i-ALERT® Monitoring Solution

Sensor | App | Ai Platform Bluetooth®

Ai Platform Diagnostic User's Manual

Table of Contents

Introduction

This manual serves as a reference for the i-ALERT™ Ai Platform Diagnostics software.
The reader will become familiar with AI Diagnostics:

1. Methodology

2. User interface

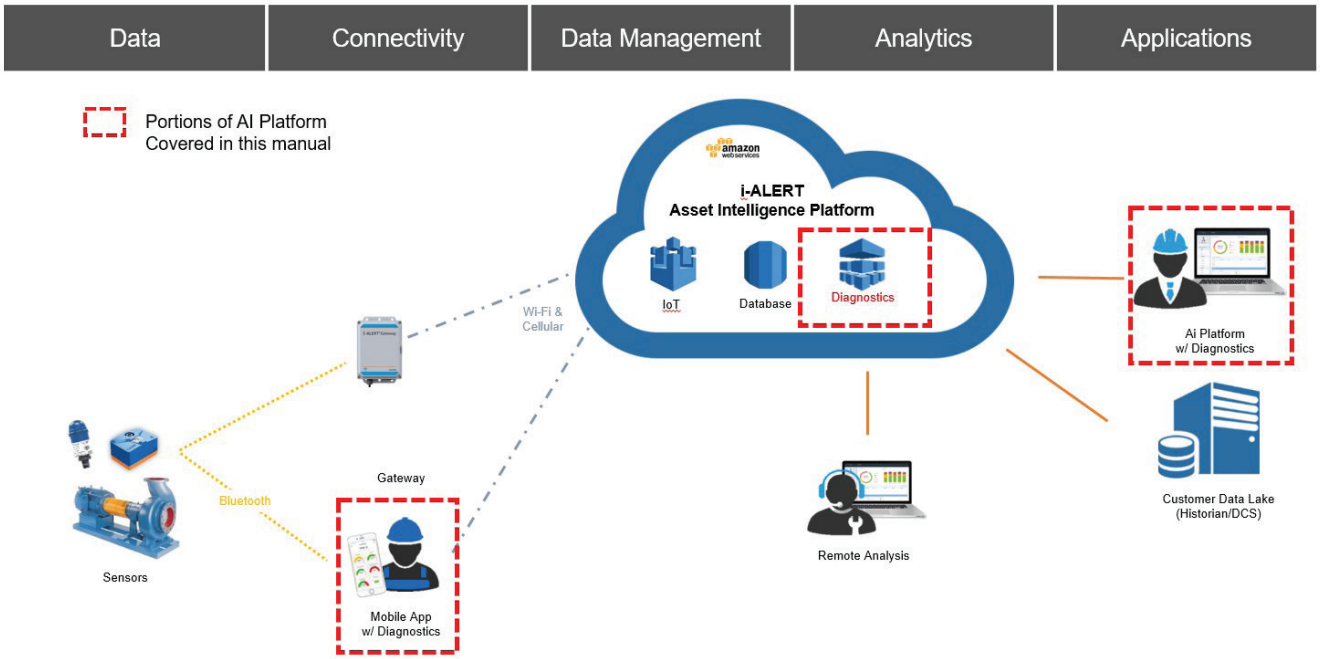
3. Equipment and asset train setup

4. Interpretation of the results

There are many standard functions embedded within the Ai Platform that are not described in this manual. For those standard features and functionality, the reader is encouraged to reference the Ai Platform Application Guide and the online resources at https://www.i-alert.com/ or contact a member of the i-ALERT Team at 315.568-7290.

System Overview

The overall architecture of the i-ALERT ecosystem is shown below.



The i-ALERT2 is a wireless 3-axis vibration and temperature sensor that interfaces with either a mobile device (phone or tablet) or a Gateway, via a Bluetooth low energy transmission protocol. The Gateway allows autonomous data collection, and allows for 2-way communication with the devices in range from a web-based application called the Ai Platform. The Mobile App allows full user functionality as an interface to the device, however the Ai Platform allows for many powerful analytical features that would not be as practical on the smaller screen of a mobile device.

Some of these features are:

- Trend notes and FFT timelines
- Detailed Equipment information in the form of documents and tables for bearing information
- Ability to overlay FFT's and Time waveform data from the same or different sensors
- Reporting and notification ability that is beyond that of the mobile App in both detail and exportability (virtually anything in the Ai Platform can be exported)
- Ability to view geographical map views and table views of the overall system (plant, area, and zone)
- Full Route setup and management
- User access control and management (Administrative functions)
- Sensor configuration
- Asset train configuration

The ability to perform the above functions and tasks from a cloud based desktop environment makes the Ai Platform a natural for setting up assets and sensors and the reports for use with automated diagnostics.

The following section describes the theory behind the automated diagnostics engine within the Ai Platform.

Theory of Operation (Diagnostics/Analytics)

For as many years as vibration measurements on machines has been routine in industry, users have requested automated methods to convert what has traditionally been accomplished by an experienced practitioner (Diagnostics and Analysis) into practice. To that end, several approaches have emerged in recent years in order to accomplish what is now known broadly as automated analysis, diagnostics and prognostics. That is, actionable information that the vibration community can use in the assessment of machine health. These approaches have generally fallen into two categories:

1. Physics based
2. Big data analytics

The first of these (physics based) is straightforward. Over the many years, vibration practitioners have created "templates" and standard rules that are applied to spectral data to determine machine condition. These (until recently), required analysis by human examination of the FFT data to look for characteristics that indicate a certain (health) condition for the machine. An example would be a pump that is in cavitation, showing a raised baseline (due to random, broadband energy) in the FFT spectrum that shows up around and beyond the vane pass frequency. Another example would be a higher than normal second harmonic peak, in cases where some type of misalignment is present; and lastly a pronounced primary peak indicating excessive unbalance in the machine. A visual example of the detection method is shown against an arbitrary spectrum below.

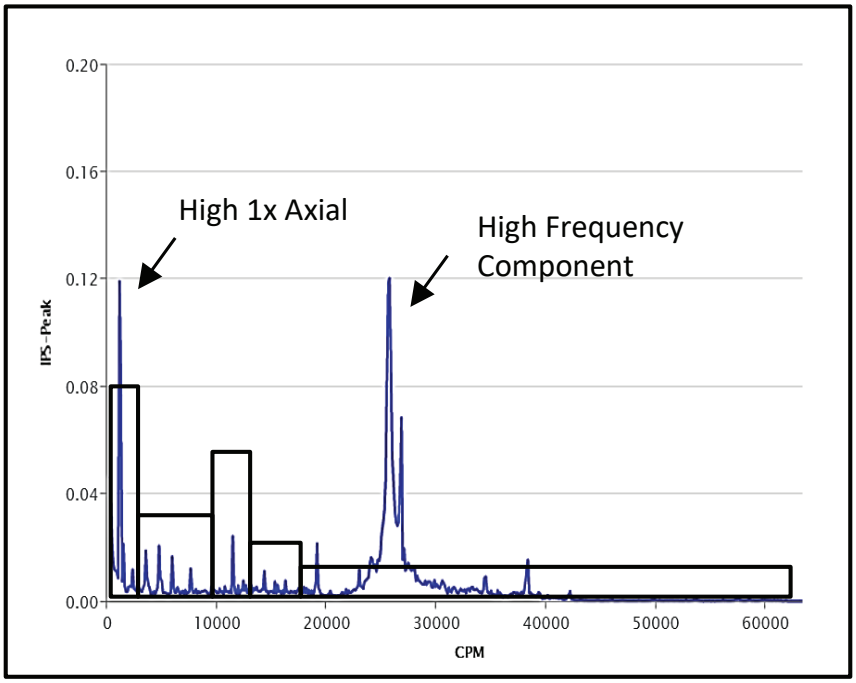


Figure 1

Theory of Operation (Diagnostics/Analytics)

The second approach, big data analytics, is based on comparison of signatures in the vibration spectrum where machine health and faults can be detected. The vibration diagnostic database within the Ai Diagnostic Platform for this method was developed over 30 years and contains over 1,200 faults diagnostics.

Big data uses vast amounts of gathered information to characterize a normal running machine against the unknown data of a particular machine under a particular health condition. For example, having data on thousands of normally operating pumps (e.g. Goulds 3196) and thousands of spectra of the same pump in a cavitation condition would allow the comparison to an unknown 3196 to expose parallels in the spectra, and thus similarities in the health condition. This methodology, while sound, requires large datasets of both normal operation and faulted operation that is generally only available to the OEM. ITT is uniquely positioned to exploit this method, given our many thousands of pumps in operation worldwide.

The first two approaches benefit greatly when baseline data is available. Baseline data is data (spectral, FFT data) that has been acquired during steady state normal operation of the equipment and identified in the system as such. In order to have the most accurate diagnostic analysis when using baselines, three or more baseline spectra should be selected. These are in turn averaged into on "standard" baseline for the asset train in question. When there is no average baseline data for a given asset train, the Ai System uses a built in synthetic baselines. The synthetic baselines are unique to each equipment type and are comprised of 17 spectral components values (1x, 2x, 3x…, 9x, etc., and various noise floor ranges) that make up a spectral mask unique to each major component group. During the diagnostic run the measured data is compared to the synthetic baseline mask to determine exceedance values for input to the logical rules. In almost all cases, use of an average of baselines is preferable to the use of a synthetic baseline. True baselines will account for any unique conditions specific to that equipment, and in general, yield results that are more specific.

The i-ALERT Ai Platform™ approach is primarily physics and big data based, using well established methods for both techniques.

In summary, the following diagram describes the two approaches currently in use by the ITT Ai Platform™.

