Ranger Pro

User Guide

Bently Nevada* Asset Condition Monitoring

BAKER HUGHES a GE company

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Contact Information

When you cannot reach your local representative, use the following contact information to reach us:

Mailing Address	1631 Bently Parkway South Minden, Nevada USA 89423
Telephone	1.775.782.3611 1.800.227.5514 (US only)
Internet	www.GEmeasurement.com

Contents

1. General Safety

This section describes how to manage personal safety hazards and avoid damaging equipment.

1.1 Receiving Inspection

Visually inspect the Ranger Pro device for obvious shipping damage. If you detect shipping damage, file a claim with the carrier and submit a copy to Bently Nevada.

1.2 Safe Handling

Proper handling of components, best practices for system installation, and diligent inspection procedures for the system will prolong the service life of the system. Additionally, procedures for dealing with system components replaced by maintenance are detailed to allow compliance with regulations relating to electronic waste.

Intended Use

Ranger Pro sensors are intended for monitoring purposes only and should not be used in control or safety systems.

Lithium Batteries

The Ranger Pro wireless sensor uses 3.6V lithium-thionyl chloride D-cell batteries. Lithium batteries are volatile. When handling and storing lithium metal batteries, follow these precautions:

- Store and handle lithium metal batteries to avoid contact with other lithium batteries.
- Don't place lithium metal batteries on metal work surfaces.
- Avoid exposing lithium metal batteries to extreme temperatures.
- If you store an inactive Ranger Pro sensor, remove the battery.
- Dispose of depleted or defective batteries in keeping with applicable statutes and regulations as well as site-specific safety requirements.

The lithium batteries will typically last up to five years. Use the Ranger Pro software or your network vendor's software to monitor battery performance and replace batteries as needed.

1.3 Safe Disposal

Hazardous Materials

This device (excluding the battery) does not use hazardous materials outlined by RoHS or battery directive statutes. These regulations confirm that lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ether, and battery related materials such as lithium are limited to no more than trace amounts within the system.

Recycling Facilities

When decommissioning devices, minimize the impact of the waste created. Refer to local or regional waste removal administration for current information on proper material collection, reuse, and recycling.

Product Disposal Statement

Customers or third parties who are not member states of the European Union are solely responsible for diligent product disposal at the end of its useful life. No person, firm, corporation, association, or agency shall dispose of the product in a way that is in violation of any applicable international, federal, state, or local regulations. Baker Hughes, a GE company, LLC ("BHGE") is not responsible for product disposal at the end of its useful life. Visit **www.weeerohsinfo.com** for recycling information.

2. Hardware

2.1 Description

The Ranger Pro sensor measures acceleration, vibration, and temperature. There are three versions of the unit:

- Ranger Pro tri-axial sensor. Measures vibration and velocity in three axis (X. Y, and Z) and measures surface temperature.
- Ranger Pro uniaxial sensor. Detects velocity and acceleration in one-axis (vertical, or Z) only and measures surface temperature.
- Ranger Pro repeater. Enables you to extend the range between sensors and network access points.

Both the tri-axial and uniaxial sensors can also act as network repeaters, although using the repeater mode depletes the unit's battery more quickly.

If a Ranger Pro device can't communicate with an access point, you can use the Ranger Pro Repeater to extend your network. We recommend connecting a maximum of three repeaters, although you may be able to connect up to eight.

2.2 System Components Required

To install, configure, and use the Ranger Pro wireless sensor, you need:

- Ranger Pro tri-axial and/or uniaxial devices.
- (Optional) Ranger Pro repeaters.
- Lithium-thionyl chloride batteries, one per device. For approved battery types, see the *Ranger Pro Datasheet*.
- Mounting hardware (plus adapters, if needed).
- Battery installation tool.
- USB device docking station.
- Ranger Pro configuration software.
- Spot facing tool, if required. (Not provided by Bently Nevada.)
- Torque wrench with ¼ inch drive, capable of tightening devices in the 5-7 Nm (44.25 to 61.96 in lb) range. (Not provided by Bently Nevada.)

