Model 3920 System Manual



Thunder Scientific Corporation

Model 3920 Low Humidity Generation System

Document #OM3920 - Edition 2.3

OPERATION AND
MAINTENANCE MANUAL



Model 3920 Low Humidity Generation System

IMPORTANT NOTICE

DO NOT LOSE THIS FLYER

Go to this website to register your Model 3920 Low Humidity Generator and download your software for FREE.

https://www.thunderscientific.com/product_registration

Once you have registered your Model 3920 Low Humidity Generator, click the link on the same page, labeled

Click here if you need to download your FREE software.

Or go to this URL https://www.thunderscientific.com/software/

Next, click on which software type you need, and go to that page, then click the Download Now button.

After downloading your software, open the ZIP file and install your software.

This is a trusted download link form Thunder Scientific, Thank You for your purchase.

For:

HumiCalc® with Uncertainty Software Package Download

IMPORTANT CONTROLOG PASSWORD INFORMATION
User: 3920
Manager: 3920.1
Administrator: Contact Thunder Scientific Technical Support
(1-800-872-7728 or support@thunderscientific.com)

Humidity Generation and Calibration Equipment
THUNDER SCIENTIFIC® CORPORATION The Humidity Source
Thunder Scientific Corporation
623 Wyoming Blvd SE
Albuquerque, NM 87123-3198
U. S. A.



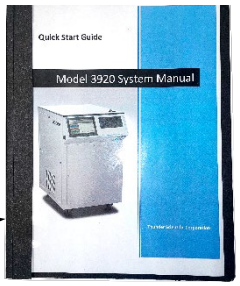
Model 3920

www.thunderscientific.com

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3920 Item Check List

1. Certificate of Calibration Traceable to (SI) (On System)
2. 3920 Quick Start Guide
3. HumiCalc® with Uncertainty Software Download
4. T10 Torx Driver
5. 1/4" WVCR x 1/4" Tube Fittings
6. 1/4" WVCR x 1/8" Tube Fitting
7. Stainless Steel 1/4" VCR Face Seal Gaskets
8. Moxa USB Serial Converter
9. Power Cable
10. Stylus Pen
11. Display Cleaning Cloth
12. 1/4" 30 Micron Muffler
13. 5/32" Ball Driver Tool
14. Methanol Funnel Assy
15. Pure Water Funnel Assy
16. T2 Test Pressure Transducer Assy
17. T2 Test Pressure Cable Assy
18. RTD2 Test Temperature Probe & Cable Assy
19. Temp Probe Removal Tool
20. 1/4" Swagelok Nut & Ferrules



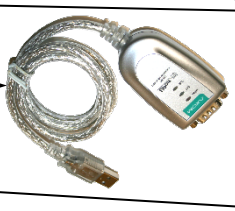














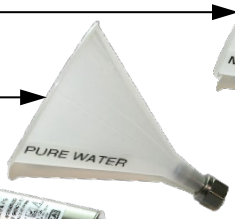










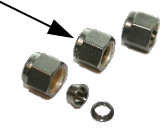












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Suomi

Tämä tuote noudattaa WEEE-direktiivin (2002/96/EY) merkintävaatimuksia. Kiinnitetty etiketti osoittaa, että tätä sähkö-/elektroniikkalaitetta ei saa hävittää kotitalousjätteissä.

Tuoteluokka: Viitaten WEEE-direktiivin liitteessä I mainittuihin laitteisiin, tämä tuote on luokiteltu luokan 9 "Tarkkailu- ja ohjauslaitteet" -tuotteeksi.



Ei saa heittää kotitalousjätteiden mukana!

Palauta tarpeettomat tuotteet ottamalla yhteyttä valmistajan websivustoon, joka mainitaan tuotteessa tai paikalliseen myyntitoimistoon tai jakelijaan.

Dansk

Dette produkt er i overensstemmelse med kravene om afmærkning i WEEE-direktivet (2002/96/EC). Det påhæftede mærkat angiver, at du ikke må bortskaffe dette elektriske/elektroniske produkt via husholdningsaffald.

Produktkategori: Med reference til kravene i WEEE-direktivets bilag I klassificeres dette produkt som et produkt til "overvågning og kontrolinstrumentering" i kategori 9.



MÅ ikke bortskaffes via husholdningsaffald!

Hvis du vil returnere uønskede produkter, skal du besøge producentens websted, som vises på produktet, eller den lokale forhandler eller distributør.

English

This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product.



Do not dispose in domestic household waste!

To return unwanted products, contact the manufacturer's web site shown on the product or your local sales office or distributor.

Français

Ce produit est conforme aux normes de marquage de la directive DEEE (2002/96/CE). La présence de cette étiquette indique que cet appareil électrique/électronique ne doit pas être mis au rebut avec les déchets ménagers.

Catégorie de EEE : Cet appareil est classé comme catégorie 9 parmi les « instruments de surveillance et de contrôle » en référence aux types d'équipements mentionnés dans l'Annexe I de la directive DEEE.



Ne pas éliminer avec les autres déchets ménagers !

Pour renvoyer les produits indésirables, contacter le site Web du fabricant mentionné sur le produit, ou son distributeur ou bureau de ventes local.

Español

Este producto cumple la Directiva WEEE (2002/96/EC) sobre requisitos de las marcas. La etiqueta que lleva pegada indica que no debe desechar este producto eléctrico o electrónico con los residuos domésticos.

Categoría del producto: con referencia a los tipos de equipo del anexo I de la Directiva WEEE, este producto está clasificado como categoría 9 de "Instrumentación de supervisión y control".



¡No lo deseche con los residuos domésticos!

Para devolver productos que no desee, póngase en contacto con el sitio Web del fabricante mostrado en el producto, o con la oficina de ventas o distribuidor local.

PN 2566073, 1/2006

Deutsch

Dieses Produkt stimmt mit den Kennzeichnungsanforderungen der WEEE-Richtlinie (2002/96/EC) überein. Das angebrachte Etikett weist darauf hin, dass dieses elektrische/elektronische Produkt nicht in Hausmüll entsorgt werden darf.

Produktkategorie: In Bezug auf die Gerätetypen in Anhang I der WEEE-Richtlinie ist dieses Produkt als Kategorie 9 "Überwachungs- und Kontrollinstrument" klassifiziert.



Nicht in Hausmüll entsorgen!

Zur Rückgabe von unerwünschten Produkten die auf dem Produkt angegebene Website des Herstellers oder die zuständige Verkaufsstelle bzw. den zuständigen Fachhändler konsultieren.

Italiano

Questo prodotto risponde ai requisiti sull'etichettatura stabiliti nella Direttiva RAEE (2002/96/CE). Il simbolo apposto indica che non si deve gettare questo prodotto elettrico o elettronico in un contenitore per rifiuti domestici.

Categoria del prodotto: con riferimento ai tipi di apparecchiature elencate nell'Allegato 1 della Direttiva RAEE, questo prodotto rientra nella categoria 9 "Strumenti di monitoraggio e di controllo".



Non gettare in un contenitore per rifiuti domestici.

Per restituire prodotti non desiderati, visitare il sito Web del produttore riportato sul prodotto o rivolgersi al distributore o all'ufficio vendite locale.

Português

Este produto está em conformidade com as exigências de rotulagem da Directiva WEEE (2002/96/EC). O rótulo afixado indica que o utilizador não deve deitar este produto eléctrico/electrónico fora juntamente com o lixo doméstico.

Categoria do produto: No que se refere aos tipos de equipamento listados no Anexo I da Directiva WEEE, este produto está classificado como produto da categoria 9, "Instrumentação de monitorização e controlo".



Não deite fora juntamente com o lixo doméstico!

Para devolver produtos indesejados, contacte o fabricante através do Website constante do produto ou contacte o seu representante de vendas ou distribuidor local.

Nederlands

Dit product voldoet aan de merktekenvereisten van de AEEA-richtlijn (2002/96/EG). Het aangebrachte merkteken duidt erop dat dit elektrische/elektronische product niet met het huishoudelijk afval mag worden afgevoerd.

Productcategorie: Met betrekking tot de apparatuurcategorieën van bijlage I van de AEEA-richtlijn, valt dit product onder categorie 9 'meet- en controle-instrumenten'.



Niet afvoeren met huishoudelijk afval!

Om ongewenste producten te retourneren, neemt u contact op met de website van de fabrikant die op het product staat vermeld, of met uw plaatselijke verkoopkantoor of distributeur.

Svenska

Denna produkt uppfyller märkningskraven enligt WEEE Directive (2002/96/EC). Märkningsetiketten anger att du inte får kassera denna elektriska/elektroniska produkt tillsammans med vanliga hushållssopor.

Produktkategori: Med hänvisning till utrustningstyperna i WEEE Directive Annex I, är denna produkt klassad som kategori 9 "Monitoring and Control Instrumentation" (Instrument för övervakning och styrning).



Får ej kasseras tillsammans med vanliga hushållssopor!

Returnera ej önskvärda produkter genom att gå till tillverkarens webbplats, vilken anges på produkten, eller till det lokala försäljningskontoret eller distributören.

Norsk

Dette produktet oppfyller bestemmelsene ifølge WEEE-direktiv (2002/96/EC) med krav til merking. Påsatt merke viser at det ikke er tillatt å kassere dette elektriske/elektroniske produktet sammen med husholdningsavfall.

Produktkategori: På grunnlag av utstyrstypene i WEEE-direktivet, vedlegg I, er dette produktet klassifisert i kategori 9, "Instrumentering for overvåking og kontroll".



Må ikke kastes sammen med husholdningsavfall!

Ved behov for returforsendelse av uønskede produkter må du gå til produsentens nettside som er angitt på produktet, eller du må kontakte det lokale salgskontoret eller den lokale forhandleren.

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2 GETTING STARTED

This section will provide the user with information about the Model 3920 low humidity generator, where to obtain technical support, software license agreement, specifications, uncertainty, facility requirements and installation. The following sections will provide further details on how to use and operate the Model 3920 generator using the ControLog® software.

2.1 ABOUT

The Thunder Scientific Model 3920 Low Humidity Generation System is a self-contained system capable of producing atmospheres of known humidity using the fundamental, NIST proven, "two-pressure" principle. This system is capable of continuously supplying frost point, dew point, parts per million, relative humidity and other calculated values for instrument calibration and evaluation as well as for precision environmental testing. This system will automatically generate manually entered humidity values as well as user created multipoint profiles. Visual indications of system status are displayed in real time on the computer monitor.

The Model 3920 low humidity generator encompasses a high-performance Data Acquisition chassis along with a Human Machine Interface (HMI) computer running ControLog. ControLog is a software application that fully automates the operation of the Model 3920 humidity generator and allows various device connections through several different interfaces. Data from the generator and connected device or devices is automatically retrieved and stored for viewing in either numerical or graphical format in real time or post process. Data can be transferred off the system via a USB drive for further viewing, post processing and printing. The ControLog software also provides the primary interface to the operator via the multi-point touch display and keyboard.

Key features of the of the ControLog® software are:

- ControLog stores data into individual data sheets (tab). Each data sheet contains a spreadsheet type view that consists of a date/time stamp and the measured data items corresponding to that date/time stamp. Data sheets consist of three similar but different types: Device Data, File Data and Data Summary. Each type has the same spreadsheet type view and operation, but all three have different data sources.
- Graphing is a powerful tool used to view previously recorded data or to monitor the current data in real-time. The graph works hand in hand with the data sheets. While the generator is in operation, data sheets store the most recent data points from the generator and or connected devices at the desired interval. A graph can be used to create a visual picture of this stored data.
- The Auto Profiling feature is very similar to the Generate mode with the main exception that profiling relies on a predefined list of setpoints referred to as a profile. The user configurable profile is used as ControLog's road map during Auto Profile operation. It defines which setpoint values to go to, at what rate to go from one setpoint to another, and how long to stay at a specific setpoint before moving to the next setpoint.
- ControLog supports a customizable interface that works with most devices. ControLog will allow the user to create a new device connection using the “Connection Wizard” or open previously saved connections. The wizard will open a separate dialog window containing various steps that will guide the user in defining the communication required to receive the desired data items from the device. The user can create as many (up to 60) or as few data items as they see fit for any one

device. Each data item can be uniquely named and once connected will be recorded in its own data sheet. ControLog also allows the user to save these interfaces for future use. The “Connection Wizard” allows the user to step through the connection configuration. Using the “Next” and “Back” buttons the user is allowed to progress through the connection configuration steps. At any time, the user may cancel the new connection or opening of a connection by selecting the “Cancel” button. Once the last step has been completed the “Finish” button will be available to complete the new connection.

2.2 NOTICE

The specifications listed and the information contained in this document is subject to change without notice. Screen shots shown in this document may differ slightly from the actual product and are given to show functionality of the examples, procedures and program. Thunder Scientific Corporation makes no warranties, either express or implied, regarding the examples, procedures and program, or the fitness of these examples, procedures or program for a particular purpose. The examples, procedures and program are made available solely on an "as is" basis and the entire risk as to their quality and performance rests with the user. Thunder Scientific Corporation shall not be liable for any incidental or consequential damages in connection with or arising out of the furnishing, use, or performance of the examples, procedures or program.

2.3 SAFETY INFORMATION

Important safety guidelines need to be observed when operating this equipment. Precautions are highly advisable so that no personal injury will occur during the operation and maintenance of the system. Observation of local and national regulations must be adhered to regarding safety standards.

FCC Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Symbols

The symbols used in the manuals and on the Product are shown below in table 1-1.

Warning indicates a potential hazard may exist and the user should be extremely careful.

Caution! identifies a condition or action that may cause damage to the system or the user.

Symbol	Description
	This symbol is shown from the WEEE directive and indicates do not dispose of this product in any municipal waste area.
	This symbol means Caution and should be observed or important information.
	This symbol indicates a potential shock hazard may exist.
	This symbol means Earth Ground.
	This symbol denotes Heat or Hot Surface, or Gases.
	Symbol means flammable material avoid igniting or open flame or spark.
	This symbol signifies Carefully read all instructions.
	See FCC, Federal Communications Commission Statement above.

Table 1-1

Warning!

To prevent possible electrical shock, fire, or personal injury:

- Carefully read all instructions.
- Read all safety information before using the Product.
- Read the safety data sheet (SDS) supplied with the purchased methanol and take necessary precautions.
- Use this Product indoors only.
- Do not put the Product where access to the mains power cord is blocked.
- Replace the power cord if the insulation is damaged or if the insulation shows signs of wear.
- Do not use an extension cord or adapter plug.
- Do not alter the Product. Use only as specified, or the protection supplied by the Product can be compromised.
- Do not use the Product if it is altered or damaged.
- Do not use the Product around explosive gas, vapor, or in damp or wet environments.
- Make sure the ground conductor in the power cord is connected to a protective earth ground. Disruption of the protective earth could put voltage on the chassis that could cause death.
- Make sure that the space around the Product meets minimum requirements.
- Use only specified replacement parts.
- Have an approved technician repair the Product.

- Do not operate the Product with covers removed or the case open. Hazardous voltage exposure is possible.

⚠ *Safety Warning: High Pressure*

- High pressure gases are potentially hazardous. Energy stored in these gases can be released suddenly and with extreme force. Proper safety precautions must be taken when applying any pressure to the Product. Before applying pressure to the Product, ensure that all pneumatic connections are properly secured and tightened. Make sure all pressure settings are set to the proper specifications before operation, testing, calibration or maintenance is performed.
- POSSIBLE INJURY! The tubing, valves, and other apparatus attached to the Product must be adequate for the maximum pressure which will be applied, otherwise physical injury to the operator or bystanders is possible.
- USE THE PROPER PRESSURE MEDIUM! Use only clean, dry, gaseous nitrogen or CO2 free air unless otherwise specified by Thunder Scientific.

⚠ *Safety Warning: Methanol*

Read the safety data sheet (SDS) supplied with the purchased methanol and take necessary precautions.

⚠🔥 DANGER: Highly flammable liquid and vapor. Causes damage to organs.

Prevention:

- Keep away from heat/sparks/open flames/hot surfaces. No smoking.
- Keep container tightly closed.
- Ground/bond container and receiving equipment.
- Use explosion-proof electrical/ ventilating/ lighting/ equipment.
- Use only non-sparking tools.
- Take precautionary measures against static discharge.
- Do not breathe dust/ fume/ gas/ mist/ vapor/ spray.
- Wash skin thoroughly after handling.
- Do not eat, drink or smoke when using this product.
- Wear protective gloves/ protective clothing/ eye protection/ face protection.

Response:

- IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
- IF exposed: Call a POISON CENTER or doctor/ physician.
- In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.

Storage:

- Store in a well-ventilated place. Keep cool.
- Store locked up.

Disposal:

- Dispose of contents/ container to an approved waste disposal plant.

⚠ *Safety Warning: This Product contains 16 oz. of R-513a refrigerant and 10 oz. of R-23 refrigerant*

R-23 EMERGENCY OVERVIEW: Colorless, volatile liquid with ethereal and faint sweetish odor. Non-flammable material. Overexposure may cause dizziness and loss of concentration. At higher levels, CNS depression and cardiac arrhythmia may result from exposure. Vapors displace air and can cause asphyxiation in confined spaces. At higher temperatures, (>250°C), decomposition products may include Hydrofluoric Acid (HF) and carbonyl halides.

⚠ R-23 POTENTIAL HEALTH HAZARDS

- SKIN: Irritation would result from a defatting action on tissue. Liquid contact could cause frostbite.
- EYES: Liquid contact can cause severe irritation and frostbite. Mist may irritate.
- INHALATION: R-23 is low in acute toxicity in animals. When oxygen levels in air are reduced to 12-14% by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate and deeper respiration will occur. At high levels, cardiac arrhythmia may occur.
- INGESTION: Ingestion is unlikely because of the low boiling point of the material. Should it occur, discomfort in the gastrointestinal tract from rapid evaporation of the material and consequent evolution of gas would result. Some effects of inhalation and skin exposure would be expected.

R-513A EMERGENCY OVERVIEW: Colorless, liquefied gas under pressure with a slight, faint ether-like odor. Nonflammable material under ambient conditions. Overexposure may cause dizziness, weakness, nausea, and loss of concentration. At higher exposure levels, central nervous system (CNS) depression and cardiac arrhythmia (abnormal heart rhythm) may occur and can prove suddenly fatal. In confined spaces, vapors are heavier than air, displace oxygen, and can cause rapid asphyxiation. At elevated temperatures (greater than 170 °C–250 °C), thermal decomposition will occur, resulting in the production of toxic and corrosive gases, including Hydrofluoric Acid (HF), carbon oxides, and carbonyl halides.

⚠ R-513a POTENTIAL HEALTH HAZARDS

- SKIN: Contact with liquid splashes or spray can cause severe freeze burns (frostbite). Repeated exposure may cause skin irritation from defatting action on tissue.
- EYES: Liquid contact or concentrated spray can cause severe irritation, corneal damage, and freeze burns (frostbite). Mist or high vapor concentrations may cause mild irritation.
- INHALATION: R-513A is low in acute toxicity. However, when oxygen levels in the air are reduced by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate, and deeper respiration will occur. Exposure to high atmospheric concentrations can cause anesthetic effects or myocardial sensitization, potentially leading to cardiac arrhythmia.
- INGESTION: Ingestion is highly unlikely due to the low boiling point of the material (rapidly converts to gas at ambient temperatures). Should it occur, liquid ingestion will cause severe freeze burns to the lips, mouth, and gastrointestinal tract, alongside rapid gas evolution and subsequent discomfort..

2.3.1 Personal Protective Equipment (PPE)

Safety glasses must be worn when performing maintenance, repairs or calibration when system panels have been removed. The following PPE is required when filling or draining the methanol heat transfer fluid.

- **Gloves:** Butyl rubber or Viton are recommended. **Note:** Nitrile gloves may only provide splash protection and can be permeated in less than a minute depending on thickness.
- **Eye Protection:** Tight-sealing safety goggles are required; a face shield is recommended.
- **Skin/Body Protection:** Chemical-resistant clothing or equivalent lab coat.

2.3.2 Methanol

Temperature conditioning of the 3920's saturator employs a fluid circulation system in conjunction with a cascade refrigeration system. Methyl alcohol (methanol) is used as the heat transfer fluid because of its low freezing point (-97.6 °C). Extreme caution is required due to the flammability and poisonous nature of methanol.

Warning!

USE CAUTION WHEN HANDLING METHANOL.
METHANOL IS FLAMMABLE AND POISONOUS
KEEP AWAY FROM SPARKS, FLAMES, OR OTHER IGNITION SOURCES. AVOID PROLONGED OR REPEATED BREATHING OF VAPORS OR CONTACT WITH SKIN. **SEE SECTION 2.3 FOR IMPORTANT SAFETY INFORMATION.**

Warning: Methanol system is vented to atmosphere via overflow line. Refer to drawing: 19D3920901 Sheet 4

Warning: Using unapproved heat transfer fluid can cause fluid circulation issues and result in inaccurate humidity output due to thermal gradients forming within the saturator. Contact Thunder Scientific for more information.

2.4 Technical Support

If the user requires assistance with any aspect of the 3920 Humidity Generating System or the ControLog application, technical support can be obtained by contacting Thunder Scientific Corporation by any of the following means:

Web: www.ThunderScientific.com

Email: support@thunderscientific.com

Tel : 1-505-265-8701

FAX : 1-505-266-6203

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2.9 SPECIFICATIONS[1]

Frost Point Temperature Range: ..... -95 to 0.01 °C
Dew Point Temperature Range: ..... -50 to 10 °C
Parts Per Million Range: ..... 0.04 to 12300 PPMv
Relative Humidity Range: ..... 0.00003% to ~50%
Temperature Specification: ..... 0.027 °C
Saturation Temperature Range: [2] ..... -80 to 12 °C
Saturation Temperature Control Stability: [3] ..... 0.008 °C
Saturation Temperature Cooling Rate: from 12 to -80 °C ..... 0.33 °C per Minute (average)
Saturation Temperature Heating Rate: from -80 to 12 °C ..... 0.33 °C per Minute (average)
Test Temperature Range (measured): ..... 0 to 50 °C
Saturation Pressure Range: ..... ~Ambient to 250 psiA
Saturation Pressure Specification: ..... 0.02% of full scale
Test Pressure Range (measured): ..... Ambient to 50 psiA
Test Pressure Specification: ..... 0.02% of full scale
Gas Type: ..... Gaseous Nitrogen or CO_2 free Air
Supply Pressure Range: ..... 80 to 250 psiG
Supply Pressure Specification: ..... ±1.25 psiG
Gas Flow Rate Range: ..... 0.5 to 10 SLPM
Gas Flow Rate Resolution: ..... 0.2 SLPM
Gas Flow Rate Specification: ..... 2% of full scale
Display Resolution: 0.001
Refrigeration: ..... 1/3 HP R-513A & 1/3 HP R-23 in cascade
Heating: ..... Stainless Steel Immersion
Test Port: ..... 1/4 Inch Swagelok VCR®
Gas Inlet: ..... 1/4 Inch Swagelok VCR®
Maximum Load ..... 100 Lbs. (45.3 Kg) Equally Distributed On Countertop
Physical Dimensions: ..... 38” H x 23” W x 35” D (965.2 mm x 584.2 mm x 889 mm)
Generator Weight (Net): ..... 400 Lbs. (181.4 Kg)

2.9.1 I/O Ports

USB Ports: ..... 2 x USB 3.0
Serial Port: ..... 1 x RS-232 COM

[1] Test pressure at 1 atmosphere.

[2] Using anhydrous methanol as the temperature heat transfer fluid from -80 to 12 °C.

[3] Temperature Control Stability is defined as the standard deviation over a 10-minute period, as measured by the saturation temperature control sensor after being at point for 60 minutes.

2.10 Uncertainty [4] [5] [6]

Dew Point Uncertainty: -50 °C to 10 °C ..... 0.01% |R| + 0.07 °C

*Example: If the dew Point reading is 10 °C. The uncertainty would then be: 0.01% *10 + 0.07 °C = 0.071*

Frost Point Uncertainty: >= -90 °C ..... 0.05% |R| + 0.07 °C

*Example: If the frost Point reading is -60 °C, the uncertainty would then be: 0.05% *60 + 0.07 °C = 0.1*

Frost Point Uncertainty: < -90 °C ..... 1.7% |R| - 1.415 °C

*Example: If the frost Point reading is -95 °C, the uncertainty would then be: 1.7% *95 - 1.415 °C = 0.2*

Temperature Uncertainty: 0 to 50 °C [7] ..... 0.031 °C

2.11 Facility Requirements

2.11.1 Environment

Operating Temperature: ..... 15 to 30 °C

Storage Temperature: ..... 5 to 50 °C

Humidity: ..... 5 to 90% RH Non-condensing

Pollution Degree: PD2

Maximum Operating Altitude: ..... 7600 feet

2.11.2 Floor Space

A floor, capable of supporting approximately 500 pounds, with a minimum space of 40" (1.0m) deep x 35" (0.89m) wide.

Refer to drawings: 19D3920901-2, 19D3920901-3, 19D3920901-4, 19D3920901-5

2.11.3 Power

Electrical Power: ..... 220 V~ (±10 %), 10 A, 1 ϕ, 50 Hz or 60 Hz

Overvoltage: ..... CAT II

2.11.4 Gas Supply

Semiconductor, 6.0 grade gaseous nitrogen or CO_2 free air is recommended. Gas supply must be filtered to a particle size of 0.5 microns or less.

Gas Supply Minimum Inlet Pressure: ..... 80 psiG @ 10 L/min

Gas Supply Maximum Inlet Pressure: ..... 250 psiG @ 10 L/min

[4] Test pressure at 1 atmosphere

[5] Uncertainty values represent an expanded uncertainty using a coverage factor, k=2, at an approximate level of confidence of 95%.

[6] Uncertainty is based on the specifications from the 3920 uncertainty analysis

[7] Includes saturation temperature and test temperature.

2.11.4.1 Pressure

The input gas supply should be regulated between 260 psiG and 250 psiG at 10 L/min. A regulated input supply pressure lower than 250 psiG is acceptable but may limit the lowest humidity obtainable from the generator and will require an internal pressure regulator (REG) adjustment.

Refer to section 2.12.4 Setting Supply Pressure Regulator for more information on adjusting the internal pressure regulator (REG).

2.11.4.2 Dryness

The input gas supply should be dry (0.5 PPMv or less) with an ambient pressure frost point of -80 °C or less. Input supply gas wetter than -80 °C frost point is acceptable but will limit the lowest humidity obtainable from the generator. The supply gas is used to purge the outlet of the saturator and is used at the inlet of the saturator, so any gas wetter than the saturation temperature will cause condensation (icing) at the saturator inlet and outlet. If the measured ambient pressure frost point of the gas supply is wetter, for example -70°C, then the user must enter this value into the system for the 3920 to operate optimally.

Refer to section 2.13.7 Supply Gas Frost Point for more information on entering the supply gas dryness.

2.11.5 Pure Water Supply

The 3920 requires pure water suitable for High-Performance Liquid Chromatography (HPLC) and Spectrophotometry such as Honeywell Burdick & Jackson® Water (MFR #365-4). The generator has a pure water capacity of 300 cc when completely full.

Refer to section 5.4 Saturator Filling for detailed instruction on how to add pure water.

2.11.6 Methanol

1.5 gallons (5.675 Liters) of anhydrous methanol such as Honeywell Burdick & Jackson® Methanol (MFR #AH230-4) is used as the heat transfer fluid due to its low viscosity at the minimum saturator temperature of -80 °C. Extreme caution in handling is required due to the flammability and poisonous nature of methanol.

Refer to section 2.12.3.2 Methanol Filling Procedure for more information on how to fill the unit.

2.12 INSTALLATION

2.12.1 Uncrating

Before uncrating, carefully inspect the crate and skid to be certain the unit was not subjected to damage. If there is damage, proceed no further and notify your inspection department and the shipping agent.

If the crate appears satisfactory:

1. Remove steel strapping.
2. Using "Clip Removal Tool" or thin pry-bar, remove top cover clips then remove top panel.
3. One panel at a time, remove the panel clips then remove panel.
4. Remove polyethylene covering from unit.
5. Inspect for any visible damage.
6. Remove any/all accessory boxes.
7. Using forklift or another suitable lifting device, lift unit from skid and place on floor.
8. The unit may now be rolled to its point of installation.

2.12.2 Positioning

Position the system to have access to all sides of the console. Remove cover panels and inspect for any visible damage that might have occurred during shipment.

2.12.3 Heat Transfer Fluid Filling Procedure

Temperature conditioning of the Model 3920 utilizes methanol as a heat transfer fluid. This fluid is circulated by a magnetically coupled centrifugal pump through the refrigeration and heating system and the fluid shell surrounding the saturator.

Warning!

USE CAUTION WHEN HANDLING METHANOL.
METHANOL IS FLAMMABLE AND POISONOUS
KEEP AWAY FROM SPARKS, FLAMES, OR OTHER IGNITION SOURCES. AVOID PROLONGED OR REPEATED BREATHING OF VAPORS OR CONTACT WITH SKIN. **SEE SECTION 2.3 FOR IMPORTANT SAFETY INFORMATION.**

Refer to drawing: 19D3920920

2.12.3.1 Equipment Required

1. Appropriate safety gear and equipment.
2. 5/32” hex ball driver.
3. 3/8" hex ball driver.
4. 7/8” Socket with 6” extension.
5. Funnel.

2.12.3.2 Methanol Filling Procedure

1. Ensure the main power switch is OFF.
2. Remove left and right side console panels.
3. Using the 5/32” hex ball driver, remove countertop screws.
4. Remove the countertop.
5. Remove RTD enclosure insulation.
6. Remove 7/8" Swagelok cap within RTD enclosure.
7. Locate expansion tank fill port (labeled "Fluid Fill Port").
8. Using the 3/8” hex ball driver, remove the expansion tank fill plug and insert funnel into fill port.
9. Slowly fill the system with methanol until methanol is observed within the neck of the 1/2" Swagelok fitting within RTD enclosure.

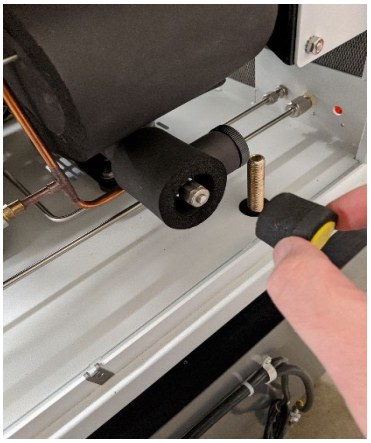
Note – *If filled too quick methanol may come out of the overflow under the unit.*

10. Remove funnel and replace expansion tank fluid fill port plug.
11. Replace 7/8" Swagelok cap.
12. Replace RTD enclosure insulation.
13. Replace countertop.
14. Replace left and right side console panels **(ensure condenser grill opening is on the left side).**

2.12.3.3 Methanol Draining Procedure

1. Ensure the main power switch is OFF.
2. Remove right side console panel.
3. Locate the drain valve at the lower right of the generator and remove the drain cap insulation.





4. Remove drain cap and connect a drain hose.
5. Open drain valve and empty the methanol into a clean container with a minimum size of 2 gallons. Save the methanol for refilling.
6. Close drain valve. Replace drain cap and drain cap insulation.
7. Replace console panel.

Refer to drawing: 19D3920901-4

2.12.4 Setting Internal Supply Pressure Regulator

The supply pressure must be regulated to ensure proper control and operation.

> **Note** – *It is always recommended to double regulate the gas supply; once at the input supply and again at the internal 3920 regulator.*

Adjust the 3920's internal pressure regulator (REG) to 10 psiG below the input gas supply pressure, but never above 250 psiG. For example, if the input supply pressure indicates 255 psiG, then adjust the internal pressure regulator to 245 psiG. For the best results operate the generator in run mode at the default flow rate to assure the regulator adjustment corrects for any pressure drop caused by the flow rate.

1. Open the Supply Pressure Dialog by selecting "Supply Pressure" from the Utilities Menu Tab
2. Rotate the internal regulator knob clockwise to increase pressure and counterclockwise to decrease pressure while monitoring the supply pressure dialog window.

Refer to drawing: 19D3920901-6

2.12.5 Pure Water Filling Procedure

Refer to section 5.4 Saturator Filling for detailed instruction on how to add pure water.

2.12.6 Supply Gas Connection Procedure

Equipment Required:

- Appropriate safety gear and equipment. See section 2.3.1 for PPE recommendations.
- 9/16” wrench.
- 3/4” wrench.
- Swagelok VCR gasket SS-4-VCR-2-ZC-VS or SS-4-VCR-2-GR-VS
- Pressure Vent Muffler (provided)

⚠ Warning!

USE CAUTION WHEN HANDLING PRESSURIZED GASES. **SEE SECTION 2.3 FOR IMPORTANT SAFETY INFORMATION.**

Refer to 3920 Operations Manual:

- Section 2.11.4 Gas Supply
- Section 2.11.4.1 Pressure
- Section 2.11.4.2 Dryness
- Section 2.13.11 Fitting Instructions

1. Provide access to rear of console.



2. Remove VCR cap from “Gas Inlet”. Remove plug from “Gas Vent”.



3. Apply a ¼” VCR gasket if not already in place.
   Before every connection, inspect the VCR glands. If dust or oil is present, wipe them with a lint-free cloth.



4. The ¼” VCR gasket must be in place before connecting input fitting.



5. Connect gas supply line to generator “Gas Inlet”. Tighten VCR nut 1/8 turn past finger tight using a 3/4” wrench.



6. Connect the other end of the gas supply line to your gas supply's regulator output. Tighten 1/8 turn past finger tight using the 9/16" wrench.

NOTE: Never use any type of grease, tape, or thread sealant on any VRC fitting, gasket or connection.

7. Install pressure vent (noise reduction) filter into vent fitting. Place a water catch container below filter.



2.12.7 Storage

The following are required when the system is put into storage or is transported.

⚠ Warning!

USE CAUTION WHEN HANDLING METHANOL.
METHANOL IS FLAMMABLE AND POISONOUS
KEEP AWAY FROM SPARKS, FLAMES, OR OTHER IGNITION SOURCES. AVOID PROLONGED OR REPEATED BREATHING OF VAPORS OR CONTACT WITH SKIN. **SEE SECTION 2.3 FOR IMPORTANT SAFETY INFORMATION.**

- Disconnect the supply and outlet lines.
- Seal all inlet and outlet ports with Swagelok VCR caps (SS-4-VCR-CP). Avoid using plastic "dust caps" for long-term storage.
- Drain the methanol following section 2.14.1.1 Methanol Draining Procedure

Storage Environment

- Storage Temperature: 5 to 50 °C (empty)
- Humidity: 5 to 95% RH Non-condensing

2.13 Quick Start

This section will provide the user with a quick start on operating the generator. For detailed information on operating the generator please refer to section 4 ControLog Interface.

⚠ CAUTION!

DO NOT OPERATE THE GENERATOR
WITHOUT HEAT TRANSFER FLUID.

2.13.1 Power-Up

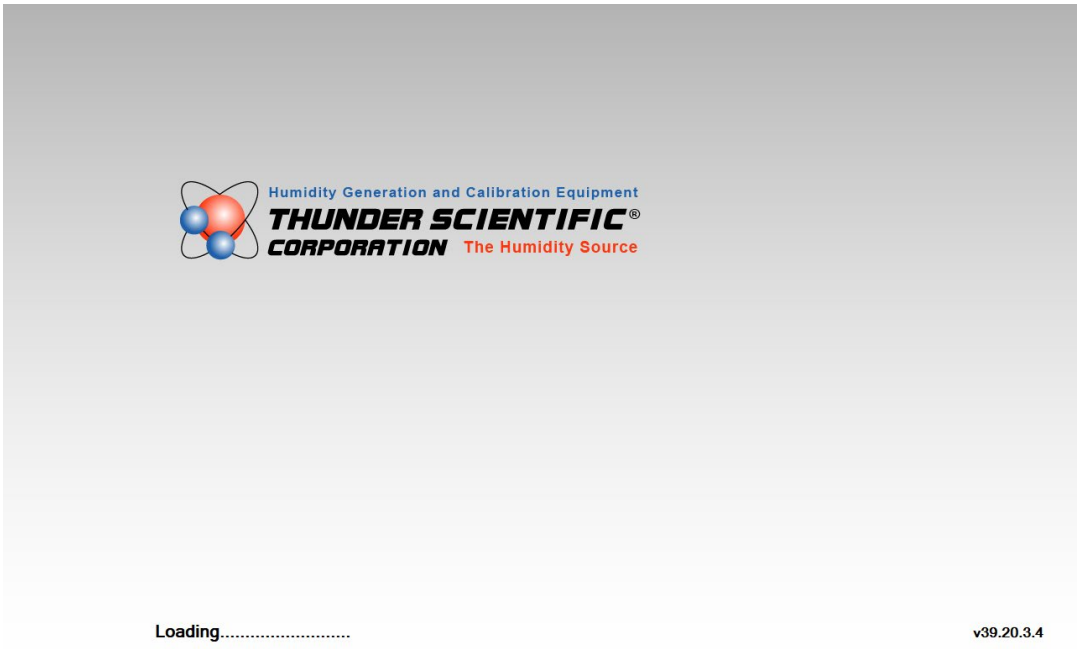
To Power-Up the generator perform the following steps:

- Verify that the inlet gas supply connection has been made and verify that any On/Off valve on the inlet gas supply line is open.
- Verify that correct AC power is connected to the generator.

- Toggle the power switch located at the upper right rear of generator to ON. The generator will begin to boot up.

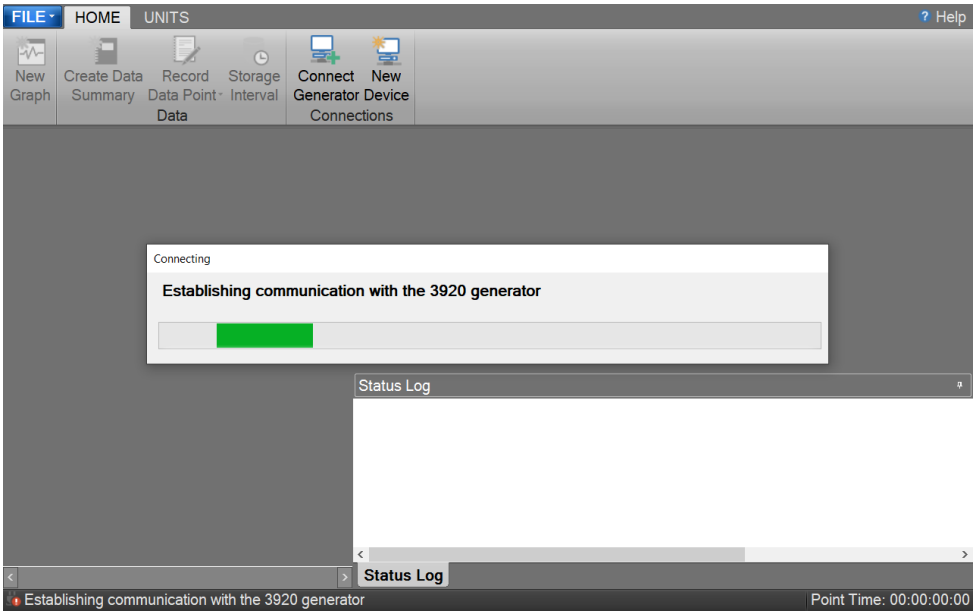
2.13.2 Loading Screen

After the system boots the generator will show a loading screen which will indicate the status of the loading process and will also show the software version of the generator.

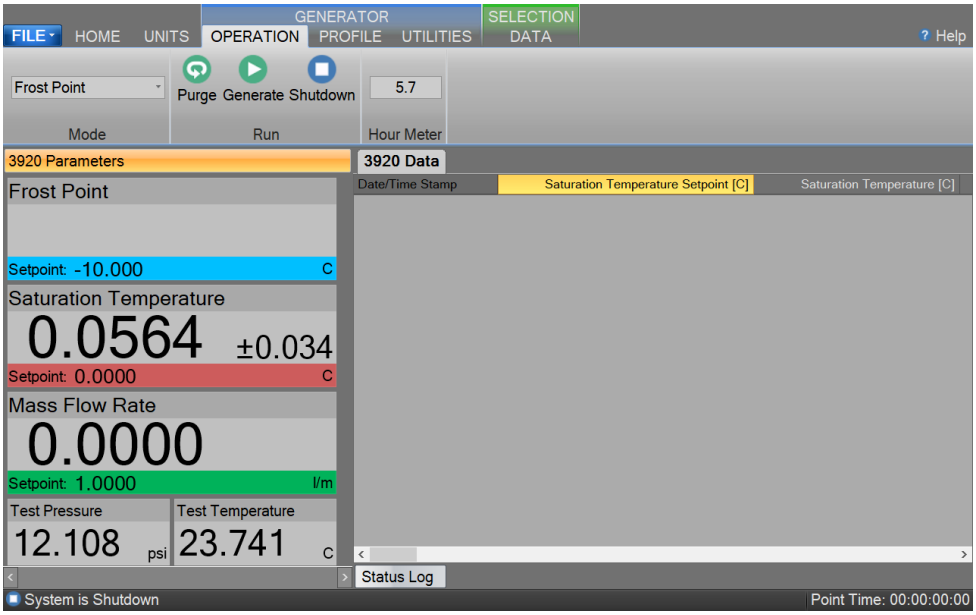


2.13.3 ControLog Screen

Upon completion of the loading process the generator will show the main ControLog page and a dialog showing the status of establishing communication with the generator.

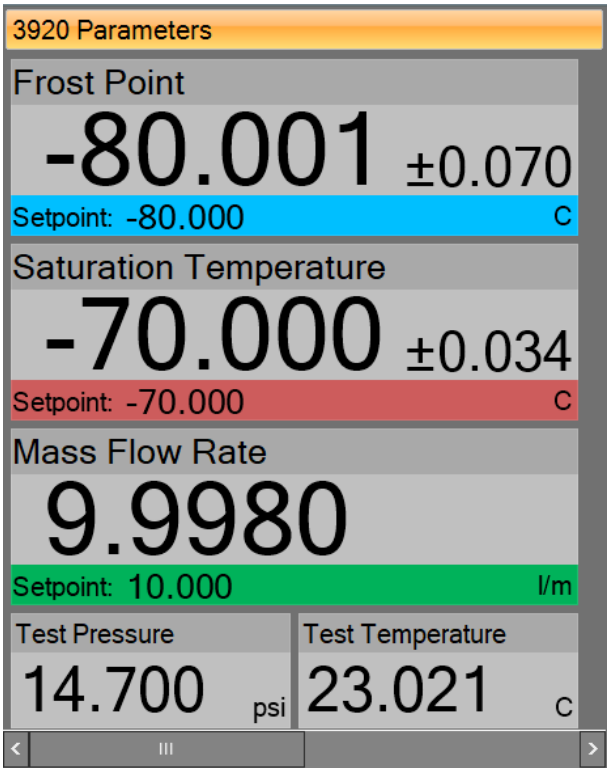


Once communication with the generator is established the generator's parameter and data tabs will be displayed.



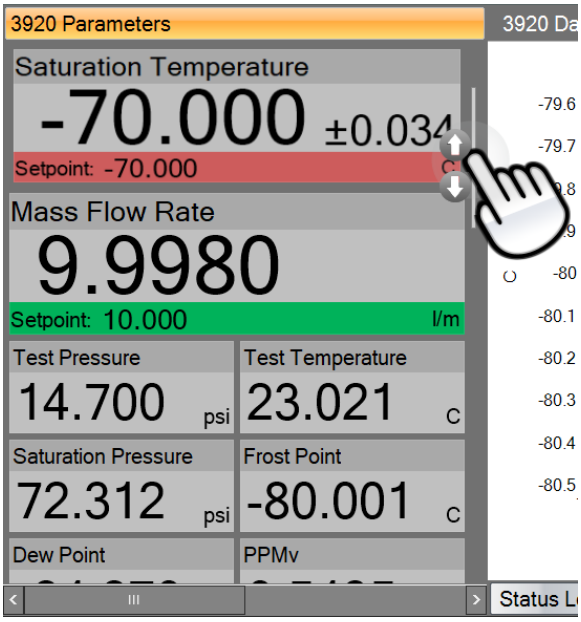
2.13.4 Control Parameters

The Parameter Tab Group is located on the left side of the application and contains a parameter tab for each connected device. The 3920 Parameters contain all the control and measurement parameters critical to the operation of the humidity generator.



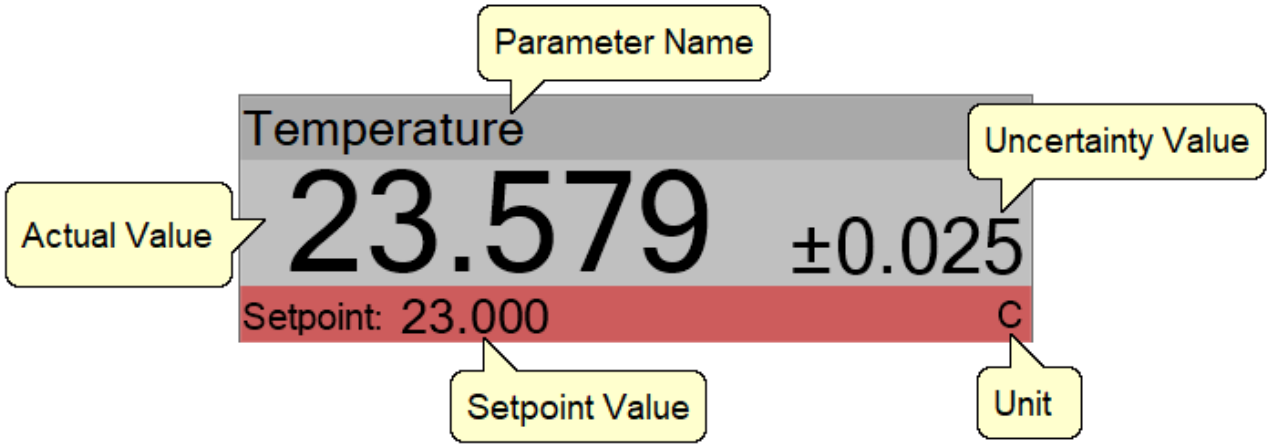
2.13.4.1 Scrolling the Parameters

Each Parameter Tab can be scrolled up and down to show additional parameters.



2.13.4.2 Setpoint Tile

The Setpoint Tiles allow the user to control the operation of the humidity generator by changing the desired setpoint that the generator will control to. The Tiles contain 5 key parts; a header with the Parameter Name, the Actual Value, the real-time Uncertainty Value, the Setpoint Value and the Unit the values are displayed in.

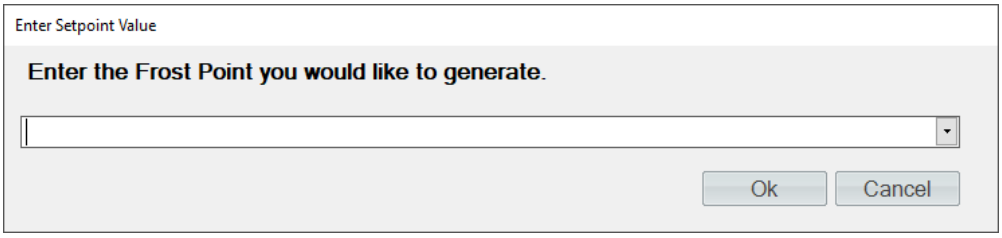


Note – *The Actual Value for the blue humidity Setpoint Tile is not shown when purging.*

Note – *The real-time uncertainty can be turned off by setting the USER[12] "HumiCalc, k" system parameter to zero. Refer to section 2.13.7 for an example on how to set a user system parameter.*

2.13.4.3 Changing Setpoints

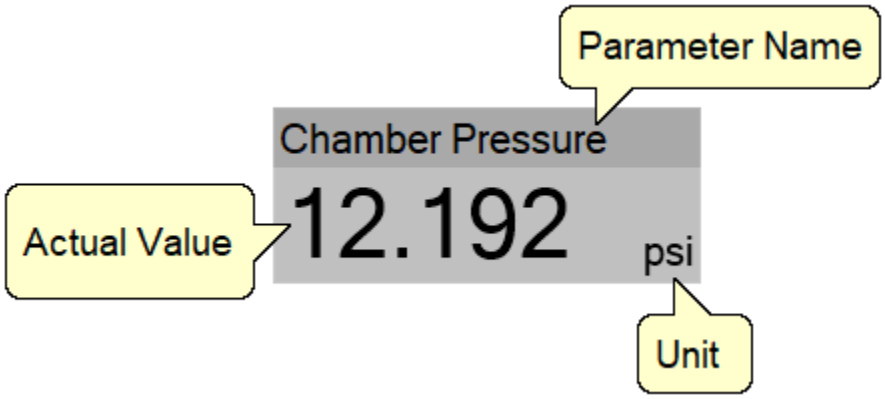
To change a setpoint, click on the setpoint tile that you would like to change. A setpoint entry box will appear. For example, to change the Frost Point setpoint click on the Frost Point setpoint tile.



Enter the new value into the Setpoint Entry box and select Ok. Notice that the Frost Point humidity setpoint value updates to the new value and the actual values begin moving toward the new setpoint.

2.13.4.4 Value Tile

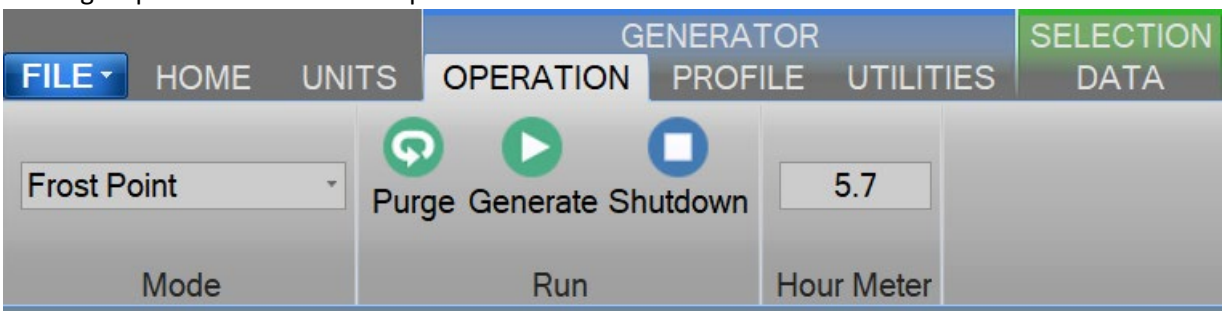
The Value Tiles display an actual value of a given parameter to the user. The Tiles contain 3 key parts; a header with the Parameter Name, the Actual Value and the Unit the value is displayed in.



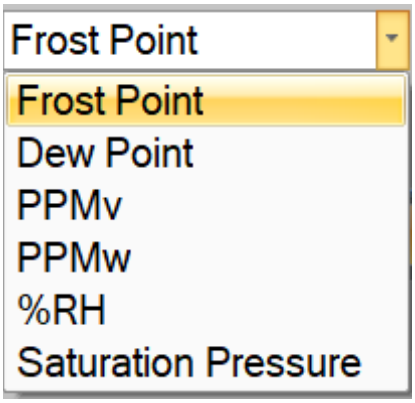
Note – *The Actual Value for a humidity Value Tile is not shown when purging.*

2.13.5 Control Modes

The user can change the operating mode of the 3920 by selecting from the drop-down menu within the Mode group on the Generator's Operation menu tab.

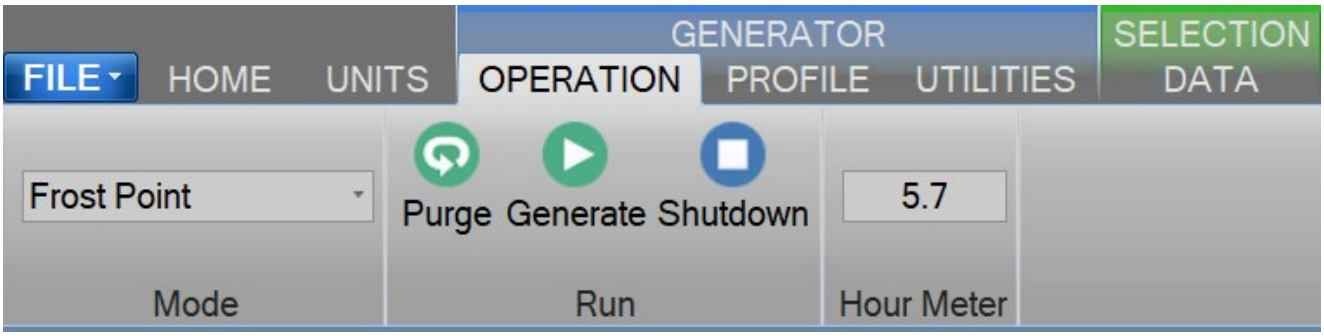


The drop-down allows the user to select between %RH, Frost Point, Dew Point, PPMv, PPMw, and Saturation Pressure.

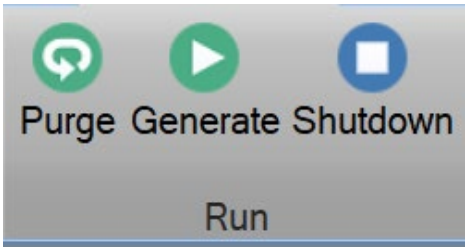


2.13.6 Purging, Generating and Shutting down

The Run Menu allows the user to run the 3920 manually.



The user can select to Purge, Generate or Shutdown. The general rule of thumb is to always use purge mode when going down in saturation temperature. This means you should purge to your lowest frost point overnight and then switch to generate and work up to your highest dew/frost. While going up in saturation temperature make sure you give adequate dwell time at each point to assure the system has reached equilibrium.



2.13.6.1 Purge Mode

Selecting Purge from the run menu commands the 3920 into purge mode. The purge mode is generally used to prevent icing within the saturator and dry the saturator outlet after movement (transportation), storage (power off, no gas flow, etc.), after performing the saturator fill procedure, or while transitioning the saturator from higher to lower temperatures. When the system is not being used (power off, no gas flow, etc.), the saturator is closed off and the gas within is static. As thermal equilibrium is reached, water vapor will condense on all inner surfaces between the saturator outlet and the expansion valve inlet. The Purge mode counteracts this condition by allowing the carrier gas to flow in the opposite direction (expansion valve to saturator), drying the affected sections of tubing. This is a necessary preparatory step in any low humidity system. As a general rule, when starting from an ambient condition the system should be purged for 24 hours or more before attempting to operate in the Generate mode. If sufficient purge time is not allowed, condensed or trapped water will remain and system accuracy will suffer. Insufficient purge time is usually indicated by higher than normal (wetter than normal) indications of the device under test. These indications can be as little as a few tenths of a degree to as much as several degrees' dew/frost point. Purging should also be performed while transitioning from warmer to colder saturation temperatures, and for approximately 5 hours after each 500 hours of continuous Generate mode operation. During Purge mode, both flow control and saturation temperature control are active, but saturation pressure control is

disabled. The generator will attempt to achieve the indicated flow and saturation temperature setpoint values.

> **Note** – *When the saturation temperature is lowered, the fluid jacket surrounding the saturator cools to reduce the saturation temperature to its new setpoint value. As the saturator cools during this transition period, temperature gradients will exist between the inside of the saturator and the fluid jacket that surrounds it. The saturator outlet passes through this fluid jacket and will also exhibit temperature gradients along its length. If gas is allowed to flow normally through the saturator during this cooling period, the 100% humidified gas of the saturator may condense at the colder saturator outlet. Therefore, Purge mode should be used while cooling the saturator to lower temperatures. For this reason, the lowest humidity of a generation sequence or profile should be performed first. This low to high order requires that a Purge be performed only once prior to the generation sequence when cooling to the lowest saturation temperature. Then, as humidity values are increased, warming the saturator to higher values, further purging is not required.*

> **Note –** *During Purge, limited gas flows to the 3920 Conditioned Gas Outlet, and consequently gas flows through the device under test if connected.*

2.13.6.2 Generate Mode

Selecting Generate from the run menu commands the 3920 into generate mode. Generate mode is used to operate the system when exact humidity points or associated time intervals have not been determined, when data must be viewed and/or verified manually before proceeding to the next humidity point, or when more immediate control over the generated humidity is required. When in the Generate mode of operation, the system will control at the currently entered setpoint indefinitely. Any time a setpoint is changed, the system immediately begins adjusting to that new value and will control at the new point indefinitely. Generate mode offers the flexibility to change the setpoint at any time and does not force you into any set sequence or for any prescribed amount of time. The Generate mode also allows you to change the humidity control mode at any time. For instance, the system may be controlling Frost Point, then immediately switched to PPMv control mode.

2.13.6.3 Shutdown

Selecting Shutdown from the run menu commands the 3920 to shut down. The 3920 may be shut down while either generating or purging. When stopped, all system functions shut down, pressure is vented, and the idle Control/Display screen is shown. During this idle time when the 3920 is stopped, gas is not flowing through the saturator. After extended periods of this idle time, the 3920 must be purged again prior to further use.

2.13.6.4 Operating Tips

Below are some key points to keep in mind when operating the 3920.

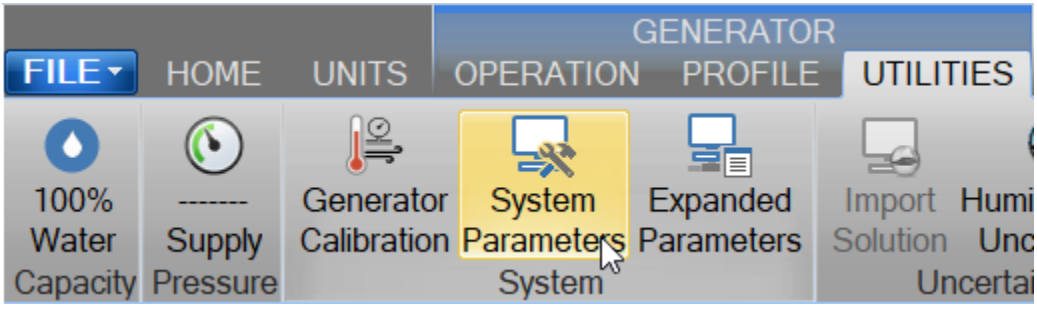
- A general rule of thumb with the 3920 is always to purge while going down in saturation temperature. For example, whenever you go to a colder frost point, you will typically operate in the purge mode down to your lowest humidity test point, switch to generate mode and then operate in generate mode as you go up in temperature. We recommend an 8-hour overnight purge before switching to generate.
- It is recommended to wait around 4 hours each time you transition from below zero to above zero. This ensures the saturator has time to completely change phases from ice to water. When you go

down in temperature, you need to do the same thing, but usually, the 8-hour overnight purge is perfect as it allows plenty of time for the saturator to phase change to ice.

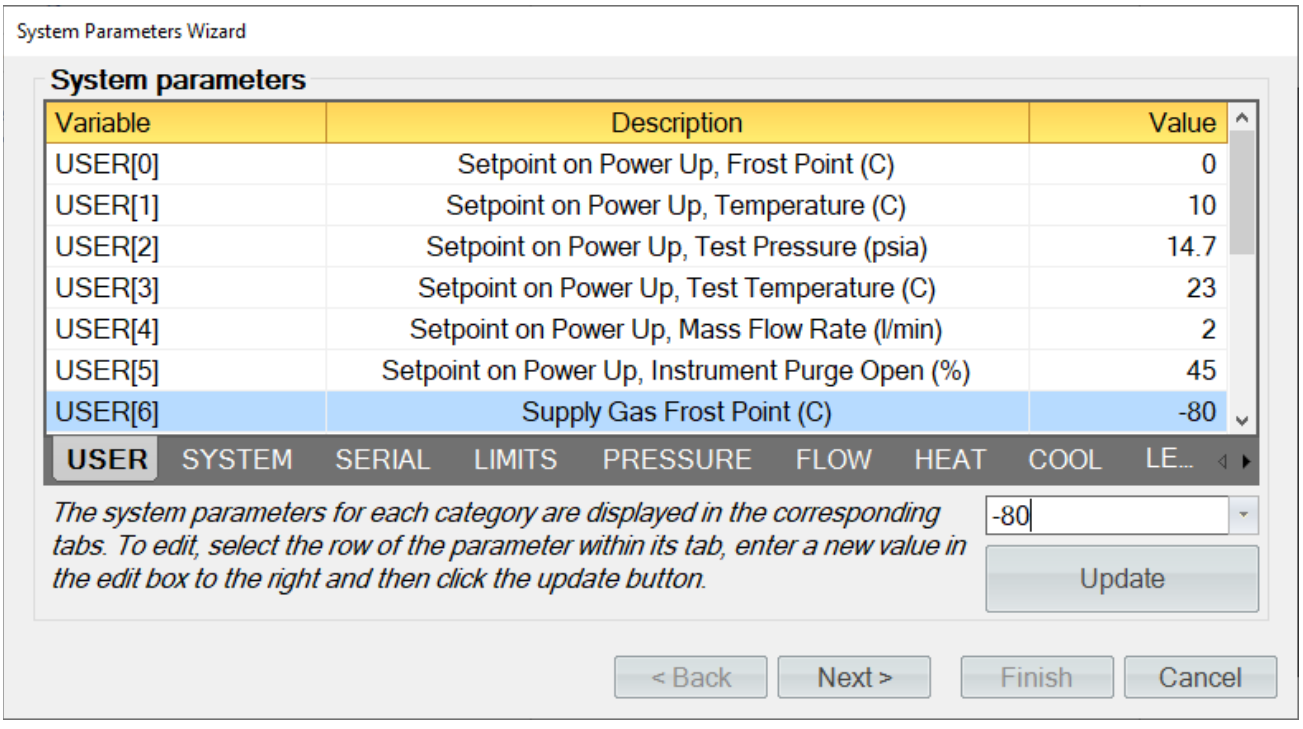
- Low frost calibration is a slow process. Most of the battle is working to dry down the sensors under test. It is very important always to use stainless steel tubing and to keep things clean and well-maintained. It is good to limit connections in your setup. Each connection introduces “dead spaces” where moisture can accumulate, which can be difficult to remove during the dry-down process.

2.13.7 Supply Gas Frost Point

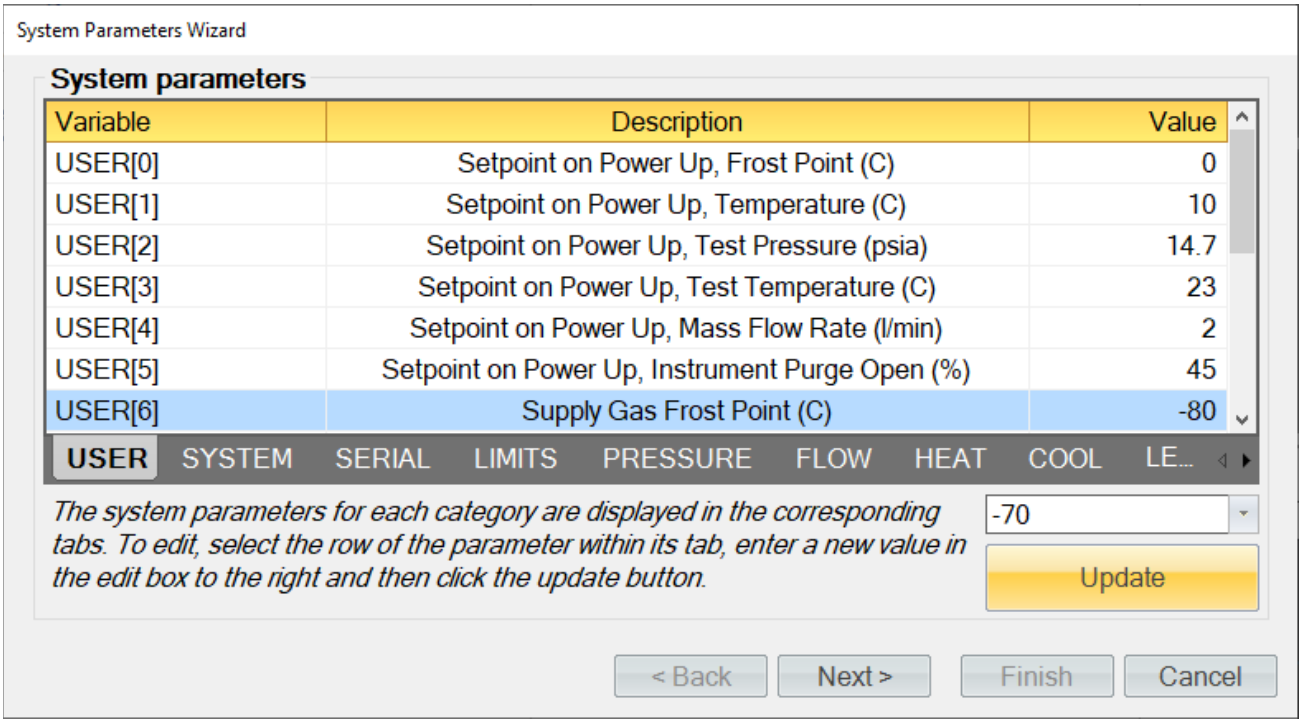
The user must enter the dryness of their supply gas if it is wetter than 0.5 PPMv or -80 °C at ambient. The supply gas is used to purge the outlet of the saturator and is used at the inlet of the saturator, so any gas wetter than the saturation temperature will cause condensation (icing) at the saturator inlet and outlet. If the measured ambient pressure frost point of the gas supply is wetter, for example -70°C, then the user must change the default “Supply Gas Frost Point” system parameter. To do this, select the Utilities tab from the Generator group and press System Parameters.



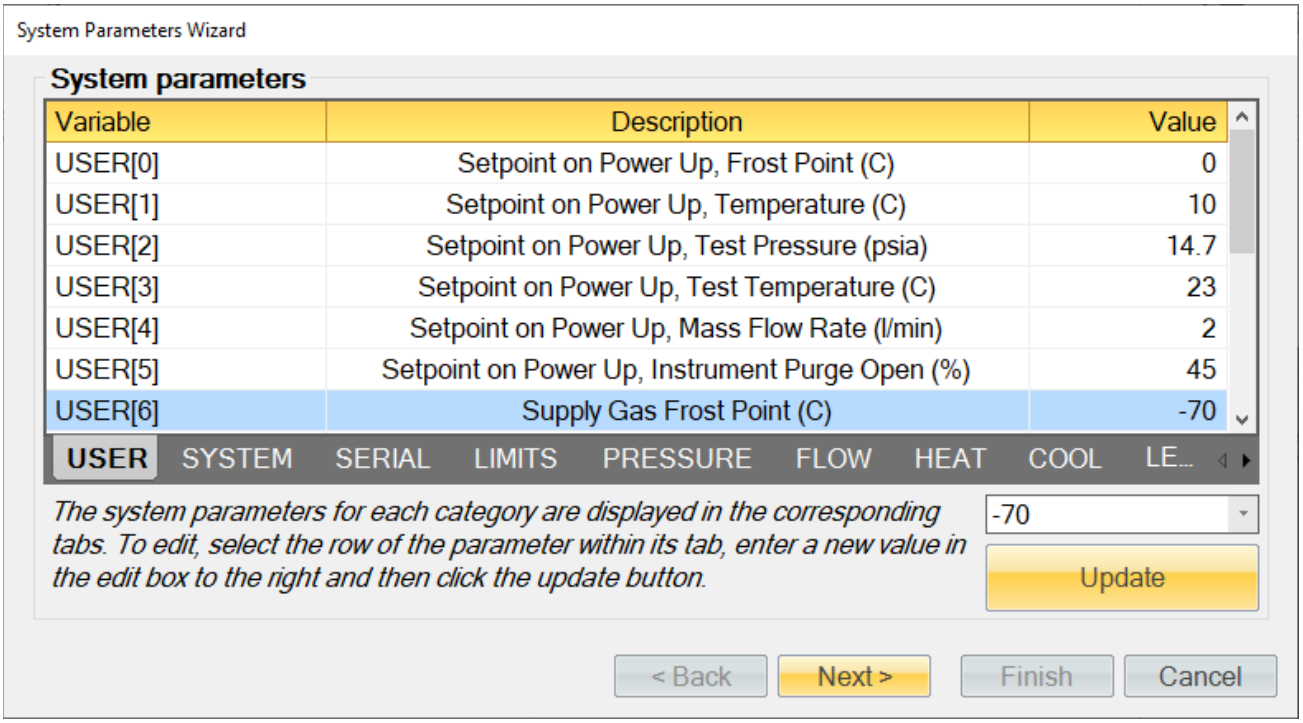
Under the User tab select the USER[6] system parameter.



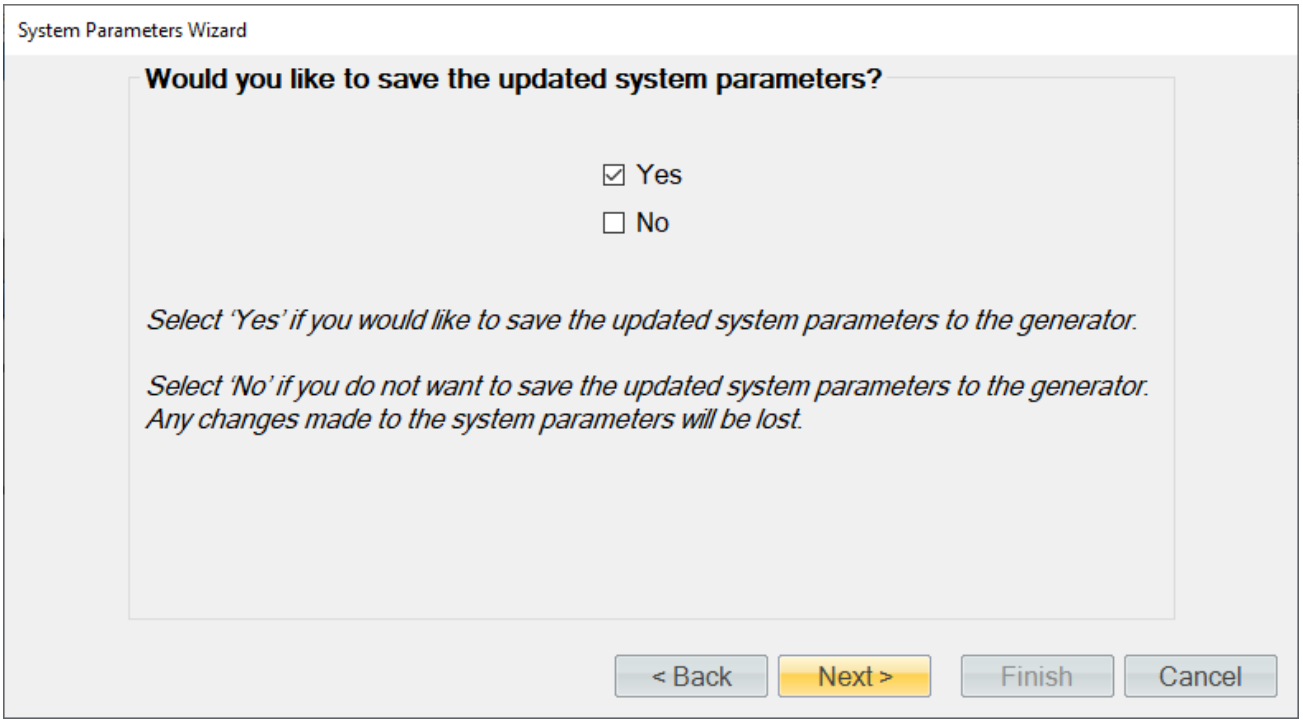
In the edit box enter the dryness of the supply gas. In this example we will use -70 °C, so enter -70 and press the Update button.



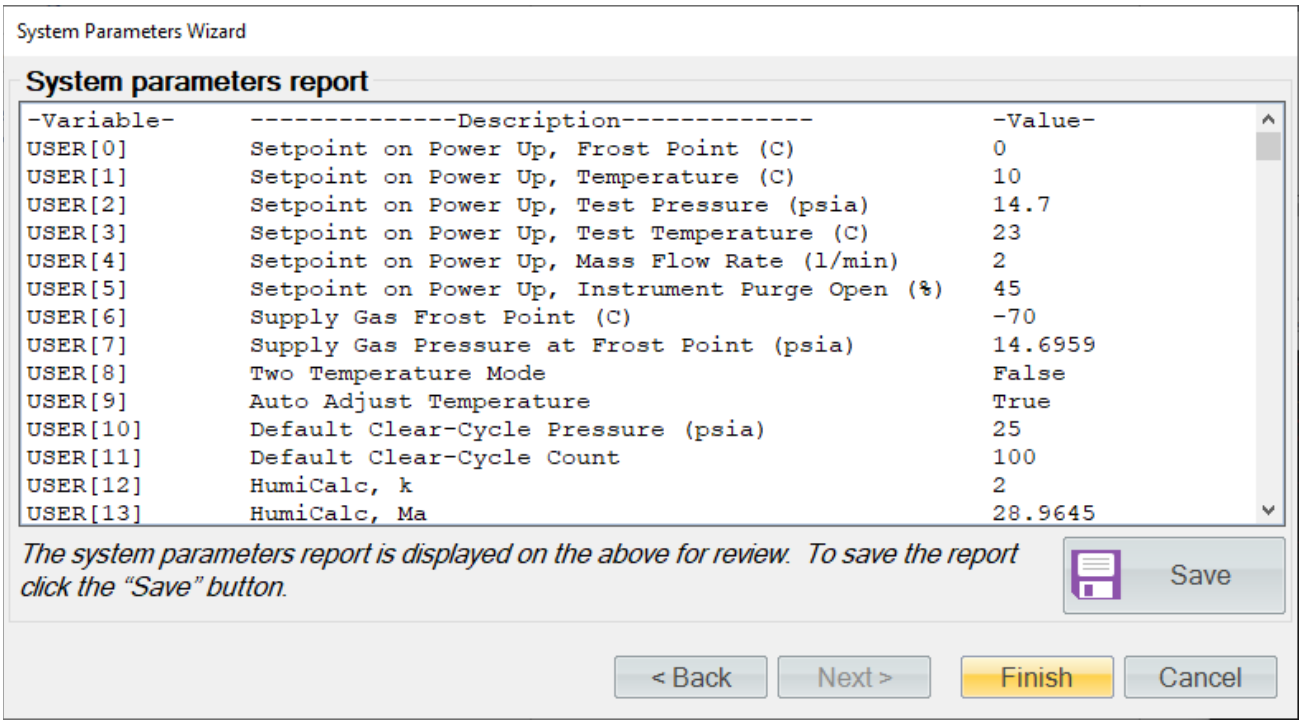
Press Next.



Select yes to updated system parameters and press Next.



A report of the current system parameters will be displayed, and the user has the option to save the file. Press Finish to close the dialog.

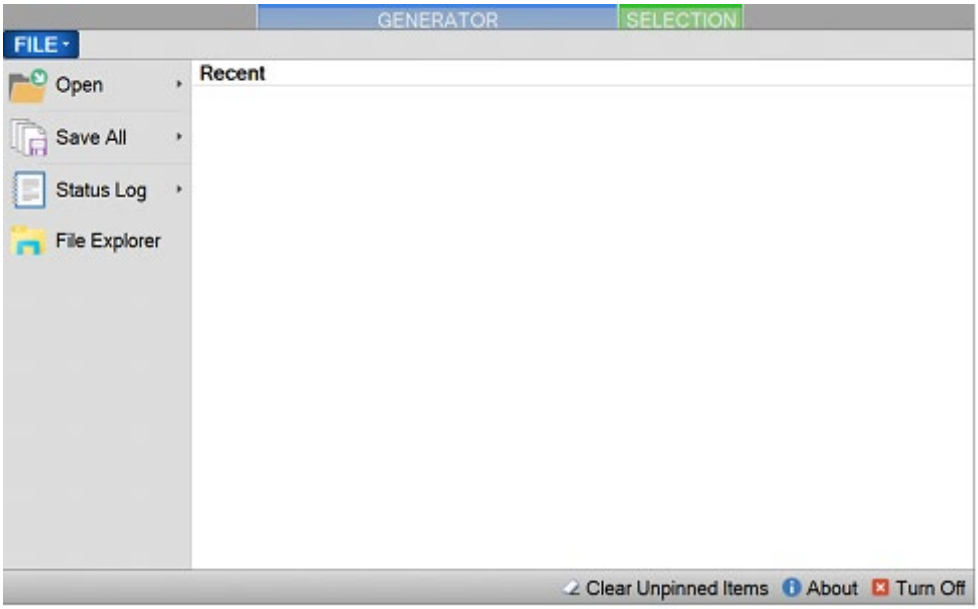


2.13.8 Power-Off

To turn the system off select the “Turn Off” command.



The “Turn Off” command is located under the “File” menu in the lower right corner.



The Turn Off command will properly exit the software and shutdown the computers so that the main power switch can be switched off.

> **Note** – *Always perform a Shutdown from the Operation Menu Tab before turning off the System.*

If there is current data that has yet to be saved the user will be asked to save the data before the system shuts down. Selecting this command when the generator is generating will result in the automatic shutdown of the generator.

The user is safe to switch the power switch to OFF once the PC has shut down completely (display goes blank).

⚠ CAUTION!

TURNING OFF POWER WITHOUT SHUTTING DOWN THE SYSTEM FIRST CAN CORRUPT THE EMBEDDED OPERATING SYSTEM.

2.13.9 Set Date and Time

The user can change the current system date and time through the status bar context menu.

> **Note** – *To avoid time stamp confusion only change the system date and time when the generator is shutdown and not recording data.*

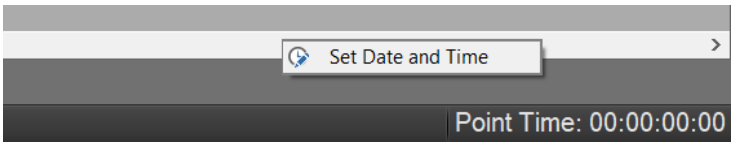
Start by long pressing or right clicking anywhere within the status bar. A long press is when you touch and hold the screen.



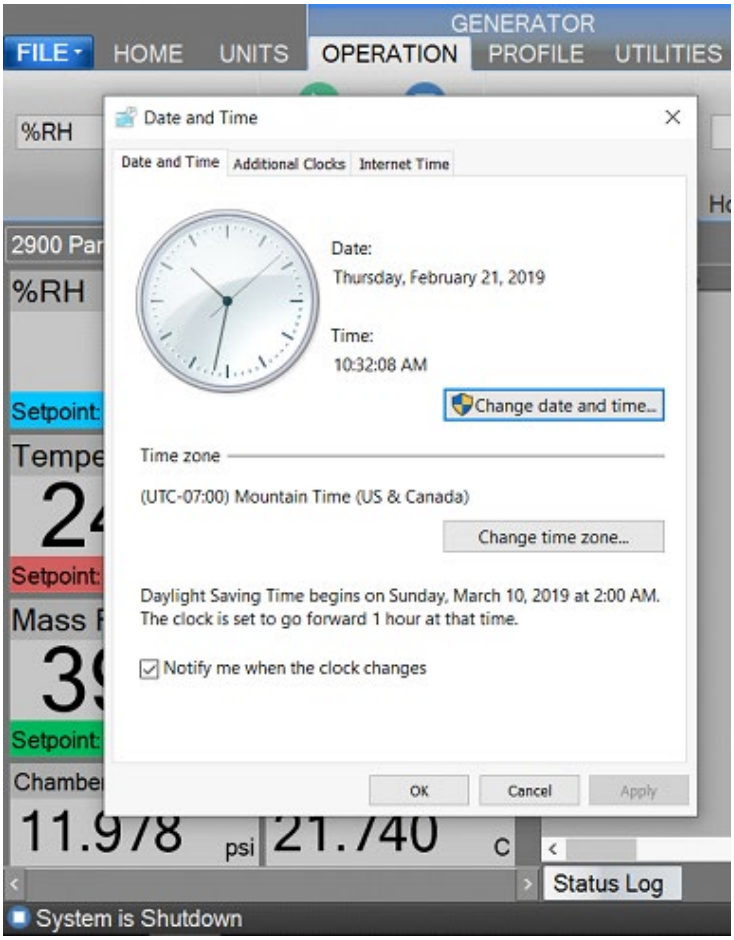
Long enough for a square selection box to appear.



Releasing will open the status bar context menu.



Select “Set Date and Time” from the context menu to open the system Date and Time dialog.



2.13.10 Help

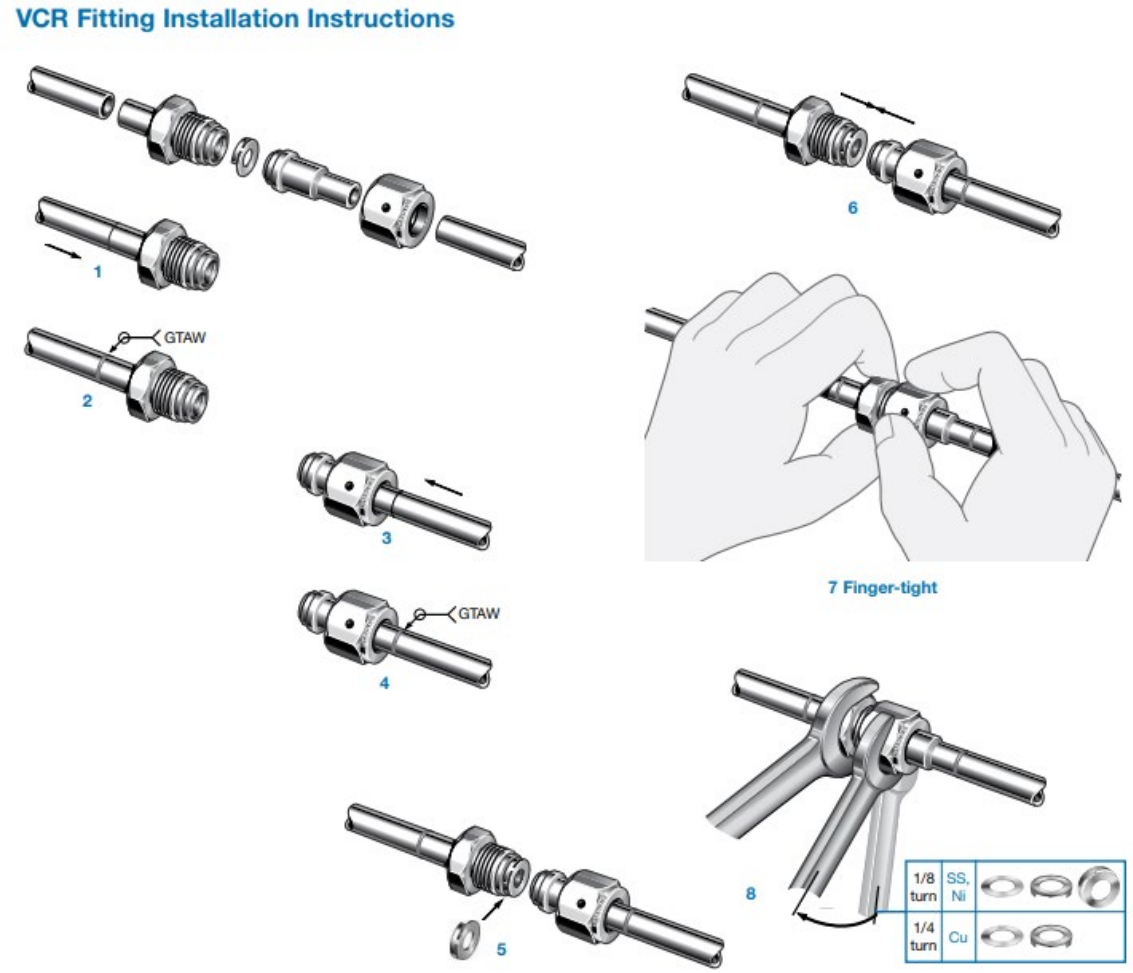
The Help Menu located on the upper right side of the screen, allows the user to open the 3920 System Manual.



> **Note –** *Refer to the Thunder Scientific website (www.thunderscientific.com) for the latest manual edition and other information on your Model 3920 Low Humidity System.*

2.13.11 Fitting Instructions

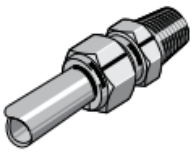
The Model 3920 low humidity generation system uses a Swagelok VCR® type fitting on the conditioned gas outlet. Please follow the Swagelok® instructions when connecting devices to the 3920 outlet.



Reassembly—All Sizes

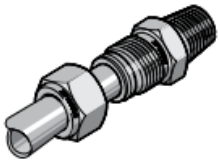
You may disassemble and reassemble Swagelok tube fittings many times.

⚠ **Always depressurize the system before disassembling a Swagelok tube fitting.**



Prior to disassembly, mark the tube at the back of the nut; mark a line along the nut and fitting body flats.

Use these marks to ensure that you return the nut to the previously pulled-up position.



Insert the tube with preswaged ferrules into the fitting until the front ferrule seats against the fitting body.

Over 1 in./25 mm sizes: *If needed, reapply lubricant lightly to the body threads and the rear surface of the back ferrule.*



While holding the fitting body steady, rotate the nut with a wrench to the previously pulled-up position, as indicated by the marks on the tube and flats. At this point, you will feel a significant increase in resistance. Tighten the nut slightly.

Refer to drawings: [19D3920901-2]

3 PRINCIPLE OF OPERATION

The Model 3920 low humidity generation system is based on the two-pressure principle. This process involves saturating gaseous nitrogen, with water vapor at a given temperature and pressure. The saturated high-pressure gas flows through an expansion valve where it is isothermally reduced to test pressure. The indications of saturation temperature, saturation pressure, test temperature, and test pressure are then used in the determination of all hygrometric parameters such as Frost Point, Dew Point, PPM, %RH, etc. Humidity generation by this system does not depend upon measuring the amount of water vapor, but rather is dependent on the measurements of temperature and pressure alone. The precision of the system is determined by the accuracy of the temperature and pressure measurements, and on the constancy of them throughout.

3.1 SATURATION TEMPERATURE (T_S)

The air stream of a two-pressure generator must be 100% saturated with water vapor at saturation temperature on the high-pressure (saturator) side of the expansion valve. This is accomplished by passing the air stream through a "Saturator". The Saturator is a vertical multi-plate pressure vessel presenting a water surface to the incoming gas stream and is maintained at saturation temperature conditions. The saturation temperature probe is used to measure the temperature at which the gas stream is fully saturated with water vapor. This is a fundamental measurement for a Two-Pressure humidity generator. Saturation temperature is controlled directly through the Temperature setpoint.

Refer to section 2.9 Specifications for range.

3.2 EXPANSION VALVE (T_V)

The expansion valve temperature probe is used in the control of the expansion valve heater, which when activated, is used to warm the expansion valve body, offsetting the cooling effects due to gas expansion. This expansion valve temperature is always maintained near ambient temperature.

3.3 TEST TEMPERATURE (T_T)

The test temperature probe is used to measure the temperature of the UUT or ambient temperature around the UUT. This is a fundamental measurement for a Two-Pressure humidity generator. Test temperature is a measurement only and not controlled.

Refer to section 2.9 Specifications for range.

3.4 SATURATION PRESSURE (P_S)

The Saturation Pressure transducer measures and controls the absolute pressure at which the gas stream is fully saturated with water vapor at saturation temperature conditions. This is a fundamental measurement for a Two-Pressure humidity generator. Saturation pressure is controlled directly using the Saturation Pressure setpoint or indirectly through the humidity mode setpoint.

Refer to section 2.9 Specifications for range.

3.5 Test Pressure (P_T)

The test pressure transducer is used to measure the pressure at the UUT. This is a fundamental measurement for a Two-Pressure humidity generator. Test pressure is normally ambient pressure but can be controlled manually using a back-pressure regulator.

Refer to section 2.9 Specifications for range.

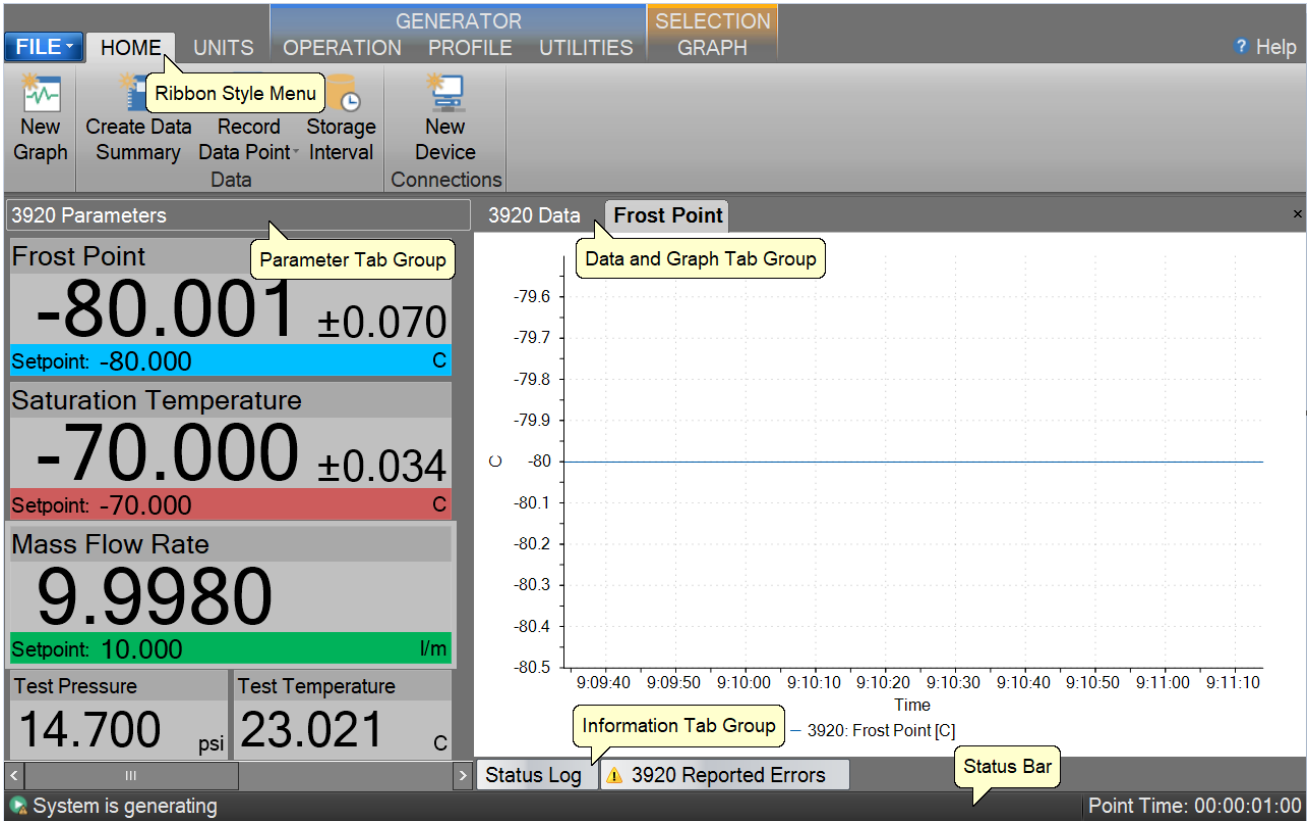
3.6 Humidity Formulas

The humidity (or water vapor content) of a gas may be expressed in a variety of ways. While some basic understanding of humidity is helpful, thorough knowledge of the formulas and their relationships to the 3920 is not a requirement for successful operation of the generator. Refer to the HumiCalc with Uncertainty Reference Manual for a full description of the equations used by the 3920 to generate a known humidity and corresponding uncertainty value.

4 CONTROLOG INTERFACE

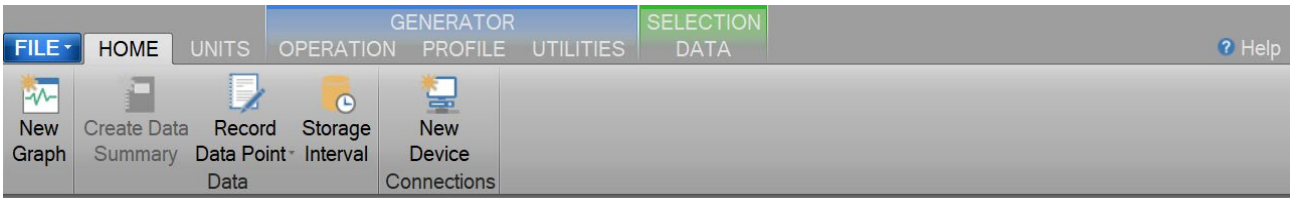
This section will provide the user with a detailed overview of ControLog's layout and design. It is intended to allow the user to gain familiarity with ControLog's user interface. The sections following will provide a deeper operational view of the functionality that ControLog offers.

The ControLog application is composed of five basic features: Ribbon Style Menu Bar, Parameter Tab Group, Data and Graph Tab Group, Information Tab Group and the Status Bar. Each feature is designed to be intuitive to use and to provide the user with detailed information on the operation of the generator and/or connected device(s).



