Platform, the screen includes a button in the upper right corner of the screen to request an envelope (demodulation) of the signal.
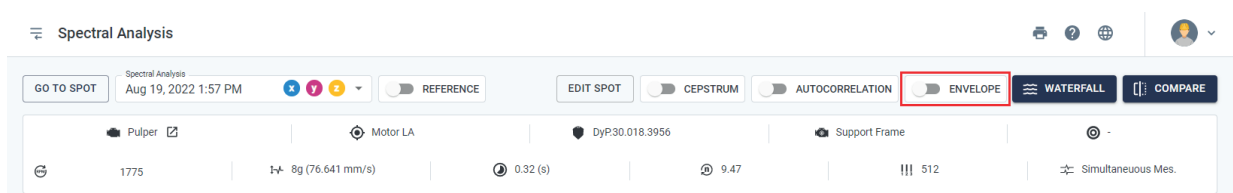
Picture: Spectral Envelope Selection Button

By clicking the button "ENVELOPE", a window will be displayed asking for the frequency range in which you want to apply the envelope. The Web Platform has predefined envelope values, parameterized by the most common frequency ranges in vibration analysis. However, it is also possible to define a custom envelope in the same window. Simply select the "Customizable" option and define the desired frequency range.

Picture: Customizable envelope configuration

After selecting the frequency range, the envelopes (spectral and waveform) will be available at the top of the page. Both have the same functionality as the spectral analysis.
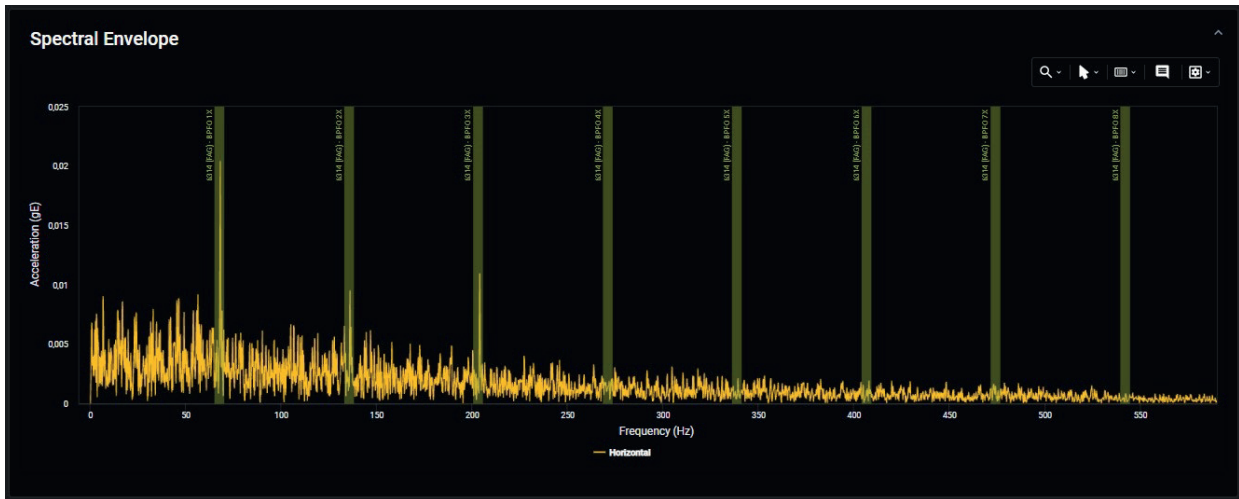
Picture: Spectral envelope with filter from 3500 to 4300 Hz, pointing BPFO bearing failure (dark mode of the Web Platform activated, for better contrast)

16.3 Waveform autocorrelation

Autocorrelation is an analysis in the time domain that correlates waveforms with themselves to calculate a correlation factor at each time instant. It can be useful in helping the vibration analyst identify periodic frequencies, improving visualization and also, analogous to the previous section, allowing it to be displayed in its circular form.

To activate the waveform autocorrelation plot, simply, in the desired spectral screen, activate the option "AUTOCORRELATION" located in the upper part of the screen.
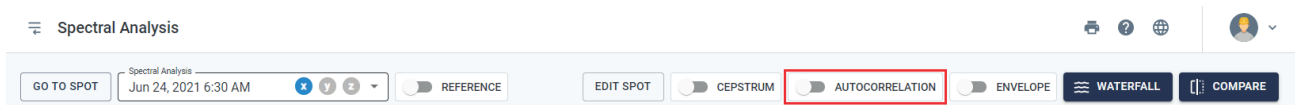
Picture: Activation of autocorrelation

The graph will be displayed just below the waveform. The same tools available for the traditional waveform are also available.
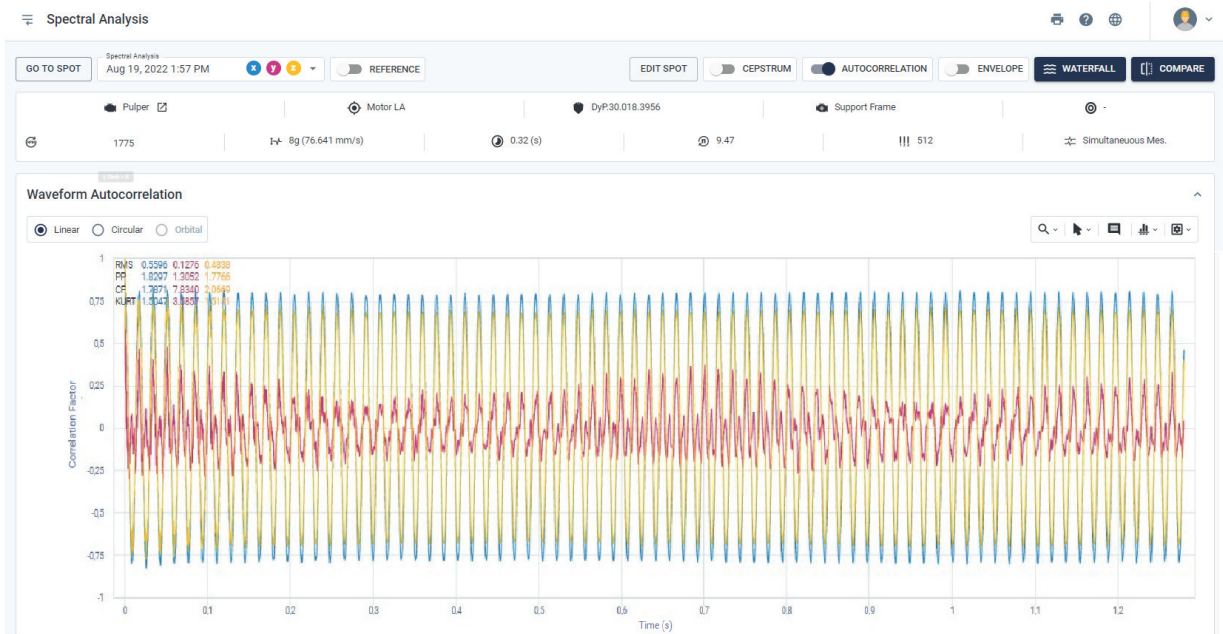
Picture: Autocorrelation of the waveform

16.4 Spectral Cascade

The waterfall is a three-dimensional graph where up to 10 spectra of a monitoring point are displayed, helping the analyst to identify fault trends from the growth of vibration amplitudes.

It can be accessed via the Cascade button present at the top of the "Spot Viewer" and "Spectral" pages.