Ranger Pro Components

The Ranger Pro device is composed of seven parts:

- Case. Contains the vibration and temperature sensors and forms the device housing (316 stainless steel body).
- Wireless E-module (glass-reinforced, impact-resistant PPS).
- E-module retaining ring.
- Battery (replaceable D-sized 3.6V lithium-thionyl chloride).
- Battery retaining ring.
- Two neoprene O-ring seals (34x1 mm).

An Installation Kit (121M7992) is also available. It includes a USB docking station, a battery installation tool, two installation wrenches, and five spare O-rings. For ordering information, see the *Ranger Pro Datasheet*.

NOTE

Use only approved D-sized lithium-thionyl chloride batteries for the Ranger Pro sensors and repeaters. If you use the wrong battery, you can negatively affect device performance, produce inaccurate readings, and void the Ranger Pro warranty. You can purchase approved batteries from Bently Nevada or third-party suppliers. For details and ordering information, see the *Ranger Pro Datasheet*.

Setup Overview

The Ranger Pro operates on the ISA100.11a wireless network protocol. To add Ranger Pro sensors to your network, complete these steps:

1. Survey your installation location.
2. Decide where to install Ranger Pro sensors and identify mounting points.
3. Locate and install access points.
4. Locate and install a device manager.
5. Install batteries in each sensor.
6. Provision Ranger Pro sensors (and repeaters, if needed).
7. Mount sensors.
8. Test and verify your installation.
9. Monitor and maintain your sensors and network.

3. Network Design

Ranger Pro sensors operate on the 2.4 GHz band on ISA100.11a wireless networks. To enhance security, the sensors use 128-bit AES encrypted packets.

3.1 Consider Sensor Range

A sensor can transmit data up to 150 meters (164 yards) to an access point when unimpeded by environmental influences. A sensor can optimally transmit data to another sensor up to 100 meters (109 yards) or more, but greater distances may negatively affect performance.

The range of Ranger Pro devices is affected by their location, line of sight, orientation of the E-module, proximity to gateway devices, gateway antenna type, and obstacles, including the density and type of materials nearby. Generally, the denser the industrial environment, the weaker the signal.

You can mount devices in any orientation necessary to monitor the machine or connect to the network. However, the radio transmission is strongest above and around the device, and weakest below it. Generally, if you mount a device horizontally, we recommend aligning it with the X-axis horizontal and Y-axis vertical.

3.2 Consider Battery Life

Batteries for the Ranger Pro device have a typical life of five years under the following conditions:

- The Ranger Pro is configured as a sensor device (not a router).
- Ambient temperatures under 40°C (104°F)
- Good quality radio frequency communications.
- Measurement interval of 30 minutes.

To maximize Ranger Pro device battery life:

- Minimize the number of hops between devices and access points. Poor quality radio frequency communications increase packet retransmission and reduce battery life.
- Avoid using Ranger Pro devices as both sensors and repeaters. Using a sensor as a router can reduce battery life to 18 to 24 months.
- Minimize the number of Ranger Pro devices routed through Ranger Pro Repeaters. Avoid connecting more than eight devices through a single Ranger Pro Repeater, or more than five devices through a sensor with router enabled. Since Ranger Pro Repeaters are continually in listen and transmit mode, their battery life is less.
- Use the lowest reasonable measurement interval to monitor vibration and temperature. More frequent vibration measurements consume more power. For example, changing the interval from 30 to 10 minutes reduces battery life by about 30%.

3.3 Choose Network Topology

The two most commonly used ISA100.11a network configurations are star and mesh topologies. Your existing network infrastructure may determine the number of devices you can connect to access points or the maximum number of hops permitted. A star topology is recommended, although you may use a combination of both, depending on your needs. Consult your network infrastructure documentation for details.

Star Topology

A star topology is the most efficient method for building a network. It is suitable for smaller areas where all devices can directly communicate with an access point.

Mesh Topology

A mesh topology creates redundant communication paths for devices on the network. Mesh topologies are suitable for devices that cover a large area. When planning a mesh network, it's critical to avoid a choke point, where many devices attempt to connect to a single point. Avoid network topologies that require more than three hops and too many nodes routed through a single node, creating a choke point.

3.4 Plan Device Placement

NOTE

Installing and configuring ISA100.11a wireless networks is beyond the scope of this user guide. For details, refer to your vendor's wireless network documentation.