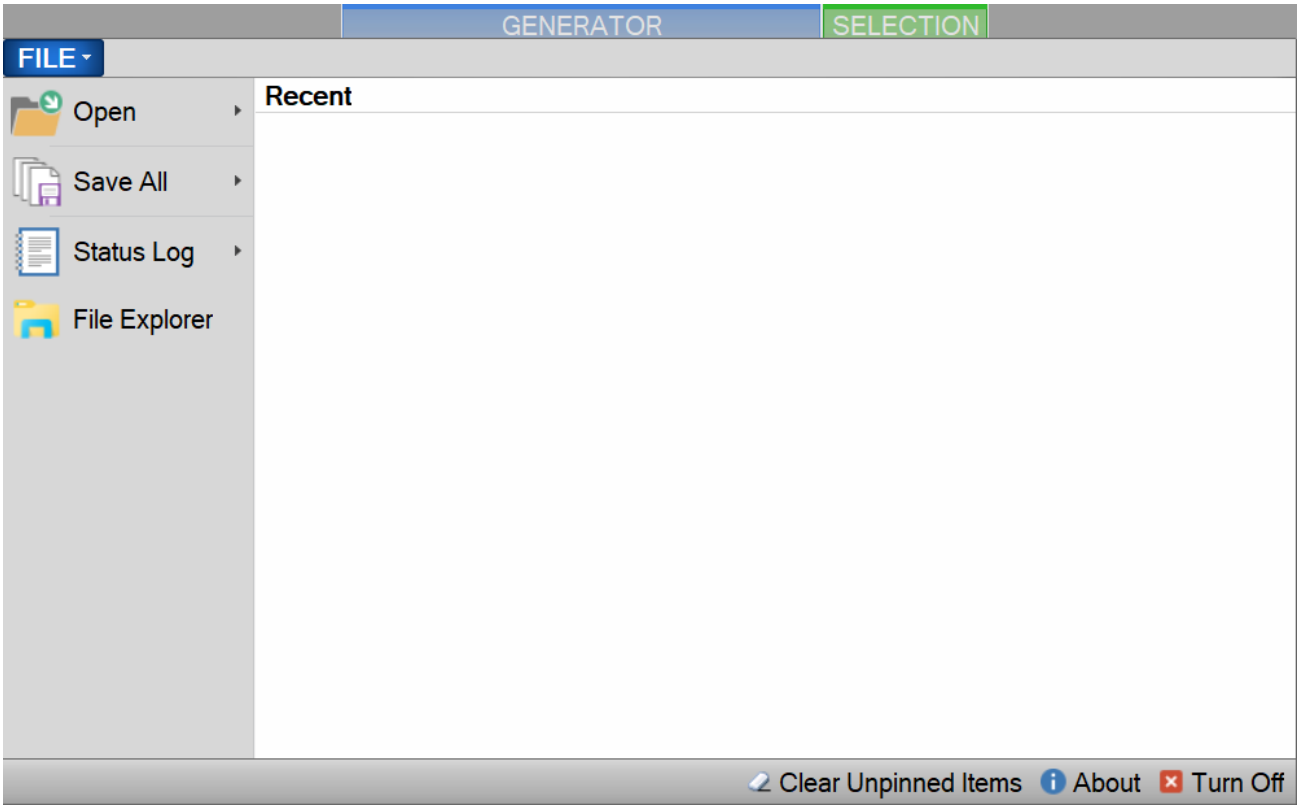
4.1 MENU BAR

The Ribbon Style Menu Bar is located at the top of the application and contains various selectable menu groups, which provide access to the different ControLog functions and controls. The Generator group provides commands that are directly related to the operation of the generator such as Operation, Profile, and Utilities. The Selection group is dynamic and provides commands based on the Data and Graph Tab Group tab that is currently selected. For example, if a data tab is selected, commands related to data will be available. If a graph tab is selected, then commands related to the graph will be available.



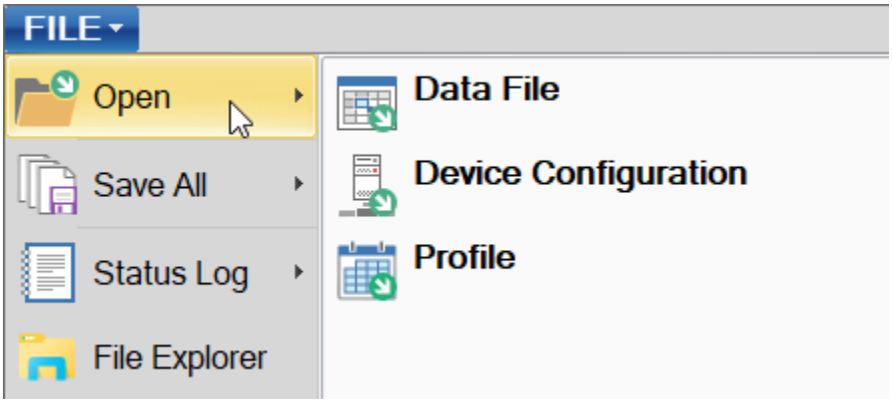
4.1.1 File Menu Tab

The File Menu allows the user to perform file specific commands to open previous data files, profiles and device configurations. It also allows the user to save all open data or graphs, clear the status log, save the status log, restore the tab layout, about the application and shutdown system.



4.1.1.1 Open Data File

The Open file menu command allows the user to open previous data files for further review and analysis, device configurations for device data logging and profiles for generator automation.

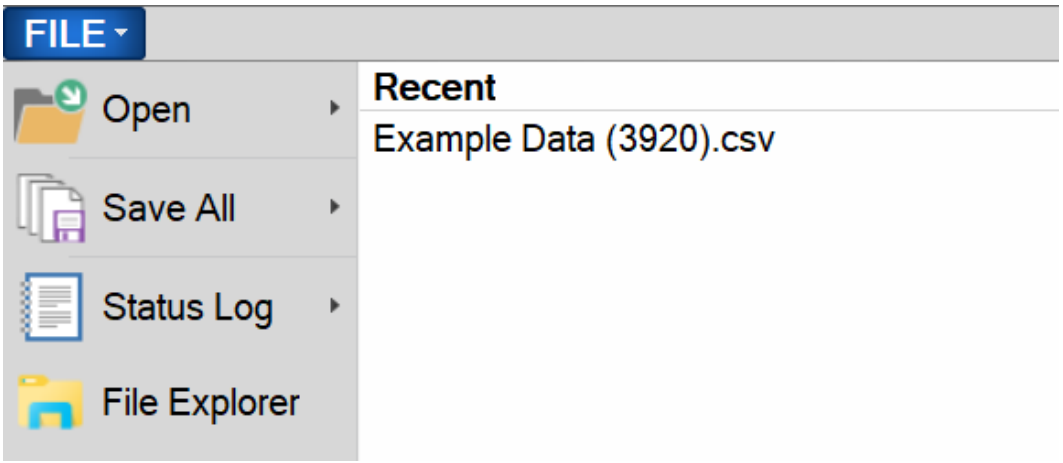


Selecting one of these commands will open a file dialog that will allow the user to browse to the desired location for the file to open.

ControLog can open data saved in the follow type and format:

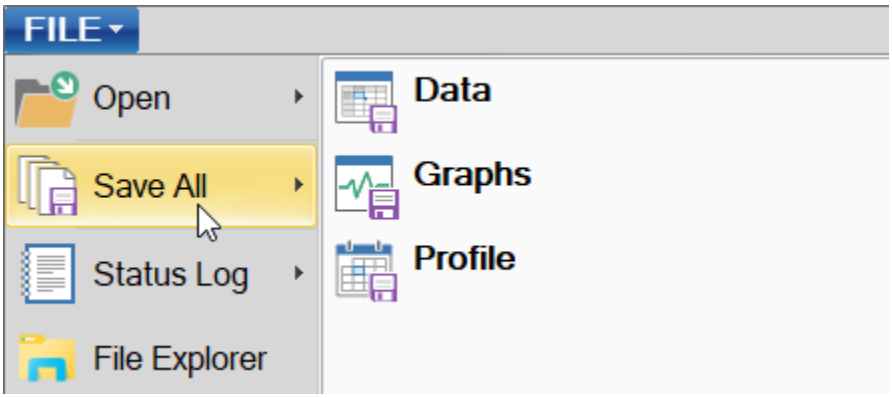
- Text File (Comma Delimited) (*.csv;*.txt)
- Text File (Tab Delimited) (*.dat;*.txt)
- Excel Workbook (*.xlsx;*.xls)
- Backup ControLog File (*.backup)

The user can also view and select to open recent files and has the option to “Pin” the file for quicker access later on. This can be very useful if you have a device configuration that is often used or a commonly used profile as it removes the process of navigating and selecting the file each time.



4.1.1.2 Save All Data

The Save All file menu command allows the user to save all current open data tabs to individual files using a common name. This feature allows the user to quickly save multiple data tabs in a single operation. Selecting this command will open a save file dialog that will allow the user to specify the name and browse to the desired location to save the file.



ControLog can save data in the following type and format:

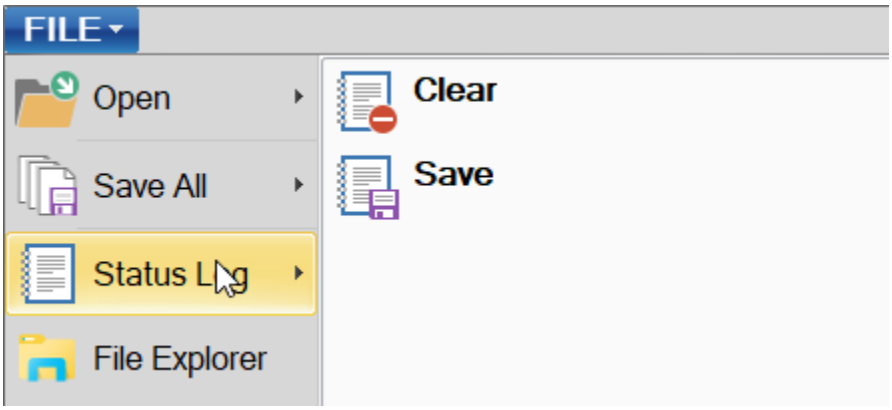
- Comma-Separated Values (*.csv)
- Text File (Comma Delimited) (*.txt)
- Text File (Tab Delimited) (*.txt)
- Excel Workbook (*.xlsx)
- Excel 97-2003 Workbook (*.xls)

Example: If the user had two data tabs open, one called “3920 Data” and the other called “Agilent 34970A Data” and the user wanted to save the files as Excel Workbooks using the name “Test Data 10Dec15”. ControLog would save two files to the user specified location with the follow names:

- Test Data 15Oct17 (3920).xls
- Test Data 15Oct17 (Agilent 34970A).xls

4.1.1.3 Status Log

The Status Log file menu command allows the user to Clear or Save the status log.

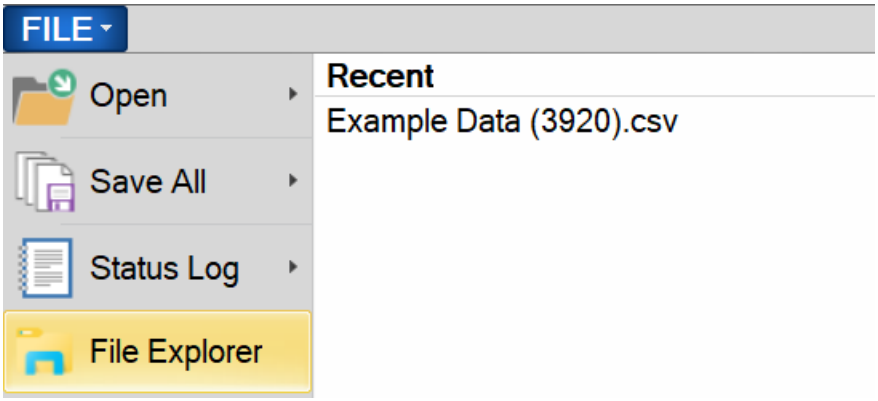


The Clear command allows the user to clear all current entries in the status log. The user will be asked to save the status log data before the log is cleared.

The Save command allows the user to save the current entries in the status log. Selecting this command will open a save file dialog that will allow the user to specify the name and browse to the desired location to save the file. All status log files are saved in HTML format (*.html).

4.1.1.4 File Explorer

Opens a Windows file explore to allow the user to manage files. This can be used to easily copy data and report files from the 3920 to an extern USB drive.



4.1.1.5 Clear Unpinned Items

Clears all unpinned items in the list of recent files.



4.1.1.6 About ControLog

The About ControLog help menu command opens a dialog giving information on the ControLog application including version number.



4.1.1.7 Turn Off

The Turn Off command allows the user to properly exit the software and shutdown the computers so that the main power switch can be switched off. If there is current data that has yet to be saved the user will be asked to save the data before the system shuts down. Selecting this command when the generator is generating will result in the automatic shutdown of the generator.

> **Note** – *Always perform a Shutdown from the Operation Menu Tab before commanding a Shutdown System.*

The user is safe to switch the power switch to OFF once the PC has shut down completely (display goes blank).

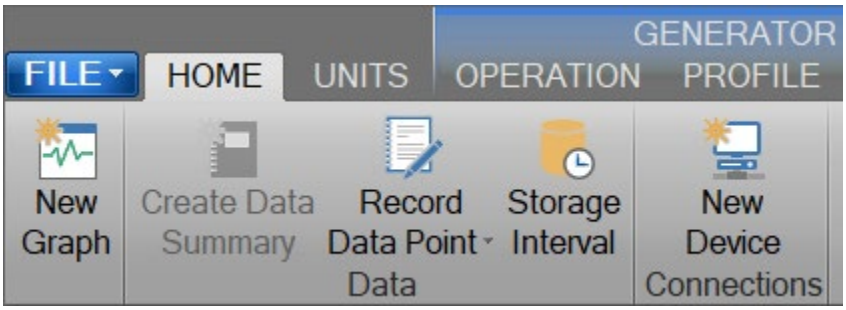


⚠ CAUTION!

TURNING OFF POWER WITHOUT SHUTTING DOWN THE SYSTEM FIRST CAN CORRUPT THE EMBEDDED WINDOW SYSTEM DRIVE.

4.1.2 Home Menu Tab

The home menu tab allows the user to create new graphs and data summaries, record data points, connect to the generator and create new device connections. It also allows the user to change ControLog's displayed units. The Temperature, Pressure, Flow Rate, Density and Enthalpy units can be changed.



4.1.2.1 New Graph

The New graph menu command allows the user to create a new graph. Selecting this command will open a New Graph Wizard dialog that will step the user through the selection process of what data the user would like to include in the new graph. This operation is always available.

4.1.2.2 Create Data Summary

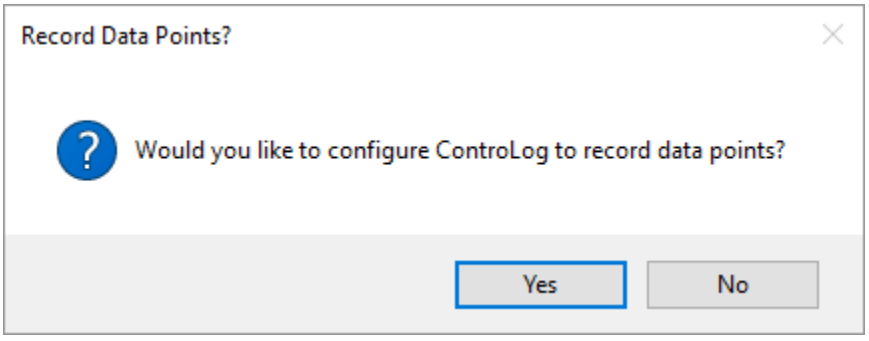
The Create Data Summary data command allows the user to create a summary of any currently opened data. The feature lets the user specify what items, from which device, and at what intervals to include in the data summary. The data summary can also calculate error between the specified standard and the device under test. This operation is available whenever there is an open Data tab that contains data.

For more information, refer to section 8 Data and Data Summary

4.1.2.3 Record Data Point

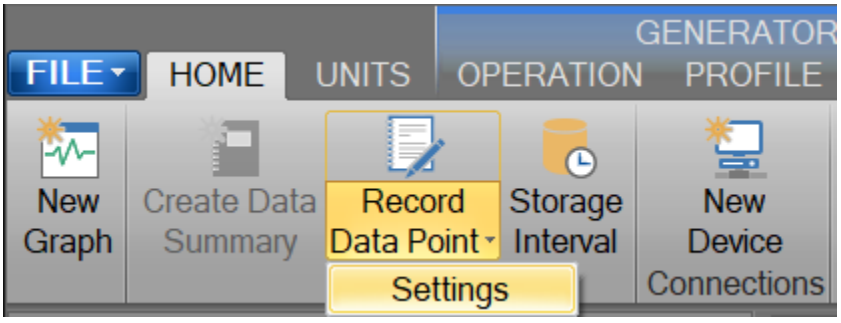
The Record Data Point data command allows the user to record certain data items from any currently connected device either manually, with each manual device entry or at the completion of each soak phase in an auto profile. The user can specify the number of prior data points to include and has the option to automatically calculate average and or standard deviation of the prior data points. There are two submenus for this menu command; Settings and Take Point. This operation is available whenever device or generator data is being logged. The user can manually take a point using the button or by using the keyboard shortcut "Ctrl-P".

If the user has not configured the system to record data points, then ControLog will ask the user if they would like to define the settings before taking a point.



4.1.2.3.1 Settings

The Settings submenu allows the user to define which data items and from which connected device they would like to record when a point is taken. They can also define the number of points prior to include and whether to calculate average and or standard deviation. The user can also configure when to take points, either manually, at the end of a profile soak phase or when a manual device entry is taken.



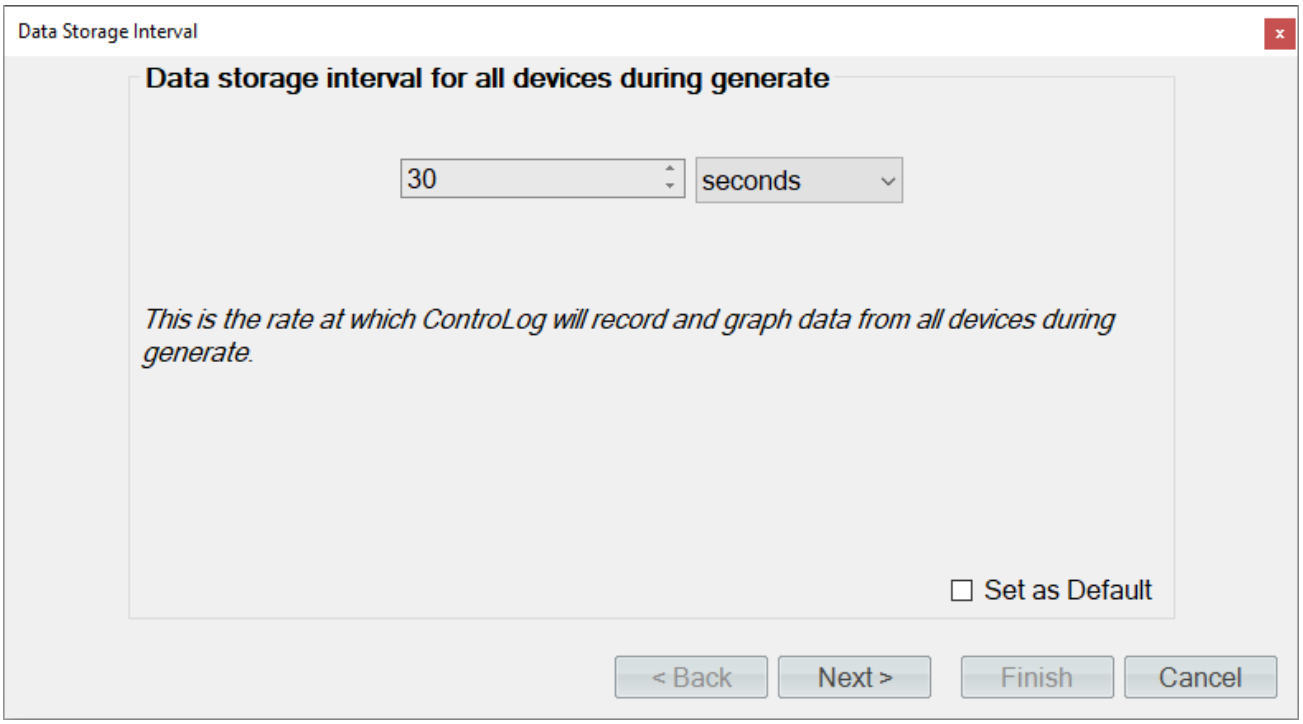
For more information, refer to section 8 Data and Data Summary

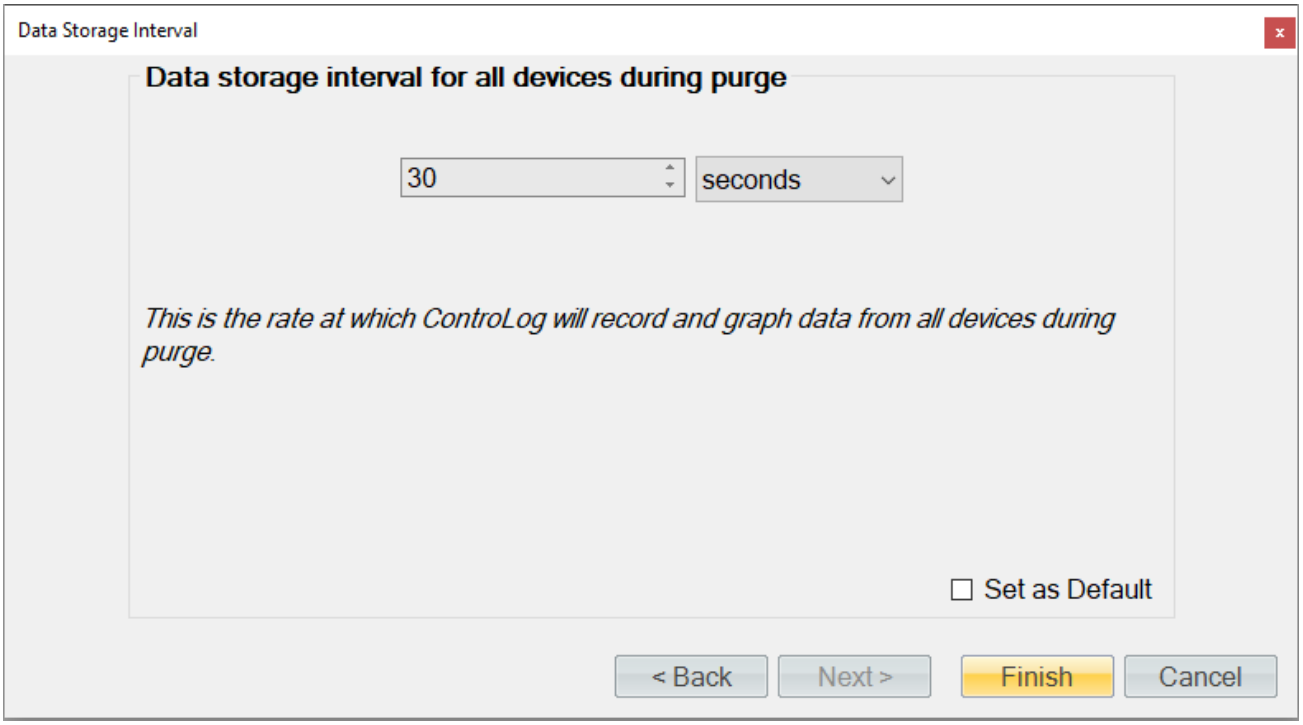
4.1.2.4 Data Storage Interval

The Data Storage Interval data command allows the user to change the storage interval that data is recorded. This is the rate at which data is recorded to the data tabs for all connected devices. Selecting this command will open the "Data Storage Interval" dialog that will allow the user to change the data storage interval during both purge and generate operations. If the "Set as Default" is checked, the new value will become the default start up interval. If not checked, the new value will only affect the current session.

⚠ IMPORTANT!

STORING AND MAINTAINING DATA CAN BECOME A TIME-CONSUMING PROCESS. THE MORE DATA THAT IS STORED IN THE DATA TAB, THE SLOWER AND LESS RESPONSIVE THE COMPUTER MAY SEEM. FOR THIS REASON, SOME CONSIDERATION SHOULD BE GIVEN TO THE AMOUNT OF DATA DESIRED, THE OVERALL TIME SPAN OF THE DATA (I.E. HOURS, POSSIBLY DAYS), AND ULTIMATELY THE DATA INTERVAL.





Note - *Data is only recorded while the 3920 is in purge or generate mode.*

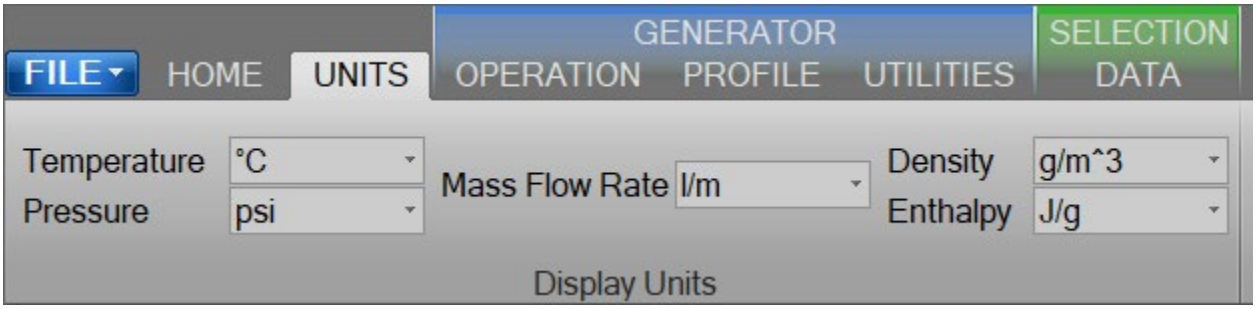
4.1.2.5 New Device

The New Device connection command allows the user to create a new device connection. Selecting this command will open a Connection Wizard dialog that will step the user through the process of creating a new connection to a device.

For more information, refer to section 10 Connections

4.1.3 Units Menu Tab

The Units Menu Tab allows the user to change ControLog's displayed units. The Temperature, Pressure, Flow Rate, Density and Enthalpy units can be changed.



> **Note** - *All parameter tabs and graph tabs will be updated with the selected unit, but the data tabs will not change. All data tab values remain in SI units which provide a consistent unit base for saved data.*

4.1.3.1.1 Temperature Unit

The Temperature Unit allows the user to change the displayed units for temperatures.

Available temperature units:

- °F
- °C
- K

4.1.3.1.2 Pressure Unit

The Pressure Unit allows the user to change the displayed units for pressure.

Available pressure units:

- psi
- atm
- Pa
- hPa
- kPa
- MPa
- bar
- millibar

4.1.3.1.3 Flow Unit

The Flow Unit allows the user to change the displayed units for flow.

Available flow units:

- l/m
- l/h
- cfm
- cfh

4.1.3.1.4 Density Unit

The Density Unit allows the user to change the displayed units for density.

Available density units:

- g/L
- g/m^3
- lb/ft^3

4.1.3.1.5 Enthalpy Unit

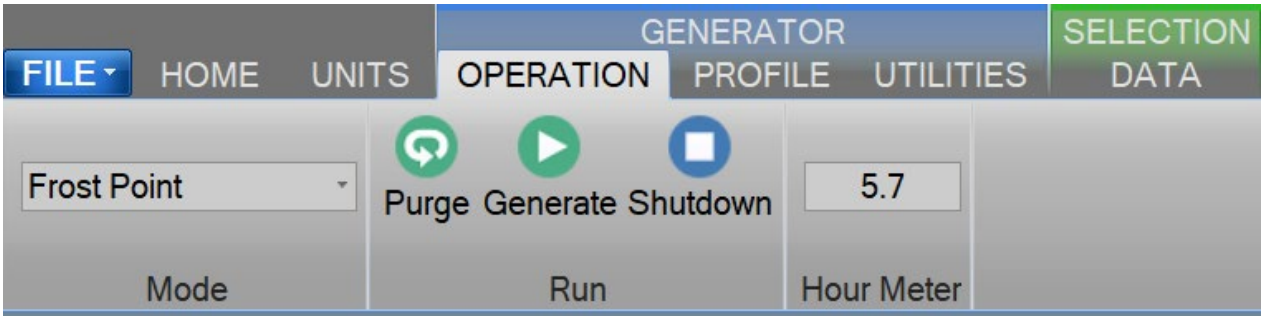
The Enthalpy Unit allows the user to change the displayed units for enthalpy.

Available enthalpy units:

- btu/lb
- J/g

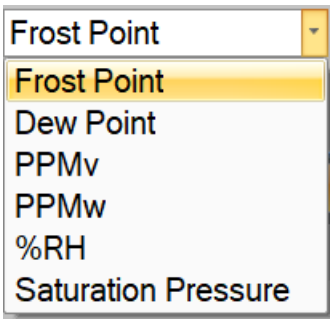
4.1.4 Operation Menu Tab

The Operation Menu Tab gives the user the ability to control the operation of the generator, from which humidity operating mode to the startup and shutdown of the generator.



4.1.4.1 Mode

The Mode Menu allows the user to change the operating mode of the 3920. It allows the user to select between %RH, Frost Point, Dew Point, PPMv, PPMw, and Saturation Pressure.



4.1.4.1.1 Frost Point Control Mode

The Frost Point Control Mode, Tf, is controlled at a constant value by varying the saturation pressure, Ps, to compensate for changes in either saturation temperature, Ts, or chamber pressure, Pt. While Frost Point is held constant other humidity parameters may vary. Frost Point is independent of chamber temperature.

4.1.4.1.2 Dew Point Control Mode

The Dew Point Control Mode, Td, is controlled at a constant value by varying saturation pressure, Ps, to compensate for any changes in either saturation temperature, Ts, or chamber pressure, Pt. While Dew Point is held constant, other humidity parameters may vary. Dew Point control mode is valid both above and below 0 °C, and Dew Point is independent of chamber temperature.

4.1.4.1.3 PPMv Control Mode

The PPMv Control Mode is controlled at a constant value by varying saturation pressure, Ps, to compensate for any changes in saturation temperature, Ts. While PPMv is held constant, other humidity parameters may vary. PPMv is independent of chamber pressure and chamber temperature.

4.1.4.1.4 PPMw Control Mode

The PPMw Control Mode is controlled at a constant value by varying saturation pressure, Ps, to compensate for any changes in saturation temperature, Ts. While PPMw is held constant, other humidity parameters may vary. PPMw is independent of chamber pressure and chamber temperature.

4.1.4.1.5 %RH Control Mode

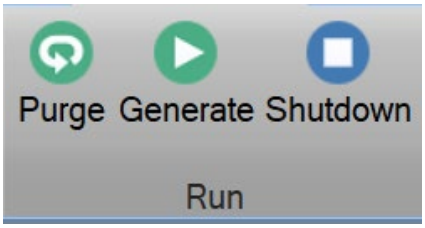
The %RH Control Mode, %RH, is controlled at a constant value by varying saturation pressure, Ps, to compensate for any changes in saturation temperature, Ts, chamber temperature, Tc, or chamber pressure, Pt. While %RH is held constant, all other humidity parameters may vary.

4.1.4.1.6 Saturation Pressure Control Mode

The Saturation Pressure Control Mode, Ps, is controlled at a constant value independent of any other pressure, temperature, or humidity value. While saturation pressure is held constant, all humidity parameters may vary.

4.1.4.2 Run Menu

The Run Menu allows the user to run the 3920 manually in generate or purge mode. The Run menu also allows the user to manually shutdown the 3920.



The user can select to Purge, Generate or Shutdown. The general rule of thumb is to always use purge mode when going down in temperature. This means you should purge to your lowest frost point overnight and then switch to generate and work up to your highest dew/frost. While going up in temperature make sure you give adequate dwell time at each point to assure the system has reached equilibrium.

4.1.4.2.1 Purge Mode

Selecting Purge from the run menu commands the 3920 into purge mode. The purge mode is generally used to prevent icing within the saturator and dry the saturator outlet after movement (transportation), storage (power off, no gas flow, etc.), after performing the saturator fill procedure, or while transitioning the saturator from higher to lower temperatures. When the system is not being used (power off, no gas flow, etc.), the saturator is closed off and the gas within is static. As thermal equilibrium is reached, water vapor will condense on all inner surfaces between the saturator outlet and the expansion valve inlet. The Purge mode counteracts this condition by allowing the carrier gas to flow in the opposite direction (expansion valve to saturator), drying the affected sections of tubing. This is a necessary preparatory step in any low humidity system. As a general rule, when starting from an ambient condition the system should be purged for 24 hours or more before attempting to operate in the Generate mode. If sufficient purge time is not allowed, condensed, or trapped water will remain and system accuracy will suffer. Insufficient purge time is usually indicated by higher than normal (wetter than normal) indications of the device under test. These indications can be as little as a few tenths of a degree to as much as several degrees' dew/frost point. Purging should also be performed while transitioning from warmer to colder saturation temperatures, and for approximately 5 hours after each 500 hours of continuous Generate mode operation. During Purge mode, both flow control and saturation temperature control are active, but saturation pressure control is disabled. The generator will attempt to achieve the indicated flow and saturation temperature setpoint values.

Note – *When the saturation temperature is lowered, the fluid jacket surrounding the saturator cools in order to reduce the saturation temperature to its new setpoint value. As the saturator cools during this transition period, temperature gradients will exist between the inside of the saturator and the fluid jacket that surrounds it. The saturator outlet passes through this fluid jacket and will also exhibit temperature gradients along its length. If gas is allowed to flow normally through the saturator during this cooling period, the 100% humidified gas of the saturator may condense at the colder saturator outlet. Therefore, Purge mode should be used while cooling the saturator to lower temperatures. For this reason, the lowest humidity of a generation sequence or profile should be performed first. This low to high order requires that a Purge be performed only once prior to the generation sequence when cooling to the lowest saturation temperature. Then, as humidity values are increased, warming the saturator to higher values, further purging is not required.*

Note – *During Purge, limited gas flows to the 3920 Conditioned Gas Outlet, and consequently gas flows through the device under test if connected.*

4.1.4.2.2 Generate Mode

Selecting Generate from the run menu commands the 3920 into generate mode. Generate mode is used to operate the system when exact humidity points or associated time intervals have not been determined, when data must be viewed and/or verified manually before proceeding to the next humidity point, or when more immediate control over the generated humidity is required. When in the Generate mode of operation, the system will control at the currently entered setpoint indefinitely. Anytime a setpoint is changed, the system immediately begins adjusting to that new value, and will control at the new point indefinitely. Generate mode offers the flexibility to change the setpoint at any time and does not force you into any set sequence or for any prescribed amount of time. The Generate mode also allows you to change the humidity control mode at any time. For instance, the system may be controlling Frost Point, then you may immediately switch to PPMv control mode.

4.1.4.2.3 Shutdown

Selecting Shutdown from the run menu commands the 3920 to shutdown. The 3920 may be shutdown while generating. When stopped, all system functions shutdown, pressure is vented, and the idle Control/Display screen is shown. During this idle time, when the 3920 is stopped, gas is not flowing through the saturator.

4.1.4.2.4 Operating Tips

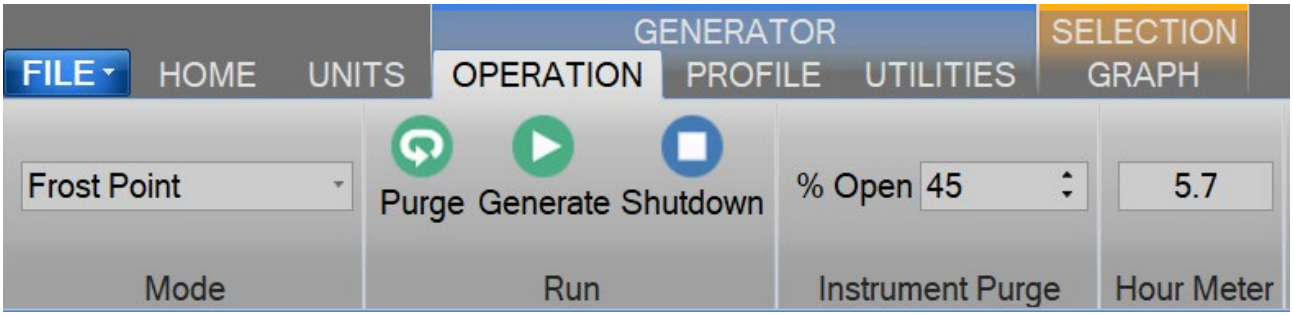
Below are some key points to keep in mind when operating the 3920.

- A general rule of thumb with the 3920 is always to purge while going down in temperature. For example, whenever you go to a colder frost point. You will typically operate in purge mode down to your lowest test point, switch to generate mode and then operate in generate mode as you go up in temperature. We recommend an 8-hour overnight purge before switching to generate.
- It is recommended to wait around 4 hours each time you transition from below zero to above zero. This ensures the saturator has time to completely change phases from ice to water. When you go down in temperature, you need to do the same thing, but usually, the 8-hour overnight purge is perfect as it allows plenty of time for the saturator to phase change to ice.
- Low frost calibration is a slow process. Most of the battle is working to dry down the sensors under test. It is very important always to use stainless steel tubing and to keep things clean and well-

maintained. It is good to limit connections in your setup. Each connection introduces “dead spaces” where moisture can accumulate, which can be difficult to remove during the dry-down process.

4.1.4.3 Instrument Purge Menu

The Instrument Purge Menu allows the user to control the amount of purge gas that is bypassed to the outlet during Purge mode. The instrument purge can be controlled from 0 (closed) to 100 (full opened). The user can specify the amount by entering a value directly or by using the up/down arrows to increment the percent open amount by 10. The percent open value indicates the opening amount or percentage of the expansion valve during purge mode. This allows purge gas to bypass the generator and to flow to any instrument connected to the outlet.

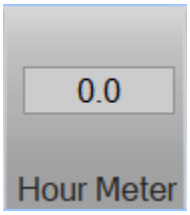


Warning! – *It is not recommended to purge with high percent open values as this can affect the generators ability to properly purge itself.*

Note – *Any backpressure regulator or value will affect the amount of purge gas that is bypassed to the outlet. It is recommended to remove any type of backpressure regulator or value when instrument purge is desired.*

4.1.5 Hour Meter

The Hour Meter allows the user to see the number of operational hours the generator has on it. The hour meter indicates the number of hours the generator has been operated in the generate mode.

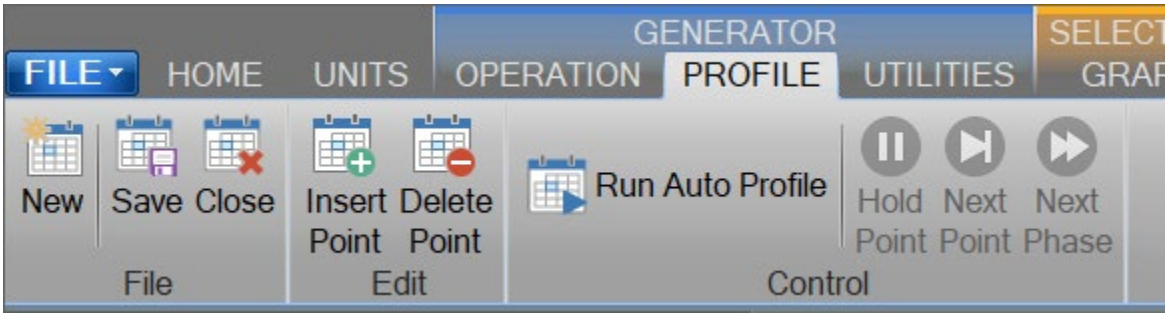


4.1.6 Profile Menu Tab

The Profile Menu Tab allows the user to manage Auto Profiles. Auto Profiles give the user the ability to program a set of humidity and temperature test points and dwell times that will automate the 3920 generation process. The profile menu is dynamic and has operations that are specific to the profile tab. Specific operations will be hidden when another non-profile tab is selected.

The Auto Profiling feature is very similar to the Generate mode with the main exception that profiling relies on a predefined list of setpoints referred to as a profile. The user configurable profile is used as ControLog's road map during Auto Profile operation. It defines which setpoint values to go to, at what rate to go from one setpoint to another, and how long to stay at a specific setpoint before moving to the next one.

For more information, refer to section 9 Profiling.



4.1.6.1 New Profile

The New profile command allows the user to create a new Auto Profile.

4.1.6.2 Save Profile

The Save profile command allows the user to save the currently opened Profile. Selecting this command will open a save file dialog that will allow the user to specify the name and browse to the desired location to save the file. ControLog Auto Profiles are saved in XML format with a *.profile extension.

4.1.6.3 Close Profile

The Close profile command allows the user to close the Profile tab. Selecting this command will close the Profile tab, but if the profile has not been saved, ControLog will ask the user to save the profile before closing the Profile tab.

4.1.6.4 Insert Point

The Insert Point command allows the user to insert new profile points between existing points. ControLog will insert a new point at the selected location and will automatically predict the values.

4.1.6.5 Delete Point

The Delete Point command allows the user to delete the selected profile point.

4.1.6.6 Run Auto Profile

The Run Auto Profile command allows the user to start an Auto Profile. Selecting this command will open the Profile Starting Point dialog which allows the user to select which point in the profile they would like to start the profile on.

4.1.6.7 Hold Point

The Hold Point profile command allows the user to hold or pause the current Auto Profile point. Selecting Hold Point pauses the current point, allowing the system to remain indefinitely at the current point. While in a hold mode, the system is prevented from completing the ramp, assurance, or soak phases for a point. To resume the profile point, select the menu item again. This re-enables the point and allows the profile to resume normal operation.

4.1.6.8 Next Point

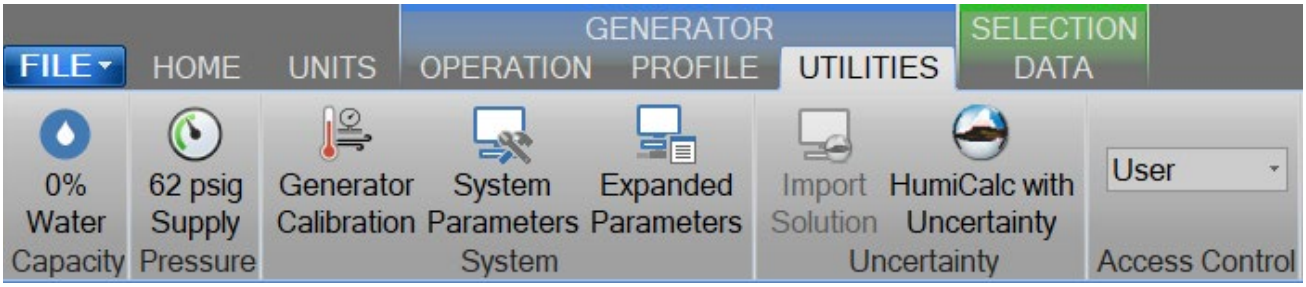
The Next Point profile command allows the user to skip to the next point in the Auto Profile. Selecting Next Point manually advances to the next point, skipping any remaining ramp, assurance, or soak phase.

4.1.6.9 Next Phase

The Next Phase profile command allows the user to skip to the next phase in the Auto Profile. Selecting Next Phase manually advances to the next phase. It causes Ramp Phase to proceed to the Assurance or Soak Phase, Assurance to proceed to Soak, or Soak to proceed to Ramp of the next profile point. This allows for early manual termination of any phase within a profile point.

4.1.7 Utilities Menu Tab

The Utilities Menu Tab gives the user access to various utilities functions such as Water Capacity, Supply Pressure, Generator Calibration, System Parameters, generator Uncertainty and Access Control.



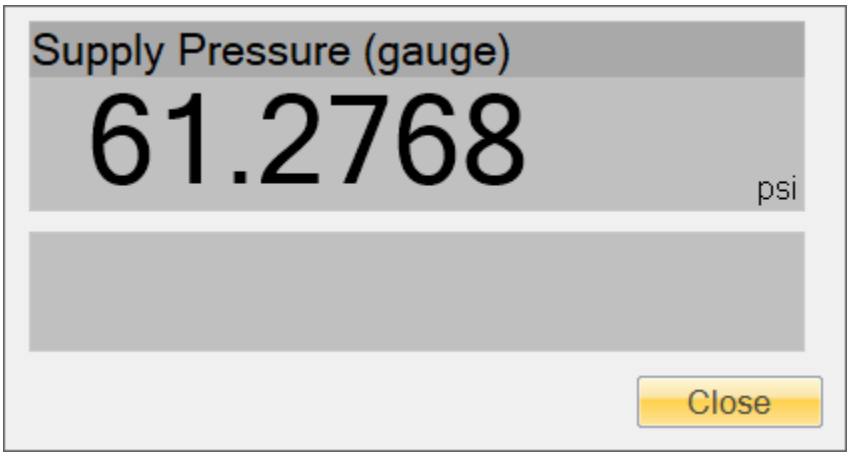
4.1.7.1 Water Capacity

The Water Capacity indicates the current water capacity of the 3920 and when pressed, opens up the 3920 Water Capacity and Clear-Cycles interaction dialog that allows the user to view the state of the water capacity and perform clear-cycles.

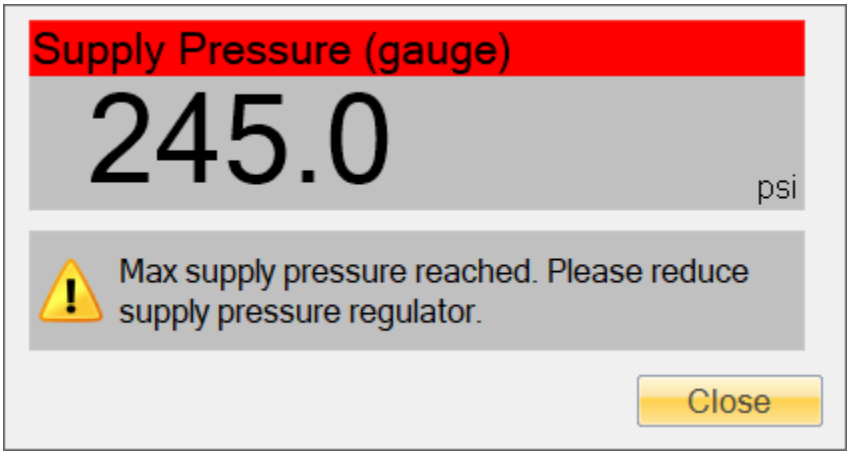
For more information, refer to section 5 Water Capacity.

4.1.7.2 Supply Pressure

The Supply Pressure indicates the current supply pressure and when pressed opens a dialog box for the user to view the current supply pressure (in gauge). If the generator is shutdown, this command will also open the supply pressure solenoid. The exact pressure value will vary based on the gas supply connected to the generator.



If the supply pressure is set too high a warning message will be displayed. The user will need to reduce the pressure regulator until the message disappears.



Refer to section 2.12.5 Setting Supply Pressure Regulator for detailed instruction on how to set the supply pressure regulator.

4.1.7.2.1 Changing Gas Supply

It is quite common to operate the system from a non-permanent gas source such as compressed bottled gas or a LN2 Dewar. These gas sources eventually become depleted and require changing. To change the gas supply without completely stopping or shutting down the system:

1) Set the Flow setpoint to 0 liters/minute. Allow a few seconds for the flow and saturation pressure indications to drop off. Temperature control will remain active.
2) Disconnect and remove the depleted gas source.
3) Connect to the new gas source.

4) Set the Flow setpoint back to the original setting. Within a few minutes, the system will return to its previous state.

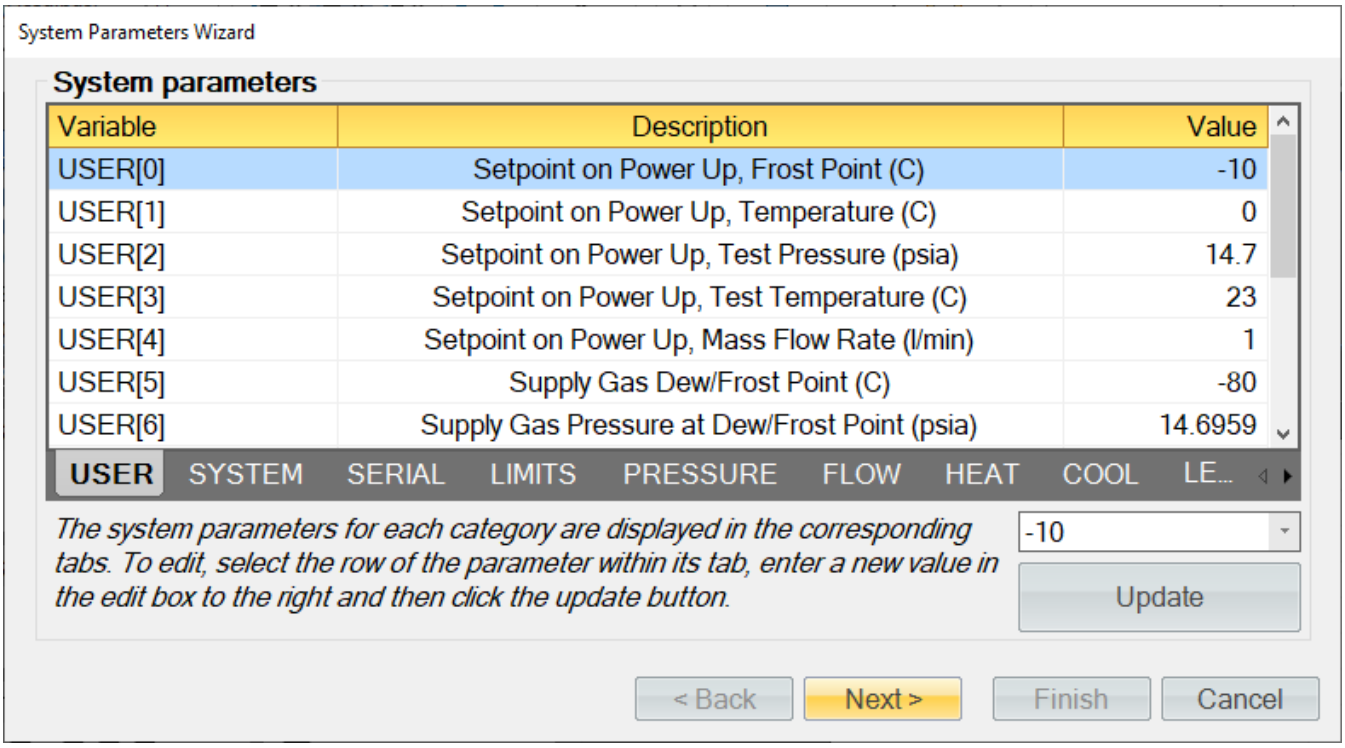
4.1.7.3 Generator Calibration

The Generator Calibration command opens the Calibration Wizard dialog for calibration of the Model 3920 Low Humidity generator's temperature probes, pressure transducers and mass flow meter.

For more information, refer to section 6 Calibration

4.1.7.4 System Parameters

The System Parameter command opens the System Parameter Wizard dialog to allow adjustment of the generator's system parameters that pertain to operation, control, limits and etc. The User tab is accessible with "User" access level and lets the user change things like power up setpoints, supply gas dryness and HumiCalc parameters such as molecular weight of the supply gas.



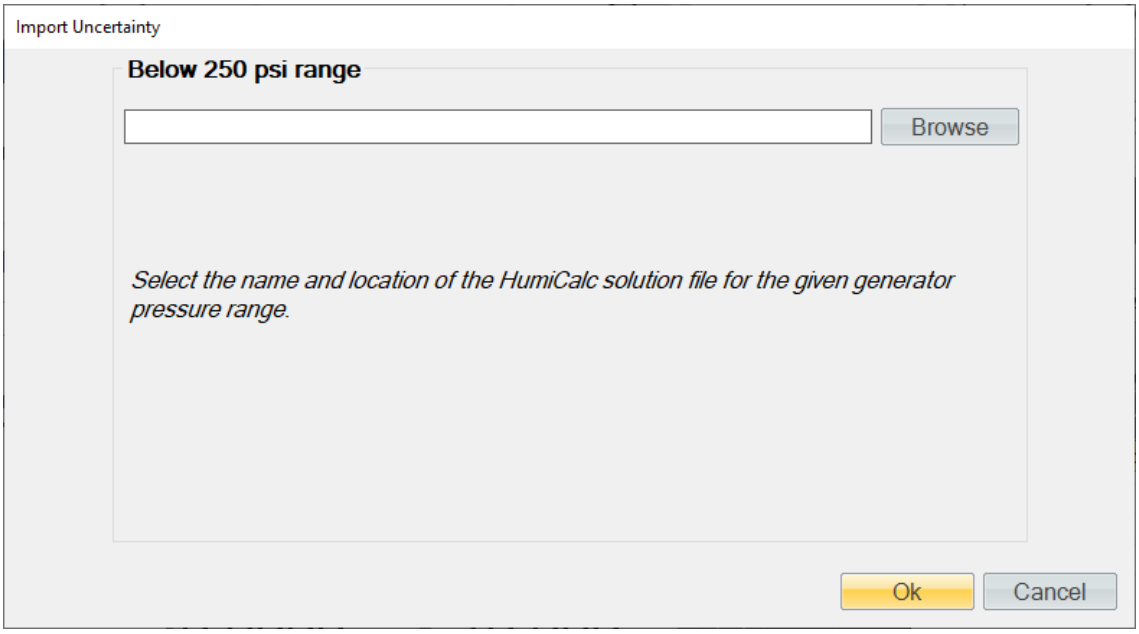
All the other tabs require "Admin" access level and changes should only be made upon request by Thunder Scientific Technical Support.

4.1.7.5 Expanded Parameters

The Expanded Parameters command opens a second tab in the Parameter Tab Group with additional generator parameters used for technical support. This tab does not need to be opened during normal operation but can be used to help diagnose problems when requesting technical support. This tab will automatically be displayed when operating the generator under the "Admin" access level.

4.1.7.6 Import Uncertainty Solution (Requires Manager Access Level or above)

The Import Uncertainty Solution file command allows a manager to import a HumiCalc with Uncertainty solution into ControLog to define the uncertainty for the Model 3920 low humidity generator. Selecting this command will open an "Import Uncertainty" dialog that will step the user through the import process. Refer to your HumiCalc with Uncertainty Reference Manual for more information on creating uncertainty solutions.



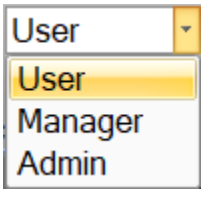
Clicking the "Browse" button will open a file dialog that will allow the user to browse to the desired location for the solution file to open. Once a file has been selected, clicking the "Ok" button will complete the import process and may display a status dialog as the solution is imported into ControLog.

4.1.7.7 HumiCalc with Uncertainty

The HumiCalc with Uncertainty command opens the standalone HumiCalc with Uncertainty application. It is recommended to use the USB keyboard when working with the HumiCalc with Uncertainty application.

4.1.7.8 Access Control

The Access Control Menu allows the user to change the access level. The user can select between User, Manager, and Admin



4.1.7.8.1 User Access Level

The User Access Level is default level and allows the user to run the generator, calibrate the generator, but does not give access to change system parameters, edit calibration coefficients or open interface console. No password is required for this level

4.1.7.8.2 Manager Access Level

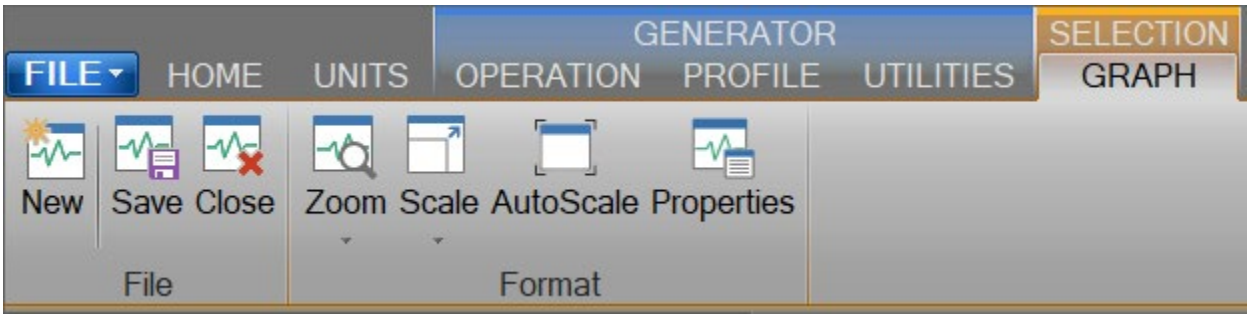
The Manager Access Level is one level above the user level and allows the user to run the generator, calibrate the generator, edit calibration coefficients but does not give access to change system parameters or open interface console. A password is required for this level. The passwords are located on the yellow product key flyer delivered with the generator.

4.1.7.8.3 Admin Access Level

The Admin Access Level gives the user full access to run the generator, calibrate the generator, edit calibration coefficients, change system parameters and open interface console. This level is intended for factory support and should not be used regularly by the user of the 3920. A password is required for this level. The passwords are located on the yellow product key flyer delivered with the generator.

4.1.8 Graph Menu Tab

The Graph Menu Tab allows the user to create a New graph, Save, Close, Zoom, Scale, Auto Scale and set the Properties for the selected graph. The graph menu tab is part of the selection group which changes based on what data, graph or parameter tab is selected. The Graph Menu Tab will only operate on the currently selected graph tab.



For more information, refer to section 7 Graphing.

4.1.8.1 New Graph

The New graph command allows the user to create a new graph. Selecting this command will open a New Graph Wizard dialog that will step the user through the selection process of what data the user would like to include in the new graph. This operation is always available.

4.1.8.2 Save Graph

The Save graph command allows the user to save the selected graph. Selecting this command will open a save file dialog that will allow the user to specify the name and browse to the desired location to save the file. ControLog graphs can be saved in following graphic file types:

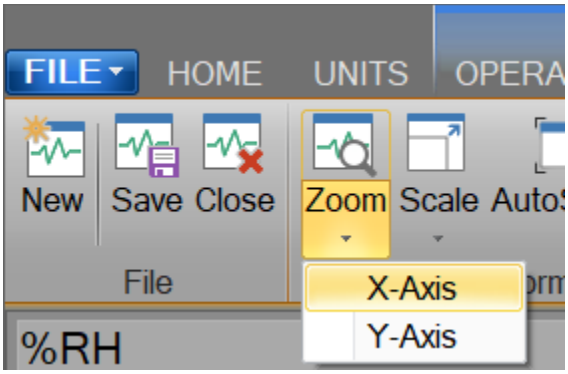
- Bitmap (*.bmp)
- Graphics Interchange Format (*.gif)
- Joint Photographic Experts Group (*.jpg)
- W3C Portable Network Graphics (*.png)
- EMF Enhanced Metafile Format (*.emf)

4.1.8.3 Close Graph

The Close graph command allows the user to close the selected graph. Selection will result in a confirmation message to assure the user wants to close the graph.

4.1.8.4 Zoom Graph

The Zoom graph command allows the user to zoom a rectangular area of the graph. Selecting this command allows the user to create a rectangular area on the graph that will be zoomed.



4.1.8.4.1 Zoom Graph's X Axis

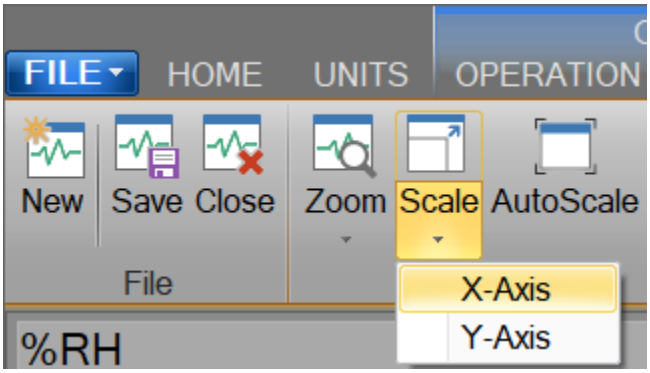
The Zoom X Axis graph command allows the user to zoom along the X Axis of the graph. Selecting this command allows the user to create a sectioned area on the graph that will be zoomed along the X Axis.

4.1.8.4.2 Zoom Graph's Y Axis

The Zoom Y Axis graph command allows the user to zoom along the Y Axis of the graph. Selecting this command allows the user to create a sectioned area on the graph that will be zoomed along the Y Axis.

4.1.8.5 Scale Graph

The Scale graph command allows the user to scale both the X and Y axis. Selecting this command allows the user to use the scale using a touch or mouse gesture. Dragging the cursor up, scales the display in (zooms in) and dragging the cursor down, scales the display out (zoom out).



4.1.8.5.1 Scale Graph X-Axis

The Scale X-Axis graph command allows the user to scale the X axis. Selecting this command allows the user to use the scale using a touch or mouse gesture. Dragging the cursor up scales the X-Axis in (zooms X-Axis in) and dragging the cursor down scales the X Axis out (zooms X-Axis out).

4.1.8.5.2 Scale Graph Y-Axis

The Scale Y-Axis graph command allows the user to scale the Y axis. Selecting this command allows the user to use the scale using a touch or mouse gesture. Dragging the cursor up scales the Y-Axis in (zooms Y-Axis in) and dragging the cursor down scales the Y Axis out (zooms Y-Axis out).

4.1.8.6 Auto Scale

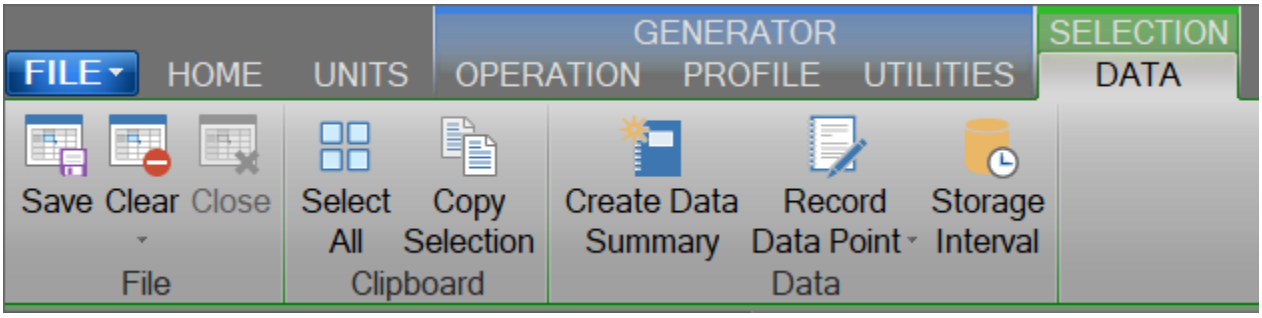
The Auto Scale graph command allows the user to reset the graph view to encompass all data. Selecting this command will automatically reset both axis of the graph so that the entire data set of each item is contained within the boundaries of the graph.

4.1.8.7 Graph Properties

The Graph Properties graph menu command allows the user to modify the properties of the selected graph. Selecting this command opens the Graph Properties dialog that allows the user to make changes to what data is graphed, the display properties for each line and the axis values.

4.1.9 Data Menu Tab

The Data Menu Tab allows the user to Save, Clear, Close, Select, Copy, Create and change the Storage Interval. The data menu tab is part of the selection group which changes based on what data, graph or parameter tab is selected. The Data Menu Tab will only operate on the currently selected data tab.



For more information, refer to section 8 Data and Data Summary

4.1.9.1 Save Data

The Save data command allows the user to save the selected data tab. Selecting this command will open a save file dialog that will allow the user to specify the name and browse to the desired location to save the file. ControLog can save data in the following type and format:

- Comma-Separated Values (*.csv)
- Text File (Comma Delimited) (*.txt)
- Text File (Tab Delimited) (*.txt)
- Excel Workbook (*.xlsx)
- Excel 97-2003 Workbook (*.xls)

4.1.9.2 Clear Data

The Clear data command allows the user to clear the selected data tab. ControLog will ask the user to save any unsaved data tab before the tab is cleared. This operation is available only when at least one data point has been recorded in the selected data tab.

4.1.9.3 Close Data

The Close data command allows the user to close the selected data tab. ControLog will ask the user to confirm before closing the tab and any unsaved data tab will also prompt the user to save the data before the tab is closed. This operation is available only when the device for the selected data tab is disconnected.

4.1.9.4 Select All Data

The Select All data command allows the user to select all the data within a data tab.

4.1.9.5 Copy Selection

The Copy Selection command allows the user to copy the selected data within a data tab to the clipboard. Selecting this command will copy the selected data within a data tab to the clipboard in a tab delimited format. This data may then be pasted into another program.

4.1.9.6 Create Data Summary

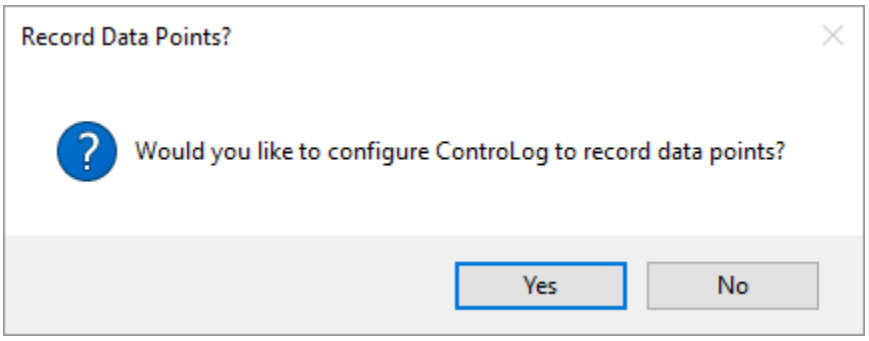
The Create Data Summary data command allows the user to create a summary of any currently opened data. The feature lets the user specify what items from which device and at what intervals to include in the data summary. The data summary can also calculate error between the specified standard and the device under test. This operation is available whenever there is an open Data tab that contains data.

For more information, refer to section 8 Data and Data Summary

4.1.9.7 Record Data Point

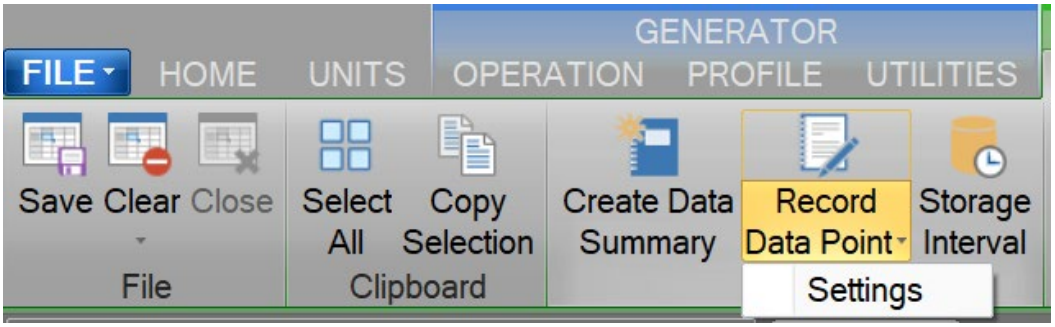
The Record Data Point data command is the same as the one on the Home tab. It allows the user to record certain data items from any currently connected device either manually, with each manual device entry or at the completion of each soak phase in an auto profile. The user can specify the number of prior data points to include and has the option to automatically calculate average and or standard deviation of the prior data points. There are two submenus for this menu command; Settings and Take Point. This operation is available whenever device or generator data is being logged. The user can manually take a point using the button or by using the keyboard shortcut "Ctrl-P".

If the user has not configured the system to record data points, then ControLog will ask the user if they would like to define the settings before taking a point.



4.1.9.7.1 Settings

The Settings submenu allows the user to define which data items and from which connected device they would like to record when a point is taken. They can also define the number of points prior to include and whether to calculate average and or standard deviation. The user can also configure when to take points, either manually, at the end of a profile soak phase or when a manual device entry is taken.



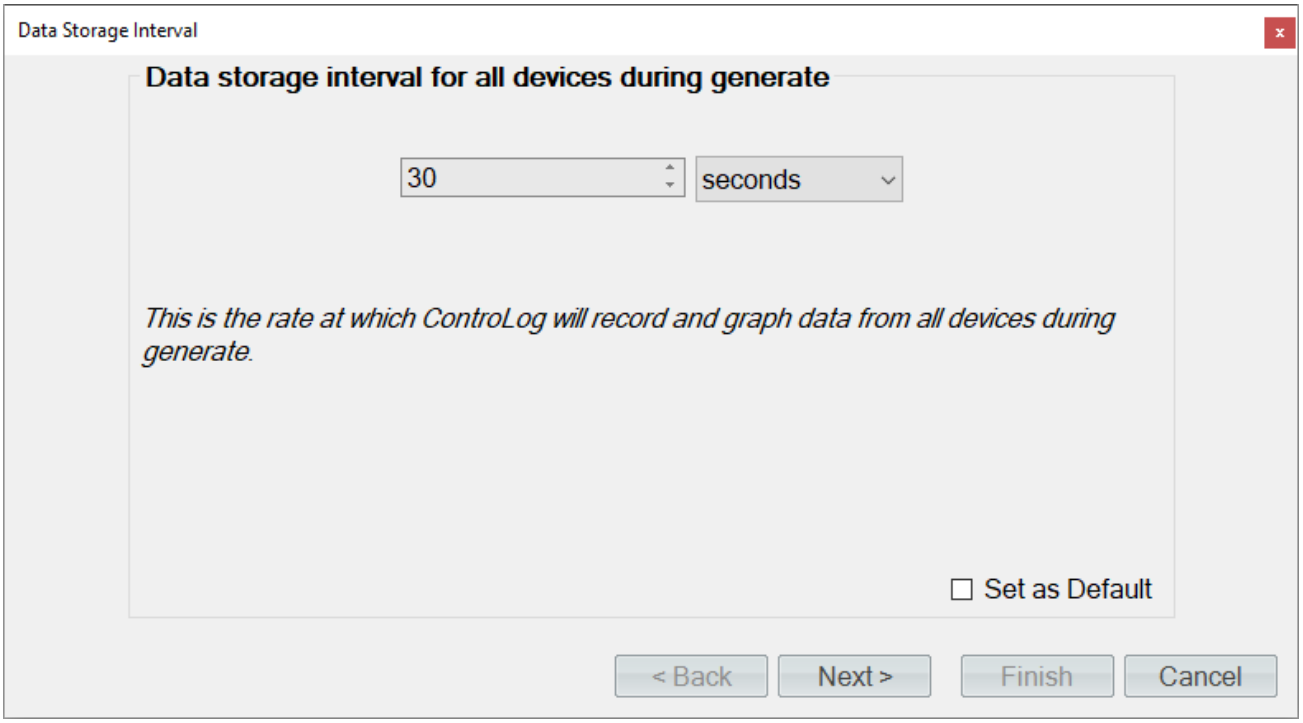
For more information, refer to section 8 Data and Data Summary

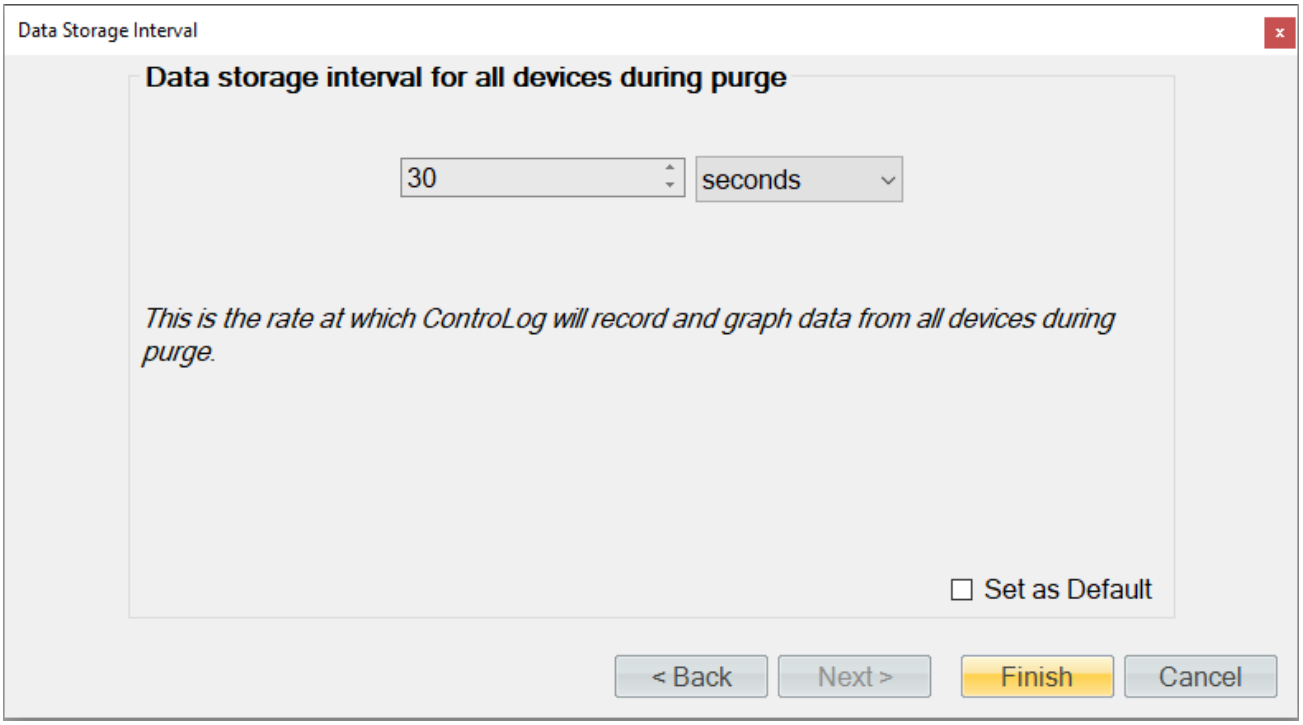
4.1.9.8 Data Storage Interval

The Data Storage Interval data command allows the user to change the storage interval that data is recorded. This is the rate at which data is recorded to the data tabs for all connected devices. Selecting this command will open the "Data Storage Interval" dialog that will allow the user to change the data storage interval during both purge and generate operations. If the "Set as Default" is checked, the new value will become the default start up interval. If not checked, the new value will only affect the current session.

⚠ IMPORTANT!

STORING AND MAINTAINING DATA CAN BECOME A TIME-CONSUMING PROCESS. THE MORE DATA THAT IS STORED IN THE DATA TAB, THE SLOWER AND LESS RESPONSIVE THE COMPUTER MAY SEEM. FOR THIS REASON, SOME CONSIDERATION SHOULD BE GIVEN TO THE AMOUNT OF DATA DESIRED, THE OVERALL TIME SPAN OF THE DATA (I.E. HOURS, POSSIBLY DAYS), AND ULTIMATELY THE DATA INTERVAL.

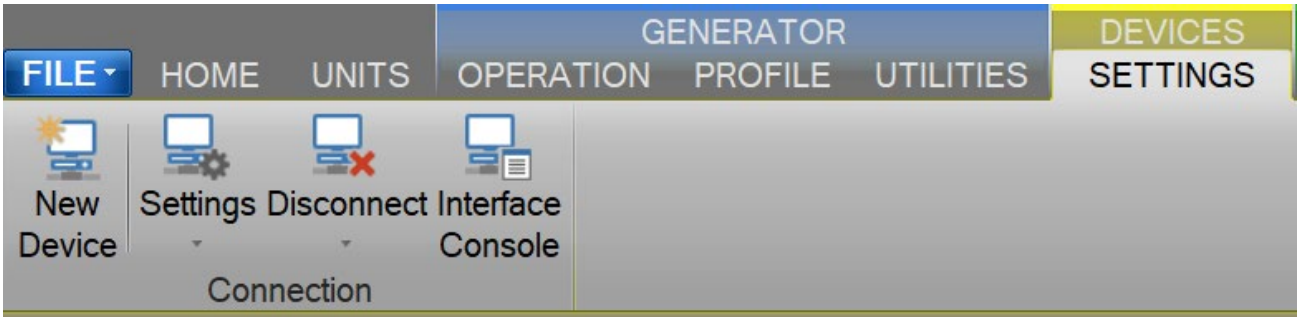




Note - *Data is only recorded while the 3920 is in purge or generate mode.*

4.1.10 Device Settings Menu Tab

The Settings Menu Tab allows the user to change the settings of a device connection, disconnect a device connection and open an interface console to view communication with a device.



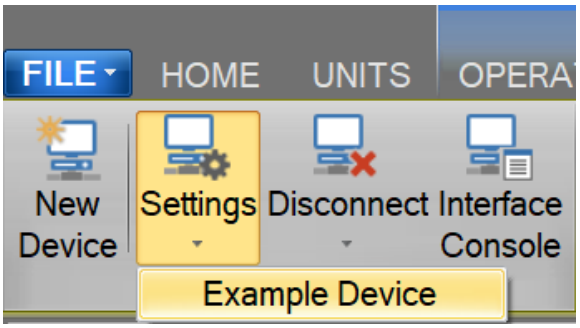
4.1.10.1 New Device

The New Device connection command allows the user to create a new device connection. Selecting this command will open a Connection Wizard dialog that will step the user through the process of creating a new connection to a device.

For more information, refer to section 10 Connections

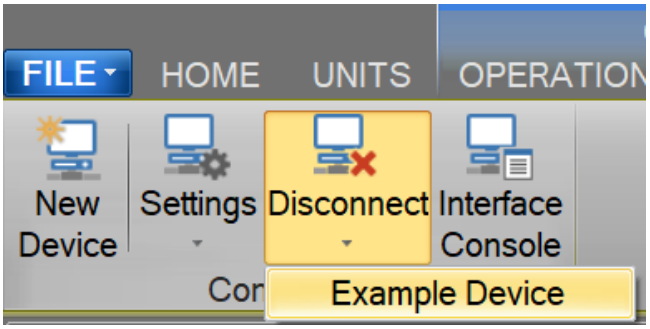
4.1.10.2 Settings

The Settings connection menu command allows the user to change the settings for a specific connection. Selecting this command will open the Connection Wizard dialog for the selected connection, allowing the user to change connection settings as desired.



4.1.10.3 Disconnect

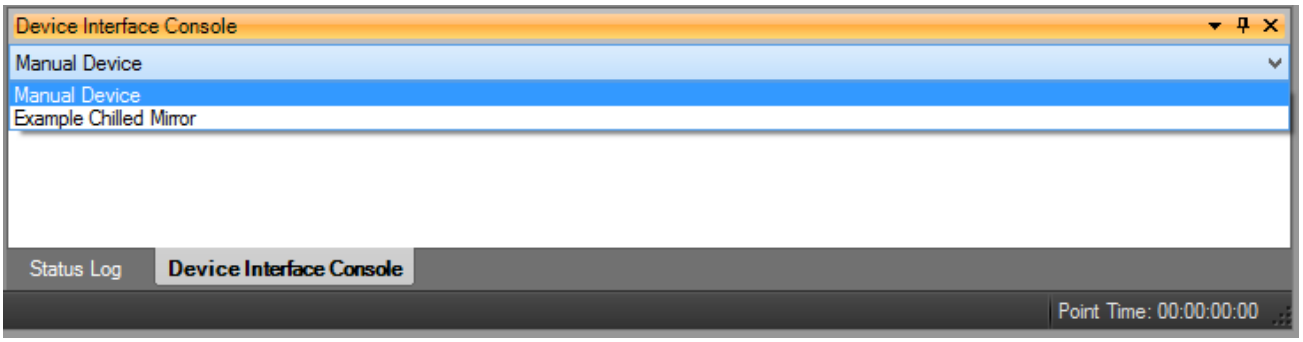
The Close connection menu command allows the user to close a specific connection. ControLog will ask the user to confirm before closing the connection.



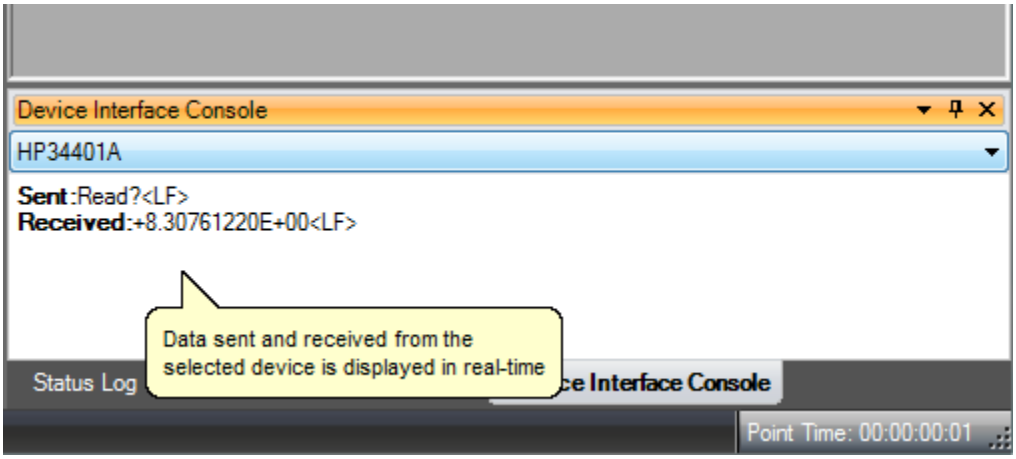
4.1.10.4 Interface Console

The Open Device Interface Console connection menu command under Settings allows the user to open a device console tab. The device console tab allows the user to view the commands being sent to and received from any given connected device.

The user can select which connected device to view using the drop-down selection at the top of the tab.

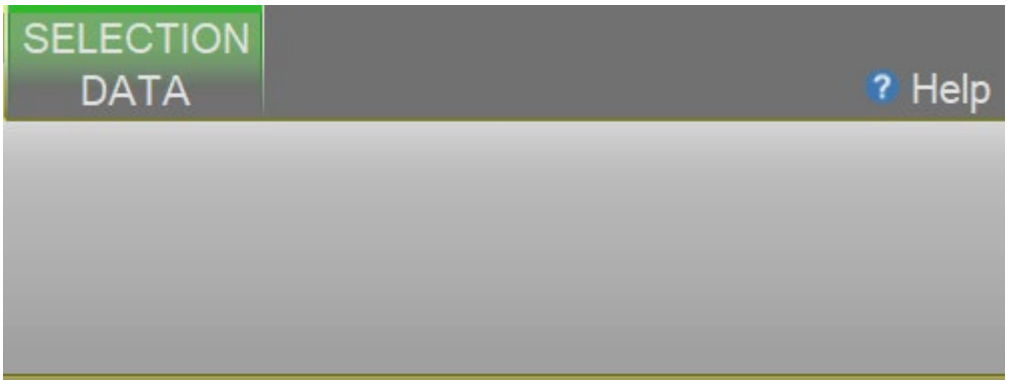


The data sent to and received from the selected device is displayed in the lower text area of the console tab.



4.1.11 Help

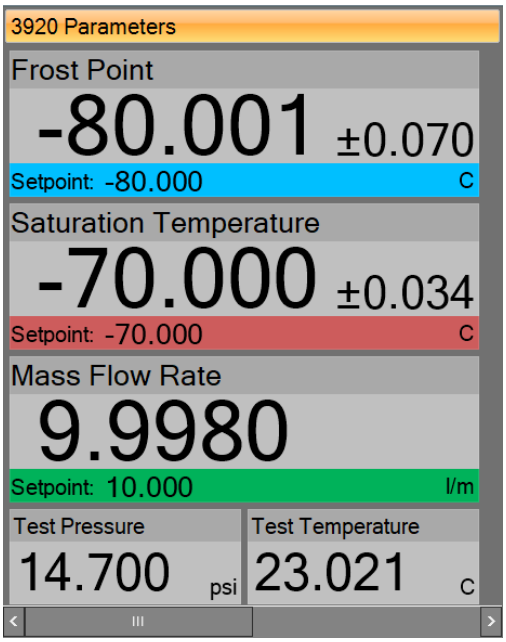
The Help Menu located on the right side of the ribbon menu, allows the user to open the 3920 System Manual (this document).



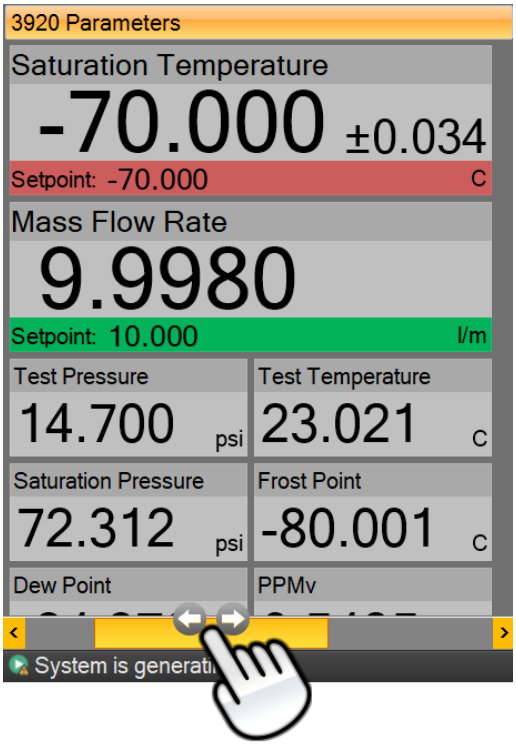
> **Note –** *Refer to the Thunder Scientific website (www.thunderscientific.com) for the latest manual edition and other information on your Model 3920 Low Humidity System.*

4.2 PARAMETERS TAB GROUP

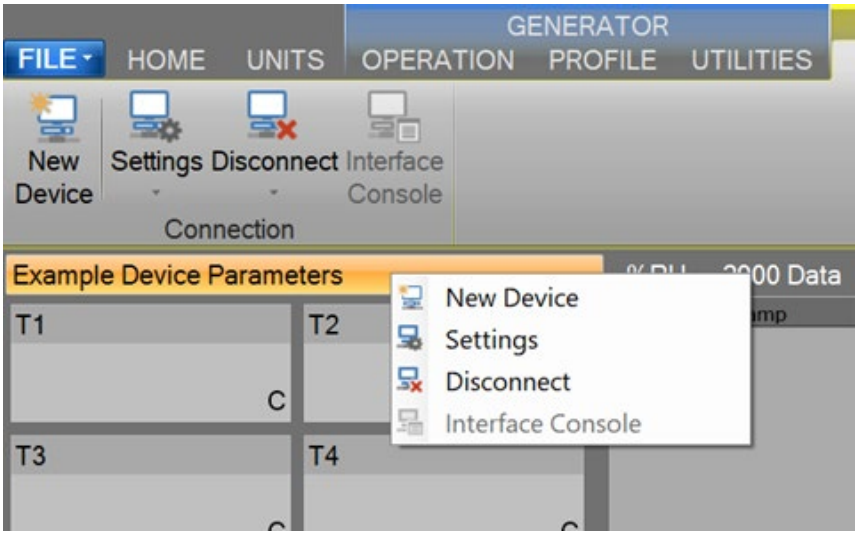
The Parameter Tab Group is located on the left side of the application and contains a parameter tab for each connected device. Each parameter tab displays the current data for its device and a parameter tab can be selected using the scroll bar at the bottom of the group.



If multiple parameter tabs are open the user can accessed other tabs using the scroll bar at the bottom of the group.

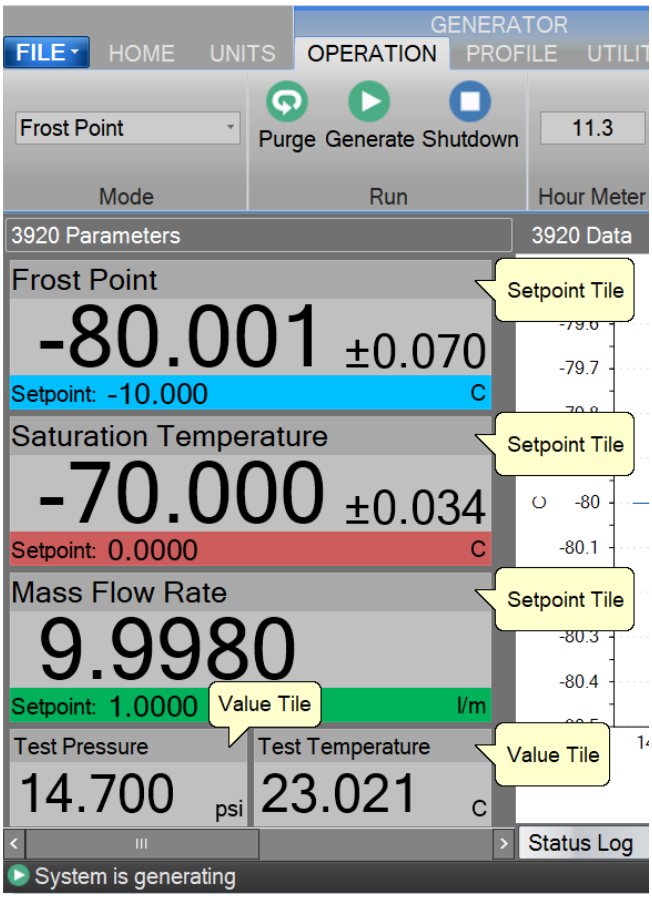


All Device Parameter Tabs have a context menu that can be displayed by long pressing the tab title area or by right clicking in the tab area. The context menu allows quick access to the device related functions that are available in the Settings Menu Tab.



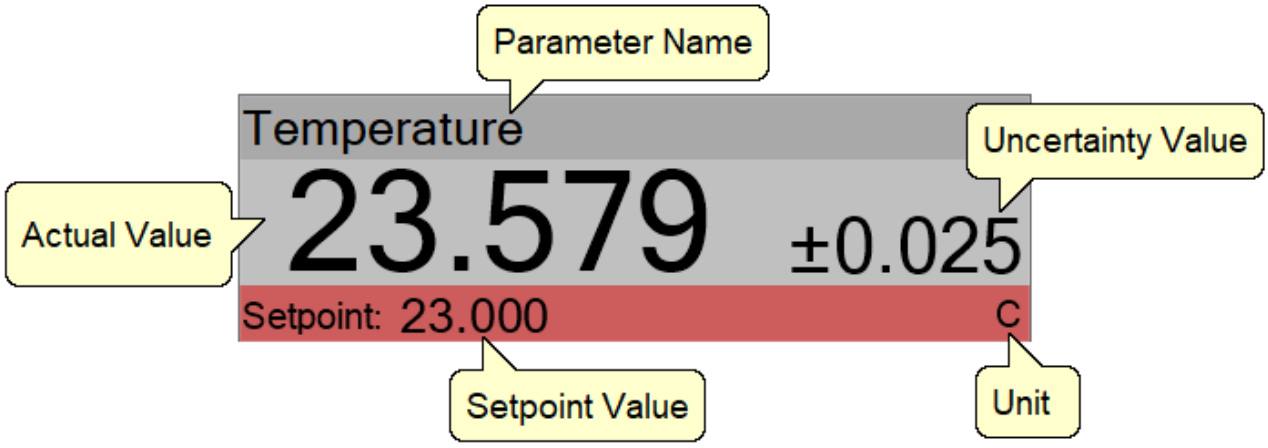
4.2.1 Tiles

Within each parameter tab area are tiles that allow the user to set setpoints, view actual values, and view real-time uncertainty values. There are two different tiles; a Setpoint Tile and a Value Tile.



4.2.1.1.1 Setpoint Tile

The Setpoint Tiles allow the user to control the operation of the humidity generator by changing the desired setpoint that the generator will control to. The Tiles contain 5 key parts; a header with the Parameter Name, the Actual Value, the real-time Uncertainty Value, the Setpoint Value and the Unit the values are displayed in.

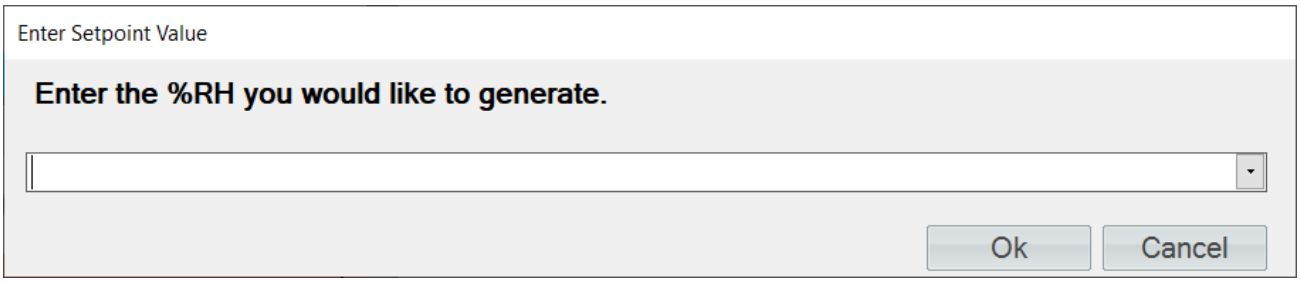


Note – *The Actual Value for the blue humidity Setpoint Tile is not shown when purging.*

Note – *The real-time uncertainty can be turned off by setting the USER[12] "HumiCalc, k" system parameter to zero. Refer to section 2.13.7 for an example on how to set a user system parameter.*

4.2.1.1.1.1 Changing Setpoints

To change a setpoint, click on the setpoint tile that you would like to change. A setpoint entry box will appear. For example, to change the Percent Relative Humidity setpoint click on the %RH setpoint tile.

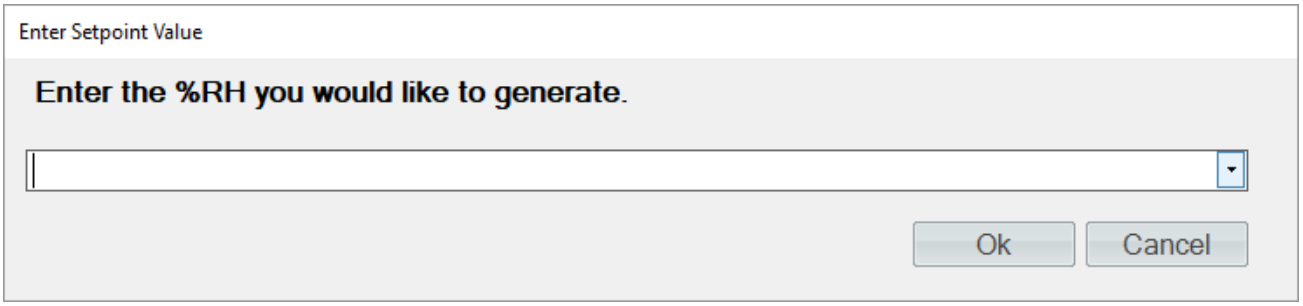


Enter the new value into the Setpoint Entry box and select Ok. Notice that the Percent Relative Humidity setpoint value updates to the new value and the actual values begin moving toward the new setpoint.

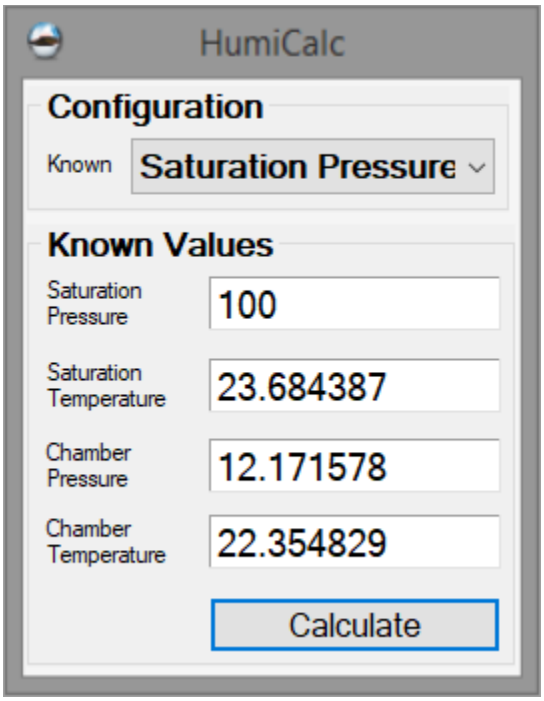
The user can also pop-up a mini version of HumiCalc to help calculate the desired setpoint by clicking the drop-down arrow on the setpoint entry box.

For example, let's say the user wants to calculate the lowest %RH achievable given a limited supply pressure of only 100 psi.