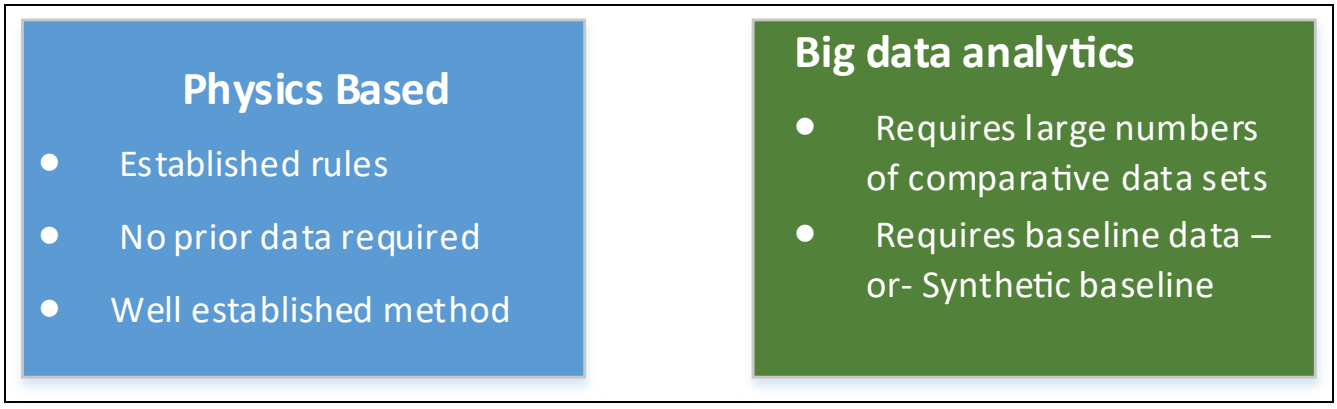


Figure 2

Asset Types

The ITT Ai Platform diagnostics works with a variety of rotating equipment, which must first be defined to the system in order for accurate analysis to occur. It is essential that the correct equipment parameters be used to obtain valid diagnostics. As the saying goes "garbage in, garbage out", so it is worthwhile to understand the options, and limitations of the system with regards to the physical inputs that describe the equipment being monitored.

Assets, as expected by the Ai System, are assumed to be comprised of no more than three types of components, although there may be multiple instances of a particular type. The three types of components are:

1. Driver

2. Intermediate

3. Driven

The asset types that are currently configurable, and have the diagnostics enabled are the following:

Drivers:

1) Electric Motors
    a. AC
    b. DC
2) Electric Motors (Variable Speed)
3) Turbines
4) Diesel Engines

Intermediates:

1. Coupling
    a. Rigid
    b. Flexible
2. Linked Drives
    a. Belt
    b. Chain
    c. Magnetic
3. Gearboxes
    a. Single
    b. Double

Driven:

1. Compressors
    a. Centrifugal
    b. Reciprocating
    c. Screw
    d. Lobed blowers
2. Fans
3. Generators
4. Pumps
    a. Centrifugal
    b. Axial Flow Propeller
    c. Rotary Thread or Gear or Screw
    d. Rotary Sliding Vane

Asset Types

Each of the three categories (Driver/Intermediate/Driven) in combination are defined as an asset train. It is possible, in the case of close-coupled equipment, to have only two of the three categories active such as only a driver and driven arrangement. For each arrangement, there is a required and optional sensor locations in order to extract enough data for the rules engine to produce an output that represents the actual state (health) of the equipment. The following images show the mandatory and optional sensor locations for a given asset train.

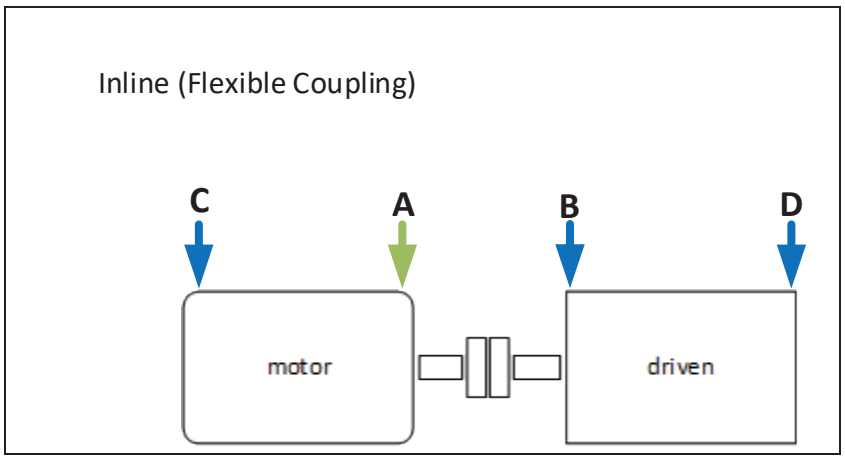


Figure 3

The sensor location shown by the arrows at 'A' are considered by the Ai Diagnostic System as a required sensor for the given asset arrangement, with the three additional sensors shown at 'B' , 'C' and 'D' can be considered advantageous for maximum results accuracy. In cases where the span is greater than 30 inches (76 cm) between the drive and driven components, it is advantageous to have additional sensors located at (a minimum) on the inboard of the driver. Additional sensors should be located on the outboard of the driver and driven for optimal results.

Another frequently encountered arrangement is close-coupled. Close-coupled pumps (as for other close-coupled equipment) use a single shaft that extends from the motor to the pump body through an opening in the cover plate. Typically the impeller is mounted directly to the motor shaft, but in some instances an adapter is utilized. Close-coupled equipment generally does not use couplings, making this option less expensive than a frame mounted counterpart. These also occupy a smaller footprint and do not require alignment.

Since there are no intermediate bearings in this arrangement, the motor bearings must handle the axial and radial loads of the application. This limits the size and power of the motor used. As stated earlier, this configuration has no intermediate component (no coupling), and consists only of a "driver" and "driven" for the purposes of the analysis engine in the Ai Diagnostics Platform.

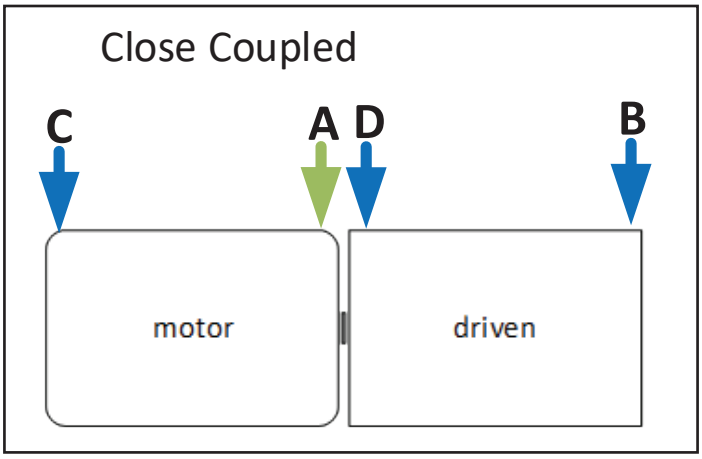


Figure 4

Much like the "in line with flexible coupling" arrangement, close-coupled requires a sensor at location 'A', and benefits greatly from a sensor at 'B'. Sensors at 'C' and 'D' are optional, and helpful for motor related or non-drive end faults. In cases where the bearing located at 'B' bears the brunt of an overhung load, or a load that has high radial forces, then including an additional sensor at that location is not only recommended but mandatory.

Belt and chain drives are a common arrangement where the motor shaft and driven equipment shaft are parallel. Normally, the reason for this type of drive is to achieve an economical reduction in speed of the driven component without the need for an expensive gearbox. It also results in a more compact configuration. In some cases (less common) the speed ratio is chosen to increase the driven speed, but the end result (from a vibration analysis standpoint) is the same in that multiple shaft speeds and phenomenon such as belt/chain induced vibration will be present in some measure. Proper sheave/sprocket alignments and proper belt/chain tensioning will minimize the contribution from those components. Locations 'B' and 'C' are necessary, and locations 'A' and 'D' are specified for maximally accurate results.

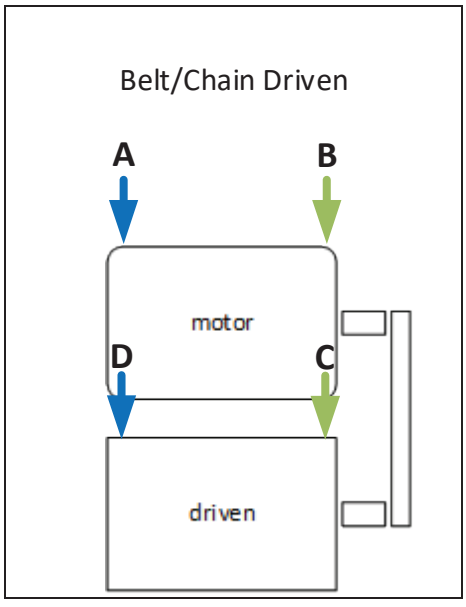


Figure 5

Asset Types

Another configuration uses a gearbox between the driver and driven. There are two common arrangements. First, and most common, is the inline gearbox with input and output driven through couplings. Locations 'B', 'F', 'E' and 'C' are necessary, and locations 'A' and 'D' are specified for maximally accurate results.

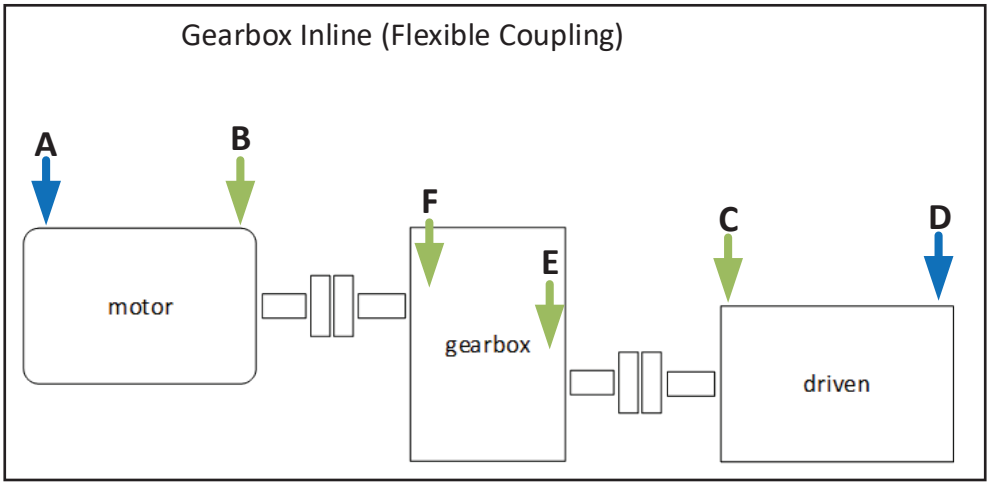


Figure 6

Most typically, the input end of the driven component, and the motor drive end are the preferred locations of interest, but in cases where there are high torsional loads on the gearbox output or high ratios involved, it is advantageous to include sensors on the input ('F') and output ('E') of the gearbox as well.

In another variation of the gearbox configuration, it is sometime advantageous to use a right-angle gearbox. Here as well there generally a flexible coupling between the motor and gearbox, and often another between the gearbox and the driven equipment. The same guidance as for the linear arrangement applies; to detect faults in the gearbox, it is necessary to have sensors located above the input and output as shown. Locations 'B', 'F, 'E' and 'C' are necessary, and locations 'A' and 'D' are specified for maximally accurate results.