Picture: Spectral Cascade selection button

In the window that will be displayed, you must select which spectra will be used to form the cascade. The available filters are: date of spectra, settings (it is necessary that all spectra have the same frequency settings, monitored axes and duration) and acceleration threshold. The acceleration threshold filters spectra whose RMS acceleration is below a user-defined value, in order to only use graphs generated while the machine is running.

With the filters set, simply select the spectra to be used by clicking on the + symbol to the right of each spectrum listed at the bottom of the window and then clicking "OPEN CHART".

Picture: Selection of Spectra to build the waterfall

The "Spectra Cascade" screen, which will open next, shows at the top some general information about the monitoring point and the spectra, such as machine, RPM, duration and number of lines

Below, the waterfall chart and the available tools are displayed. The time period appears on one of the axes, in an increasing manner for a comparison of possible failure evolution.
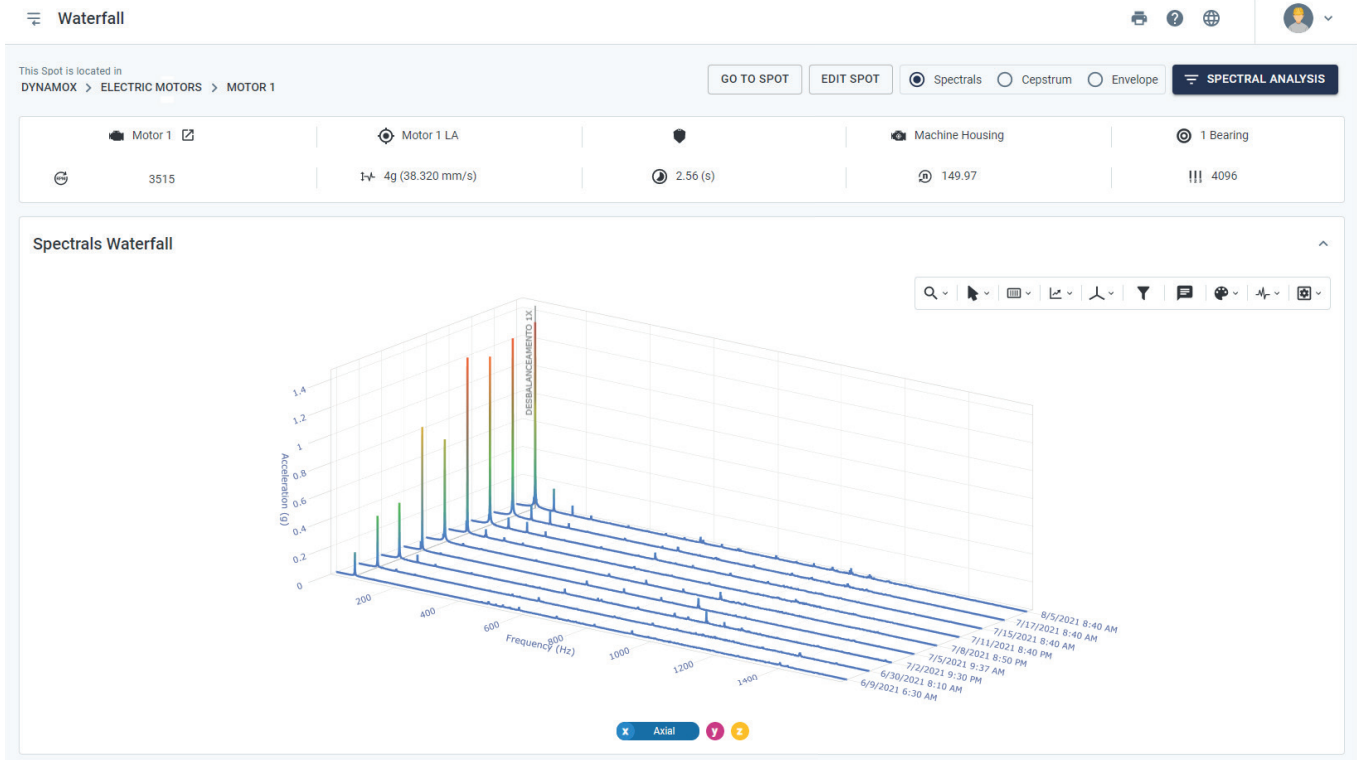
To facilitate the visualization of the graph, it can be moved to the most suitable position for analysis. The following are the available forms of movement:

CTRL + Click + mouse movement: lateral movement;
Click + mouse movement: rotation;
Scroll mouse button: zoom in or out (graphic).

In addition, the " **SPECTRAL ANALYSIS** " button allows you to change the spectra used to generate the graph.

Picture: Metric options for cascading

Waterfall is also available for envelope and cepstro view, as shown above. Enabling either of these options will update the chart to reflect these types of metrics.

In the right corner of the chart some analysis tools are available that can be applied to the waterfall, such as:
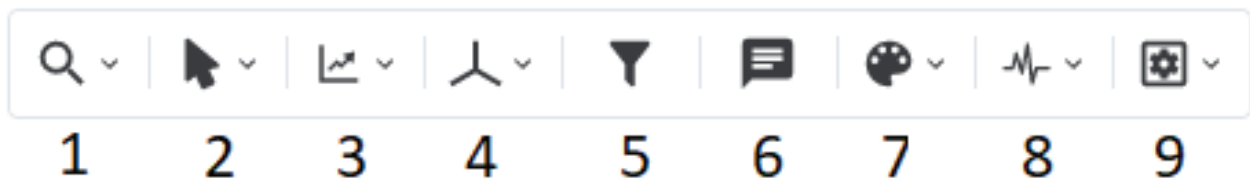
Picture: Spectral cascade visualization tools

Zoom tools, which allow you to analyze a specific frequency range of the spectra.

2. Cursor tools, which allow you to add single, harmonic or side-band cursors at specific frequencies.

3. Defining the metric on which the graphs will be displayed below (acceleration, velocity or displacement) and their respective units.

4. Definition of the analyzed axis (X, Y or Z). In the case of triaxial spectra, the user must define which axis will be analyzed each time.

5. Filter tool. High-pass, low-pass and band-pass filters are available for each spectrum of the waterfall.

6. .Notes. Tool that allows you to add comments on a specific graph and frequency.

7.Color visualization tool. Definition of the colors of the graphics in a way that facilitates visualization, available in 4 modes.

7.1. Global maximum amplitude: color gradient that takes all spectra into account. Peaks of higher amplitude will be displayed in warm colors.