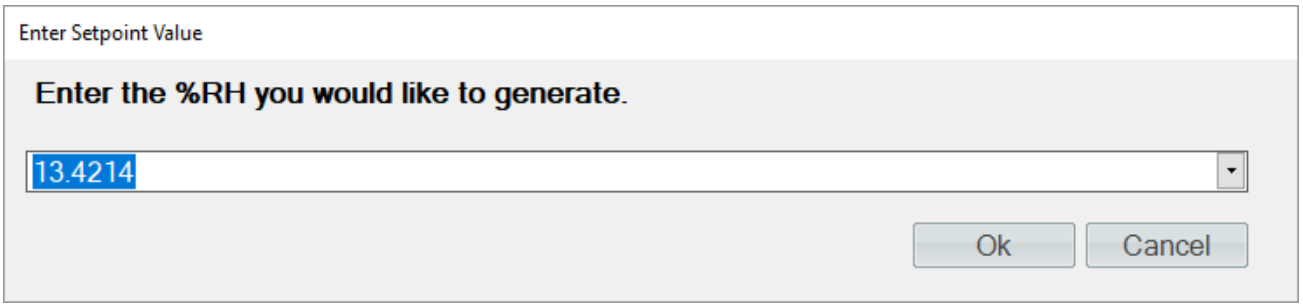
Start by opening the HumiCalc pop-up using the drop-down arrow at the right of the setpoint entry box.



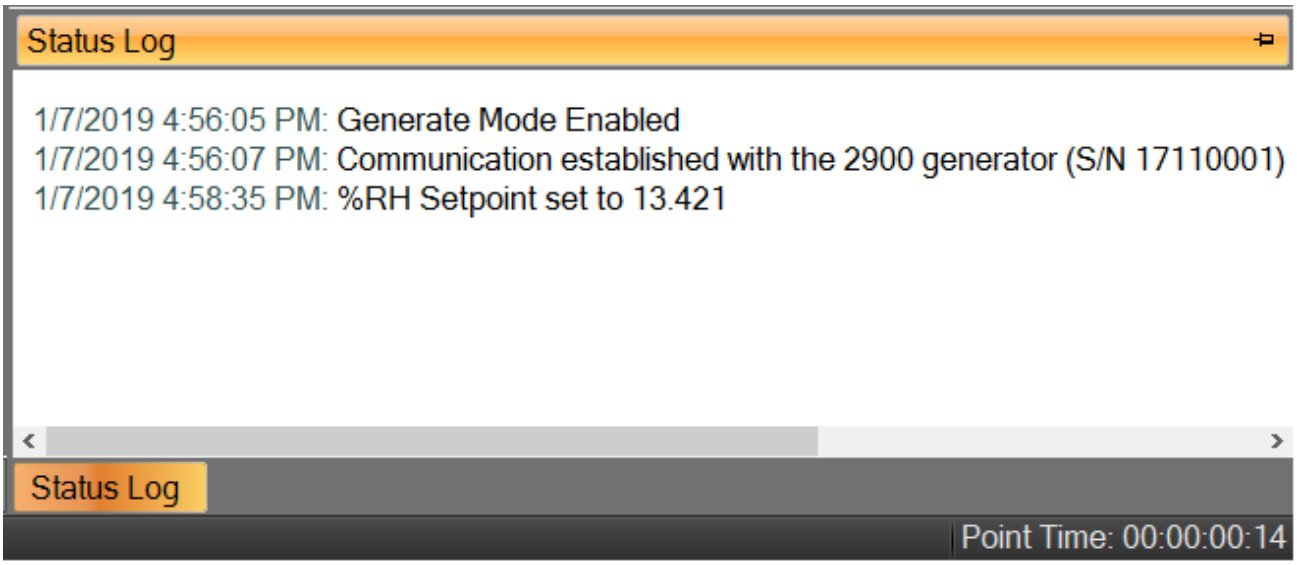
Next, select the known to be Saturation Pressure and enter the 100 psi supply pressure max.



Clicking the “Calculate” button will result in the calculated %RH based on the 100 psi limit being placed in the Setpoint Entry Box and will close the HumiCalc pop-up.

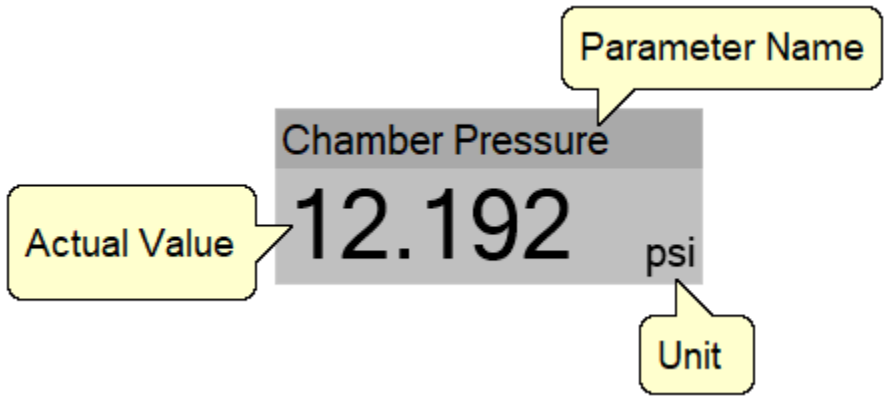


Clicking “Ok” will close the setpoint entry and will send the setpoint to the Model 3920 Low Humidity generator.



4.2.1.1.2 Value Tile

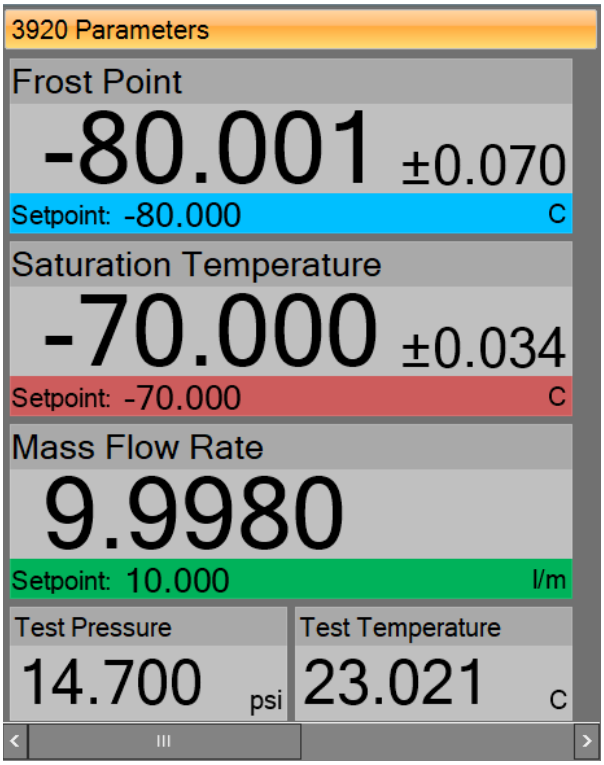
The Value Tiles display an actual value of a given parameter to the user. The Tiles contain 3 key parts; a header with the Parameter Name, the Actual Value and the Unit the value is displayed in.



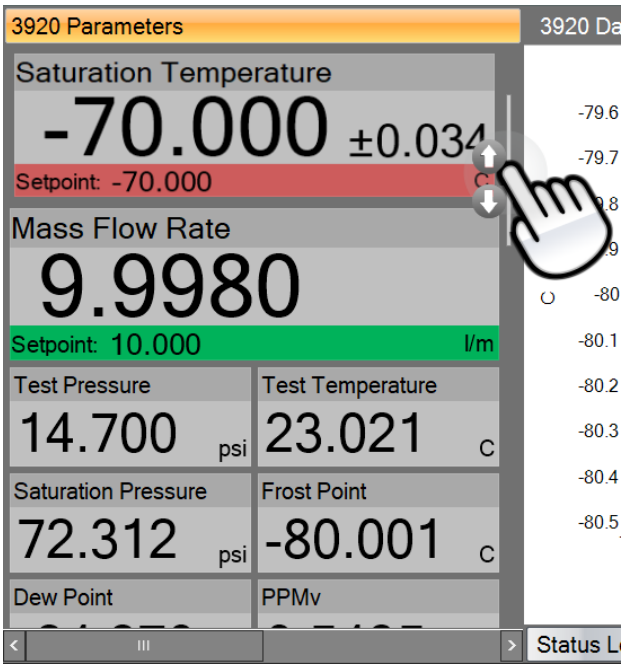
Note – *The Actual Value for a humidity Value Tile is not shown when purging.*

4.2.2 3920 Parameter Tab

The 3920 Parameters contain all the control and measurement parameters critical to the operation of the humidity generator.



The 3920 Parameters can be scrolled up and down to show the currently generated humidity in different humidity terms that are calculated using the HumiCalc with Uncertainty engine, along with other values that are important to the operation of the 3920 generator.



4.2.2.1 Actively Controlled Humidity

The first tile on the Control Parameters is the actively controlled humidity parameter. For instance, if ControLog were set to control the generator on dew point, then Dew Point would be listed as the first parameter rather than Frost Point.

This setpoint controls the humidity being generated.

4.2.2.2 Saturation Temperature

Saturation Temperature is the temperature reading of the saturator temperature probe (RTD1).

This setpoint controls the fluid system temperature within the system while purging or generating.

For more information, refer to section 3 Principle of Operation

4.2.2.3 Mass Flow Rate

Mass Flow Rate is the mass flow reading of the flow meter (T4). This is the actual flow of the air supply entering the Pre-Saturator and is an indication of the total flow through the system once the saturation and chamber pressure have stabilized.

The Mass Flow Rate setpoint controls the mass flow rate of the system.

4.2.2.4 Test Pressure

Test Pressure is the pressure reading of the chamber pressure transducer (T2).

For more information, refer to section 3 Principle of Operation

4.2.2.5 Test Temperature

Test Temperature is the temperature reading of the test temperature probe (RTD2).

For more information, refer to section 3 Principle of Operation

4.2.2.6 Saturation Pressure

The Saturation Pressure is the pressure reading of the saturator pressure transducer (T1).

For more information, refer to section 3 Principle of Operation

4.2.2.7 Frost Point

Frost Point Temperature is the temperature to which a gas must be cooled in order to just begin condensing water vapor in the form of frost or ice, and therefore only exists at values below 0.01 °C. When operating the system with indicated Frost Points above 0.01 °C, the values indicated are to be interpreted as Dew Points. However, Frost Point is not the same as Dew Point for values below freezing. Frost Point is independent of test chamber temperature.

4.2.2.8 Dew Point

Dew Point Temperature is the temperature to which a gas must be cooled in order to just begin condensing water vapor in the form of dew. Generally, Dew Point exists at temperatures above freezing. In many instances, Dew Point may actually exist at indicated values below freezing (super-cooled dew). However, it is important to note that Dew Point is not the same as Frost Point. Dew Point is independent of test chamber temperature.

4.2.2.9 PPMv

Parts per Million by Volume is a ratio of the number of molecules of water vapor to the number of molecules of the other constituents in the gas. Once established, PPMv is pressure and temperature insensitive, and is therefore independent of test chamber temperature and test chamber pressure.

4.2.2.10 PPMw

Parts per Million by Weight is a ratio of the weight of the water vapor in a sample to the weight of the remaining constituents in the gas. Once established, PPMw is pressure and temperature insensitive, and is therefore independent of test chamber temperature and test chamber pressure.

4.2.2.11 %RH

Percent Relative Humidity (%RH) is the ratio of the amount of water vapor in a given sample to the maximum amount possible at the same temperature and pressure. %RH is calculated at the chamber pressure and chamber temperature relative to the saturation pressure and saturation temperature. This is the most accurate calculation of %RH at the point in the immediate vicinity of the chamber temperature probe. Placing the chamber temperature probe at the humidity sensing point of the devices under test gives the actual value of the relative humidity being imposed on the devices, as it is dependent on both pressure and temperature.

4.2.2.12 Grains/lb

Grains per pound is a ratio of the weight, in grains, of water vapor to the weight, in pounds, of the other constituents in the gas. (7000 grains = 1 pound). Once established, Grains/lb is pressure and temperature insensitive, and is therefore independent of test chamber temperature and test chamber pressure.

4.2.2.13 Enthalpy

Enthalpy is a measure of the amount of energy required to change a gas from one temperature/humidity value to another. In application, enthalpy is not used as an absolute value, but rather it is the difference in enthalpy between two distinct points which are of interest. The datum point which results in zero enthalpy was therefore arbitrarily chosen at a test temperature of 0 °C and 0 %RH. Applying enthalpy is a matter of computing the difference in enthalpy between two or more distinct data points.

4.2.2.14 SVP@Tt

Saturation Vapor Pressure (SVP) computed at the Test Temperature.

4.2.2.15 SVP@Td

Saturation Vapor Pressure (SVP) computed at the Dew/Frost Point Temperature.

4.2.2.16 SVP@Ts

Saturation Vapor Pressure (SVP) computed at the Saturation Temperature.

4.2.2.17 F@Tt.Pt

Enhancement Factor at Test Temperature and Pressure.

4.2.2.18 F@Td.Pt

Enhancement Factor at Dew/Frost Point Temperature and Test Pressure.

4.2.2.19 F@Ts.Ps

Enhancement Factor at Saturation Temperature and Pressure.

4.2.2.20 Specific Humidity

Specific Humidity is a ratio of the weight of the water vapor to the total weight of the humidified gas. Specific Humidity is independent of test chamber temperature.

4.2.2.21 Absolute Humidity

Absolute Humidity is the weight of the water vapor per unit volume of humidified gas.

4.2.2.22 Dry Air Density

Dry Air Density is the *partial* density in weight per unit volume of only the dry air portion of a moist air sample. In other words, if the water vapor were removed from a fixed volume of air, the remaining dry air would exhibit this density.

4.2.2.23 Moist Air Density

Moist Air Density is the total weight per unit volume of a moist air sample. This density includes both the weight of the air and the weight of the water vapor.

4.2.2.24 Wet Bulb Temperature

Wet Bulb temperature is used in wet bulb/dry bulb aspirated Psychrometry, and is the temperature measured by a temperature probe whose tip is coated with water (typically by being covered with a wet sock). When aspirated at a constant air velocity, the wet bulb will cool due to evaporation of the water from the probe. The cool temperature, to which it equilibrates, is used in the calculation of humidity parameters.

4.2.2.25 Mixing Ratio by Volume

Mixing Ratio by Volume is a ratio of the partial pressure of the water vapor to the partial pressure of the remaining constituents in the sample. Mixing Ratio by Volume is independent of test chamber temperature.

4.2.2.26 Mixing Ratio by Weight

Mixing Ratio by Weight is a ratio of the weight of the water vapor to the weight of the remaining constituents in the sample. Mixing Ratio by Weight is independent of test chamber temperature.

4.2.2.27 Percent by Volume

Percent by Volume is a ratio (expressed as a percentage) of the partial pressure of the water vapor to the total pressure of the sample. Percent by Volume is independent of test chamber temperature.

4.2.2.28 Percent by Weight

Percent by Weight is a ratio (expressed as a percentage) of the weight of the water vapor to the total weight of the sample. Percent by Weight is independent of test chamber temperature.

4.2.2.29 Vapor Mole Fraction

Vapor Mole Fraction is the mole fraction of water vapor in a sample.

4.2.2.30 Dry Air Mole Fraction

Dry Air Mole Fraction is the mole fraction of the dry air portion of a sample. The dry air portion is considered to be all constituents in a gas exclusive of the water vapor.

4.2.2.31 Cabinet Temperature

Cabinet Temperature is the temperature reading of the cabinet temperature probe (RTD5).

4.2.2.32 Exp-Valve Temperature

The Exp-Valve Temperature is the temperature reading of the expansion valve probe (RTD3)

For more information, refer to section 3 Principle of Operation

4.2.2.33 Supply Pressure

Supply pressure is the pressure reading of the gas supply pressure transducer (T3). The supply pressure value is gauge pressure.

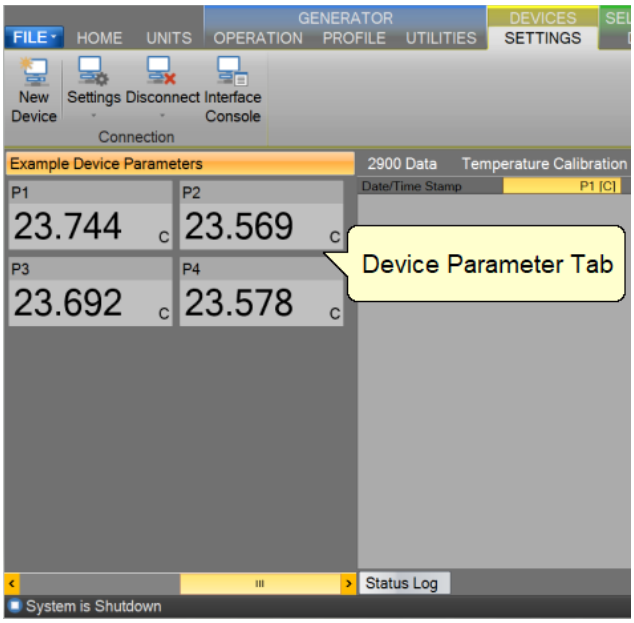
4.2.2.34 Water Capacity

Water capacity is an estimated percentage of water remaining in the system.

Refer to section 5 Water Capacity for detailed instruction on how to add water.

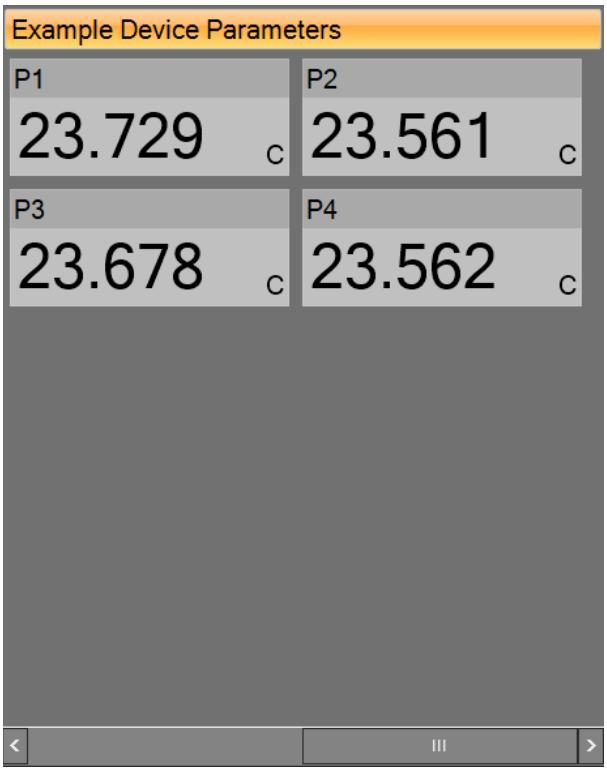
4.2.3 Device Parameter Tabs

The Device Parameter Tabs show the current actual values for the given device. The tabs are visible whenever the device is connected. The Device Parameters will display a scrollbar as needed to allow for varying display sizes without loss of data.



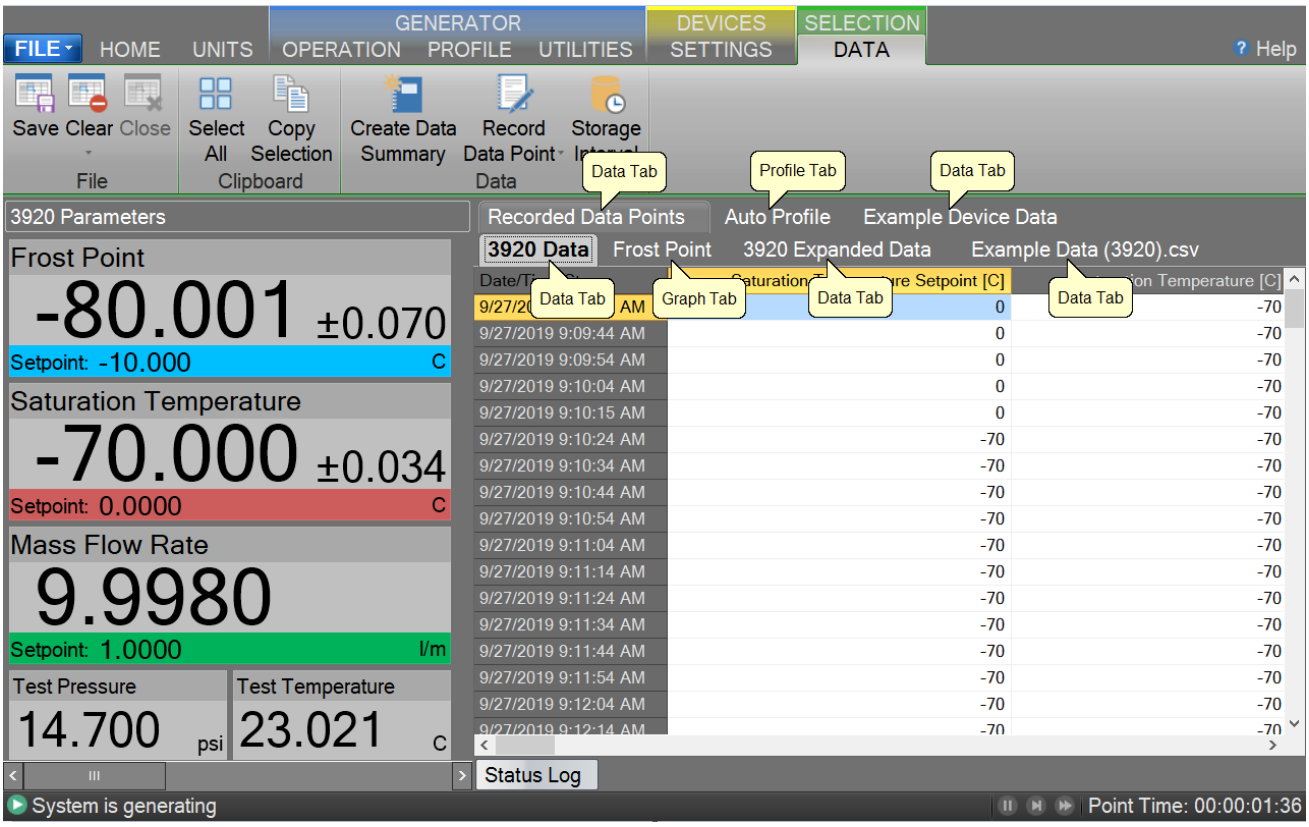
4.2.3.1 Device Parameters

Device Parameters contain all the most recent actual measurement parameters received from the device. Each parameter is displayed in a separate Value Tile.

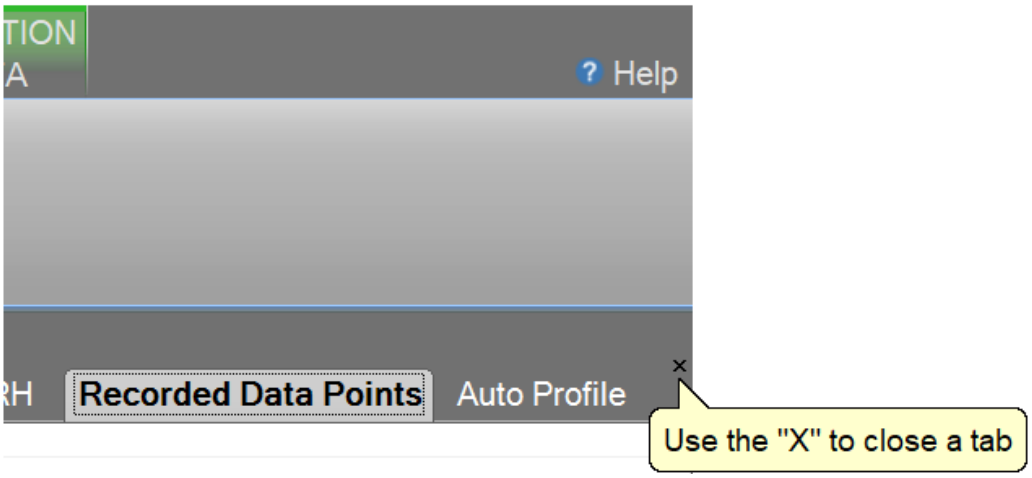


4.3 DATA AND GRAPH TAB GROUP

The Data and Graph Tab Group is located in the middle right of the application and can contain data, graph, and profile tabs. Data and Graph tabs are fixed tab style windows that can be selected by clicking the desired tab labels at the top.



In addition to using the “Close Data” command from the ribbon menu a Data and Graph Tab can be closed depending on the state of the device or generator using the “X” in the upper right-hand corner.



4.3.1 Data Tabs

Data Tabs contain a spreadsheet type view of the logged data.

For more information, refer to section 8 Data and Data Summary

4.3.2 Graph Tabs

Graph Tabs contain a pictorial view of the logged data.

For more information, refer to section 7 Graphing

4.3.3 Profile Tab

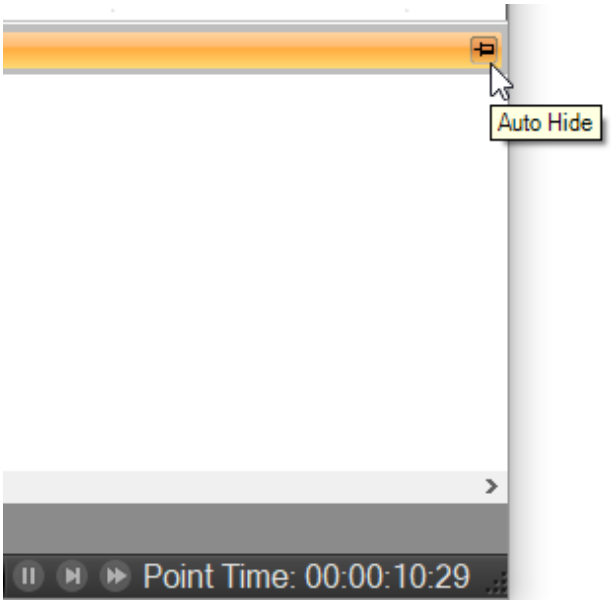
The Profile Tab contains the profile point definitions for an auto profile.

For more information, refer to section 9 Profiling

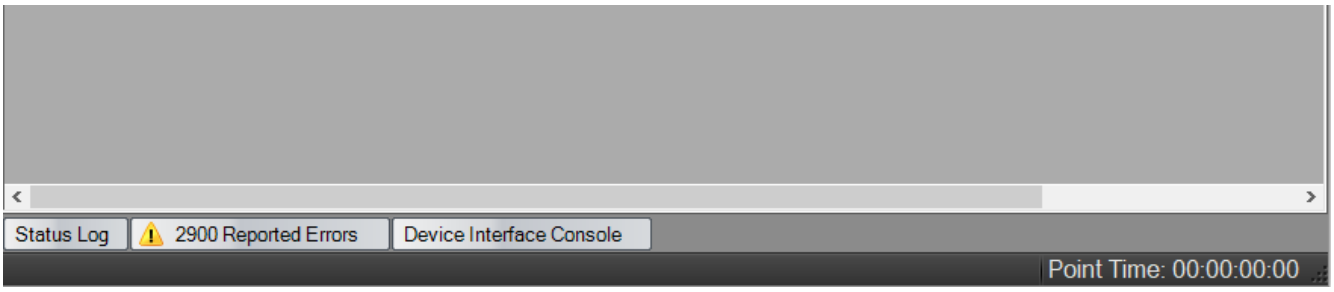
4.4 INFORMATION TAB GROUP

The Information Tab Group is located on the bottom right hand side of the application. This is a docking style window that can be “pinned” open or allowed to close when not active. An information tab is selected by clicking its tab label at the bottom of the group. The Information Tab Group contains status information about the operation of the generator and its connected devices. The group can consist of a Status Log tab, 3920 Reported Errors tab and a 3920 Interface Console tab.

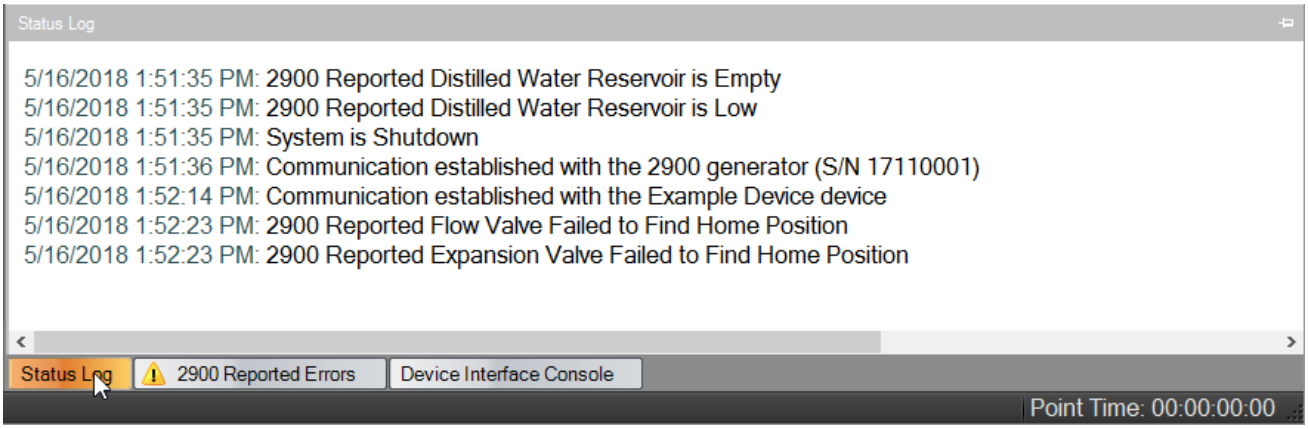
By clicking the pin icon on any information tab, the user can pin or unpin the Information tabs.



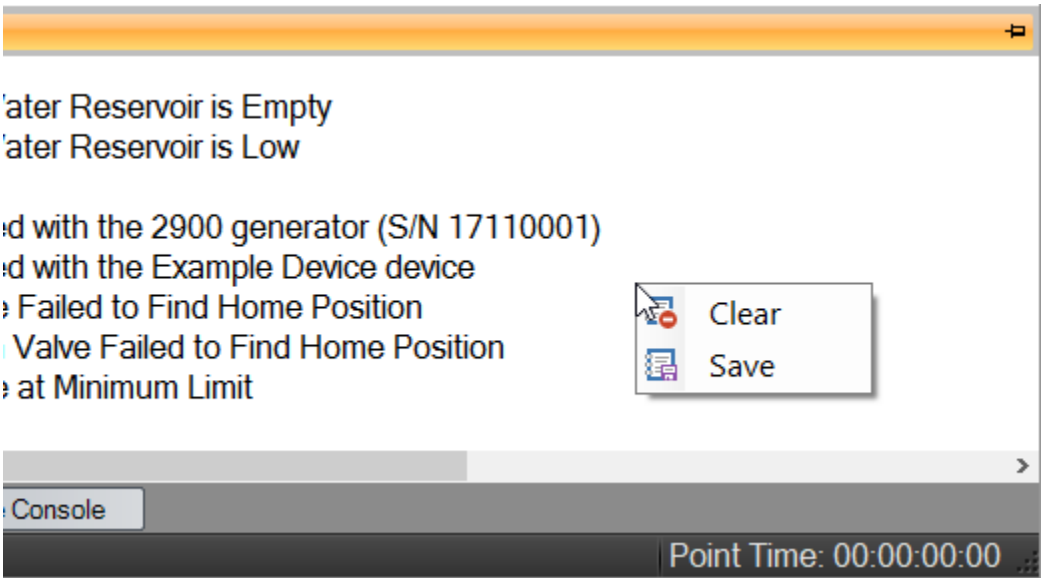
By default, the information tabs are unpinned, and they will automatically hide.



The user can access the hidden tabs by clicking the desired information tab label at the bottom.



All Information Tabs have a context menu that is displayed by long pressing or right clicking in the tab. The context menu allows quick access to functions that can clear and save the information.



4.4.1 Status Log

The Status Log tab contains chronological information about the system status, changes in operational modes, changes in setpoints, and runtime errors due to communication or mechanical difficulties encountered by the generator.



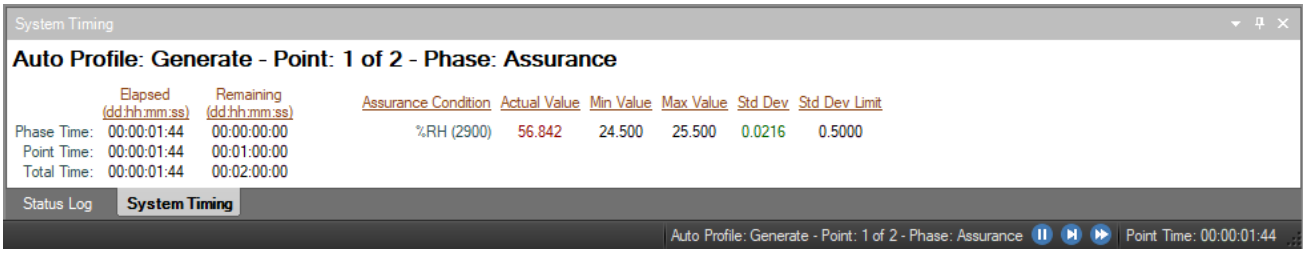
4.4.2 3920 Reported Errors

The 3920 Reported Errors tab only appears when the 3920 reports an error. This is a very important information tab because it reports 3920 system errors to the user. These types of errors can cause the 3920 to shutdown and require immediate attention by the operator. The  icon will be displayed to help draw the attention of the user to the reported 3920 errors.



4.4.3 System timing

The System Timing tab shows information about the current timing associated with the current operation such as elapsed run time at current conditions. This window may be shown at any time by clicking the "Point Time" in the status bar and is automatically shown when an Auto Profile is started. The tab gives detailed information on the Auto Profile as it runs. Elapsed and remaining Phase, Point and Total time are listed along with the detailed assurance conditions values and tolerances.



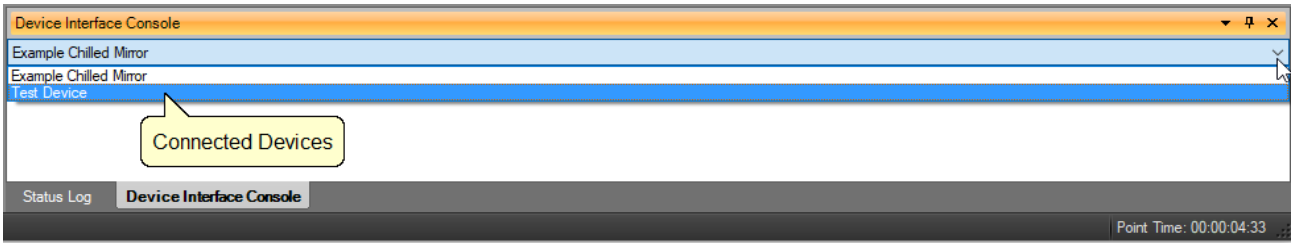
4.4.4 3920 Interface Console

The 3920 Interface Console tab allows the user to send and receive commands to and from the 3920. The console tab is opened by selecting "Interface Console" from the Utilities Menu Tab. This feature is intended for factory support and should not be used regularly by the user of the 3920.

4.4.5 Device Interface Console

The Device Interface Console tab allows the user to view the commands being sent to and received from any given connected device. The device console tab is opened by selecting “Interface Console” from the Settings Menu Tab whenever a device is connected.

The user can select which connected device to view using the drop-down selection at the top of the tab.



The data sent to the device is indicated by a bold “Sent:” label in the lower text area of the console tab.

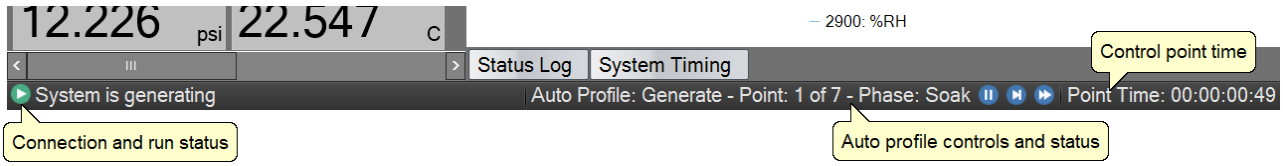


The data received from the device is indicated by a bold “Received:” label in the lower text area of the console tab.



4.5 STATUS BAR

The Status Bar is located on the bottom of the application window. The Status Bar displays the current Connection and Run Status of the generator, Auto Profile Controls and Status, and current Point Time.



4.5.1 Connection and Run Status

The Connection and Run Status is shown on the left-hand side of the status bar and gives the user a quick visual and textual reference to the current state of the Model 3920 Low Humidity generator. As new events are recorded into the Status Log, the event will be displayed for a short period of time in the status bar to inform the user of the new event.

4.5.1.1 Disconnected

The status bar will show an "unplugged" icon and "Disconnected" when the 3920 is not connected to ControLog.



4.5.1.2 Purging

The status bar will show a green circular arrow icon and "System is purging" when the 3920 is purging.



If the 3920 is reporting an error, the green circular arrow icon will also appear with a small yellow warning.



4.5.1.3 Generating

The status bar will show a green forward arrow icon and "System is generating" when the 3920 is generating.

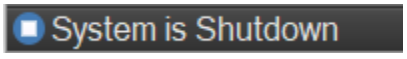


If the 3920 is reporting an error, the green forward arrow icon will also appear with a small yellow warning.



4.5.1.4 Shutdown

The status bar will show a blue stop icon and "System is shutdown" when the 3920 is shutdown.

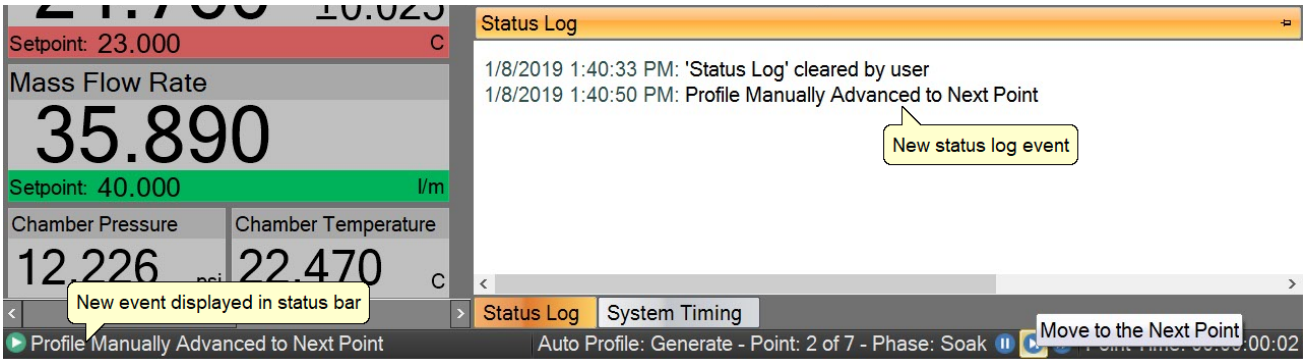


If the 3920 is reporting an error, the blue stop icon will also appear with a small yellow warning.



4.5.1.5 New Event

During any state, the most recent status log event will be shown briefly in the status bar.



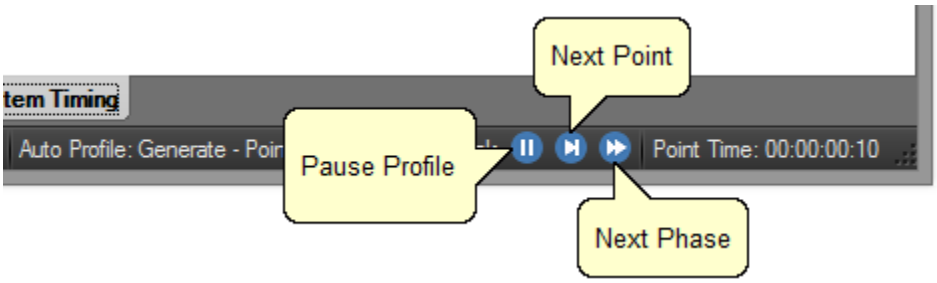
4.5.2 Auto Profile Controls and Status

The Auto Profile Controls and Status are shown on the right-hand side of the status bar and give the user quick control and status over a running profile. The Auto Profile consists of three status parts and three control parts.

For more information, refer to section 9 Auto Profiling

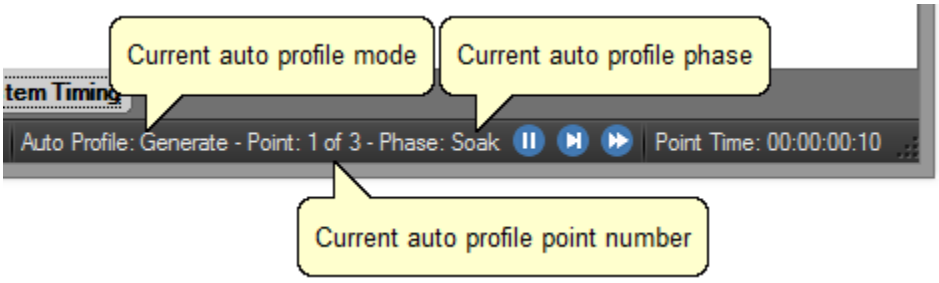
4.5.2.1 Auto Profile Controls

The Auto Profile controls consist of a “Pause” button, “Next Point” button and a “Next Phase” button.



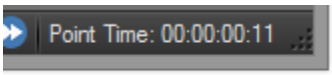
4.5.2.2 Auto Profile Status

The Auto Profile status consists of the generator “Run Mode” for the current profile point, the “Profile Point” the system is currently running and the “Phase” of the current point.

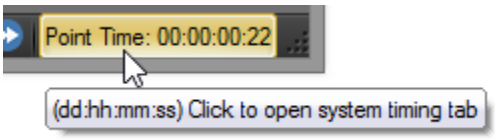


4.5.3 Current Point Time

The Current Point Time is shown on the right-hand side of the status bar and gives the user a quick display to the amount of time the system has been at point. Point Time is not the amount of time at setpoint but simply the amount of time since the last setpoint or mode change.



The user can click the point time to open the system timing tab.



4.5.4 Set Date and Time

The user can change the current system date and time through the status bar context menu.

> **Note** – *To avoid time stamp confusion only change the system date and time when the generator is shutdown and not recording data.*

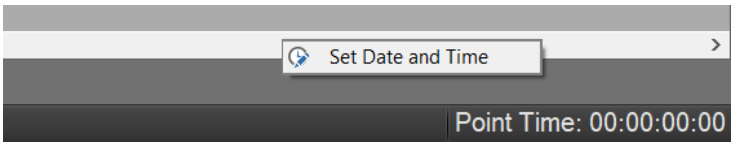
Start by long pressing or right clicking anywhere within the status bar. A long press is when you touch and hold the screen.



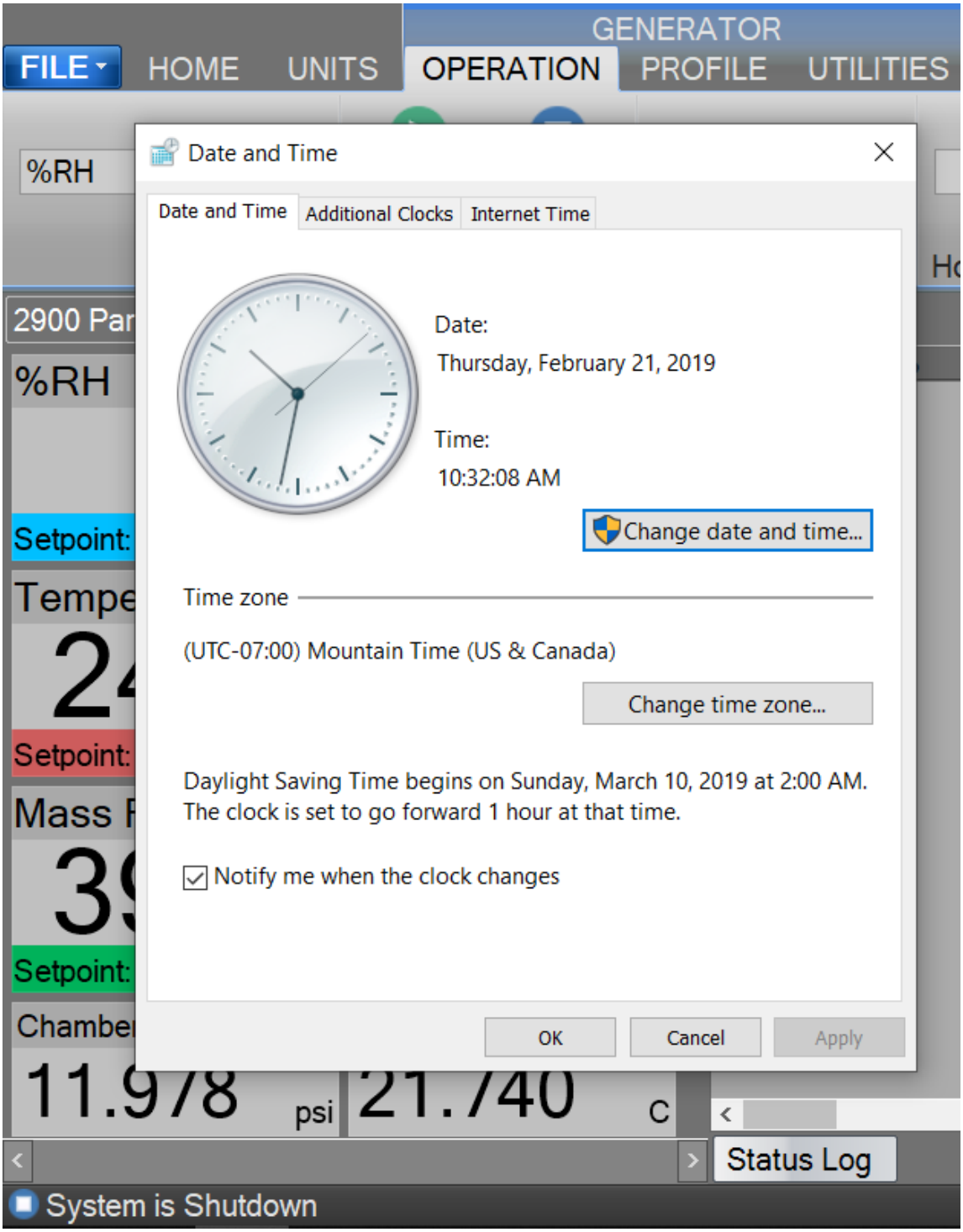
Long enough for a square selection box to appear.



Releasing will open the status bar context menu.



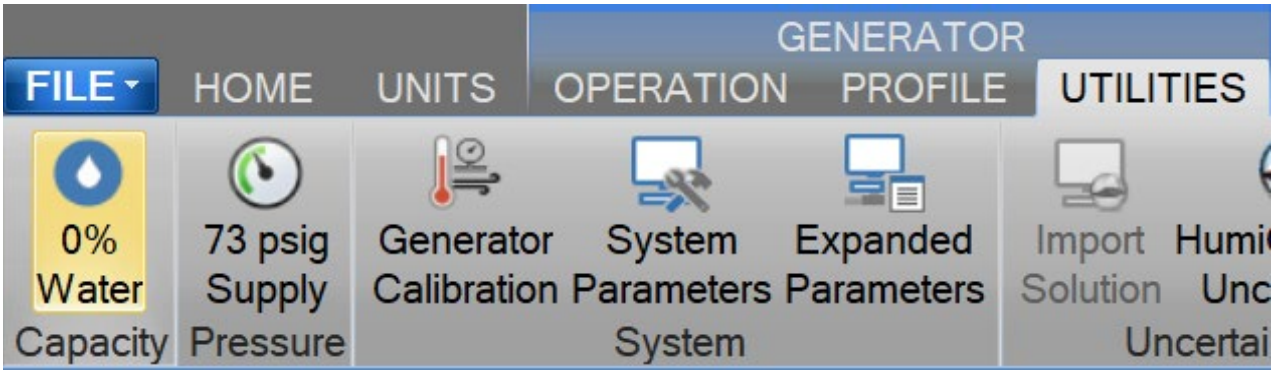
Select “Set Date and Time” from the context menu to open the system Date and Time dialog.



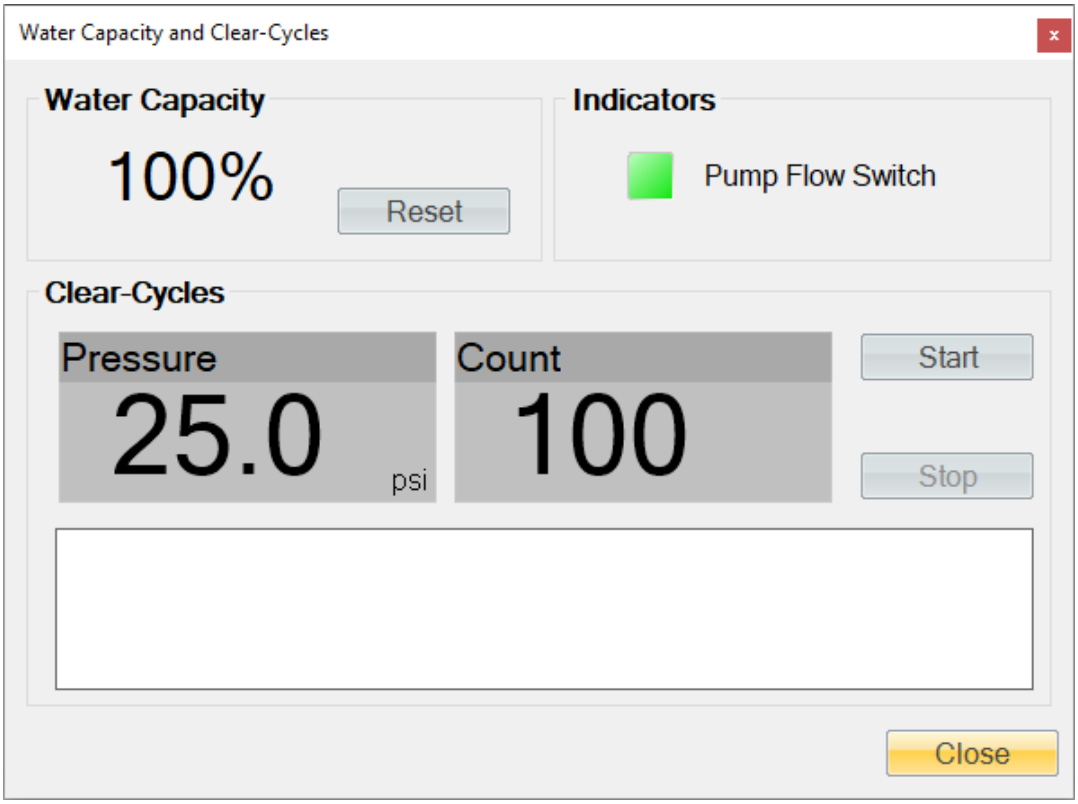
5 WATER CAPACITY

The Water Capacity dialog allows the user to view the current estimated water remaining in the generator, indication of pump flow and allows the user to perform clear cycles after filling.

To access the Water Capacity and Clear-Cycle dialog, select Water Capacity from the Generator Utilities menu.



For more information, refer to section [12.4 Fluid System]



5.1 WATER CAPACITY

Water capacity is an estimated percentage of water remaining in the system, because the system relies on multiple stacks of ice layers to saturate the air stream, no mechanical method can be used to determine the water level. Instead the system uses a predictive water usage algorithm to estimate the amount. A water capacity of 100% indicates the unit has just been filled and is full. The percentage will decrement as the generator is operated until it reaches 0% indicating the need to stop operation and fill per the saturator filling procedure. Every time the unit is filled press the Reset button to reset the water capacity back to 100%.

*****⚠WARNING⚠*****

A POWER LOSS OR EVENT THAT CAUSES THE 3920 TO BE POWERED OFF WHILE PURGING OR GENERATING MAY CAUSE THE WATER CAPACITY ALGORITHM TO LOSE ITS LATEST CONSUMPTION VALUES. IT IS RECOMMENDED TO WARM THE GENERATOR UP WHEN POWER IS RESTORED AND THEN FOLLOW THE PROCEDURE TO ADD WATER TO THE SYSTEM (*5.4 Saturator Filling*). THIS WILL ASSURE CORRECT WATER CAPACITY CONSUMPTION CALCULATIONS.

IF THE 3920 IS MOVED OR RELOCATED AT ANYTIME, WATER CAN FALL FROM THE SATURATOR PLATES RESULTING IN INCORRECT WATER CAPACITY. IT IS RECOMMENDED TO FOLLOW THE PROCEDURE TO ADD WATER TO THE SYSTEM (*5.4 Saturator Filling*). THIS WILL ASSURE CORRECT WATER CAPACITY CONSUMPTION CALCULATIONS AFTER MOVING OR RELOCATING THE GENERATOR.

5.2 INDICATORS

The Pump Flow Switch (FS1) is a discrete indication that the cooling fluid circulation pump is operating correctly. When the pump flow switch indication is red, cooling fluid is not being circulated within the system. Cooling fluid will only be circulated when operating in the Purge or Generate mode.

5.3 CLEAR-CYCLES

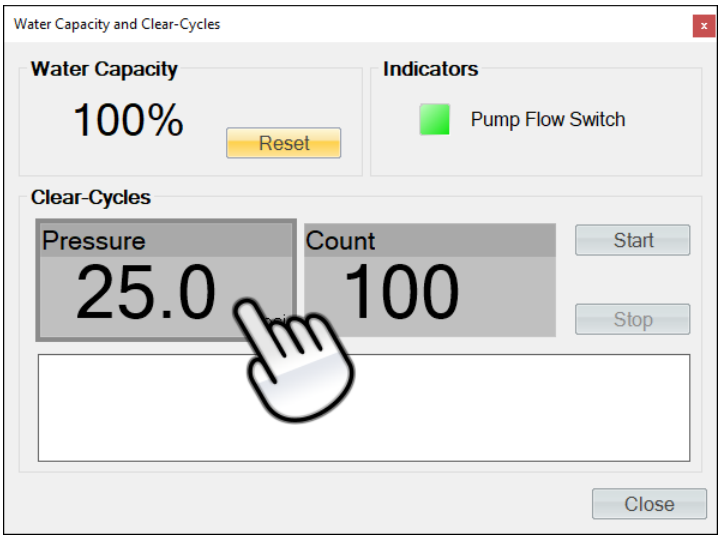
The Clear Cycle procedure is used to clear the saturator of any excess water that may have occurred as a result of filling, as a result of movement (such as transportation), or as a result of freezing and thawing a full saturator. Any time that water is observed at the gas vent whether after filling, movement, or thawing, the saturator should be cleared several times until no further indication of excess water exists. If the saturator has not been recently filled, and the generator not moved, saturator clearing is normally not needed.

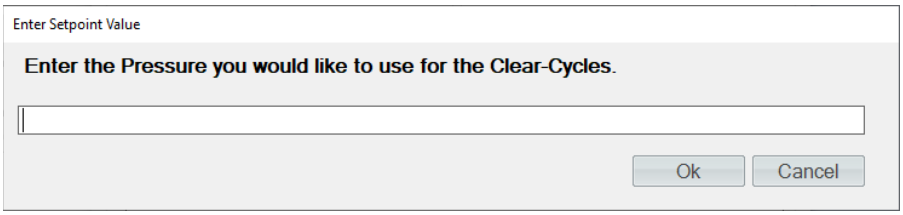
> **Note –** *The saturation temperature must be above 0 °C for a minimum of four hours before proceeding with the saturator clear procedure. This allows any ice in the saturator to completely melt.*

5.3.1 Clear-Cycles Pressure

The clear-cycle pressure is the amount of pressure the saturator will be pressurized to during a single clear-cycle. To change this pressure, click on the pressure tile and enter the desired value in the entry dialog.

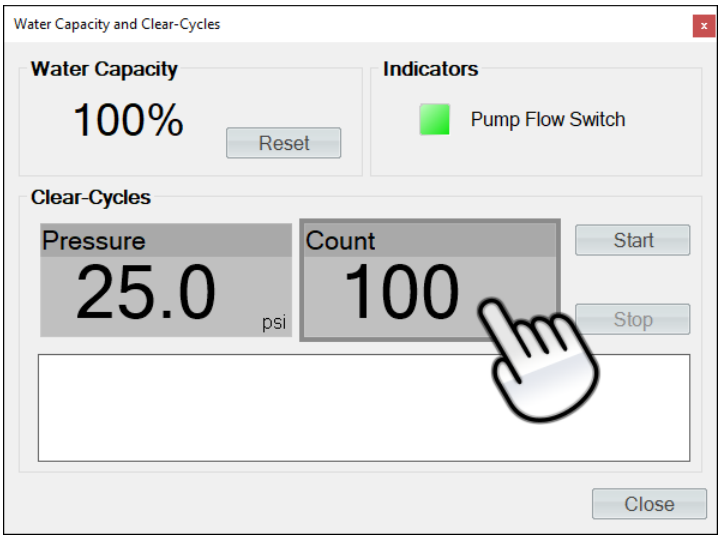
> **Note** – *Default pressure is recommended unless otherwise stated.*

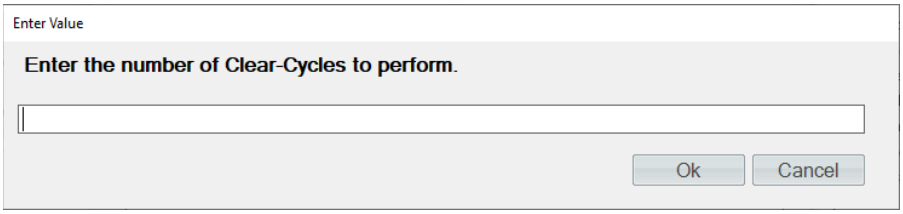




5.3.2 Clear-Cycles Count

The clear-cycle count is the number of clear-cycles to be performed. To change this number, click on the count tile and enter the desired value in the entry dialog.





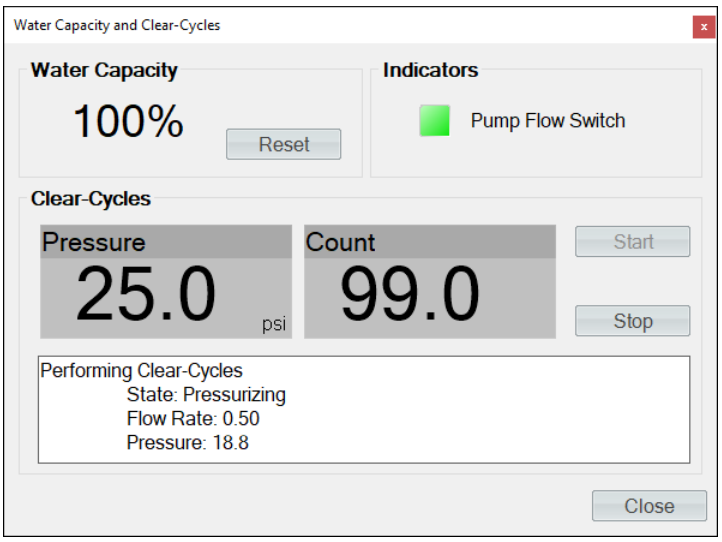
5.3.3 Clear-Cycles Start

To begin the clear-cycle process press the “Start” button. The generator will start purging and will begin to pressurize and vent with each cycle.

> **Note –** *Set the desired mass flow rate on the 3920 Parameter Tab before starting clear cycles. The recommend flow rate is 2.0 L/min.*

5.3.4 Clear-Cycles Status

The clear-cycle status will show the current state of the process, current flow rate and current pressure.



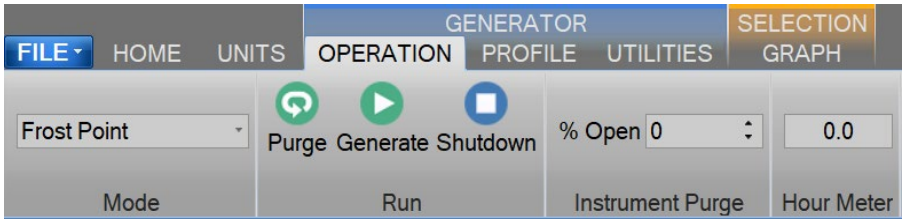
5.3.5 Clear-Cycles Stop

To stop the clear-cycle process at any time press the “Stop” button. The generator will vent and continue to operate in purge mode.

5.4 Pure Water Saturator Filling Procedure

The saturator filling procedure should be performed upon initial use after installation, and approximately every 500 hours or more of operation, thereafter, depending upon the humidity and flow rates generated. Colder temperatures (lower humidity) require less water than higher temperatures (higher humidity). The generator may require up to 300 cc of pure water (HPLC and/or Spectrophotometry grade) per fill.

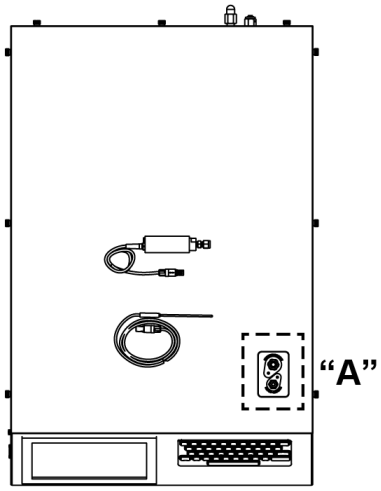
1) Put the system into Purge mode.
2) Set Instrument Purge to 0% Open



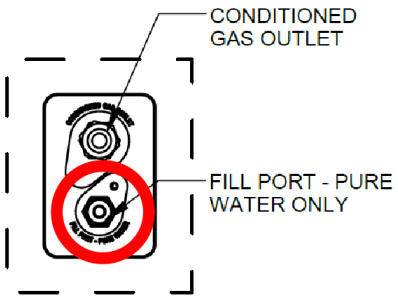
3) Adjust flow setpoint to 0.5 liters/minute.
4) View the Saturation Temperature and if the Saturation Temperature is below 0 °C, then adjust the dew point to 2 °C or warmer and adjust the saturation temperature to 5 °C or warmer. Allow the Saturation Temperature to warm above 0 °C and stabilize before proceeding to allow all ice in the saturator to completely melt.

> **Note -** *Due to the large thermal mass of the saturator, the saturation temperature must be above 0 °C for a minimum of four hours before proceeding with the saturator fill procedure. This allows for sufficient thermal lag time when undergoing an ice/water phase change within the saturator.*

5) Locate the saturator fill port at the front right of the countertop and remove the port cap.



TOP VIEW

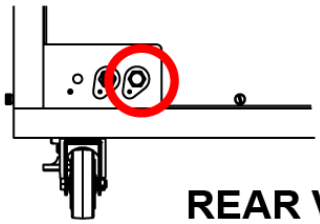


DETAIL "A"

6) Attach supplied pure water funnel.
7) ***Slowly*** add 300cc of pure water (HPLC and/or Spectrophotometry grade)

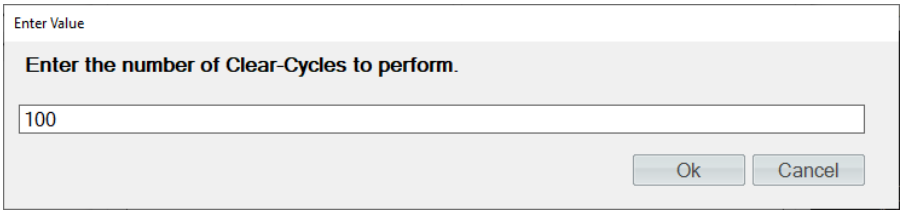
Note – *Saturator capacity is approximately 300 cc.*

8) Once all water has drained from the funnel, remove the funnel, and replace the fill port cap. Tighten fill port cap 1/8 turn past finger tight.
9) Adjust the flow setpoint to 2.0 liter/min.
10) Place a small beaker or container at the gas vent port next to the gas inlet on the back of the generator to capture the expelled water from the clear-cycle process.

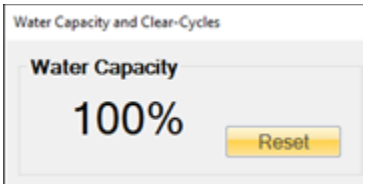


REAR VIEW

11) Open the "Water Capacity and Clear-Cycles" dialog by selecting Water Capacity from the Utilities tab.
12) Set the clear cycle count to 100 if not set already.



13) Press "Start" and allow the system to begin the clear-cycle process.
14) Once the system has completed the 100 clear-cycles, reset the water capacity to 100% by pressing the "Reset" button.



15) Close the "Water Capacity and Clear-Cycles" dialog.
16) Upon completion of the Saturator Clear process, the system remains in the Purge mode, but it is recommended to switch to the Generate mode for a short period of time to assure no water has entered the supply line into the saturator.
    a. Press Generate from the Operation Tab.
    b. Let the system generate for 15 minutes.
    c. Press Purge from the Operation Tab.
    d. If water is still observed at the gas vent port repeat step 16 until all excess water has been cleared.
17) Continue purging for 24 hours.
18) While remaining in the Purge mode, adjust setpoints to the desired settings and allow the saturation temperature to achieve setpoint.

6 CALIBRATION

Proper calibration of the temperature and pressure transducers is critical to the accuracy of the generated humidity. Each time a probe or transducer is calibrated its current calibration coefficients and calibration data are stored to disk. Calibration of the system requires the following support equipment:

Note - *The Expansion Valve (RTD3) and the Cabinet Temp (RTD4) do not require calibration and cannot be removed.*

Note - *The following information is provided as a recommendation for the calibration of the Thunder Scientific 3920 Humidity Generator. It is the user's responsibility to ensure the standards used meet/exceed their organization's specific test limit/guard banding requirements.*

1) **Saturation Temperature**, range -80 to +12 °C:

- If not using the 3920 as the temperature source, then a precision temperature bath of specified range with a liquid medium (recommend FC-77 Fluorinert®, a 3M® product).
- **Note -** *Less stable baths may require the use of a thermal block.*
- Standard or reference thermometer (PRT) of specified range with an accuracy to assure ±0.027 °C test limit or guard band.

2) **Test Temperature**, range 0 to +50 °C:

- Precision temperature bath of specified range with a liquid medium (recommend FC-77 Fluorinert®, a 3M® product).
  Note - *Less stable baths may require the use of a thermal block.*
- Standard or reference thermometer (PRT) of specified range with an accuracy to assure ±0.027 °C test limit or guard band.

3) **Test Pressure**, range ambient to 50 psi absolute:

- Stable static gas pressure source.
- Standard or reference pressure gauge with an accuracy to assure ±0.02 % of full-scale (50 * 0.02% = ±0.01 psi absolute) test limit or guard band.

4) **Saturation Pressure**, range ambient to 250 psi absolute:

- Stable static gas pressure source.
- Standard or reference pressure gauge with an accuracy to assure ±0.02 % of full-scale (250 * 0.02% = ±0.05 psi absolute) test limit or guard band.

5) **Flow**, range 0 to 10 standard liters/min:

- Reference flow meter with an accuracy low enough to assure ±2 % of full-scale (10.0 * 2% = 0.2 liter/min) test limit or guard band.
  Note – *Flow is standardized with a reference temperature of 21.1 °C at 760 Torr*

6.1 TEMPERATURE CALIBRATION

The temperature calibration procedure is used in conjunction with the 3920 for calibration of the saturation temperature probe and in conjunction with a precision temperature bath for calibration of the test temperature probe. By using the 3920 or precision temperature bath to generate up to five known temperatures, the coefficients will be calculated automatically and used to update the system calibration for each temperature probe. The calibration report will be generated and can be saved for each temperature probe at the conclusion of the calibration sequence.

Refer to drawings: 19D3920901-2, 19D3920901-5

6.1.1 Equipment Required

1. 5/32" hex ball driver.
2. Silicone grease.
3. Standard or Reference thermometer.
4. Precision Temperature Bath for calibrating the Test Temperature Probe (RTD2) only.

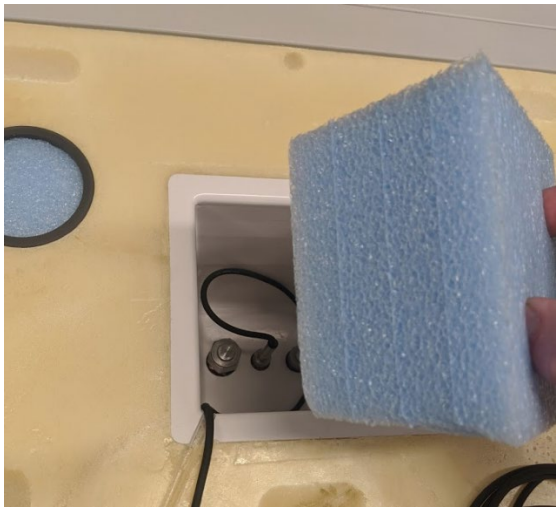
6.1.2 Calibration Procedure

This procedure describes the calibration of the Saturation Temperature probe but can be used for any of the temperature probes by substituting that probe's specific ranges and points. For safety purposes, perform a shutdown, perform a shutdown system, switch system "POWER" to OFF and remove power cord before removing any panels.

⚠ CAUTION!

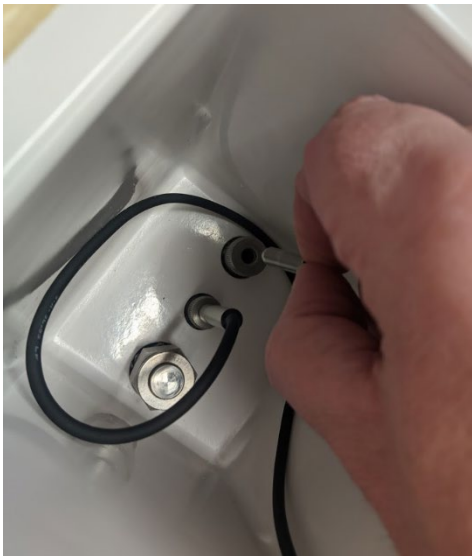
ALL SYSTEM PRESSURE MUST BE VENTED BEFORE PROCEEDING.

1. Remove left-side and right-side console panels.
2. Using the 5/32" hex ball driver, locate and remove the four countertop retaining screws then remove the countertop.
3. Replace the left-side and right-side console panels
4. Remove RTD access insulation.

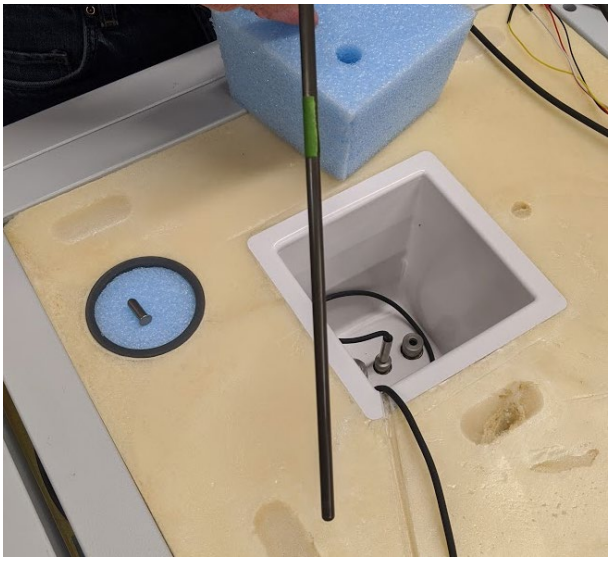
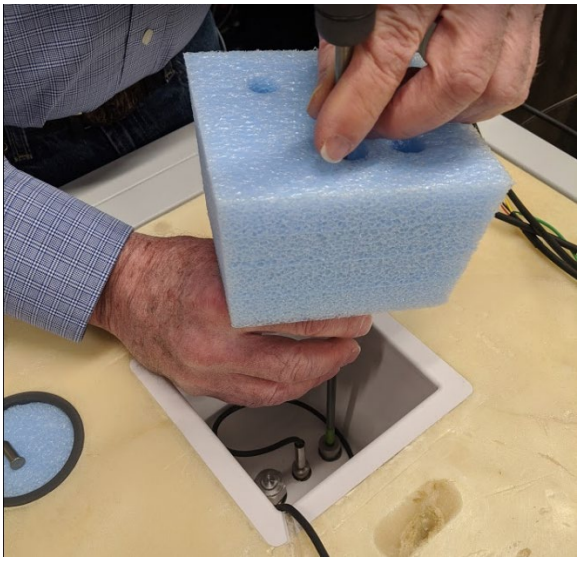




5. Locate the calibration port (next to the Saturation Temperature Probe RTD1). Loosen the Ultra Torr Knurled Nut approximately 1/2 turn counterclockwise and remove 1/4" port plug insert.

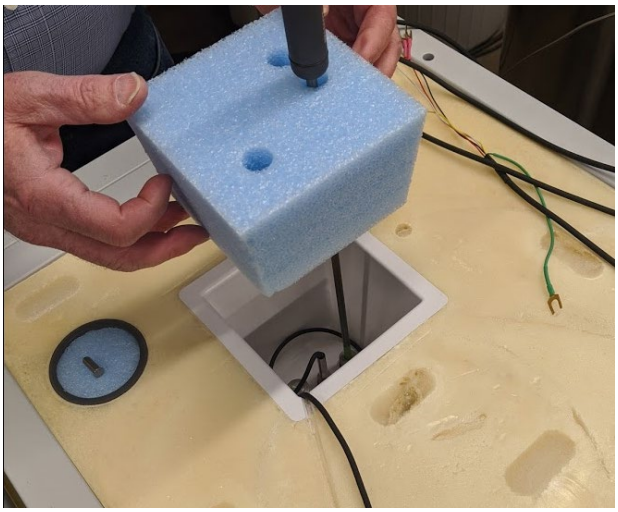


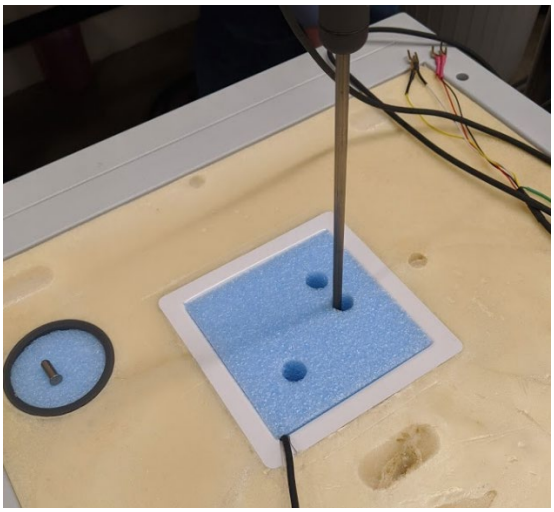

6. Apply a very thin coat of silicone grease to the first six inches of the reference thermometer and insert Reference Thermometer into calibration port approximately 6" deep. Tighten the Ultra Torr Knurled Nut so as to have an airtight seal.

Tip – *Place a piece of masking tape 6" from the end of the reference thermometer to help with determining the emersion depth into the saturator. This will also help to prevent the probe from sliding to far into the saturator and hitting the bottom.*

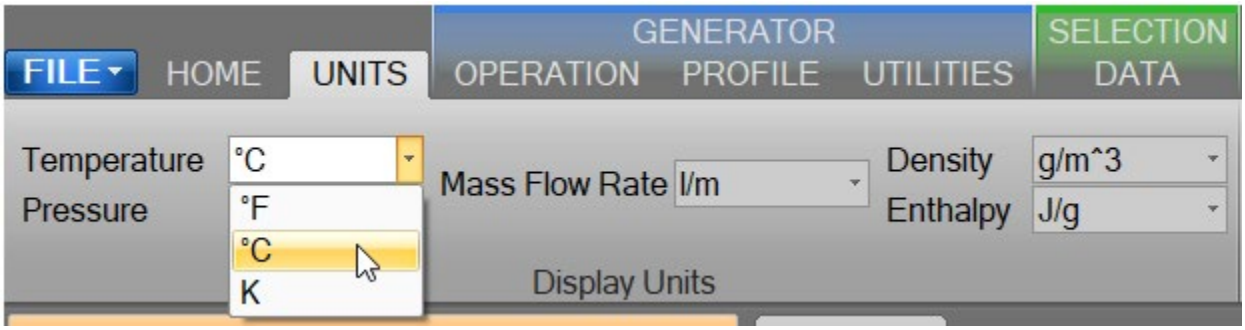
7. Replace RTD access insulation to seal around reference thermometer.



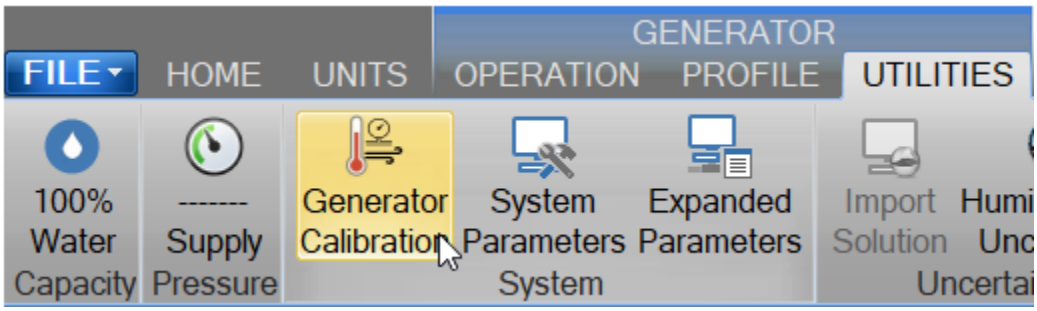


8. Connect power and switch main console power to ON. Wait a few moments for the system to initialize and for the main screen to appear.

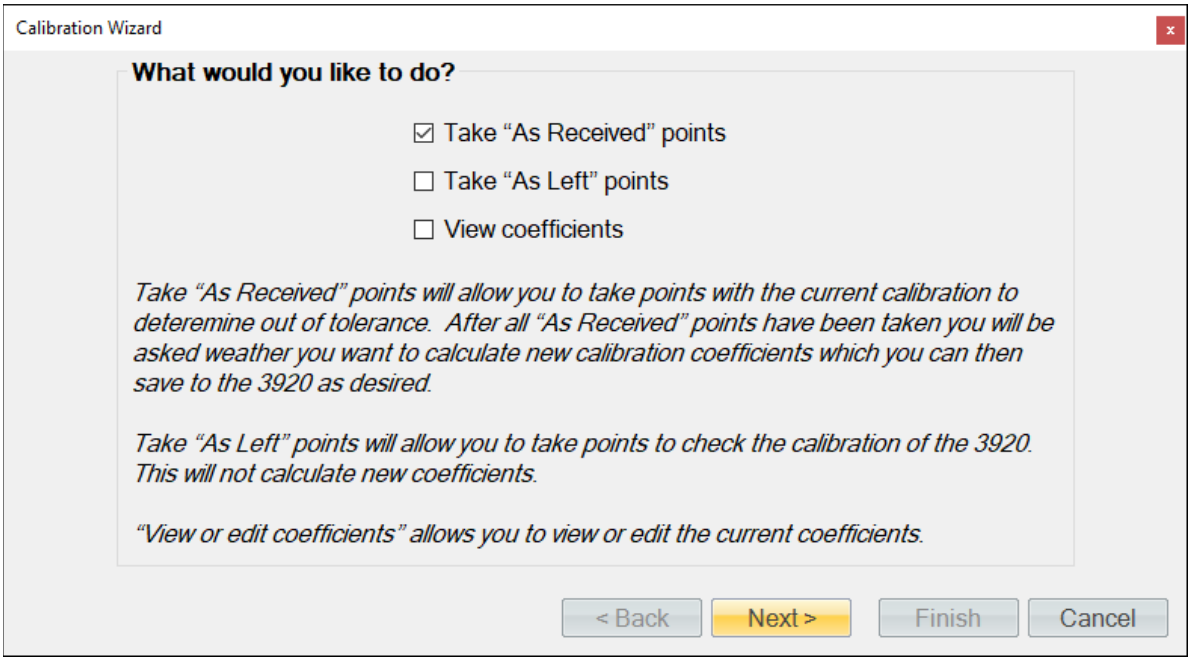
From the Units menu tab select the desired temperature units for calibration. Once calibration has begun, the units should not be changed again until the calibration is complete.



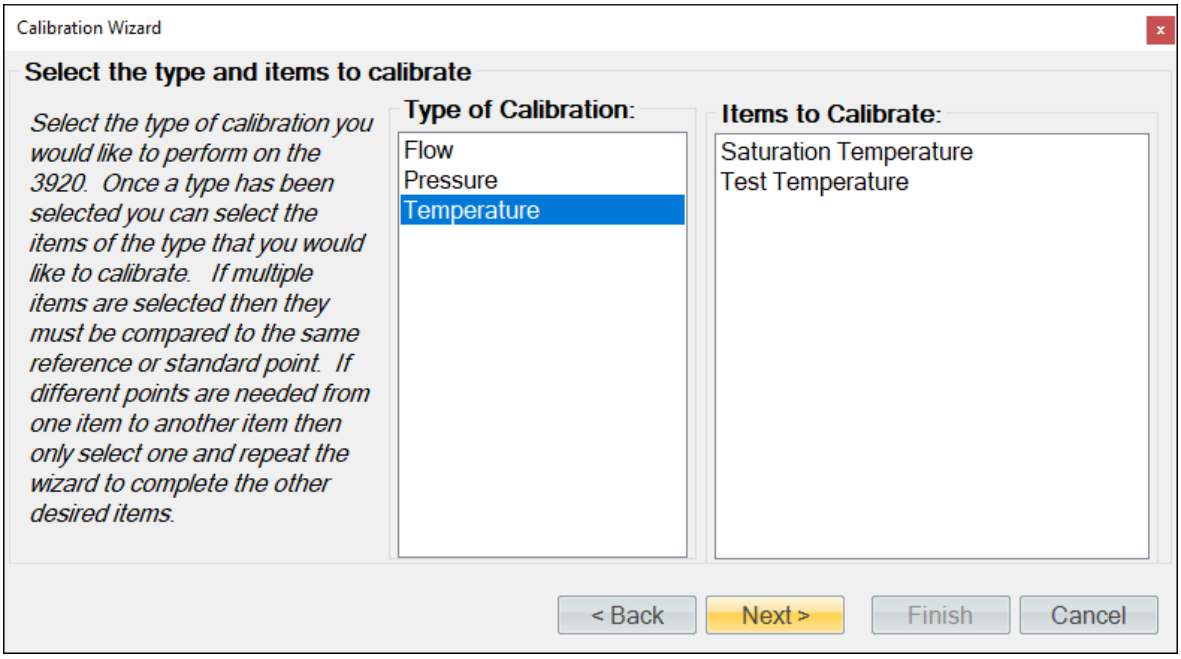
Select Generator Calibration from the Utilities menu tab to open the Calibration Wizard.



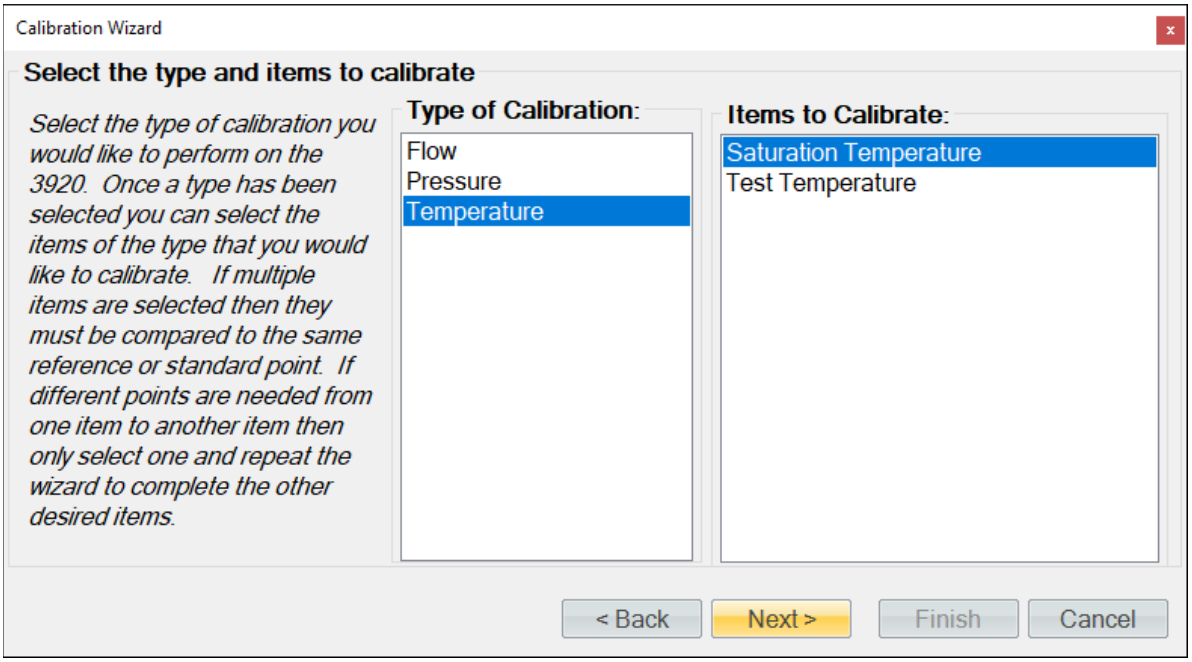
Select, "Take "As Received" points". This will allow the user to take points with the current calibration to determine out of tolerance. After all "As Received" points have been taken the user will be asked whether they want to calculate new calibration coefficients.



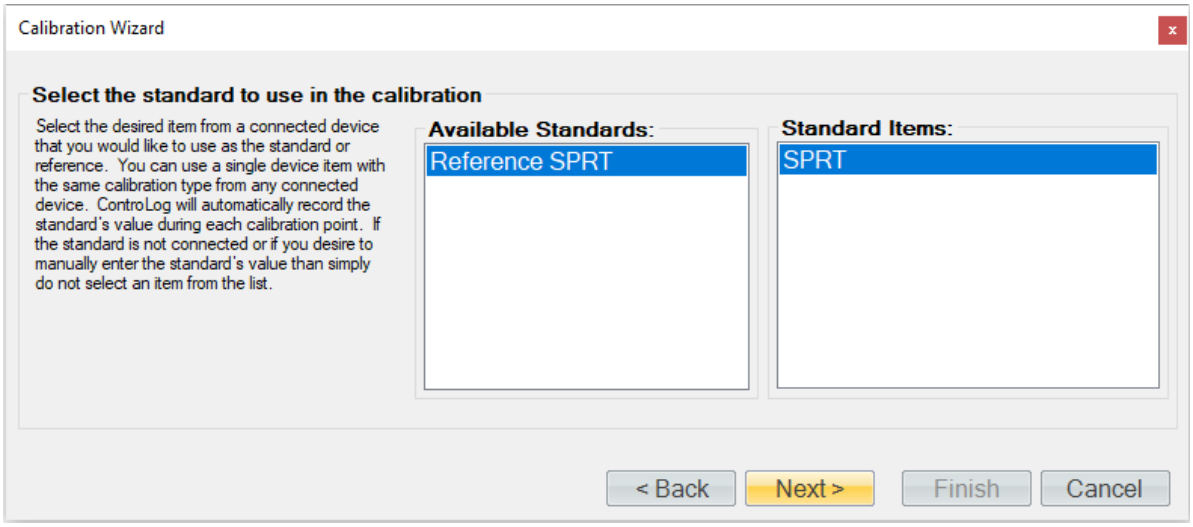
Set the type of calibration to Temperature.



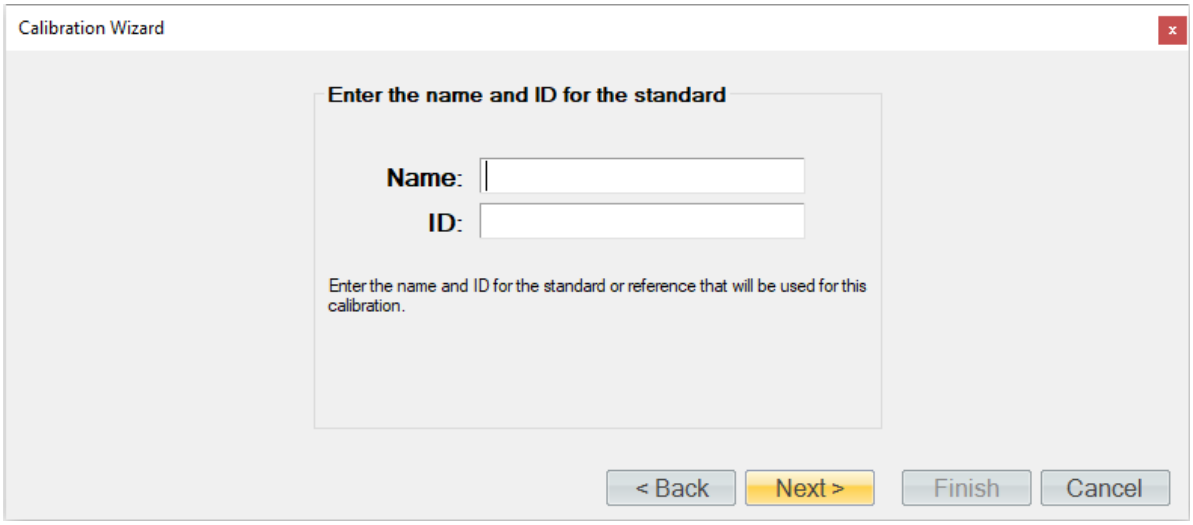
Select the temperature probe to calibrate. In this example we will perform the calibration on the saturation temperature probe, but the same procedure can be done on the test temperature probe using a precision temperature bath instead of the 3920.



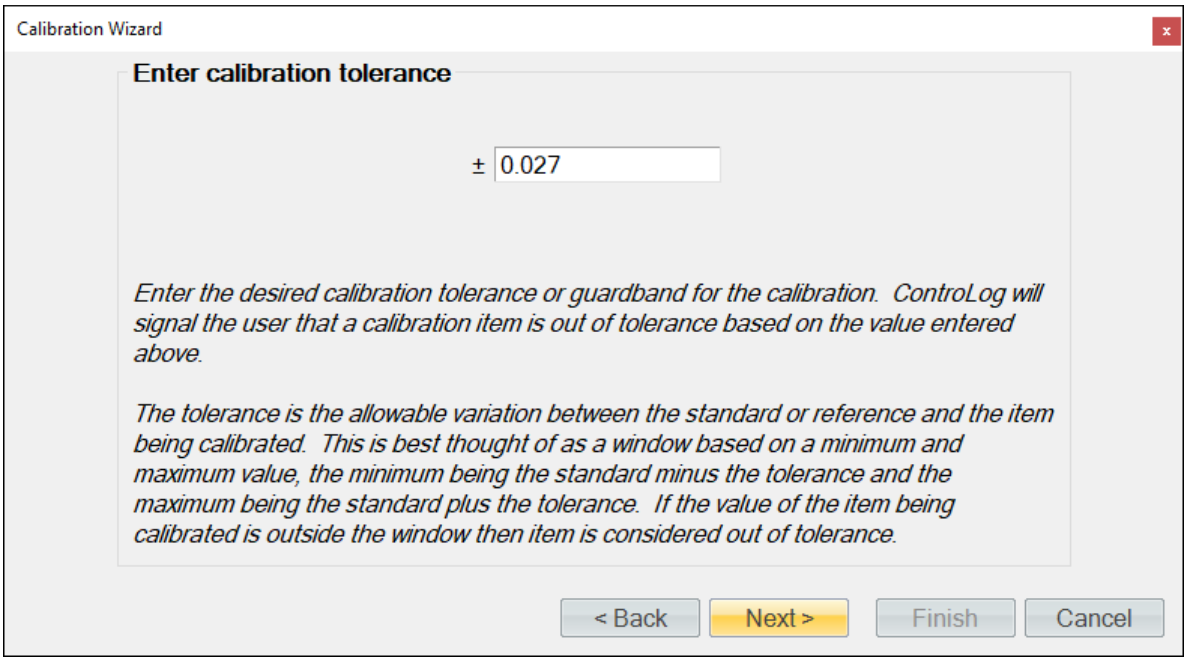
If the temperature standard is a connected device (refer to section 10 Connections), you may select it for the calibration. You can use a single device item with the same calibration type from any connected device. ControLog will automatically record the standard's value during each calibration point. If the standard is not connected or if you desire to manually enter the standard's value, then simply do not select an item from the list.



Enter the Name and ID of the standard being used. This information will be populated on the calibration report. Selecting "Next" without entering a Name will result in ControLog giving the standard a generic name.

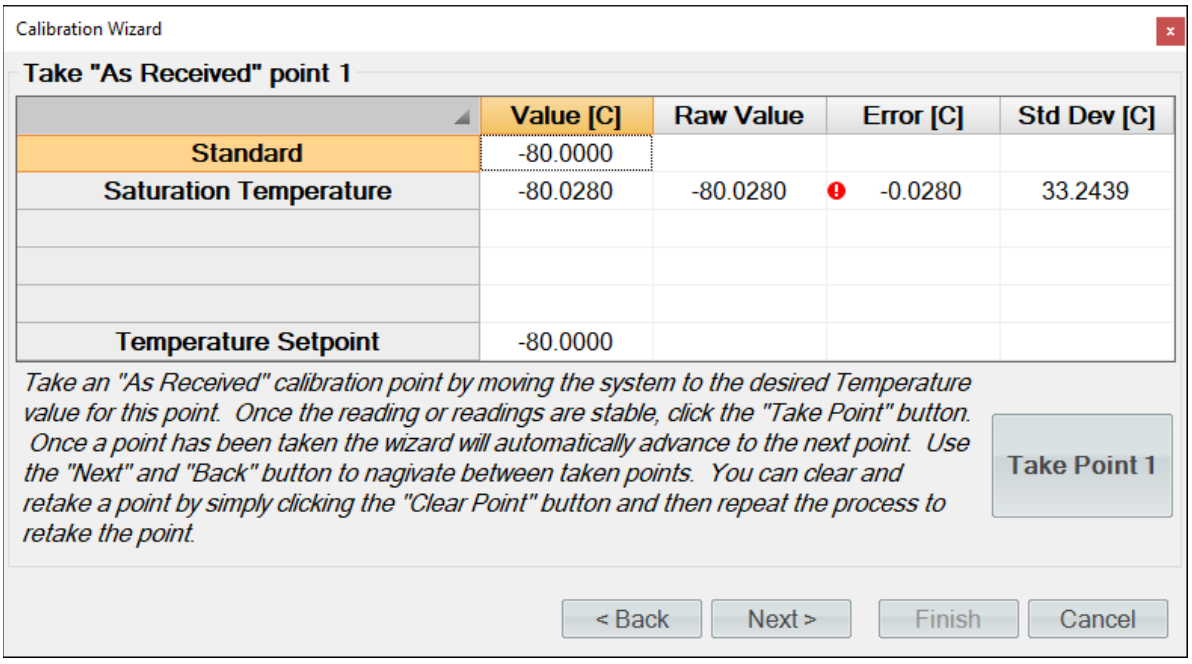


Enter the desired calibration tolerance or guard band for the calibration. ControLog will signal the user that a calibration item is out of tolerance based on the value entered above.