Obtain or develop an accurately scaled site plan detailing the placement of the machinery you need to monitor, including architectural details like walls and pillars. Then complete a site survey and plan.

To develop a survey and plan:

1. On the accurately scaled site plan, mark the locations where you need to install sensors.
   - Mount sensors as close as possible to the machine point being monitored.
   - To avoid destructive interference, install devices at least 18 inches apart.
   - Whenever possible, avoid obstructions such as machinery or walls that might “hide” devices from routing devices or access point antennae.
   - Allow clearance for mechanical installation and suitable clearance around the top (100 mm or 4 inches).
   - If possible, install devices at least two meters (6 ½ feet) above ground level with clear line of site to at least two other devices.
2. Determine the optimal wireless range for each device. Use the map scale and draw a circle representing the nominal radio frequency range around the proposed location of each Ranger Pro sensor. (When connecting to an access point, the range is about 50%

greater.)

When the device is placed among:	Draw a circle with:
Dense metal structures with no line-of-sight	25 m (82 ft) radius
Sparse metal structures with limited line-of-sight	50 m (164 ft) radius
Unobstructed, clear line-of-sight locations	100 m (328 ft) radius

3. Pinpoint the locations of any existing access points and gateways.
    - If you're installing sensors in extremely congested plant areas or in areas with insufficient wireless connectivity, consider installing additional gateways and access points.
    - Add locations where you need to install additional access points and gateways.
    - When placing access points and gateways, consider the location of line power and suitable connections to the existing plant network.
    - Place access points in locations where as many sensors as possible can connect directly to each access point. We recommend that you don't exceed 40 devices per access point.
    - Where possible, minimize the distance from the access point to the furthest Ranger Pro device.
4. Plan for multiple connections for each device.
    - Multiple communication paths are required to increase network redundancy and prevent a single path failure that would result in a loss of communication.
    - Depending on the circle (short, medium, or long) that applies to the location of each Ranger Pro sensor, verify that each device is within range of at least two, and preferably three, access points or Ranger Pro repeaters.
    - Avoid connecting more than five devices through a single Ranger Pro sensor, or more than eight devices through a single Ranger Pro Repeater.
5. To extend the range of the wireless network or to reach devices beyond the range of an access point, consider adding Ranger Pro repeaters. Repeaters ought to be positioned:
    - Relatively high above the sensors, preferably at least two meters (6 ½ feet) above grade. Higher placement dramatically increases signal strength.
    - To improve radio frequency transmission, we recommend you install the repeaters upside down and at least 33 cm (1 ft) from walls and pillars.
    - Within a clear line of sight to two other repeaters or access points.
6. Plan for a maximum of four hops between each Ranger Pro device and an access point, although we recommend a maximum of three hops.
7. If your installation is complex or likely to require additional access points, consider temporarily installing your network access points and Ranger Pro devices to test your plan. Use temporary magnetic mounting adapters to test device placement.

To obtain optimal results, carefully plan your network. For complete information, see your network infrastructure documentation.

4. Operation

4.1 Provision and Configure Devices

Before installing Bently Nevada, LLC Ranger Pro sensors, you must prepare each sensor to join your ISA100.11a network. Use your Honeywell or Yokogawa gateway to provision your sensors over-the-air. When you provision the device, you provide it with the correct UTC adjustment (if needed), a network ID, and the network join key.

Ranger Pro devices must be in an unprovisioned state to join the network.

Provisioning Using the Yokogawa Gateway

To provision Ranger Pro devices on a Yokogawa gateway:

1. On the Yokogawa gateway, access the Field Wireless Management Console Monitor.
2. Choose Tools > OTA Provisioning Manager.
3. To allow unprovisioned devices to join, select Enable Provisioning Network. Wait for unprovisioned Ranger Pro devices to display in the Provisioning Network list.
4. Select the devices desired and choose Start Provisioning.
5. Wait for all devices to be provisioned and display in the Operating Network List.

Depending on the number of devices and their current sleep state, provisioning may take up to several hours. If a device fails to join the network, See "Reset the Device" on page 10.

Provisioning Using the Honeywell Gateway

To provision Ranger Pro devices on a Honeywell gateway:

1. On the Honeywell OneWireless gateway device manager, select the appropriate access point.
2. Enable Over-the-Air Provisioning for a duration of 60 minutes. Wait for the unprovisioned devices to display.
3. Select the un-provisioned devices and accept them for provisioning.