7.2. Local maximum amplitude: color gradient for each spectrum. Higher amplitude peaks will be displayed in warm colors.

7.3. Pattern per axis: solid color, same for all spectra;

7.4. Individual pattern: solid color, individual for each spectrum.
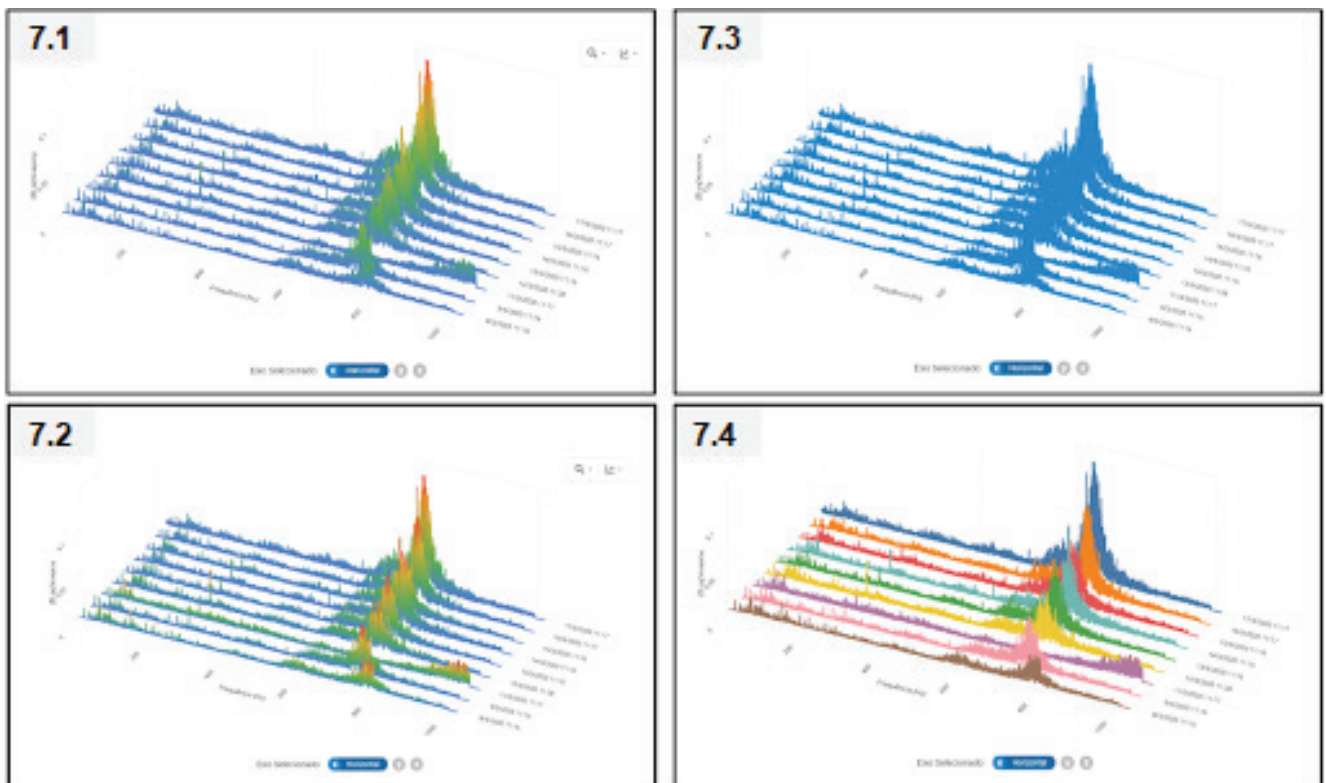
Picture: patterns of the Spectral Cascade

8. Show/Hide spectra. Allows the user to view only a portion of the spectra defined when generating the cascade.

9. Option to hide/display grid at the bottom of the graph and view the waterfall in logarithmic scale.

16.5 Side-by-Side Spectral Comparison

Além da comparação espectral através de um espectro de refIn addition to spectral comparison using a reference spectrum, it is also possible to view two vibration spectra side by side, making it easy to compare vibration spectra collected some time ago at the same spot, and even between different spots.

This option is available to the user on the spectral screen, using the "COMPARE" button on the upper right of the screen.
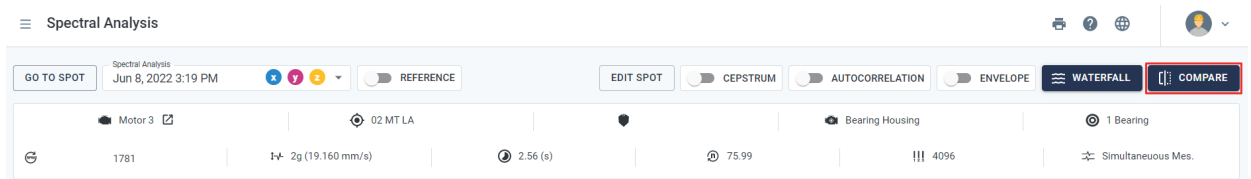
Picture: Spectral screen with side-by-side comparison option

Clicking on this button will display a window showing the spectra available for side-by-side comparison.

To select a spectral window, click on the "+ button, displayed right next to the window and confirm the selection by clicking on "SELECT". To find the desired spectrum more easily, you can search by machine name, Spot, or sensor serial number.

Picture: Filter to choose spectral of comparison

This tool can be useful in fault diagnosis. The analyst can, for example, compare side by side spectra or vibration waveforms of the same spot, on different collection dates, making clear the evolution of vibration amplitude or even the appearance of new failure frequencies at the spot.
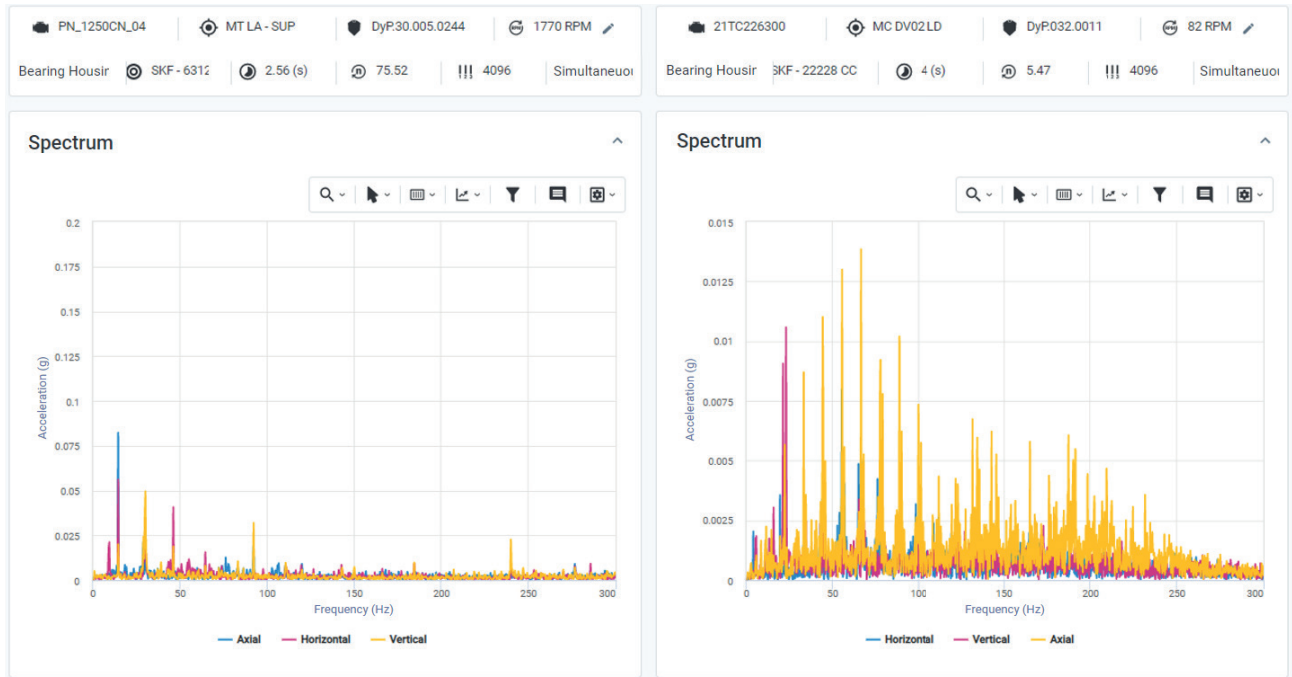
Picture: Spectral waveform comparison

In addition, after viewing the spectra, you can access all the tools to do a more detailed analysis on each of the viewed spectra.

17. Creation of reports (predictive analyseys)

The analysis of the data collected by DynaLoggers can be done in several ways through the Web Platform. The Predictive Analysis tab has as main objective to enable the elaboration of technical reports about failures, alerts or recommendations regarding the health of the monitored asset. The Predictive Analysis section is found at the end of the "Spot Viewer" and "Machine Viewer" pages.