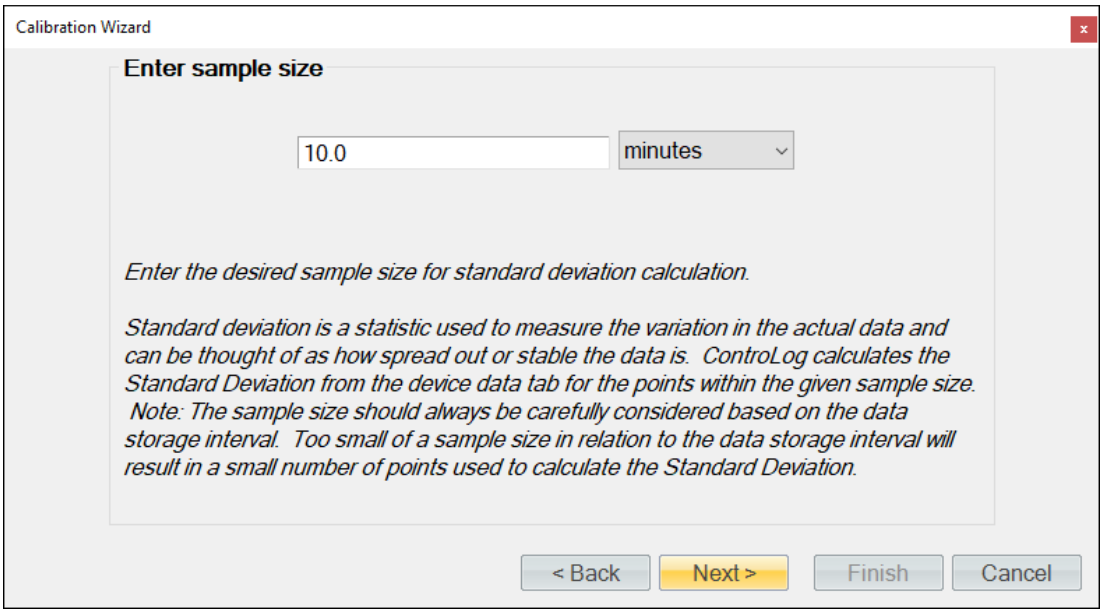
The tolerance is the allowable variation between the standard or reference and the item being calibrated. This is best thought of as a window based on a minimum and maximum value, the minimum being the standard minus the tolerance and the maximum being the standard plus the tolerance. If the value of the item being calibrated is outside the window, then the item is considered out of tolerance.

An out of tolerance condition will be indicated by a red circle with an exclamation point for the out of tolerance probe in the Error column.

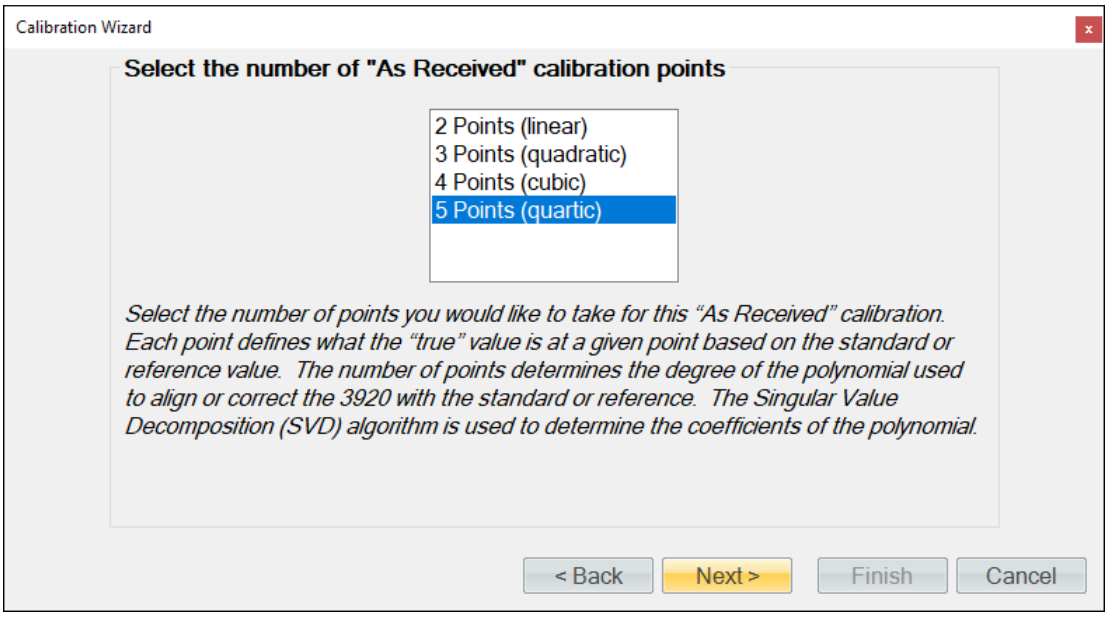


Enter the sample size used to perform the standard deviation calculation. The sample size is the given time that ControLog will use to determine which data points to use to determine the standard deviation of each probe.

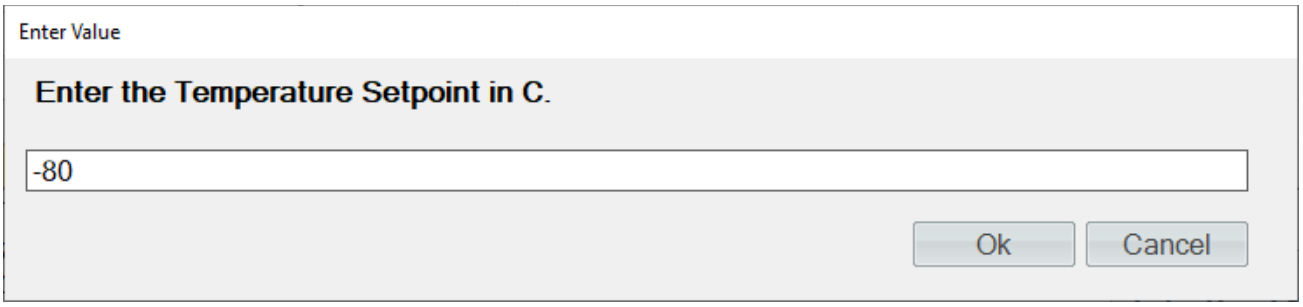
> **Note** - *The number of points used will be based on the data storage rate you have selected along with the desired sample size. For example, if the data storage rate is every 30 seconds then a sample size of 10 minutes will result in 20 points being used to calculate the standard deviation.*



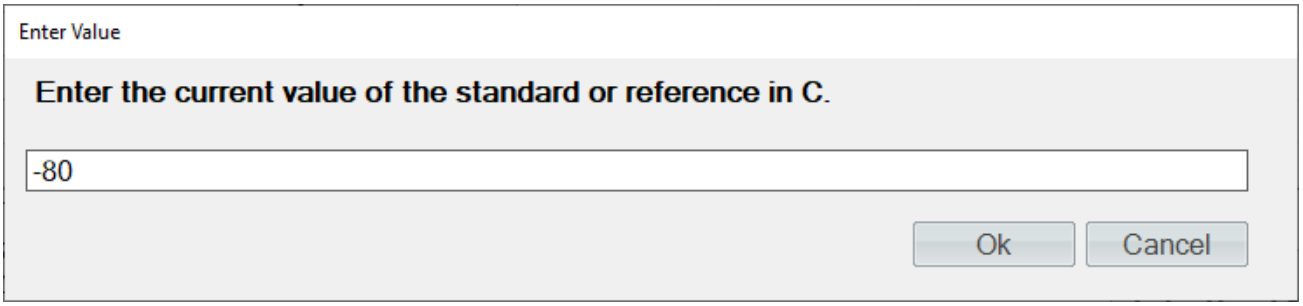
Select the number of points you would like to take for this "As Received" calibration. Each point defines what the "true" value is at a given point based on the standard or reference value. The number of points determines the degree of the polynomial used to align or correct the generator with the standard or reference.



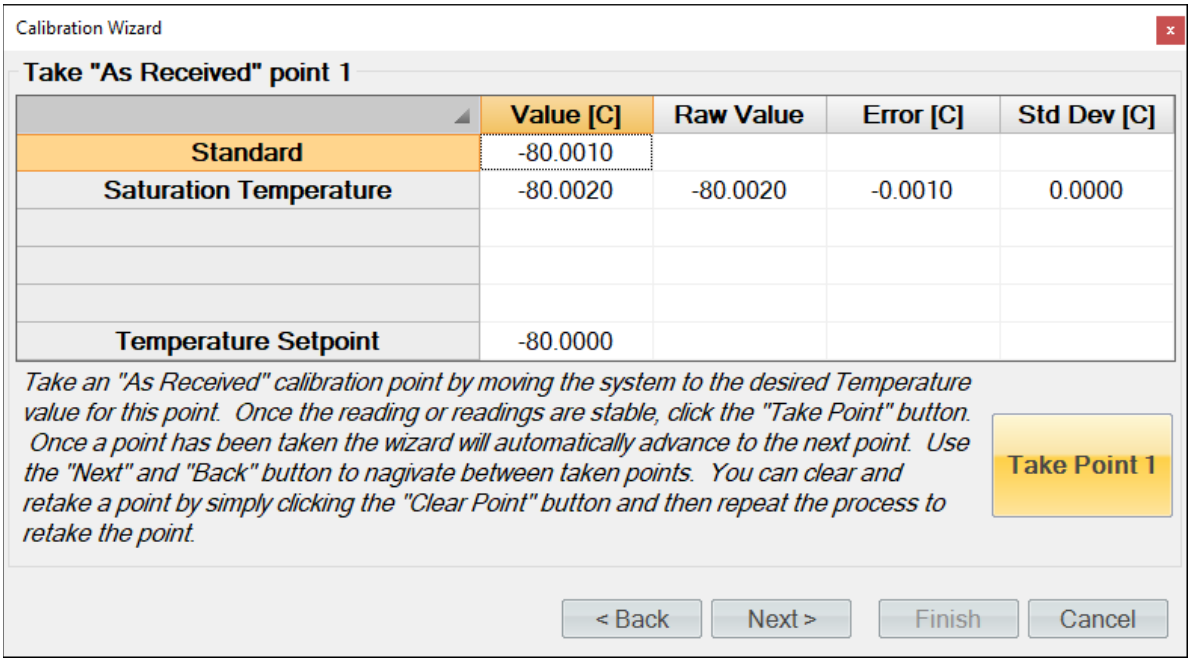
If using the 3920 as the temperature bath, generate the first temperature point (-80 °C) by entering -80 in the “Temperature Setpoint” row and “Value” column. Operate the 3920 in purge mode with a flow rate setpoint of 0.5 to 1 L/min while you perform the saturation temperature calibration. This will ensure the best temperature control performance during the calibration process.



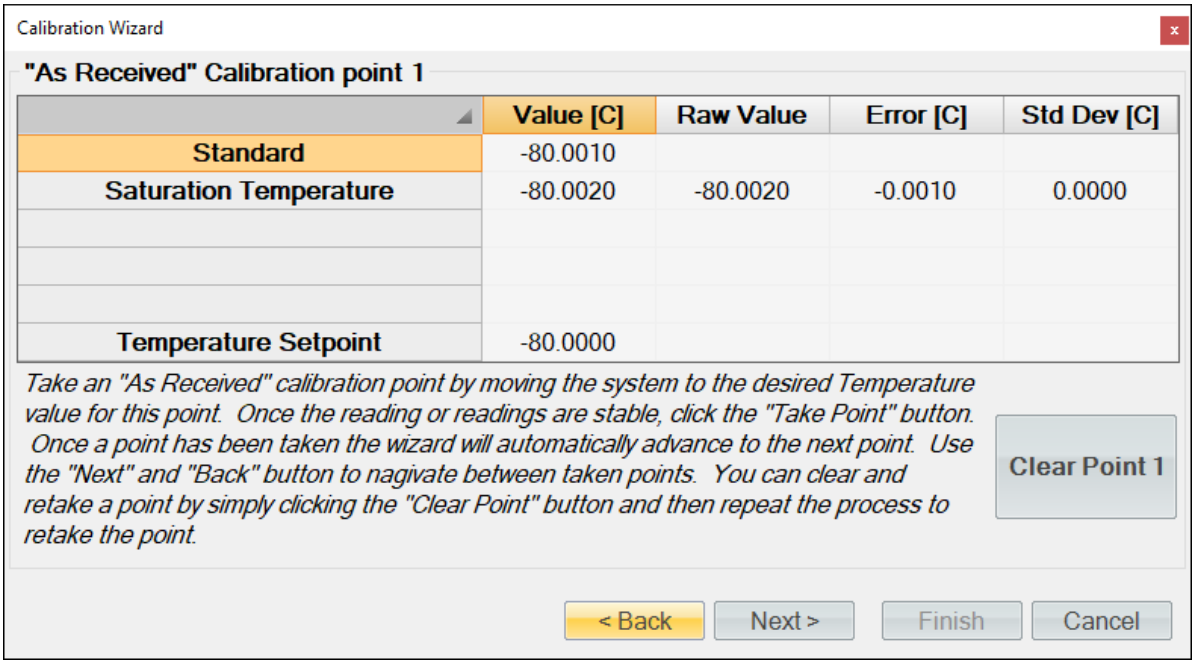
If the standard is not a connected device, then ControLog will ask for the value before taking the point. You can also enter a standard or reference value before taking a point by clicking the cell in the “Standard” row and “Value” column. This is useful for seeing error values before a point is taken.



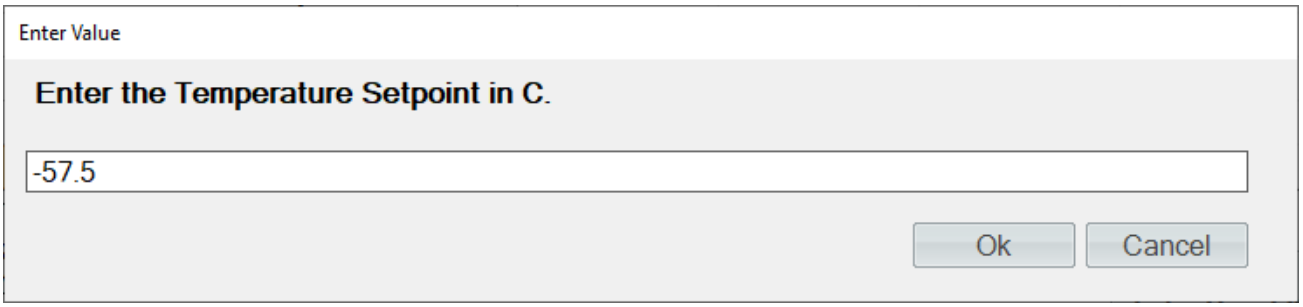
Once the readings are stable, click the “Take Point” button. Once a point has been taken the wizard will automatically advance to the next point.



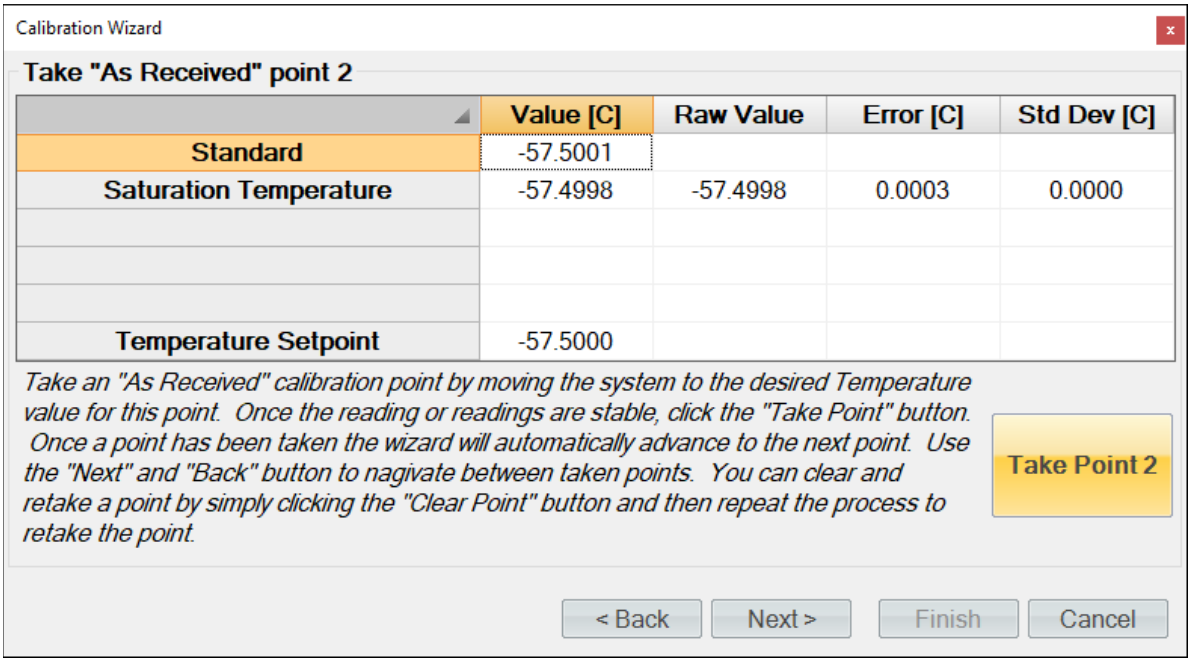
Tip - *Use the "Next" and "Back" button to navigate between taken points. You can clear and retake a point by simply clicking the "Clear Point" button and then repeat the process to retake the point.*



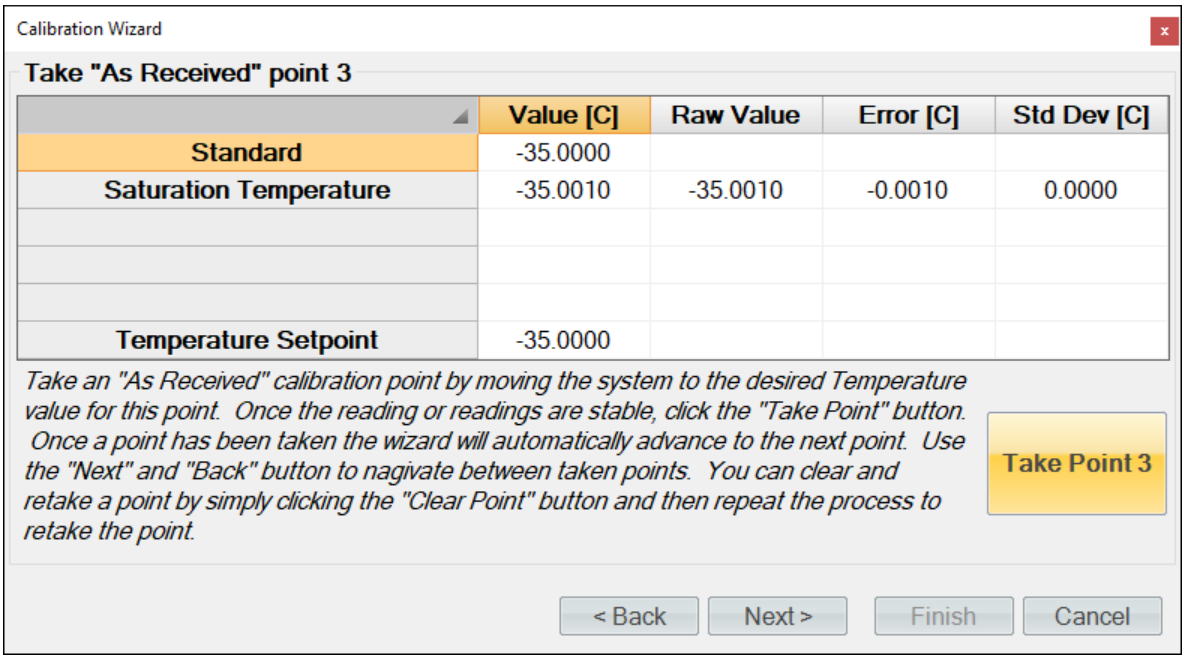
Generate the second temperature point (-57.5 °C) by entering -57.5 in the "Temperature Setpoint" row and "Value" column.



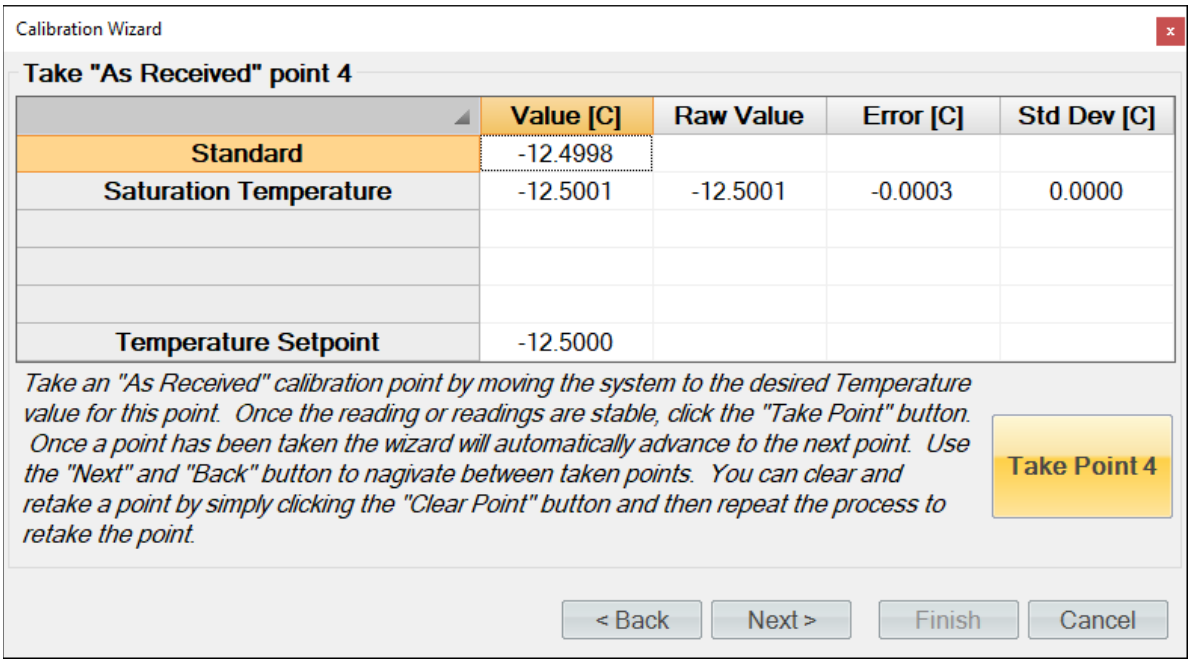
Once the readings are stable enter the standards value and click the “Take Point” button.



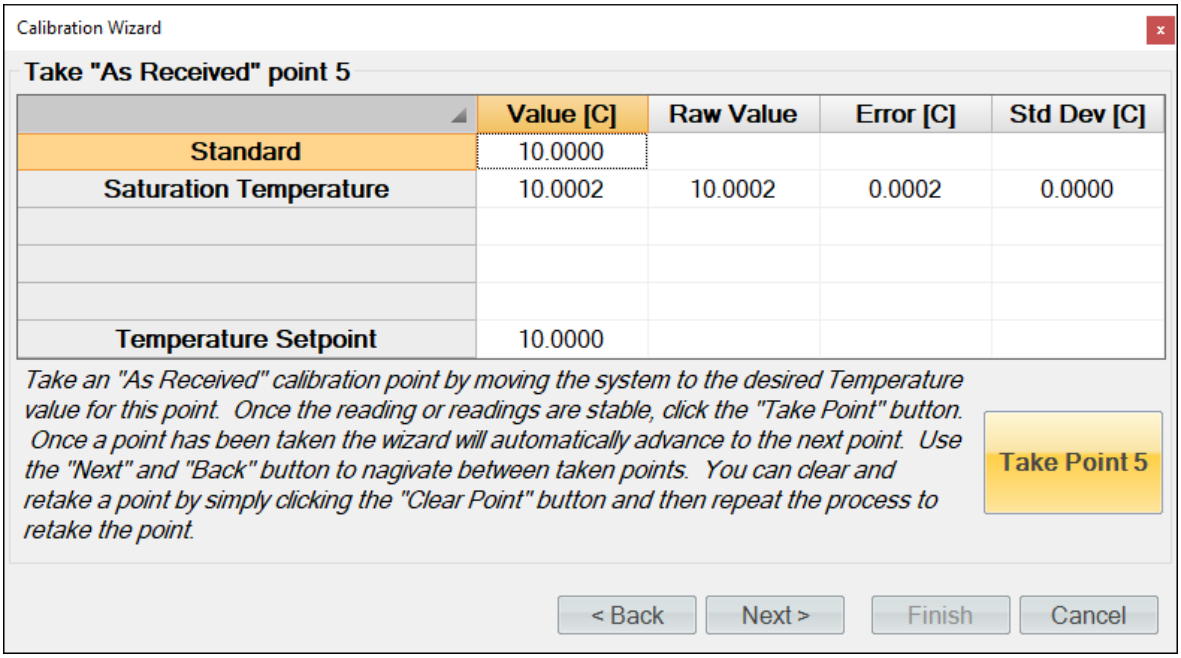
Generate the third temperature point (-35 °C) by entering -35 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



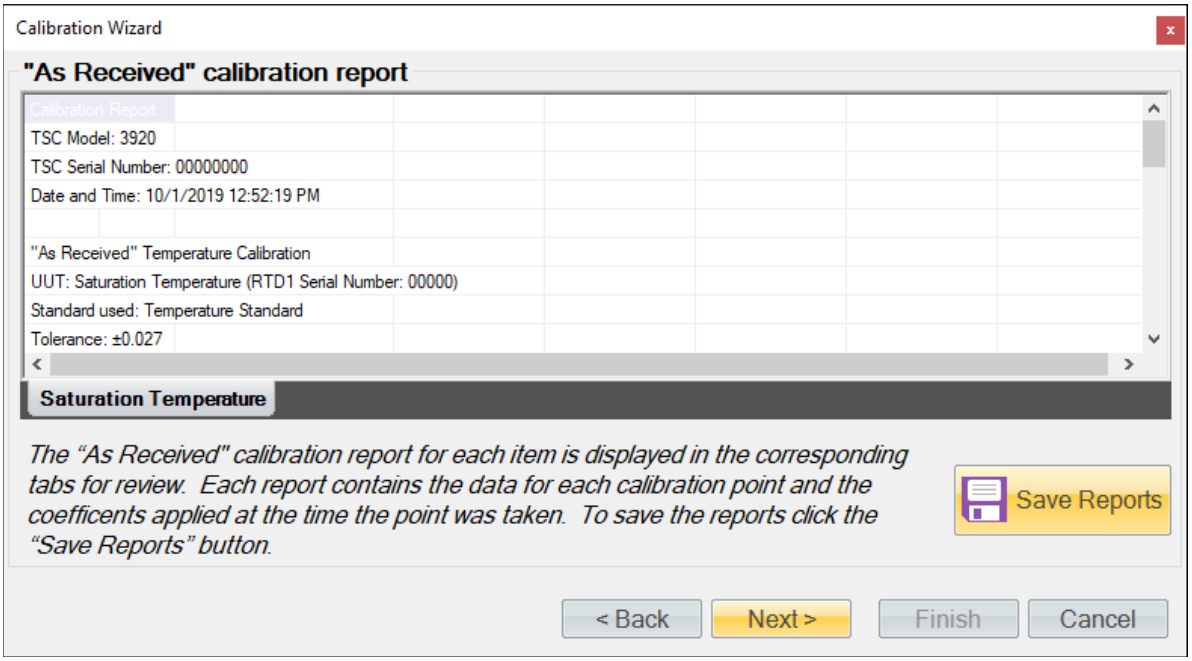
Generate the fourth temperature point (-12.5 °C) by entering -12.5 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



Generate the last temperature point (10 °C) by entering 10 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.

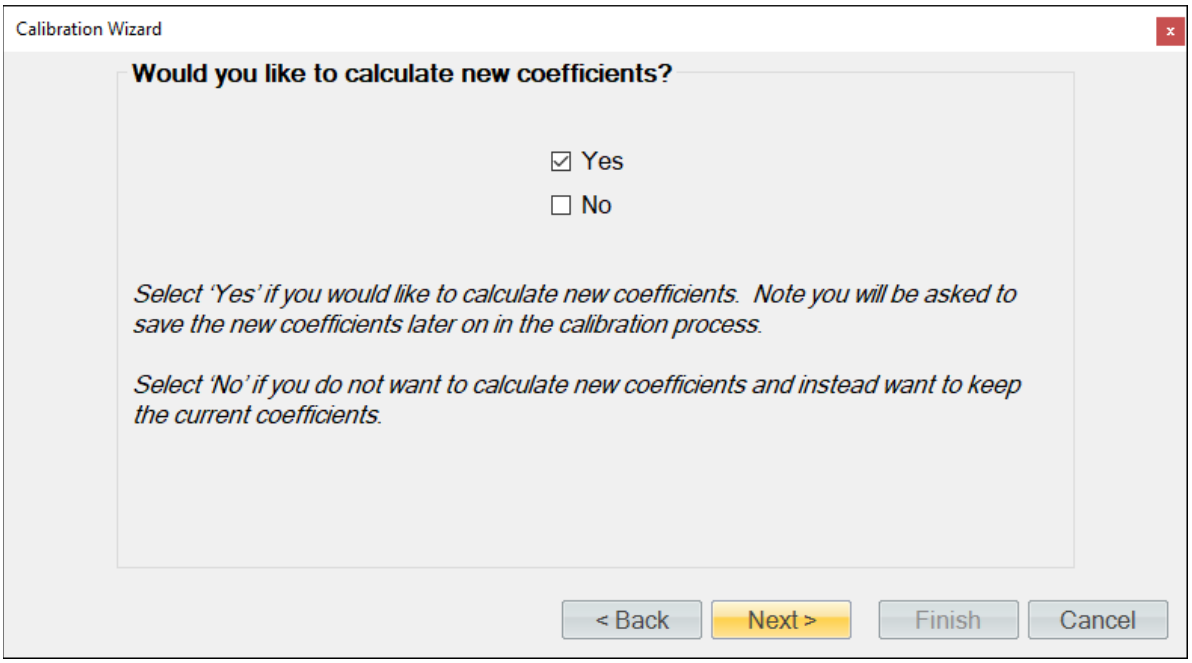


When all temperature points have been entered, ControLog will advance to the “As Received” calibration report. Each temperature probe will appear in its own tab and contains the data for each calibration point along with the coefficients used at the time the points were taken.

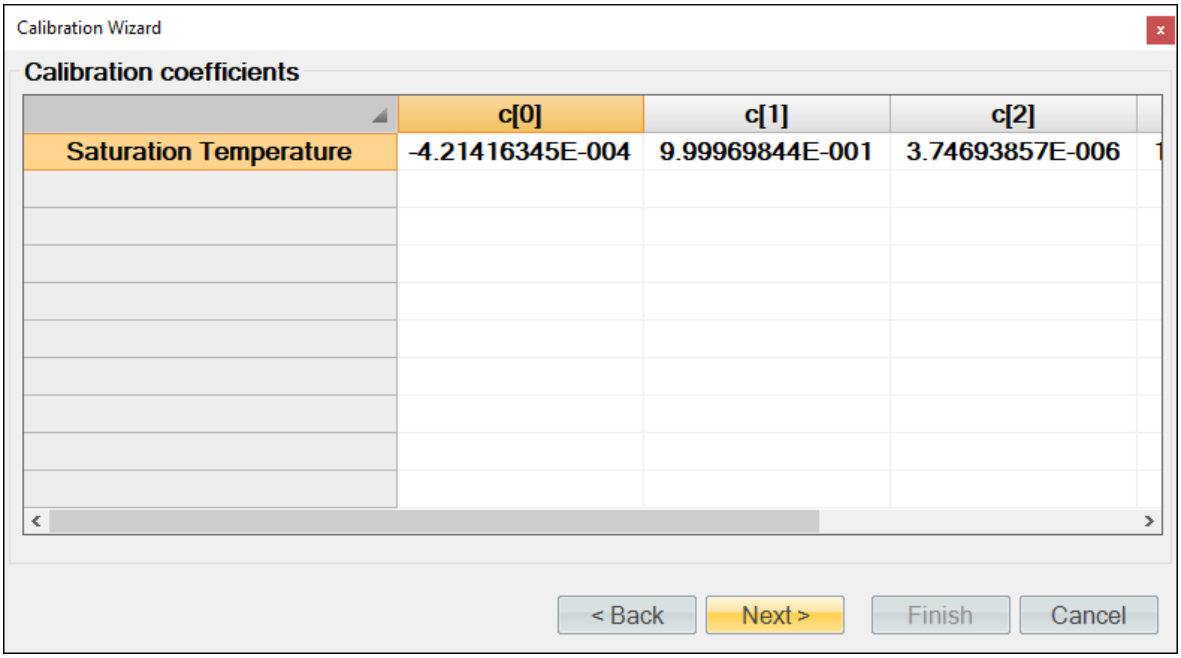


Clicking the “Save Reports” button will open a file dialog to save the report. The default file location is …Documents\Thunder Scientific\3920 ControLog\Reports\. If the report is saved in an Excel format, then each probe will appear in its own tab within the workbook. The user needs to save in a text-based format then a file for each probe calibrated will be created.

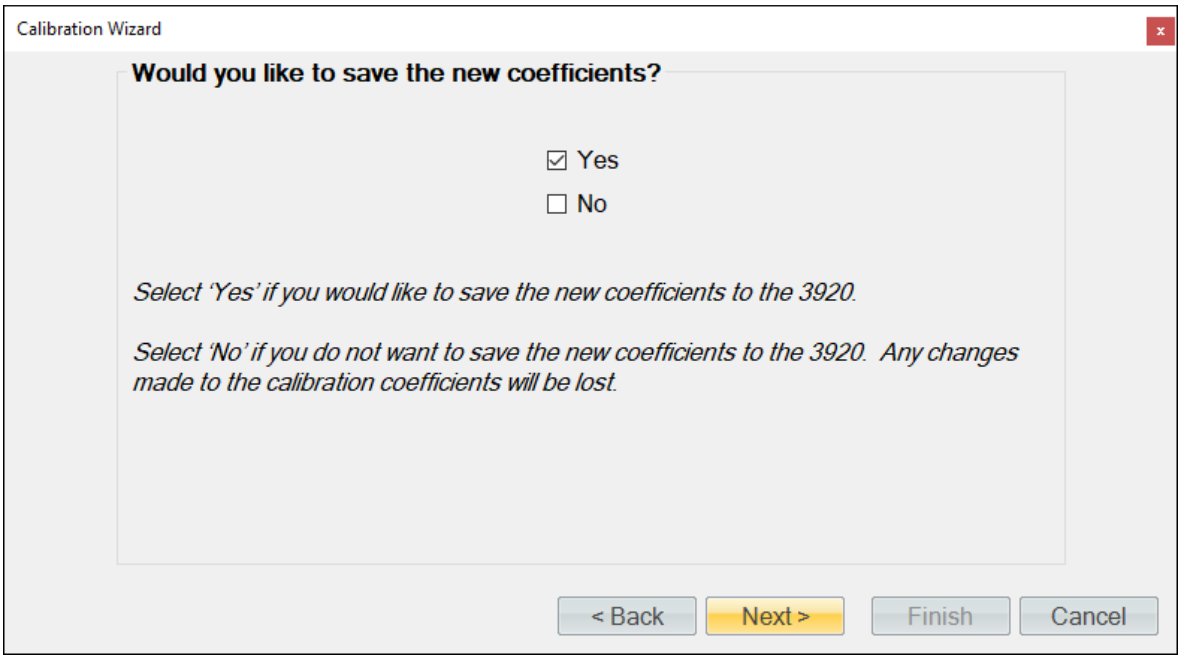
Clicking “Next” will ask the user if they want to calculate new coefficients using the “As Received” data points just taken.



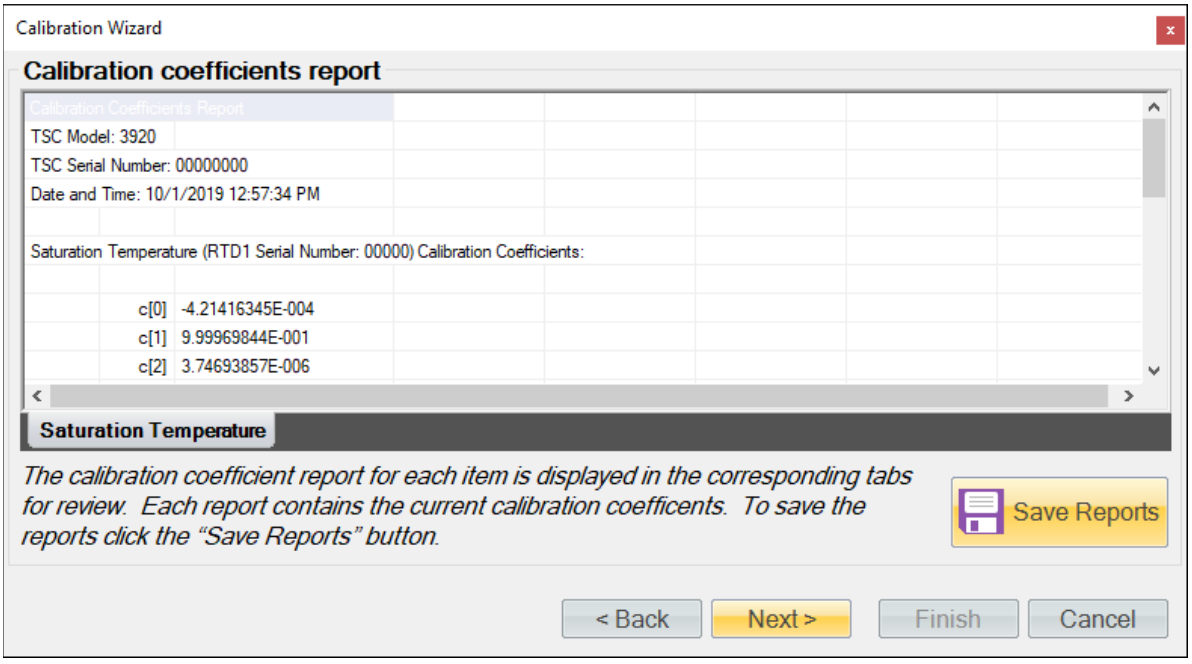
If the user selected to calculate new coefficients, they will be calculated and displayed. If any problem calculating the coefficient occurs, ControLog will issue a message telling the user that the coefficients could not be calculated.



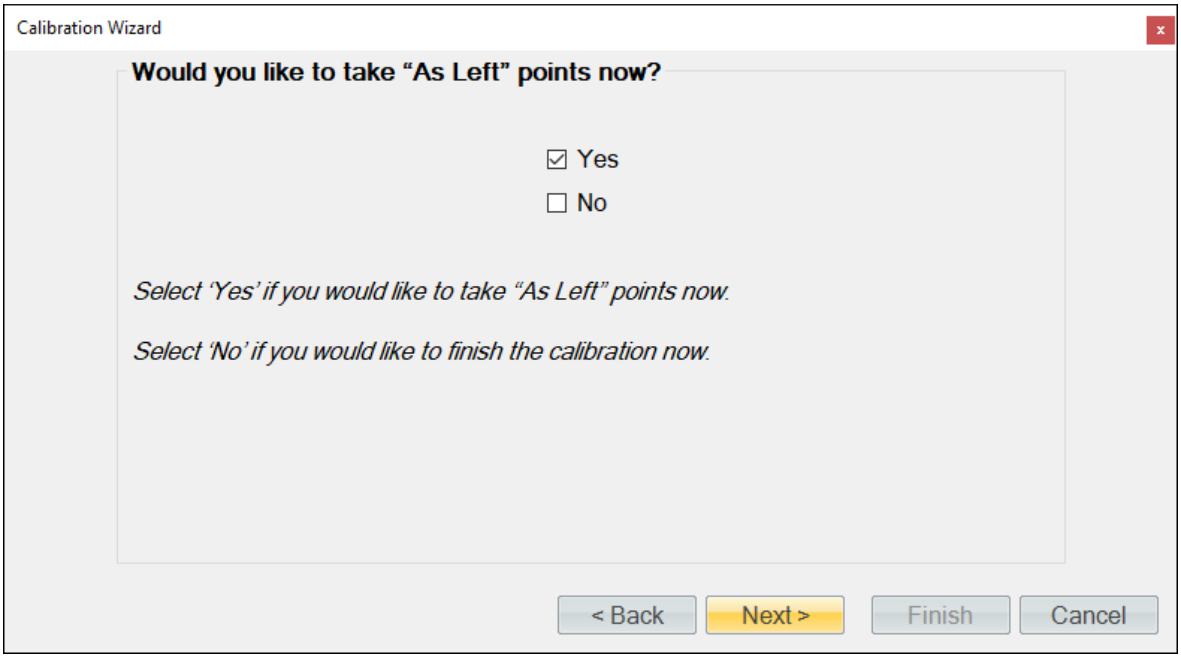
Next, the user will be asked to save the new coefficients to the system. Selecting “Yes” will result in the current coefficients being over-written by the newly calculated coefficients.



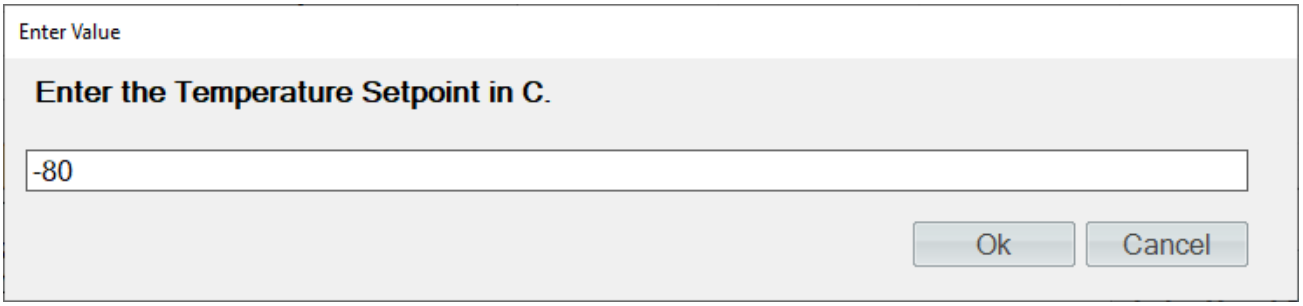
Next, the user can view and save the calibration coefficients report for the probe.



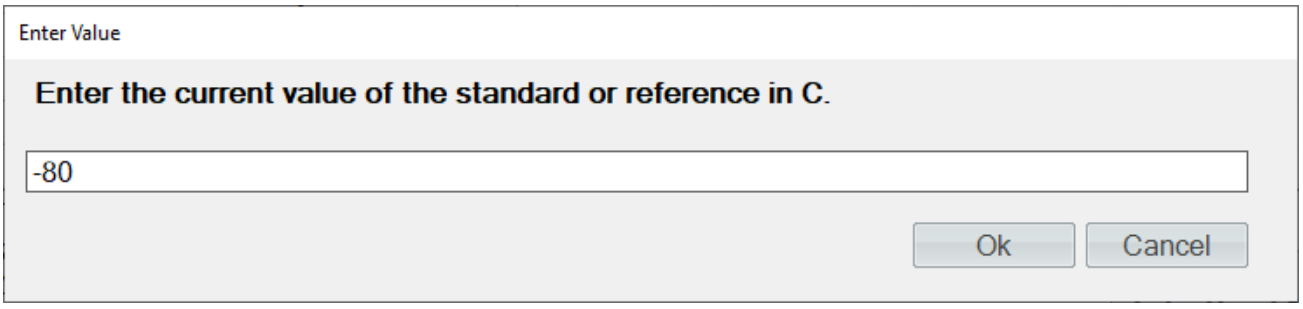
Next, the user can complete the calibration or can choose to take “As Left” points.



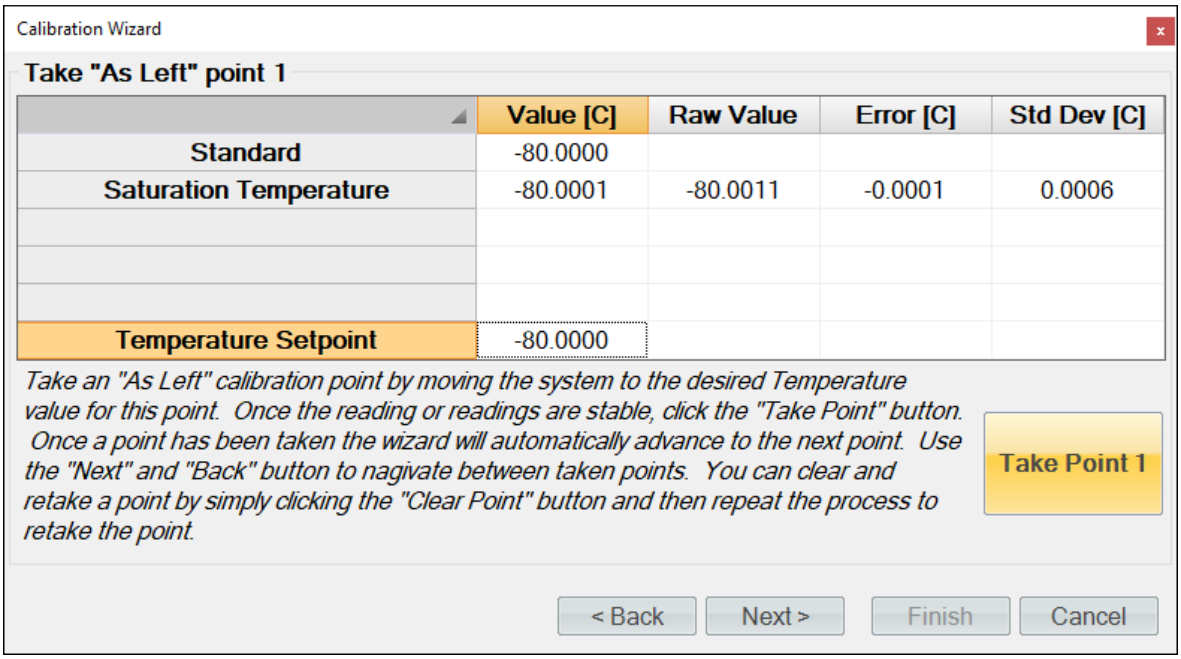
ControLog allows the user to take as many “As Left” points as they would like. In this example we will check every 10°C points starting at -80 °C and ending at 10 °C. If using the 3920 as the temperature bath, generate the first temperature point (-80 °C) by entering -80 in the “Temperature Setpoint” row and “Value” column.



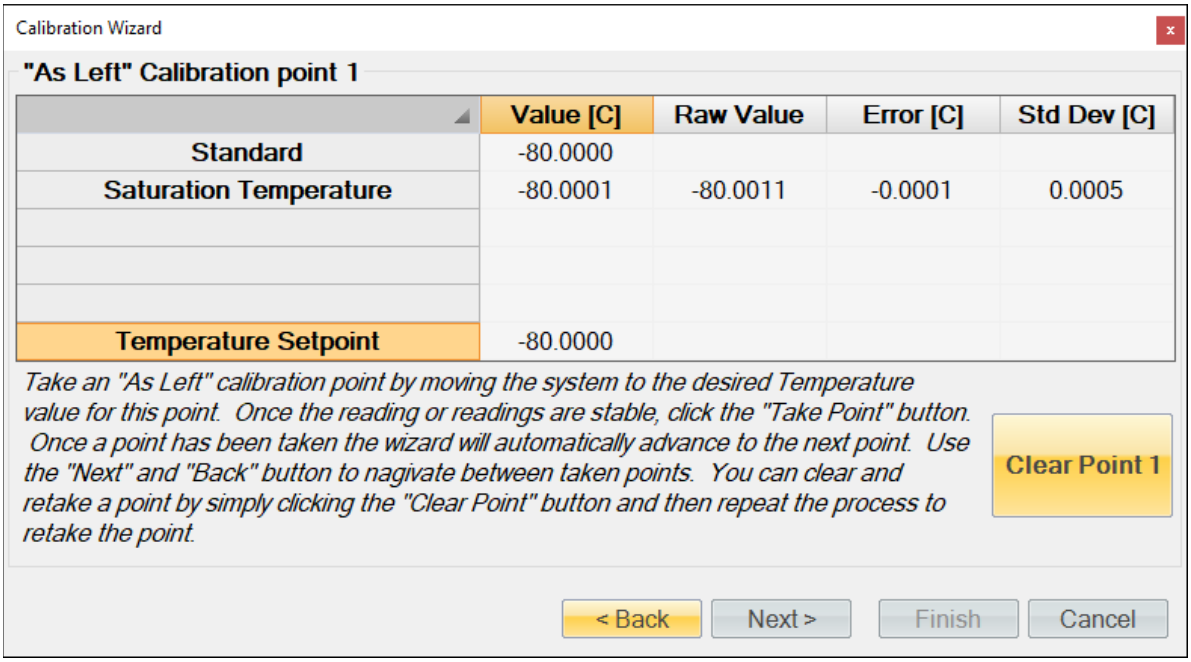
If the standard is not a connected device, then ControLog will ask for the value before taking the point. You can also enter a standard or reference value before taking a point by clicking the cell in the “Standard” row and “Value” column. This is useful for seeing error values before a point is taken.



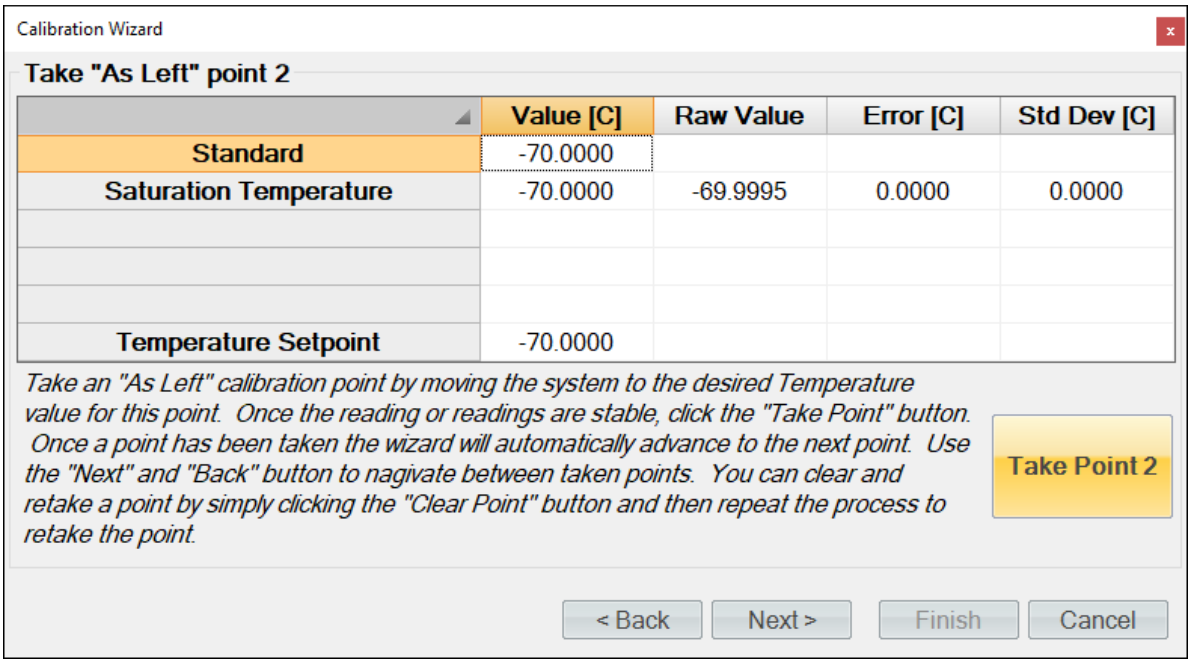
Once the readings are stable, enter the standards value and click the “Take Point” button. Once a point has been taken, the wizard will automatically advance to the next point.



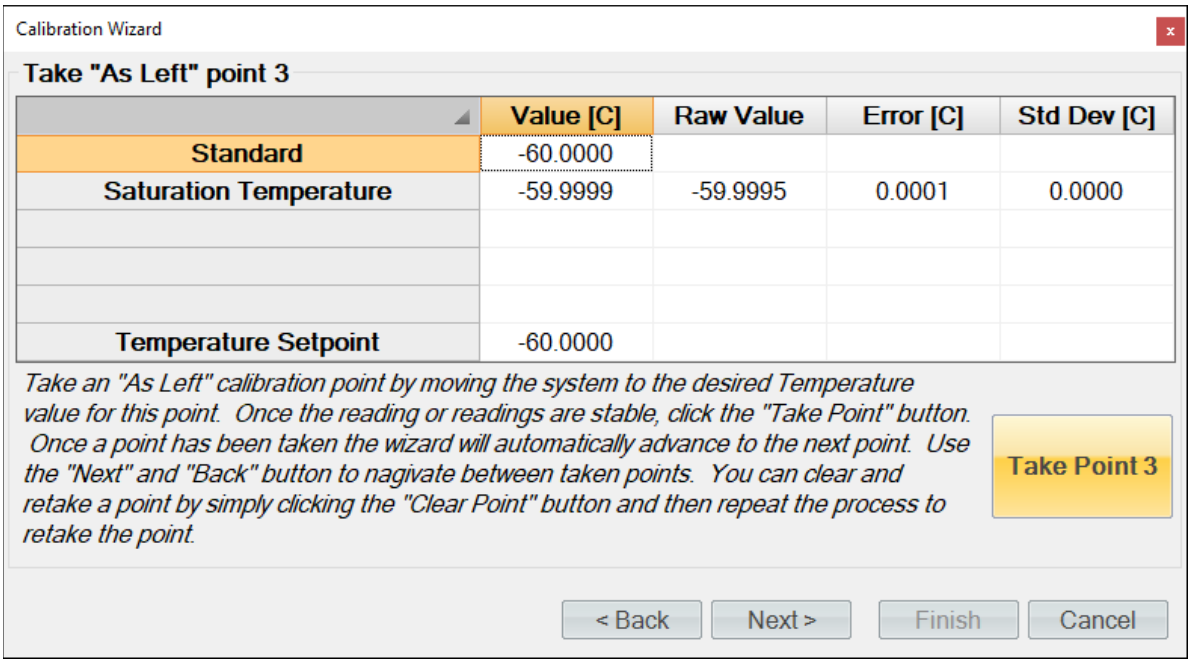
Tip - *Use the “Next” and “Back” button to navigate between taken points. You can clear and retake a point by simply clicking the “Clear Point” button and then repeat the process to retake the point.*



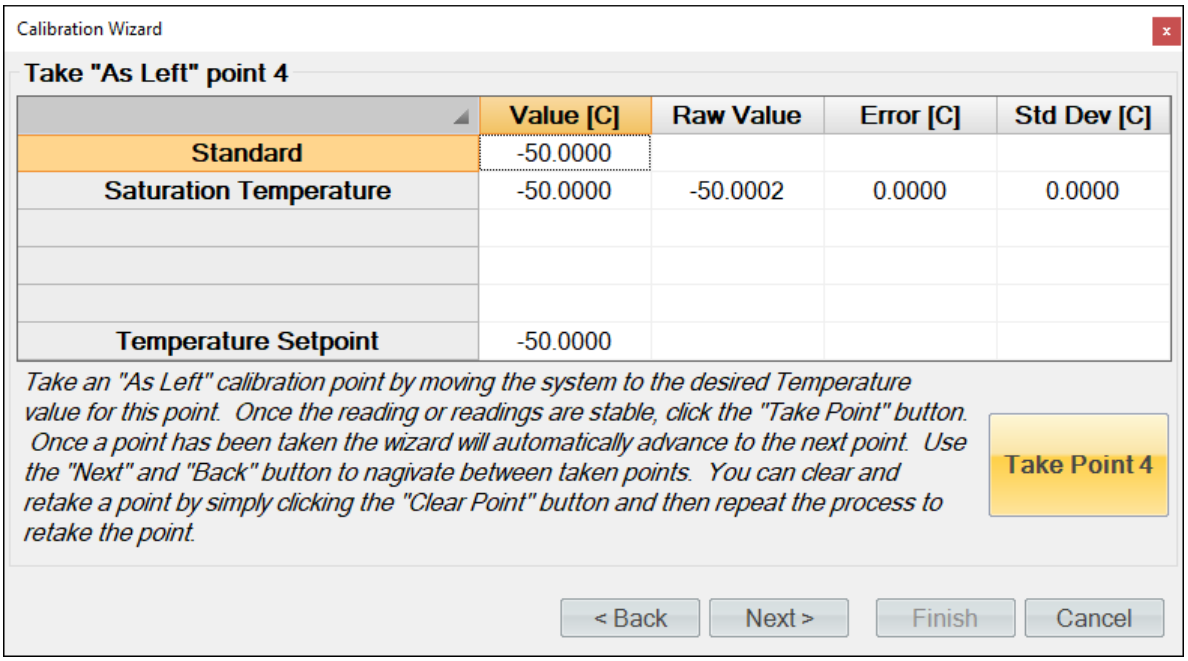
Generate the next temperature point (-70 °C) by entering -70 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



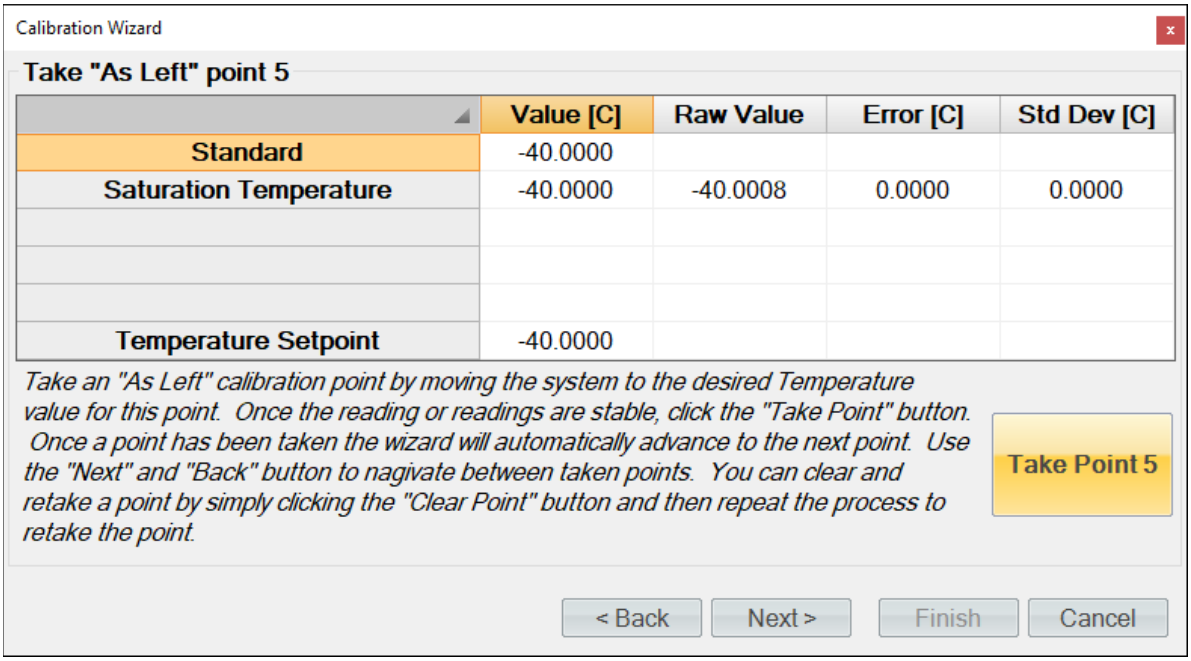
Generate the next temperature point (-60 °C) by entering -60 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



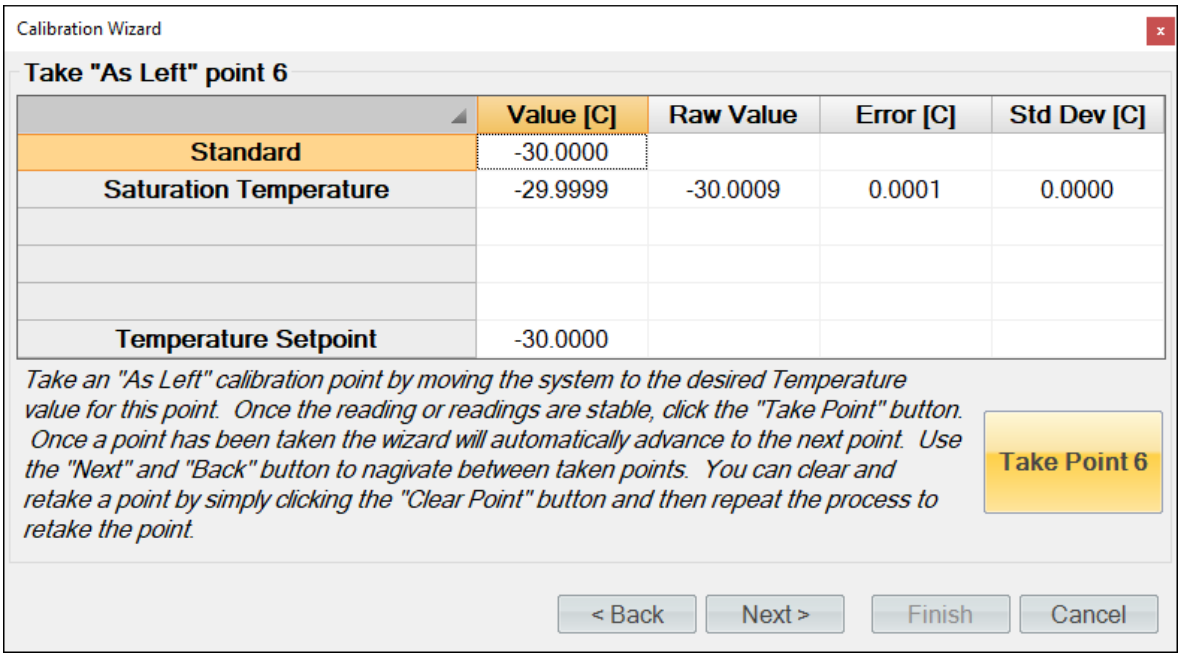
Generate the next temperature point (-50 °C) by entering -50 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



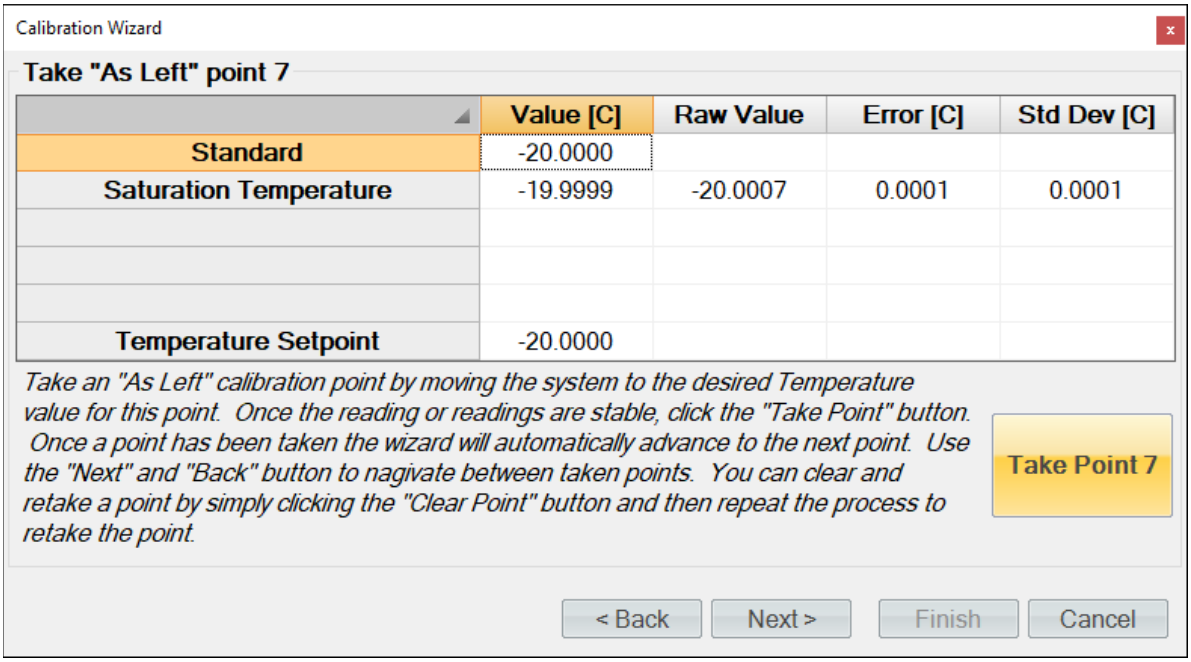
Generate the next temperature point (-40 °C) by entering -40 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



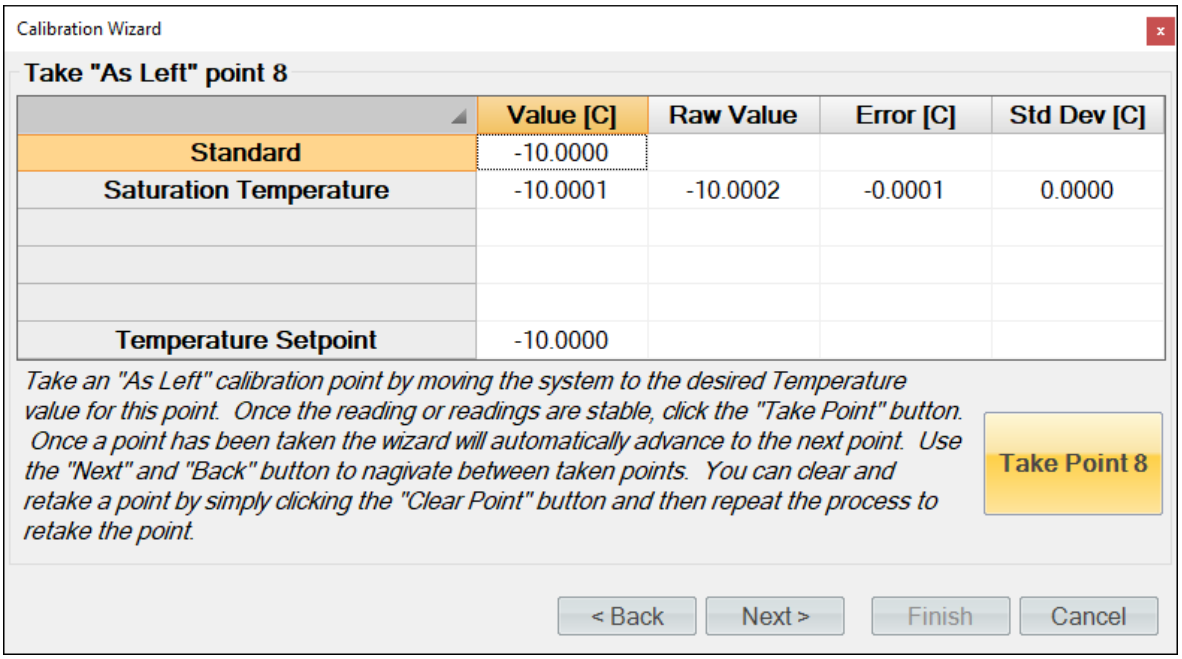
Generate the next temperature point (-30 °C) by entering -30 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



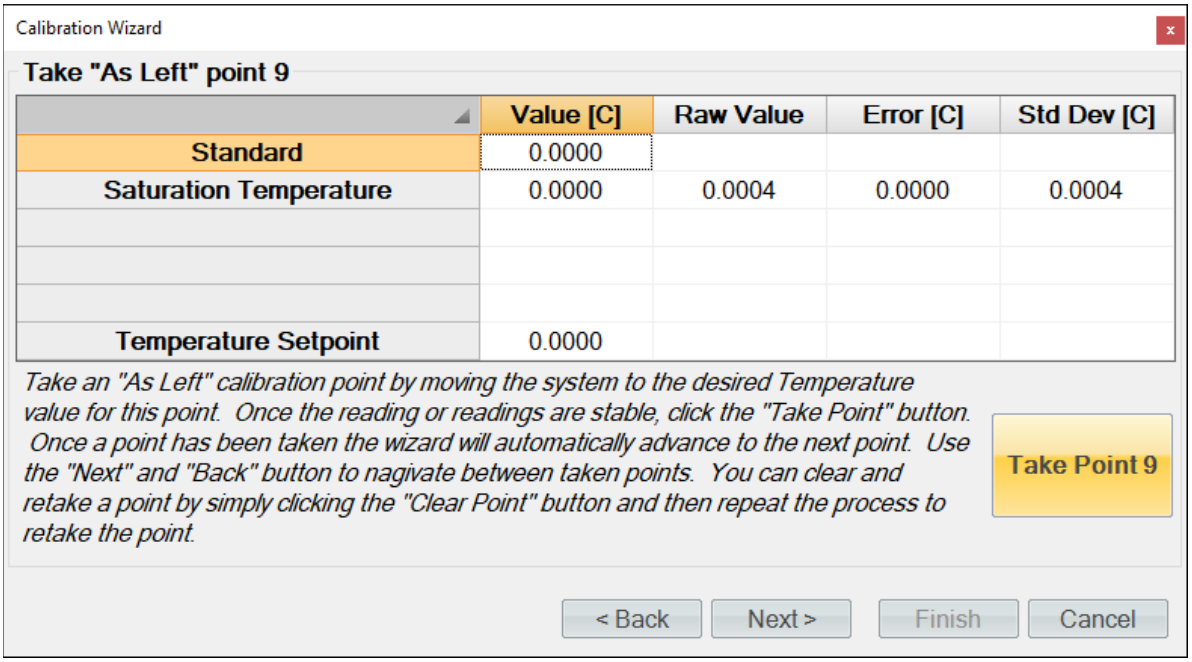
Generate the next temperature point (-20 °C) by entering -20 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



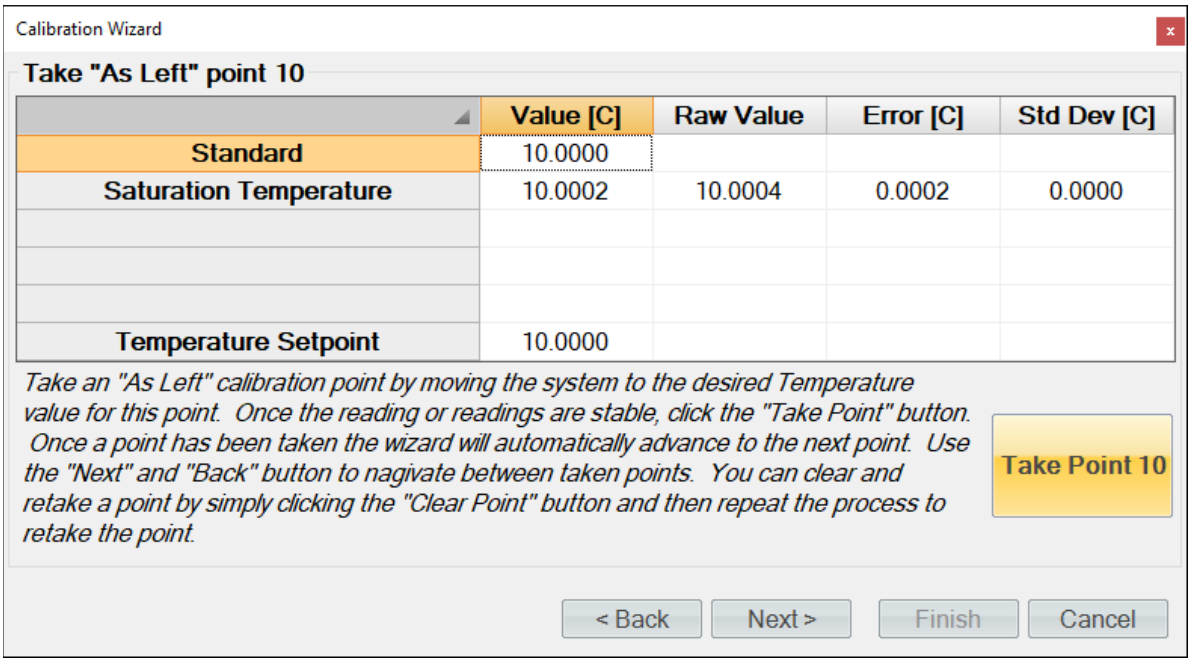
Generate the next temperature point (-10 °C) by entering -10 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



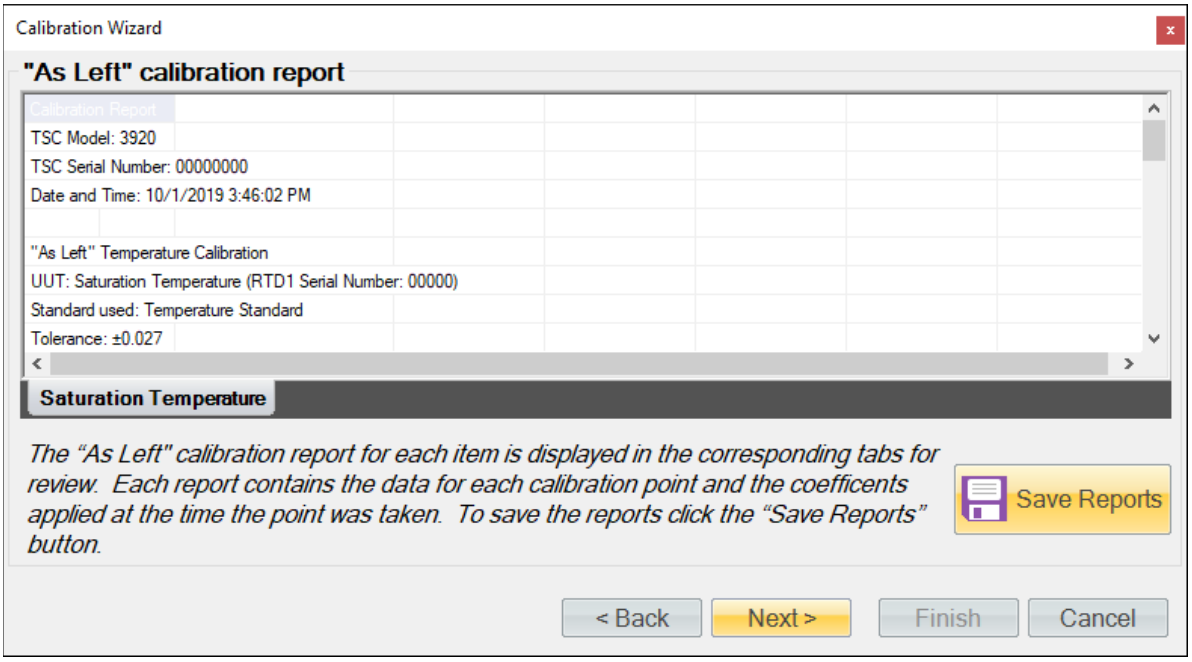
Generate the next temperature point (0 °C) by entering 0 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.



Generate the last temperature point (10 °C) by entering 10 in the “Temperature Setpoint” row and “Value” column. Once the readings are stable enter the standards value and click the “Take Point” button.

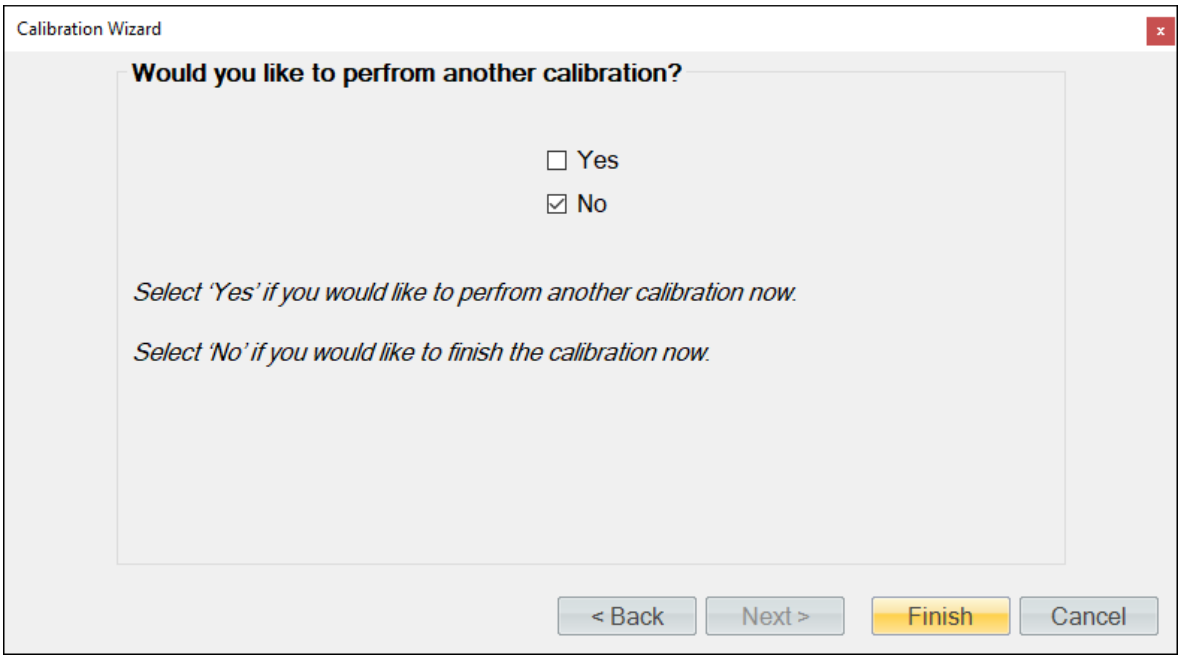


When you have taken the desired amount of “As Left” temperature points click the “Next” button to view the “As Received” calibration report. Each temperature probe will appear in its own tab and contains the data for each calibration point along with the coefficients used at the time the points were taken.



Clicking the “Save Reports” button will open a file dialog to save the report. The default file location is …Documents\Thunder Scientific\3920 ControLog\Reports\. If the report is saved in an Excel format, then each probe will appear in its own tab within the workbook. The user wishes to save in a text-based format then a file for each probe calibrated will be created.

When finished, close the Temperature Calibration window, quit ControLog, and then switch the power OFF. Remove the power cord.



1. Remove Standard PRT.
2. Replace 1/4" port plug insert. Tighten the Ultra Torr Knurled Nut to insure an airtight seal.
3. Reinstall RTD access insulation. Insure a tight seal
4. Reinstall countertop.
5. Replace left-side and right-side console panels (ensure condenser grill opening is on the left side).

6.1.3 Test Temperature

Repeat this same calibration procedure for test temperature probe (RTD 2) using a Precision Temperature Bath instead of the 3920. There is no need to remove any panel as the test temperature probe connects via the front hood. Calibrate over the range of 10 °C to 50 °C. Example points are (10 °C, 20 °C, 30 °C, 40 °C, 50 °C) but can be any sequence of numbers within the range. Just use best metrology practices when determining which the points to take. For more details refer to section *6.1.2 Calibration Procedure*.

6.2 Pressure Transducer Calibration

The pressure calibration procedure is used in conjunction with a precision pressure standard to calibrate the pressure transducers. The calibration calibrates the transducer as part of the system, much in the same way the temperature probes are calibrated. It uses up to five known pressures and all coefficients are calculated automatically by the computer and used to update the system calibration. Calibration reports will be generated for calibrations and can be saved for each of the pressure transducer at the conclusion of each calibration sequence.

Refer to drawings: 19D3920901-2, 19D3920901-3

6.2.1 Equipment Required

1. Standard or Reference pressure gauge and or source.
2. 9/16” wrench
3. 1/2” wrench

6.2.2 Calibration Procedure

This procedure describes the calibration of the Saturation Pressure Transducer but can be used for any of the pressure transducers by substituting that transducer’s specific ranges and points. For safety purposes, perform a shutdown, perform a shutdown system, switch system "POWER" to OFF and remove power cord before removing any panels.

⚠ CAUTION!

ALL SYSTEM PRESSURE MUST BE VENTED BEFORE PROCEEDING.

1. Remove the left side console panel from the generator
2. Using the appropriate tools, remove pressure transducer (T1) to be calibrated, leaving it electrically connected to the system.
3. Connect transducer to be calibrated to the reference pressure controller.
4. Connect power and switch main console power to ON. Wait a few moments for the system to initialize and for the main screen to appear.

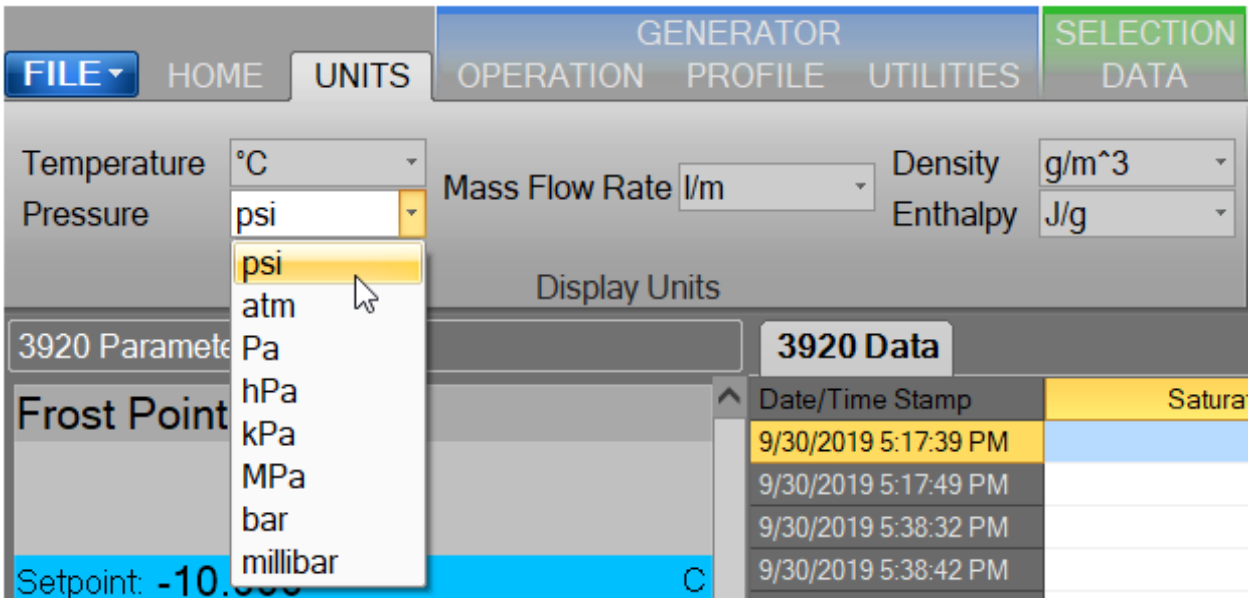
Note: Only one pressure transducer can be calibrated at any given time. Each transducer is operated over a limited range and requires calibration within this range only.

- Saturation Pressure Transducer (T1) - Calibrate from ambient to 250 psiA.
- Test Pressure Transducer (T2) - Calibrate from ambient to 50 psiA.
- Supply Pressure Transducer (T3) - Calibrate from ambient to 250 psiG.

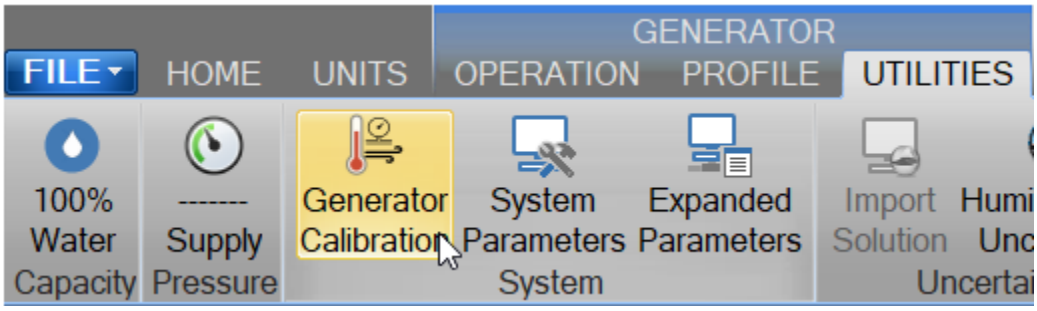
⚠ CAUTION!

DO NOT ENABLE PRESSURE CONTROL WITH PRESSURE TRANSDUCERS DISCONNECTED FROM SYSTEM.

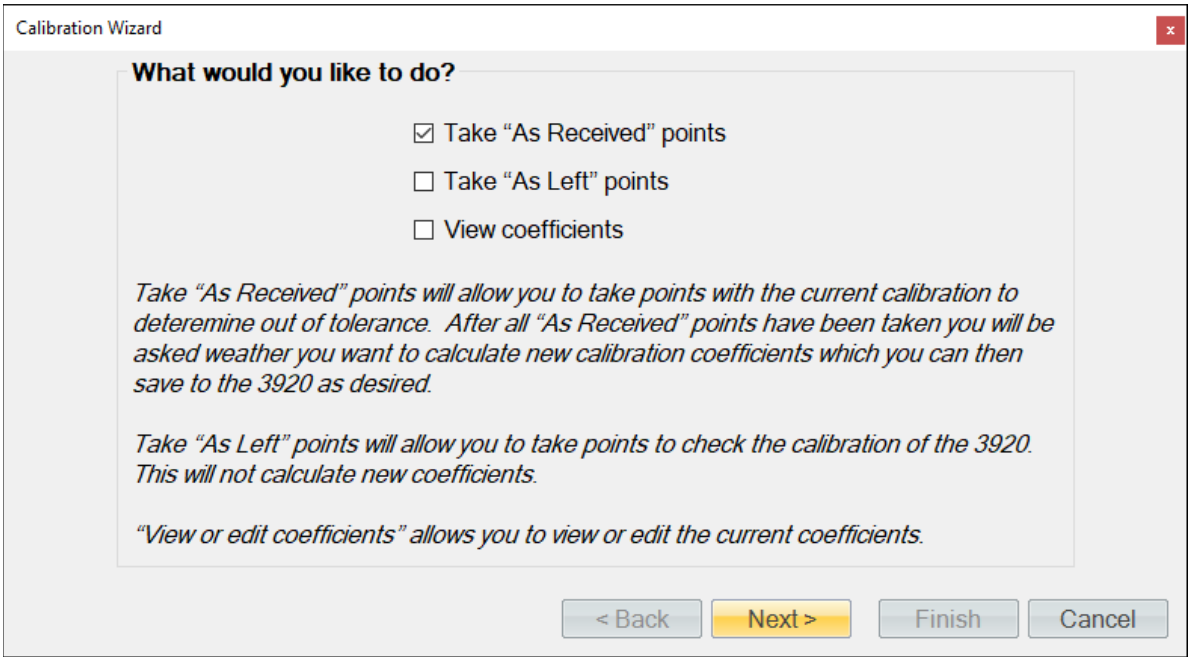
From the Units menu tab select the desired pressure units for calibration. Once calibration has begun, the units should not be changed again until the calibration is complete.



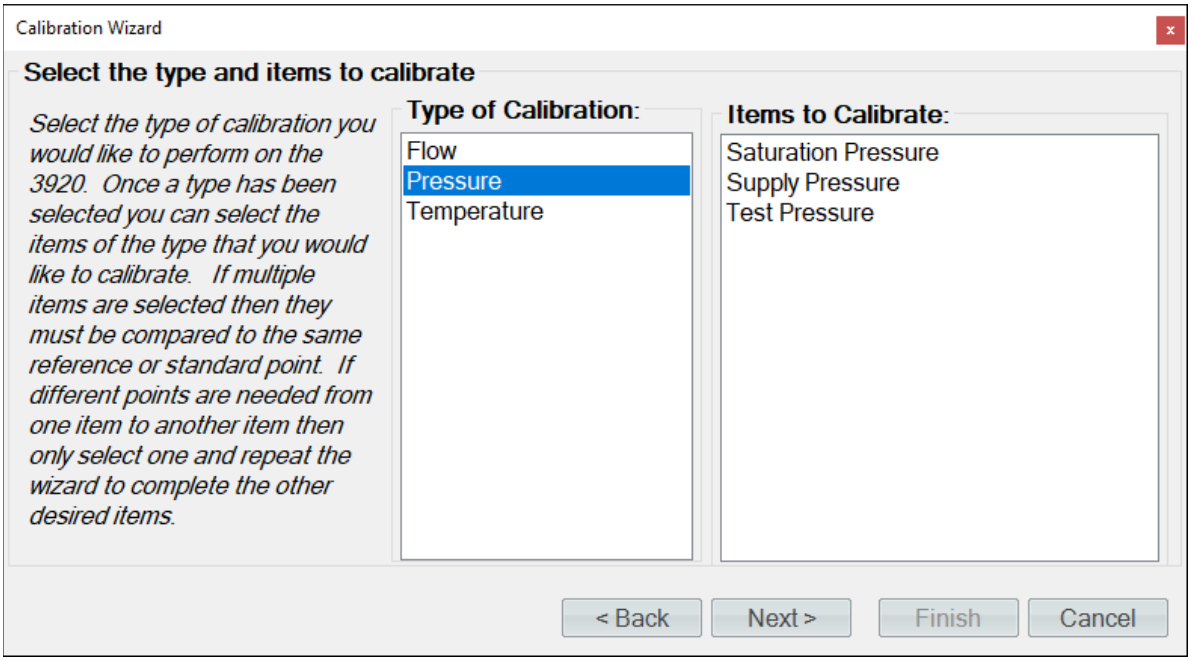
Select Generator Calibration from the Utilities menu tab to open the Calibration Wizard.



Select, “Take “As Received” points”. This will allow the user to take points with the current calibration to determine out of tolerance. After all “As Received” points have been taken the user will be asked whether they want to calculate new calibration coefficients.

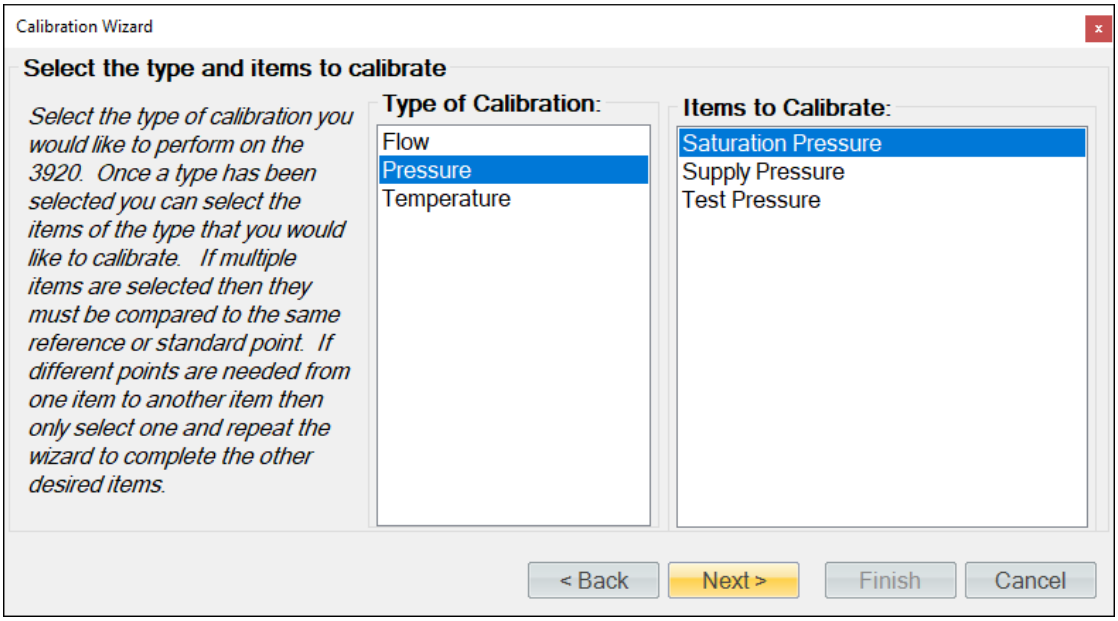


Set the type of calibration to Pressure.



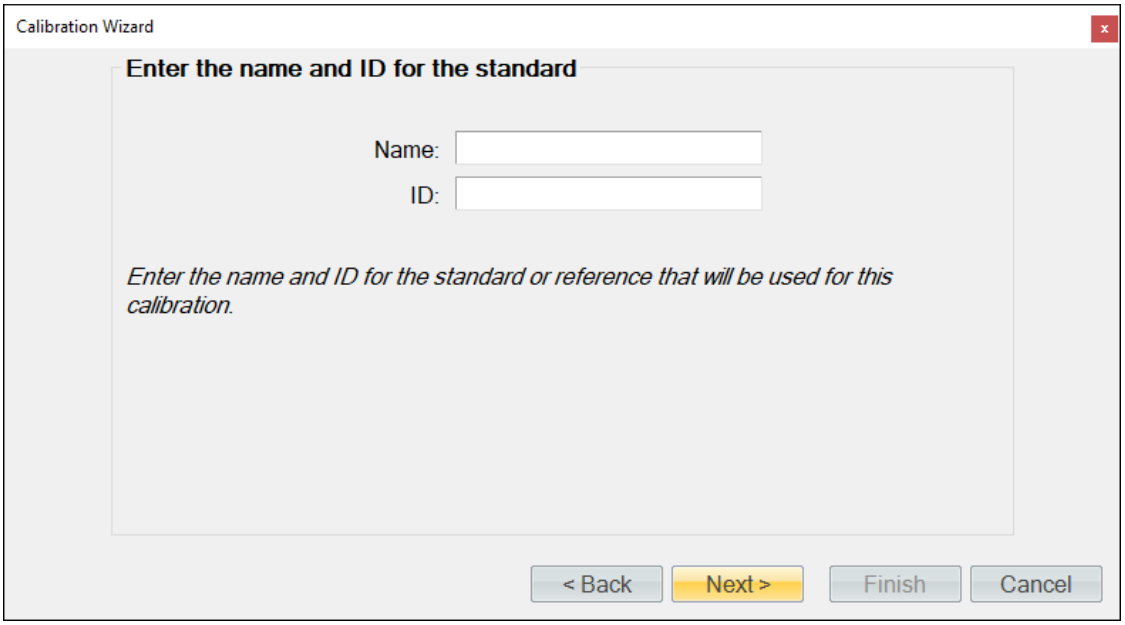
Select the pressure transducer to be calibrated.