Depending on the number of devices and their current sleep state, provisioning may take up to several hours. If a device fails to join the network, See "Reset the Device" on page 10.

After the Ranger Pro devices are provisioned, use the OneWireless device manager to configure each device's tag name, routing assignment, and join assignment.

NOTE

If over-the-air provisioning fails, you may be required to use the USB docking station and Ranger Pro software to reboot or unprovision the device.

Configure Sensor Interval

Using the USB docking station, you can configure how often sensor data is collected and transmitted.

NOTE

Using the USB docking station on a bare metal surface can cause interference. Insulate the docking station from the metal surface by placing a 2.5 cm (1 in.) thick book or similar material under the docking station.

1. Connect the USB docking station to the computer running the Ranger Pro software.
2. Place the Ranger Pro sensor on the docking station pad.
3. Access the Ranger Pro software.
4. Choose Provisioning and Configuration > Network Trended Values.
5. Configure the interval at which vibration and temperature measurements are taken.

NOTE

Shorter vibration and temperature periods reduce battery life.

6. Click Apply.

Configure Units and Subunits

Ranger Pro devices detect single or tri-axial acceleration using a piezoelectric ceramic sensing element in the sensor base. The sensor derives velocity from the acceleration signal. The Ranger Pro devices measure surface contact temperature using a sensor in the device base. The sensor reports a single temperature per device. You can choose what units are used to measure the data.

To change the measurement units:

1. Connect the USB docking station to the computer running the Ranger Pro software.
2. Place the Ranger Pro device upside down on the docking station pad with the E-module in contact with the pad.
3. Access the Ranger Pro software.
4. Choose Provisioning and Configuration > Units and Subunits.
5. Select the values appropriate to your site's needs.
6. Click Apply. If the sensor is currently publishing data, wait two measurement intervals for the new units to take effect.

For ranges and complete specifications, see the *Ranger Pro Datasheet*.

Unprovision Sensors

If you remove a sensor from the network, or if you need to disable it for any reason, you can unprovision it.

Unprovision Using the Network

Using a Yokogawa gateway, open the configurator. Select the devices and unprovision them.

Using a Honeywell gateway, open the device manager. Select the devices and inactivate their IO channels. When the channels are inactivated, unprovision the device.

NOTE

When you inactivate a devices' IO channels on a Honeywell gateway, you must reactivate the IO channels. You can only do this after you re-provision the device using the Honeywell gateway.

Unprovision Using the Docking Station

To unprovision a device using the docking station:

1. Connect the USB docking station to the computer running the Ranger Pro software.
2. Place the Ranger Pro sensor upside down on the docking station pad.
3. Access the Ranger Pro software.
4. Click Provisioning and Configuration > Unprovision.

The Ranger Pro software resets the sensor to its default state, disconnecting it from the network.

Reset the Device

Once you insert a battery into a device, the E-module is ready to receive a join key from the network. If it fails to receive a join key, it enters an increasingly long sleep cycle. It periodically wakes from sleep mode to attempt to join the network.

The device progressive sleep cycle is:

Interval after battery in inserted or sensor is disconnected from a network:	Sensor tries to connect every:
0 to 20 minutes	2 min
>20 min to 120 min	5 min
>120 min to 10 hours	15 min
>10 hours to 48 hours	30 min
>48 hours	60 min

If after several hours the device fails to join the network, reset the sensor. Remove the sensor from the field and reset the device in an equipment room or similar environment.

To reset the device:

1. Connect the USB docking station to the computer running the Ranger Pro software.
2. Place the Ranger Pro device upside down on the USB device docking station.
3. Access the Ranger Pro software.
4. Choose Maintenance and Diagnostics > Reboot.

4.2 Mount Devices

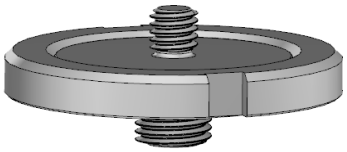
Do not replace batteries in a hazardous area. Use only approved battery types given in the Ranger Pro Datasheet.