Realizando uma Análise Preditiva

To make a technical report of a Spot, just access the section through the Spot Viewer (at the bottom of the page) and select the "PREDICTIVE ANALYSIS" option.
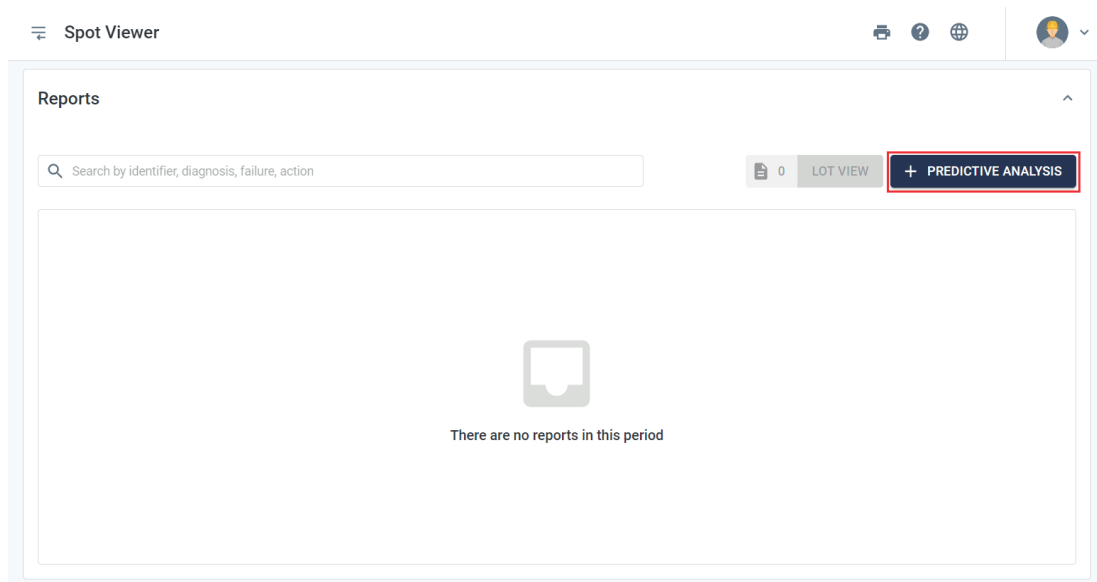
Picture: Creating Predictive Analysis

A new screen will be shown, requesting Spot analysis information:

Batch Predictive Analysis

✓ Choose Spots ———— ② Analysis

| Information | Images |

Status

⦿ 🟥 Intervention ◯ 🟧 Alert ◯ 🟩 Normal

Diagnosis *

Unbalance

Failure Detected *

Unbalance ✕   ▾

Recommended Action *

Keep following the next days and plan for balancing

Service Note

Observation

Date in which the fault was detected

📅   09/08/2022

Deadline for the recommended action

📅   09/24/2022

CANCEL   RETURN   SAVE

Picture: Filling in the predictive report

The information tab has the following fields:

Status: selection of the current asset condition. Three options are available to inform the severity of the report;
Diagnosis: brief description of the problem encountered by the analyst;

Detected failure: selection of the failure found at the monitoring point among a series of categories;
Recommended action: indication of which actions should be taken based on the analysis performed;
Note: addition of infos that have not yet been cited;
Date on which the failure was detected: optional info to register from which moment the failure could be identified;
Deadline for Action: add deadline for action based on the "recommended action".

The Spot Viewer tab, on the other hand, brings the graphs referring to the history of the analyzed spot data, with the objective of providing background for the analyst when making his report. It is possible to add temperature, acceleration, and speed graphics with customized time periods. It is also possible to add an explanatory comment below the graph.
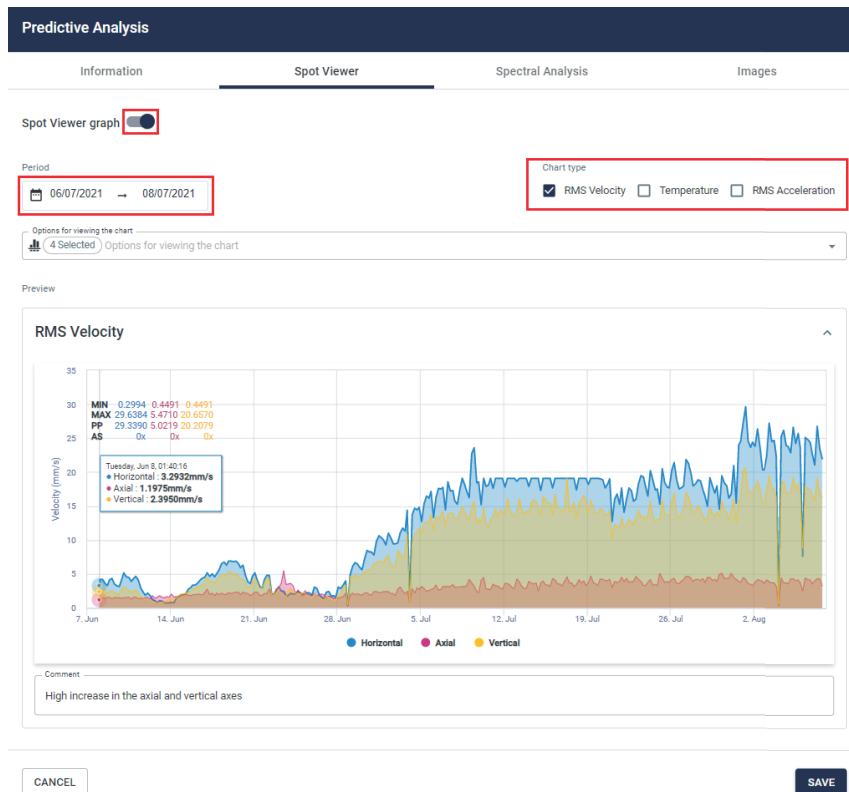
Picture: Data history tab available when creating a predictive analysis

The "Spectral Analysis" tab allows the addition of spectra that prove the detected failure. The selected spectra will be part of the report.