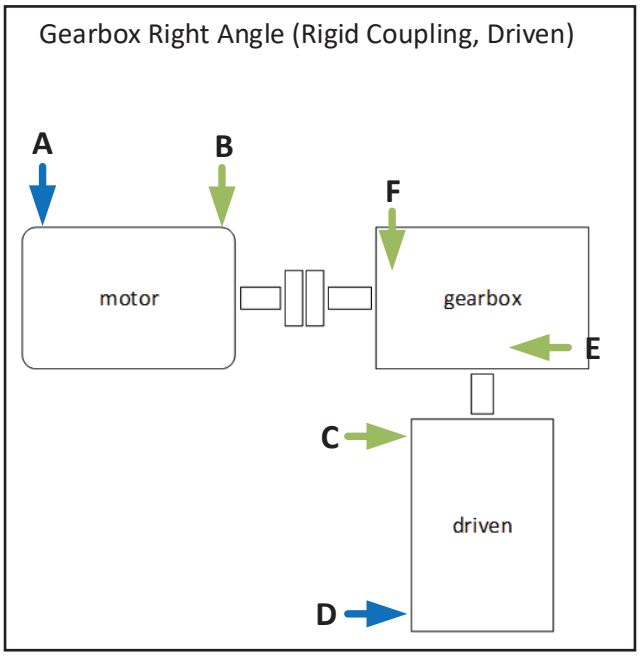


Figure 7

Another consideration is that often the gearbox output is directly connected to the driven equipment (often by a “face flange” and/or a splined shaft arrangement. In this case, it becomes essential that the gearbox output be fitted with a sensor as well.

The last configuration shown is the vertical one. This is very similar to the linear equivalent, except that the driven supports are less rigid. The system takes this factor into account in the analysis. Locations ‘B’ and ‘C’ are necessary, and locations ‘A’ and ‘D’ are specified for maximally accurate results.

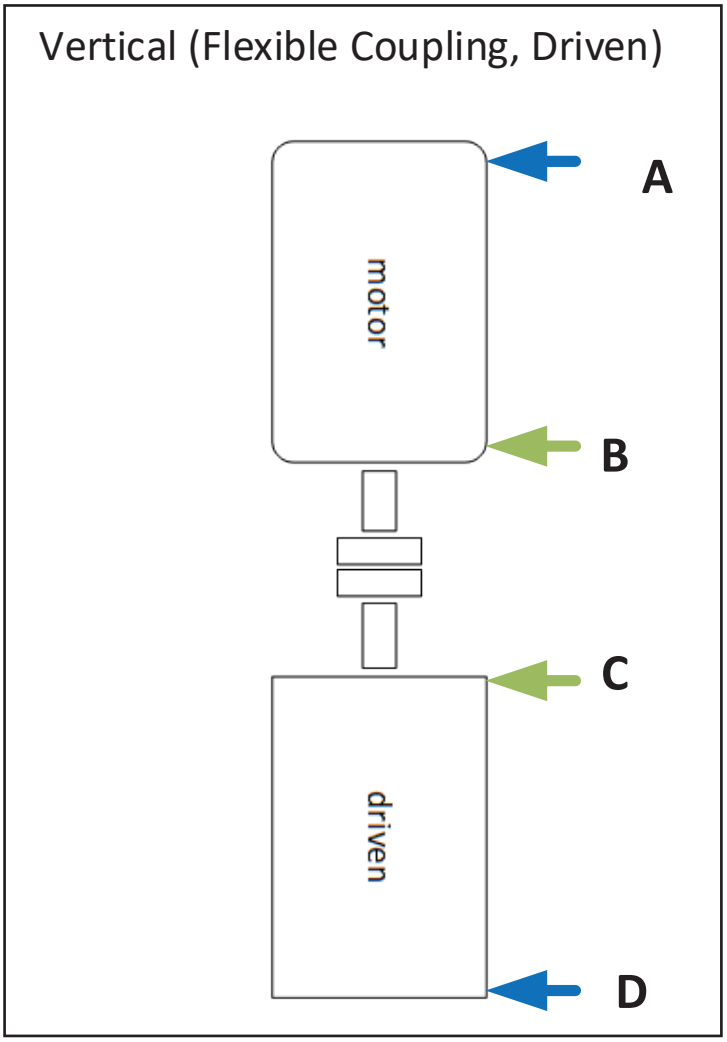


Figure 8

Asset Types

The following table lists the driven components that are acceptable to the system for analysis. Others (that are not shown) may just need to be made active in the system in order to allow analysis.

If you have a need for diagnostics on a piece of equipment that is not shown, please reach out to the i-ALERT Team for consultation.

Item	Machine Type
1	Centrifugal Pumps
2	Axial Flow Propeller Pumps
3	Rotary Thread, Screw, Gear Pumps
4	Fans
5	Drivers (Electric Motors, Diesel, Turbine)
6	Couplings (Flexible, Rigid, magnetic, close-coupled)

Figure 9

It should be noted that the equipment types above are in place and have been fully supported. There are other equipment types available; if an equipment type is not shown, it may be available. Please contact the i-ALERT Team for guidance.

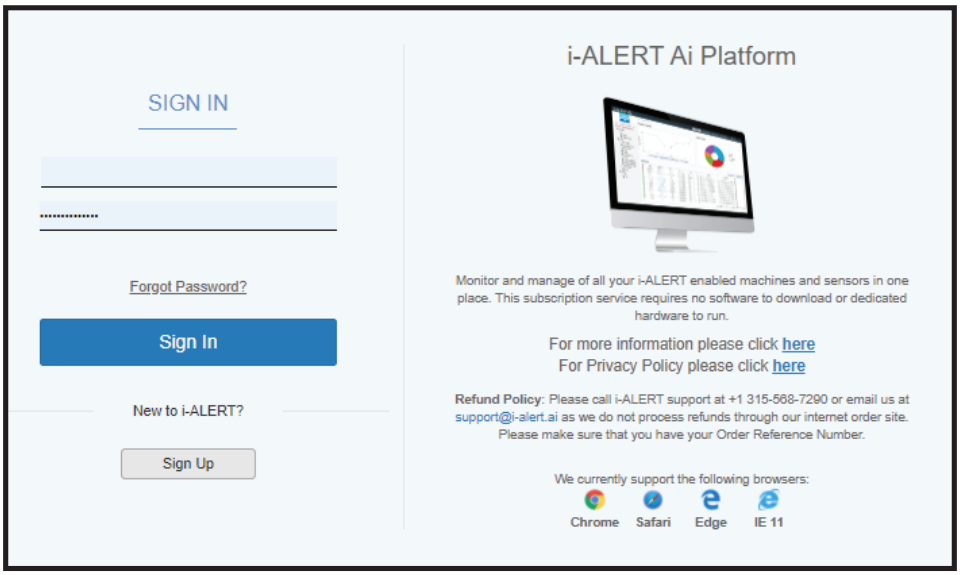
It is also important to point out that misalignment faults can only be obtained with multiple sensors. Misalignment calls therefor require a sensor on the input of the driven and the output of the driver in order to be detected by the Ai Diagnostics.

Ai Platform

Initial login to the i-ALERT Ai Diagnostics Plaform is from the following URL:

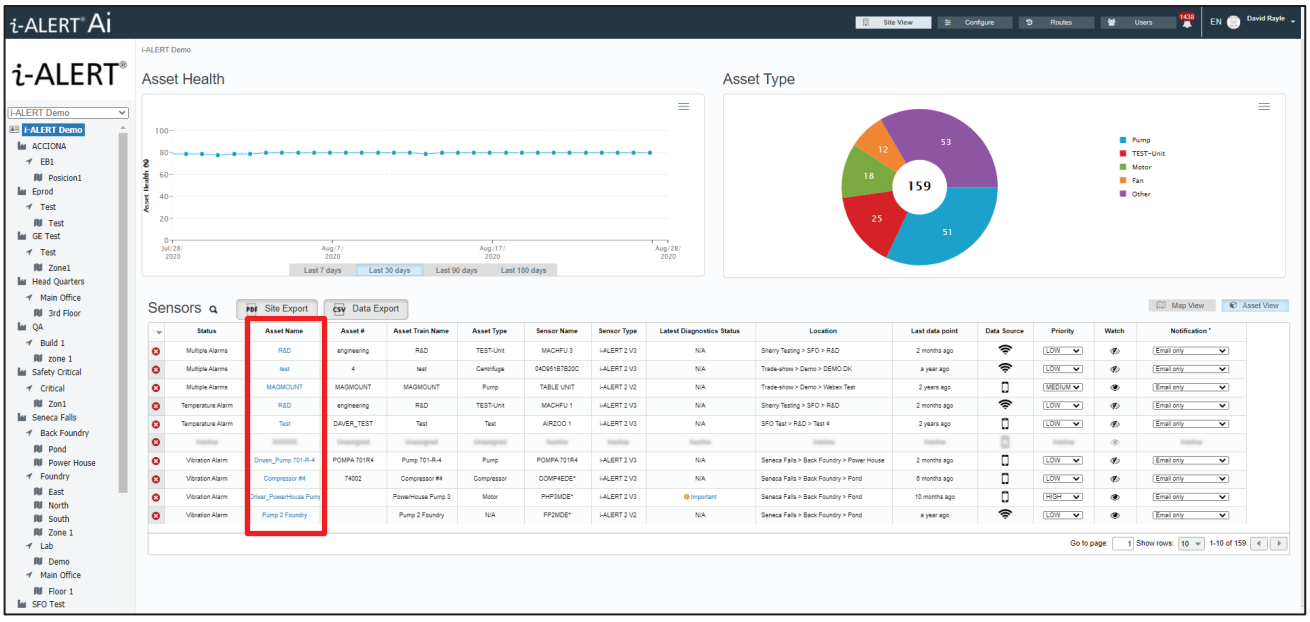
https://www.i-alert.ai/#/

This takes the user to the login page. The login ID and Password are the same as for the Mobile App.



The initial landing page (after successful login) called the Site View page, shows the Asset Health (a running trend of the percentage of sensors that are not in alarm) as well as the Asset Type mix. Clicking on any sector of the pie chart will display only the equipment selected.

Below the pie chart, the user can select the Asset View (default) or the Map View.