Choose Mounting Hardware

Once you determine where to mount your sensors, choose the mounting hardware that meets your needs. Depending on your equipment, the thickness of the machinery housing, warranty requirements, placement, and other factors, you can choose from standard studs, adhesive studs, or tri-axial alignment studs. For details and ordering information, see the *Ranger Pro Datasheet*.

To mount a Ranger Pro device:

1. Choose a mounting position on the machine housing.
    a. Determine what kind of mount to use. Refer to the machine warranty or other documentation and verify that the housing is suitable for drilling a mounting hole. If not, consider using an adhesive mounting pad.
    b. Provide enough clearance to mechanically install the sensor using the provided wrench.
    c. Locate the device for optimal radio frequency connectivity. We recommend at least 100mm (4 inches) clearance around the E-module on the top of the device.



2. Prepare the mounting position.
    a. Prepare a flat, clean mounting surface.
        - The mounting diameter should be a minimum of 40mm (1 ½ inches) on the machine at the mounting point.
        - On curved surfaces, use a spot facing tool to provide a flat mounting surface.
        - Use a steel brush to remove all paint from the mounting surface.
    b. Prepare the mounting site.
        - (Recommended) Drill and tap a suitable hole in the center of the prepared surface.

          OR
        - Cement an adhesive mounting pad onto the prepared surface with a suitable bonding agent.
3. Align the axis of the device as needed to the axis of the acceleration or vibration being monitored.

- The vertical or z-axis of the Ranger Pro sensor is the most sensitive.
- Where possible, mount the device in the axial or radial direction of the machine.

NOTE

Aligning the tri-axial Ranger Pro device to the axis of the machine being monitored can be difficult. To make this easier, use the tri-axial alignment studs that are available as spare mounting adapters.

4. Apply a suitable thread locking compound to the machine mounting stud. This is necessary due to vibration.
5. Apply a lower-strength thread locking compound to secure the Ranger Pro device to the mounting stud or pad.
6. To improve high frequency response and reduce transverse vibration, apply a very light amount of silicone grease to the base of the device.
7. Attach the device to the machine surface and tighten the stud.
    a. If using the M6x1 to M8x1.25 tri-axial alignment stud, tighten the device using a torque wrench to 6 Nm (53.1 in-lb) maximum.
    b. For all other mounts, tighten the device to 6-7 Nm (53.1 to 61.96 in lb).
8. (Optional) Secure the device by passing a 1mm (.04 inch) lanyard (not provided by Bently Nevada) through the fall protection hole in the base. Secure the lanyard to a suitable retaining point.

5. Verification

5.1 Verify Network Connectivity

Ranger Pro broadcasts data through a gateway using Modbus over TCP. The data is described in the Ranger Pro capability files available for download from Bently Nevada technical support.

Verify Network Joining

To verify that your sensors have joined your network, use your network vendor's software.

NOTE

It can take several hours for a large number of Ranger Pro devices to join your network.

If a device fails to join your network after several hours, try these options:

- Modify the device.
  - Reset the sensor. This increases the frequency that the device attempts to join the network. (See "Reset the Device" on page 10.)
  - Verify the device's network connection. Dismount the device from the machine and position it closer to an access point or router.
  - If possible, improve the device's radio frequency communication by relocating it or reorienting the device's axis or orientation relative to the access point.
- Add a device or Repeater.
  - In areas that are extremely congested, configure a Ranger Pro device as a router or, preferably, add a Ranger Pro Repeater.
  - Verify that each device has a good network connection.
  - Remember that using a Ranger Pro sensor as a router decreases its battery life.
  - Remember to stay within the recommended number of hops per device. (See "Plan Device Placement" on page 6.)
- Move the device or access point antenna.
  - Relocating a device or reorienting its axis or orientation relative to the access point as little as 6 cm (2 1/3 inch), or one-half of a 2.45 GHz wavelength, may improve signal strength.
- Change access points.
  - Use a higher gain antenna on the access point. Verify that the increased
  - Modify the antenna polarization of the access point.
  - Add access points.

Verify Signal Strength and Packet Error Rates

Check that the devices' signal strength and packet error rate are within your network vendor's guidelines. Use your wireless network gateway to monitor device signal strength and packet error rates.

- Signal strength (RSSI) must be above -85 dBm, and preferably above -78 dBm.
- Packet error rate (PER) must be less than 50%, and preferably less than 20%.