Picture: Adding spectra where faults are identifiable

Finally, the "Images" tab allows the user to add pictures to the report. By selecting the "Add Image" option, files saved on the user's computer can be added and will become part of the report.
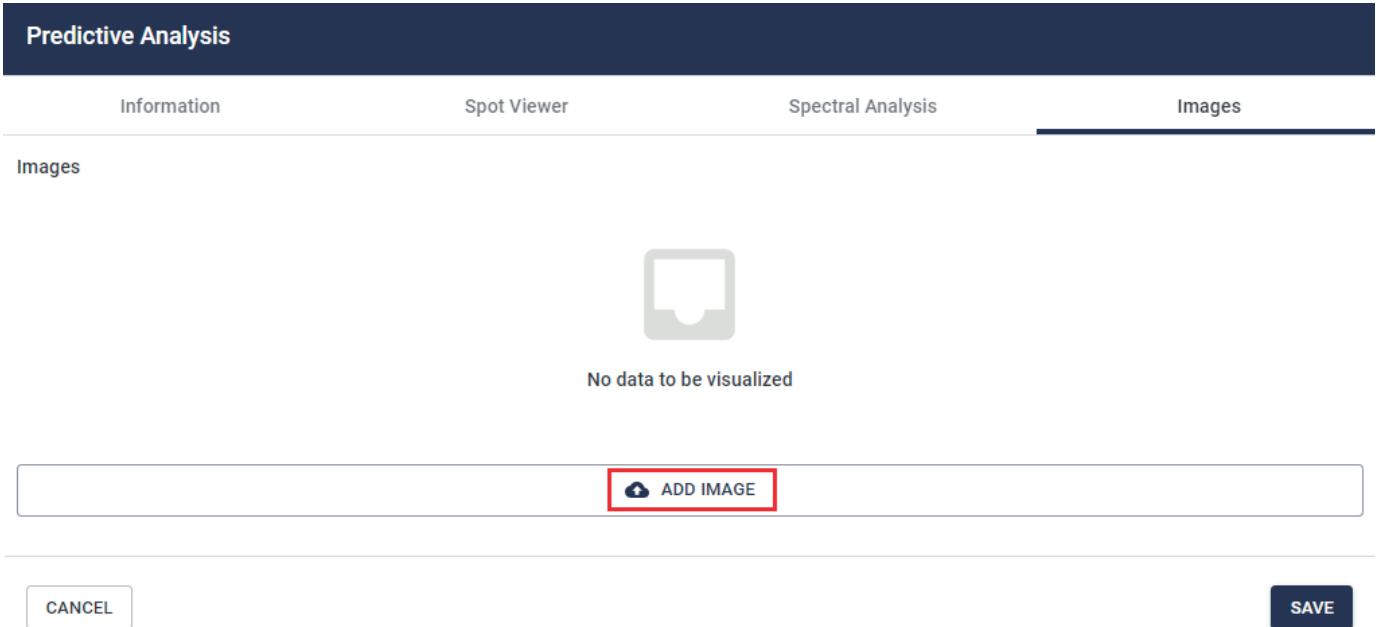
Picture: Adding images to the predictive report

Predictive Analysis Visualization

The predictive analyses performed are available for viewing and access in several ways, as presented below. To access the full version of the report, click on the report icons in any of the options listed below.

In the Spot viewer screen itself (data history): at the bottom of the screen, below the RMS acceleration graph.
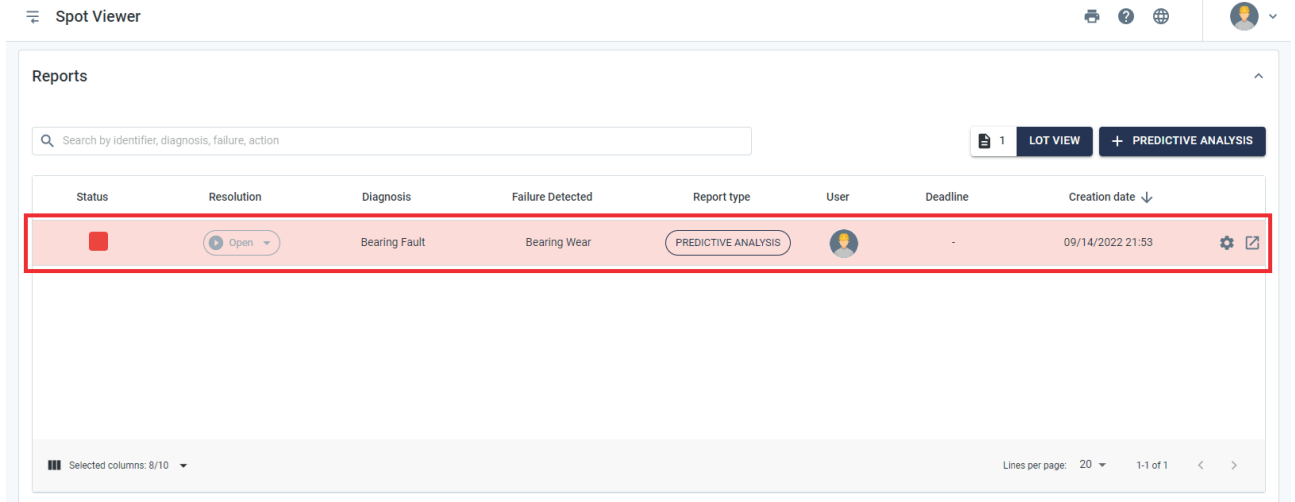
Picture: Predictive Analysis in the Spot Viewer screen

2. In the timeline of the Spot Viewer screen: to access the complete report, simply click on the icon in the timeline.
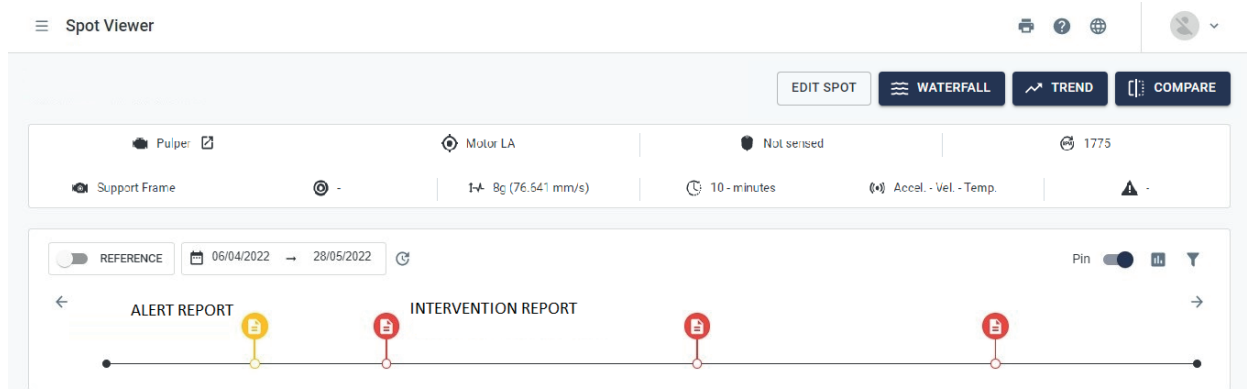
Picture: Reports shown on the timeline of the data history screen
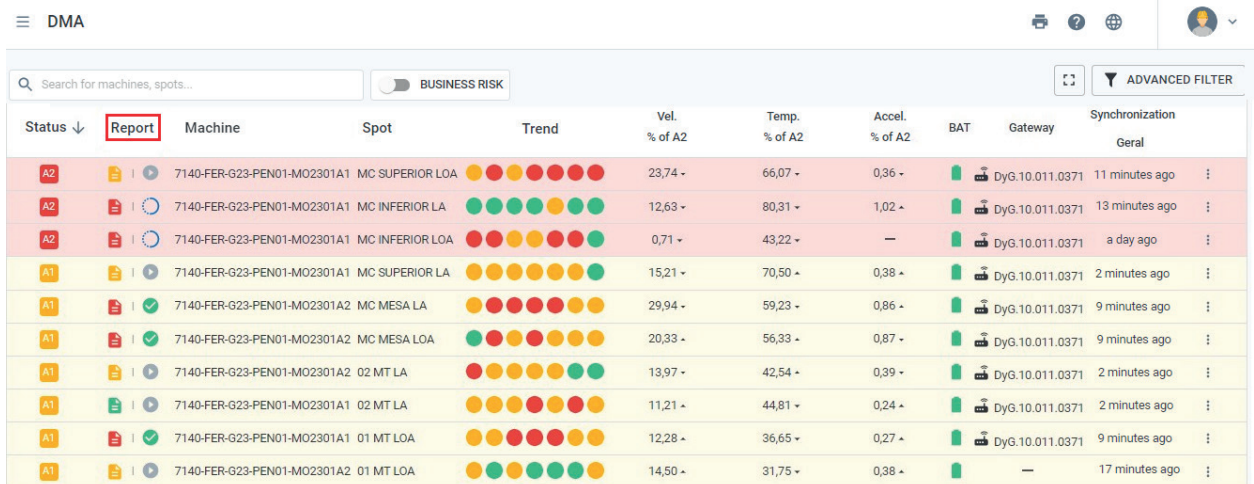
3. Through the Integrated Dashboard's Reports screen

On this screen you have all the reports history for all the Spots for which this type of report has already been generated. More details can be found in the "Viewing Reports" section below.