Using the System

The Map View allows an easy geographical “look down” on all monitored assets. Each pin represents an i-ALERT, and can be clicked on to obtain asset name, status and a link to all that sensors data.

Once the user has clicked on a link either in the Site View page under the Asset Name column or in the Map View, the Asset Page appears. This is where equipment can be grouped into an Asset Train, and configured according to the parameters specified in the previous chapter.

The Asset Page and how to configure assets will be discussed in detail below.

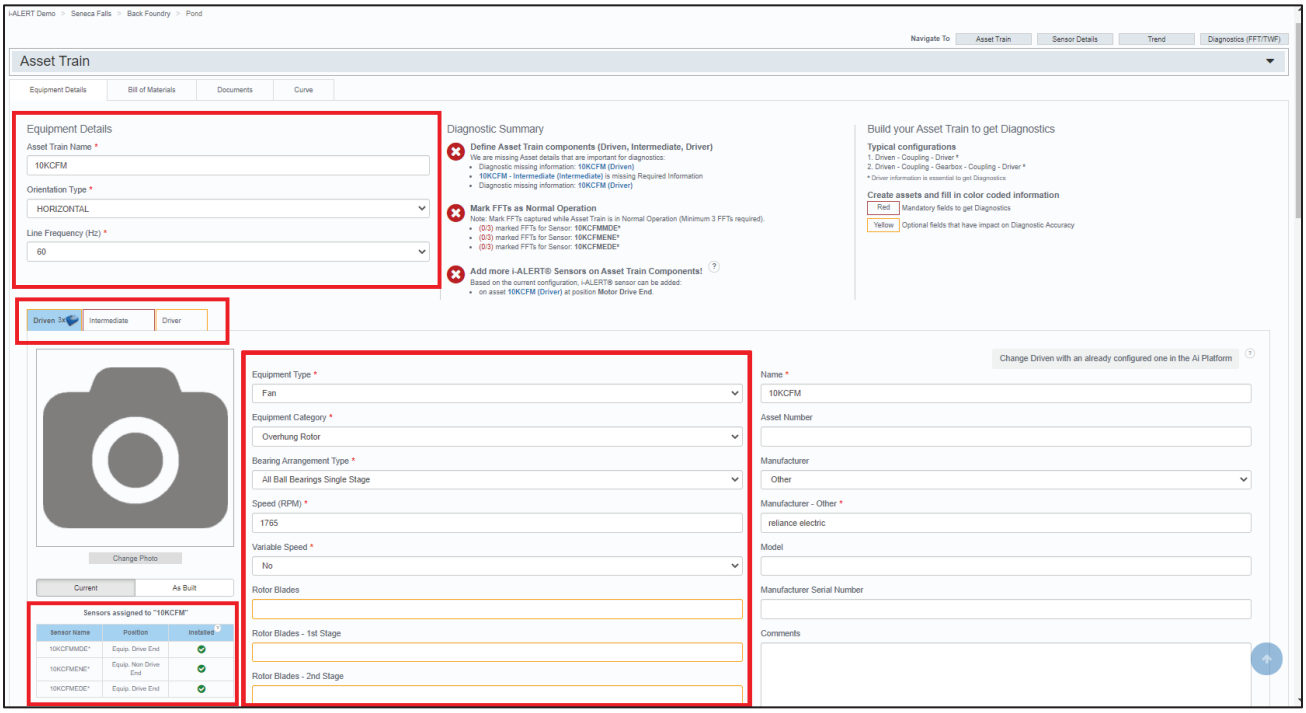
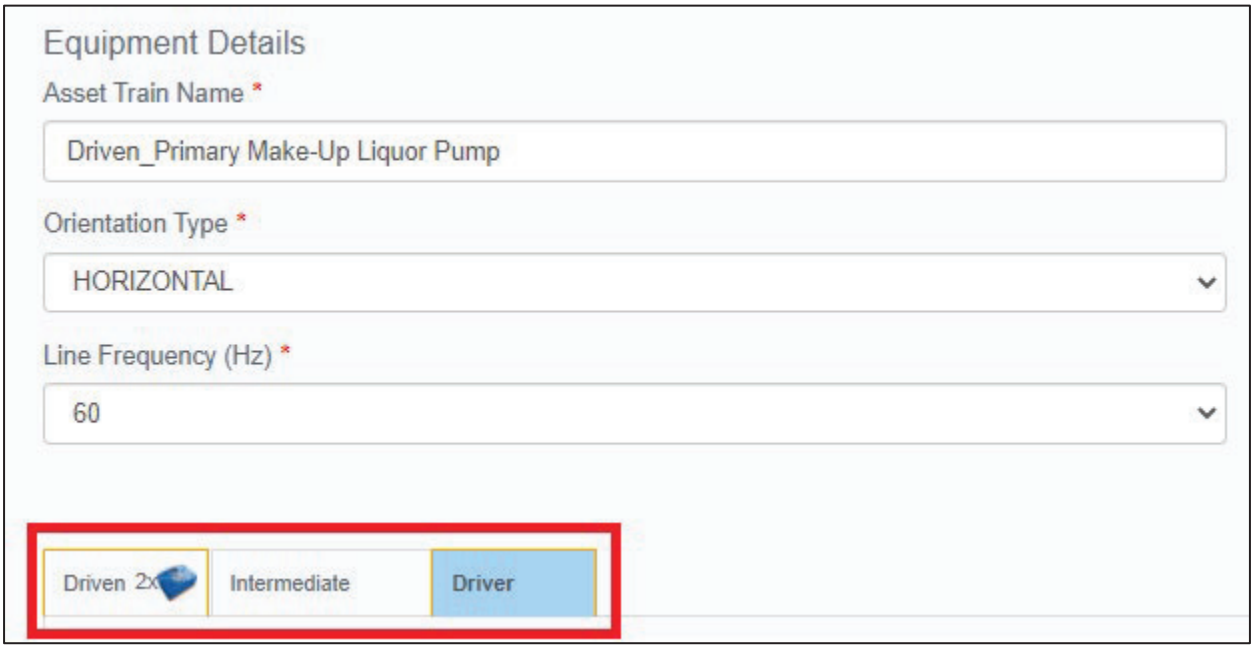


Figure 11

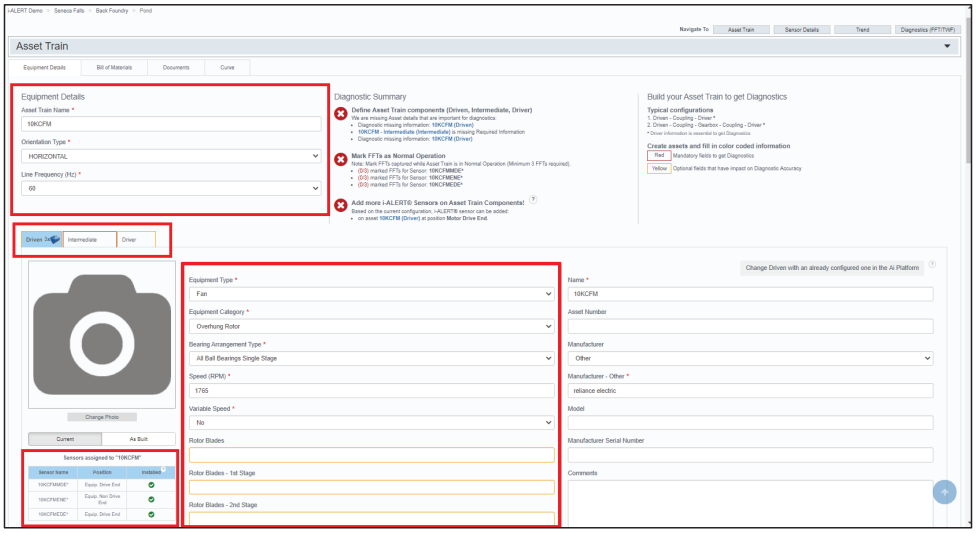
The first items that define the Equipment Details portion of the asset train, are the Asset Train Name, and the Orientation Type. This is the overall asset orientation, which in most cases will be horizontal; an exception to this would be vertical turbine pump.

Below the equipment details, tabs will appear showing the three components of the asset train.



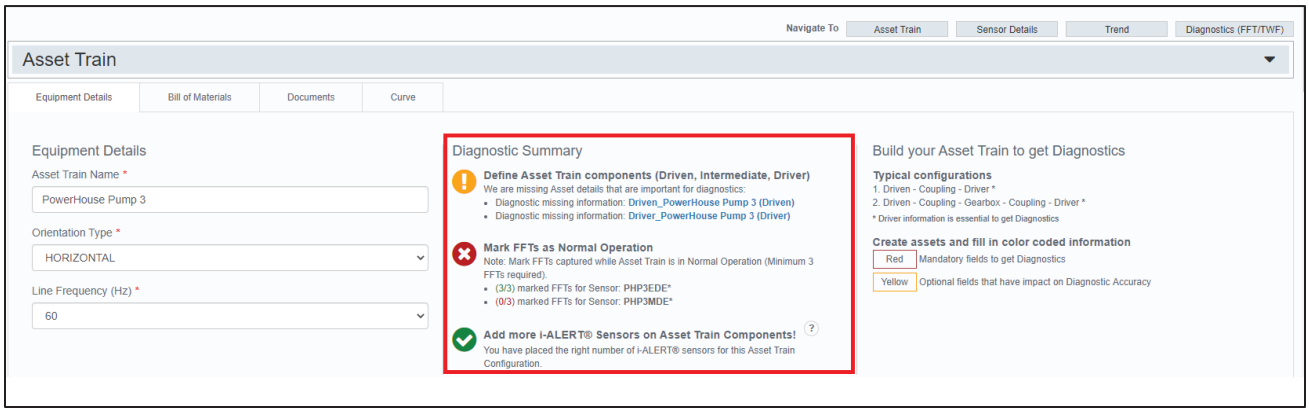
The number of sensors on the created asset train is shown graphically in the three tabs; if a sensor is attached to an equipment component, it shows as a small i-ALERT icon in the corner of the tab. In this screen, the Ai Platform will guide the user to enter fields associated with the equipment chosen. It is important to note that the requested fields change depending on the equipment chosen for each of the Drive, Driven and Intermediate components.

It is equally important to provide as much information as possible to allow the rules engine to compute the best result, although in many cases the information requested for a particular component may not be available. In such cases, provide as much information as is known, but no more. Fields designated with a star are required to be filled in, while other fields are beneficial but optional. Entering information into a field as a "best guess" is not desirable, as this could lead to results that are not representative of the asset condition. The screen below shows the Driven component information.