5.2 Validate Device Data

Depending on the wireless management software you are using, there are several ways to validate that each device is transmitting data.

After provisioning and configuring the Ranger Pro devices, use a suitable Modbus or OPC client to validate your system installation and configuration.

Device Variables

Depending on whether you are using a uniaxial or tri-axial Ranger Pro device, it broadcasts variables via ISA100.11a defined standard Analogue Input Objects (AIO) on these channels:

1. Temperature
2. Vibration X-axis RMS
3. Vibration X-axis peak
4. Vibration Y-axis RMS
5. Vibration Y-axis peak
6. Vibration Z-axis RMS
7. Vibration Z-axis peak

Device Channels

Ranger Pro devices broadcast data on these channels:

- Uniaxial sensor: channels 1, 5, and 7
- Tri-axial sensor: all seven channels.
- Ranger Pro Repeater: no channels.

Data Output

You can output the data to third-party software or using OPC to GE System 1. (Additional licenses may be required.) For complete information, refer to your Bently Nevada System 1 documentation.

In some cases, you can use your network infrastructure to validate device data. For details, refer to your vendor's network infrastructure documentation.

6. Maintenance

The Ranger Pro device needs minimal maintenance. If a device fails, it may be due to a weak battery, environmental damage, or even a blocked wireless connection.

6.1 Monitor Battery Levels

To monitor your Ranger Pro device's battery status, use your network infrastructure software or the USB docking station and the Ranger Pro software. Depending on the device operating mode and configuration, the battery will last up to five years.

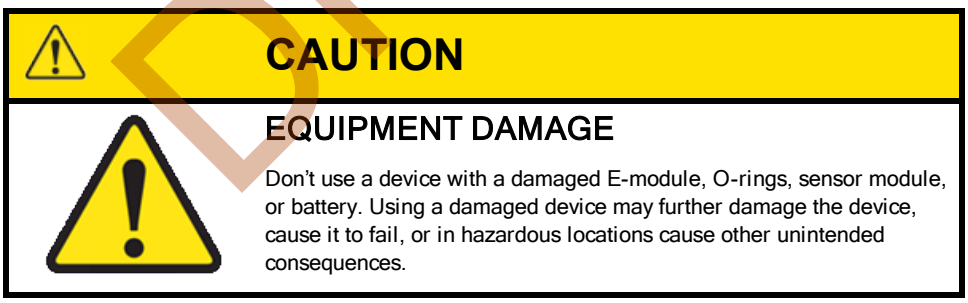
Check the devices' battery status monthly. If a battery status is medium, be sure you have replacement batteries in stock or on order. However, for optimal device life, we recommend that you don't store batteries for more than 12 months. If a battery status is low, replace the battery within a week or two.

Install only approved D-sized 3.6V lithium-thionyl chloride batteries. For details and ordering information, see the *Ranger Pro Datasheet*.

6.2 Clean and Inspect Devices

To clean the exterior of the Ranger Pro devices in potentially hazardous environment, use a damp cloth.

Before maintaining Ranger Pro devices in a potentially hazardous environment, verify that hazardous materials, atmospheres and conditions have been removed.



Clean the Exterior

When cleaning a Ranger Pro device in an equipment room or a similar environment:

- Use a clean, dry, non-abrasive, anti-static cloth to clean the exterior. Don't use solvents or solutions.
- To remove deposits from the exterior of the sensor, use an electronic contact or switch cleaner.

Diagnose Device Status

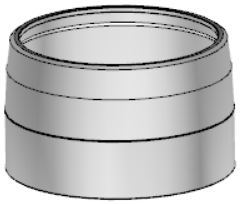
If a device fails, you can learn the nature of the fault using the USB docking station.

NOTE

Using the USB docking station on a bare metal surface can cause interference. Insulate the docking station from the metal surface by placing a 2.5 cm (1 in.) thick book or similar material under the docking station.