4. Through the DMA Dashboard, in the "Report" column

In the case of visualization of the analyses through the DMA dashboard, the last report performed and the criticality to which it was assigned is shown.

Picture: Column for viewing reports from the DMA

Predictive Analysis for multiple monitoring points

In the Machine Viewer screen, it is possible to perform technical reports for more than one monitoring point simultaneously. At the bottom of the page, you will find the option "+ BATCH ANALYSIS ".
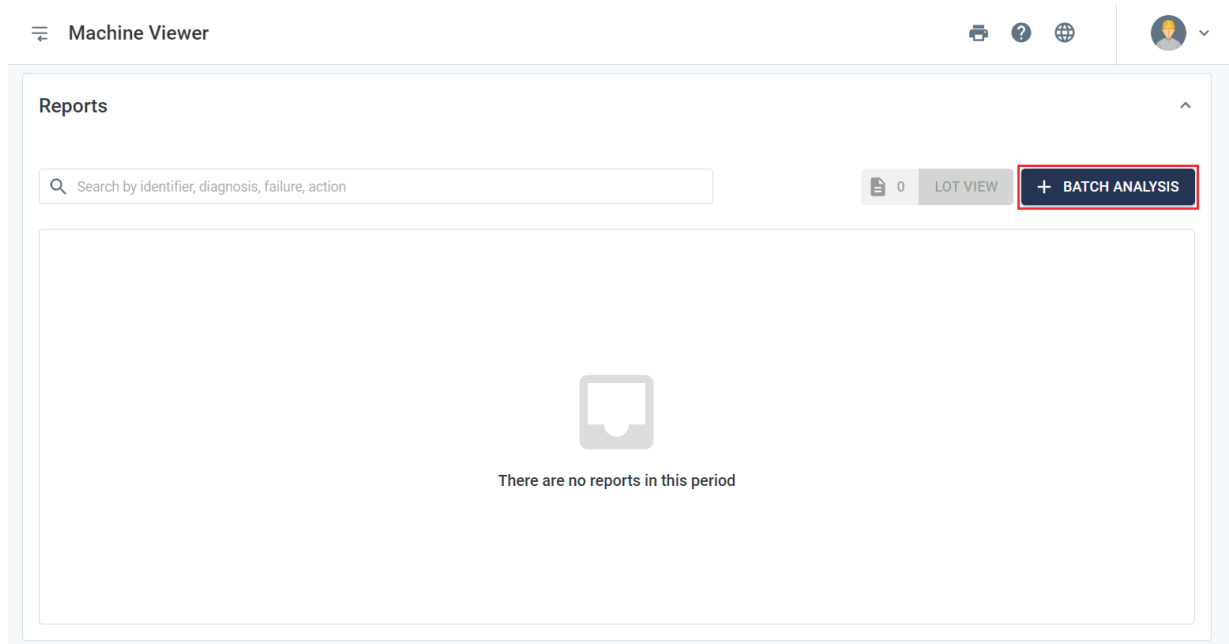
Picture: Option to issue report by machine

Clicking on this option will result in the opening of a window similar to the one discussed in the previous section. The difference, in this case, is the need to include which Spots the analyst wants to add to the report.
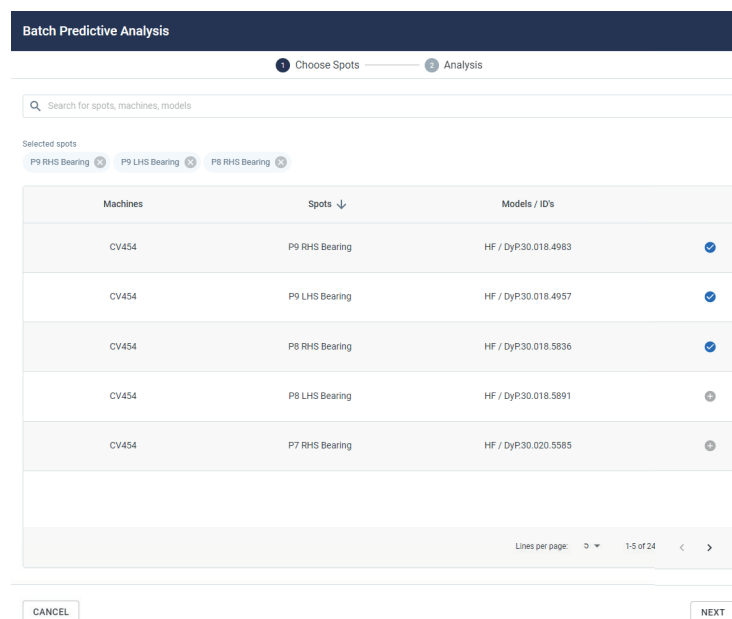
Picture: Predictive Analysis for Multiple Spots

When the list of Spots for the machine appears, simply select, in the rightmost column, which ones will be added to the analysis using the + button. Going forward, the diagnostics, the appointed failure, status, and recommended action options will be the same as those already present in the Predictive Analysis for just one monitoring point, detailed in the previous section.

When performing a batch predictive analysis, as in this case, the selected Spots will inherit the report, which will be available through the options listed in this section.

18. Integrated Dashboard
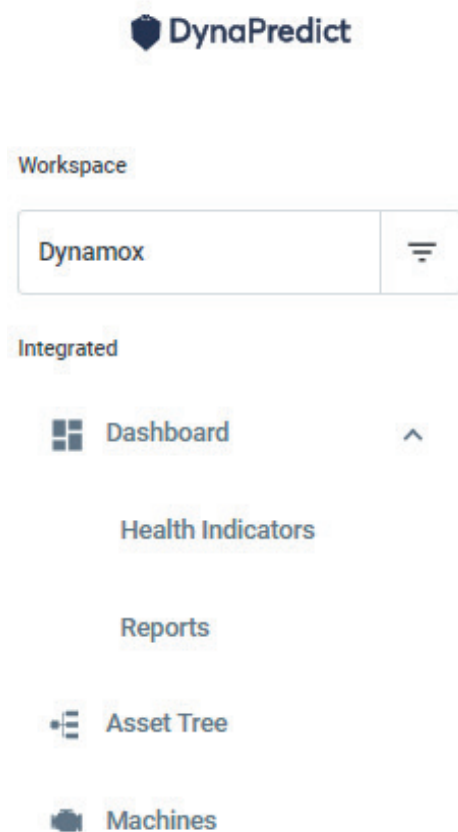
The integrated Dashboard, available in the side menu of the Platform (picture beside) takes into account both the predictive module (vibration and temperature monitoring) and the sensitive module (DynaSens) that has checklists and inspection routes.