Using the System

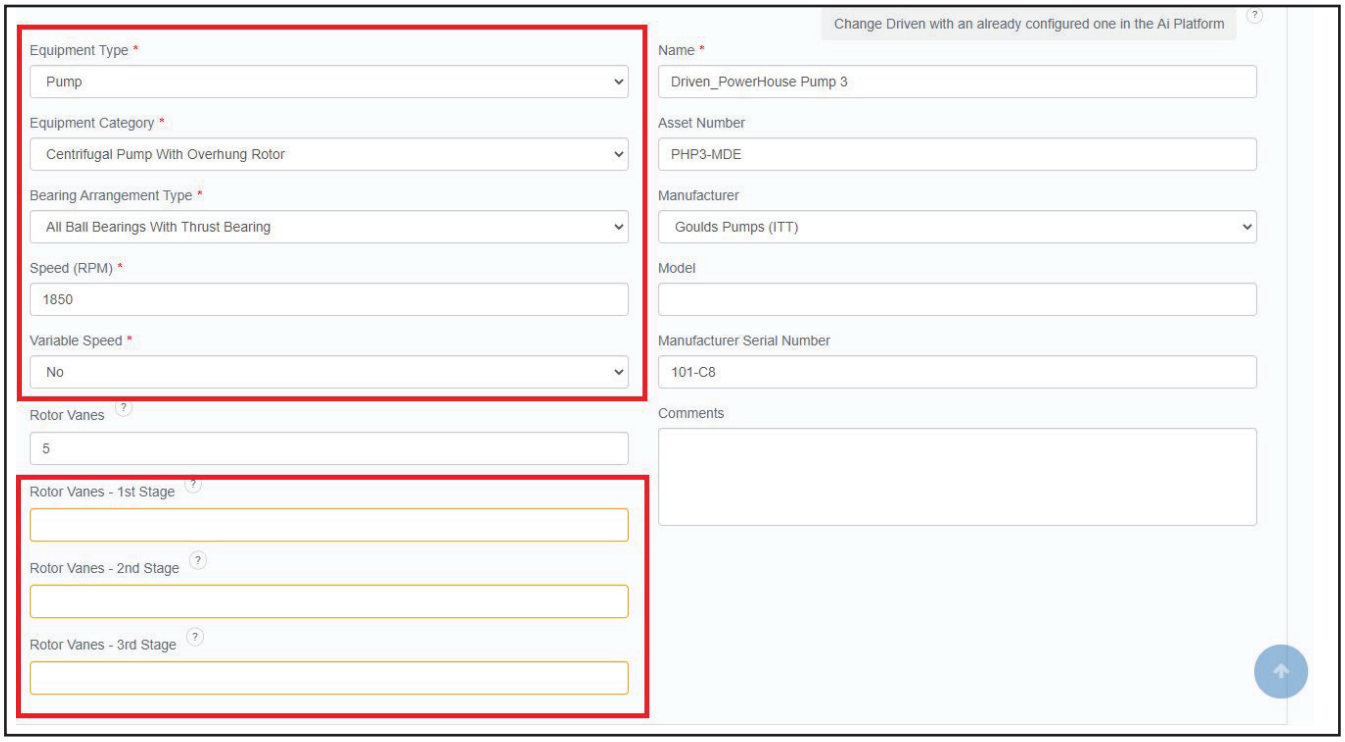
Note that if the panes are not filled out completely or if required information is missing, the items in need of updating will be shown under the Diagnostics Summary heading (shown below).



The red x's under the Diagnostic Summary heading will indicate a mandatory field(s) that are missing information which will prevent the system from computing a diagnostic result.

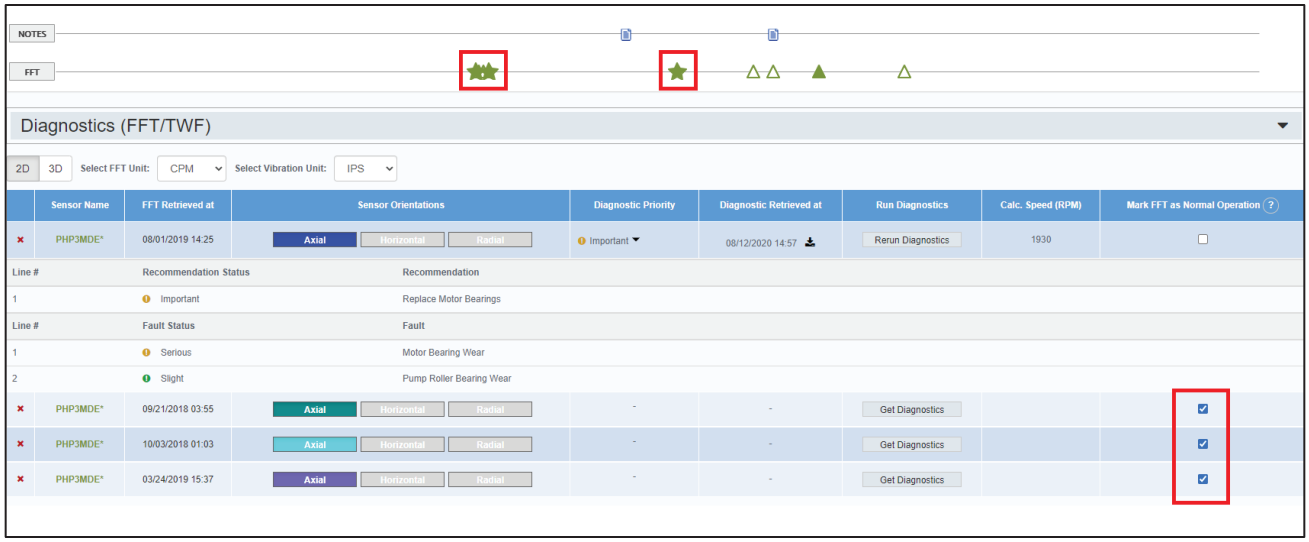
A warning in the Diagnostic Summary indicates something missing that is important for accurate results, but not required.

Helpful information as well as confirmation that the asset train is set up properly is denoted by the green check.

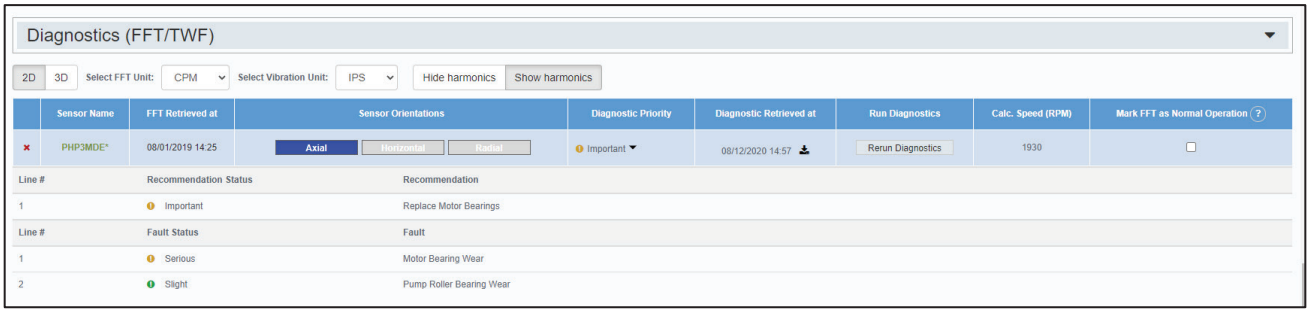


In the case where at least three good baseline data samples exist, the baselines are selected by clicking on the desired FFT's to use in the timeline below the trend as shown below. This will cause the FFT's to show up in the Diagnostics Table below, where they are checked in the column labeled Mark FFT as Normal Operation. The set up and result for the case of real baselines is shown below.

Using the System



Once the asset has been fully set up, and the use of a synthetic baseline or at least three real baselines have been chosen, the user is ready to run the diagnostics. In the screen below, a diagnostic was performed without using any real baselines (synthetic). The diagnostic outputs are shown below.



The diagnostics results include several helpful outputs. One is the Recommendation Status. The status is broken down into four category

Recommendation Status
No recommendation
Emerging
Important
Mandatory

Fault Status
Slight
Moderate
Serious
Extreme

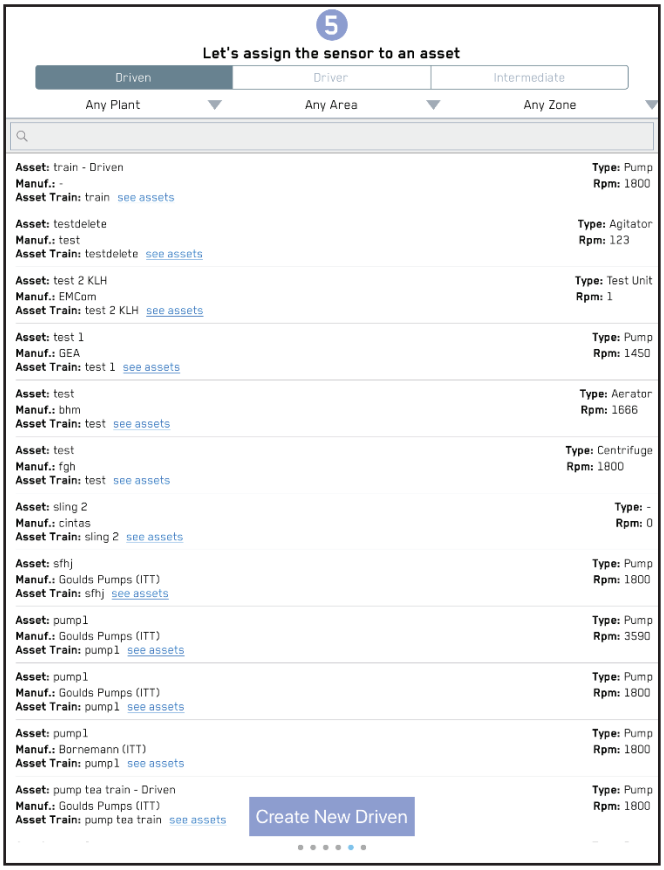
i-ALERT Mobile App:

The i-ALERT Mobile App for iOS and Android should be updated to the latest version to ensure diagnostics are available. i-ALERT Mobile App versions 3.0 and higher have automated diagnostics available. In this section we will go over the updates that have been made and show how diagnostics can be run in the Application

Registration:

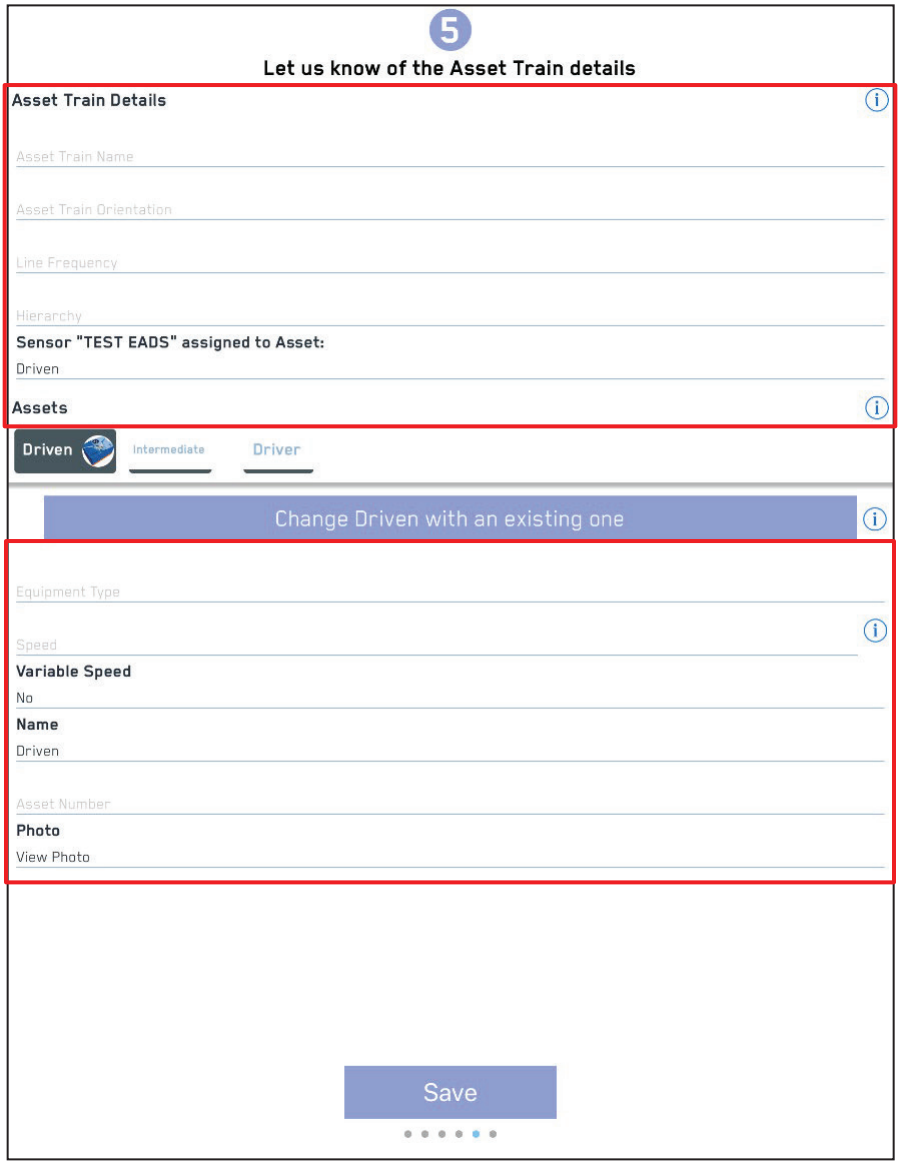
Registration is a key step when it comes to making sure we get the best value proposition for the i-ALERT hardware. Without registering the unit the user will not be able to use diagnostics

The first 4 steps when it comes to registration has not changed.



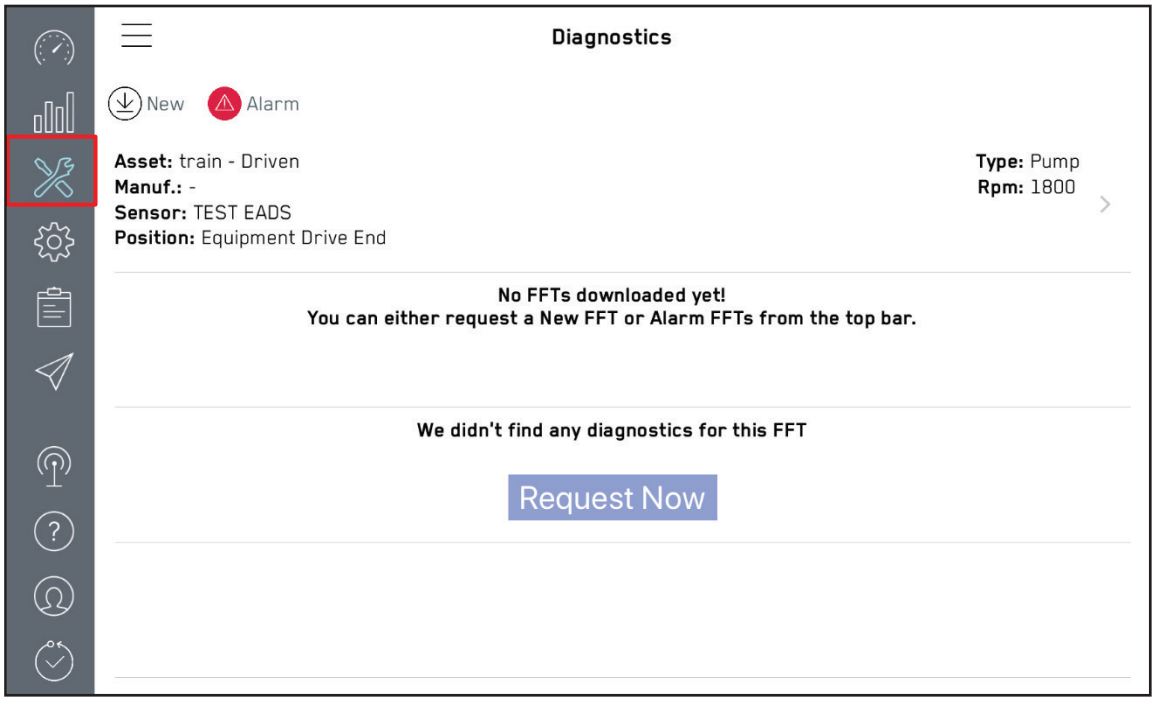
Using the System

The user can choose from the list of Asset trains already created or can create a new one. If the user selects to create a new Driven, the following page will show:

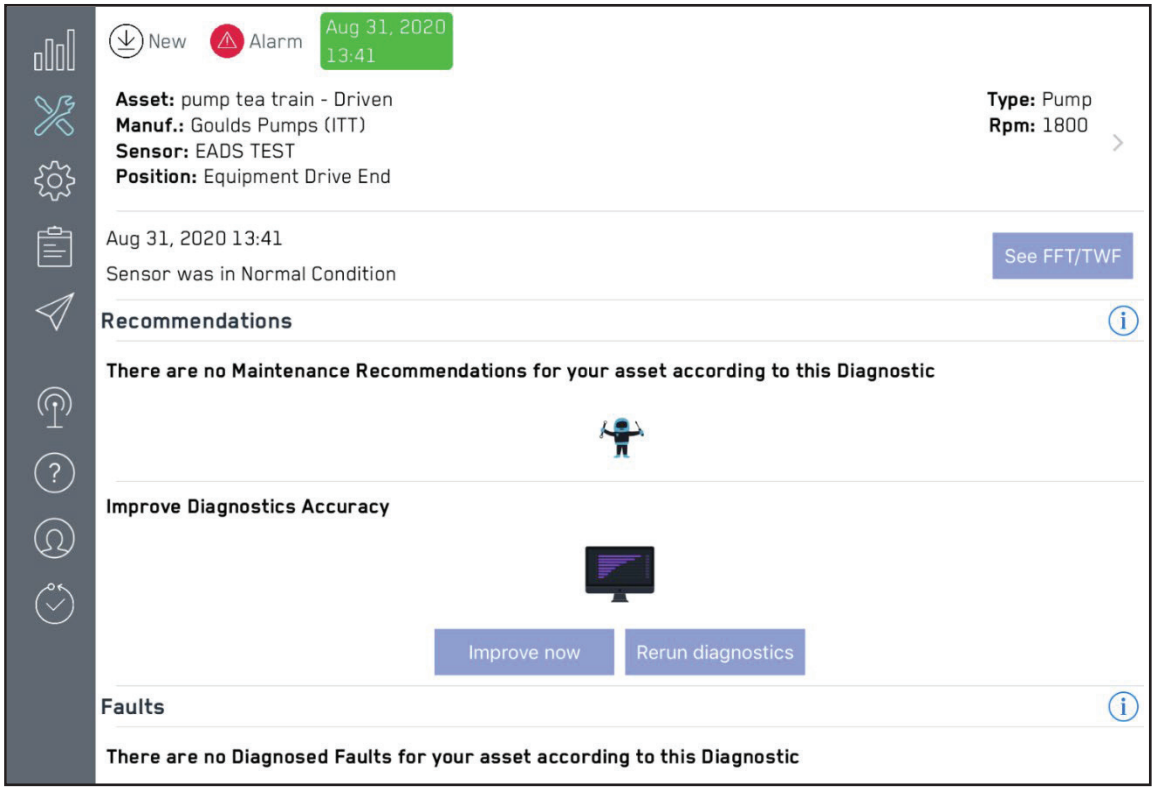


The first items that define the Equipment Details portion of the asset train, are the Asset Train Name, and the Orientation Type. This is the overall asset orientation, which in most cases will be horizontal; an exception to this would be vertical turbine pump.

Depending on how you defined the sensor in the equipment type in step 2 in the registration process that will define which part of the component train the sensor will be assigned to. Once the user has completed the registration process the user will be directed to the diagnostics page under the advanced tool page.