To diagnose a fault in a device:

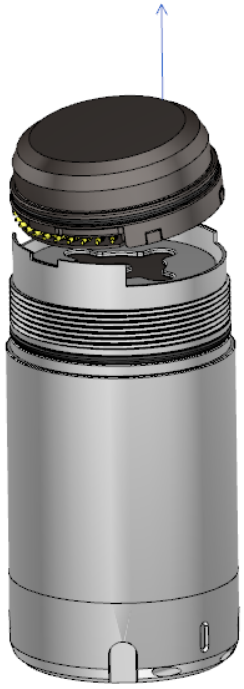
1. Connect the USB docking station to the computer running the Ranger Pro software.
2. Place the Ranger Pro device upside down on the USB device docking station.
3. Access the Ranger Pro software.
4. The Diagnostics field displays the status of the device and whether a fault is present.
5. Choose Maintenance / Diagnostics. The Sensor Diagnostics field displays sensor, temperature, and vibration faults, if any.



Open the Device

NOTE

Before opening the device, remove it from the field and operating environment.



To prevent damage to the O-rings, turn the E-module retaining ring counter-clockwise ½ to one turn, and then clockwise about ¼ turn, and repeat until you can remove the retaining ring.

If you experience difficulty removing the retaining ring, the E-module may be rotating with the retaining ring. Turn the retaining ring clockwise slightly and press down lightly on the E-module to hold it in place. Then turn the retaining ring counter-clockwise.

Clean the Interior

To clean the interior, remove the components.

- Remove the E-module at top. Press upward lightly on the side opposite the module's contact pins.
- Remove the battery using the battery installation tool.
- To clean the interior, use a clean, dry, anti-static cloth.
- Inspect the enclosure for degradation or cracks in the stainless-steel casing.

Inspect the E-module

Inspect the E-module at the top of the device. Verify that the enclosure, battery terminal spring, and contact pins are undamaged.

- Remove the E-module from the retaining ring by pressing firmly on the side opposite the contact pins.
- Inspect the E-module battery terminal spring. Look for chemical corrosion or deposits.
- Verify that the E-module contact pins move when pressed against the sensor module contact pads.

Inspect the Sensor Module

Inspect the sensor at the bottom of the device.

- Inspect the sensor battery terminal spring. Look for chemical corrosion or deposits.
- Verify that the sensor contact pads at the top of the case are undamaged and free of carbon deposits.

Inspect the O-rings

The Ranger Pro device uses two neoprene O-rings to seal the unit against dust and moisture. The O-rings maintain the device's IP67 dust and water-resistant rating.

Inspect the O-rings.

- Verify that the O-rings are free from dust and debris.
- To remove dust and dirt, use a clean, dry cloth.
- When you install new O-rings, coat them very lightly with silicone grease.

If they're damaged, or if you're replacing the battery, always replace the O-rings. For details and ordering information, see the *Ranger Pro Datasheet*.

Inspect the Battery

Before removing the battery, look for signs of impending battery failure, including:

- Swelling, deformation, or elongation.
- Indentations or lifting of battery terminals.
- Moisture or liquid on the battery surface.
- Chemical corrosion or deposits on the battery terminals.
- If a battery leaks, don't touch the corrosive electrolyte.

If the battery is damaged or is leaking, follow your site's hazardous materials handling procedures.

Replace the Battery

Install batteries indoors in an equipment room or a similar environment, not in the field.

NOTE

Use only approved D-sized lithium-thionyl chloride batteries. For details and ordering information, see the *Ranger Pro Datasheet*. Whenever you replace a battery, replace the O-rings.

To replace the battery:

- Use the battery installation tool to remove the battery retaining ring.
- Install only approved D-sized 3.6V lithium-thionyl chloride batteries. For details and ordering information, see the *Ranger Pro Datasheet*.
- Verify that the positive end of the battery is up and then insert the battery.
- Install the battery retaining ring using the battery installation tool.
- Hand-tighten the ring until it contacts the battery, and then torque to 5 Nm (44.25 in lb), about 2 additional turns.

To dispose of used or partially-expended batteries, follow your site's or locality's hazardous materials handling procedures.