This part of the Web Platform is divided into two sections:

Health indicators
Reports

Picture: Integrated Dashboard

18.1 Health Indicators

The Health Indicators, within the Integrated Dashboard, display the health indices of different plants or work areas of the client company. Each is represented by a pie chart indicating the health of the assets in the area, based on the number of Spots and inspection routes that triggered alerts in A1 and A2.
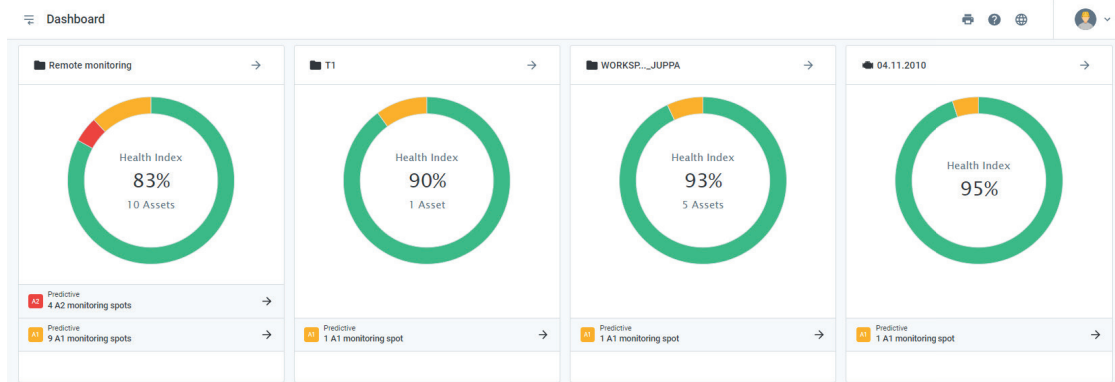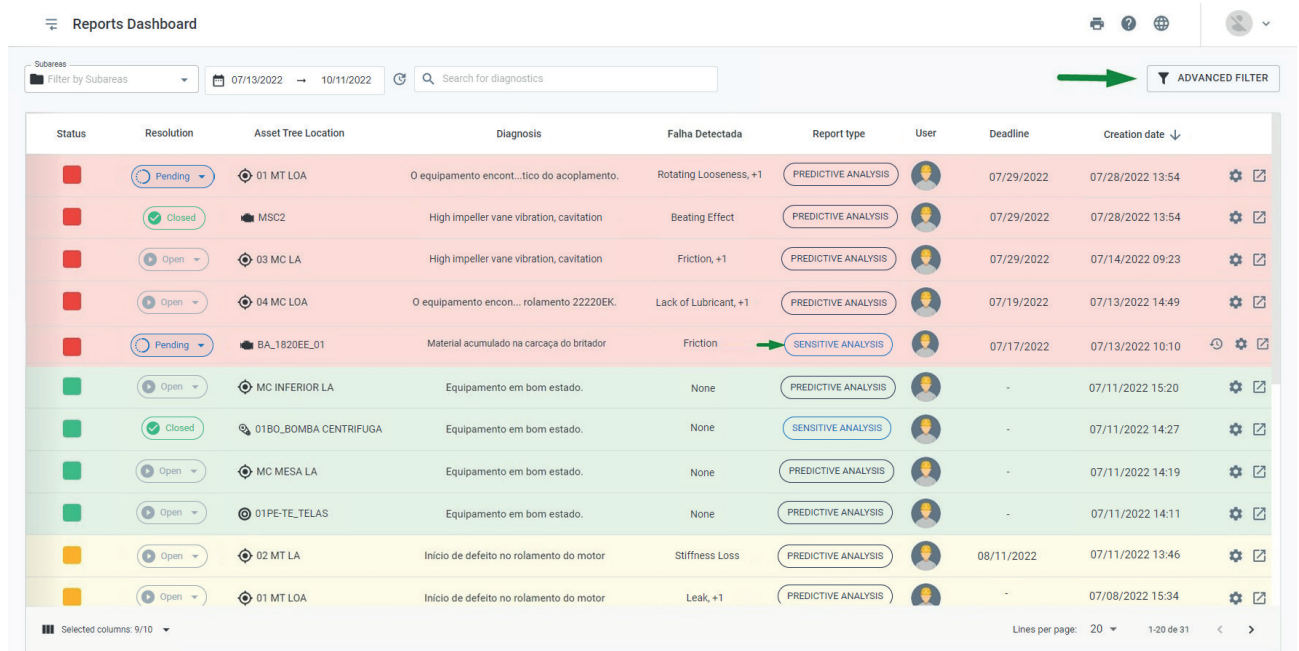
Picture: Health indices by sectors or plants

In this same screen, you can click on the side arrows in each pie chart so that, within the organization of the asset tree, a new Dashboard is generated with the subsets and machines related to the selected one. In this way, it is possible to perform an integrated and specific visualization of all areas and sub-areas of the plant.

The purpose of this screen is to show which areas need more attention from the maintenance or reliability team, i.e., which of them are theoretically in more compromised health and are impacting the overall health levels.

18.2 Viewing Reports (Predictive Analysis Reports)

The "Reports" division, present in the Integrated Dashboard, presents all the analysis reports (predictive and sensitive) issued by the system users.

Picture: Sensitive and predictive reports

Regarding the columns shown:

Status: shows how critical the report performed by the user is.
   Red: intervention required;
   Yellow: alert condition;
   Green: no problems found.

Resolution: presents information about the treatment given to the report.
   Open: the report was issued, but no corrective action was registered for the report;
   In progress: a corrective action for the reported problem is in progress;
   Resolved: the reported problem was corrected through some action / action of the team. By clicking on the line of the generated report, you can check what action was taken, if the user who changed the status has filled in details of the action.

Location in the asset tree: points to where the Spot or machine belongs within the company's hierarchical structure.

Diagnosis: informs the diagnosis filled in by the user for the failure found.

Detected Failure: informs which failure category was filled in by the user who created the report.

Type: This screen shows predictive and sensitive reports. The "type" option indicates the origin of each report.
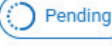
User: information about which user filled out each report. Hovering the mouse shows the user's name and e-mail.

Deadline: filled in by the user in the report itself, represents the deadline for the action recommended by the report creator.

Creation date: date on which the report was created.

In addition, if any of the reports have undergone changes, the " ⟲ " symbol (placed on the far right of the line of the modified report) will allow you to check which information has changed and by which users. By clicking on this symbol, a new tab will be displayed showing the changes.

Picture: Historical changes in performed report

19. Machine Viewer

The Machine Viewer is a tool for viewing information about the company's machines, joining information from the sensitive and predictive modules. There are two ways to access the functionality: through the side menu, in the "Machines" option, or by clicking on the desired machine through the asset tree. This screen encompasses all information relating to a particular machine in the plant, grouping Subets, Components and Spots common to it.

Applicable information and filters

The top of the Machine Viewer shows the path within the asset tree where this machine is located, a table with machine information, and filters for Subsets and Components. If any of these filters are applied, the information shown in the rest of the screen will refer only to the filtered items. In addition, you must define the starting instant and the number of revolutions displayed in the graph.
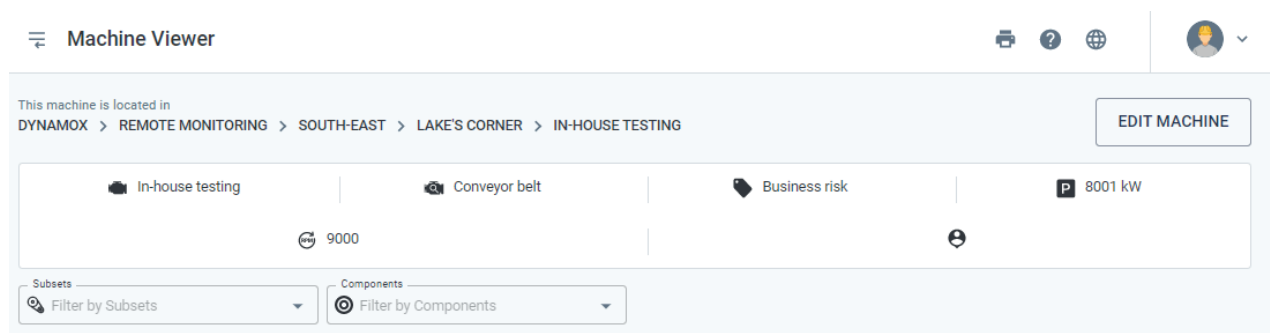
Picture: Machine information and applicable filters.