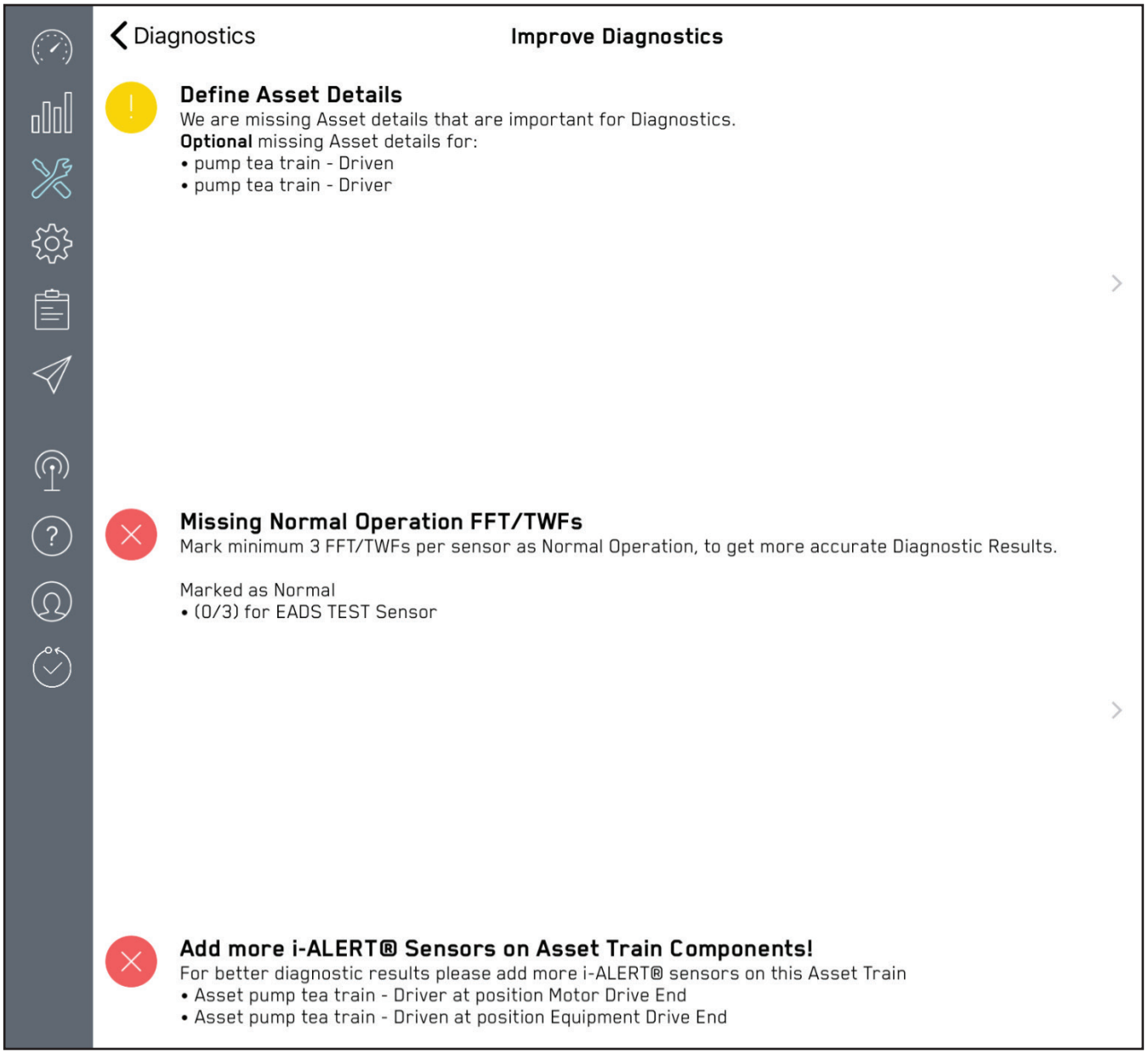


The user can request a new Spectrum or the Alarm Spectrum by clicking the Button respectively. Once the spectrums are downloaded the user can click the "REQUEST NOW" button to get the diagnostics.



To get more acqurate data the user will need to fill all the information requested. To see how to improve the accuracy the user needs to click the "Improve Now" button and the Rerun Diagnostics. Here is an example of what the current status would look like.

Using the System



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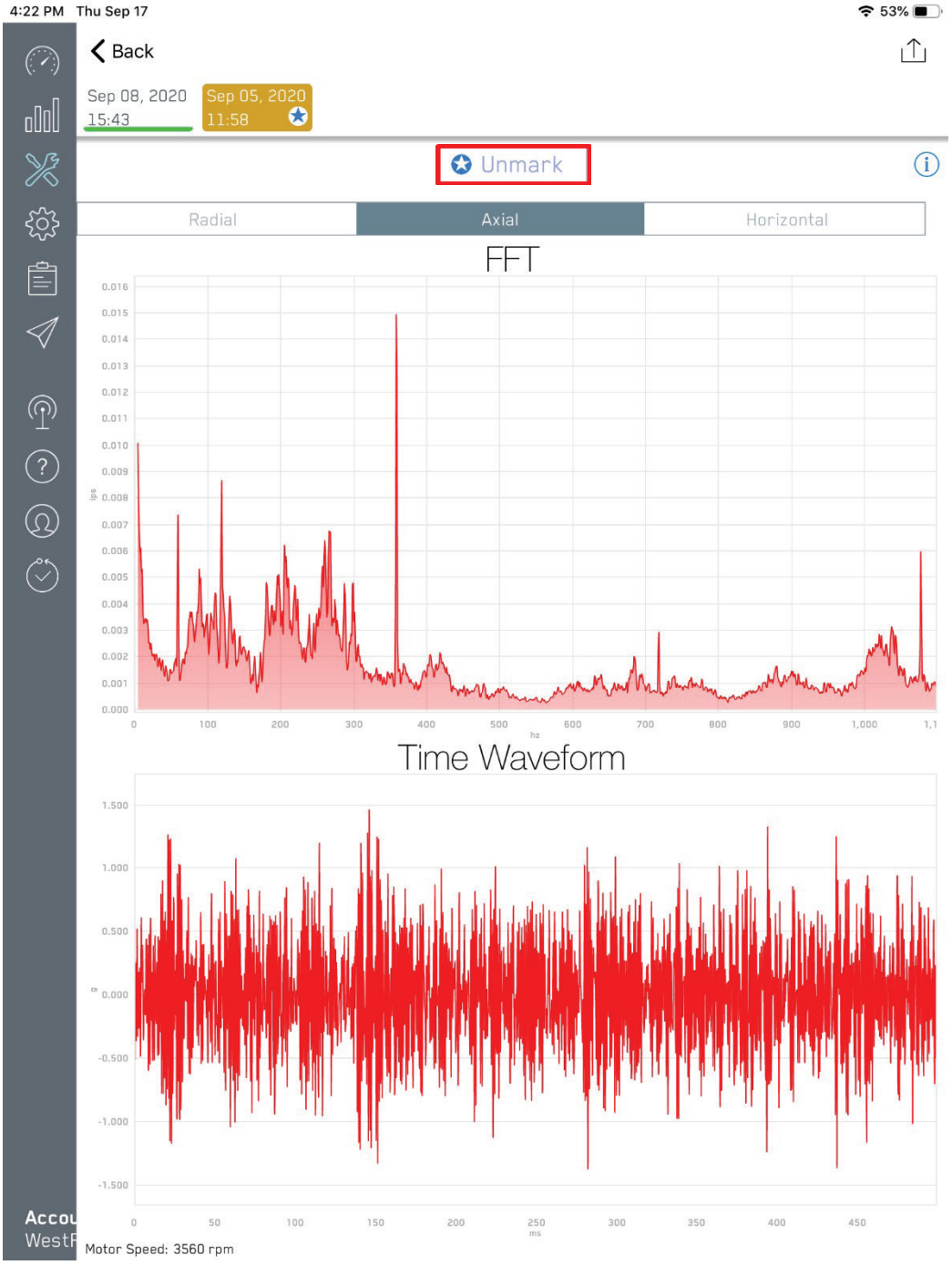
Using the System



It is recommended to have 3 Normal operating Spectrum to get the best results.

The results will be distinguished as the following:

Fault Status
Slight
Moderate
Serious
Extreme

Recommendation Status
No recommendation
Emerging
Important
Mandatory

Appendix 1 Applications

Eliminate Unplanned Downtime

Pulp & Paper mill in USA, "We added i-ALERTs to the our roll bearings on the #15 paper machine. We were able to find two bad bearings within 1 month that we are usually not able to detect. We repaired the bearings on a scheduled outage instead of unplanned. We saved thousands of dollars in maintenance and production costs."

Eliminate Bad Actors

Chemical plant in Thailand, install i-ALERTs to monitor 8 pumps with chronic failures. After a few months of operation one of the pumps experience 16 alarm events over 9 days. The root cause was traced back to a failure in the suction control valve. The payback of the i-ALERT solution was 700%.

Improve Productivity

Copper mine in Chile, Leveraging i-ALERT and the Ai Platform, the maintenance department is saving 16 hours per week to monitor 10 pumps. The ease of use of the i-ALERT enabled the local operators to collect machine health data directly from their mobile phones and maintenance could view the data remotely from the Ai platform.

Improve Safety

Oil refinery in UK, "Half of our plant is hydrofluoric acid. You have to wear big rubber chemical suits to go in. We've got lots of pumps in there and they all need vibration monitoring. I could connect to the i-ALERT standing 25 meters away on the outside - in the safe zone. For me, that was a real win-win."

Appendix 2 FAQ

Appendix 3 FAQ

Communication

Does the i-ALERT2 sensor only need a Bluetooth connection to use the diagnostics function? The diagnostics analysis can be completed from the Mobile App, providing the mobile app has a connection to the internet. The i-ALERT2 sensor will need to be within Bluetooth range of the mobile app to transfer data to the app.

Does it require Wi-Fi or cellular service to collect and process the data? The diagnostic functions are performed on the Ai Platform. The mobile device requires web connectivity in order to provide results.

Installation/Start up

How do I enable diagnostics with my current i-ALERTs? Diagnostics can be enabled from within the AI Platform or via either version (IOS/Android) within the Mobile App.

Does this change my alarm settings? No changes to alarm settings will take place upon enabling diagnostics.

Does this change the default baselines on new sensors? It does not change the baseline taken by the sensor used for setting alarm levels, nor will it change the baseline (alarm/warning levels) if manually set by a user. Baseline, as referred to in the context of diagnostics, is the selection of an FFT reading that represents normal operation of the equipment under normal operation. This reading is used within the diagnostic algorithms to detect impending failures.

Do I need to have a new baseline taken to setup diagnostics? It is not mandatory, but will greatly enhance the accuracy of the analysis. As such, it is highly recommended. In the absence of real baseline data, the system will automatically create and use synthetic baselines for use in the diagnostic calculations.

Does the mounting requirements of the sensors change with diagnostics use? No changes needed to the mounting requirements for diagnostics accuracy.

What do I need to do if I move a sensor to another machine? The same procedure as before (rename sensor, reset alarms and warning levels to the new equipment), AND taking a new baseline FFT reading is recommended.