6.3 Assemble the Device

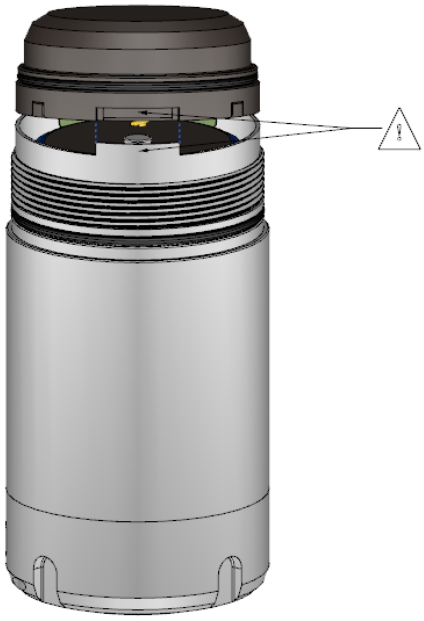
Assemble a Ranger Pro device indoors in an equipment room or a similar environment.

NOTE

To maintain the device's IP67 dust and water-resistant rating, carefully assemble the device.

To assemble a Ranger Pro device:

1. Verify that the exterior threads of the Ranger Pro case aren't damaged.
2. Inspect the two O-rings to verify that they are present, clean, and undamaged.
3. Inspect the interior threads of the E-module retaining ring to be sure they aren't damaged.
4. Make sure the entire device is clean and dry. Avoid assembling the device in humid conditions.
5. Verify that the positive end of the battery is up and then insert the battery.



NOTE

Use only approved D-sized lithium-thionyl chloride batteries. For details and ordering information, see the *Ranger Pro Datasheet*.

6. Insert the battery retaining ring and use the battery installation tool to tighten the ring.
7. Hand-tighten the ring until it contacts the battery, then torque to 5 Nm (44.25 in lb), about 2 additional turns.

8. Apply a very light coating of silicon-based O-ring lube to both O-rings.
9. Align the contact pins of the E-module with the contact points in the case.
10. Align the notch in the E-module with the notch in the case. Apply slight pressure until the E-module is seated. You can feel or hear a click when it is in place. Hold the E-module in place.
11. Align the E-module retaining ring over the E-module and tighten the threads until the O-ring is covered.
12. To prevent damage to the O-rings, turn the E-module retaining ring clockwise ½ to one turn, and then counter-clockwise about ¼ turn, and repeat until the ring is tightened. There shouldn't be any gap between the E-module retaining ring and the case.

6.4 Reset the Sensor

After installing a battery, the E-module is ready to receive join keys from the network. If after several hours it fails to join the network, reset the sensor. See "Reset the Device" on page 10.

6.5 Update Device Firmware

You may on rare occasions need to update the E-module or radio device firmware. Download firmware updates from Bently Nevada technical support. You can update firmware using the USB docking station or over-the-air. Each method has advantages and disadvantages.

Update Firmware Using the USB Docking Station

To update E-module firmware using the USB docking station, you must remove each Ranger Pro device from the field. Depending on the number of devices, this can be a manually time consuming process. But using the USB docking station is quick and the firmware update is applied immediately.

To update the E-module firmware:

1. Connect the USB docking station to the computer running the Ranger Pro software.
2. Place the Ranger Pro device upside down on the docking station pad with the E-module in contact with the pad.
3. Access the Ranger Pro software.
4. Choose Maintenance and Diagnostics.
5. Click Open Upgrade File and select the new firmware.

Update Firmware Over-the-air

To update E-module firmware over-the-air, use your network vendor's infrastructure software. The update process can take several hours per device. Due to the delay, you should update no more than six sensors at a time, otherwise the remaining devices are likely to time out and fail. If you have a large number of devices, updates can take many hours to apply. But you don't have to remove devices from the field.

To update E-module firmware over-the-air:

1. Use your network vendor's software.
2. In multi-hop or mesh networks, we recommend you update the outer layer of devices on the mesh first.
3. If you are using Ranger Pro Repeaters, you can only update one child device on each Repeater at a time.

Update Radio Firmware

To update radio firmware, use your network vendor's software to complete this step over-the-air.

6.6 Harden the System

The security risk to your network when using Ranger Pro devices is like that in any distributed control system or industrial control system. You need to take all reasonable steps to properly secure these devices.

At a minimum, to secure Ranger Pro devices:

- Securely manage all device docking stations.
- Verify that the latest firmware is installed on all docking stations and device E-modules and sensors.
- Follow your site's standards or industry's best practices for strong passwords.
- Only install Ranger Pro software on computers dedicated to that purpose and maintain appropriate physical security of those computers.