Timeline

Just below the filter options, a timeline is displayed with the events of all the monitoring points registered on the machine, such as Spots creation/deletion, Spots parameterization, spectral analysis, A2 alerts triggered, checklists performed, and reports issued. By default the events of the last seven days will be shown, but this interval can be changed through the calendar in the upper left corner.

Picture: Machine's timeline.

It is worth noting that the events presented in the machine timeline are for the time period selected above. In the same way presented in the Spot Viewer, one can comment on each event individually, generating a history of conversation between users.

Monitoring Points

Below the timeline, in the Machine Viewer, a reduced version of the DMA is shown, with only the Spots referring to that machine (or subsets/components, if a filter is applied). The information follows the same pattern as that displayed in the traditional DMA.

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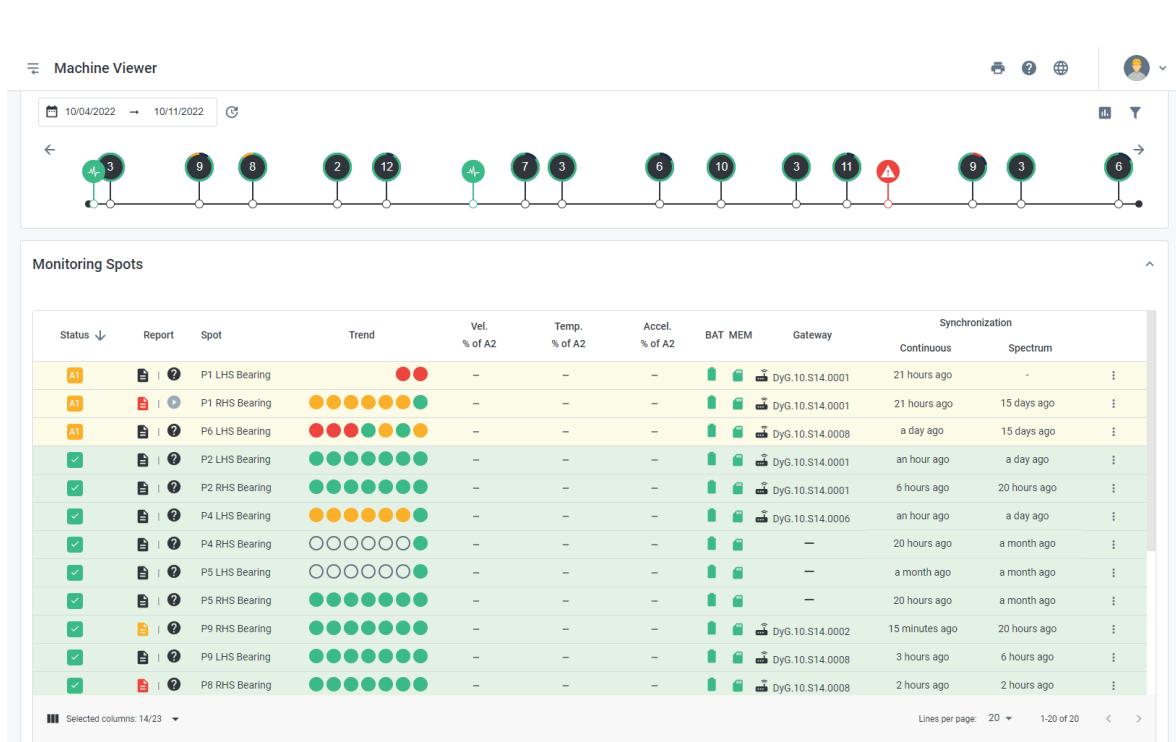
Picture: Reduced version of the DMA Dashboard on the machine screen

Anomalies - Sensitive Module

The "Anomalies" field lists all the anomalies reported by users in the checklists's answers filled out during the sensitive module routes, for the customers who purchased it. Listed in this section are: the anomalies, observations, user responsible, subset/component, and date/time. By clicking on one of these anomalies, the user is redirected to the checklist report for that report.

Picture: Anomalies - Sensitive Module

As in the other features on this screen of the Platform, the information displayed follows the pattern according to the time period chosen on the machine timeline.

Manual Measurements

Also belonging to the sensitive module, below the "Anomalies" field, a graph is displayed with the results of the manual measurements performed on the routes of the sensitive module. To select which magnitudes will be displayed in the graph, simply click on the "GRAPHS" option and select the desired magnitude.
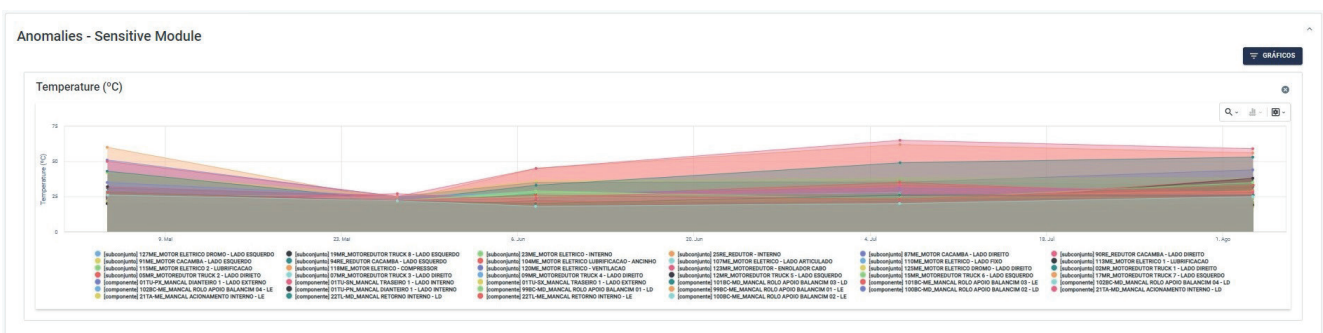
Picture: Manual Measurement Graphs - Sensitive Module

The Sensitive Module is a tool in the DynaPredict solution for managing inspection routes in the field. For more information about the usability of the solution, please see the Sensitive Inspection Manual.

Predictive Analysis

At the bottom of the page is the "Predictive Analyses" section, referring to the performance of technical reports from multiple monitoring points on the machine. All reports performed in the period are presented.

Picture: Predictive Analyses performed on the machine, per monitoring point

To make new reports, the user simply selects the icon "+ BATCH ANALYSIS" and selects which Spots will be analyzed.

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20. DynaGateway (optional)

The DynaGateway is the automated data collector for the Dyna-Predict and its purpose is to interact with the DynaLoggers within its bluetooth range, collecting measurements and requesting spectra according to user-defined time intervals. The collected data is sent directly to the Web Platform via Wi-Fi, Ethernet and Mobile Networks (according to the model chosen).

In the Web Platform, the user has the possibility to manage the Gateways, associated to the Desktop, through the Gateways screen. To access this screen, use the predictive section, from the side menu, and select the "Gateways" option.

Picture: Information tab of the Gateways of the selected workarea.

Accessing this screen you will find a list of all the Gateways that have been associated with the Desktop, as well as information about their operation.

For more information about the prerequisites for operating the device, as well as the system configuration and management screens, refer to the Gateway User Manual.

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