> **Note –** *Only one pressure transducer can be calibrated at any given time due to the different scaling of the transducers.*

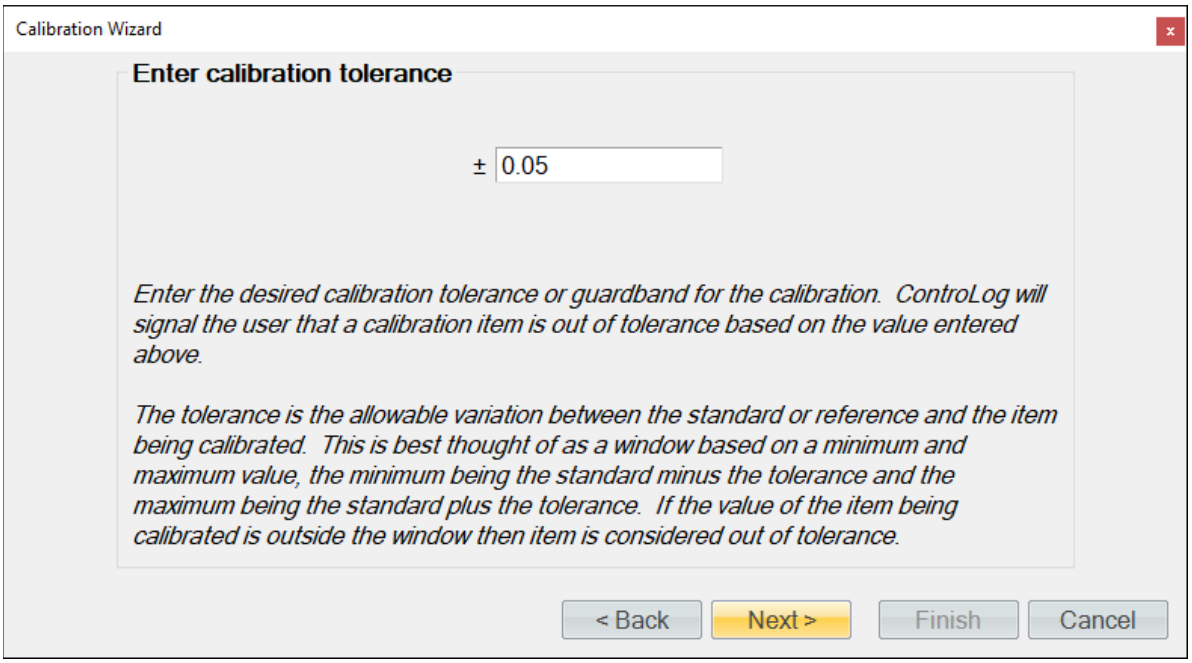


If the pressure standard is a connected device (refer to section 10 Connections), you may select it for the calibration. You can use a single device item with the same calibration type from any connected device. ControLog will automatically record the standard's value during each calibration point. If the standard is not a connected device or if you desire to manually enter the standard's value do not select an item from the list.

Enter the Name and ID of the standard being used. This information will be populated on the calibration report. Selecting "Next" without entering a Name will result in ControLog giving the standard a generic name.

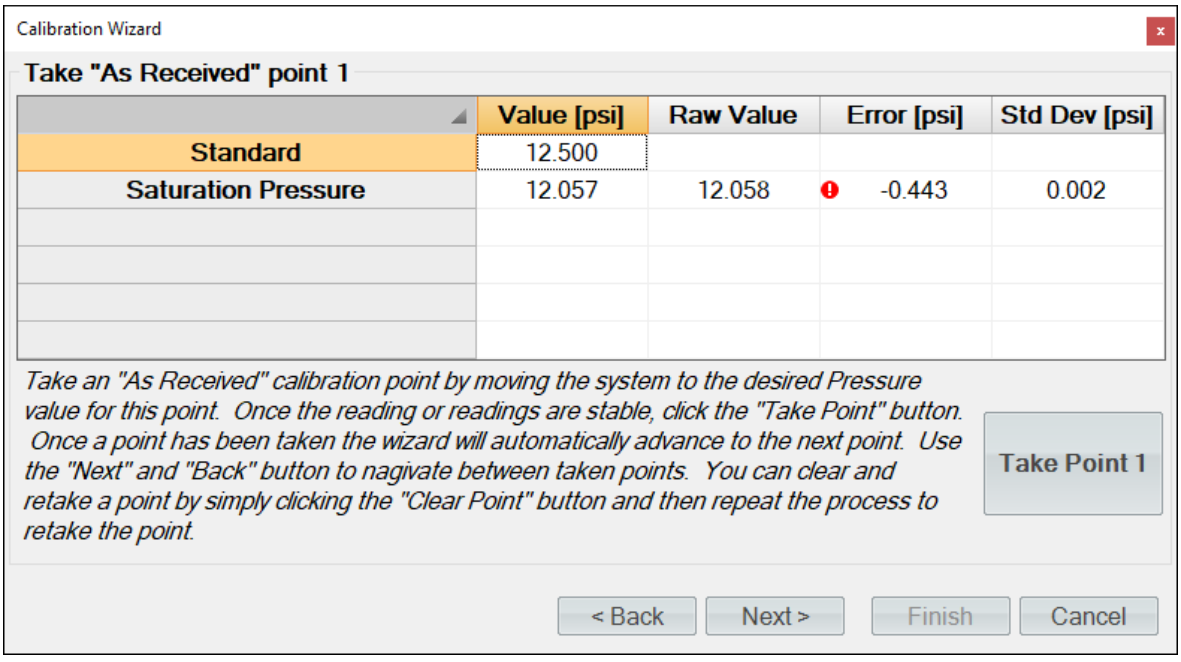


Enter the desired calibration tolerance or guard band for the calibration. ControLog will signal the user that a calibration item is out of tolerance based on the value entered below.



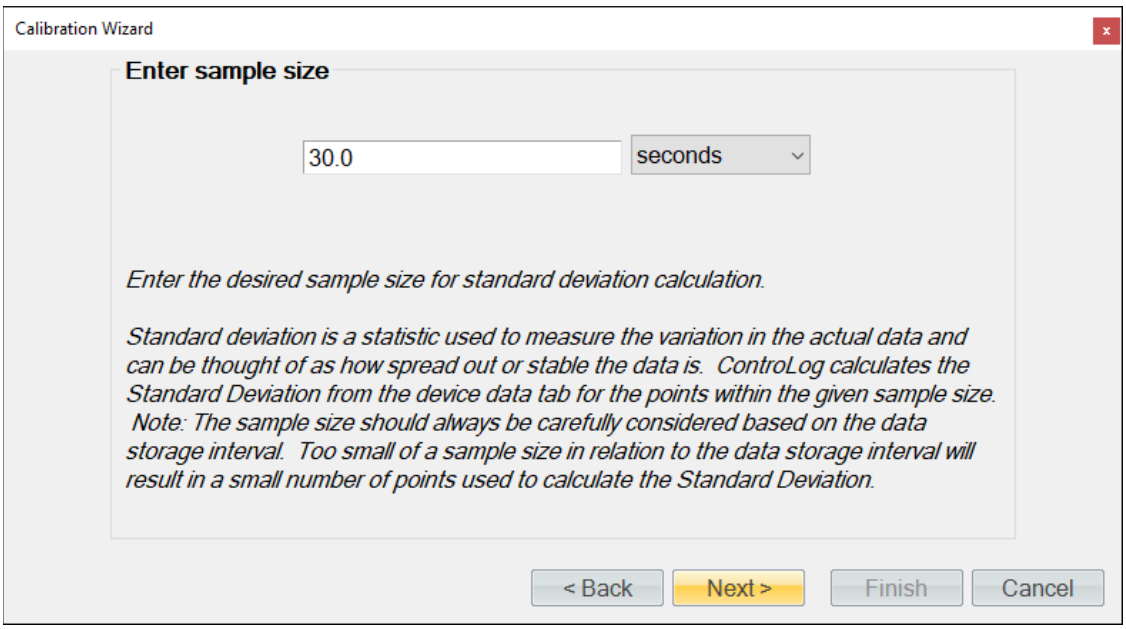
The tolerance is the allowable variation between the standard or reference and the item being calibrated. This is best thought of as a window based on a minimum and maximum value, the minimum being the standard minus the tolerance and the maximum being the standard plus the tolerance. If the value of the item being calibrated is outside the window, then item is considered out of tolerance.

An out of tolerance condition will be indicated by a red circle with an exclamation point for the out of tolerance transducer in the Error column.

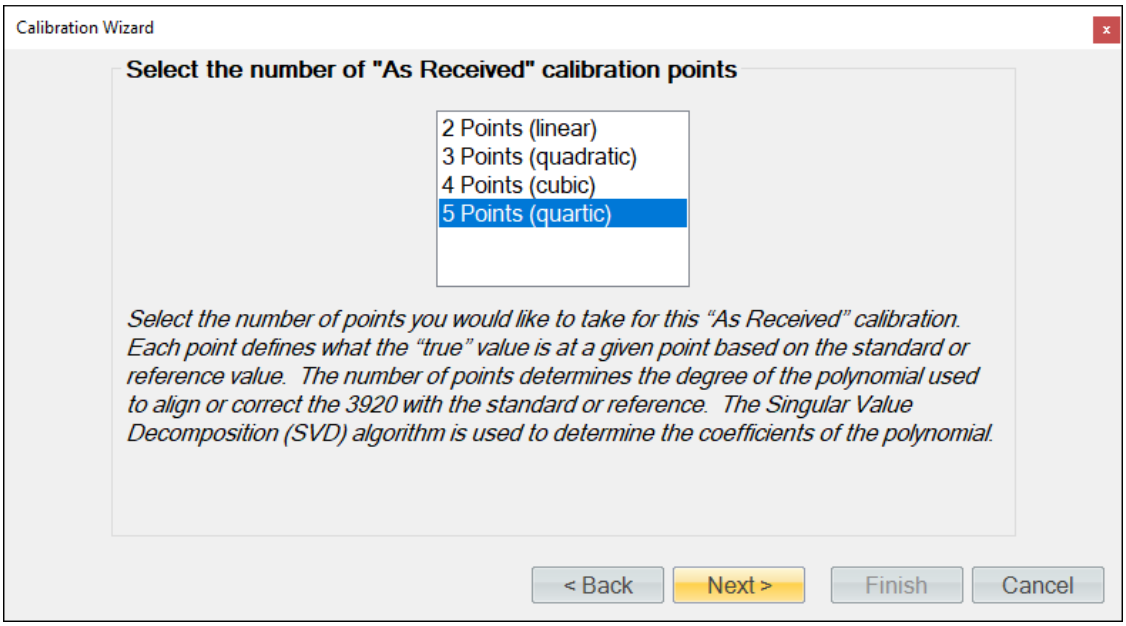


Enter the sample size used to perform the standard deviation calculation. The sample size is the given time that ControLog will use to determine which data points to use to determine the standard deviation of each probe.

> **Note** - *The number of points used will be based on the data storage rate you have selected along with the desired sample size. For example, if the data storage rate is every 10 seconds then a sample size of 1 minute will result in 10 points being used to calculate the standard deviation.*



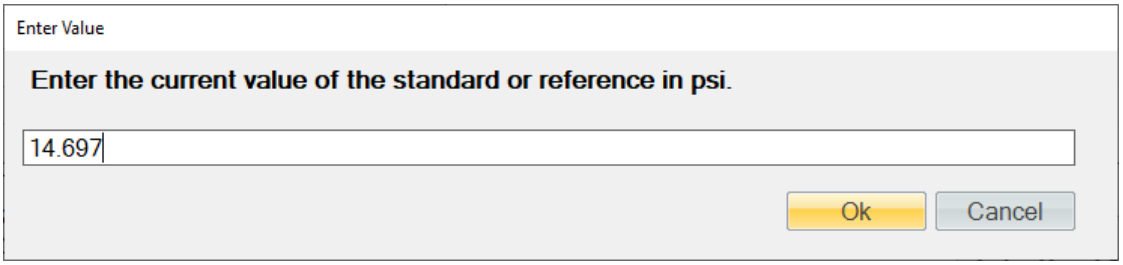
Select the number of points you would like to take for this "As Received" calibration. Each point defines what the "true" value is at a given point based on the standard or reference value. The number of points determines the degree of the polynomial used to align or correct the generator with the standard or reference.



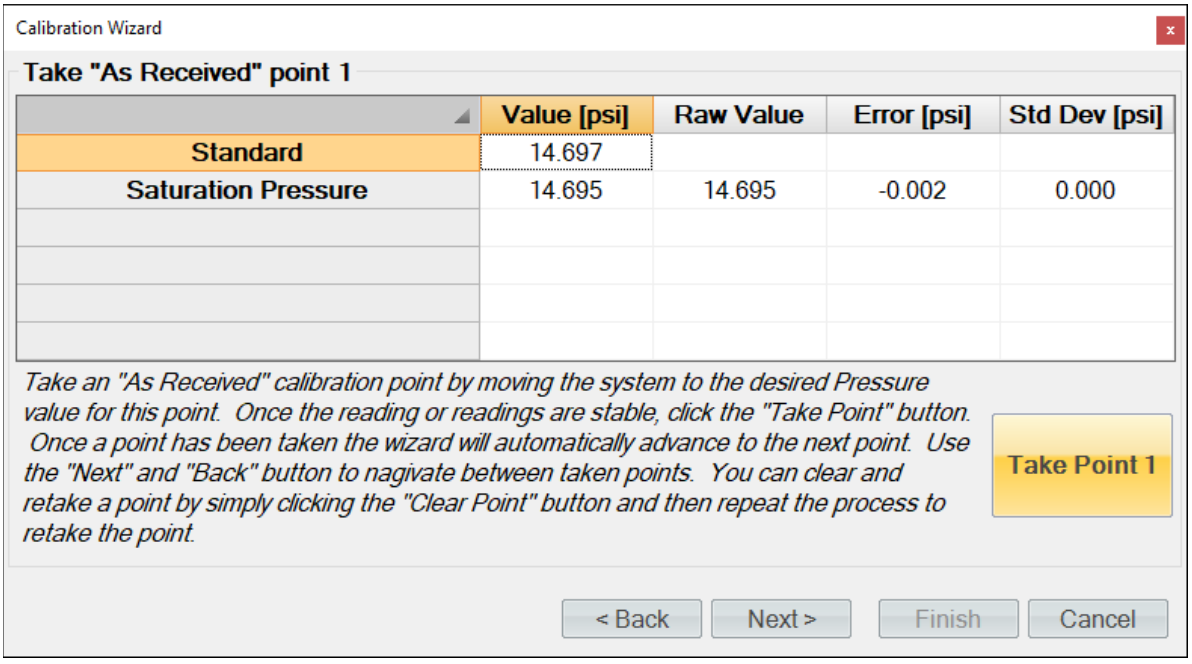
Note - *Each transducer is operated at or above ambient pressure, requiring calibration between ambient and full scale only. There is no need for below ambient testing or calibration.*

Note – *The specific points can be different than those used in the example. For this example, the points, Ambient, 40, 80, 120. 160 were used, but it could have also been Ambient, 25, 50, 100, 160. Just use best metrology practices when determining which the points to take.*

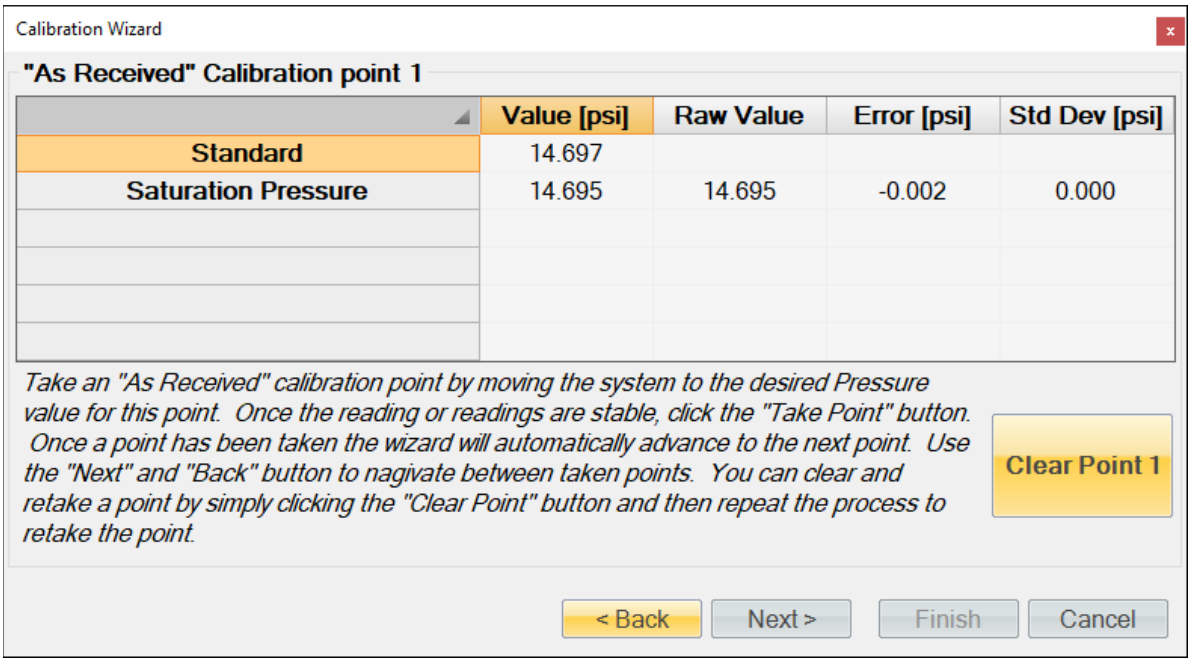
Using the pressure standard, generate and measure an ambient pressure. If the standard is not a connected device, then ControLog will ask for the value before taking the point. You can also enter a standard or reference value before taking a point by clicking the cell in the "Standard" row and "Value" column. This is useful for seeing error values before a point is taken.



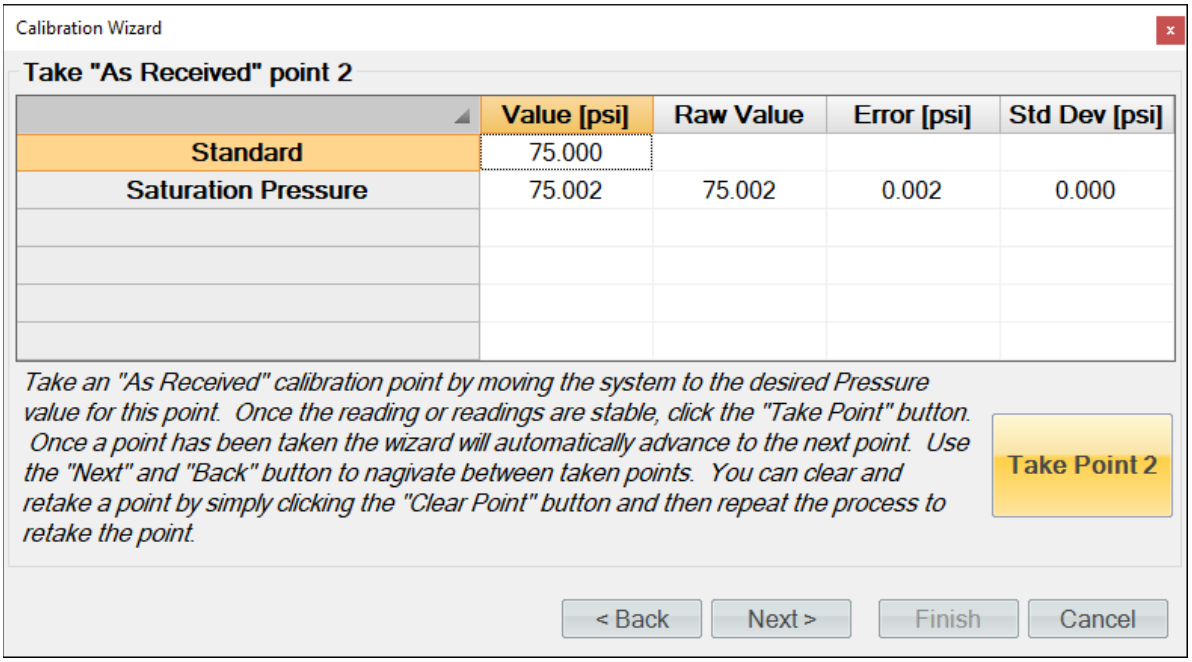
Once the reading is stable, click the "Take Point" button. Once a point has been taken, the wizard will automatically advance to the next point.



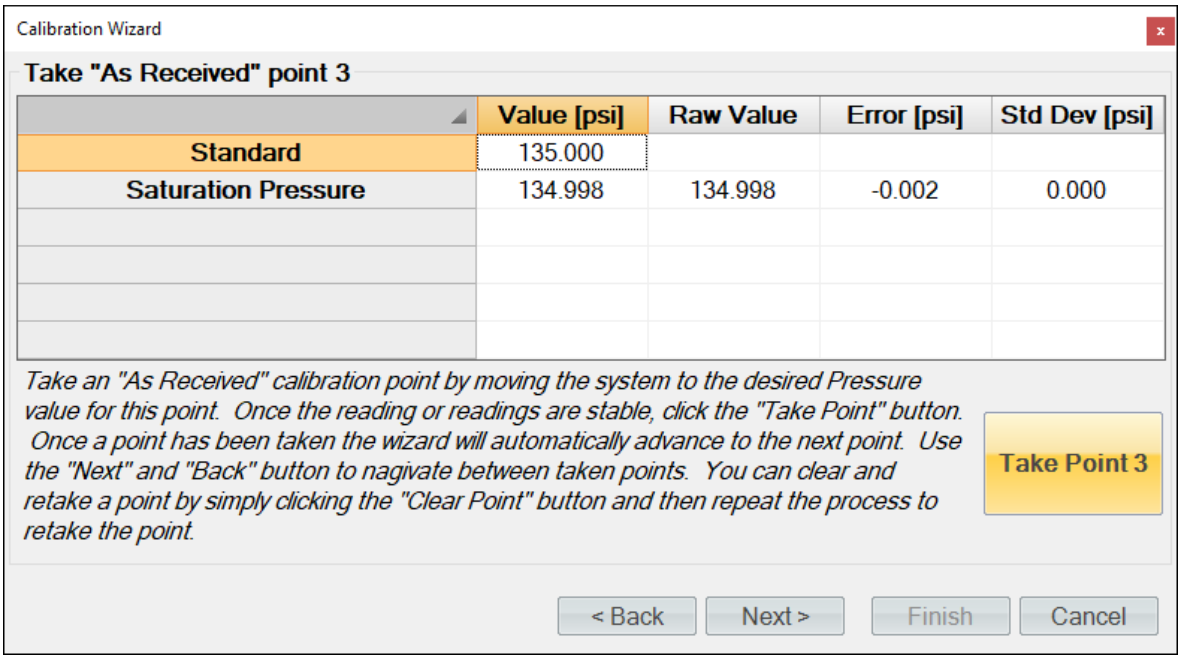
Tip - *Use the "Next" and "Back" button to navigate between taken points. You can clear and retake a point by simply clicking the "Clear Point" button and then repeat the process to retake the point.*



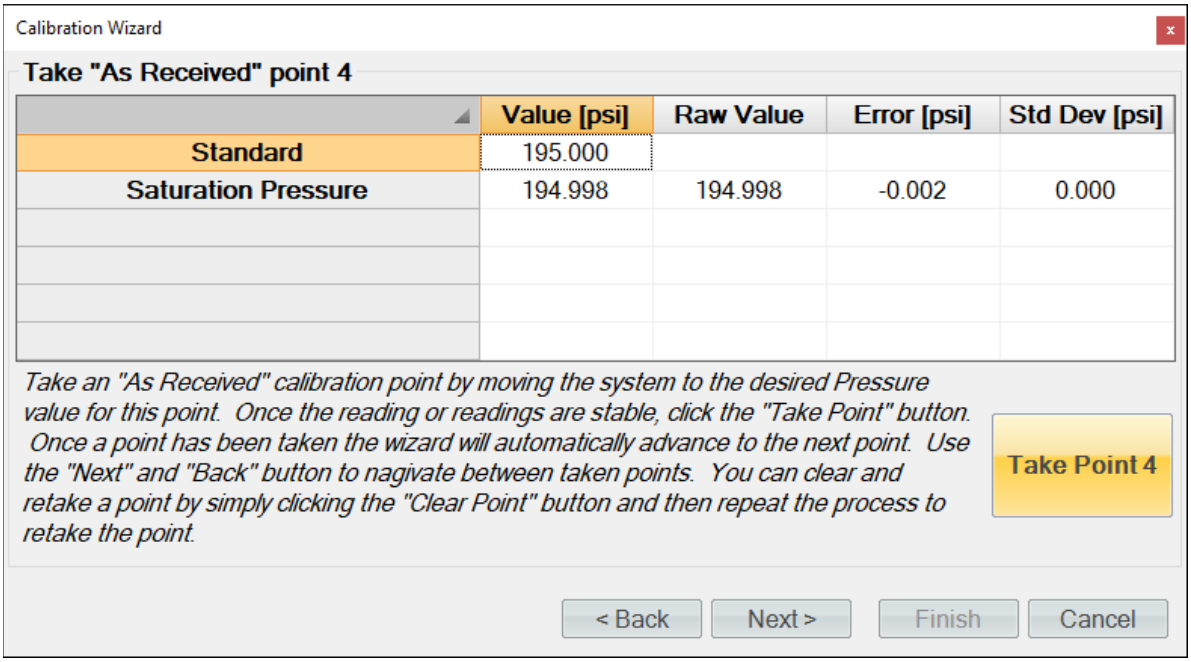
Using the pressure standard, generate and measure the next pressure point (75 psi). Once the readings are stable, enter the standards value and click the “Take Point” button.



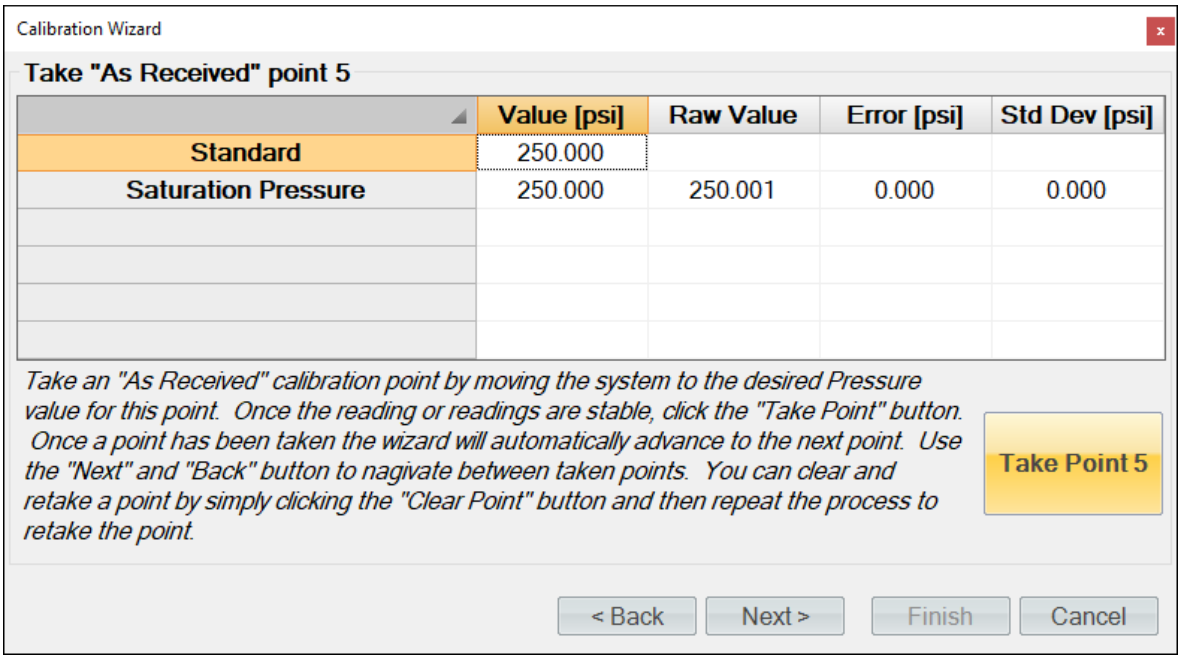
Using the pressure standard, generate and measure the next pressure point (135 psi). Once the readings are stable, enter the standards value and click the “Take Point” button.



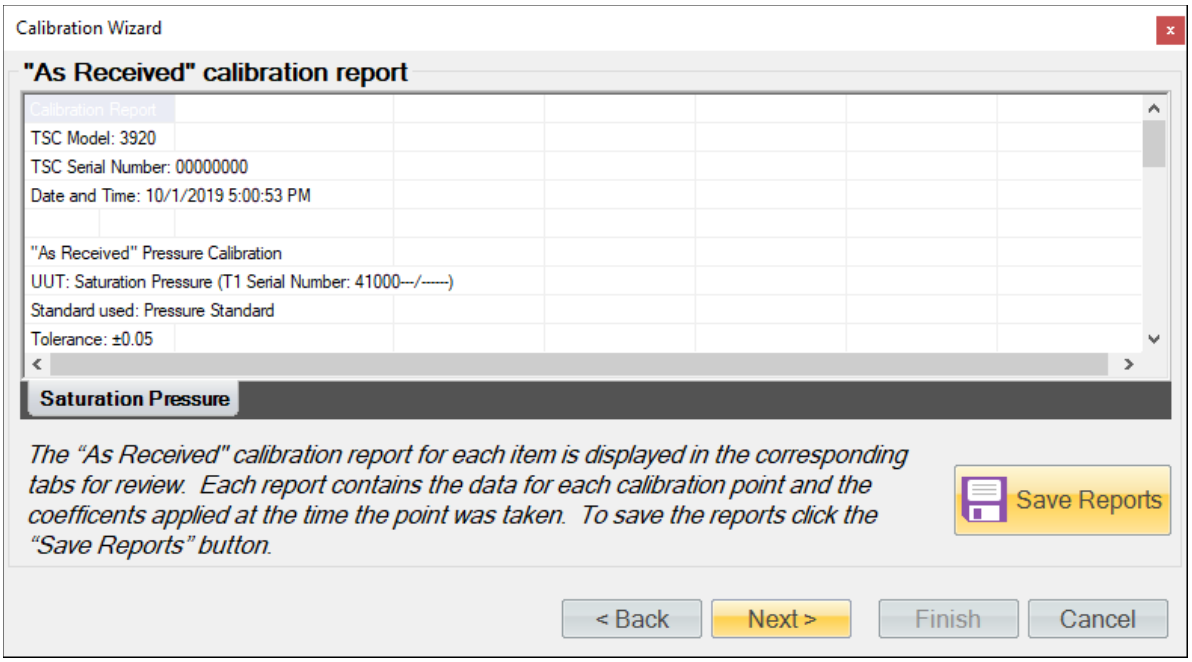
Using the pressure standard, generate and measure the next pressure point (195 psi). Once the readings are stable, enter the standards value and click the “Take Point” button.



Using the pressure standard, generate and measure the last pressure point (250 psi). Once the readings are stable, enter the standards value and click the “Take Point” button.

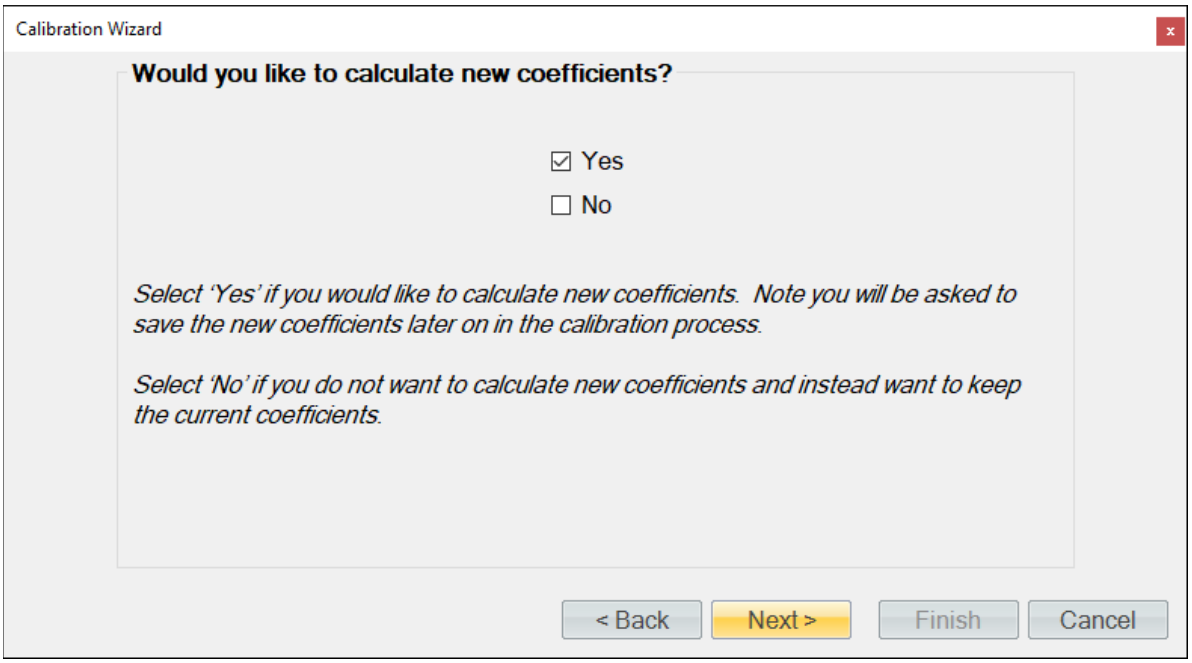


When all pressure points have been entered, ControLog will advance to the “As Received” calibration report. The transducer will appear in its own tab and contains the data for each calibration point along with the coefficients used at the time the points were taken.

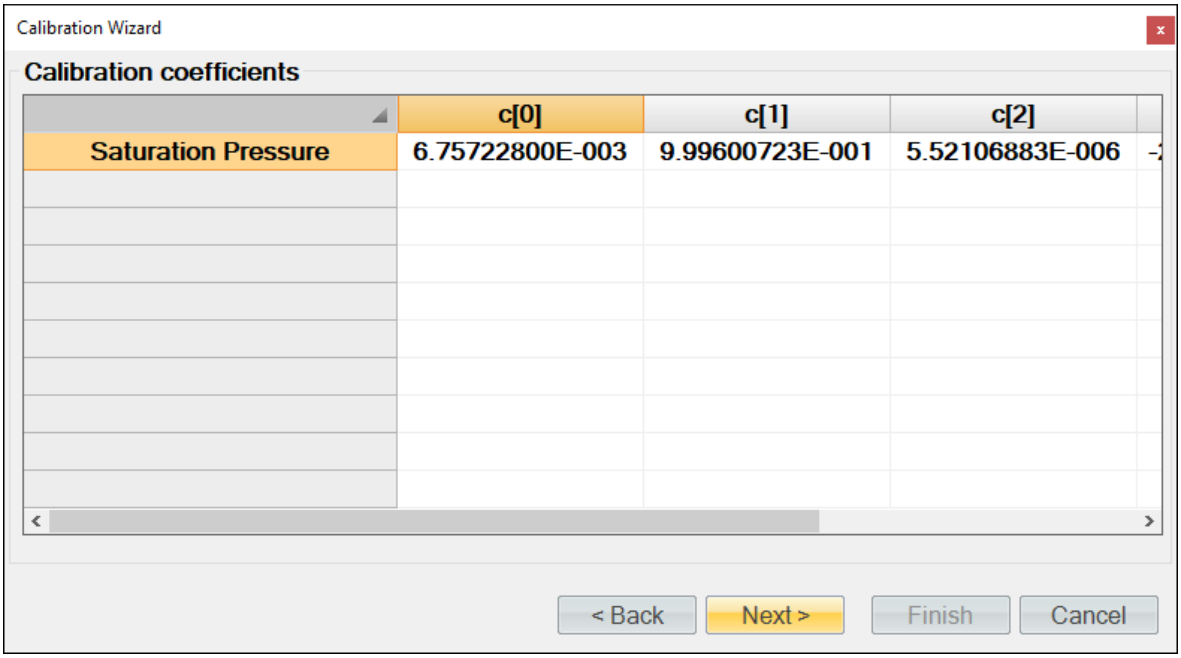


Clicking the “Save Reports” button will open a file dialog to save the report. The default file location is …Documents\Thunder Scientific\3920 ControLog\Reports\.

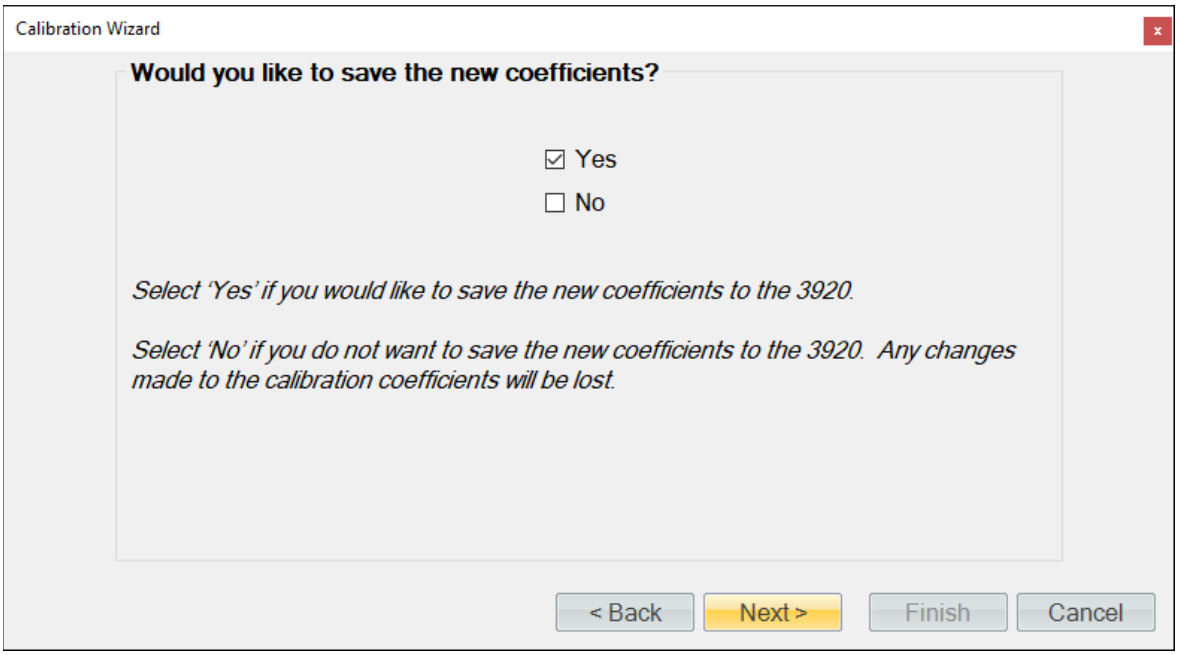
Clicking “Next” will ask the user if they want to calculate new coefficients using the as received data points just taken.



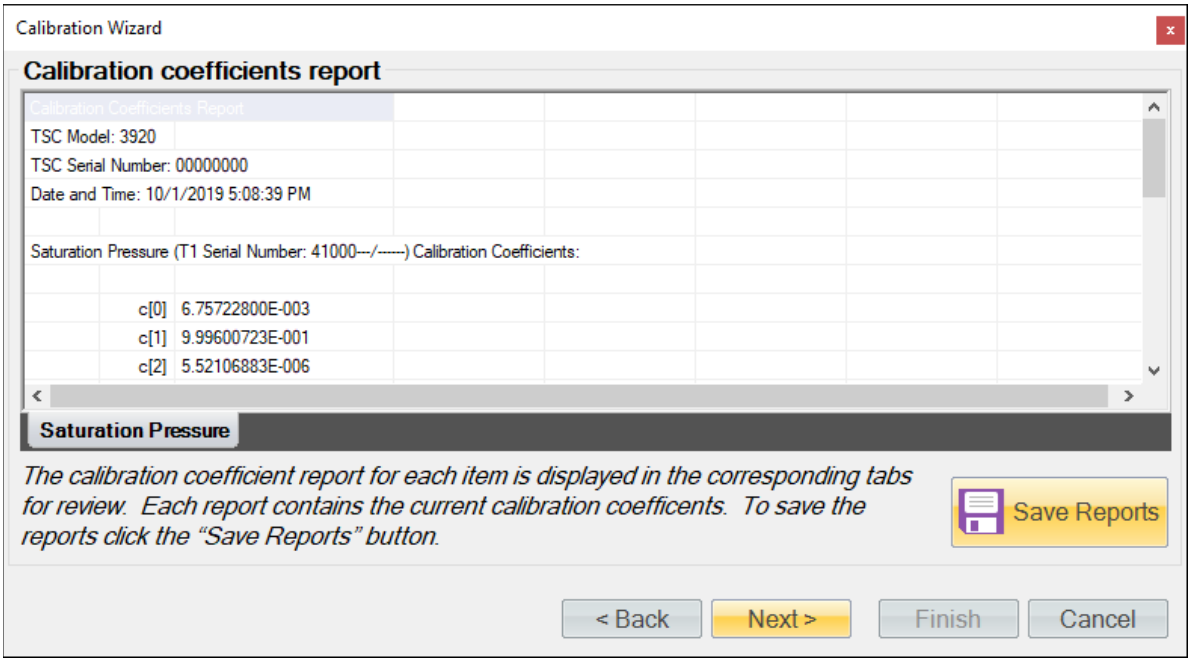
If the user selected to calculate new coefficients, they will be calculated and displayed. If any problem calculating the coefficient occurs, ControLog will issue a message telling the user that the coefficients could not be calculated.



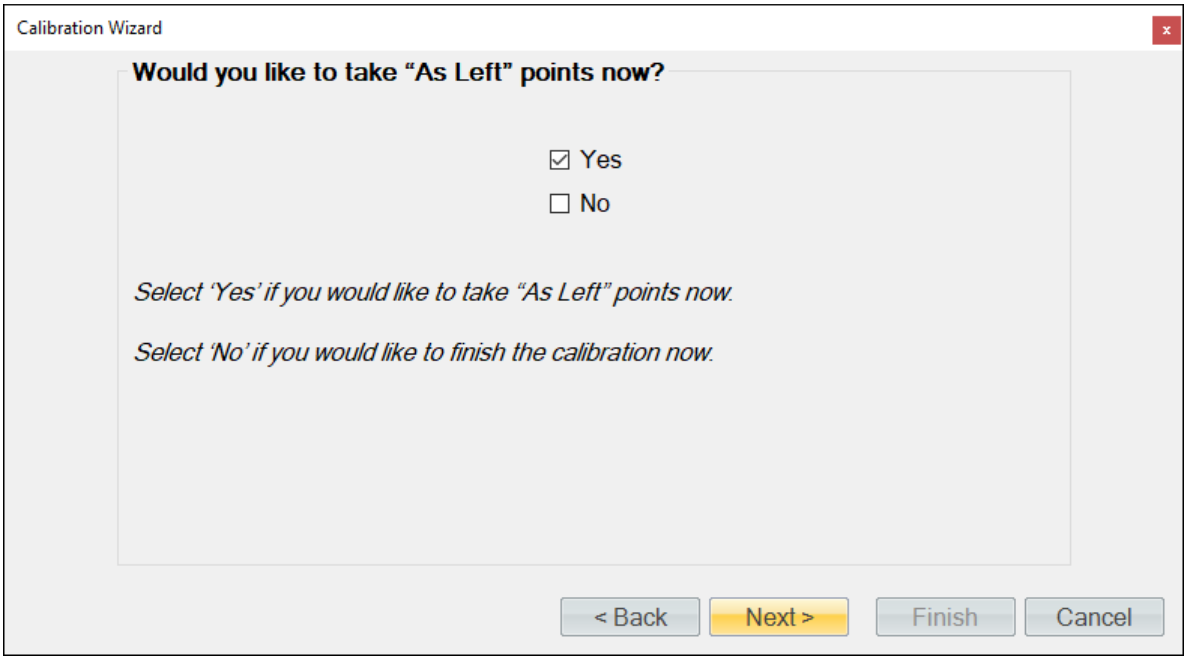
Next, the user will be asked to save the new coefficients to the system. Selecting “Yes” will result in the current coefficient being over-written by the newly calculated coefficients.



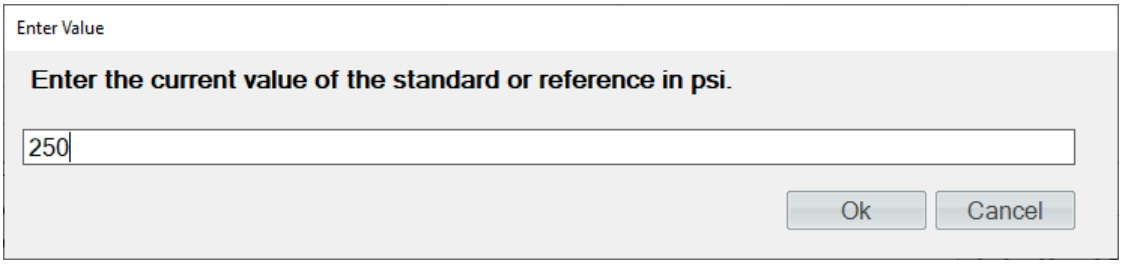
Next, the user can view and save the calibration coefficients report for the transducer.



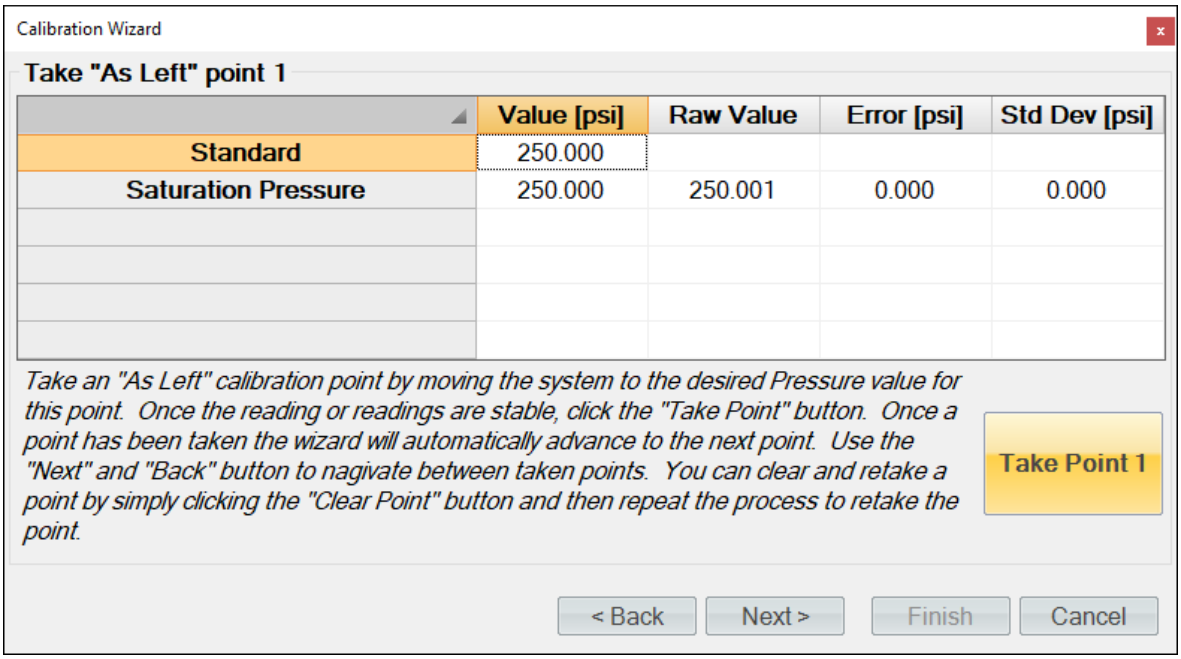
Next, the user can complete the calibration or can choose to take “As Left” points.



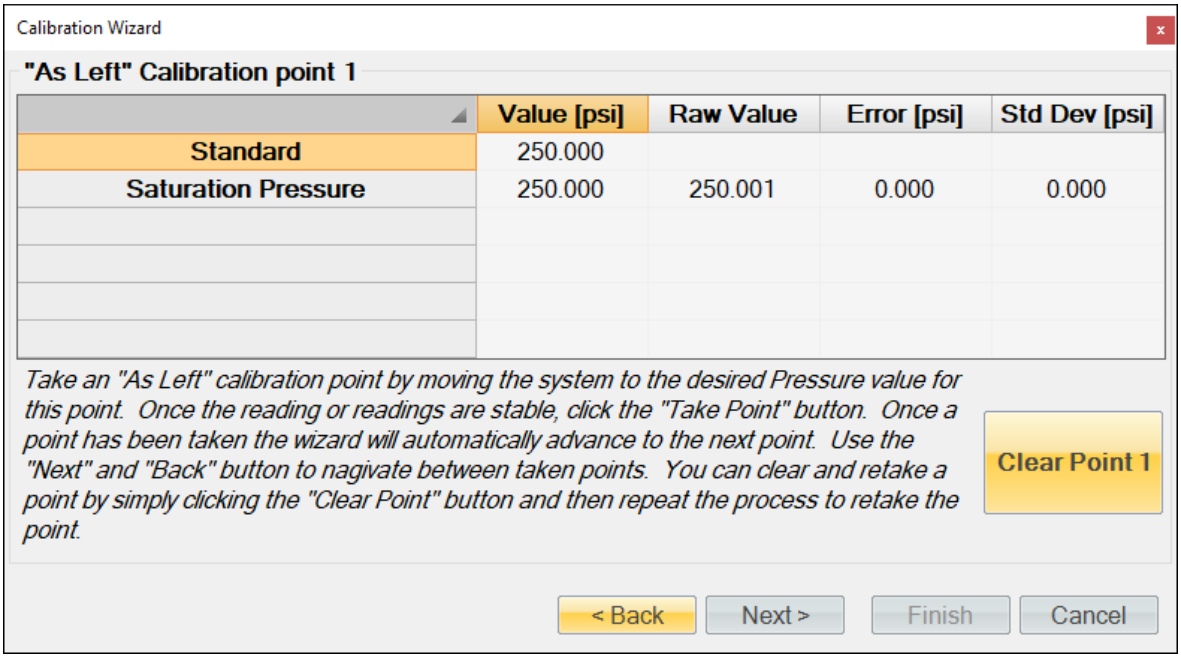
ControLog allows the user to take as many “As Left” points as they would like. In this example we will check every 50 psi starting at 250 psi and ending at atmospheric pressure. If the standard is not a connected device, then ControLog will ask for the value before taking the point. You can also enter a standard or reference value before taking a point by clicking the cell in the “Standard” row and “Value” column. This is useful for seeing error values before a point is taken.



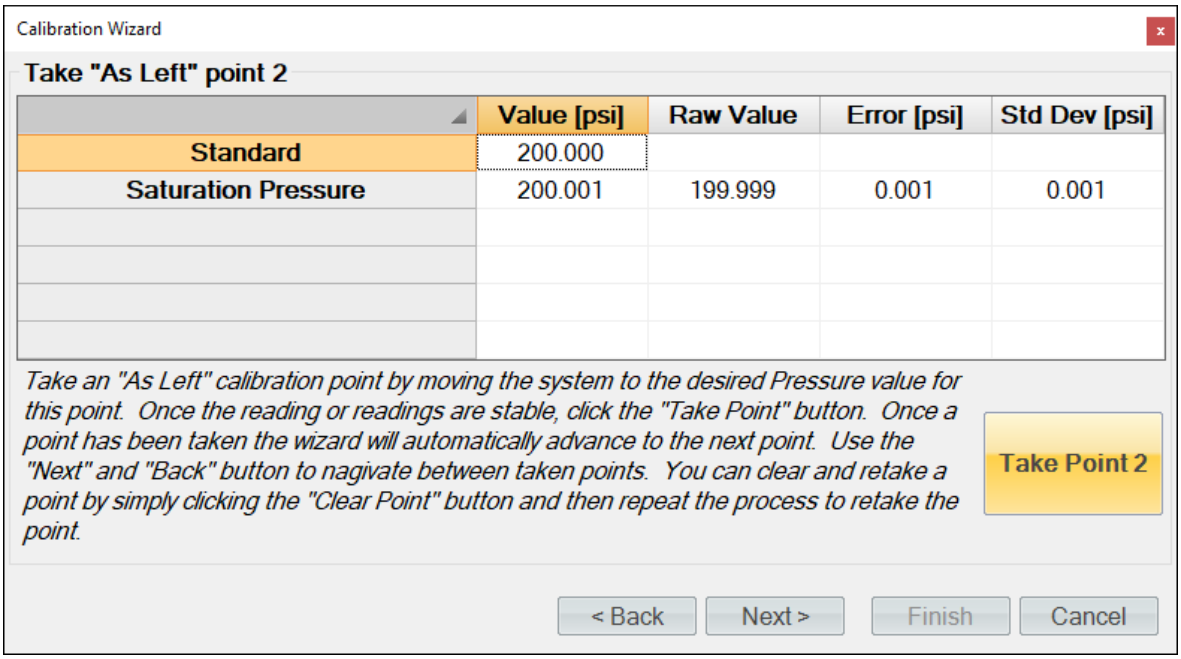
Once the readings are stable, enter the standards value and click the “Take Point” button. Once a point has been taken, the wizard will automatically advance to the next point.



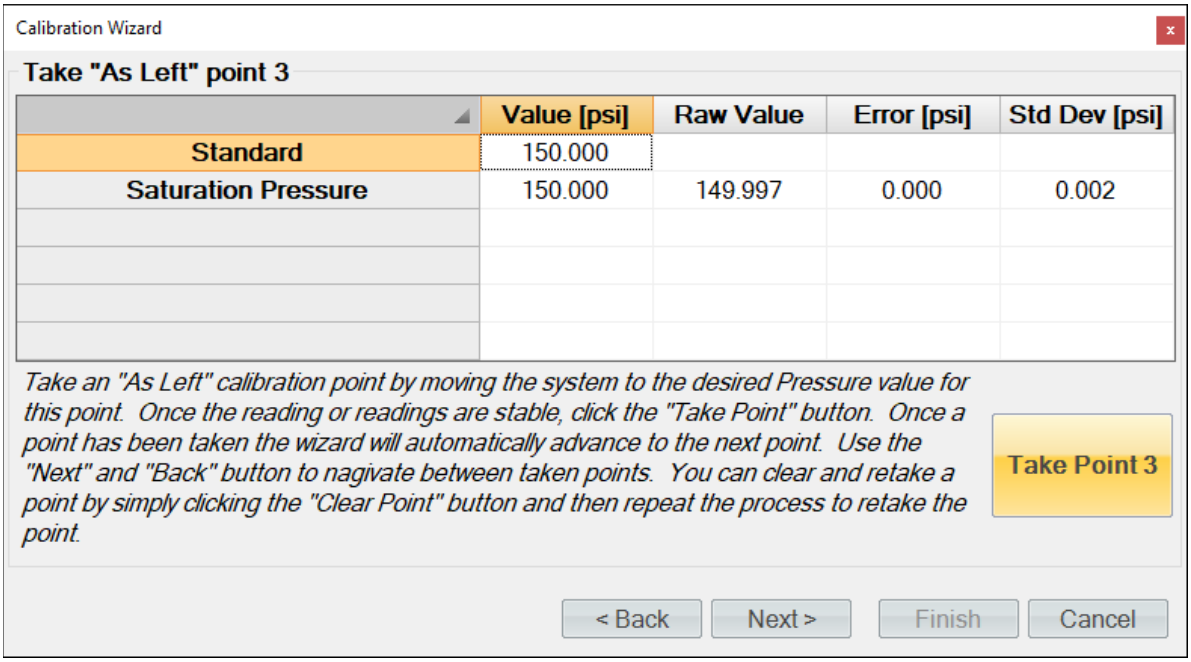
Tip - *Use the “Next” and “Back” button to navigate between taken points. You can clear and retake a point by simply clicking the “Clear Point” button and then repeat the process to retake the point.*



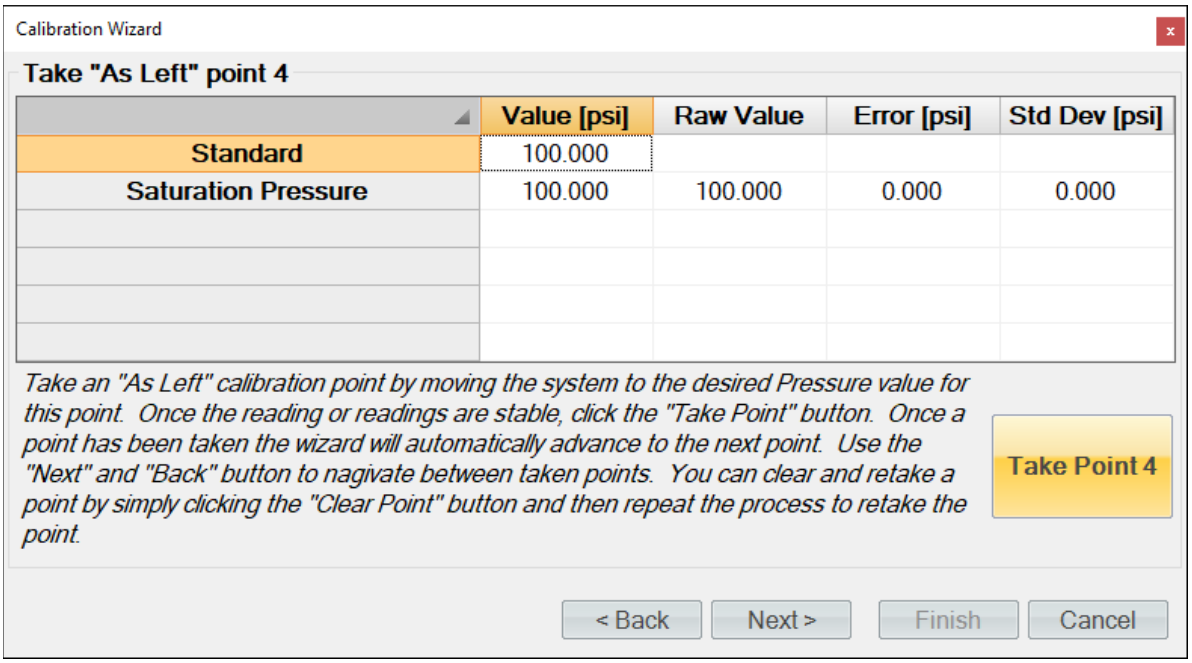
Using the pressure standard, generate and measure the next pressure point (200 psi). Once the readings are stable, enter the standards value and click the “Take Point” button.



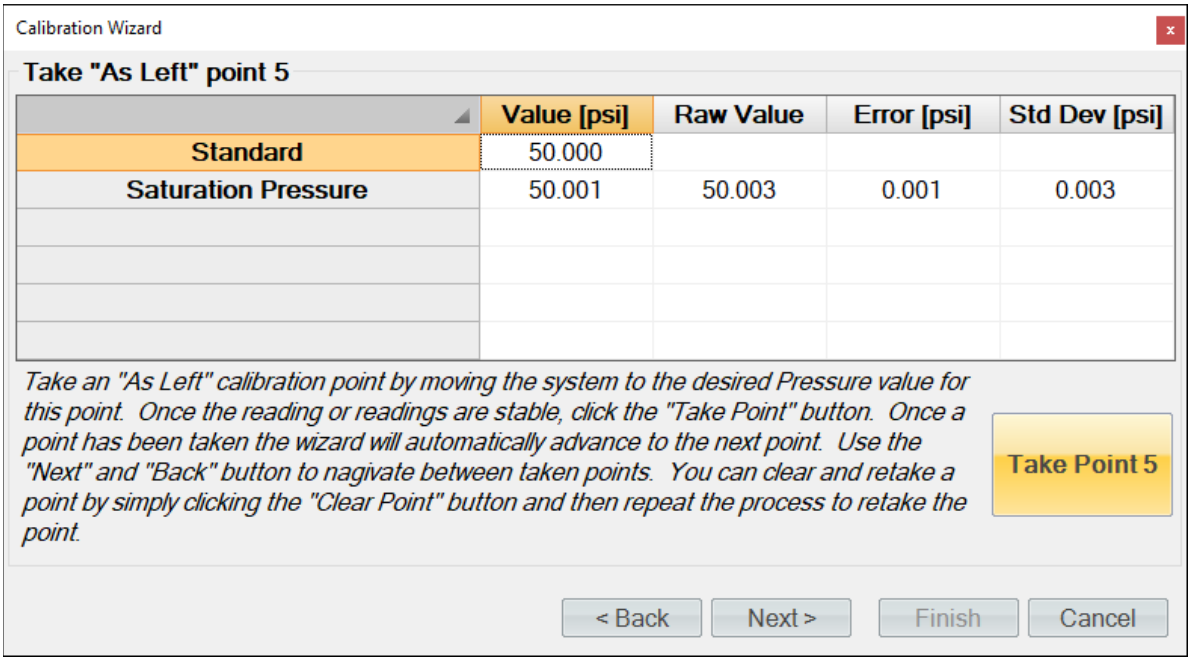
Using the pressure standard, generate and measure the next pressure point (150 psi). Once the readings are stable, enter the standards value and click the “Take Point” button.



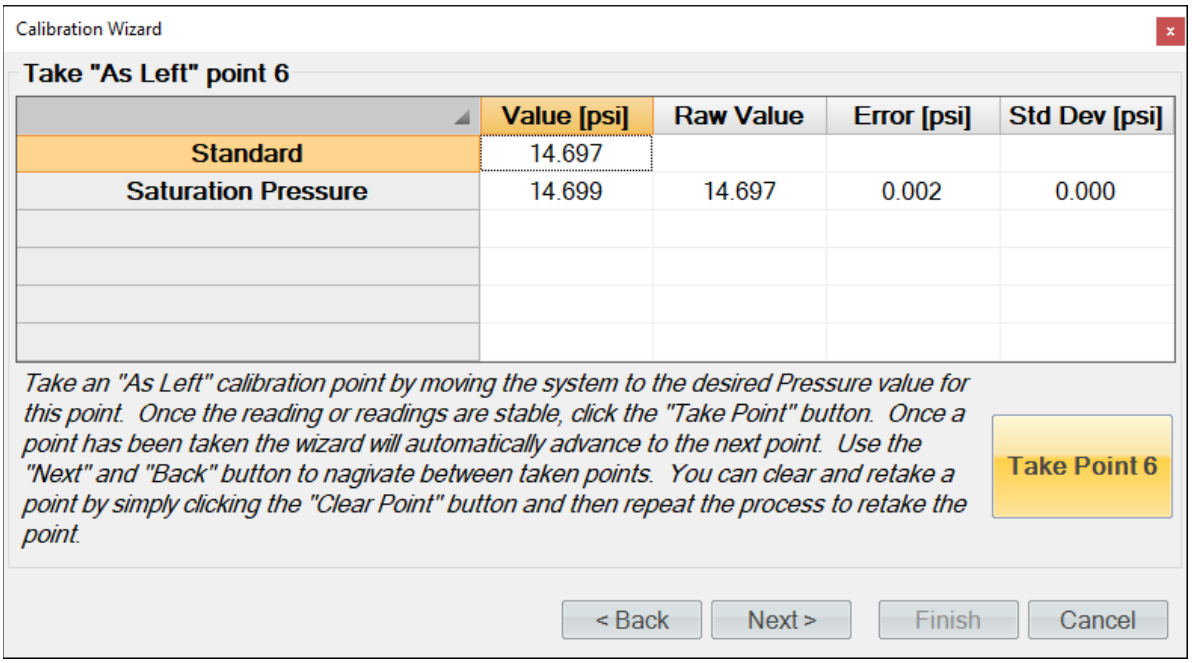
Using the pressure standard, generate and measure the next pressure point (100 psi). Once the readings are stable, enter the standards value and click the “Take Point” button.



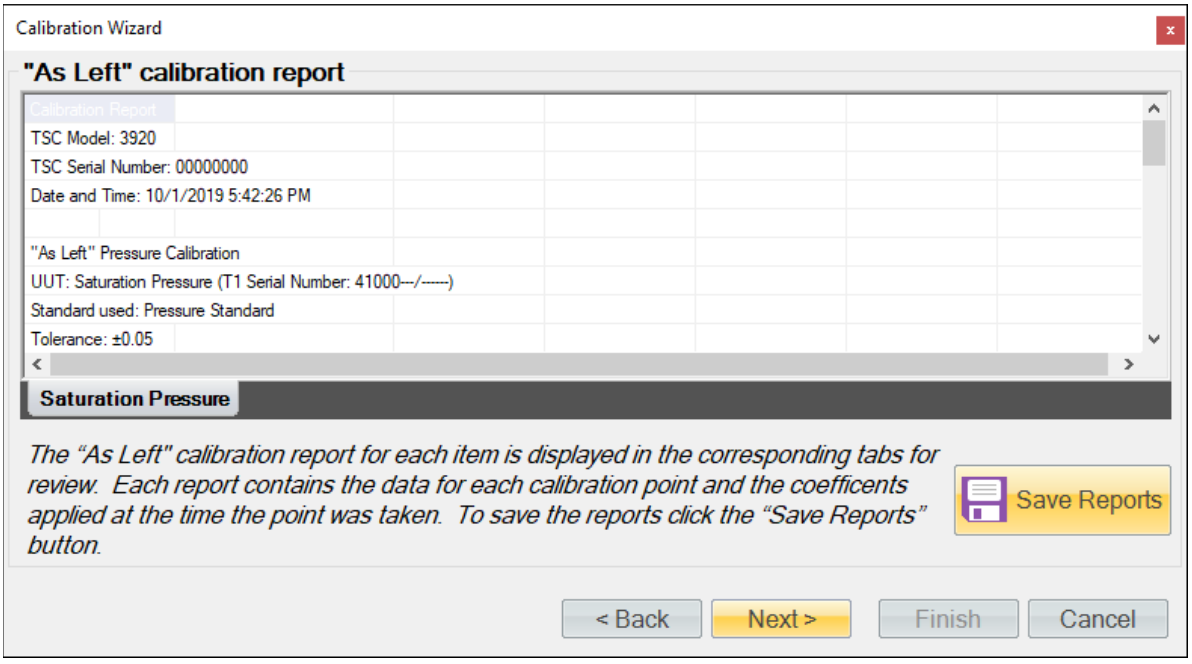
Using the pressure standard, generate and measure the next pressure point (50 psi). Once the readings are stable, enter the standards value and click the “Take Point” button.



Using the pressure standard, generate and measure the last pressure point (atmospheric pressure). Once the readings are stable, enter the standards value and click the “Take Point” button.

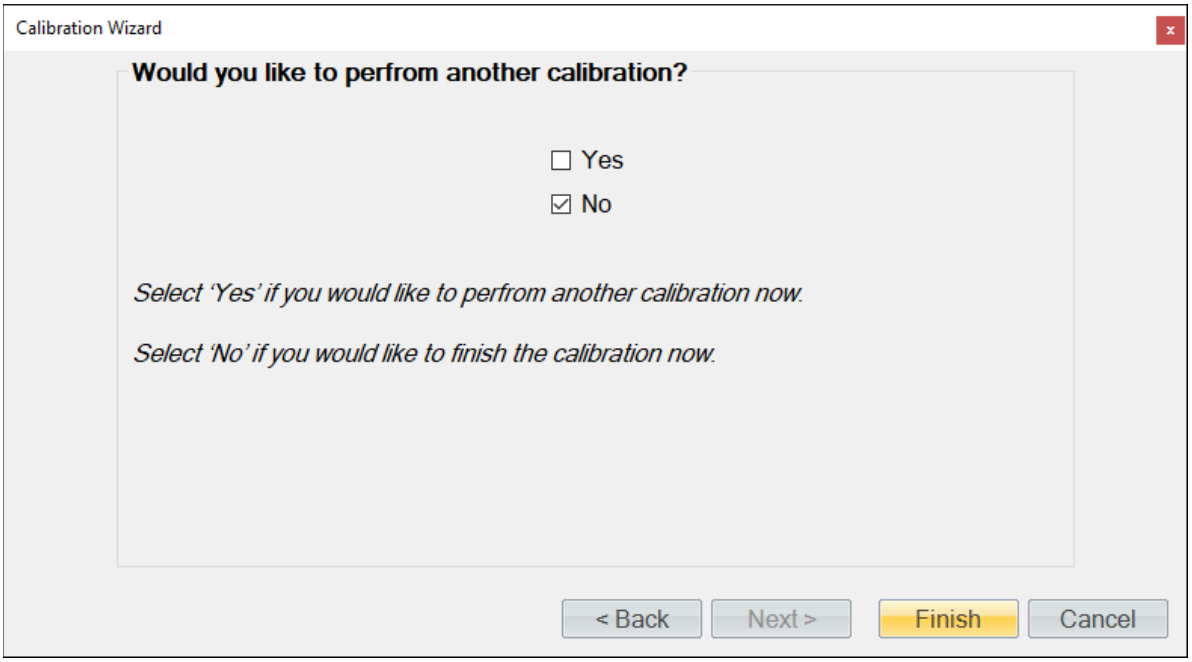


When you have taken the desired amount of “As Left” pressure points, click the “Next” button to view the “As Received” calibration report. Each transducer will appear in its own tab and contains the data for each calibration point along with the coefficients used at the time the points were taken.



Clicking the “Save Reports” button will open a file dialog to save the report. The default file location is …Documents\Thunder Scientific\3920 ControLog\Reports\.

When finished, close the Pressure Calibration window.



Reinstall the saturation pressure transducer in the system:

- Reinstall the pressure transducer, tightening nut 1/8 turn past finger tight.
- Replace left-side console panel.

6.2.3 Test Pressure

Repeat this same calibration procedure for the test pressure transducer to calibrate it to its specific range. There is no need to remove any panel as the test pressure transducer connects via the front hood. Calibrate over the range of ambient to 50 psiA. Example points are (ambient, 20, 30, 40, 50 psiA) but can be any sequence of numbers within the range. Just use best metrology practices when determining which points to take. For more details refer to section *6.2.2 Calibration Procedure*.

6.2.4 Supply Pressure

The supply pressure, while indicated on the screen, is not critical to the accuracy of the generated humidity and is not used in the humidity calculations. Therefore, supply pressure calibration requirements depend upon the needs of the user. The procedure to calibrate the supply pressure is the same as the previous calibration procedure. Calibrate over the range of 0 to 250 psiG. Example points are (0, 150, and 250 psiG) but can be any sequence of numbers within the range. Just use best metrology practices when determining which points to take. For more details refer to section *6.2.2 Calibration Procedure*.

Note – *The supply pressure transducer must be calibrated in gauge pressure.*

6.3 Mass Flow Meter Calibration

The mass flow rate measurement, while indicated on the screen, is not critical to the accuracy of the generated humidity and is not used in the humidity calculations. Therefore, flow calibration requirements depend upon the needs of the user.

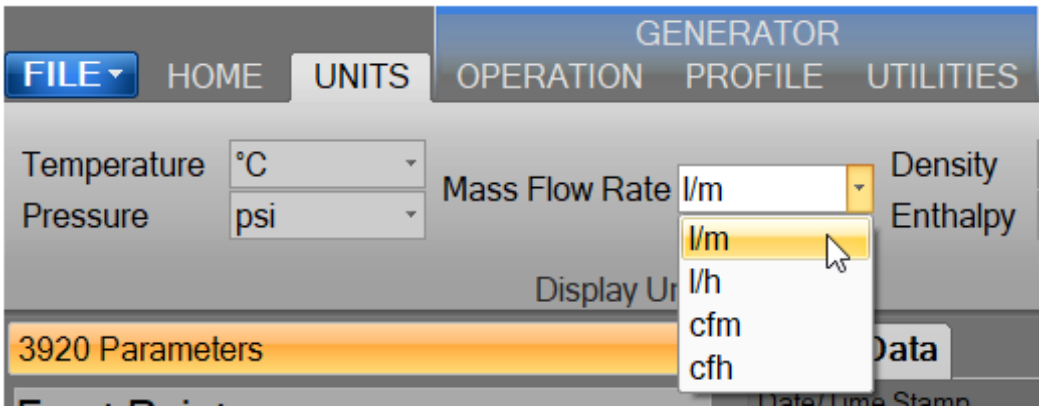
6.3.1 Equipment Required

1. Standard or Reference flow meter.

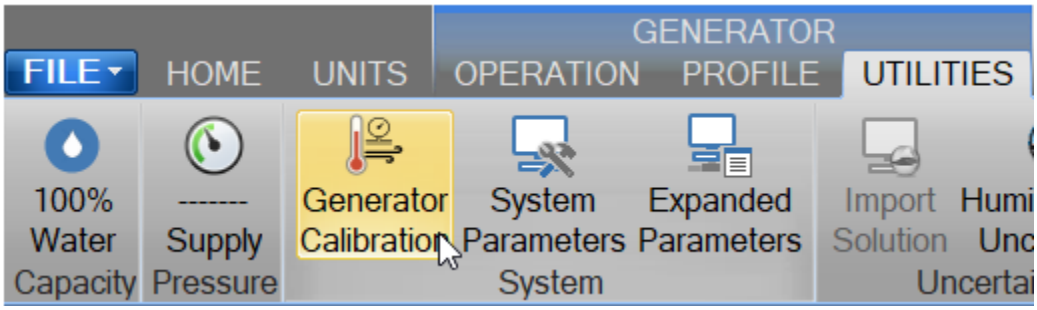
6.3.2 Calibration Procedure

Connect the reference flow meter to the gas outlet on the top of the 3920.

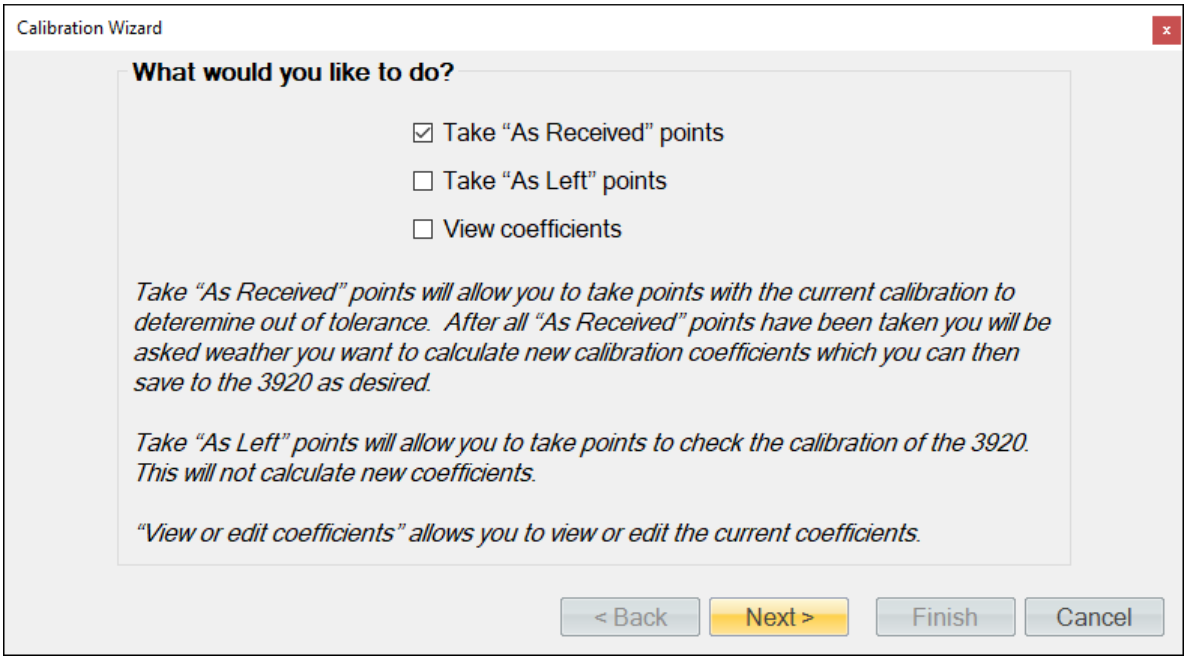
From the Units menu tab select the desired mass flow rate units for calibration. Once calibration has begun, the units should not be changed again until the calibration is complete.



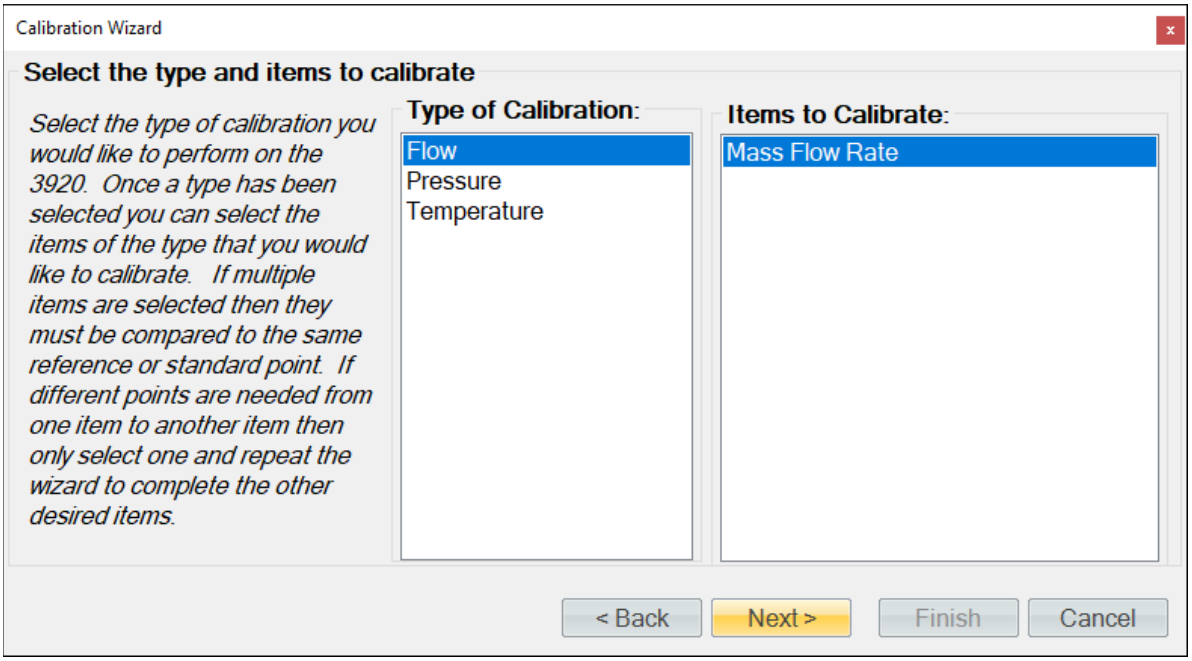
Select Generator Calibration from the Utilities menu tab to open the Calibration Wizard.



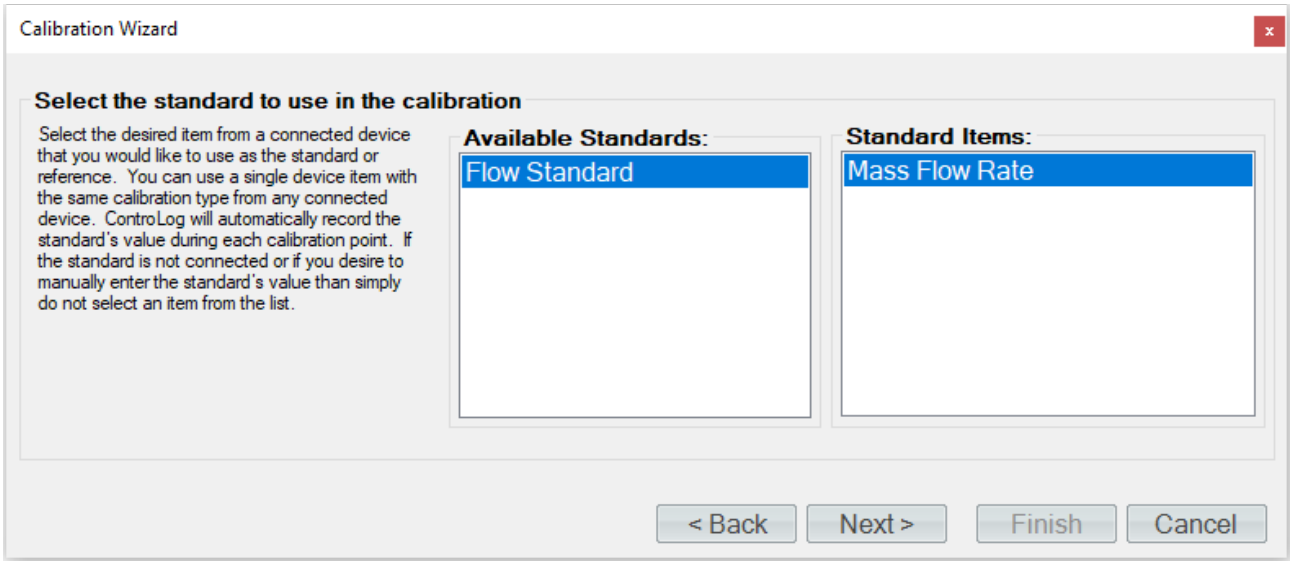
Select, “Take “As Received” points”. This will allow the user to take points with the current calibration to determine out of tolerance. After all “As Received” points have been taken the user will be asked whether they want to calculate new calibration coefficients.



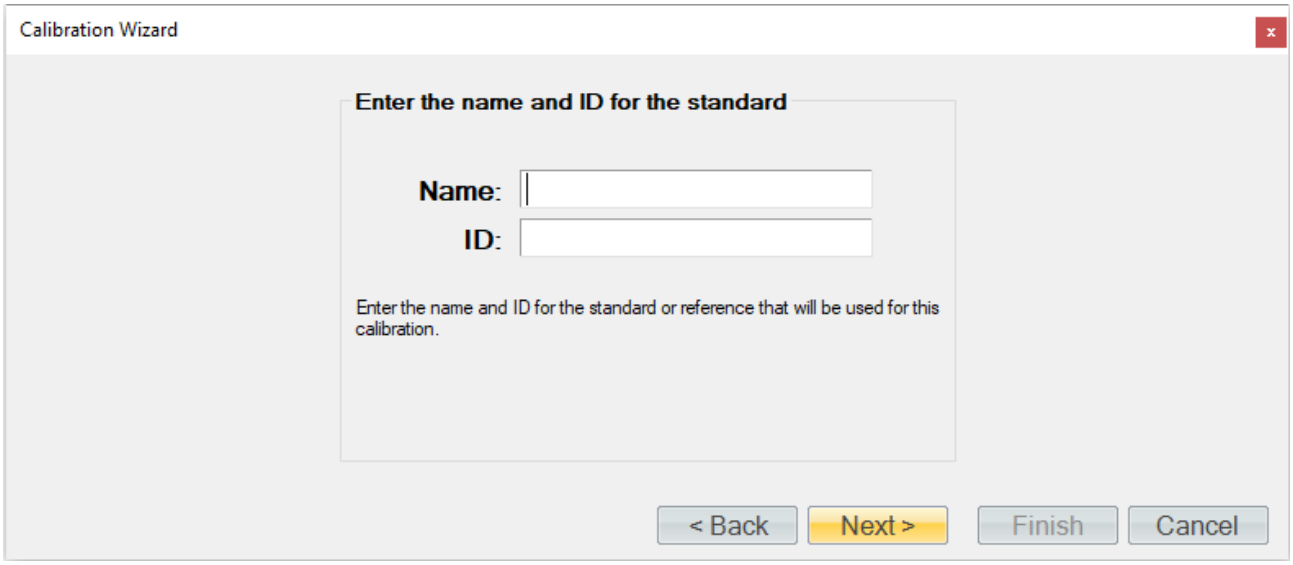
Set the type of calibration to Flow and select the Mass Flow Rate as the item to calibrate.



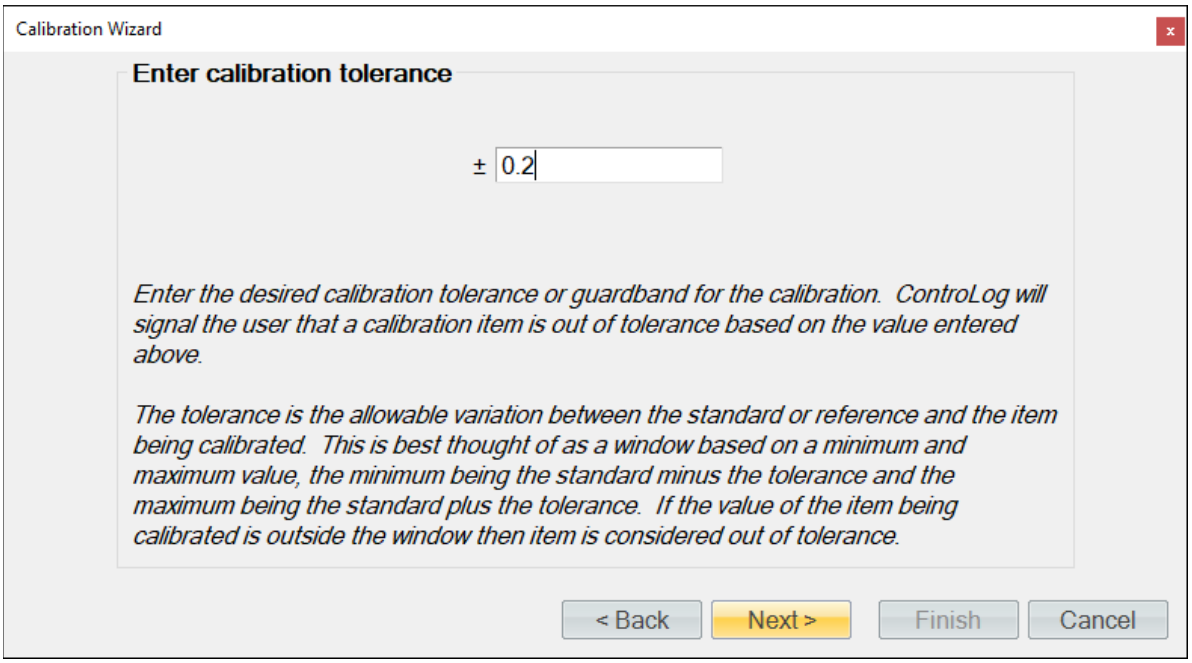
If the mass flow rate standard is a connected device (refer to section 10 Connections), you may select it for the calibration. You can use a single device item with the same calibration type from any connected device. ControLog will automatically record the standard's value during each calibration point. If the standard is not a connected device or if you desire to manually enter the standard's value do not select an item from the list.



Enter the Name and ID of the standard being used. This information will be populated on the calibration report. Selecting "Next" without entering a Name will result in ControLog giving the standard a generic name.

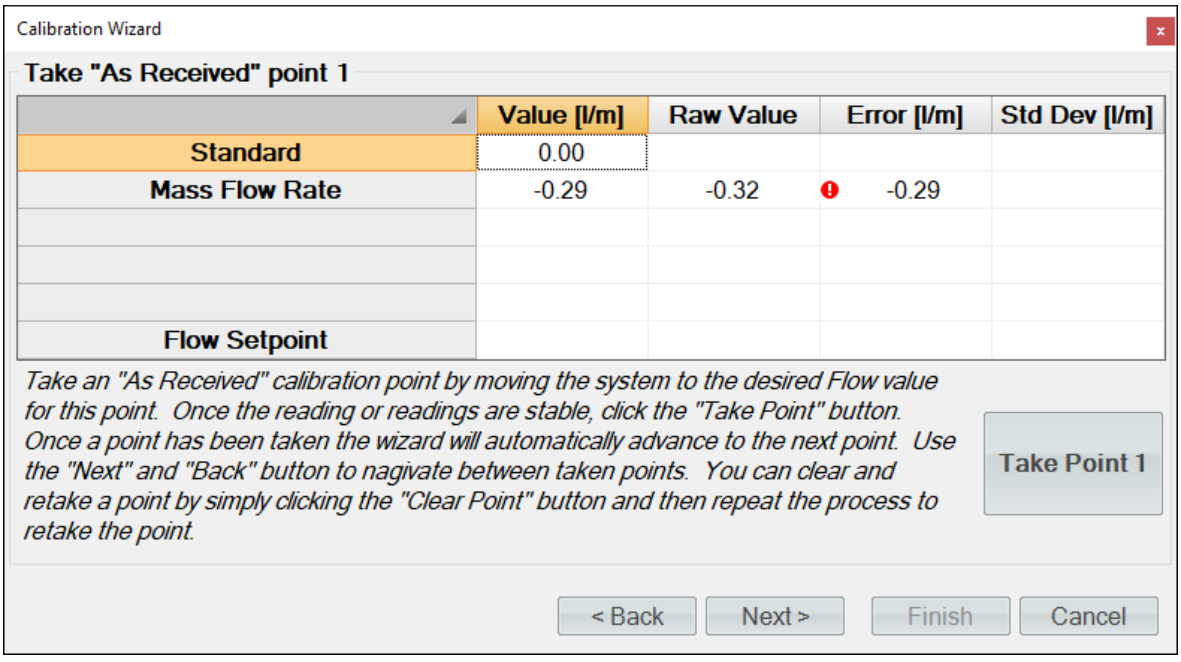


Enter the desired calibration tolerance or guard band for the calibration. ControLog will signal the user that a calibration item is out of tolerance based on the value entered above.



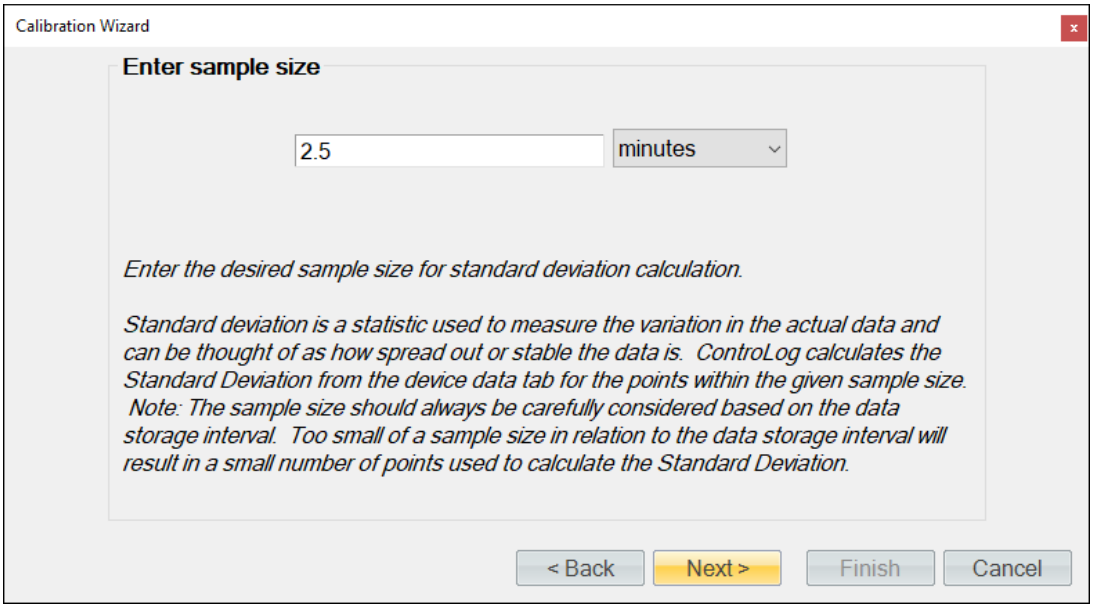
The tolerance is the allowable variation between the standard or reference and the item being calibrated. This is best thought of as a window based on a minimum and maximum value, the minimum being the standard minus the tolerance and the maximum being the standard plus the tolerance. If the value of the item being calibrated is outside the window, then item is considered out of tolerance.

An out of tolerance condition will be indicated by a red circle with an exclamation point for the out of tolerance transducer in the Error column.

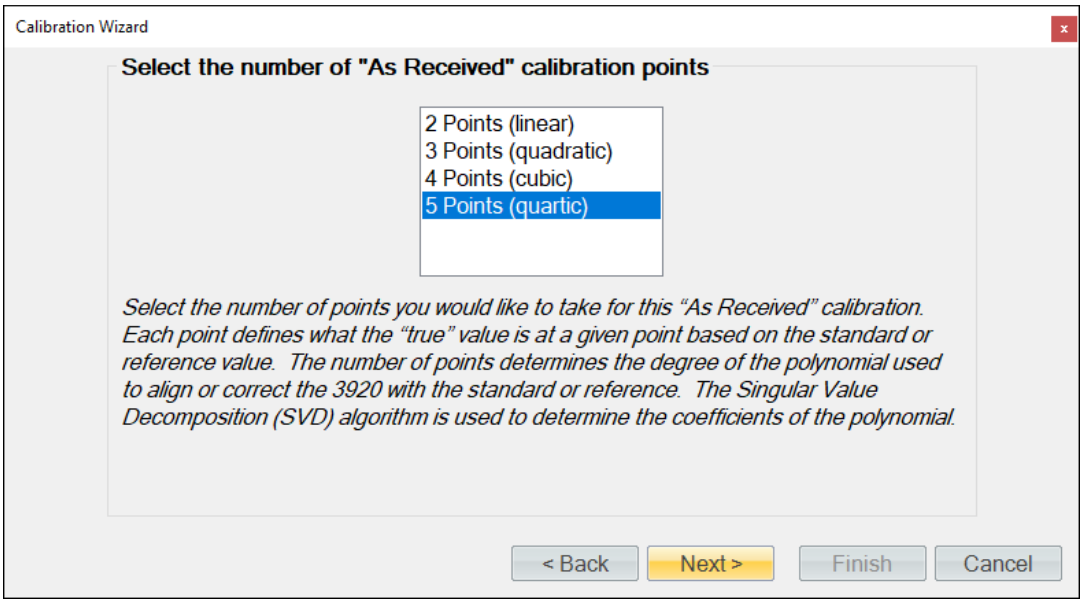


Enter the sample size used to perform the standard deviation calculation. The sample size is the given time that ControLog will use to determine which data points to use to determine the standard deviation of each probe.

> **Note** - *The number of points used will be based on the data storage rate you have selected along with the desired sample size. For example, if the data storage rate is every 15 seconds then a sample size of 2.5 minute will result in 10 points being used to calculate the standard deviation.*



Select the number of points you would like to take for this "As Received" calibration. Each point defines what the "true" value is at a given point based on the standard or reference value. The number of points determines the degree of the polynomial used to align or correct the generator with the standard or reference.



The best way to eliminate instability caused by the expansion valve during the flow calibration is to run the generator manually in saturation pressure mode with a setpoint below ambient pressure. A saturation pressure setpoint below ambient pressure will cause the system to open the expansion valve completely, effectively removing it from impacting the gas outlet to the flow standard.