Should I have multiple sensors on my equipment to get better diagnostics information? More sensors will yield more accurate results. It is recommended to have (in general) a sensor on the drive and free end of the equipment, and at least one sensor above the bearing on the output shaft of the motor or driver.

Does the diagnostics work on non-Goulds Pumps equipment? Absolutely. The diagnostics will work on many different machine types, from any manufacturer.

Does my environmental temperature changes around my equipment effect the diagnostics readings? Temperature changes will not affect the diagnostic accuracy.

Data

What are the baseline levels set to? Baseline levels within the diagnostics are either user selected (i.e., selecting an FFT reading as baseline that represents normal equipment operation), or if not selected, the system will utilize a synthetic baseline. It is preferable to use a real (user acquired) baseline FFT for maximum accuracy.

How far back does the diagnostics access my sensor readings (30, 90, 120 days)? The diagnostics can be performed on data up to 6 months old.

How does this work with my trend data? Diagnostics utilize changes in the trend data as well as information contained in the FFT and Time waveforms to calculate potential issues.

Does this effect the stored data? Diagnostics has no effect on stored data.

Is there any impact on the FFT, TWF and overall RMS measurements? There are no changes to any stored measurements by the Diagnostics System.

Hardware

Is there a firmware update to my current sensors? No update is needed.

How does diagnostics impact sensor battery life? Diagnostics has no effect on battery life.

Software

Do I need to download a new app to use diagnostics? There will be an update to the App; if "automatic updates" is enabled in the phone or tablet, the update will happen automatically.

Routes

Does the route creation function change when using diagnostics? Diagnostics has no effect on routes.

Pressure Sensor

How does the diagnostics function work with the pressure sensor? Diagnostics (currently) does not utilize the pressure data if it exists on a machine.

Gateway

Do I need an i-ALERT Gateway to use diagnostics? Although very beneficial, a Gateway is not required to use diagnostics.

i-ALERT Ai

Do I need an i-ALERT Ai subscription to use diagnostics? An Ai subscription with diagnostics is required to use diagnostics, however the diagnostics can be accessed through either the mobile app or the Ai Platform.

Appendix 3 FAQ

What equipment works with automated diagnostics?

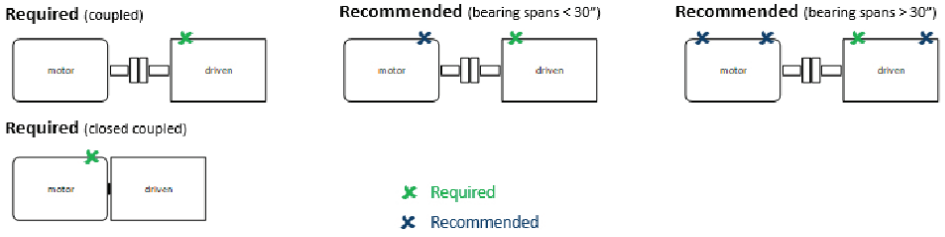
Driven Equipment	Power Transmission
Centrifugal Pump, Screw Pump, Progressive Cavity (Thread) Pump, Gear Pump, Fan, Centrifugal Blower, Cooling Tower Fan, Agitator, Mixer and Aerator	Rigid, Flexible and Closed Coupled, Belt or Chain and Gearbox

Will automated diagnostics work with other equipment not listed?

- For equipment not listed please contact the i-ALERT engineering team for evaluation. Automated diagnostics may be available. Depending on complexity of the machine train a one-time non-recurring setup fee may be required for this service.

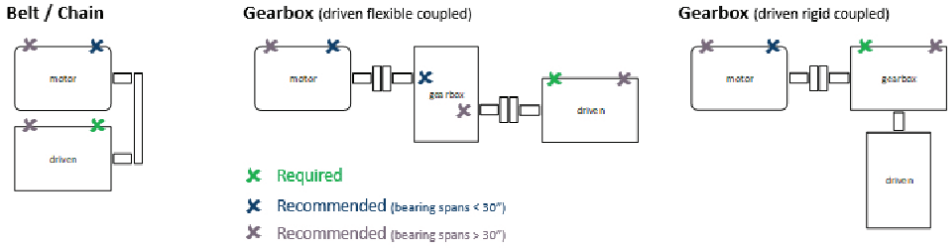
How many sensors do I need per machine?

- The automated diagnostics will work with only one sensor per machine train. However, for the best accuracy it is recommended two i-ALERT sensors are installed on the driver inboard bearing and driven equipment inboard bearing for bearing spans less than 30". For larger equipment with bearing spans greater than 30" it is necessary to have an i-ALERT sensor to be installed on both the inboard and outboard driven bearing. The guide shown below illustrates the required and recommended sensors and locations.



How many sensors do I need when the driver and driven equipment are not directly coupled?

- The automated diagnostics will work with machine trains in which there is an intermediate power transmission device such as a belt/chain or gearbox. Below are examples of recommended sensor placement for these types of machine trains.



How do I get automated diagnostics on my current i-ALERTs?

- To get automated diagnostics on your current i-ALERTs you will need to upgrade the i-ALERT to the diagnostics bundle which requires an annual subscription. The Diagnostics bundle includes the automated diagnostic software and access to the Ai Platform for each sensor with a subscription.

Appendix 4 Detectable Faults by Sensor Install Locations

Equipment	Pump		Motor		Pump and Motor	
Sensor Count	1x	2x	1x	2x	1x each	2x Each
Fault	Availability					
Cavitation or Air Ingress	Y	Y	N	N	Y	Y
Pump Diffuser Wear or Flow Problem	Y	Y	N	N	Y	Y
Pump Flow Restriction	Y	Y	N	N	Y	Y
Pump Flow Restriction or Disturbance	Y	Y	N	N	Y	Y
Pump Impeller Looseness	Y	Y	N	N	Y	Y
Pump Imbalance	Y	Y	N	N	Y	Y
Indication of Pump Impeller Impacting	Y	Y	N	N	Y	Y
Pump Shaft Looseness	Y	Y	N	N	Y	Y
Pump Roller Bearing Wear	Y	Y	N	N	Y	Y
Pump Thrust Bearing Problem	Y	Y	N	N	Y	Y
Pump Bearing Wear or Flow Noise	Y	Y	N	N	Y	Y
Pump Mounting Flexibility	Y	Y	N	N	Y	Y
Pump Bearing or Rotor Misalignment	Y	Y	N	N	Y	Y
Possible Non-Standard Impeller	Y	Y	N	N	Y	Y
Waveform Events (High Crest Factor)	Y	Y	N	N	Y	Y
Warning: Waveform Overload (Clipping)	Y	Y	N	N	Y	Y
Foundation Vibration	Y	Y	N	N	Y	Y
Pump Drive End Roller Bearing Wear	N	Y	N	N	N	Y
Pump Free End Roller Bearing Wear	N	Y	N	N	N	Y
Pump Drive End Shaft Looseness	N	Y	N	N	N	Y
Pump Free End Shaft Looseness	N	Y	N	N	N	Y
Indication of Pump Mounting Weakness	N	Y	N	N	N	Y
Warning: Pump Free End Bearing High Amplitude Demod	N	Y	N	N	N	Y
Warning: Pump Drive End Bearing High Amplitude Demod	N	Y	N	N	N	Y
Unspecified Pump End Problem or Flow Noise	N	Y	N	N	N	Y
Pump Free End Impeller or Bearing Shell Looseness	N	Y	N	N	N	Y
Pump Drive End Impeller or Bearing Shell Looseness	N	Y	N	N	N	Y
Waveform Events (High Crest Factor) on Pump Free End	N	Y	N	N	N	Y
Waveform Events (High Crest Factor) on Pump Drive End	N	Y	N	N	N	Y
Parallel Misalignment	N	N	N	N	Y	Y
Coupling Wear	N	N	N	N	Y	Y
Angular Misalignment	N	N	N	N	Y	Y
Irregular Axial Movement of Driver at Coupling	N	N	N	N	Y	Y
Irregular Axial Movement of Driven Component at Coupling	N	N	N	N	Y	Y
Indication of Coupling Wear or Looseness	N	N	N	N	Y	Y
Imbalance	N	N	Y	Y	Y	Y
Motor Shaft Looseness	N	N	Y	Y	Y	Y
Motor Imbalance	N	N	Y	Y	Y	Y
Motor Mounting Flexibility	N	N	Y	Y	Y	Y
Motor Cooling Fan Blade Damage	N	N	Y	Y	Y	Y
Motor Bearing Wear	N	N	Y	Y	Y	Y
Motor Shaft Thrust Looseness	N	N	Y	Y	Y	Y
Motor Bearing Misalignment	N	N	Y	Y	Y	Y
Indication of Damaged Rotor Bars or Shorting Rings	N	N	Y	Y	Y	Y
Eccentric Motor Rotor or Stator, or Loose Power Connection	N	N	Y	Y	Y	Y
Motor Rotational Rate Vibration	N	N	Y	Y	Y	Y
Indication of Motor Bearing Wear	N	N	Y	Y	Y	Y
Structural Vibration or Resonance	N	N	Y	Y	Y	Y
Motor Bearing Noise	N	N	Y	Y	Y	Y
Foundation Vibration	N	N	Y	Y	Y	Y
Motor Foundation Weakness	N	N	Y	Y	Y	Y
Motor Shaft Attached Oil Pump Internal Wear	N	N	Y	Y	Y	Y
Motor Bearing Fit Problem	N	N	Y	Y	Y	Y
Indication of Bent Motor Shaft	N	N	Y	Y	Y	Y
Warning: Motor Roller Bearing High Amplitude Demod	N	N	Y	Y	Y	Y
Warning: Motor Roller Bearing Very High Amplitude Demod	N	N	Y	Y	Y	Y
Warning: Spectrum Overload (Ski Slope)	N	N	Y	Y	Y	Y

For additional support on the Ai Diagnostics, or any of the i-ALERT Products below, please reach out to us at any of the contact options at the bottom of the page.

SENSORS
Monitor tri-axial vibration, temperature, run-time hours and pressure

MOBILE APP
Monitor your machine right from your phone with the free mobile app

GATEWAY
Add remote monitoring capabilities by leveraging remote data collection

DIAGNOSTICS
Built in intelligence automatically detects and diagnoses machine issues

Ai PLATFORM
Monitor all of your i-ALERT sensors and machines from a simple web app

For More Details:

visit: https://www.i-alert.com

contact: support@i-alert.ai

call: 1.315.568.7290

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