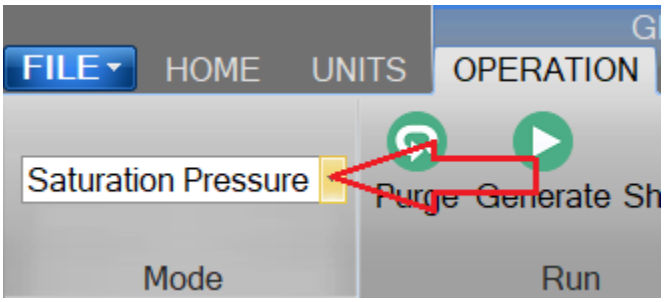
- Unplug the test pressure transducer.



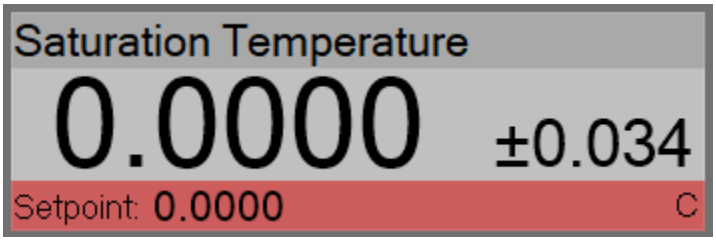
- Manually enter a test pressure value of 10 psi.



- Under the Generator>Operation tab, select "Saturation Pressure" as the Mode.



- Set the saturation temperature setpoint to 0° C to avoid outputting high humidity to the flow standard.



- Under the Generator>Operation tab, select "Purge" to start the system.

- Wait until the saturation temperature reaches setpoint (0 °C).

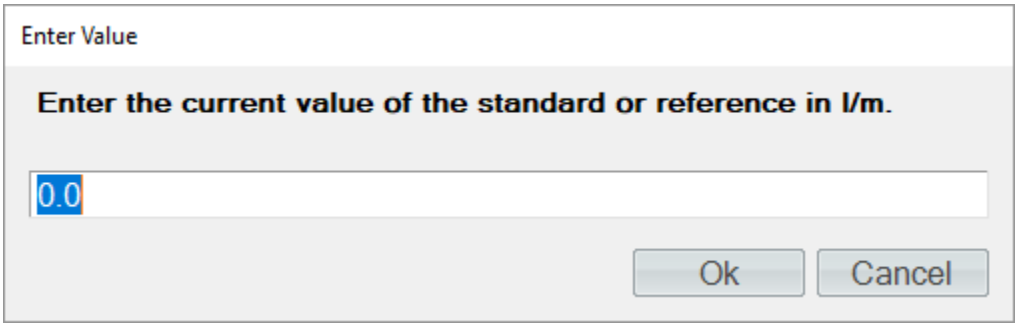
- Enter a saturation pressure setpoint of 10.5 psi.



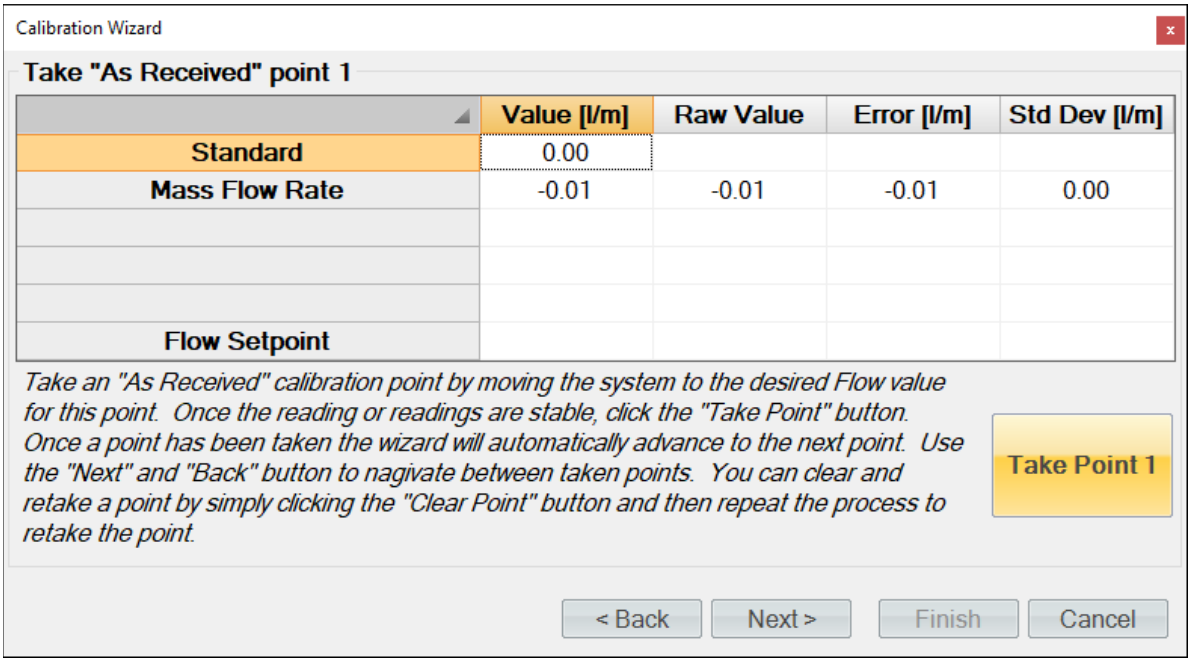
- Under the Generator>Operation tab, select "Generate" to switch the system to generate Mode.

- Wait 10 to 20 minutes to allow the system to open the expansion valve fully. Note the system will issue the warning "Expansion Valve at Maximum Limit - Reduce Mass Flow Rate." This warning is okay and can be ignored.

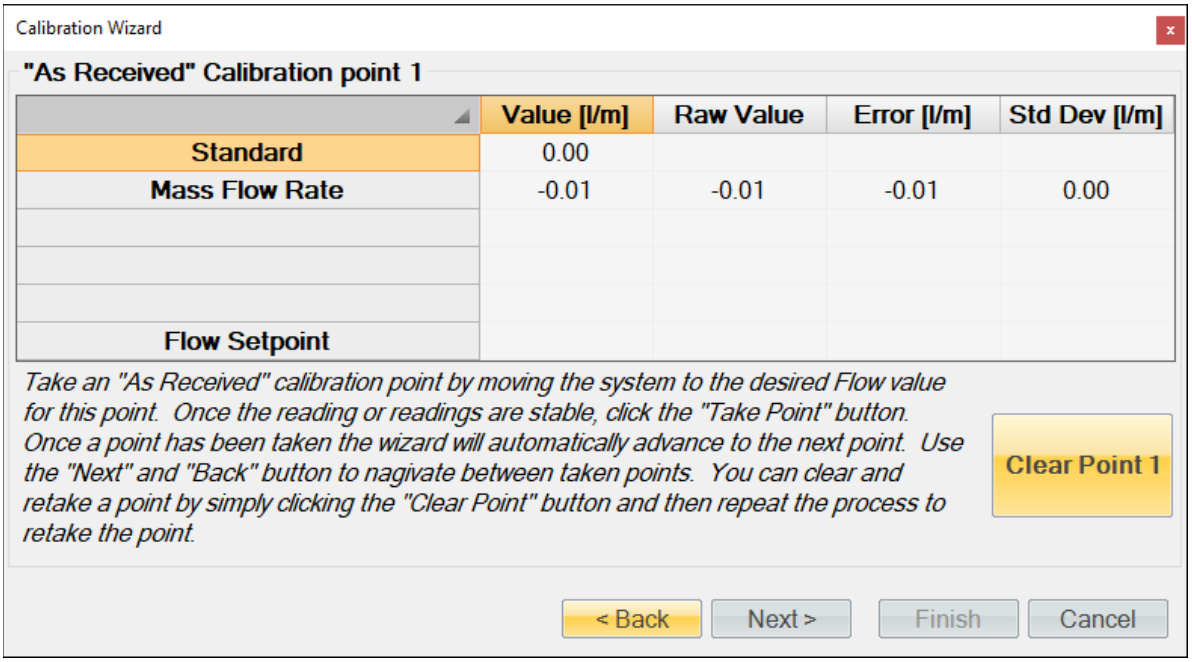
Take a zero flow point. If the standard is not a connected device, then ControLog will ask for the value before taking the point. You can also enter a standard or reference value before taking a point by clicking the cell in the “Standard” row and “Value” column. This is useful for seeing error values before a point is taken.



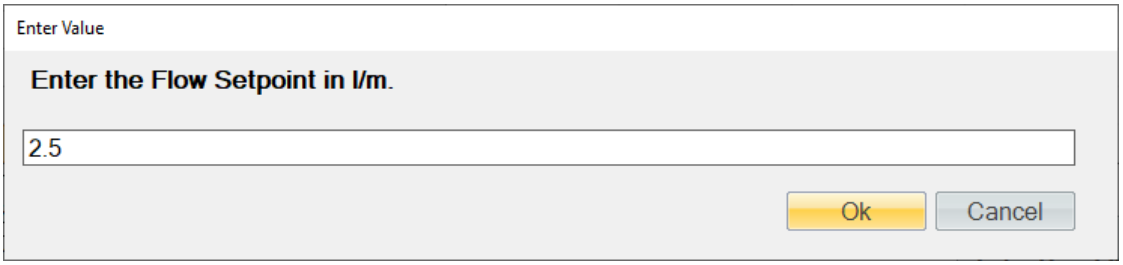
Once the reading is stable, click the “Take Point” button. Once a point has been taken, the wizard will automatically advance to the next point.



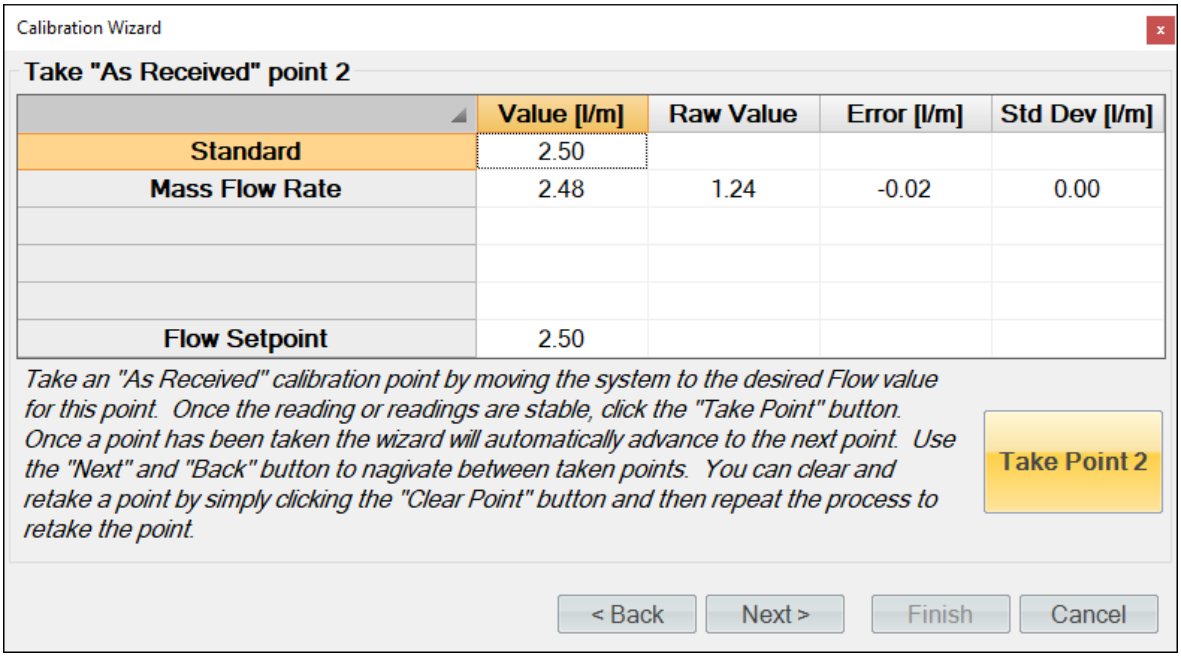
Tip - *Use the “Next” and “Back” button to navigate between taken points. You can clear and retake a point by simply clicking the “Clear Point” button and then repeat the process to retake the point.*



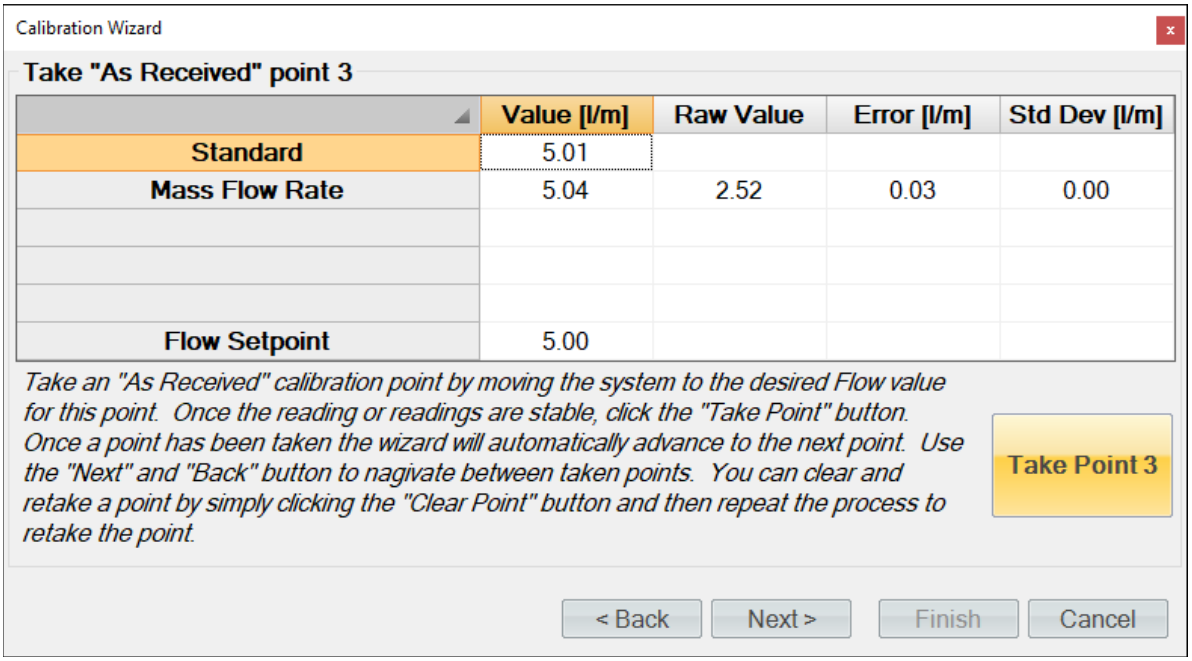
Continue generating and advance the flow rate to the next point (2.5 l/m).



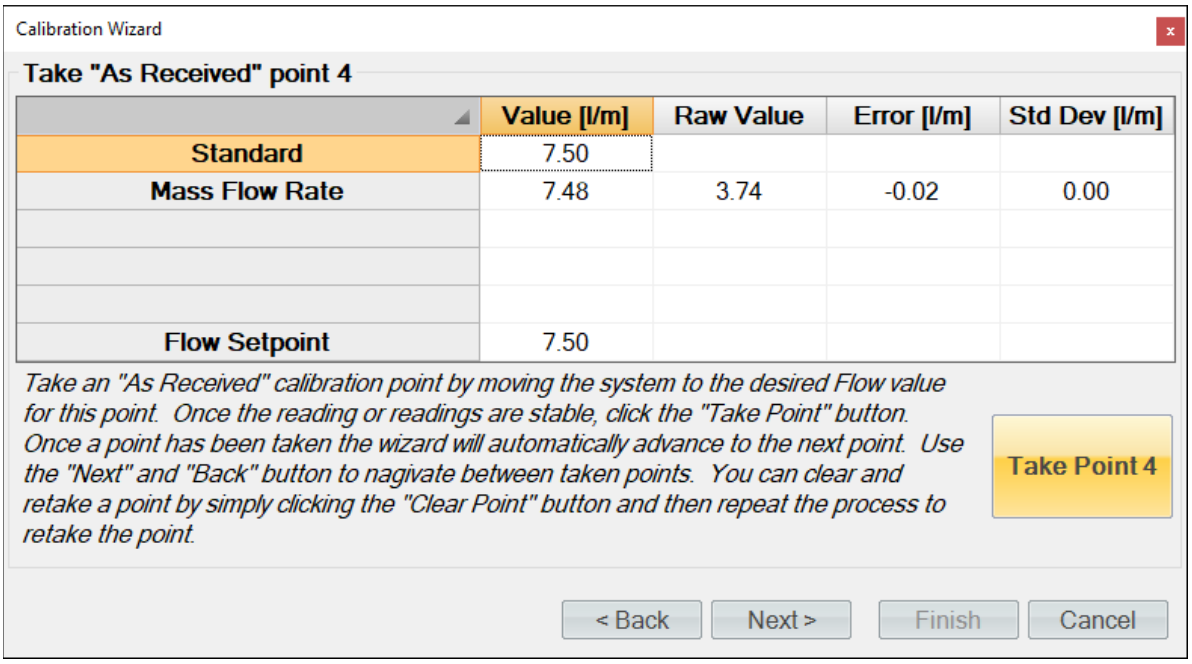
Using the flow standard, measure the next point. Once the readings are stable enter the standards value and click the “Take Point” button.



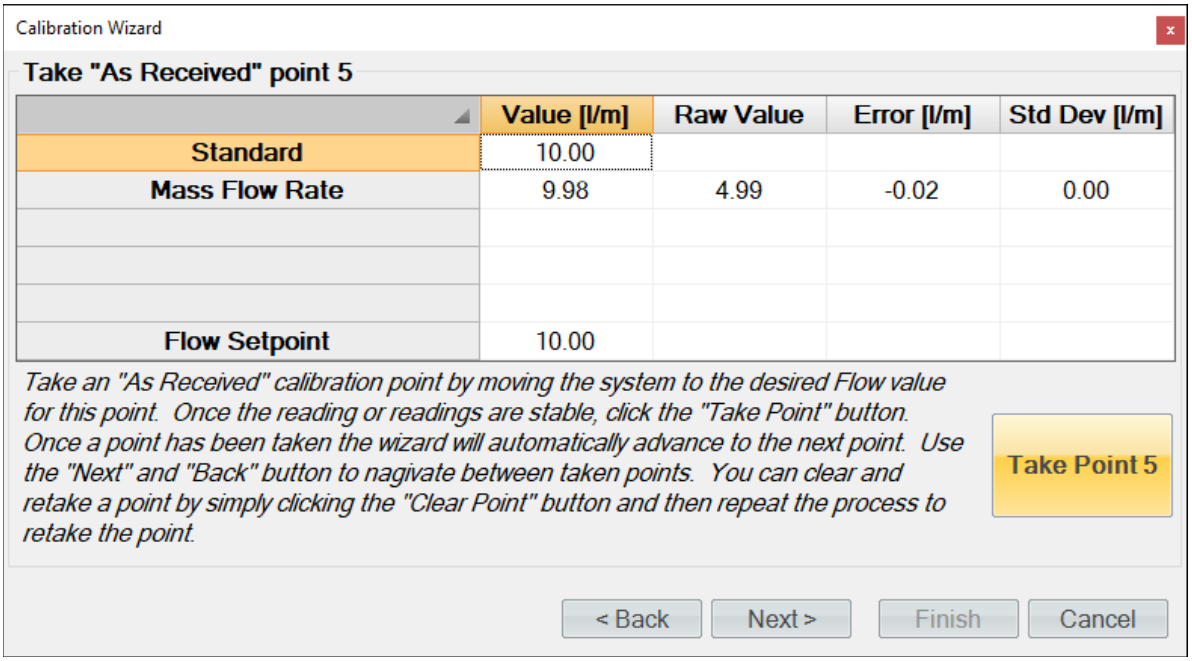
Continue generating and advance the flow rate to the next point (5.0 l/m). Using the flow standard, measure the point and once the readings are stable enter the standards value and click the “Take Point” button.



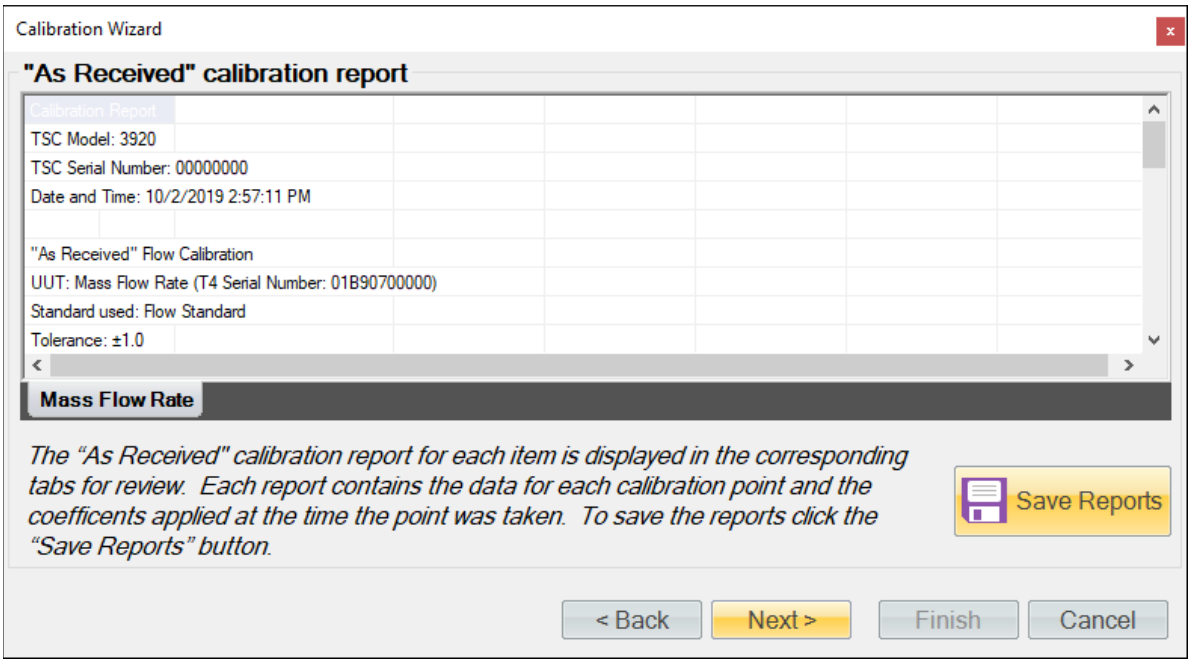
Continue generating and advance the flow rate to the next point (7.5 l/m). Using the flow standard, measure the point and once the readings are stable enter the standards value and click the “Take Point” button.



Continue generating and advance the flow rate to the last point (10.0 l/m). Using the flow standard, measure the point and once the readings are stable enter the standards value and click the “Take Point” button.

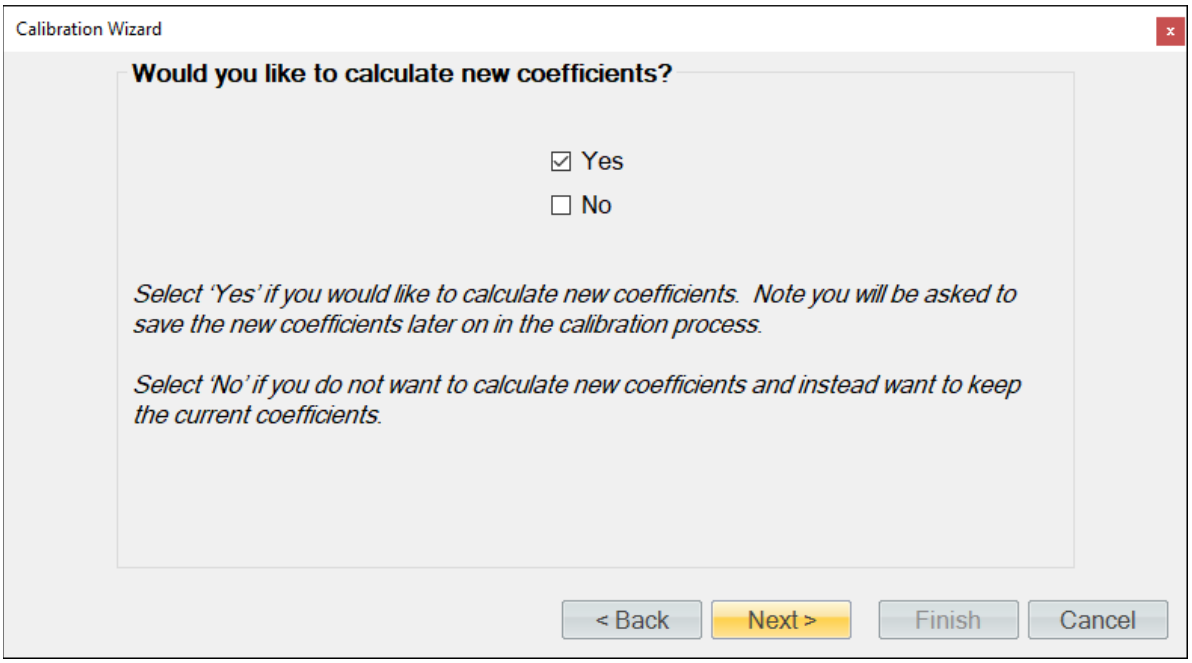


When all flow points have been entered, ControLog will advance to the “As Received” calibration report. The flow meter will appear in its own tab and contains the data for each calibration point along with the coefficients used at the time the points were taken.

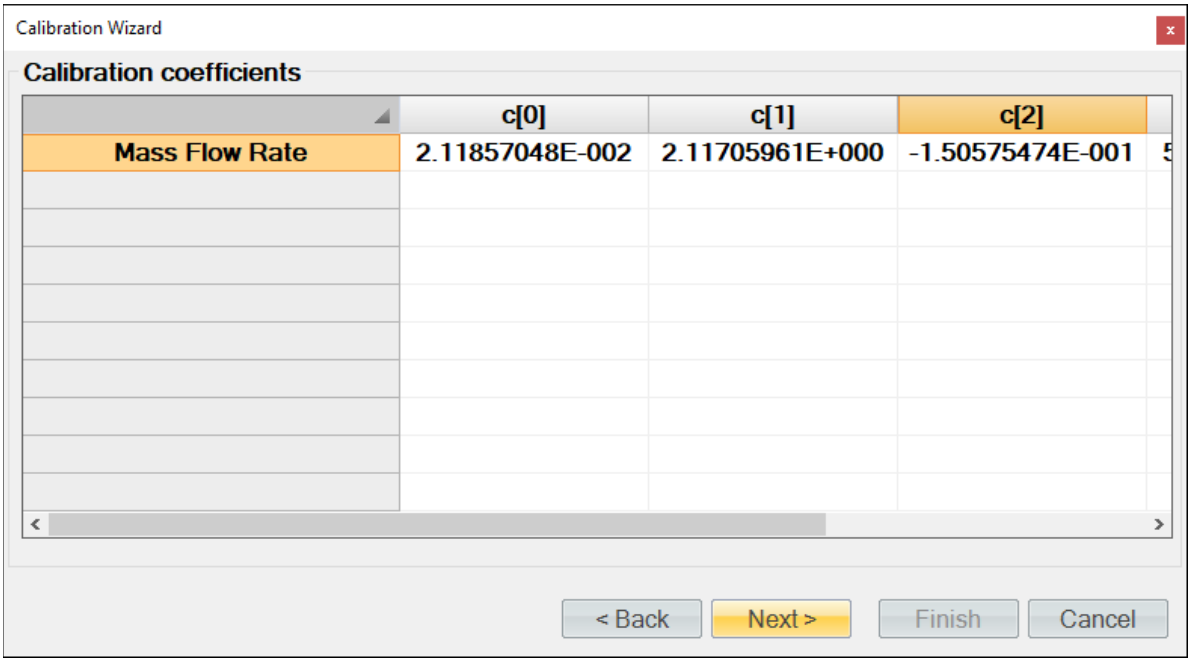


Clicking the “Save Reports” button will open a file dialog to save the report. The default file location is …Documents\Thunder Scientific\3920 ControLog\Reports\.

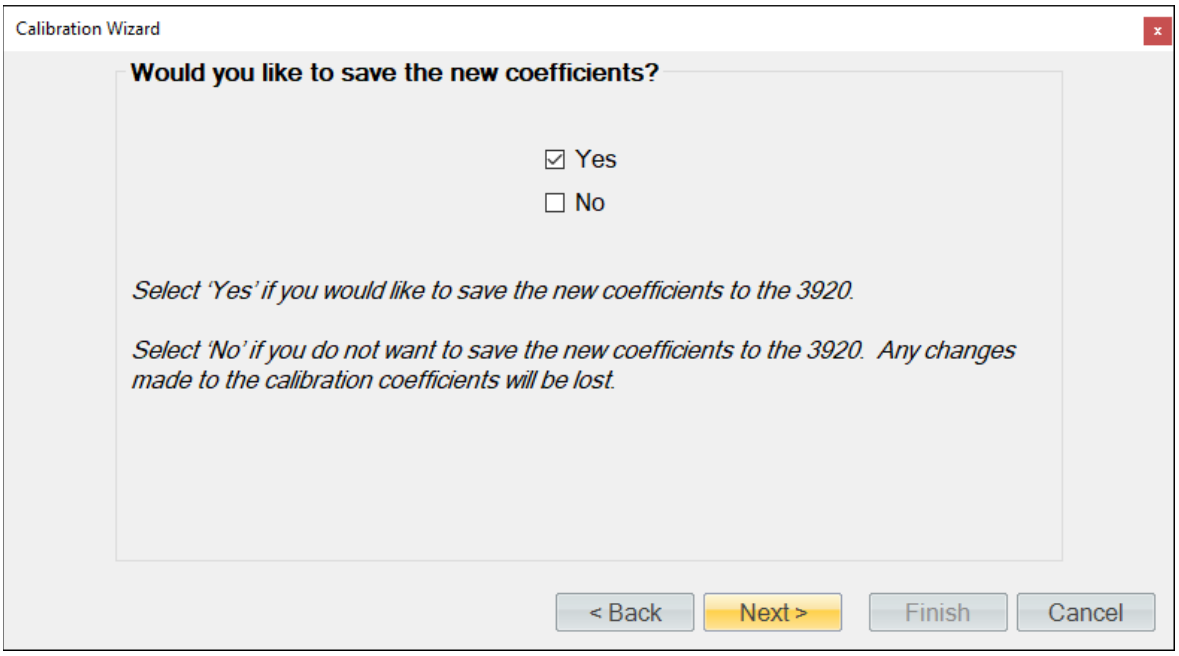
Clicking “Next” will ask the user if they want to calculate new coefficients using the as received data points just taken.



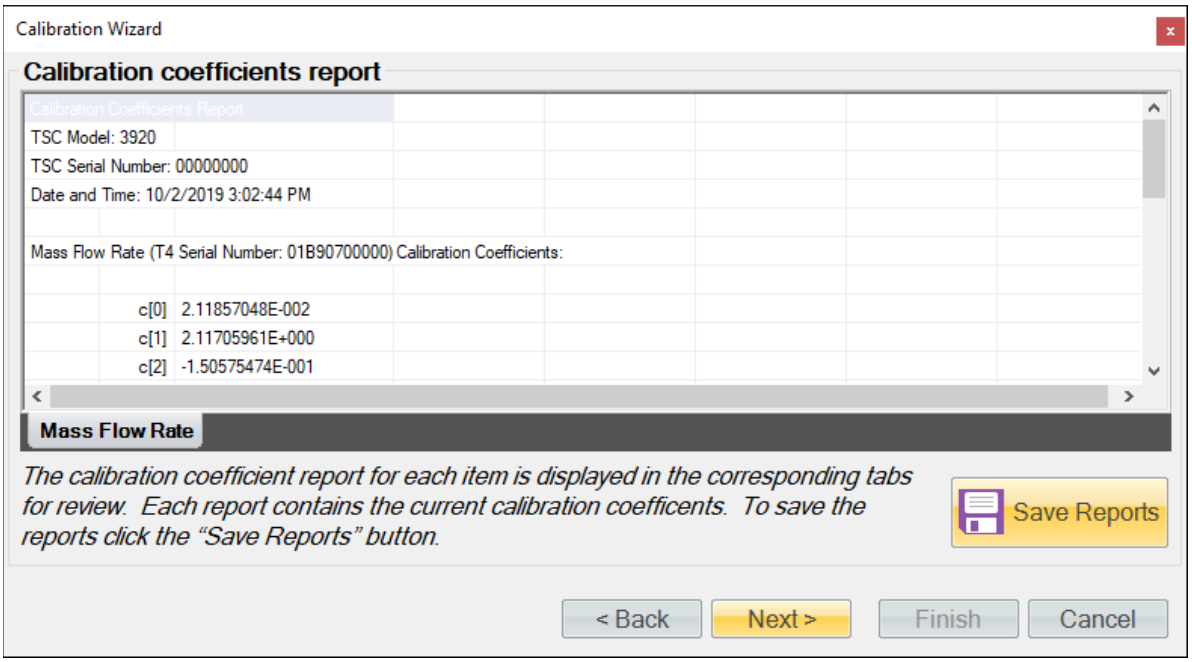
If the user selected to calculate new coefficients, they will be calculated and displayed. If any problem calculating the coefficient occurs, ControLog will issue a message telling the user that the coefficients could not be calculated.



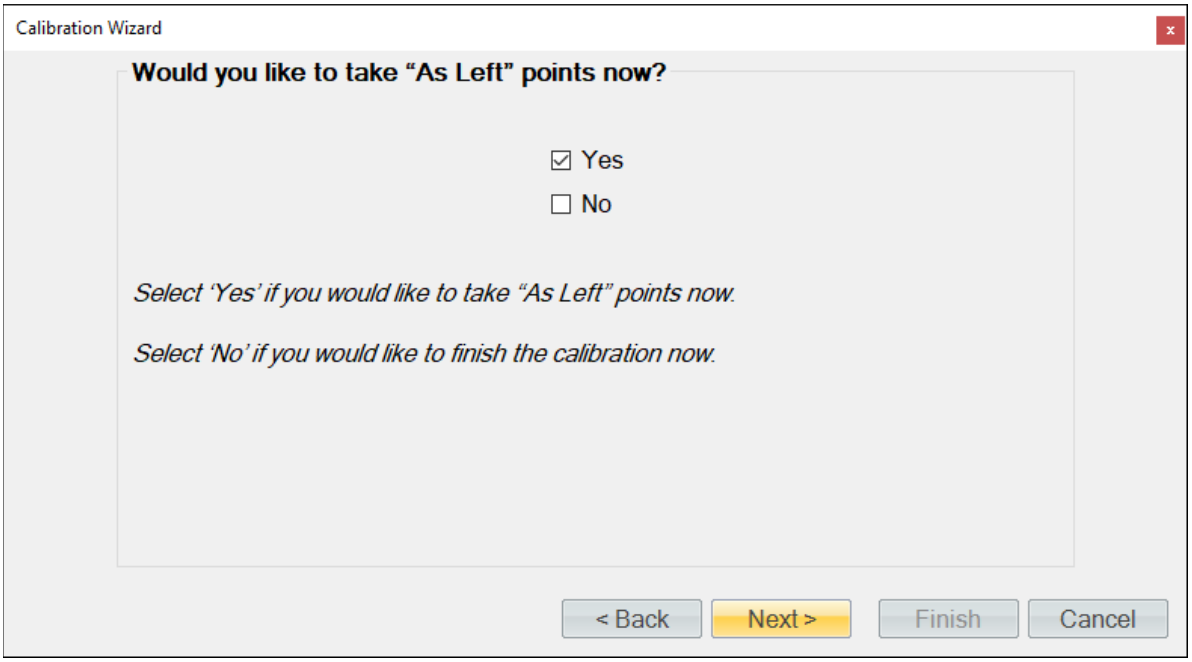
Next, the user will be asked to save the new coefficients to the system. Selecting “Yes” will result in the current coefficient being over-written by the newly calculated coefficients.



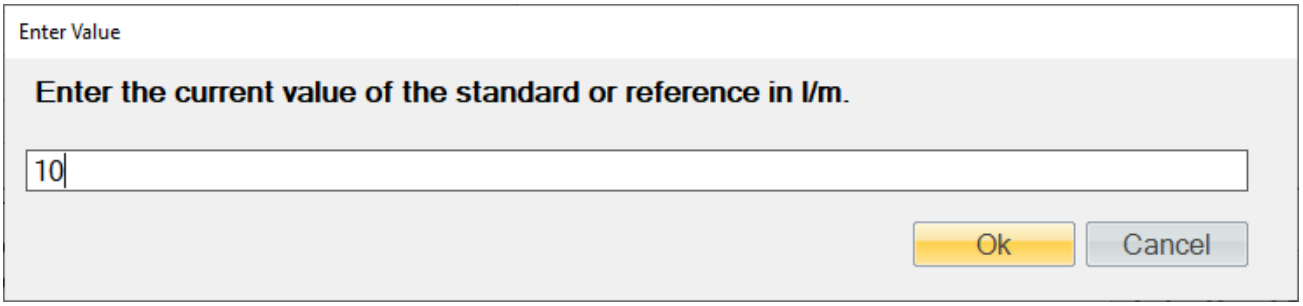
Next, the user can view and save the calibration coefficients report for the flow meter.



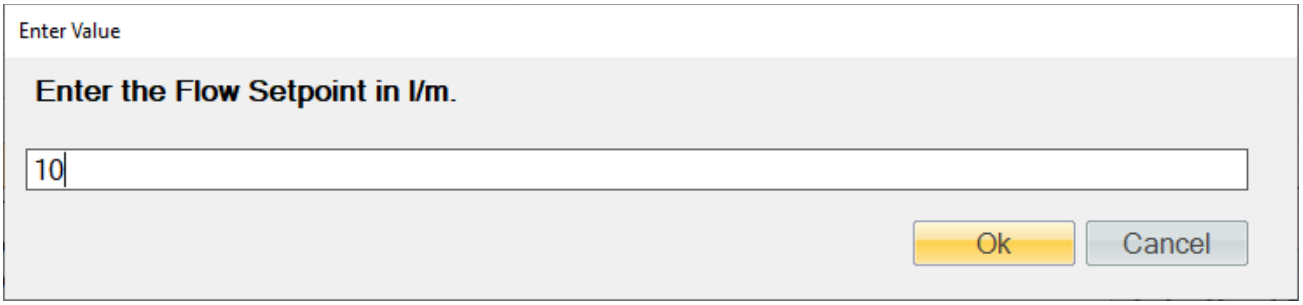
Next, the user can complete the calibration or choose to take “As Left” points.



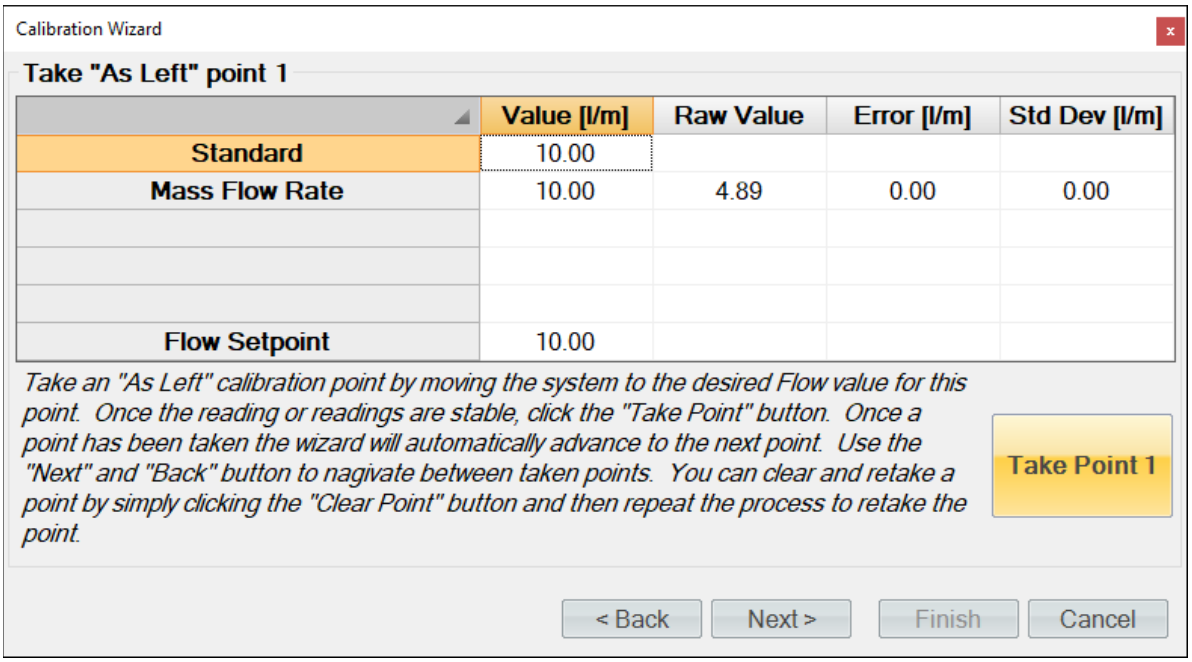
ControLog allows the user to take as many “As Left” points as they would like. In this example we will check five points. If the standard is not a connected device, then ControLog will ask for the value before taking the point. You can also enter a standard or reference value before taking a point by clicking the cell in the “Standard” row and “Value” column. This is useful for seeing error values before a point is taken.



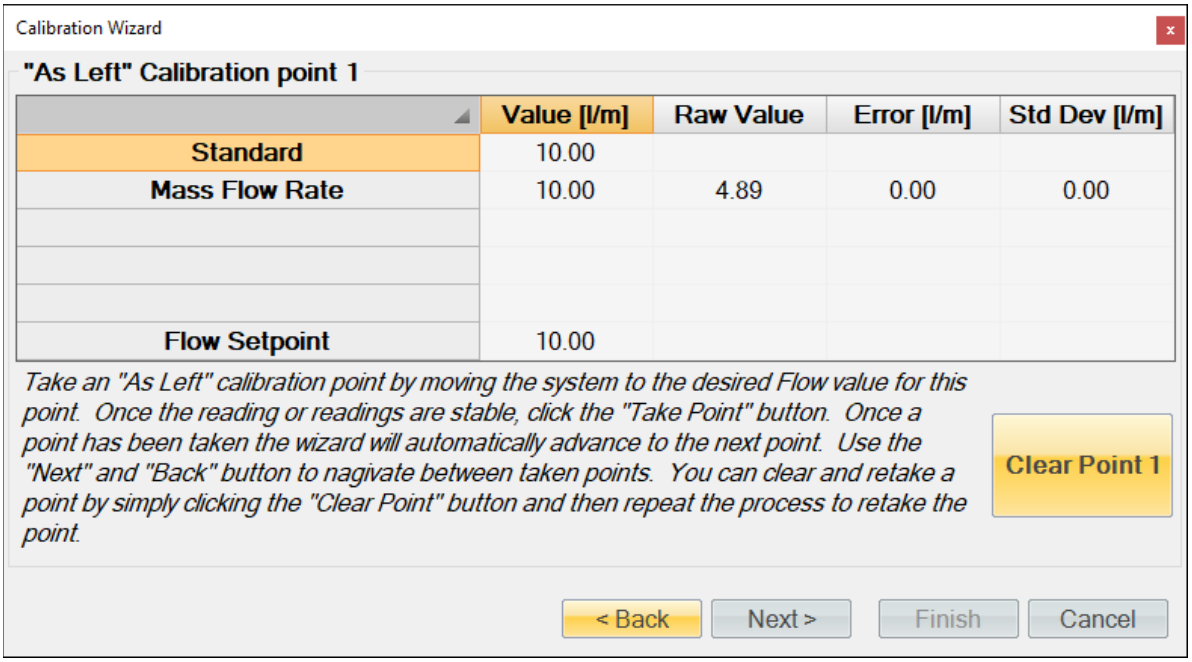
Enter the first flow rate (10.0 l/m) in the Flow Setpoint “Value” cell to continue generating a 0 °C dew point.



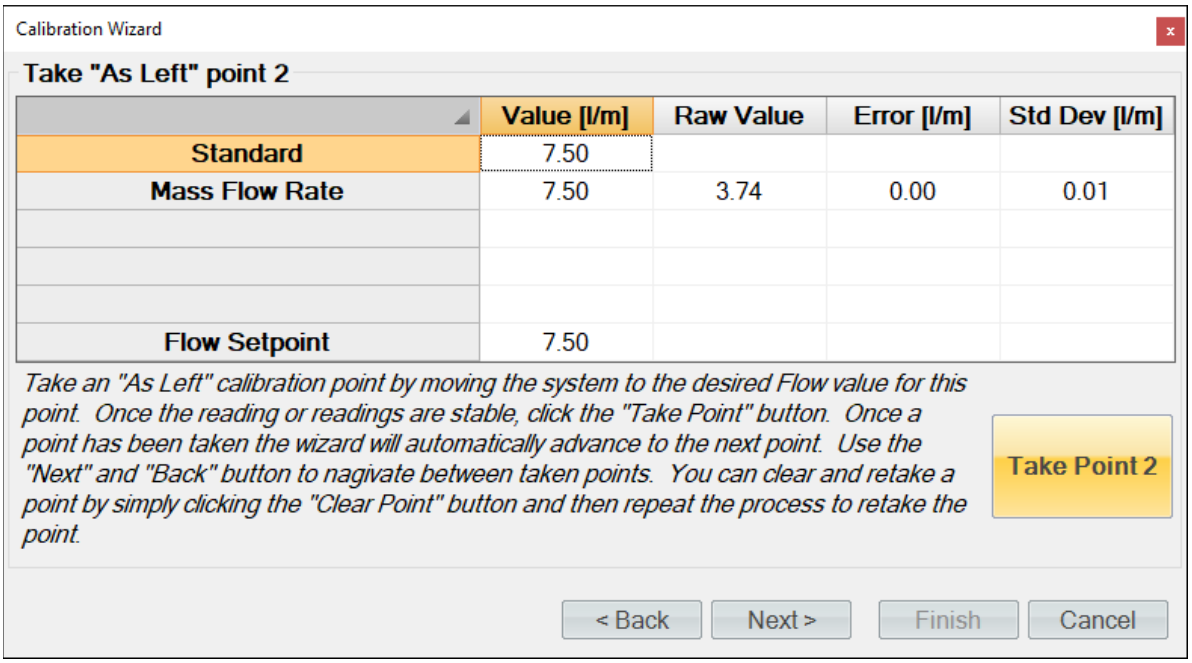
Using the flow standard, measure the point and once the readings are stable enter the standards value and click the “Take Point” button.



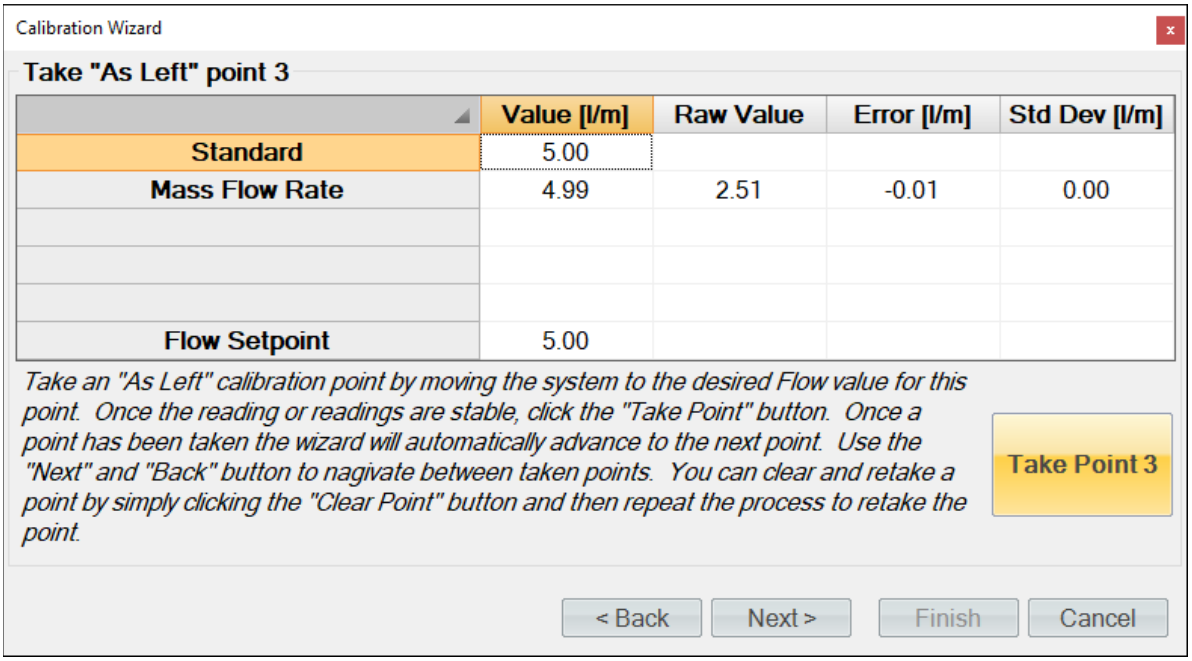
Tip - *Use the "Next" and "Back" button to navigate between taken points. You can clear and retake a point by simply clicking the "Clear Point" button and then repeat the process to retake the point.*



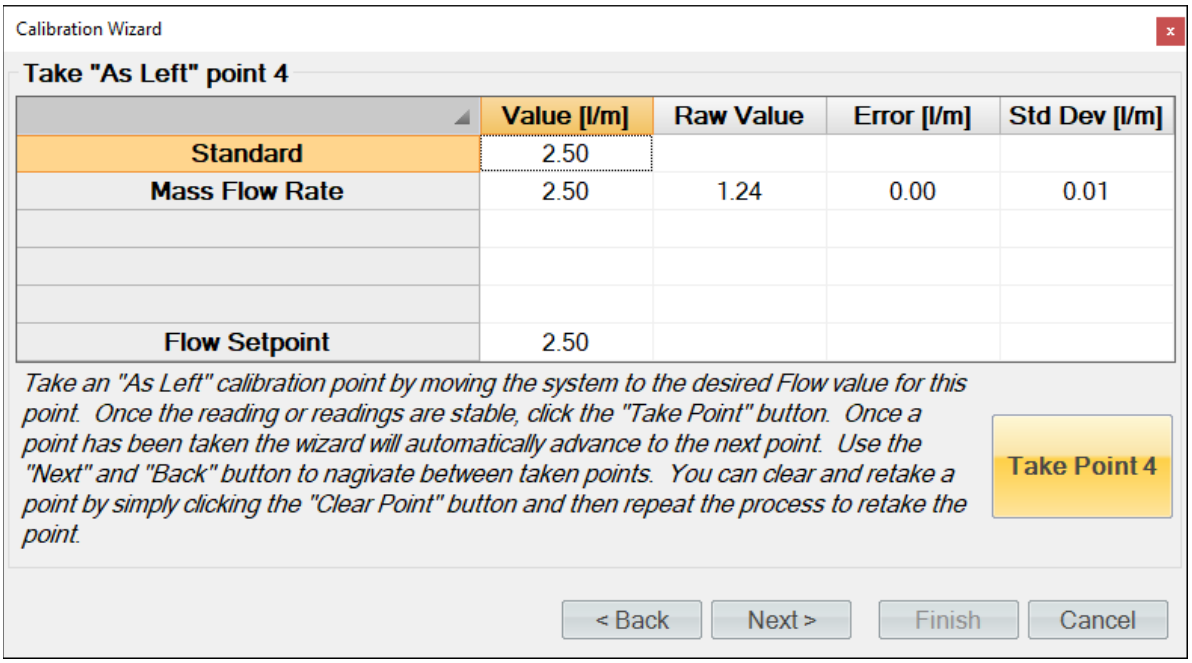
Continue generating and set the flow rate to the next point (7.5 l/m). Using the flow standard, measure the point and once the readings are stable enter the standards value and click the “Take Point” button.



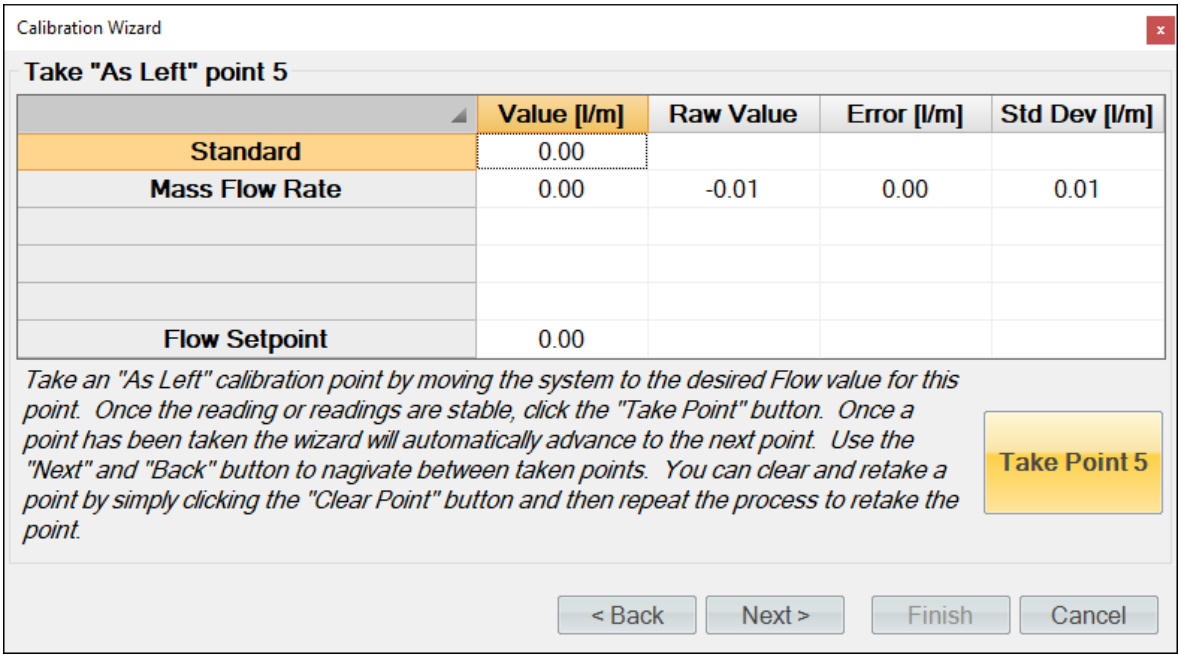
Continue generating and set the flow rate to the next point (5.0 l/m). Using the flow standard, measure the point and once the readings are stable enter the standards value and click the “Take Point” button.



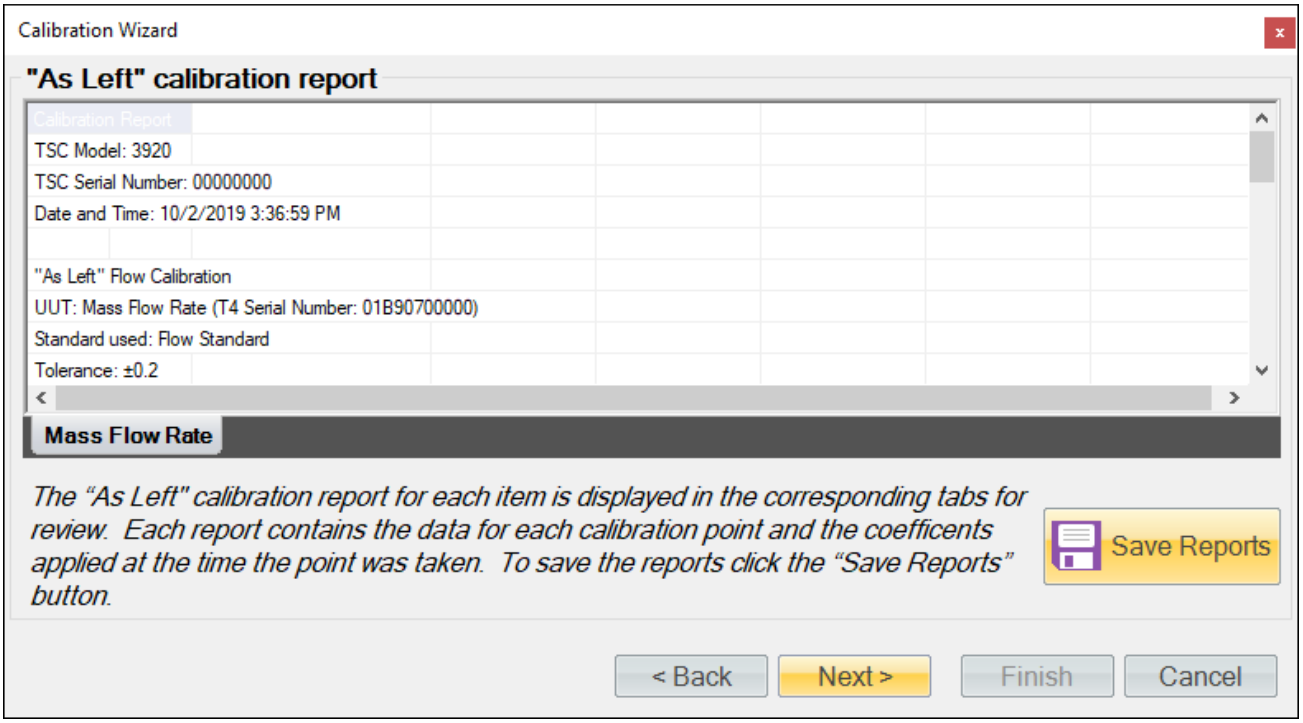
Continue generating and set the flow rate to the next point (2.5 l/m). Using the flow standard, measure the point and once the readings are stable enter the standards value and click the “Take Point” button.



Set the final flow rate to (0.0 l/m). Using the flow standard, measure the point and once the readings are stable enter the standards value and click the “Take Point” button.



When you have taken the desired amount of “As Left” flow points, click the “Next” button to view the “As Left” calibration report. The flow meter will appear in its own tab and contains the data for each calibration point along with the coefficients used at the time the points were taken.



Clicking the “Save Reports” button will open a file dialog to save the report. The default file location is …Documents\Thunder Scientific\3920 ControLog\Reports\.

6.4 Viewing and Editing Calibration Coefficients

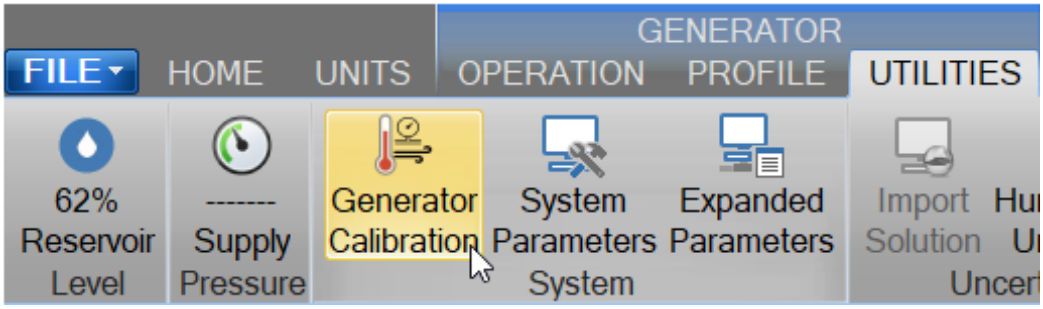
The calibration coefficients for any calibration item can be viewed and or edited using the Calibration Wizard. ControLog uses the follow equation to apply calibration coefficients:

$$f(x) = c_4x^4 + c_3x^3 + c_2x^2 + c_1x + c_0$$

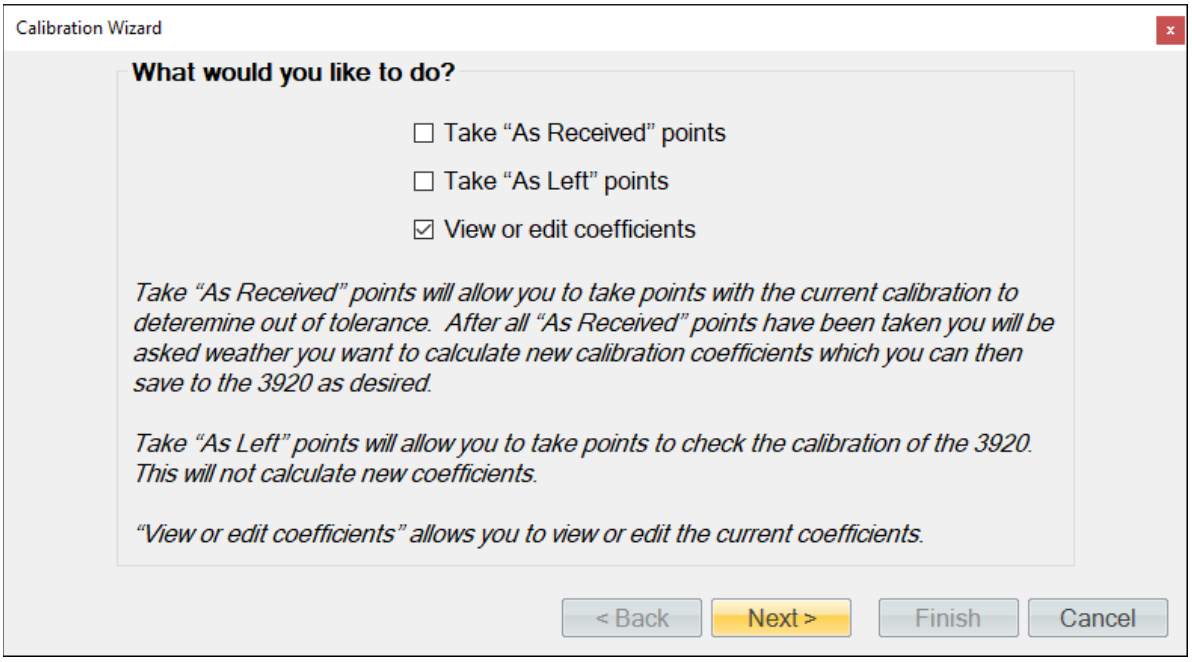
Where x is the raw value, c0, c1, c2, c3 and c4 are the coefficients and f(x) is the calibrated value for the given coefficients and raw value.

Note – *Editing calibration coefficients requires Manager Access Level or above.*

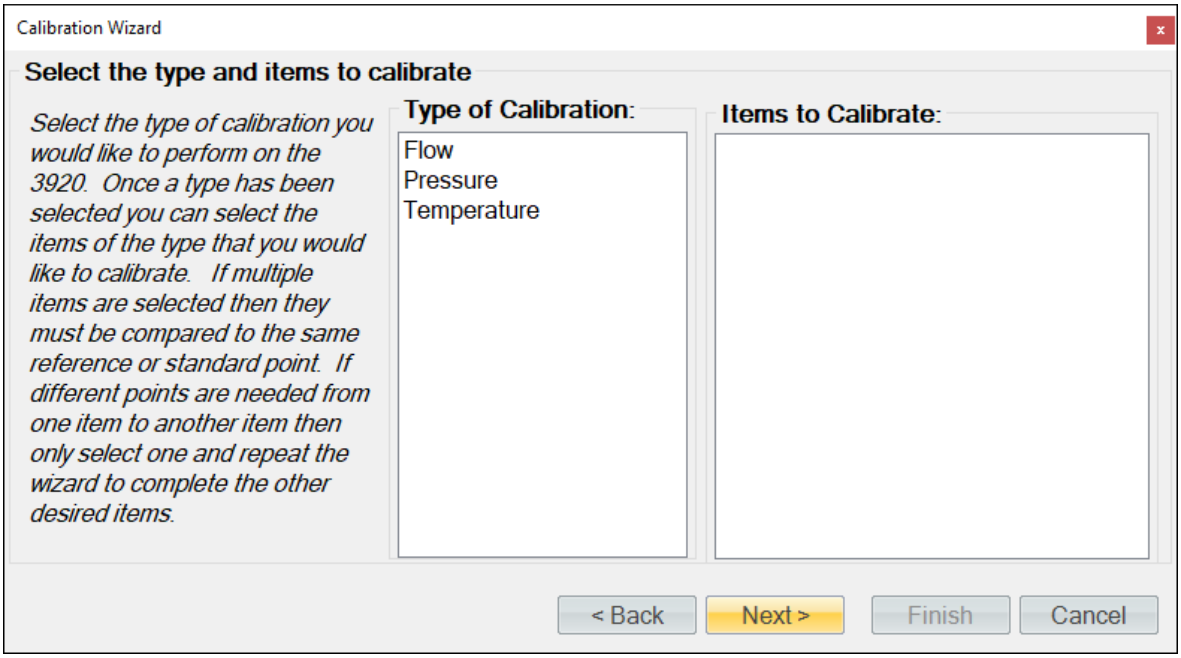
Select Generator Calibration from the Utilities menu tab to open the Calibration Wizard.



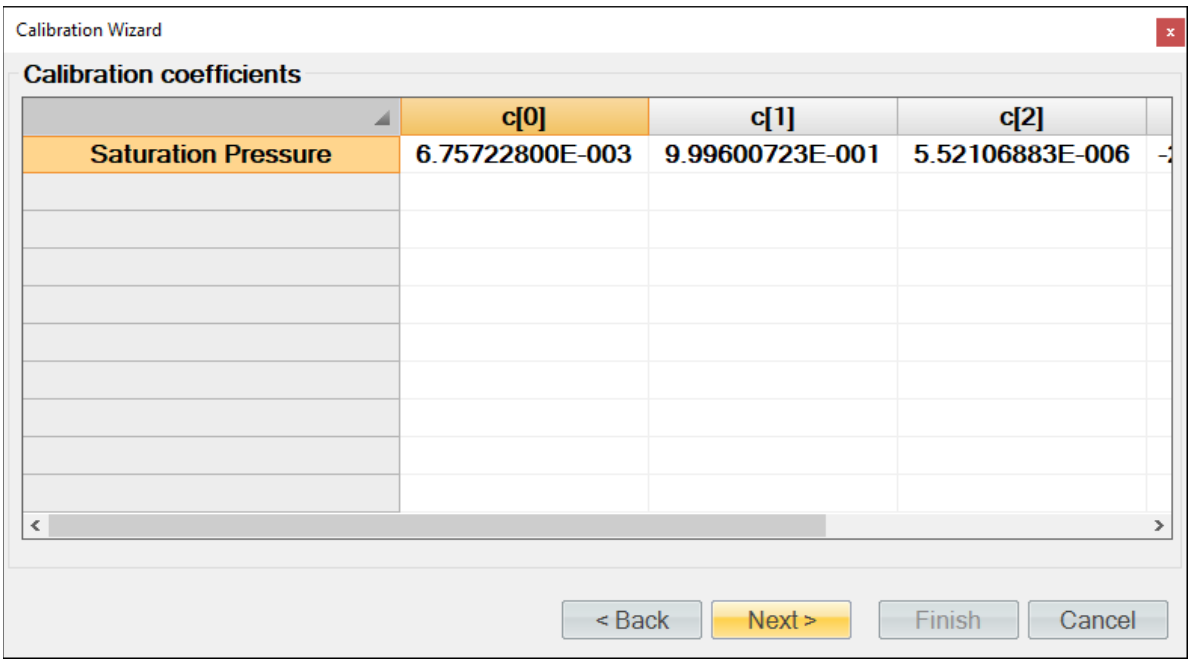
Select View or edit coefficients.



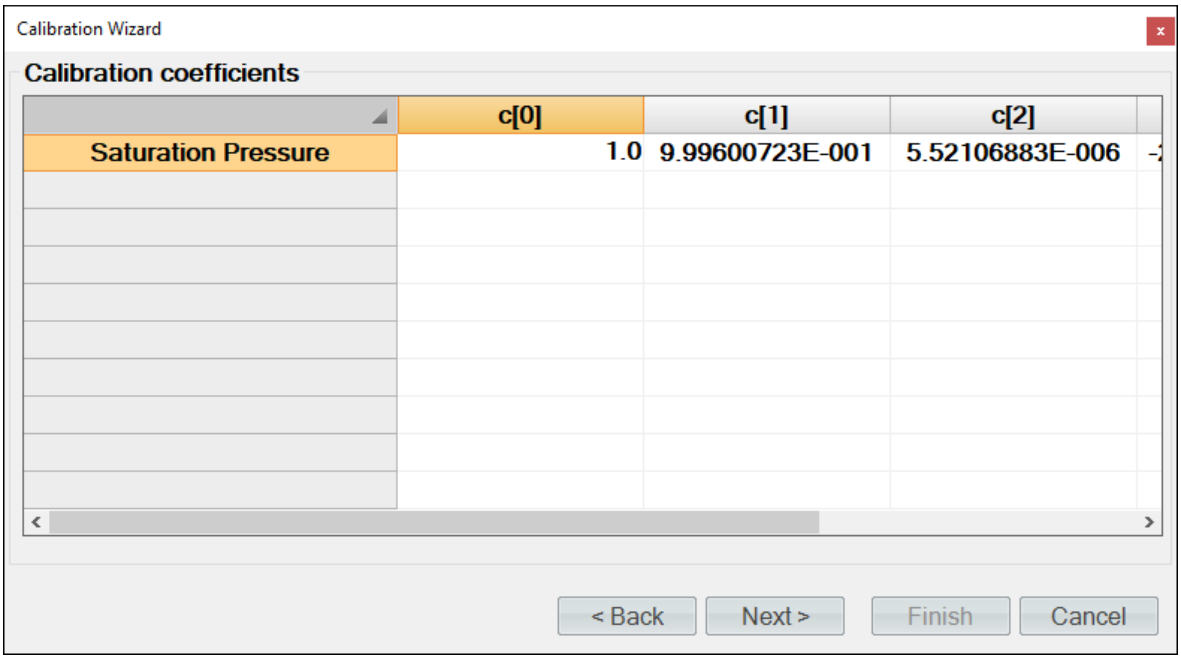
Select the type of calibration and the items you wish to view or edit coefficients for.



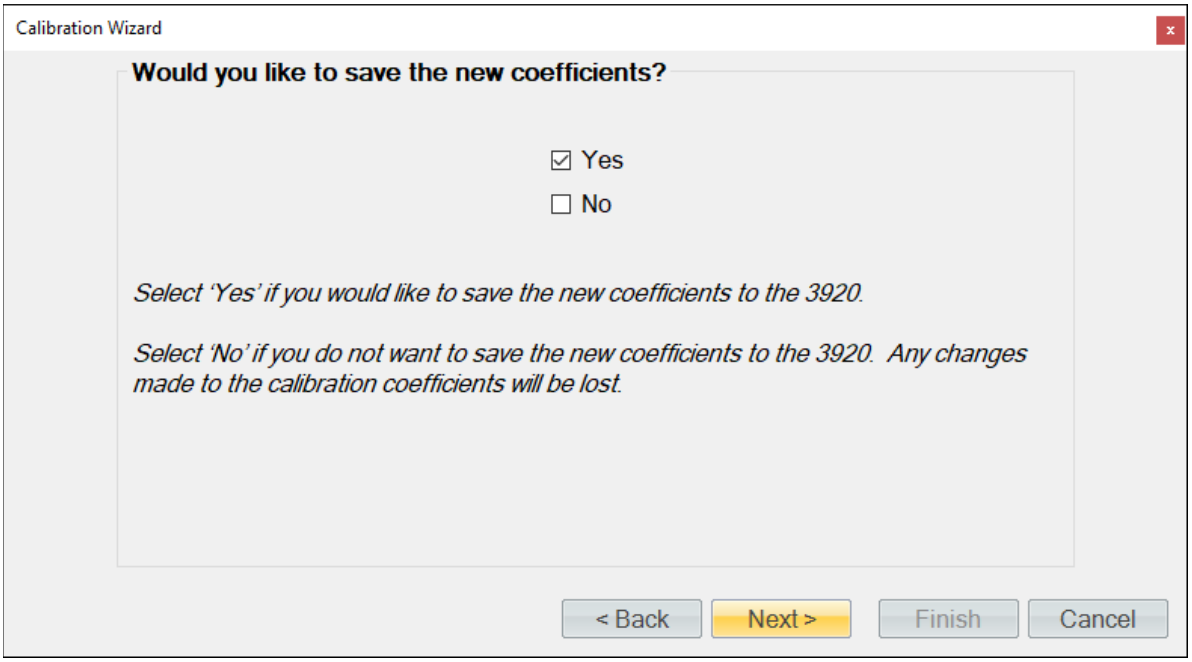
The calibration coefficients are then shown for the selected items.



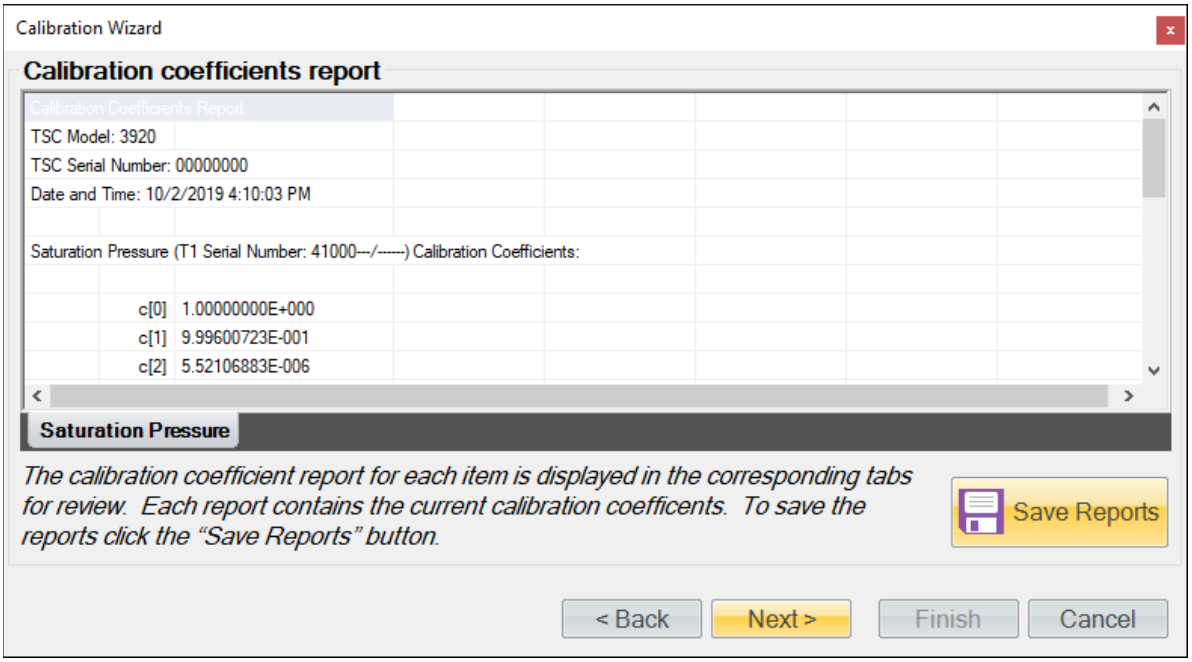
To edit the coefficients, simply click in the cell of the coefficient you wish to edit and enter a new value using the keyboard.



Next, the user will be asked to save the new coefficients to the system. Selecting "Yes" will result in the current coefficient being over-written by the newly calculated coefficients.



A new calibration coefficients report will be generated.



Clicking the "Save Reports" button will open a file dialog to save the report. The default file location is …Documents\Thunder Scientific\3920 ControLog\Reports\. If the report is saved in an Excel format, then each probe or transducer will appear in its own tab within the workbook. The user wishes to save in a text-based format then a file for each probe calibrated will be created

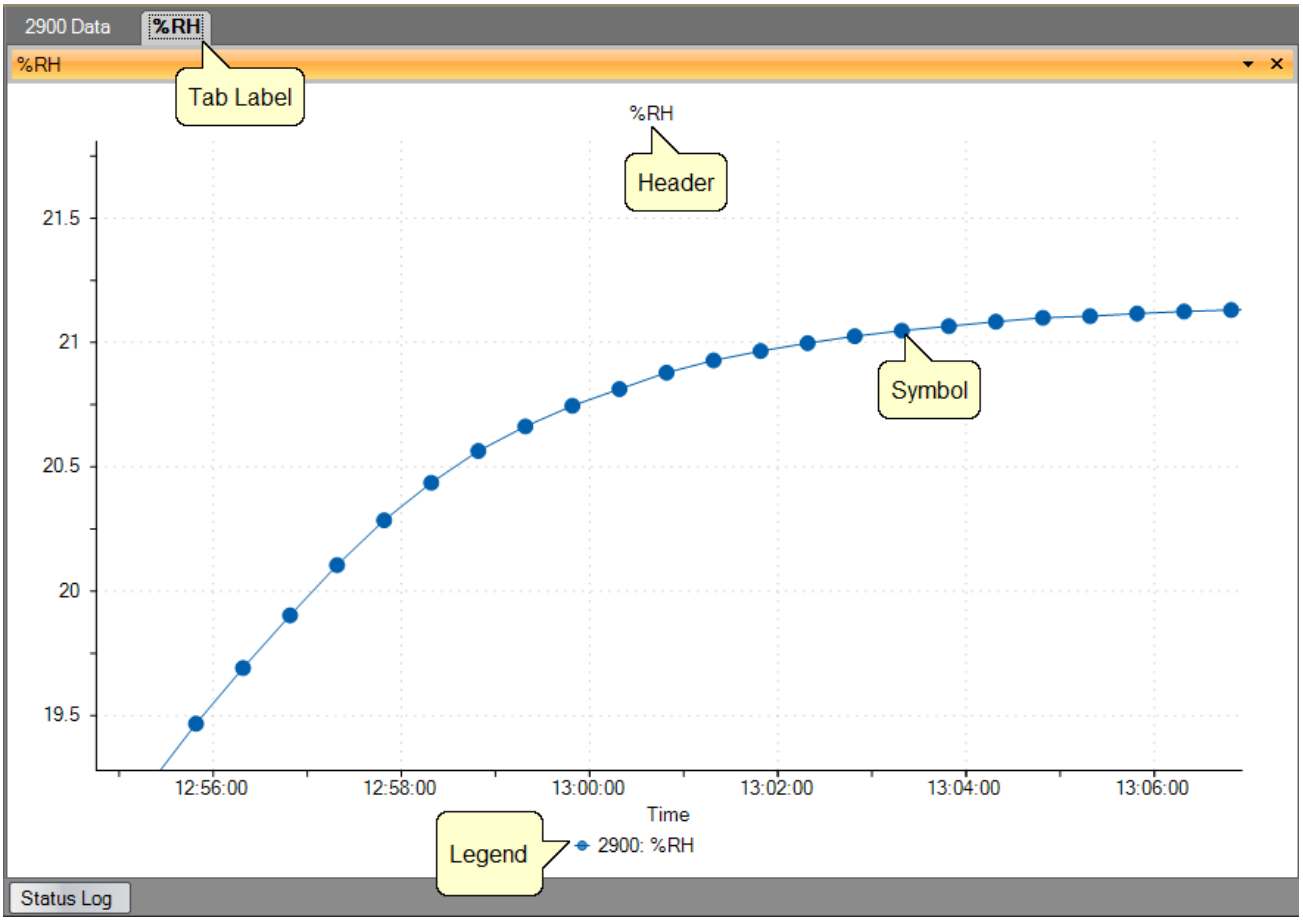
7 GRAPHING

Graphing is a powerful tool used to view previously recorded data or to monitor the current data in real time. The graph works hand in hand with the data tabs. While the generator is in operation, data tabs store the most recent data points from the connected devices at the desired interval. A graph can be used to create a visual picture of this stored data.

Graph operations can be accessed by two means, either by selecting the desired command from the graph menu at the top or by long pressing or right clicking a graph tab and opening a context menu. The functionality of the commands is the same regardless of which method is used, but remember that the menu commands are dynamic and reflect operations that can be performed on the selected graph tab.

Note - *ControLog has a limit of twelve graph tabs opened at any given time.*

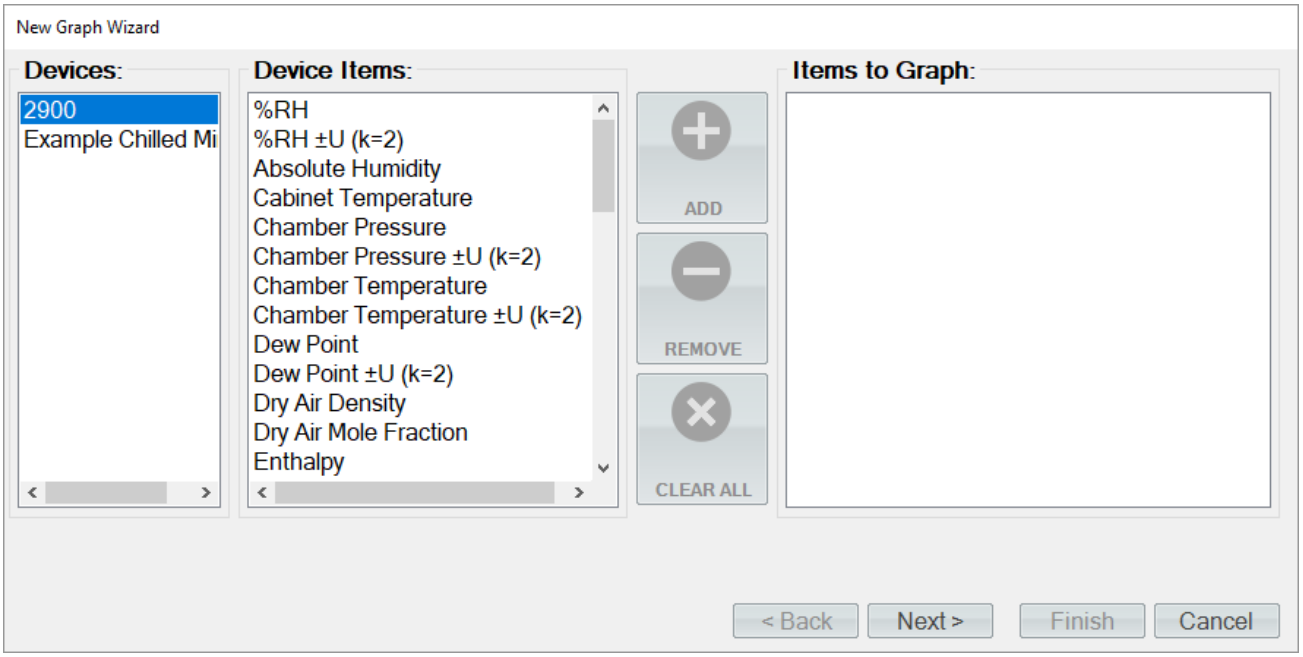
Each graph tab consists of a two-dimension plot across an X and Y Axis. The graph can be customized to display different point symbols, various line colors, a legend and a header.



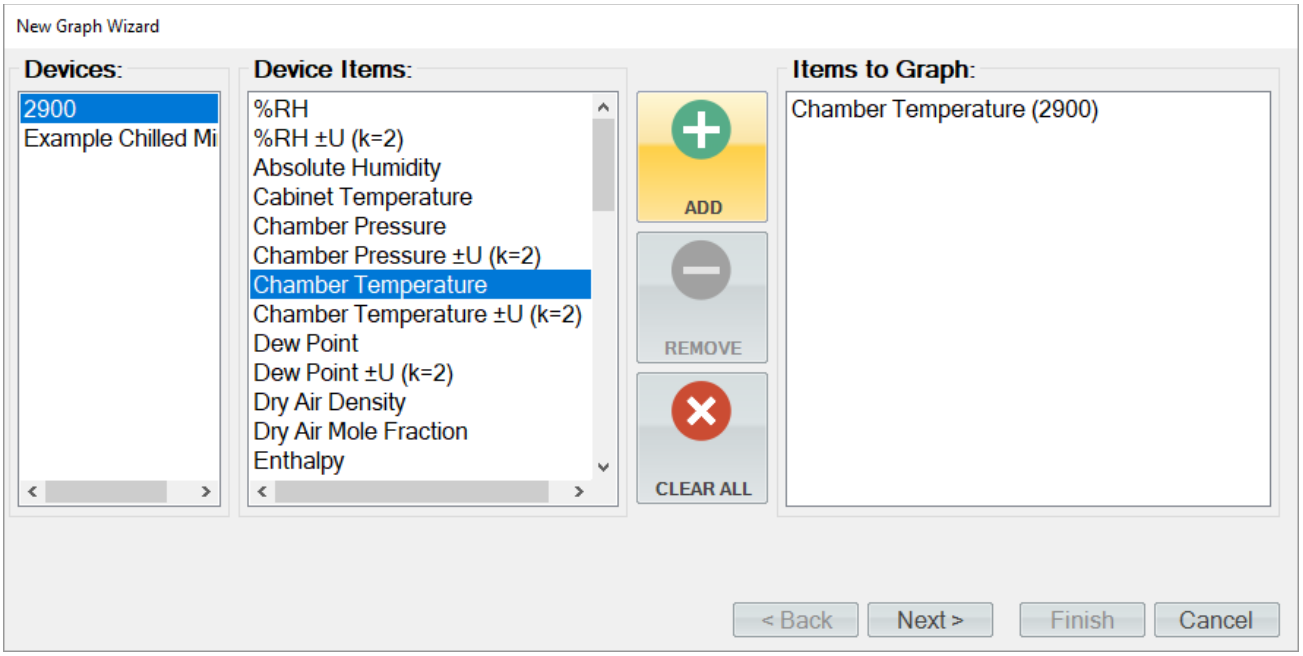
7.1 CREATING A NEW GRAPH

A new graph can be created using the New Graph Wizard dialog. The wizard will walk the user through the selection process of what data the user would like to include in the new graph and how it should look. To create a new graph, select “New” from the Home Menu Tab, Graph Menu Tab or right click any graph tab and select “New” from its context menu.

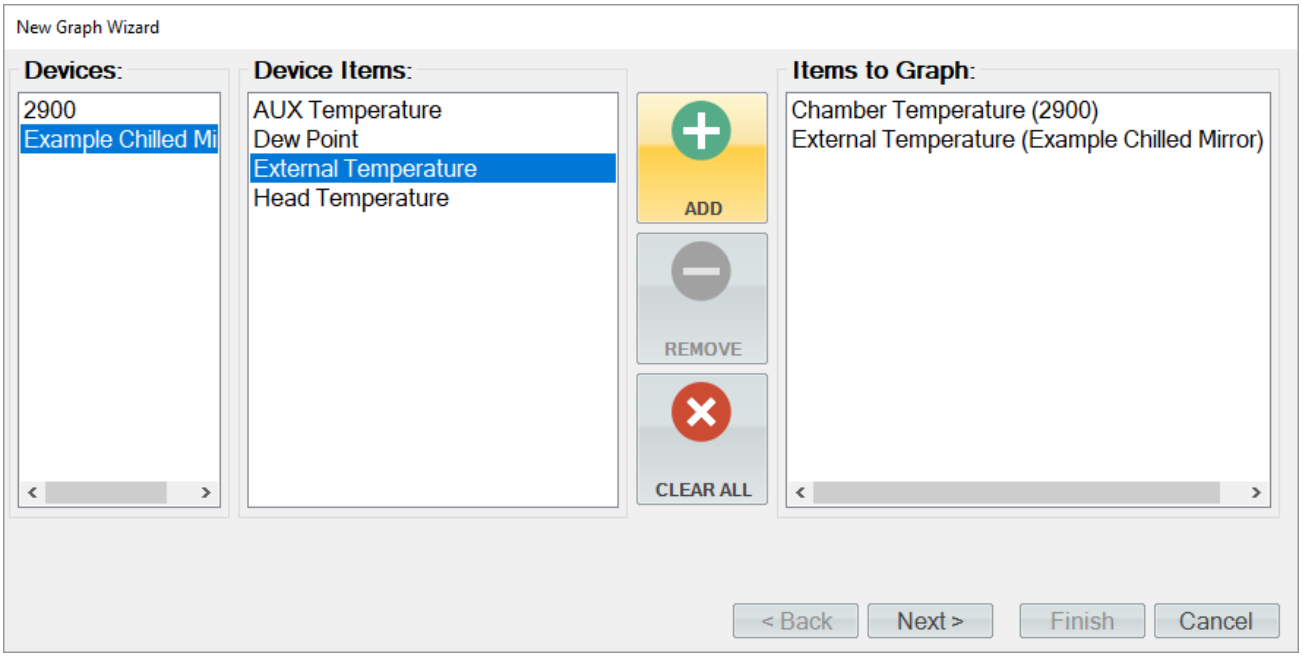
A “New Graph Wizard” dialog will appear.



The first page of the New Graph Wizard is where the user selects which device items they would like to include in the graph. On the left-hand side is a list of all available devices. Selecting a device will result in the "Device Items" list being updated to reflect the available items for the selected device. To add an item, highlight the desire item or items in the "Device Items" list and click the "Add" button.

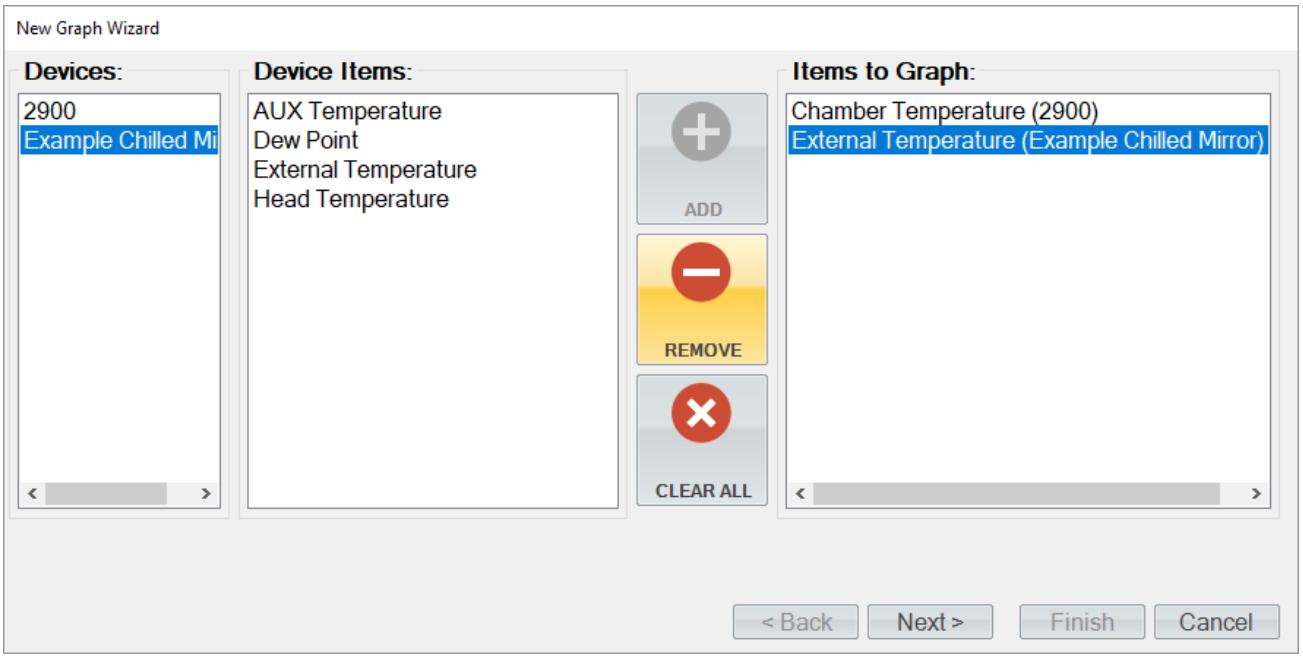


Repeat this process until all of the desired items are listed on the right side.

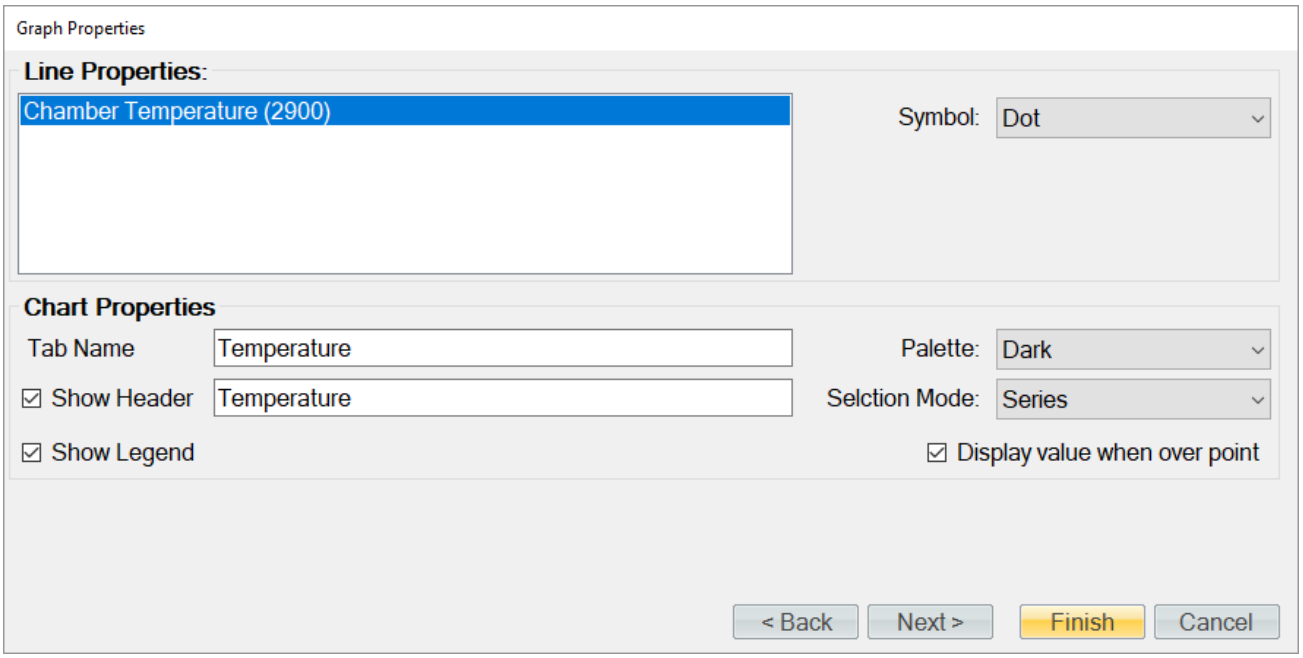


Note - *The user can invert any selection by right clicking. This will highlight all items that are not currently highlighted and will remove highlight from any items that are currently highlighted.*

To remove an item from the list of items to graph, the user can either click the “Clear All” button to remove all items or simply select the desired item from the “Items to Graph” list and click the “Remove” button.



Once complete, clicking the “Next” button will bring up the Properties page. From the properties page the user can customize the look of each graphed line along with the chart itself.



7.1.1 Line Properties

Line Properties define the color and point symbol for the selected line. Select the desired line from the selection box and set the Color, Symbol, whether to smooth the line, and whether to show data labels and how often to show them.

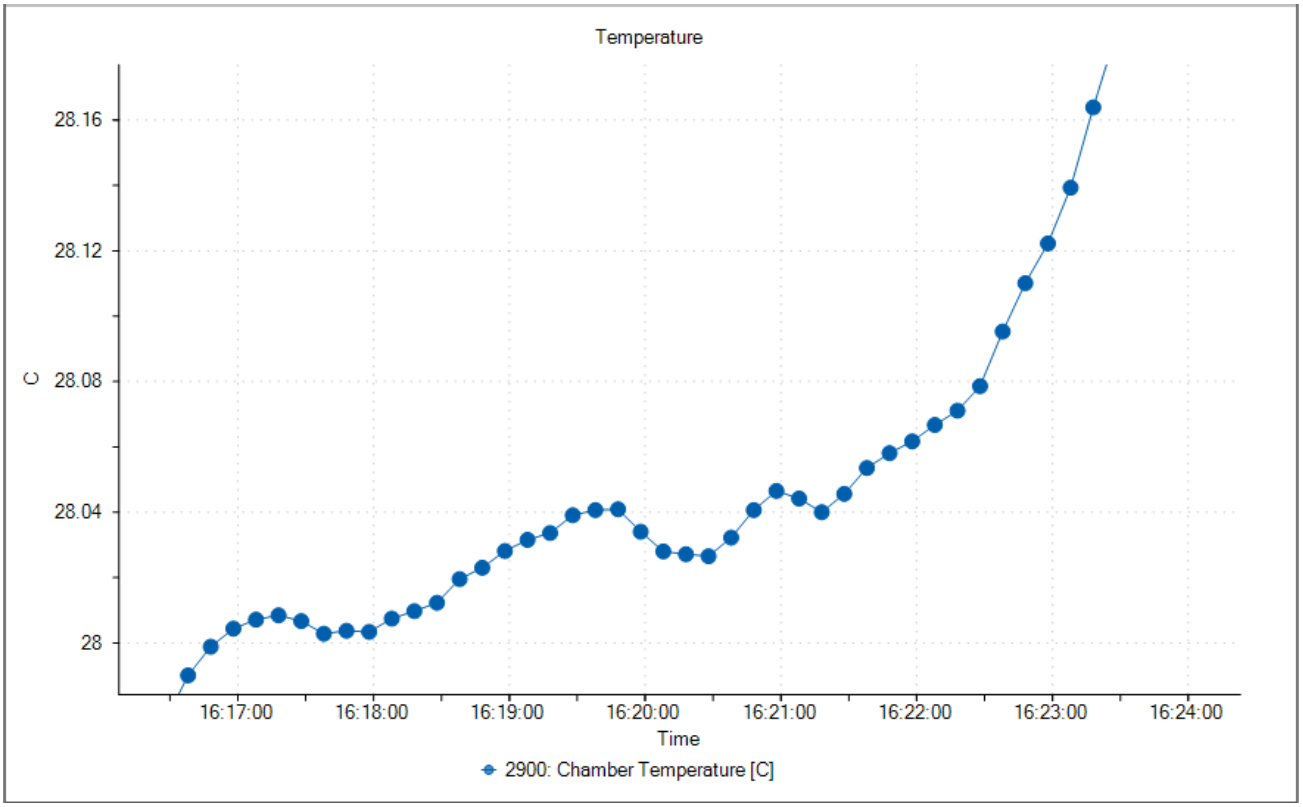
- Symbol defines the symbol drawn at each point. The symbol will be the same color as the line and will be shown at each data point. To change the symbol, select the desired symbol from the drop-down list.

7.1.2 Chart Properties

Chart Properties define the name of the graph tab, indicates whether to show a header on the graph and whether to show a legend of the lines plotted.

- Tab Name defines the name of the graph tab. This is the name the user will see appear in the Data and Graph Tab Group.
- Show Header defines the header that will appear at the top of the graph. To add a header to the graph, check the checkbox and enter the desired text description for the header.
- Show Legend defines whether a legend will be displayed on the right-hand side of the graph indicating which colored line is which data item.
- Palette defines the color palette that the lines will be drawn in. To change the palette, select the desired color palette from the drop-down list.
- Selection Mode allows the user to highlight different lines within the graph.

Once complete, clicking the “Finish” button will display the new graph in the Data and Graph Tab Group.

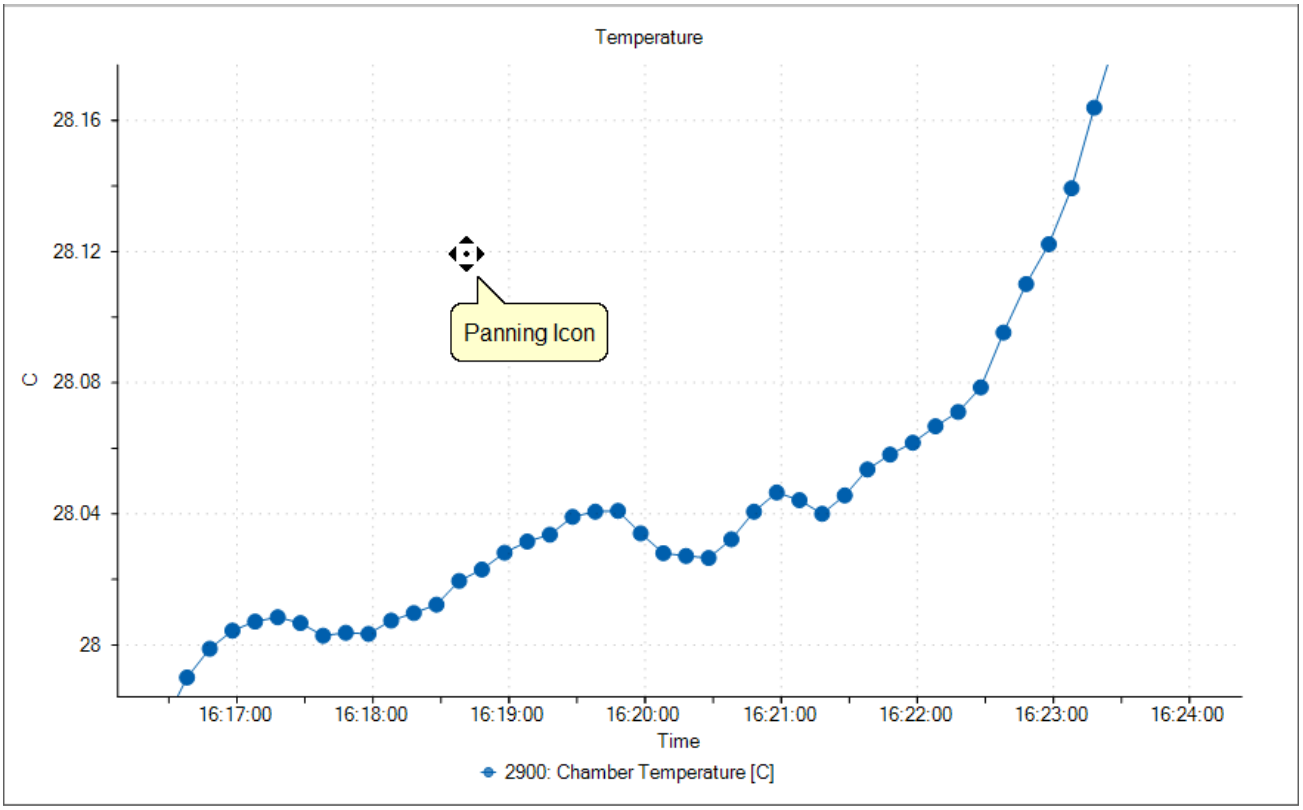


7.2 CUSTOMIZING A GRAPH

Each graph tab can be customized to display the data in different means. The user can Pan, Zoom and Scale the graph to the desired appearance.

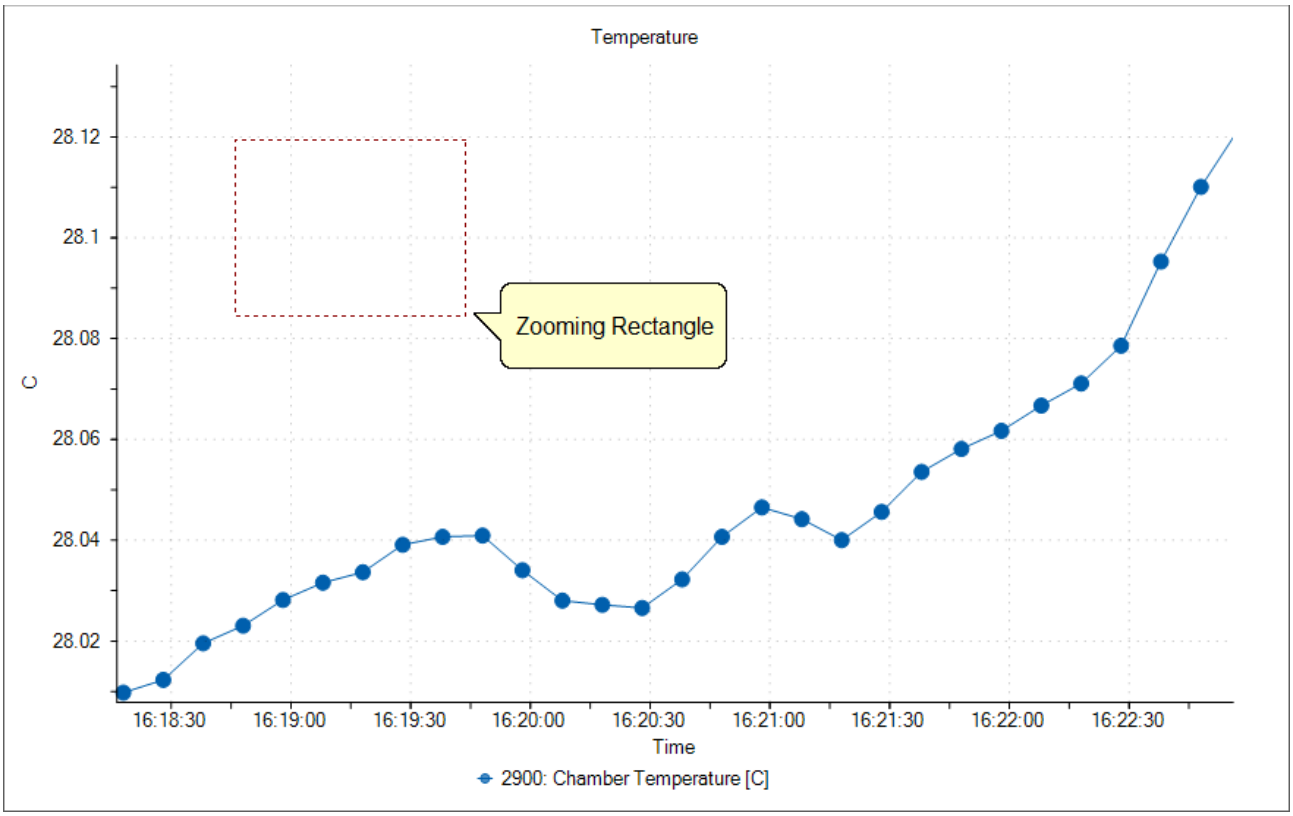
7.2.1 Pan

The graph can be panned up and down as well as left and right by a left click and hold of the mouse button or by a touch gesture while the user moves the cursor around. Panning is useful when you have zoomed the graph and want to view different parts of the data without changing the scaling.



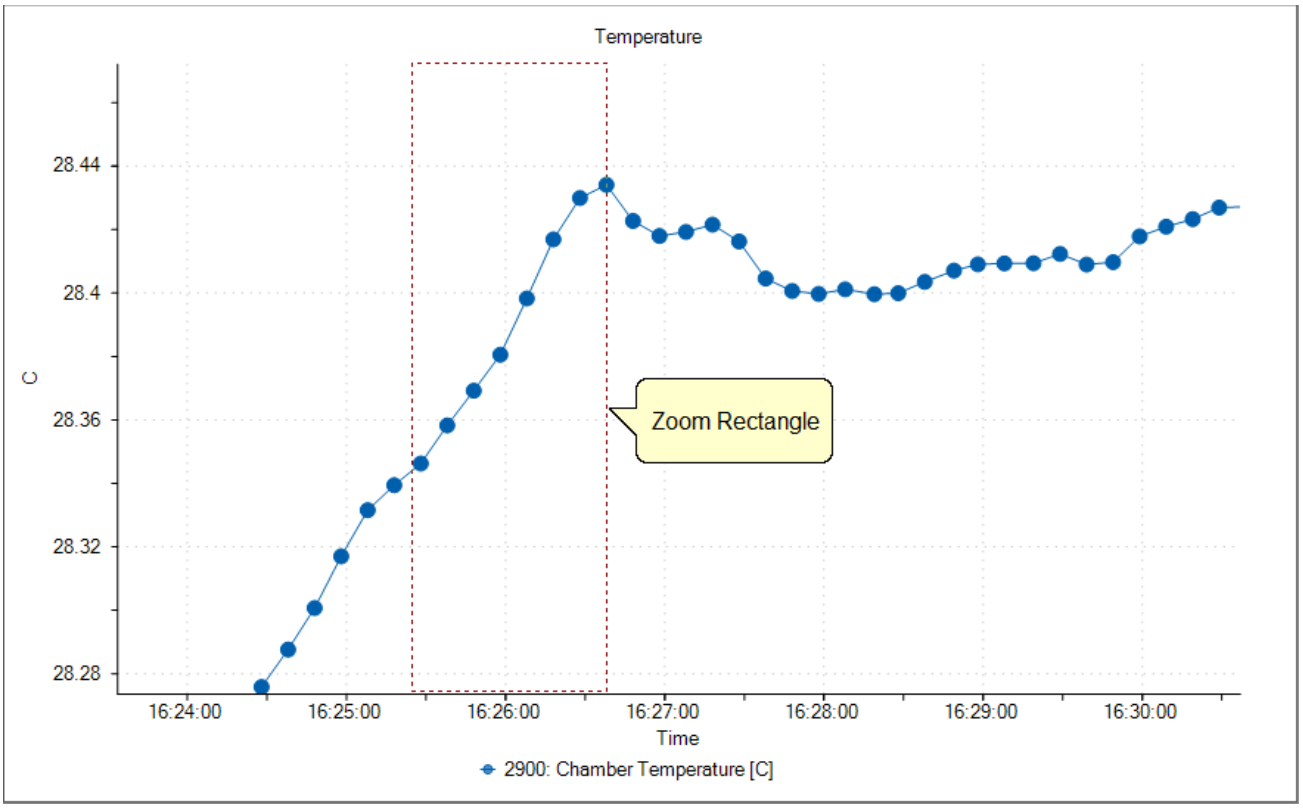
7.2.2 Zoom

The user can select to zoom the graph from the Graph Menu Tab or by using a “pinch” gesture. Using the cursor, left click and drag to create a box around the portion to zoom and release the left mouse button. The portion of the graph within the drag box will expand to fill the entire graph. The time and Y-axis limits update accordingly.



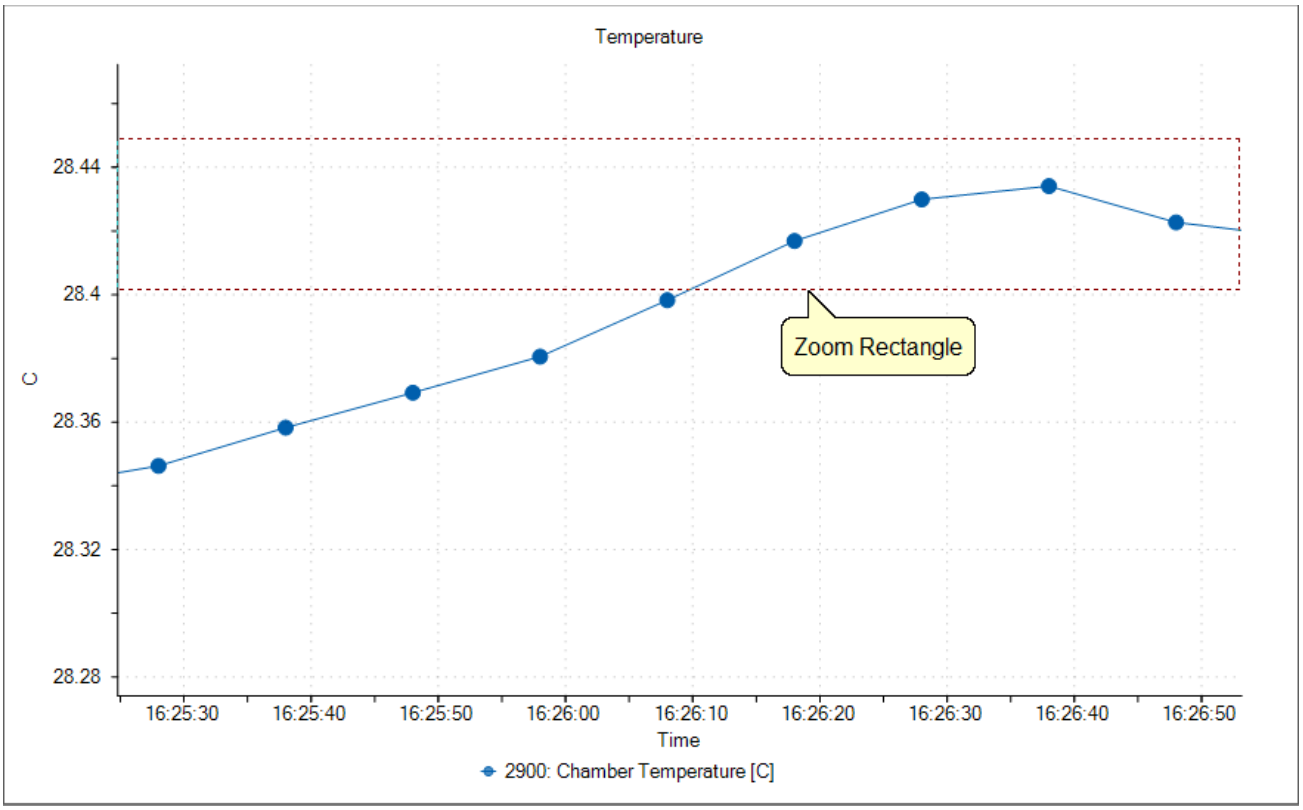
7.2.3 Zoom Graph's X Axis

The user can select to zoom the X axis of the graph from the Graph Menu Tab. Using the cursor, left click on the graph and drag the cursor so that the portion of the X-axis (time axis) of interest is contained within the two vertical dashed lines. The portion contained within this region will expand to fill the entire X-axis. The Y-axis remains unchanged.



7.2.4 Zoom Graph's Y Axis

The user can select to zoom the Y axis of the graph from the Graph Menu Tab. Using the cursor, left click on the graph and drag the cursor so that the portion of the Y-axis of interest is contained within the two horizontal dashed lines. The portion contained within this region will expand to fill the entire Y-axis. The X-axis remains unchanged.



7.2.5 Auto Scale

Selecting the Auto Scale command will automatically reset both axis of the graph so the entire data set for each selected item is contained within the boundaries of the graph.

7.2.6 Scale

The Scale command allows the user to scale the X and Y axis. Dragging the cursor up scales the display in (zooms in) and dragging the cursor down scales the display out (zoom out).

7.2.7 Scale X Axis

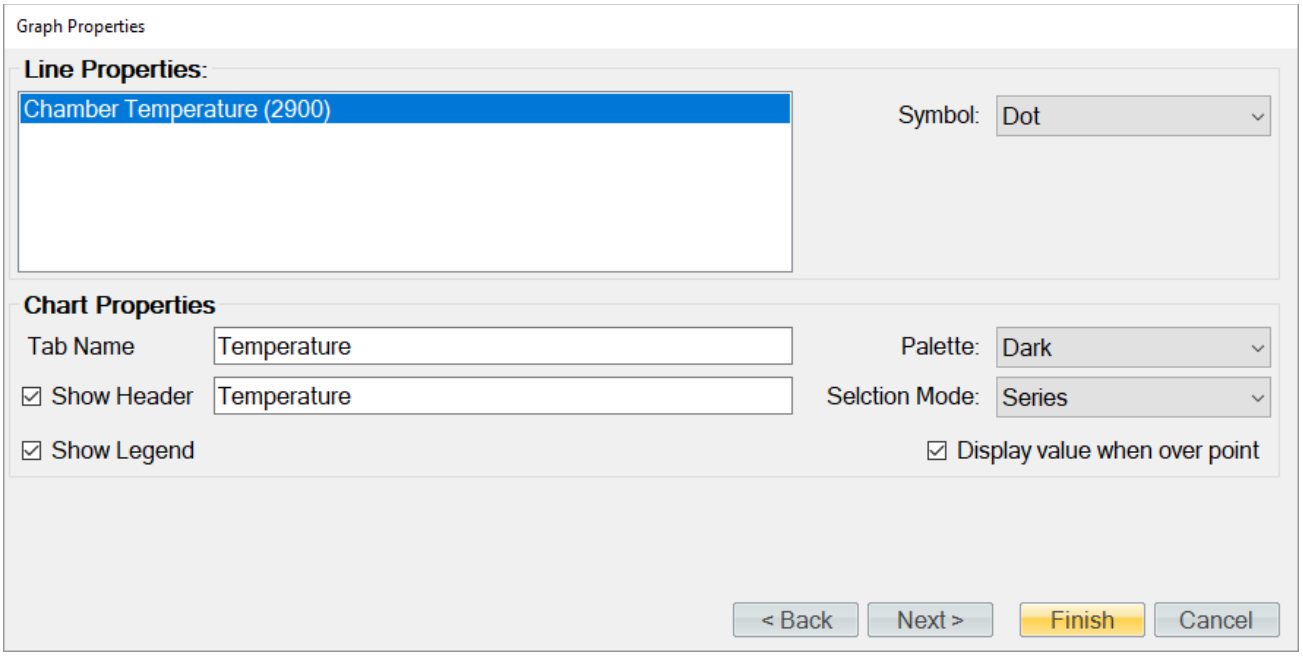
The Scale X Axis command allows the user to scale the X axis. Dragging the cursor up scales the X Axis in (zooms Y Axis in) and dragging the cursor down scales the X Axis out (zooms X Axis out).

7.2.8 Scale Y Axis

The Scale Y Axis command allows the user to scale the Y axis. Dragging the cursor up scales the Y Axis in (zooms Y Axis in) and dragging the cursor down scales the Y Axis out (zooms Y Axis out).

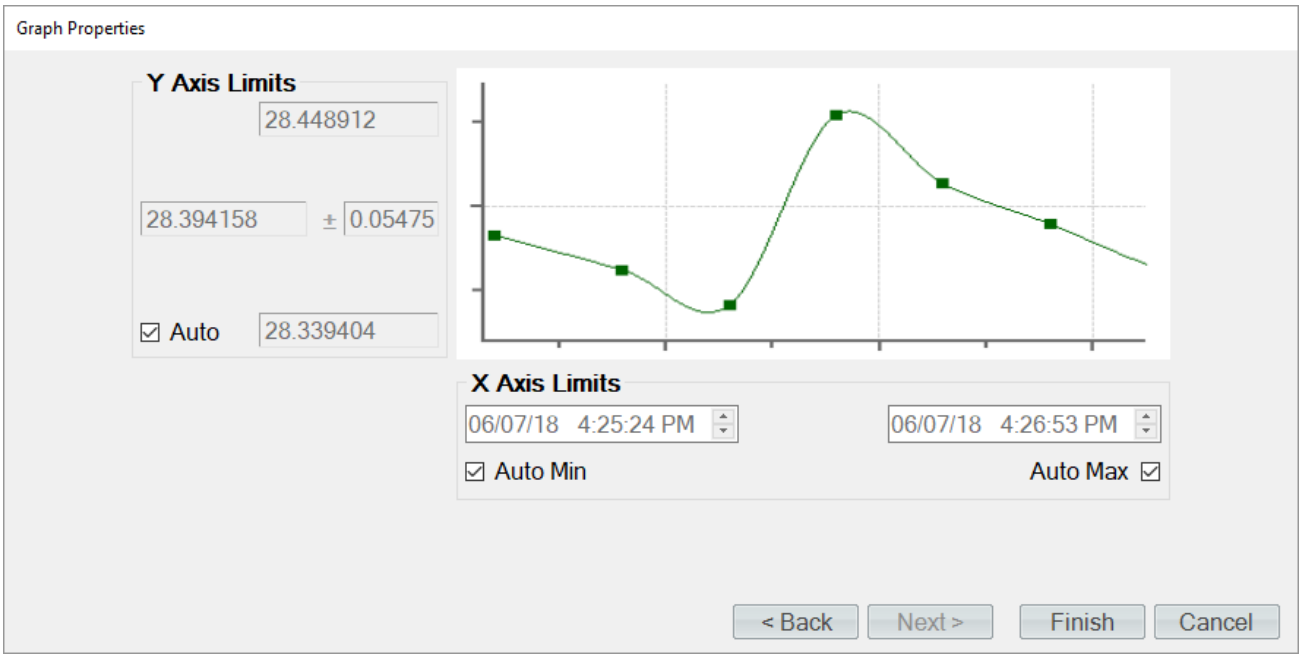
7.2.9 Graph Properties

The Graph Properties command allows the user to modify the properties of the selected graph. Selecting the command opens the Graph Properties dialog that allows the user to make changes to what data is graphed, line properties and axis values.



The first two pages of the Graph Properties dialog are the same as the New Graph Wizard that is used to create new graphs. The Graph Properties dialog starts on the properties page from which the user can customize the look of each graphed line as well as the chart itself. Clicking the “Back” button will move back to the data selection page where the user can select which device items they would like to include in the graph.

Clicking the “Next” button will move to the Axis page where the user can specify the starting and ending X and Y axis values.



7.2.9.1 Y Axis Limits

The Y Axis Limits define the maximum, minimum, middle and span values for the Y Axis.

- The Maximum value defines the maximum Y value for the Y Axis. No values beyond this maximum will be displayed on the graph.
- The Minimum value defines the minimum Y value for the Y Axis. No values below this minimum will be displayed on the graph.
- The Middle value defines the middle Y value for the Y Axis.
- The Span value defines the amount above and below the middle value where the maximum and minimum Y values lie.
- The Auto check box tells ControLog to automatically calculate the best Y Axis limits to encompass the current data.

Note - *The maximum, minimum, middle, and span values are interrelated and changing any one value may result in another value automatically changing to assure all values mathematically equate.*

7.2.9.2 X Axis Limits

The X Axis Limits define the maximum and minimum values for the X Axis.

- The Minimum value defines the minimum date and time for the X Axis. No values below this minimum date and time will be displayed on the graph.
- The Auto Min check box tells ControLog to automatically use the starting date and time for the current data as the X Axis minimum.
- The Maximum value defines the maximum date and time for the X Axis. No values above this maximum date and time will be displayed on the graph.
- The Auto Max check box tells ControLog to automatically use the last date and time for the current data as the X Axis maximum. The graph will constantly expand as new data points are recorded.

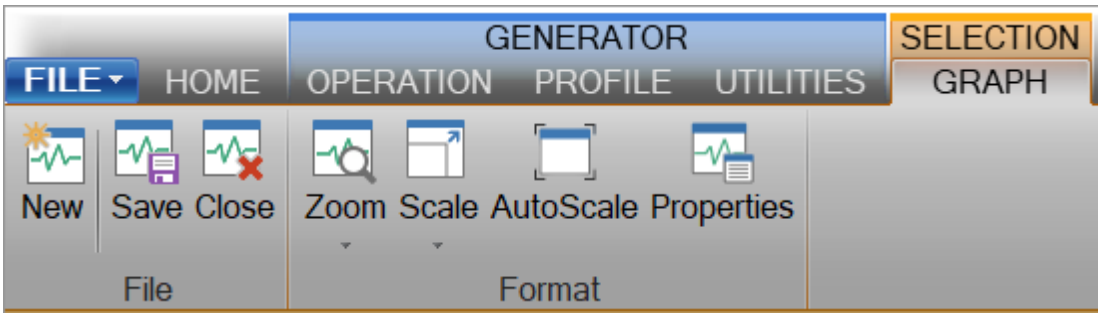
Once complete, clicking the "Finish" button will display the graph in the same tab with the new property settings.

7.3 SAVING A GRAPH

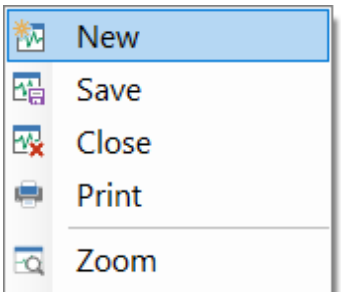
Each graph tab can be saved to a file in any of the following graphic file types:

- Bitmap (*.bmp)
- Graphics Interchange Format (*.gif)
- Joint Photographic Experts Group (*.jpg)
- W3C Portable Network Graphics (*.png)
- EMF Enhanced Metafile Format (*.emf)

To perform the save, select “Save” from the graph menu tab or right click a graph and select “Save”.

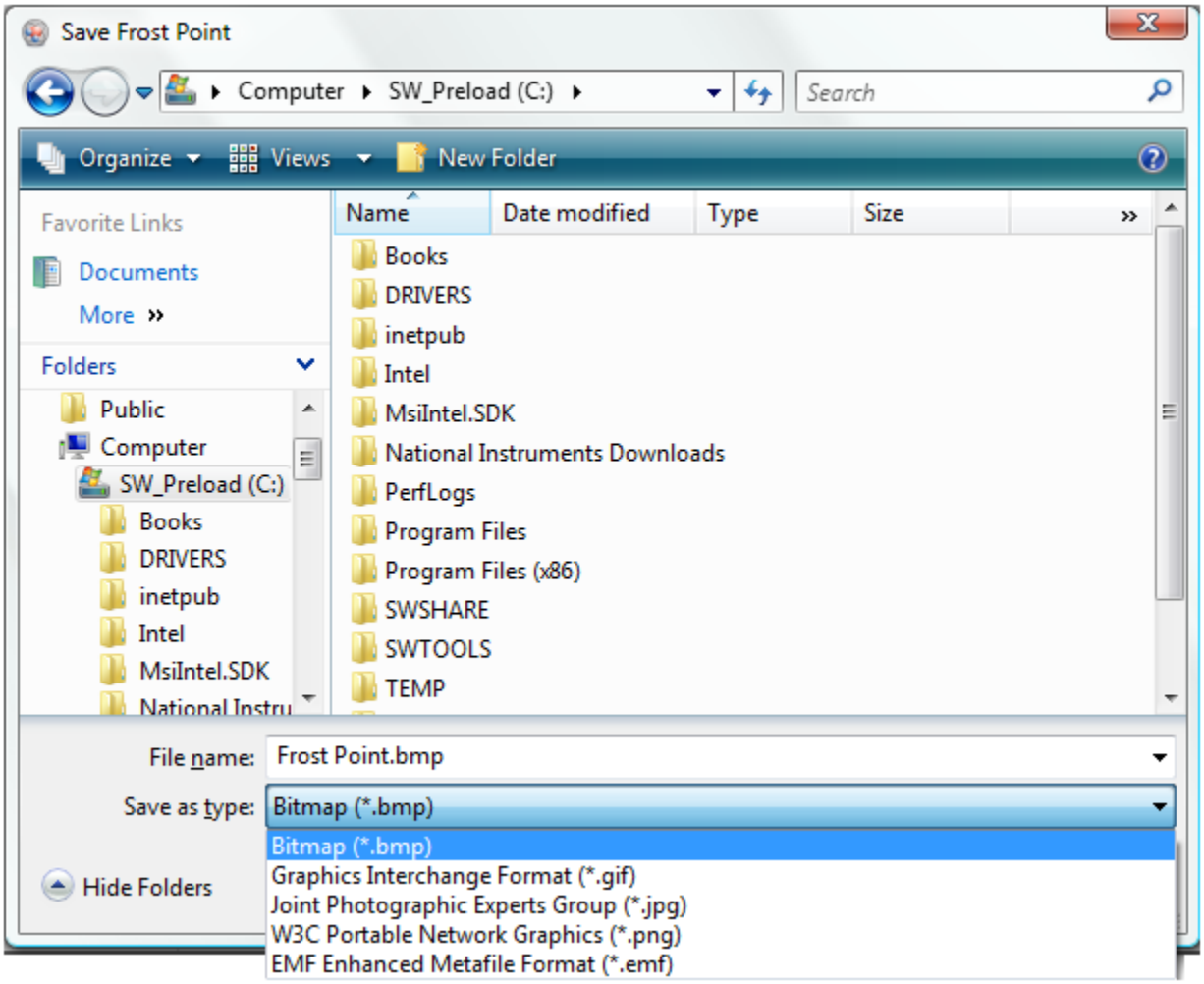


Or



Using the “Save” dialog, select the location, name and graphic type you want to the save the graph as.

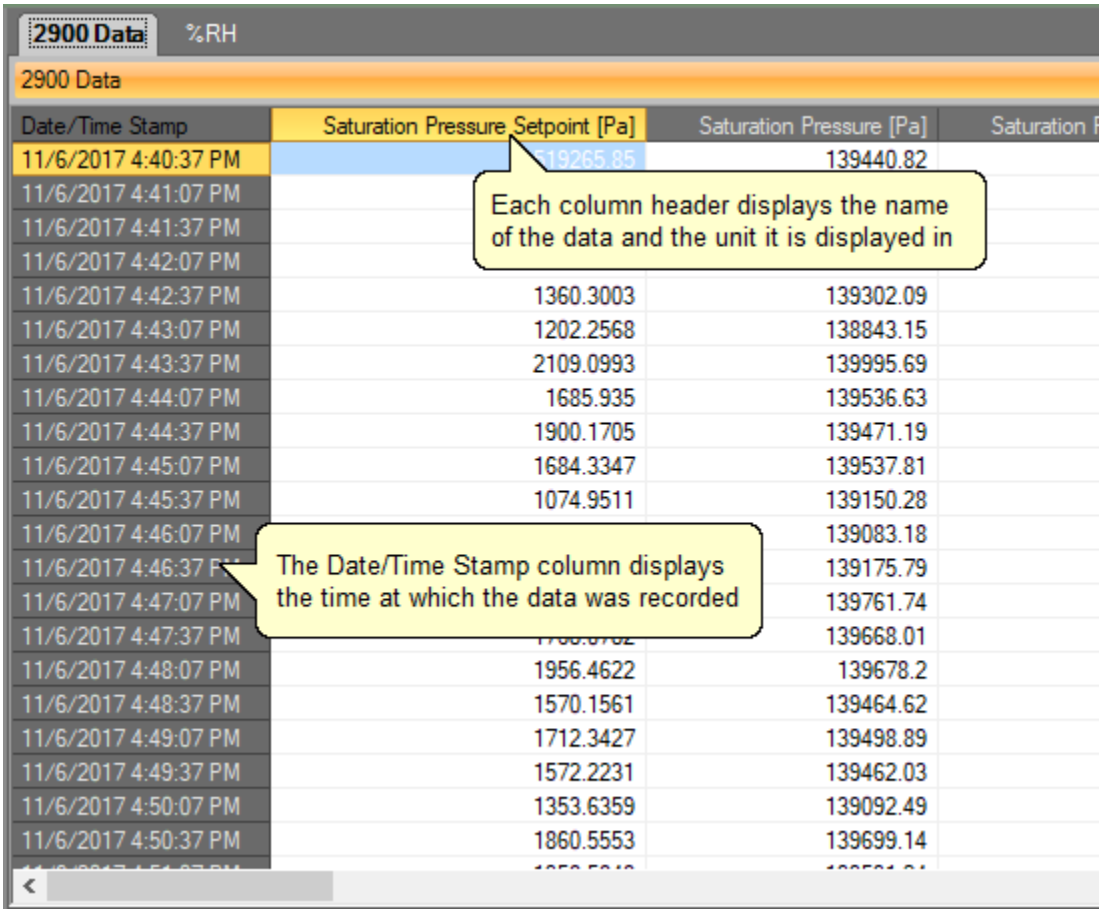
Note - *ControLog defaults the file name to the name of the graph tab.*



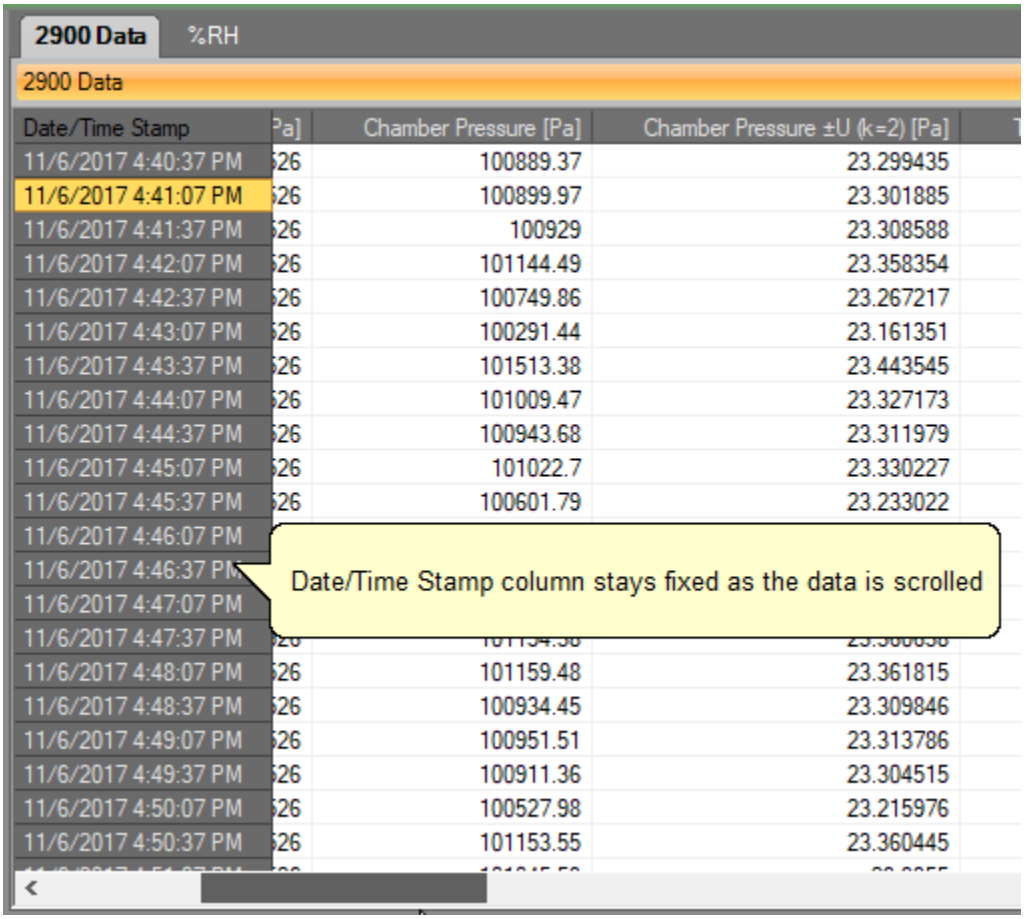
8 DATA AND DATA SUMMARY

ControLog stores data into individual Data Tabs. Each data tab contains a spreadsheet type view that consists of a date/time stamp and the measured data items corresponding to that date/time stamp. Data tabs consist of three similar but different types: Device Data, File Data and Data Summary. Each type has the same spreadsheet type view and operation, but all three have different data sources.

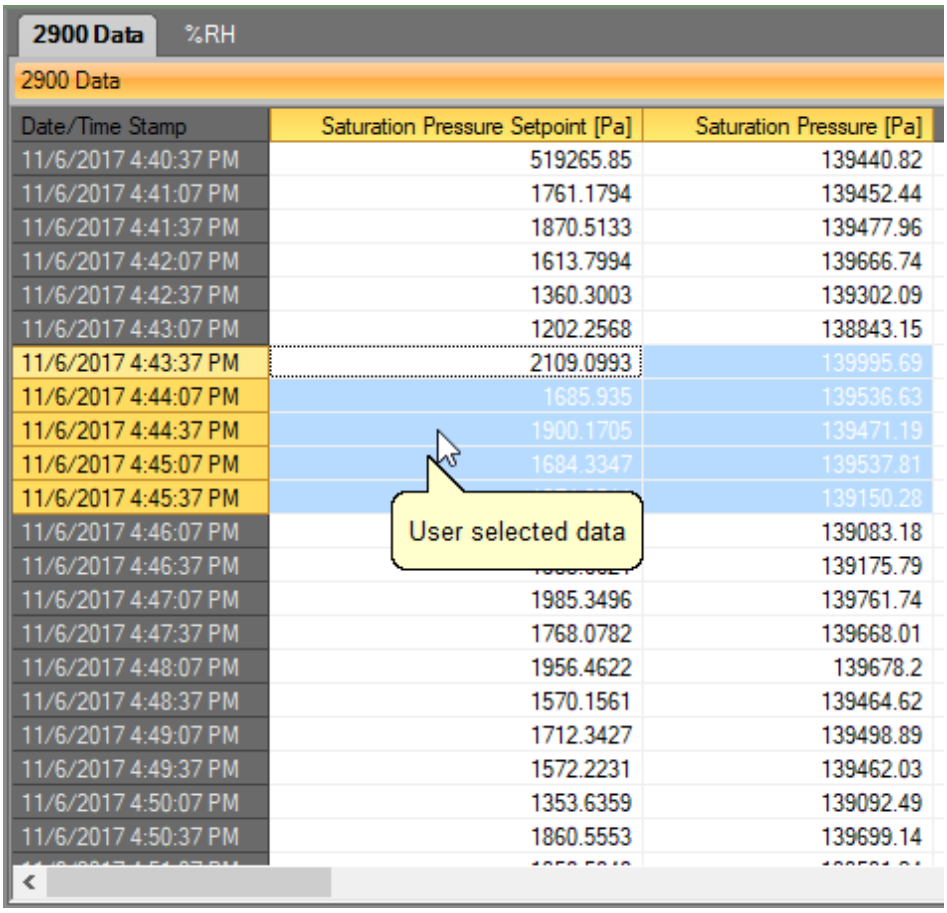
> **Note** - *The data tab data is always stored in SI units regardless of the current system unit settings. The only exception is for Data Summary tabs which are created using currently selected system units but will not update on further unit changes.*



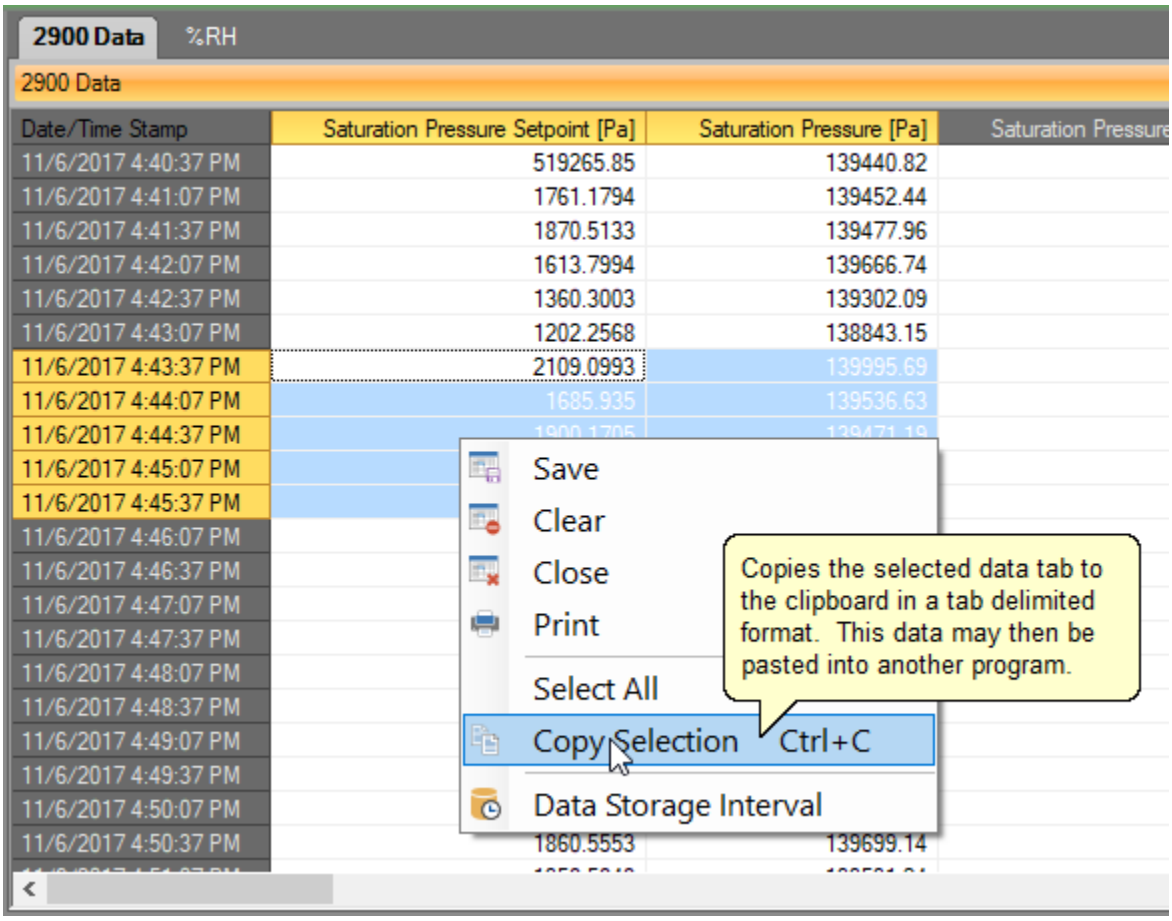
The user can navigate through the data using the scroll bars .



The user can also select specific data by clicking and draging the desired cells.



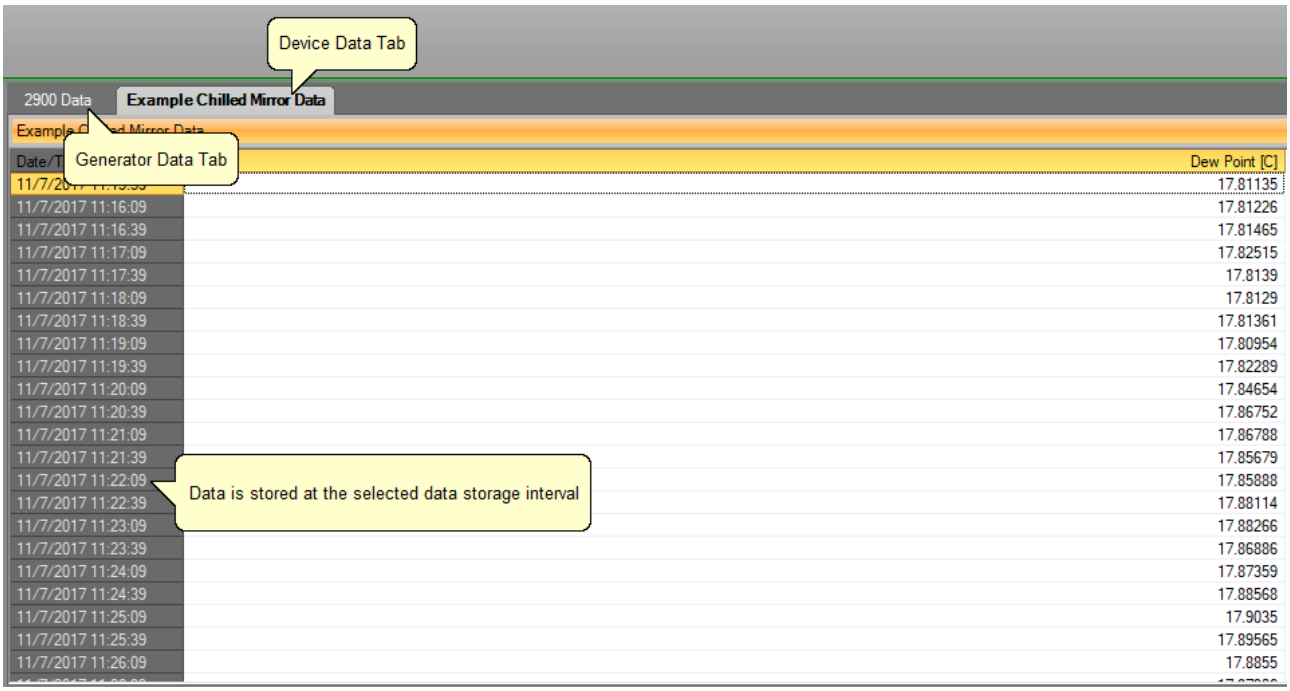
The user can then copy selected data to the clipboard by selecting “Copy Selection” from the context menu or by using the keyboard shortcut combination of Crtl+C.



8.1 DEVICE DATA TABS

The Device Data Tabs contain stored data values obtained by the connected generator or device. After establishing communication with the generator or device an individual data tab for the device will be created. These tabs store the data readings from the connected device at the specified data storage interval.

> **Note** - *Data is only recorded while the 3920 is in generate mode. Data is also stored at the generate rate whenever a device is connected and the 3920 is not connected. This gives the user the ability to use ControLog as a logging application for any device they connect without the need of a Model 3920 Low Humidity generator.*



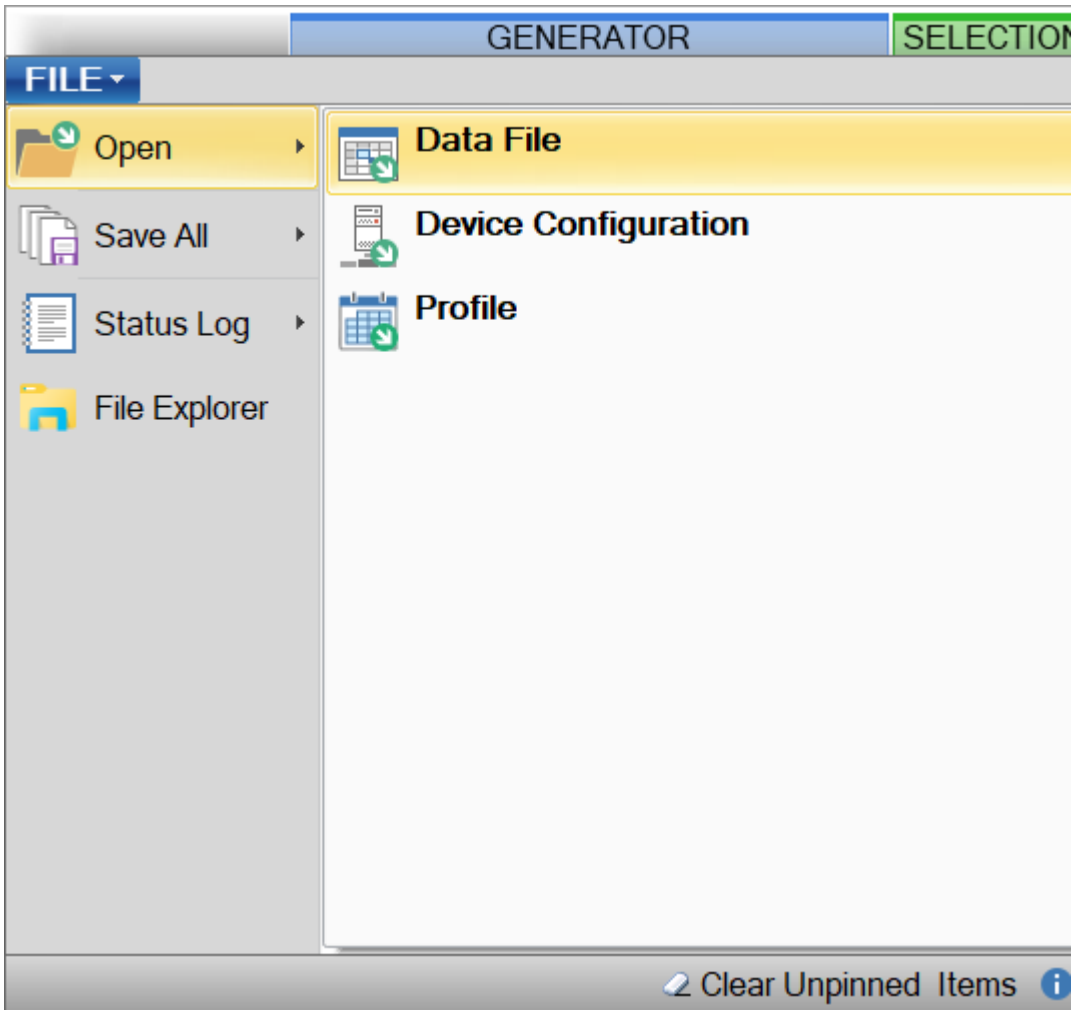
8.2 File Data Tabs

The File Data Tabs contain data values loaded from a previously saved Device Data Tab. ControLog can open data saved in the following types and formats:

- Text File (Comma Delimited) (*.csv;*.txt)
- Text File (Tab Delimited) (*.dat;*.txt)
- Excel Workbook (*.xlsx;*.xls)
- Backup ControLog File (*.backup)

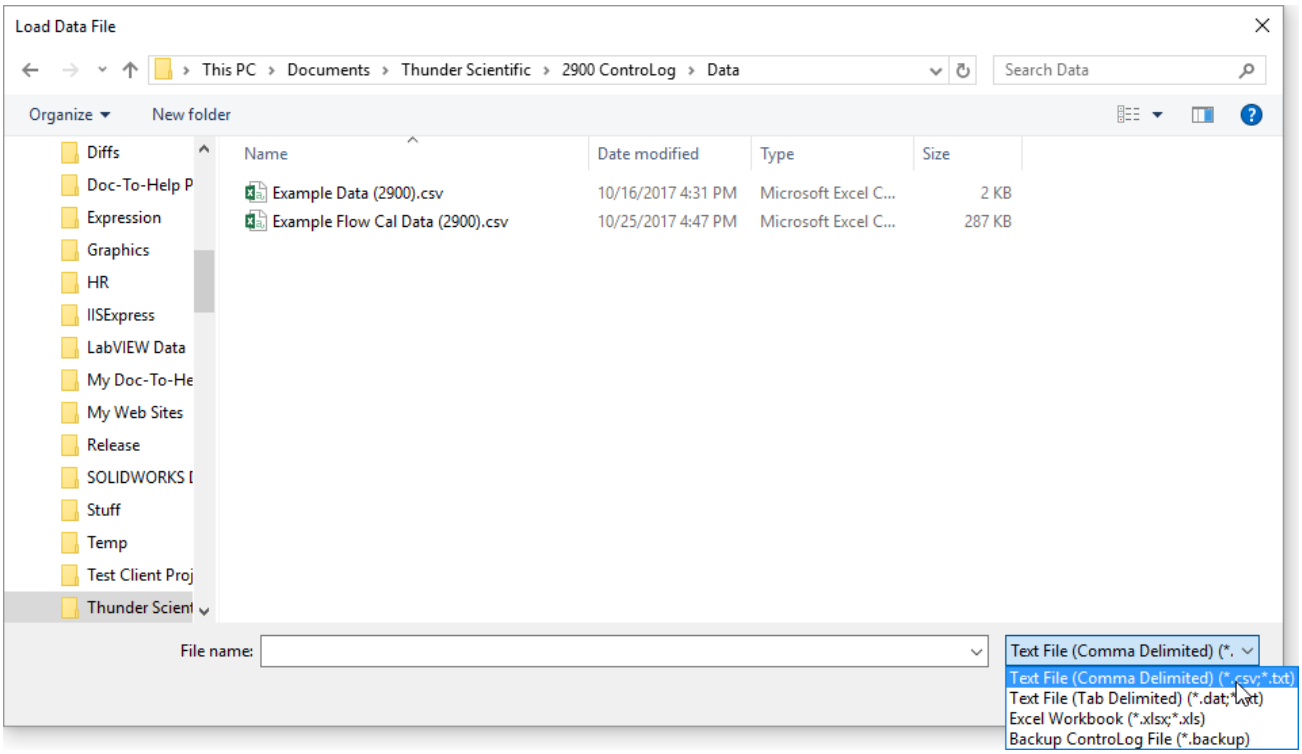
The only requirement for loading data from the above-mentioned data files is the data must be formatted so date/time values appear in the first column and all other columns contain numeric values.

To open a data file, select “Open>Data File” from the file menu.

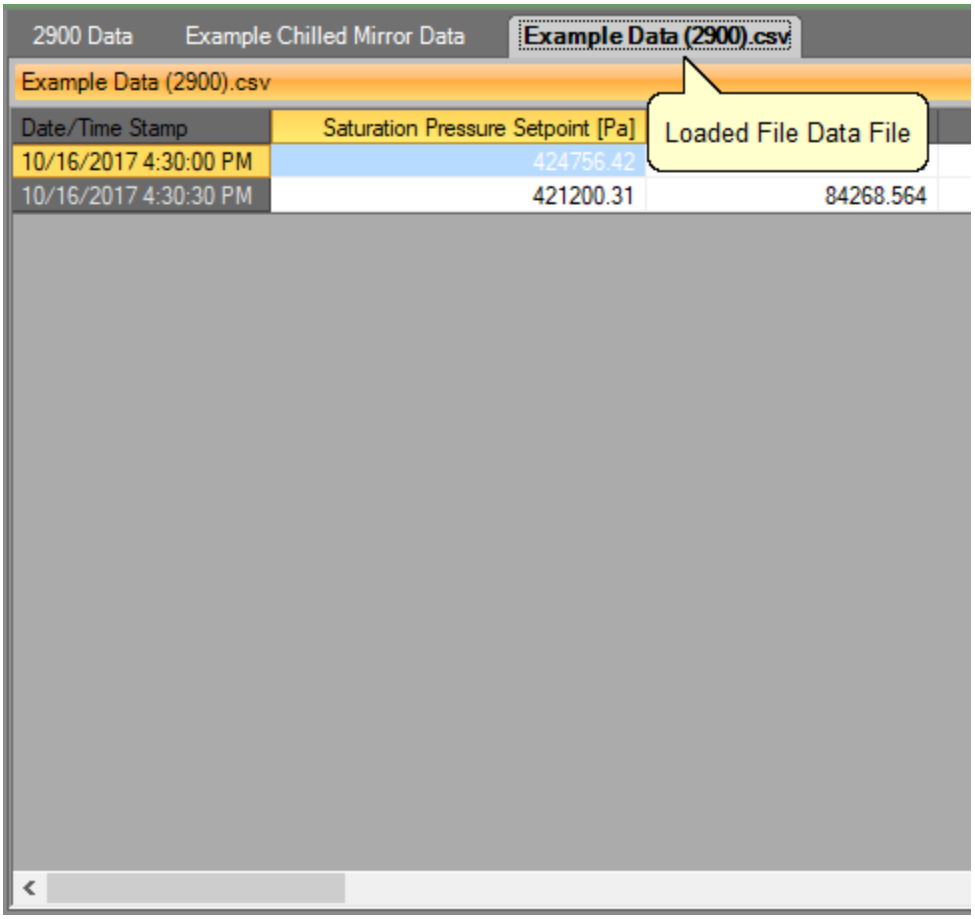


Note - *ControLog has a limit of five file data tabs opened at any given time.*

Using the “Load Data File” dialog, browse and select the data file you want to open.



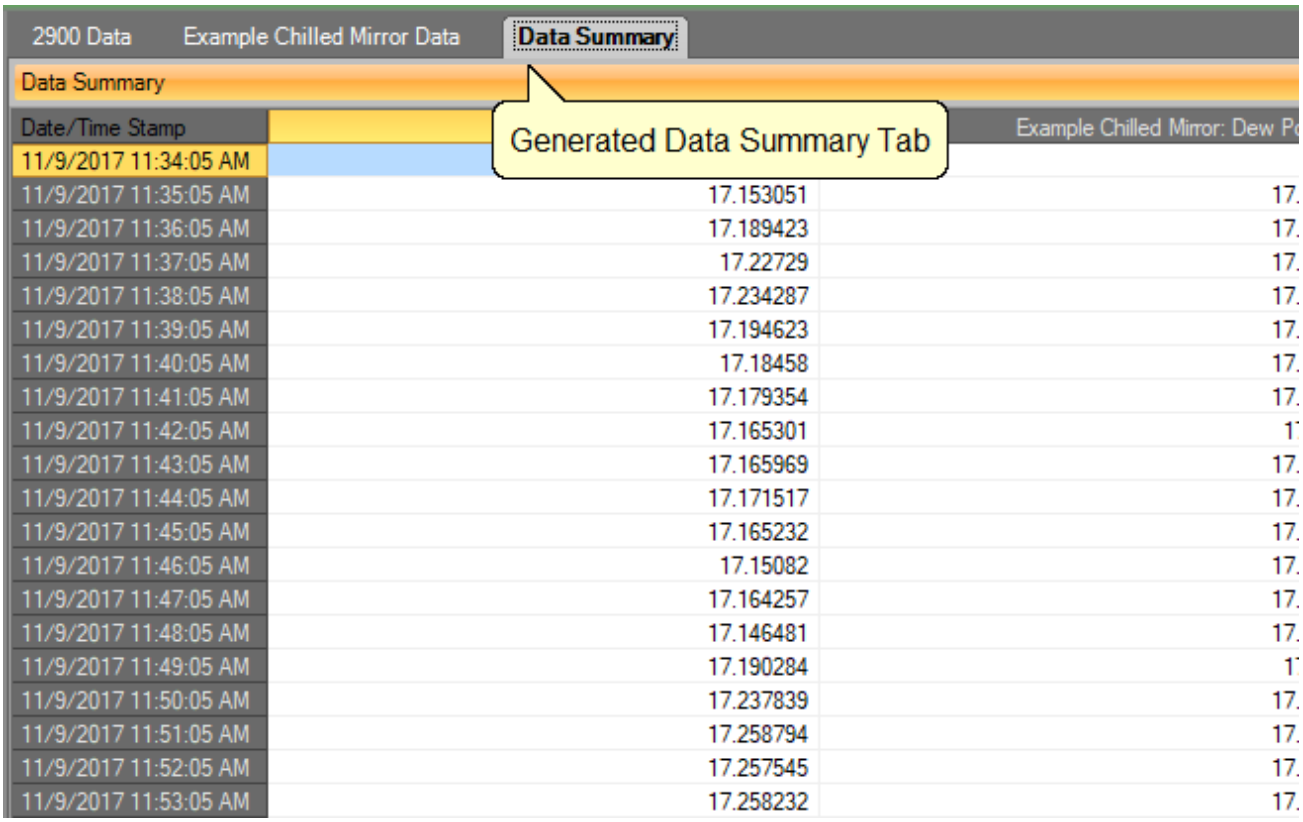
Once the load is complete the loaded file data tab will be displayed.



8.3 DATA SUMMARY TABS

The Data Summary Tabs contain data values generated from a Data Summary. The data summary allows the user to summarize the available data into a single data tab. The data summary also allows the user to calculate error or differences between a selected standard values and selected device values.

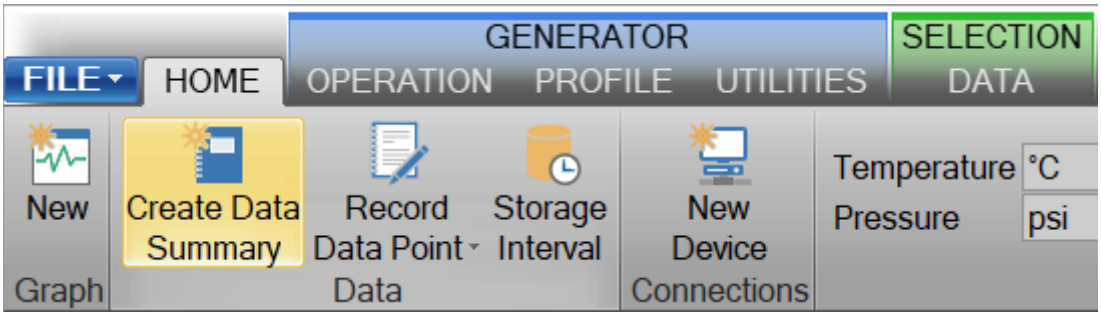
> **Note** - *Data Summary tabs are created using the currently selected system units instead of SI units. ControLog has a limit of five data summary tabs opened at any given time.*



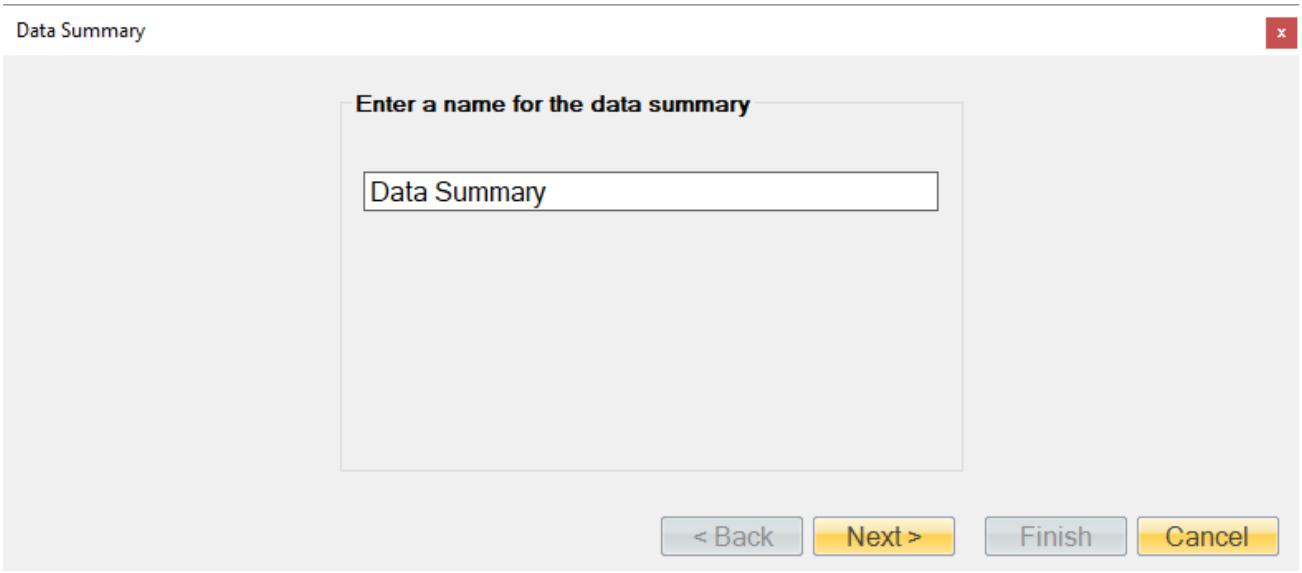
Date/Time Stamp		Example Chilled Mirror: Dew Po
11/9/2017 11:34:05 AM		
11/9/2017 11:35:05 AM	17.153051	17.
11/9/2017 11:36:05 AM	17.189423	17.
11/9/2017 11:37:05 AM	17.22729	17.
11/9/2017 11:38:05 AM	17.234287	17.
11/9/2017 11:39:05 AM	17.194623	17.
11/9/2017 11:40:05 AM	17.18458	17.
11/9/2017 11:41:05 AM	17.179354	17.
11/9/2017 11:42:05 AM	17.165301	1
11/9/2017 11:43:05 AM	17.165969	17.
11/9/2017 11:44:05 AM	17.171517	17.
11/9/2017 11:45:05 AM	17.165232	17.
11/9/2017 11:46:05 AM	17.15082	17.
11/9/2017 11:47:05 AM	17.164257	17.
11/9/2017 11:48:05 AM	17.146481	17.
11/9/2017 11:49:05 AM	17.190284	1
11/9/2017 11:50:05 AM	17.237839	17.
11/9/2017 11:51:05 AM	17.258794	17.
11/9/2017 11:52:05 AM	17.257545	17.
11/9/2017 11:53:05 AM	17.258232	17.

8.3.1 Creating a Data Summary

To create a Data Summary, select “Create Data Summary” from the Home ribbon menu tab. Selection will open the Data Summary Wizard dialog that will step the user through the creation process.



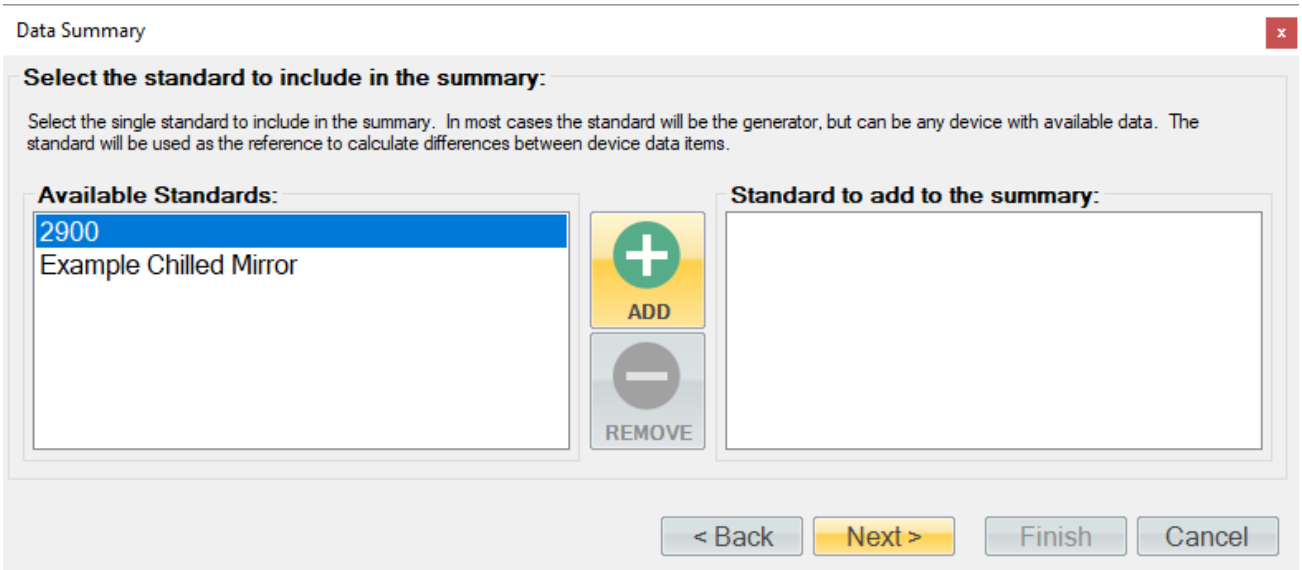
The first step in the data summary creation process is to give the data summary a name. This will be the name of the tab that appears in the Data and Graph Tab Group.



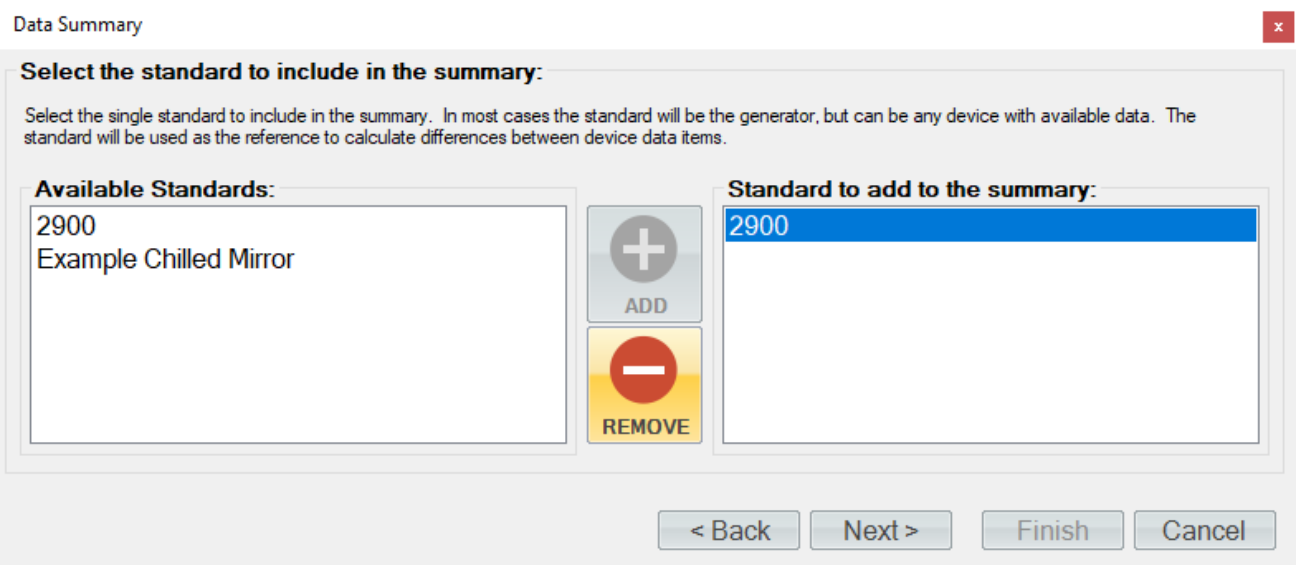
The next step in the data summary creation process is to select the standard. The standard will be used as the reference to calculate differences between the device data items if the user chooses to do so.

On the left-hand side is the available devices to choose from and on the right-hand side is the selected standard to add to the summary. To select a device, highlight it and click the "Add" button. In almost all cases the standard will be the 3920.

Note - *Only one device can be selected as the standard for the summary.*

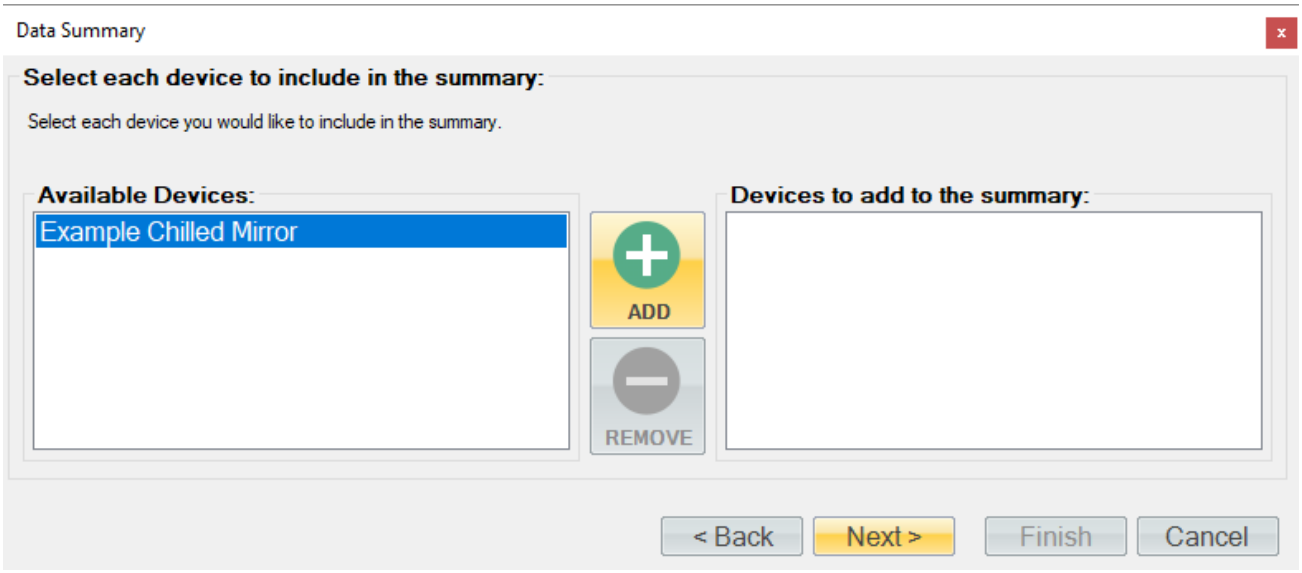


To remove an item as the selected standard, select the desired item from the right-hand side and click the "Remove" button.



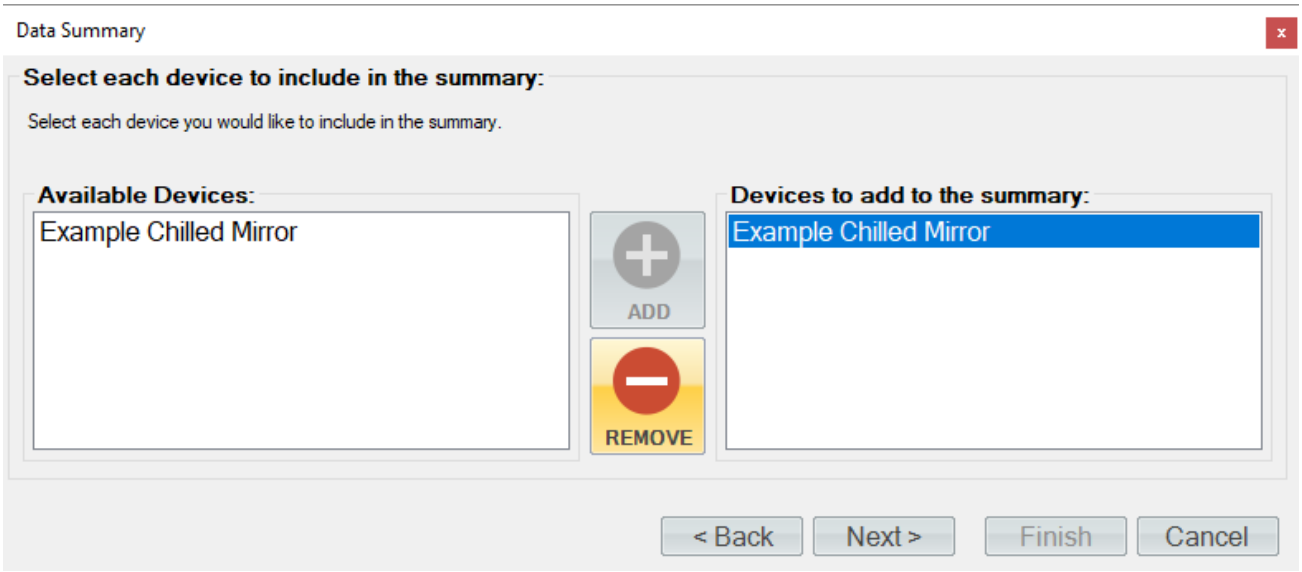
Once complete, selecting the “Next” button will allow the user to select each device they would like to include in the summary. On the left-hand side are the available devices to choose from and on the right-hand side are the selected devices to add to the summary. To select a device, highlight it and click the “Add” button.

Note - *Multiple devices can be selected and added to the summary.*

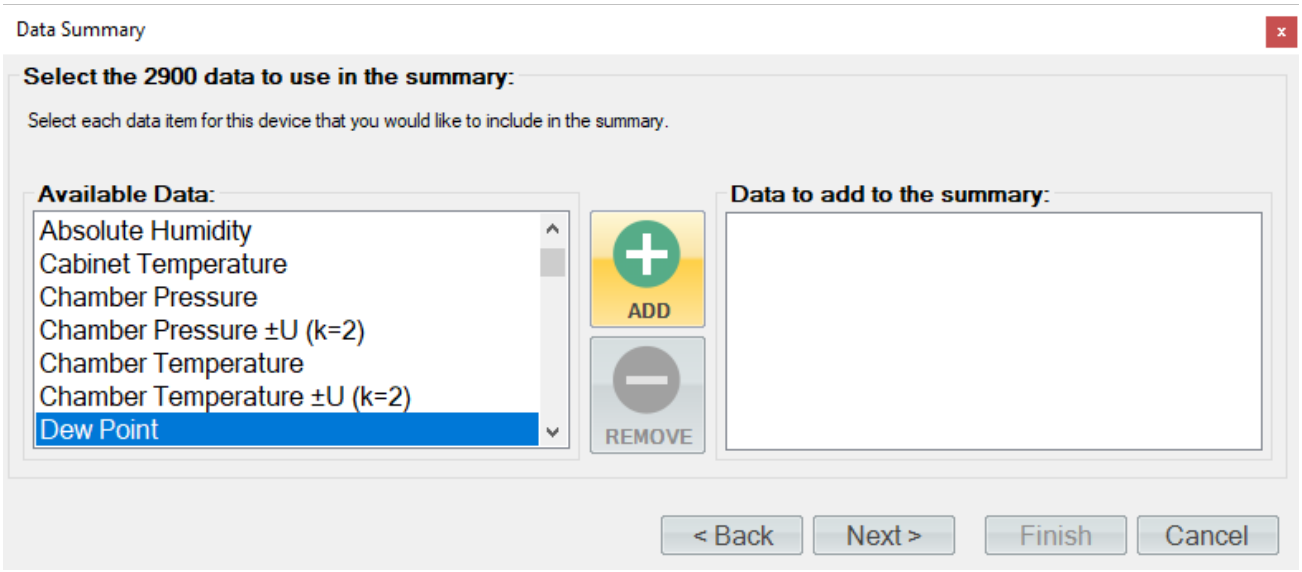


Note - *The user can invert any selection by right clicking. This will highlight all items that are not currently highlighted and will remove highlight from any items that are currently highlighted.*

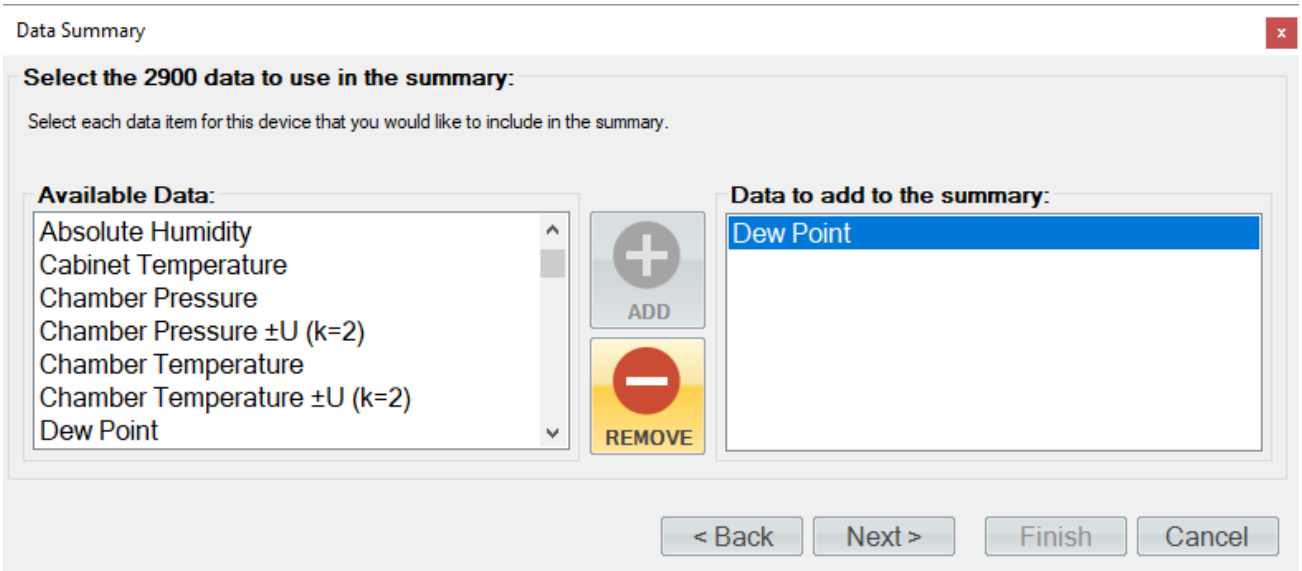
To remove an item from the list of devices, select the desired item or items from the right-hand side and click the “Remove” button.



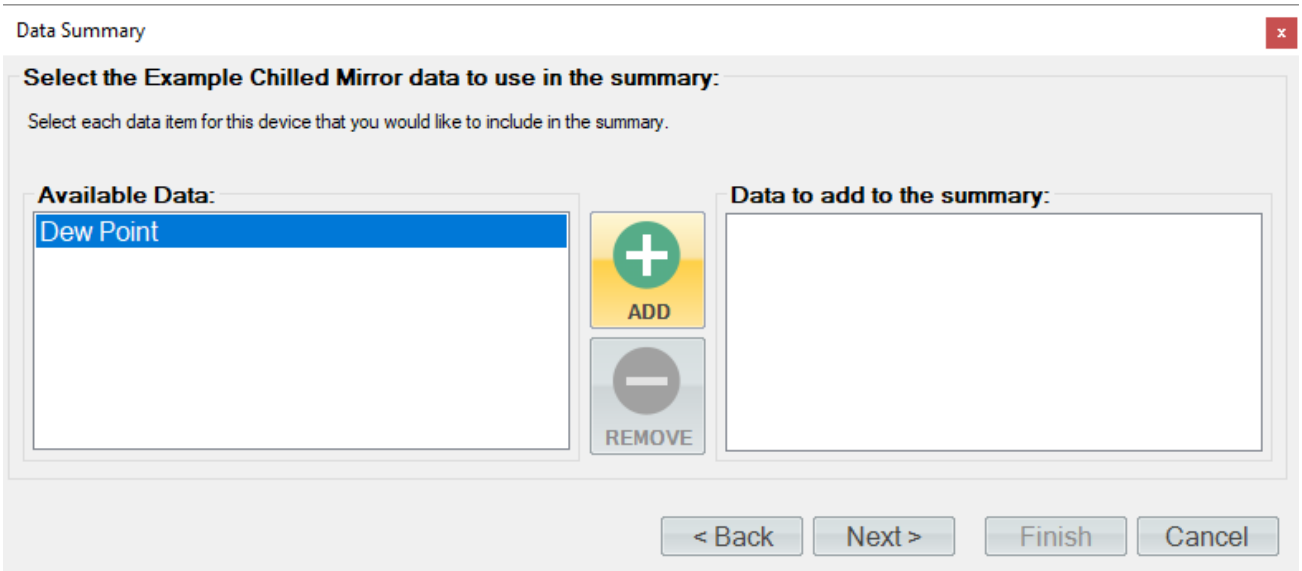
Once complete, selecting the “Next” button will allow the user to select the standard’s data items they would like to include in the summary. On the left-hand side are the available data items to choose from and on the right-hand side are the selected data items to add to the summary. To select a data item or items, highlight them and click the “Add” button.



To remove an item or items from the list of data items, select the desired item or items from the right-hand side and click the “Remove” button.

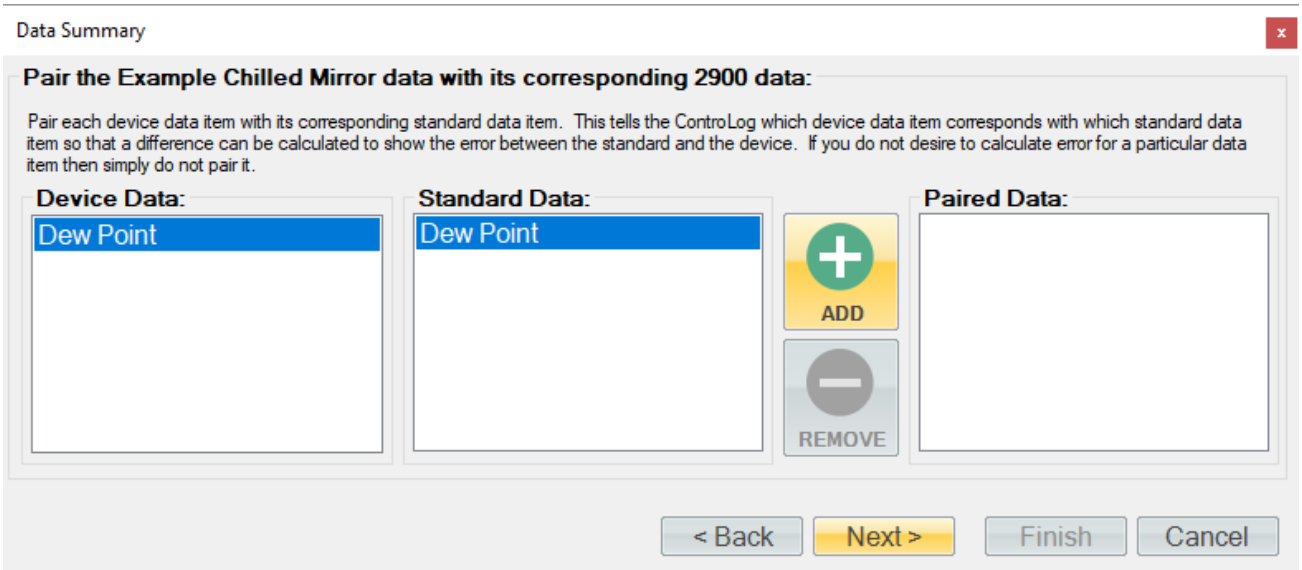


Selecting the “Next” button will repeat the process of selecting data for the next device in the series. This will continue until the user defines all the device data they wish to include in the data summary.

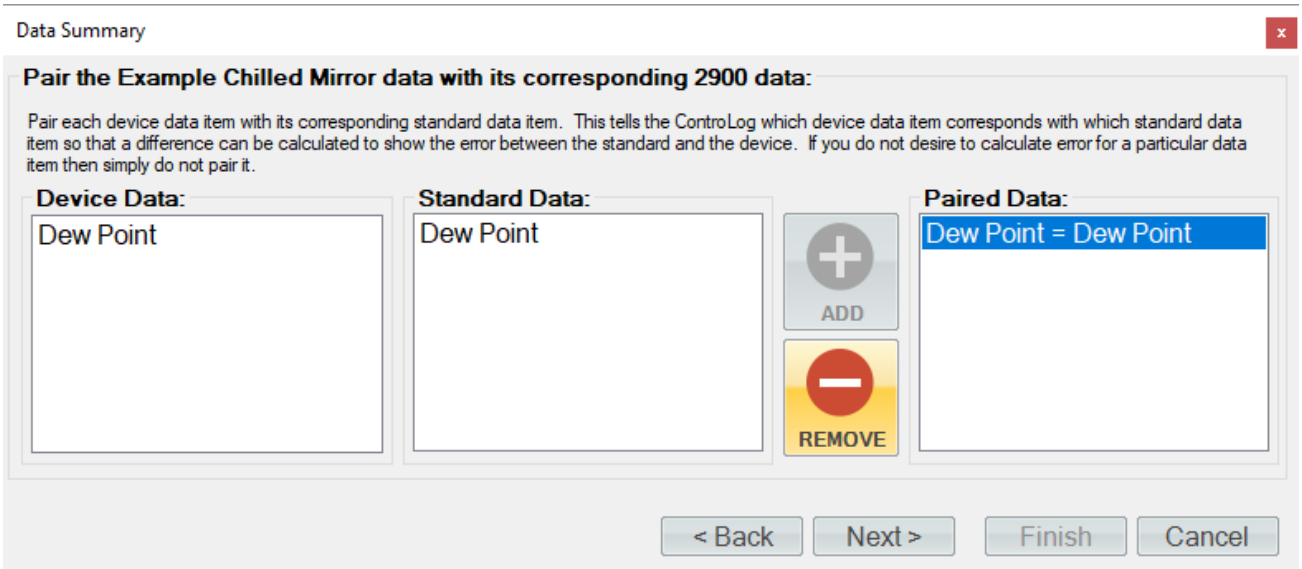


Once the user has completed selecting data, ControLog will ask the user to pair each device data item with its corresponding standard data item. This tells ControLog which device data item corresponds with which standard data item so that a difference can be calculated and the error between the standard and the device can be included in the summary. If the user does not desire to calculate error for a particular data item, they simple need not pair it.

To pair a data item, select the desired device data item and the standard data item you would like to pair it with. Select “Add” to create the pairing.



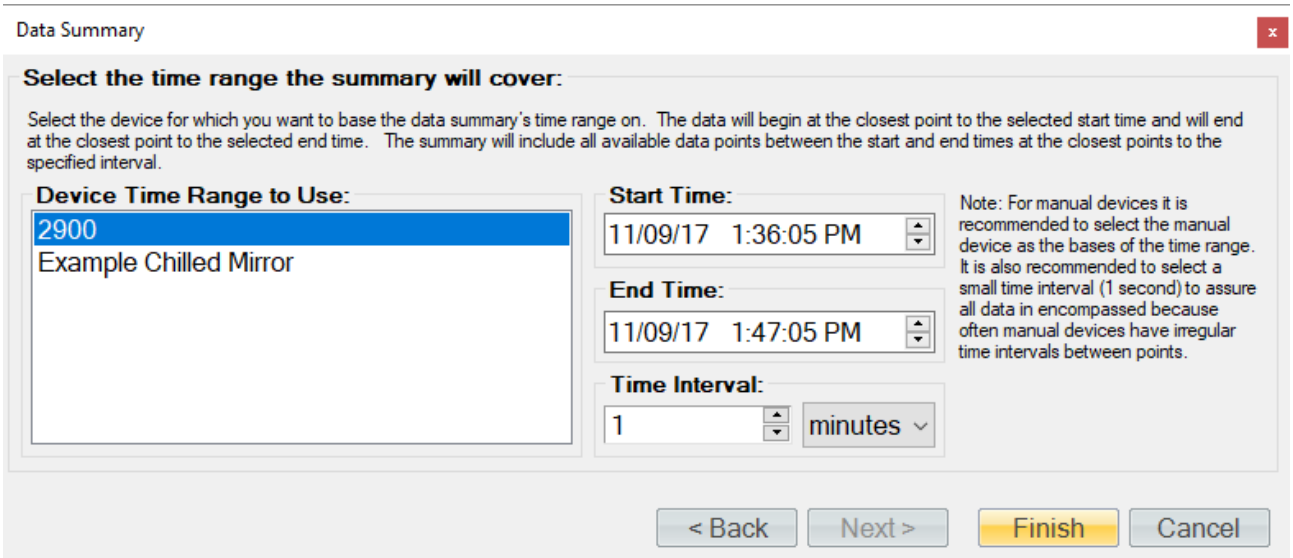
To remove a data item pairing, select the desired pair or pairings from the right-hand side and click the "Remove" button.



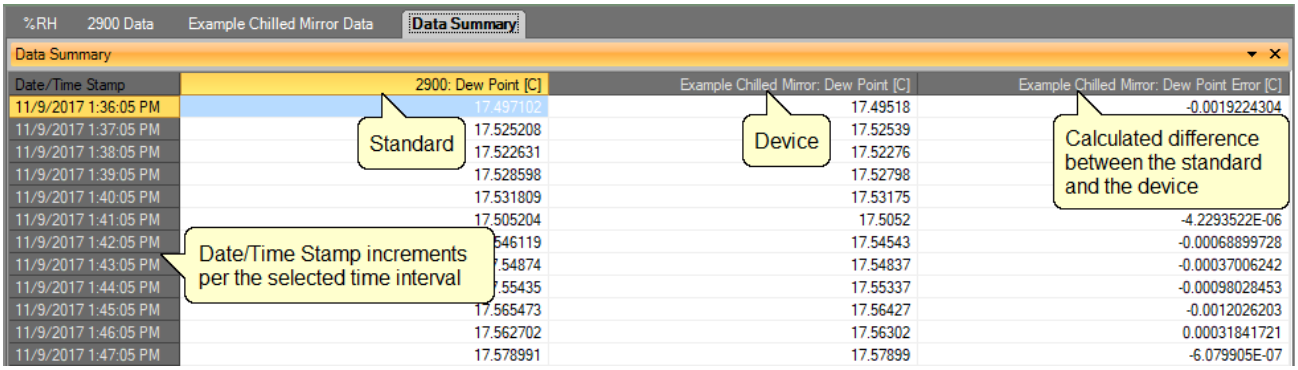
Selecting the "Next" button will repeat the process of pairing data for the next device in the series. This will continue until the user defines all the desired data pairs, they wish to include in the data summary.

Once data pairing is complete, the user will be asked to select the time range and interval that the data summary will cover. The selected device's time range will be used to determine which points to include. The data will begin at the closest point to the selected start time and will end at the closest point to the selected end time. The summary will include all available data points between the start and end times at the closest points to the specified interval. If a particular device does not have a corresponding time for a given base time, then the value fields will be left blank for that device for that given time.

> **Note** - *For manual devices, it is recommended to select the manual device as the bases for the time range to use. It is also recommended to select a small time interval (1 second) to assure all data is encompassed because often manual devices have irregular time intervals between points.*



Upon clicking the “Finish” button, ControLog will open a new data tab with the newly created data summary.

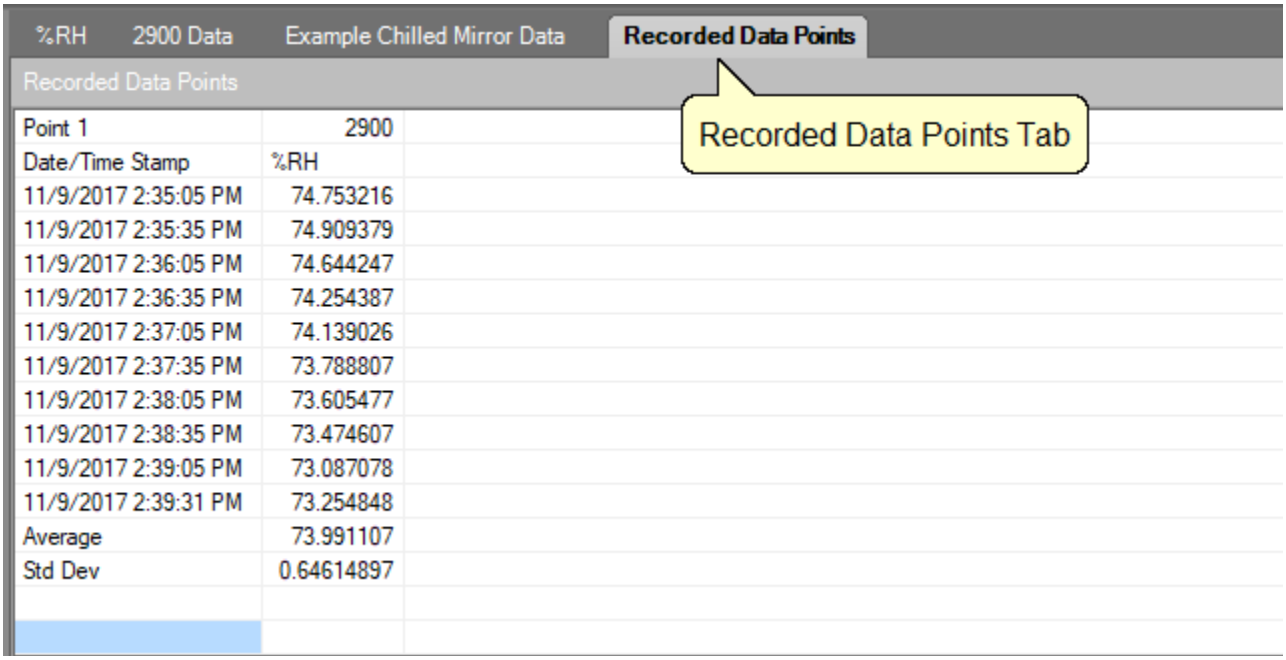


Date/Time Stamp	2900: Dew Point [C]	Example Chilled Mirror: Dew Point [C]	Example Chilled Mirror: Dew Point Error [C]
11/9/2017 1:36:05 PM	17.497102	17.49518	-0.0019224304
11/9/2017 1:37:05 PM	17.525208	17.52539	
11/9/2017 1:38:05 PM	17.522631	17.52276	
11/9/2017 1:39:05 PM	17.528598	17.52798	
11/9/2017 1:40:05 PM	17.531809	17.53175	
11/9/2017 1:41:05 PM	17.505204	17.5052	-4.2293522E-06
11/9/2017 1:42:05 PM	546119	17.54543	-0.00068899728
11/9/2017 1:43:05 PM	.54874	17.54837	-0.00037006242
11/9/2017 1:44:05 PM	.55435	17.55337	-0.00098028453
11/9/2017 1:45:05 PM	17.565473	17.56427	-0.0012026203
11/9/2017 1:46:05 PM	17.562702	17.56302	0.00031841721
11/9/2017 1:47:05 PM	17.578991	17.57899	-6.079905E-07

8.4 Recorded Data Points Tab

The Recorded Data Points Tab contains the recorded data points that have been taken either manually by the user, after a manual device entry or at the completion of a soak phase during an auto profile. Each data point can also calculate the average and or standard deviation for the defined number of prior points taken with each recorded data point.

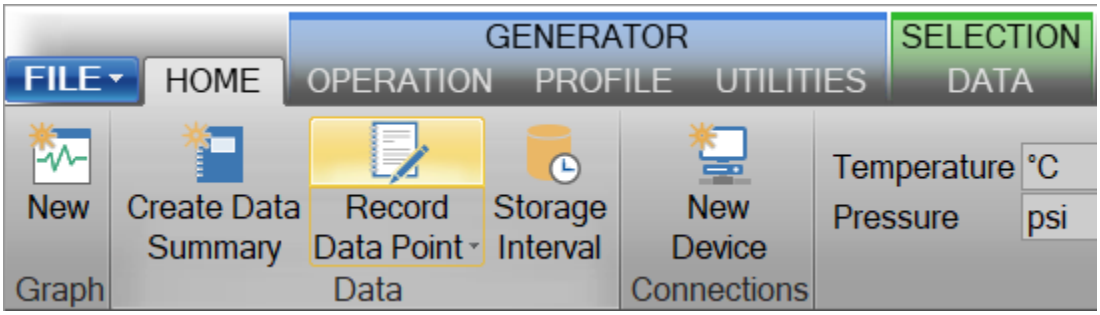
> **Note** - *Each entry point in the Recorded Data Points tab is created using the currently selected system units.*



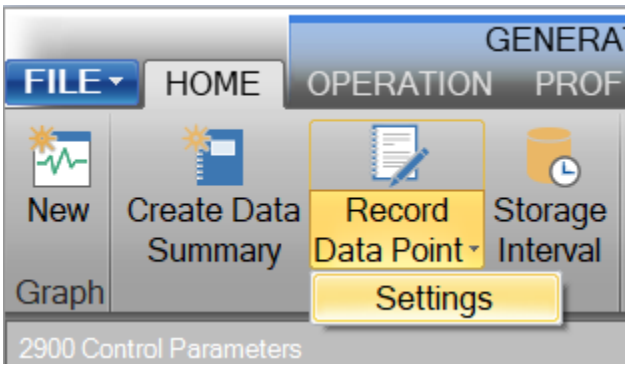
Point 1	2900
Date/Time Stamp	%RH
11/9/2017 2:35:05 PM	74.753216
11/9/2017 2:35:35 PM	74.909379
11/9/2017 2:36:05 PM	74.644247
11/9/2017 2:36:35 PM	74.254387
11/9/2017 2:37:05 PM	74.139026
11/9/2017 2:37:35 PM	73.788807
11/9/2017 2:38:05 PM	73.605477
11/9/2017 2:38:35 PM	73.474607
11/9/2017 2:39:05 PM	73.087078
11/9/2017 2:39:31 PM	73.254848
Average	73.991107
Std Dev	0.64614897

8.4.1 How to Record a Data Point

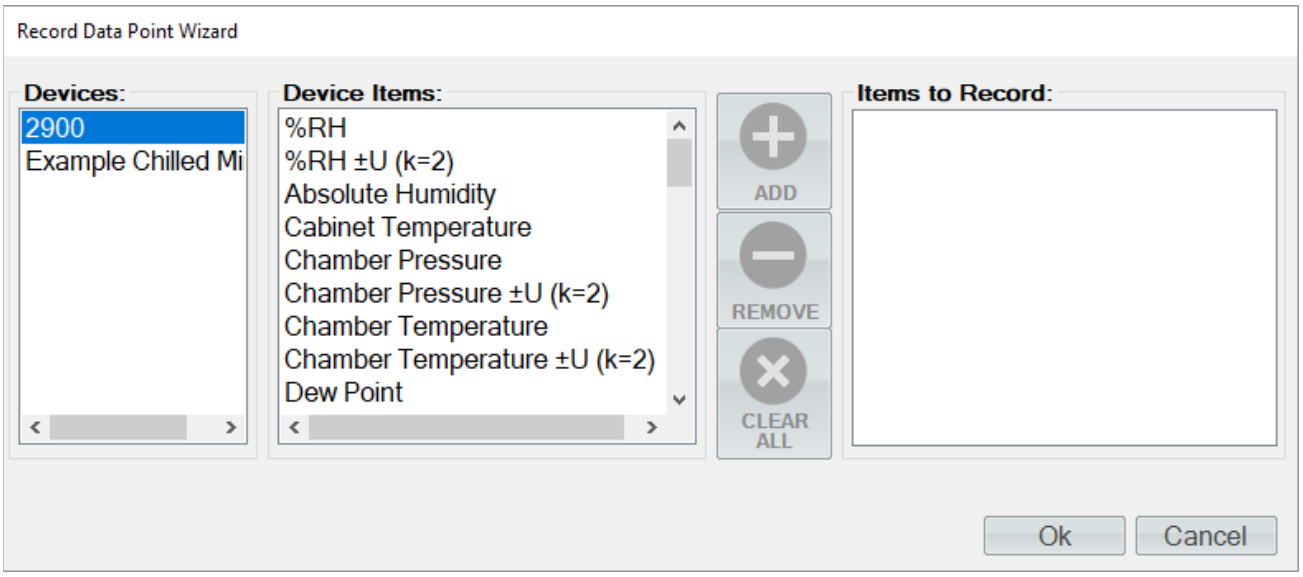
To Record a Data Point, select “Record Data Point” from the main menu or right click a data tab and select “Record Data Point”.



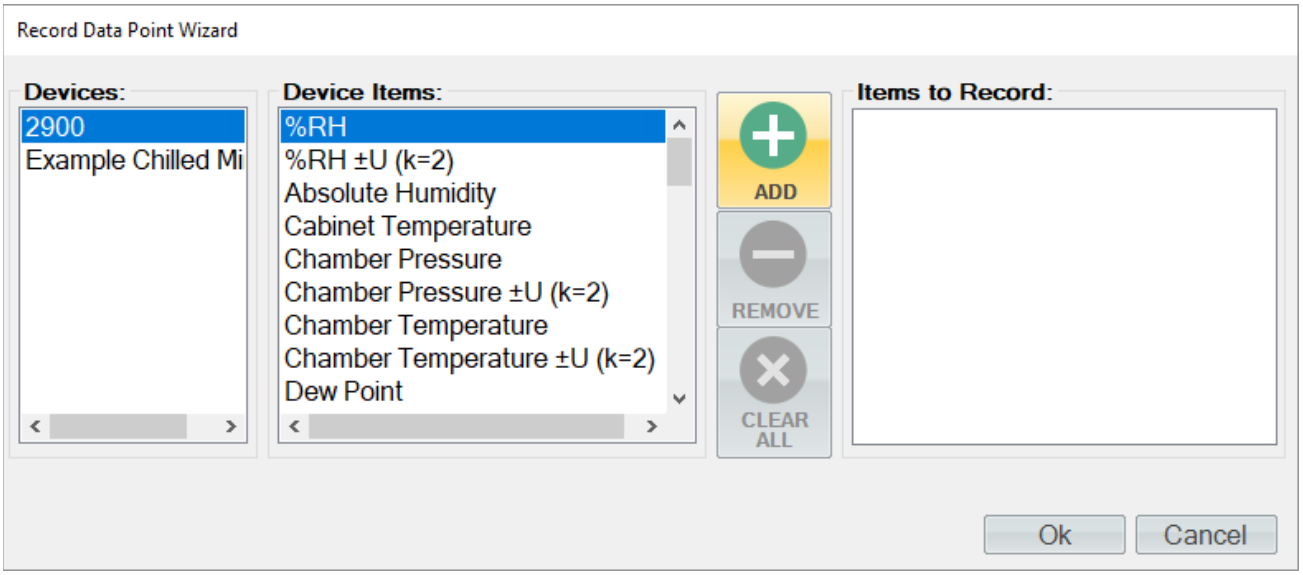
The first step in recording data points is to configure what and how to take each point. Use the Settings menu to open the Record Data Point Wizard to define the data points to be taken.



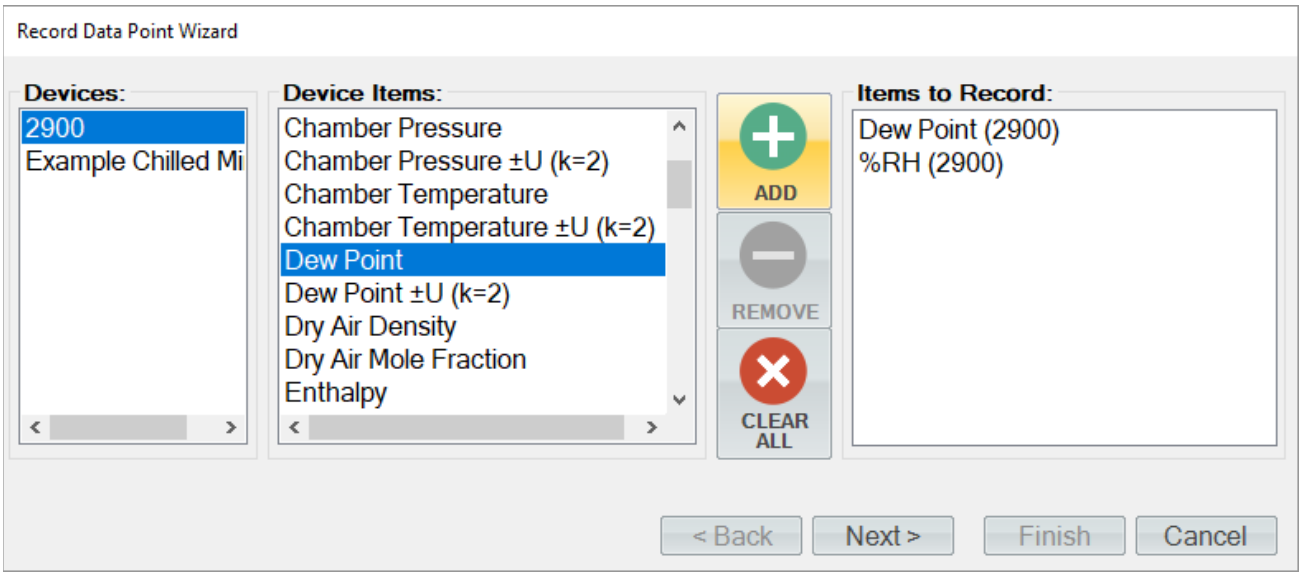
A “Record Data Point Wizard” dialog will appear.



The first page of the Record Data Point Wizard is where the user selects which device items they would like record. On the left-hand side is a list of all available devices. Selecting a device will result in the "Device Items" list being updated to reflect the available items for the selected device. To add an item, highlight the desired item or items in the "Device Items" list and click the "Add" button.

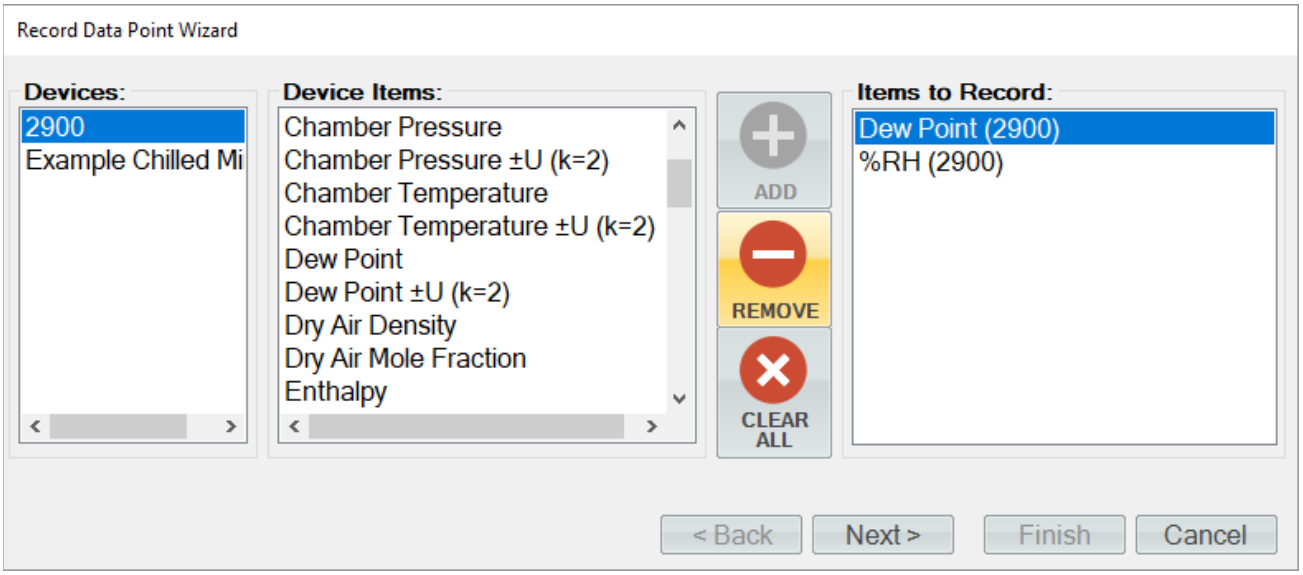


Repeat this process until all the desired items are listed on the right side.

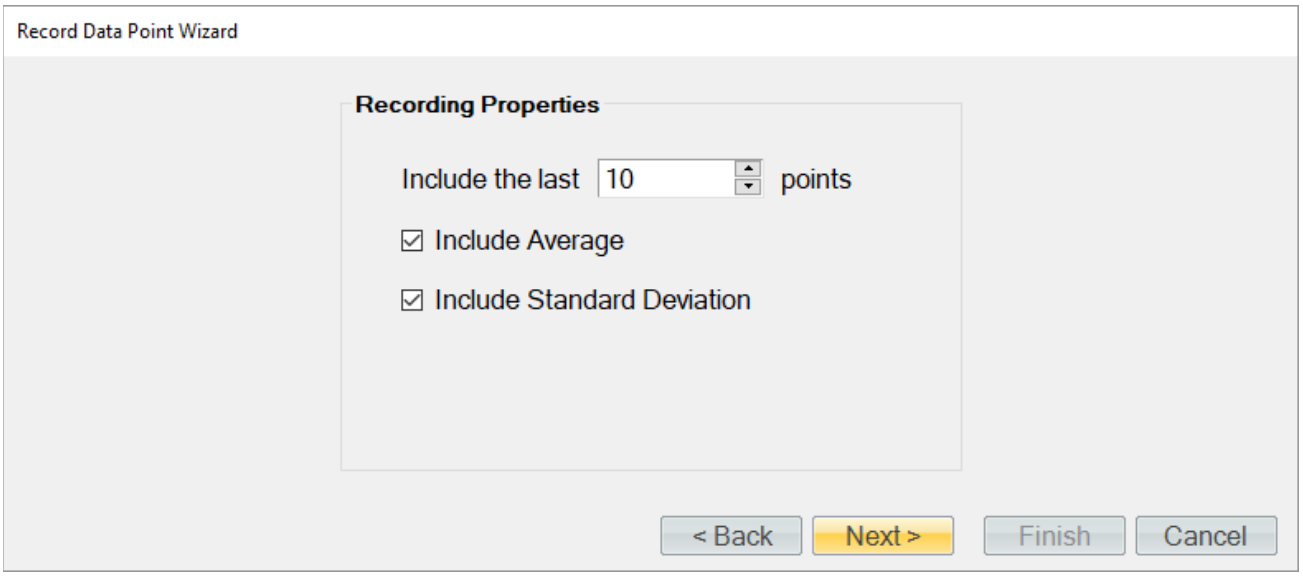


Note - *The user can invert any selection by right clicking. This will highlight all items that are not currently highlighted and will remove highlight from any items that are currently highlighted.*

To remove an item from the list of items to record, the user can either click the “Clear All” button to remove all items or simply select the desired item from the “Items to Record” list and click the “Remove” button.



Once complete, clicking the “Next” button will bring up the Properties page. From the properties page the user can define what will be recorded for each point.

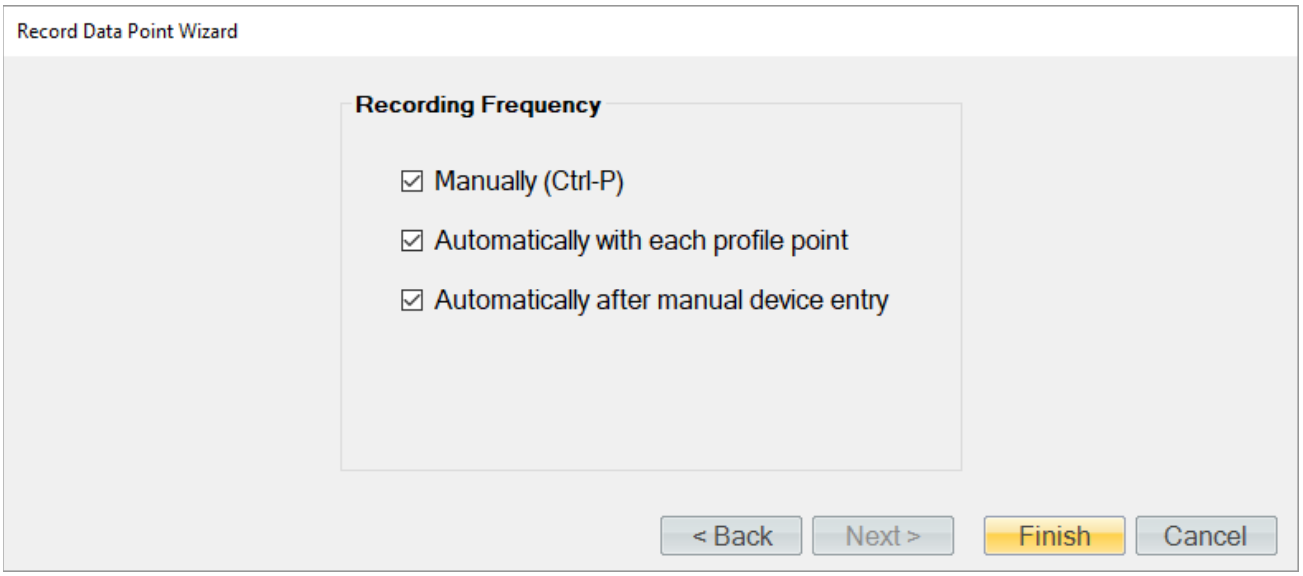


Recording Properties define the number of prior (last) points to include and whether to calculate the average and or standard deviation for the defined number of prior points taken with each recorded data point.

- ***Include the last … points*** defines the number of prior points to include with each recorded data point. The prior points are determined from the Data Tab for each point being recorded. ControLog will include the number of prior (last) points directly using the entries in the Data Tab for the given point from the time the data point was recorded.

- ***Include Average*** defines whether to include an average of the defined number of prior points for the recorded data items for each point taken.
- ***Include Standard Deviation*** defines whether to include the standard deviation of the defined number of prior points for the recorded data items for each point taken.

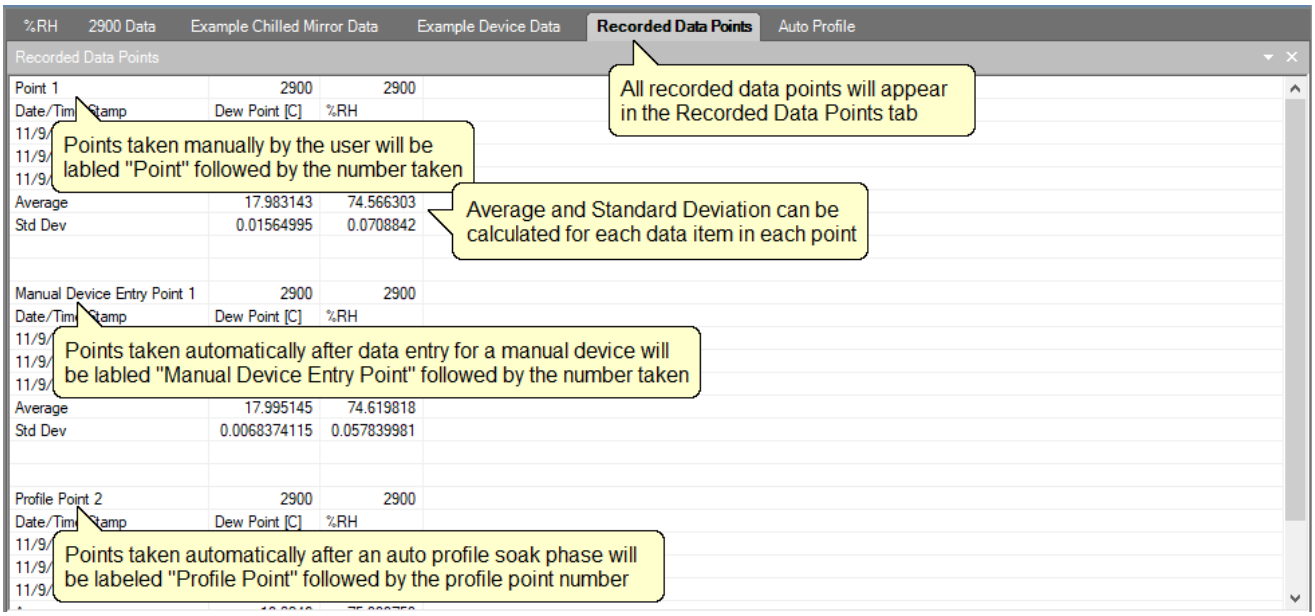
Once complete, clicking the "Next" button will bring up the frequency page. From the frequency page the user can define when and how to take a data point.



Recording Frequency defines when and how the system will take a data point. The user should select (place check mark) by each method they would like to use.

- ***Manually*** indicates that the user will manually take points when they want, using either the "Take Point" menu item or by pressing the Ctrl-P key combination on the keyboard when ControLog is the active window.
- ***Automatically with each profile point*** indicates that a point will be taken automatically at the completion of each profile soak phase.
- ***Automatically after manual device entry*** indicates that a point will be taken automatically when the user completes a manual device entry.

Once complete, clicking the “Finish” will close the wizard and save the user selection for recording data points.

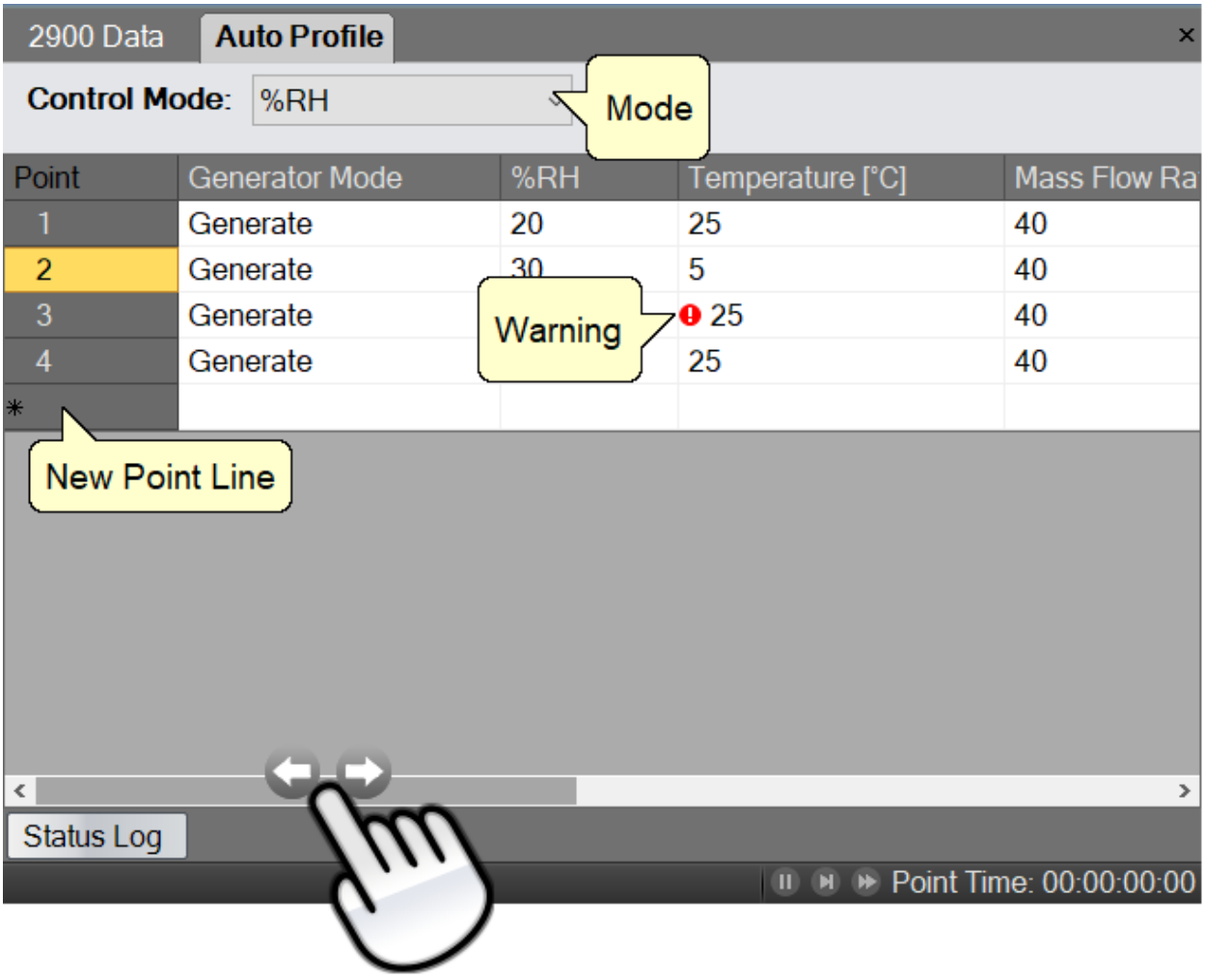


9 AUTO PROFILING

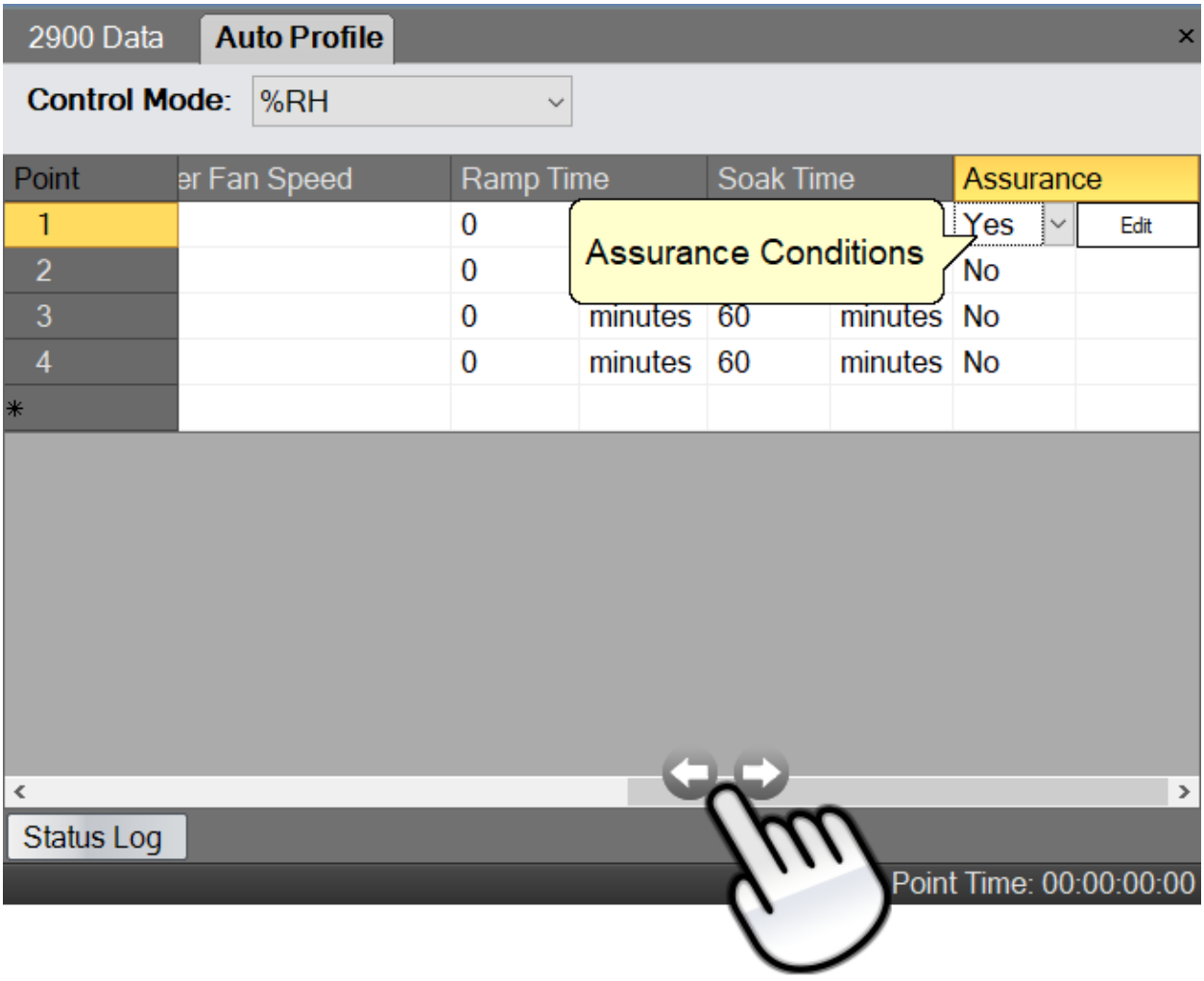
The Auto Profiling feature is very similar to the Generate mode with the main exception that profiling relies on a predefined list of setpoints referred to as a profile. The user configurable profile is used as ControLog's road map during Auto Profile operation. It defines which setpoint values to go to, at what rate to go from one setpoint to another, and how long to stay at a specific setpoint before moving to the next setpoint.

> **Note** - *Before attempting to operate the system in an Auto Profile mode, you should become thoroughly familiar with the manual Generate mode of operation.*

The Profile Tab is used to create and modify auto profiles. The tab consist of drop drowns, entry fields and a data grid.



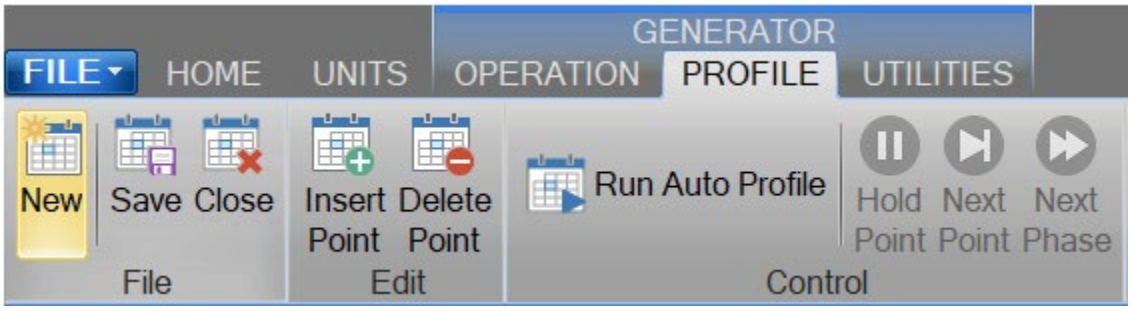
The scrollbar at the bottom can be used to scroll to the remaining profile fields.



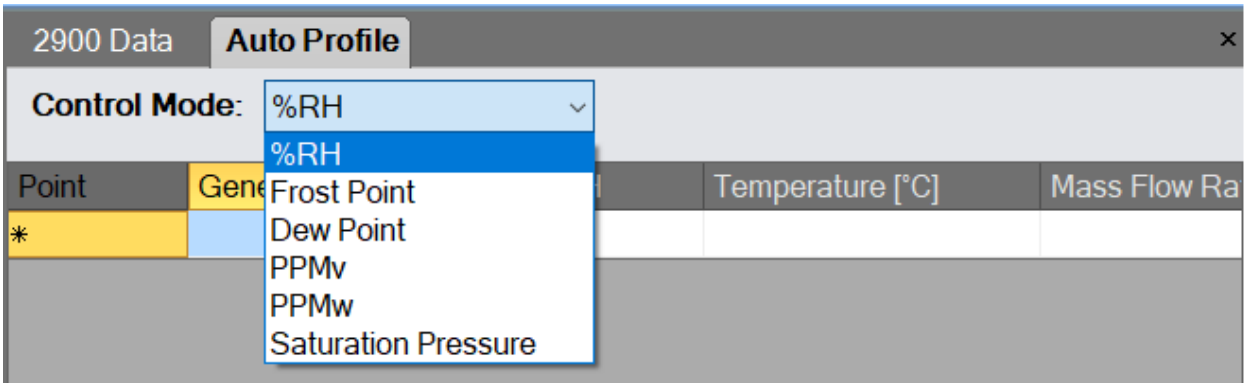
9.1 Creating a New Profile

A profile is a list of humidity, temperature, pressure, flow, and time parameters that are used during automated control of the Model 3920 Low Humidity generator. The profile essentially programs the computer/controller operations.

Open a new profile tab by selecting “New” from the profile menu.



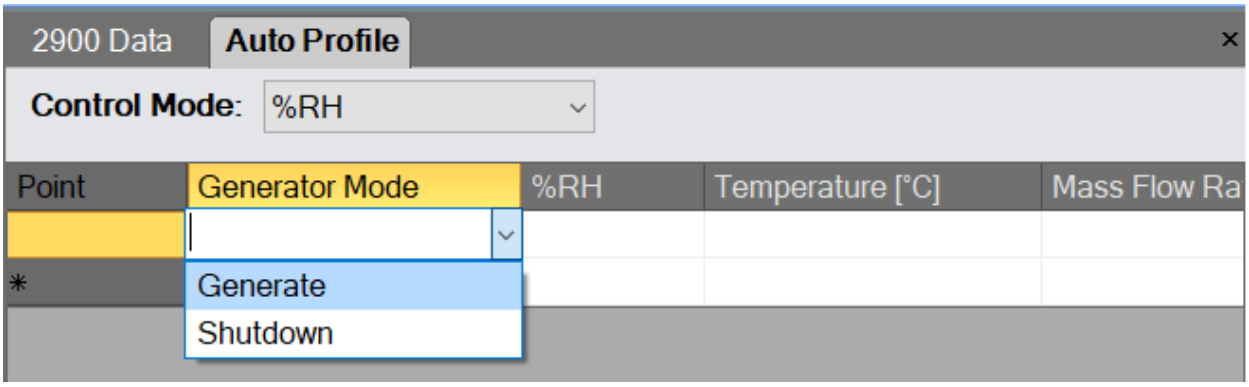
Select the desired **Control Mode** for the entire profile. The Control Mode is what the user would like to generate during the profile. The control modes are the same modes available during manual operation.



For more information, refer to section [4.1.4.1 Mode]

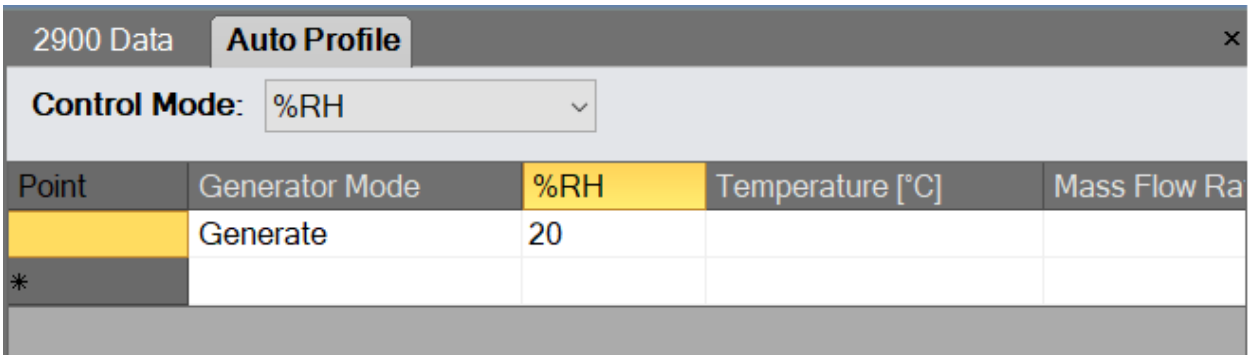
The first column, next to the point numbers, is the Generator Mode. The Generator Mode defines the run mode that the 3920 will operate in for this profile point. The Generator Modes are the same run modes available during manual operation.

Note - *Shutdown is only available for the last point.*

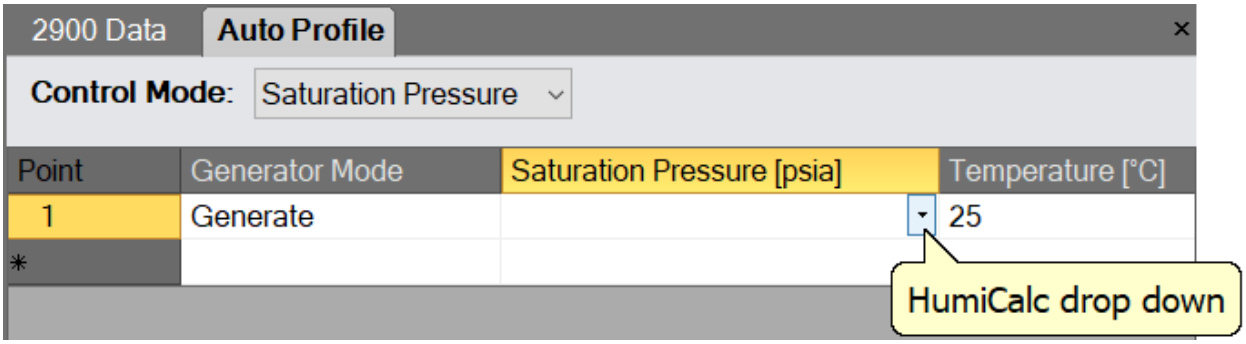


For more information, refer to section [*4.1.4.2 Run Menu*]

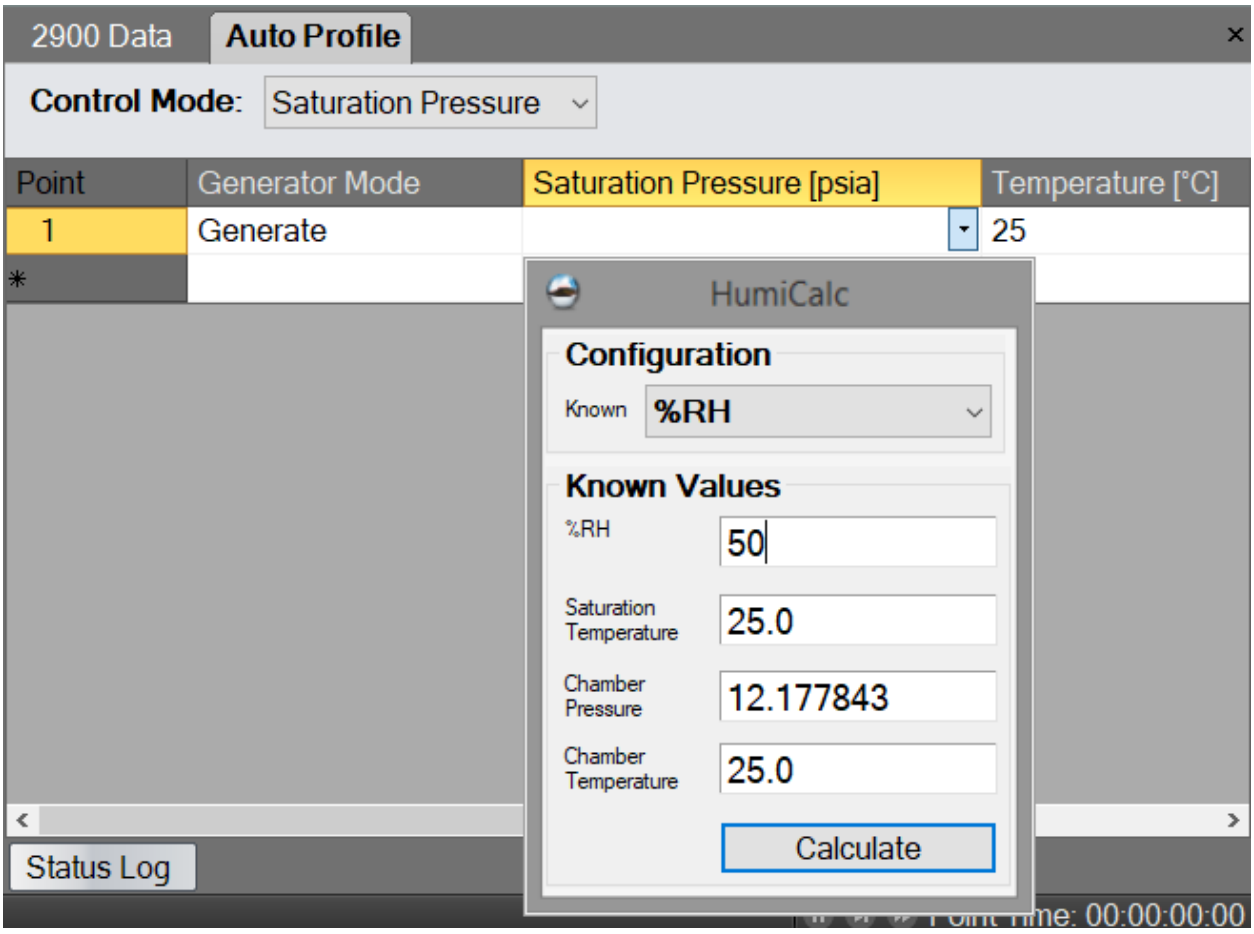
The first column next to the Generator Mode contains the humidity value to generate and is titled at the top according to the currently selected control mode. In the example shown, the profile control mode is set to %RH. Whenever the profile control mode is changed, the title on this column changes to reflect the control mode selected.



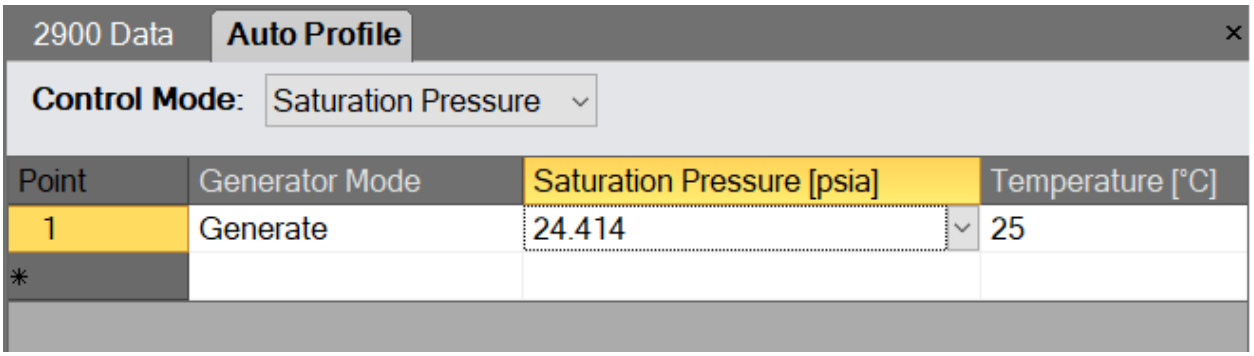
When the Control Mode is set to Saturation Pressure, the first column next to the Generator Mode contains the Saturation Pressure followed by the Temperature. In this control mode the user can also drop down a Mini version of HumiCalc to help calculate the desired Saturation Pressure by clicking the drop-down arrow on the cell. For example, let's say the user wants to calculate the required Saturation Pressure needed to generate a 50 %RH with a Saturation Temperature of 25.0 °C. Start by selecting Saturation Pressure as the Control Mode. Next, enter a 25.0 °C Temperature and then click the Saturation Pressure HumiCalc drop down at the right of the grid cell box.



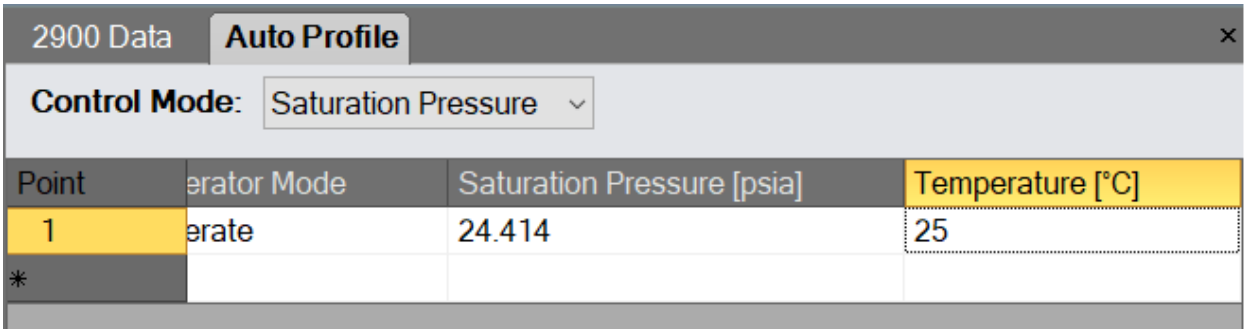
Next, select the known to be %RH and enter the desired percent relative humidity of 50. Notice that ControLog automatically entered the other known values based on the already entered profile values.



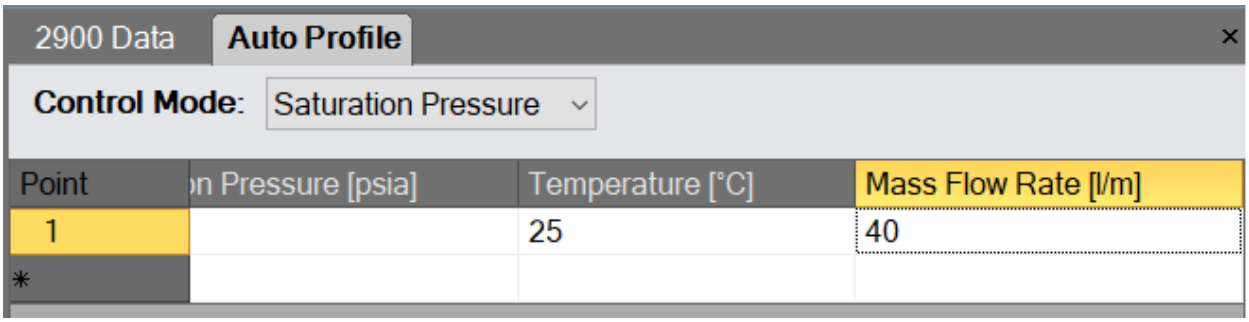
Clicking the "Calculate" button will result in the calculated Saturation Pressure being placed in the profile cell and the HumiCalc dropdown will close.



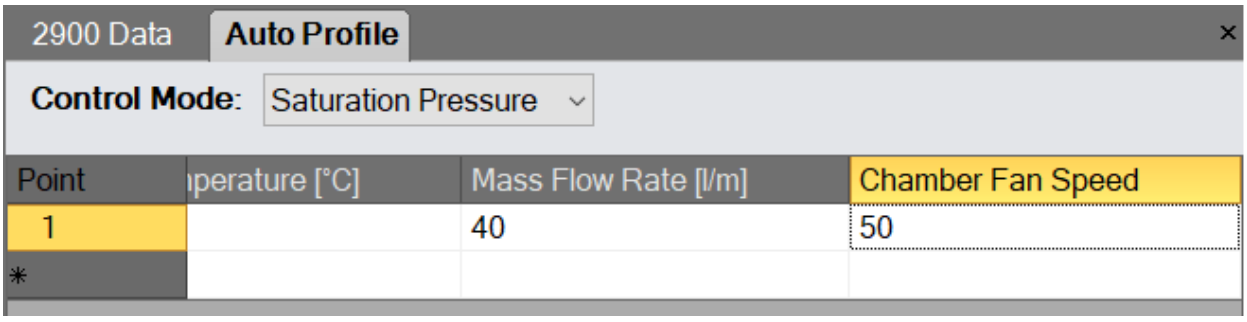
The Temperature column contains value for the saturation temperature for the given point.



The Mass Flow Rate column contains values of the air flow at which the generator will operate. Although not affecting the generated value of humidity, flow rate does affect the air exchange rate, equilibration time of the instruments under test and permeation.

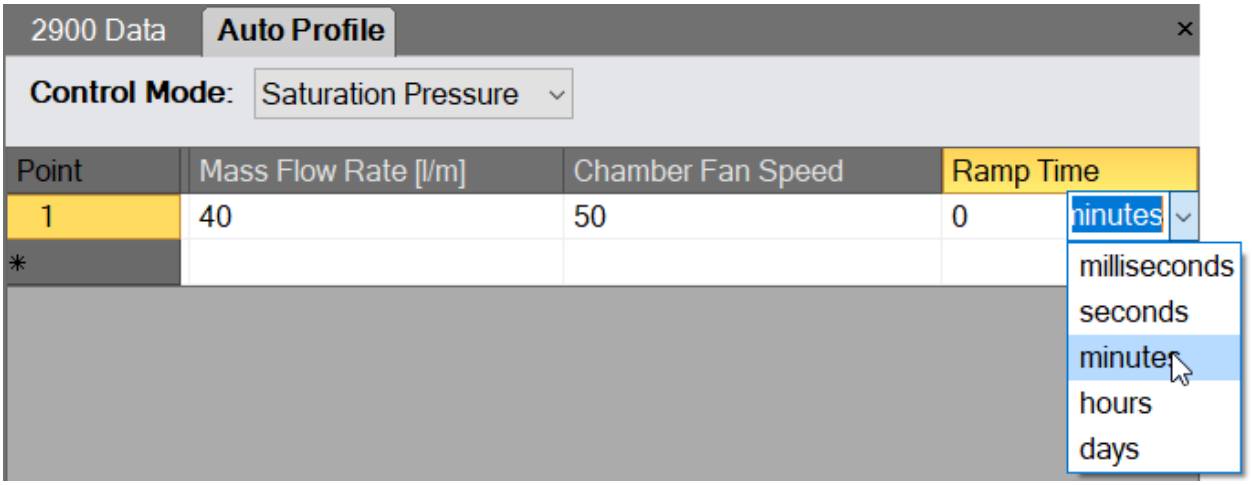


The Chamber Fan Speed column contains percent speed value of the chamber fan for the point. 0 meaning the fan is off and 100 meaning the fan is at full speed.

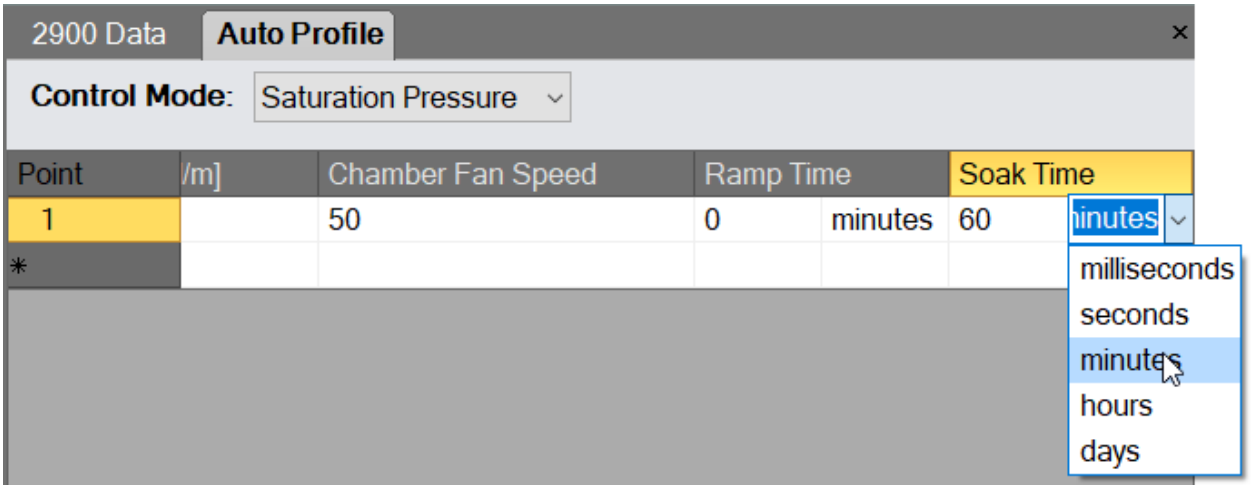


Ramp Time is the desired amount of time the 3920 should take to transition from one profile test point to another. Setting a ramp time of zero instructs the 3920 to make the transition as quickly as possible. Zero is the setting used for most profiles.

Note - *The first point cannot have a ramp time, because the starting setpoints can vary.*

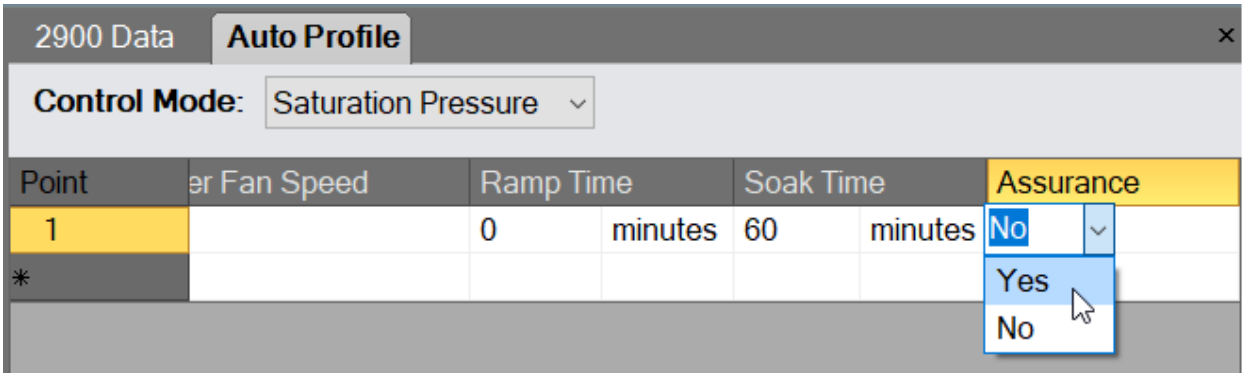


Soak Time is the desired amount of time to generate at a particular profile point. The soak time required depends on the application but should be a significant amount of time based upon the humidity devices being calibrated.

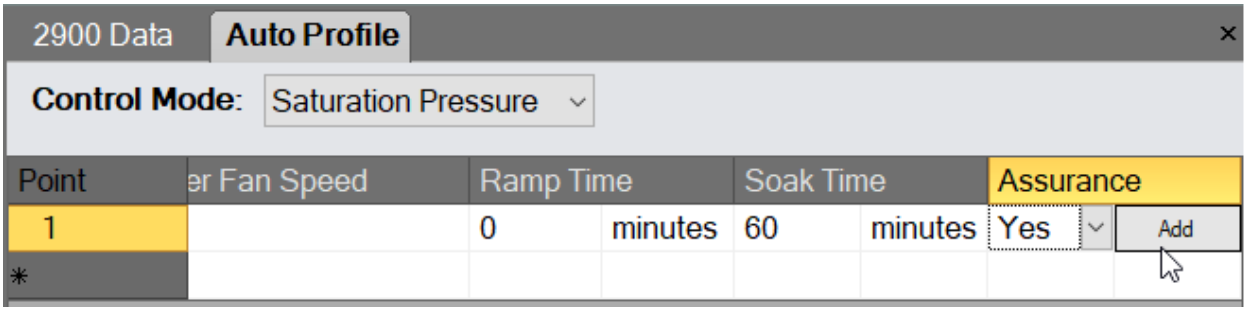


Note - *Both Ramp Time and Soak Time are limited to a maximum time of 24.855 days. You likely to run out of water before this maximum time is ever reached.*

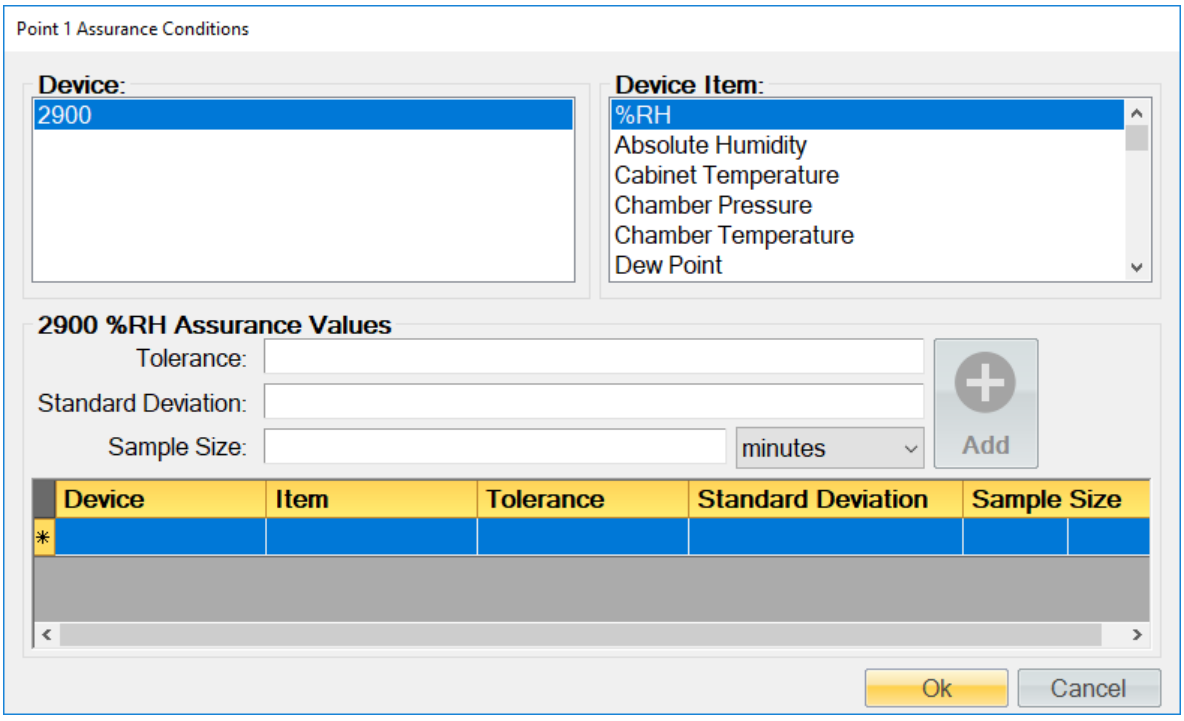
Assurance, if set to "*Yes*", forces the system to wait until the measured values are within a specified tolerance and/or stability before ControLog will start the Soak Phase. If "*No*" is set, the Soak Phase will start immediately upon completion of the Ramp Phase.



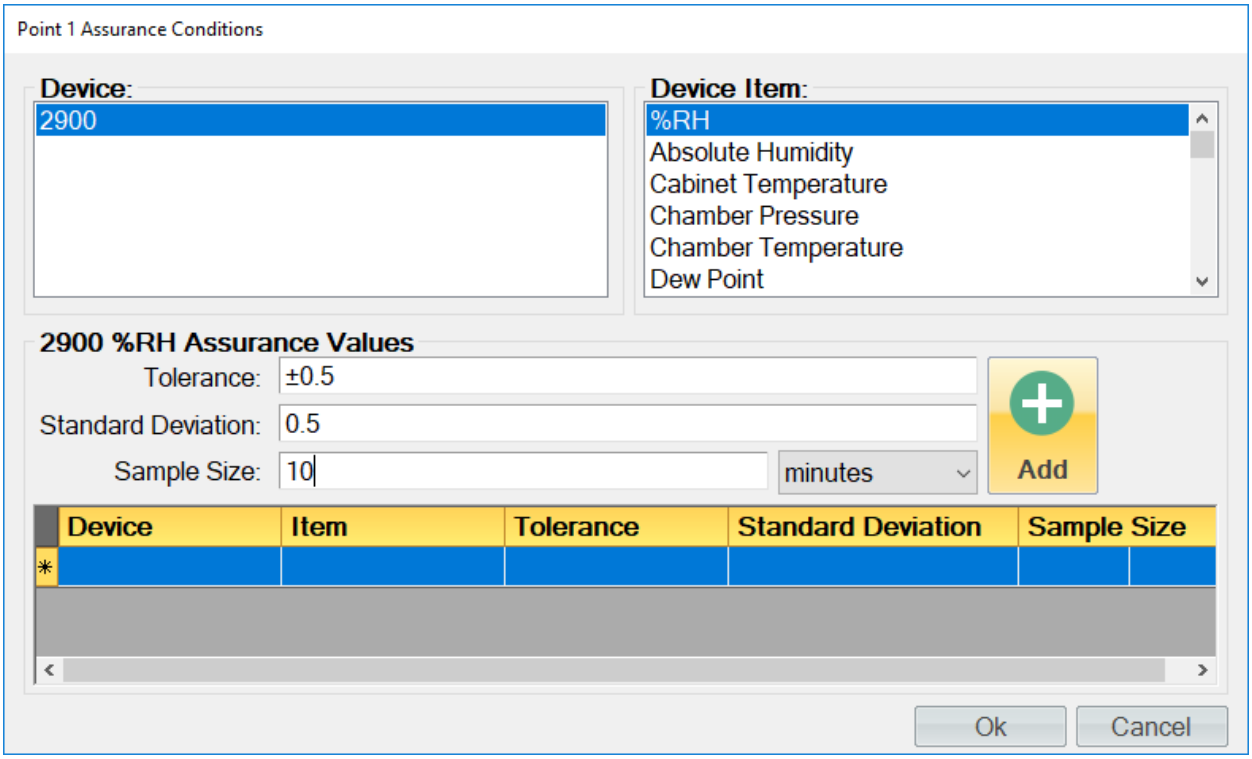
If Assurance is set to "*Yes*", a small "Add" button will appear on the right-hand side.



Clicking the "Add" button will open the "Assurance Conditions" dialog for the point. The dialog allows the user to enter various assurance conditions for the profile point.



On the upper left-hand side is a list of all available devices. Clicking a device will result in the Device Items list being updated to reflect the available items for the selected device. To add an item, highlight the desired item in the Device Item list, enter the desired Tolerance and/or Standard Deviation and click the "Add" button. For quicker assurance times, increase the Tolerance and/or the Standard Deviation values. Tighter tolerances or standard deviations (smaller values) result in longer assurance times. Setting these values too small could prevent assurance conditions from being met, therefore preventing the system from advancing to the next profile point.



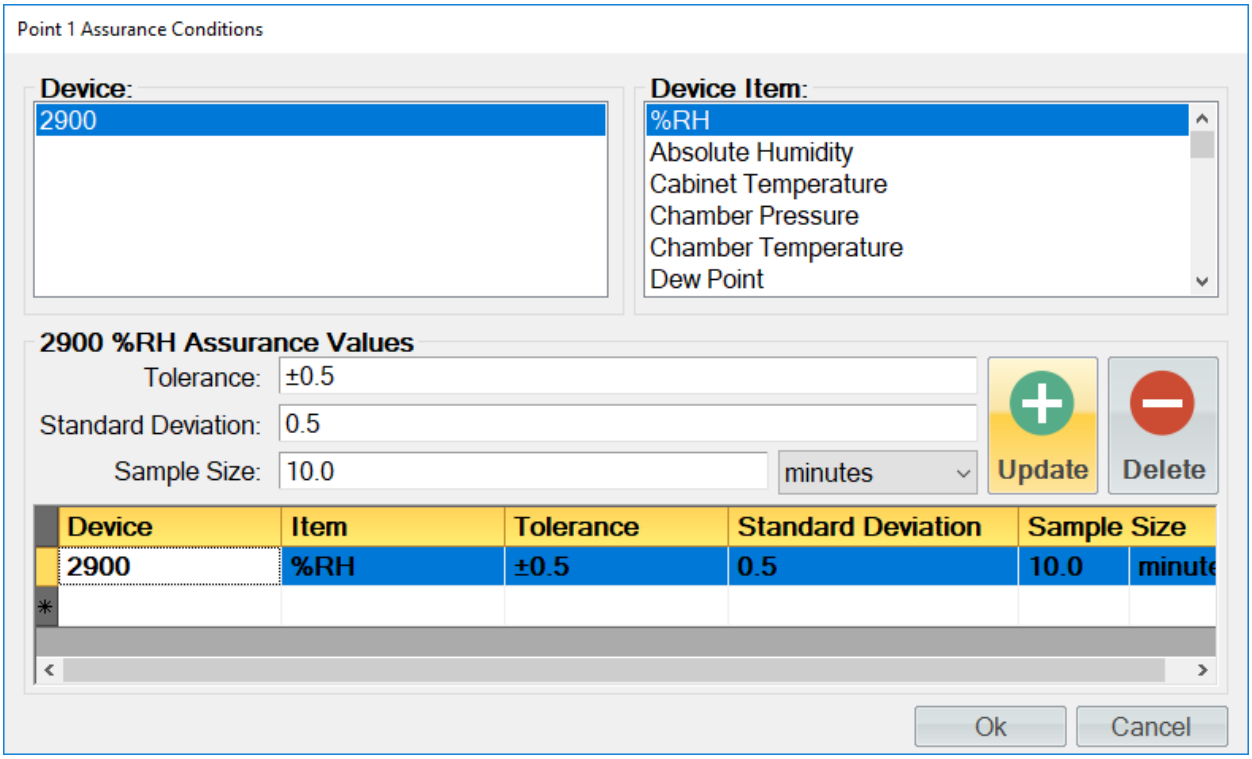
The Tolerance is the allowable variation between the setpoint and the actual. This is best thought of as a window based on a minimum and maximum value, the minimum being the setpoint minus the tolerance and the maximum being the setpoint plus the tolerance. Once the actual value is within the window the tolerance portion of the condition is considered met.

> **Note** - *Tolerances can only be entered for 3920 setpoints. The field will be grayed out for all other non 3920 setpoint device items. This is because ControLog can only assure a tolerance for an item that it has the ability to control.*

Standard Deviation is a statistic used to measure the variation in the actual data and can be thought of as how spread out or stable the data is. ControLog calculates the Standard Deviation from the device data tab for the points within the given **Sample Size**. When the actual standard deviation is less than the defined limit, the standard deviation portion of the condition is considered met.

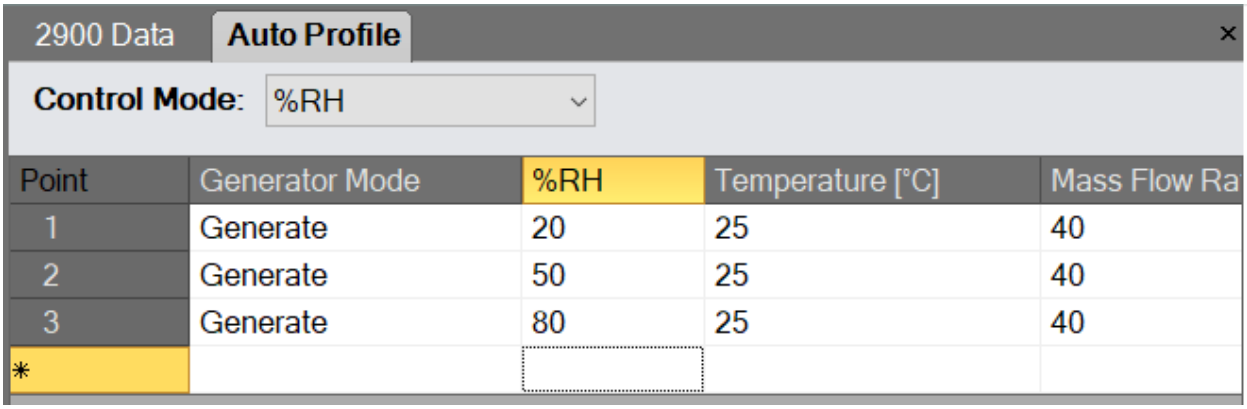
> **Note** - *The sample size should always be carefully considered based on the data storage interval. Too small of a sample size in relation to the data storage interval will result in a small number of points used to calculate the Standard Deviation.*

To update an assurance condition, select the desired condition from the list at the bottom, make the desired changes and select the Update button. To delete an assurance condition, select the desired condition from the list at the bottom and select the Delete button.

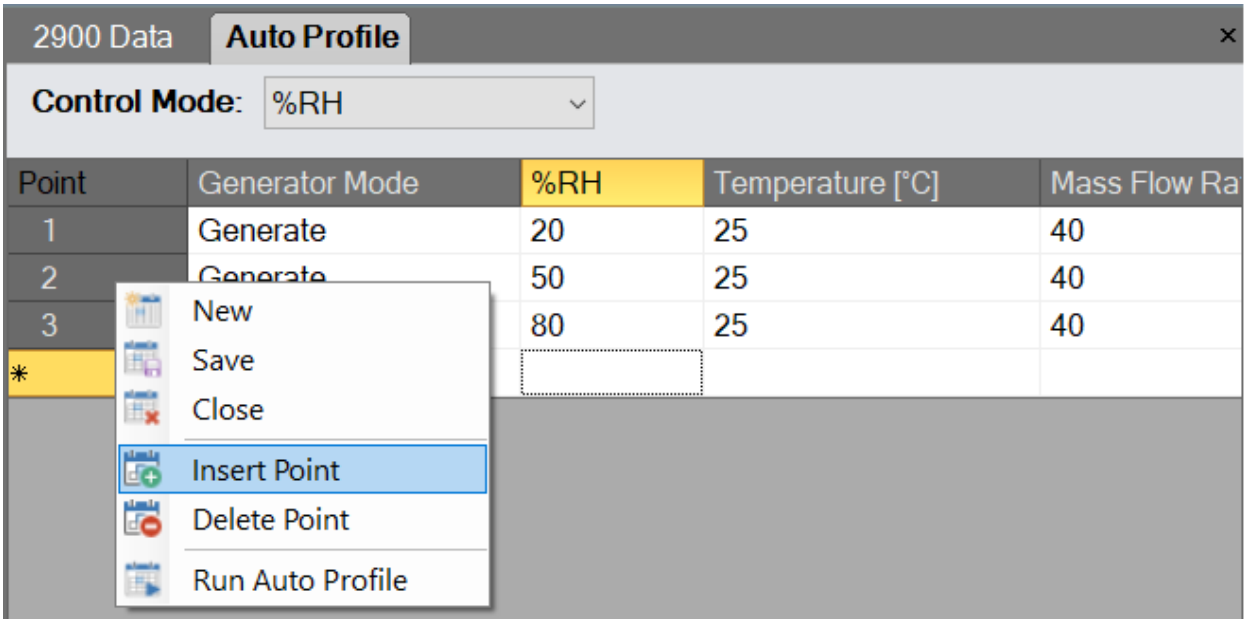


Once all assurance conditions have been completed, select the “Ok” button to close the dialog.

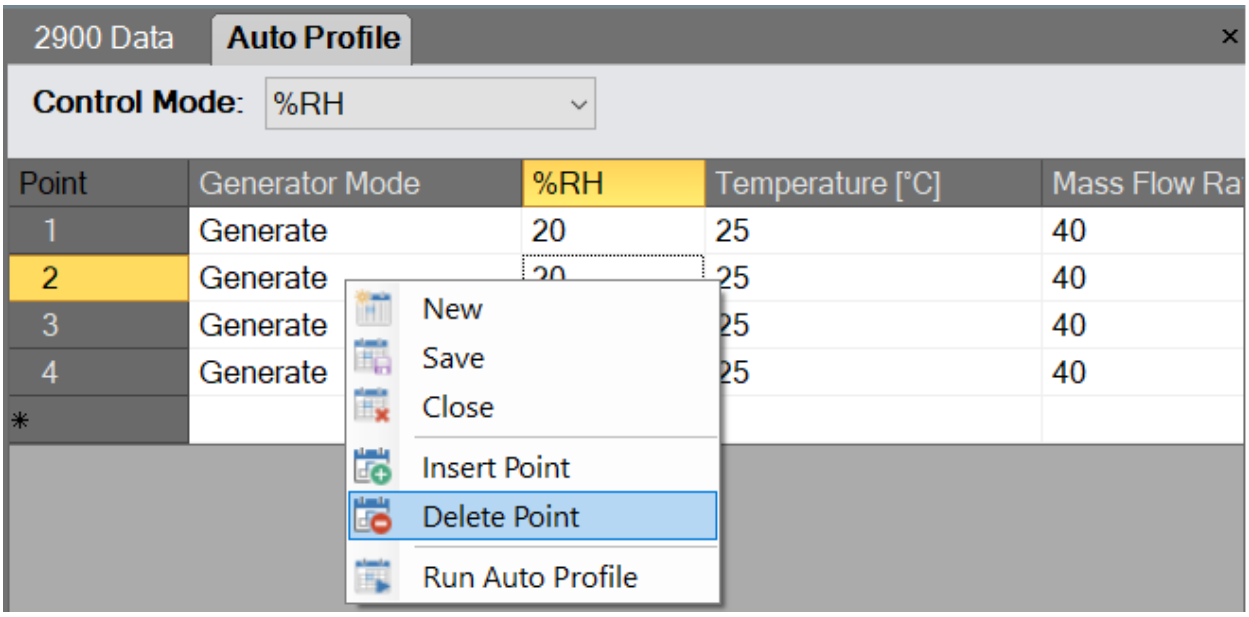
Adding more points to the auto profile is the same process as entering the first point, but the user can let ControLog help fill in values for the new point by simply entering the desired values and then by selecting the new point line (indicated by the * asterisk). ControLog will predict values for any empty field by either copying the values from the point above or by continuing the pattern from the previous points. For example, if the previous %RH points were 20% and 50% ControLog will automatically use 80% for the next point if the user leaves that field empty.



New points can also be inserted between existing points by long pressing or right clicking and selecting "Insert Point" from the context menu. ControLog will insert a new point at the selected location and will automatically predict the values.



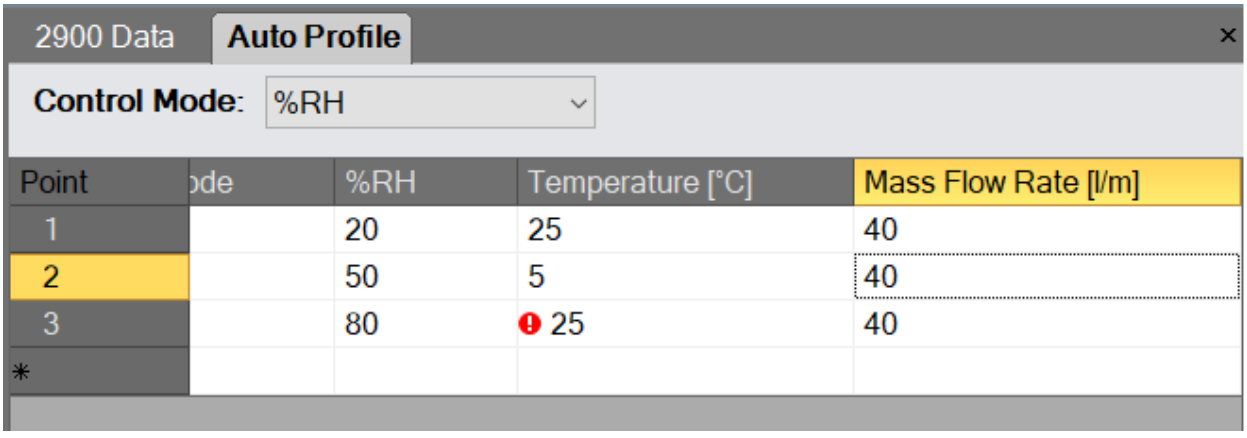
Existing points can also be deleted by selecting the desired point and then by long pressing or right clicking and selecting “Delete Point” from the context menu.



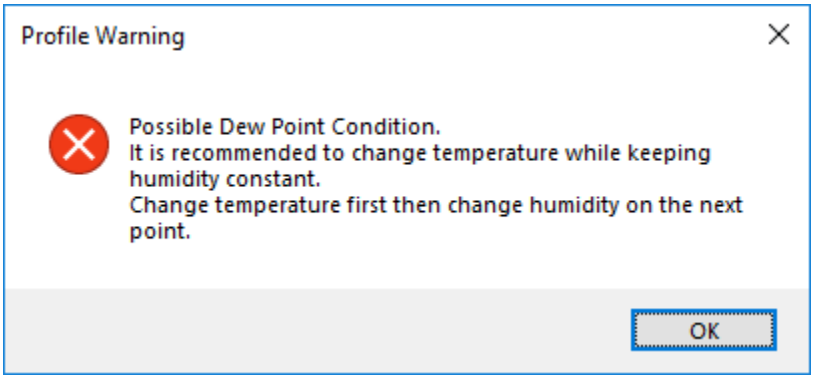
Profile points that cause operational issues for the 3920 are automatically flagged by ControLog and are indicated by a red circle with an exclamation point.

⚠ CAUTION!

THE USER SHOULD ADDRESS AND RESOLVE ALL ISSUES BEFORE ATTEMPTING TO RUN THE AUTO PROFILE.



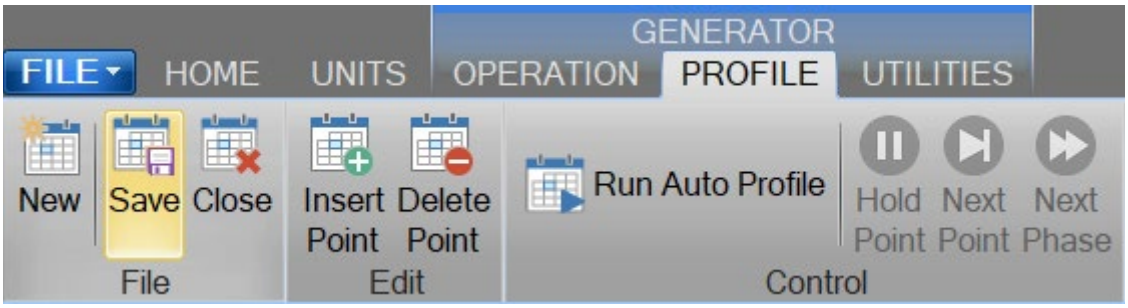
An explanation of the issue will also be displayed.



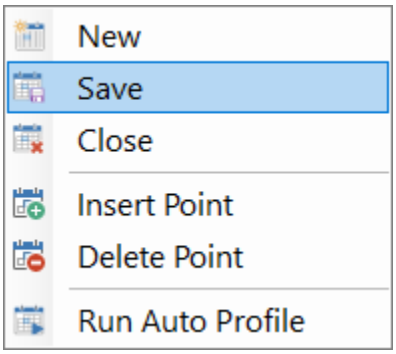
9.2 SAVING A PROFILE

The Profile tab can be saved to file for future recall. ControLog Auto Profiles are saved in XML format with a *.profile extension.

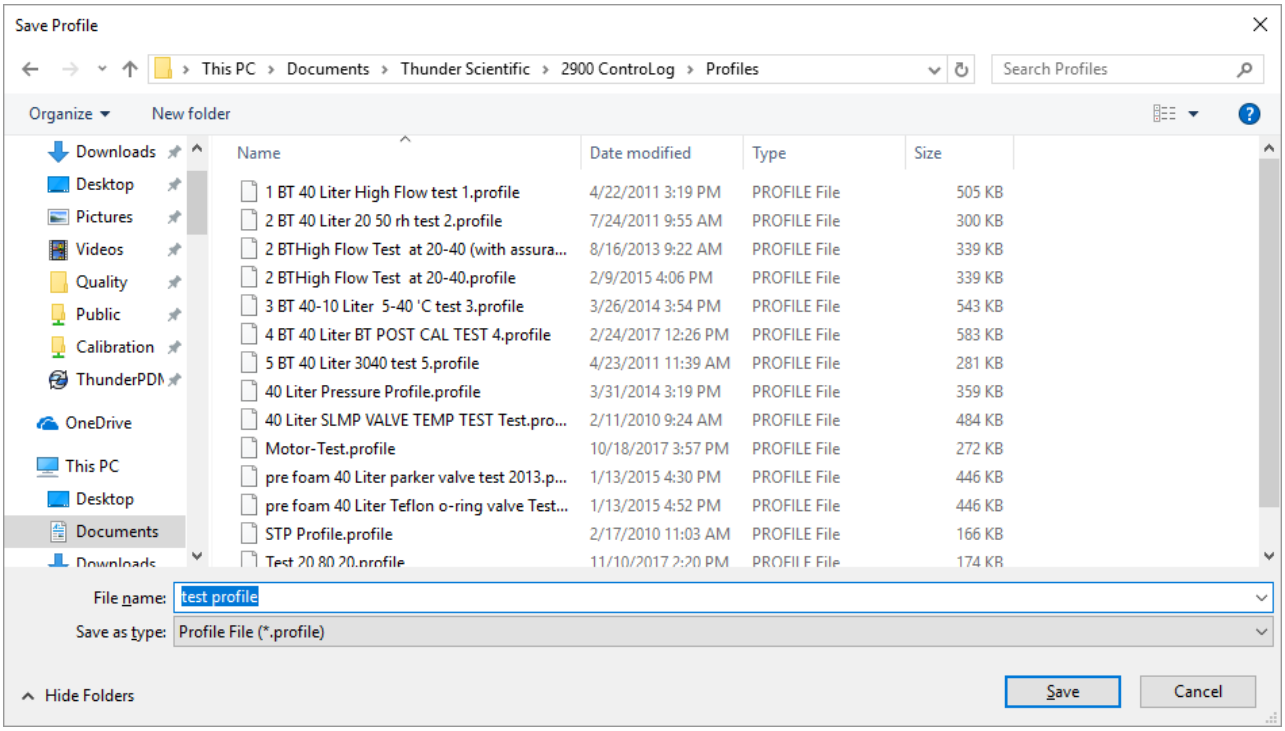
To perform the save, select “Save” from the main menu or right click a profile tab and select “Save”.



Or



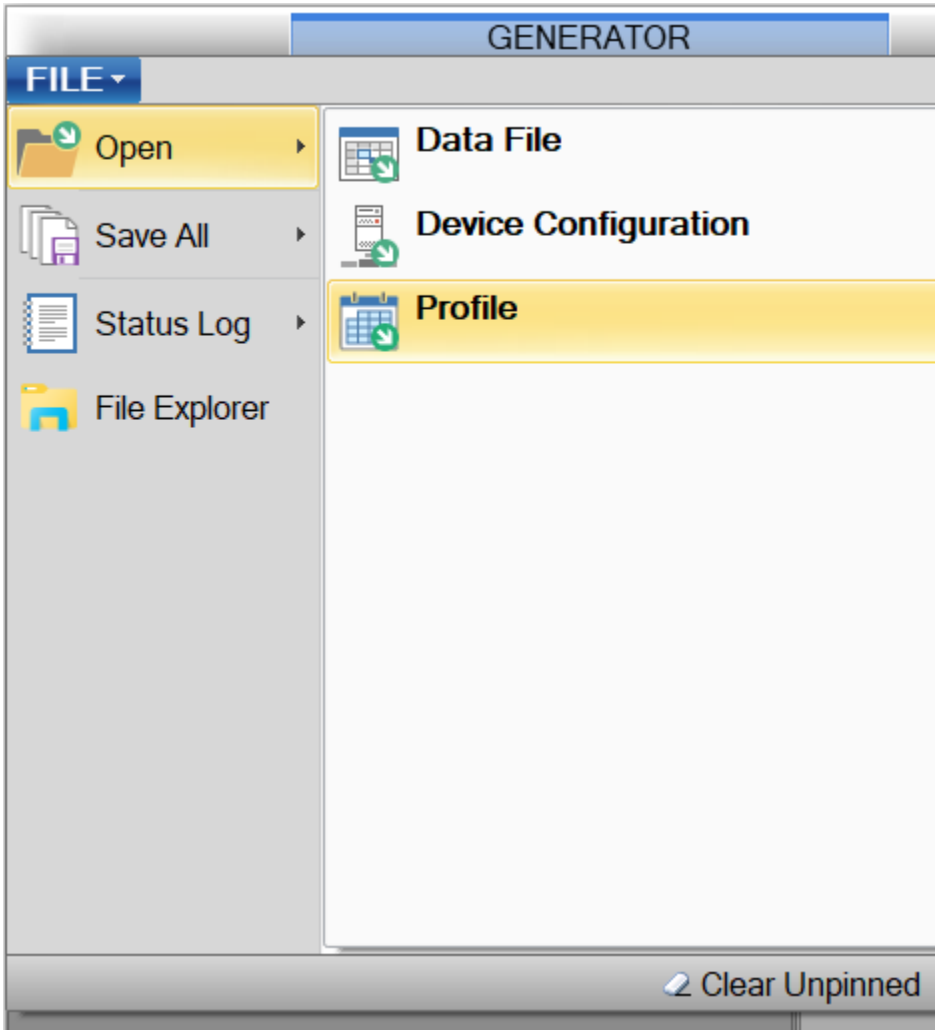
Using the “Save Profile” dialog, select the location and name you want to the save the profile as.



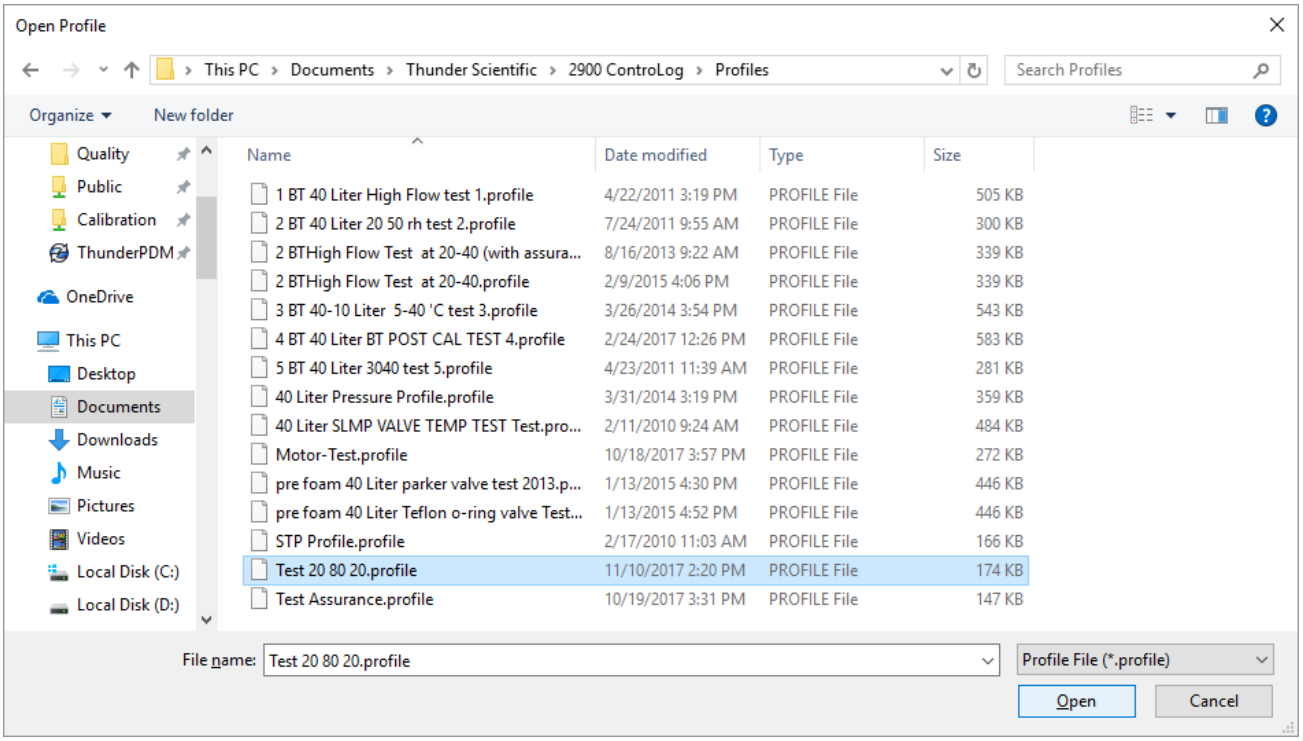
9.3 Opening a Profile

Profiles can be loaded from previously saved profile files.

To perform the open, select “Open” from the file menu and select Profile.



Using the “Open Profile” dialog, browse and select the profile file that you want to open.

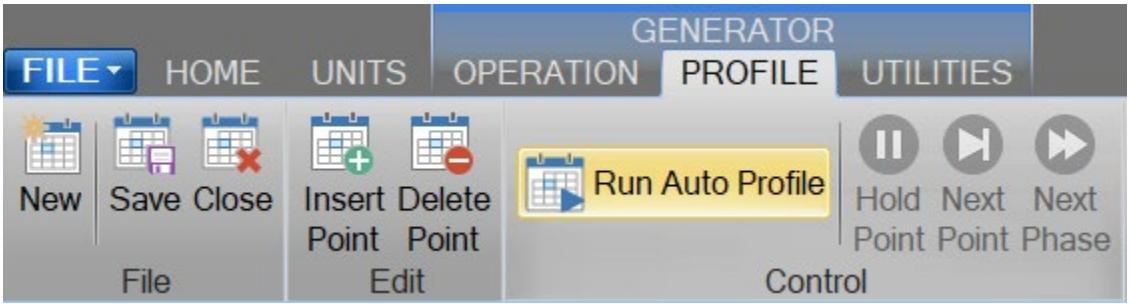


Once the load is complete, the profile tab will be displayed with the loaded profile points.

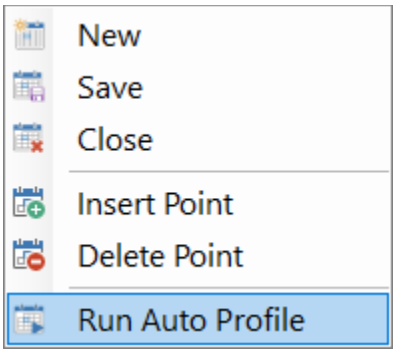
9.4 RUNNING AN AUTO PROFILE

To run an auto profile, select “Run Auto Profile” from the main menu or right click a profile tab and select “Run Auto Profile”.

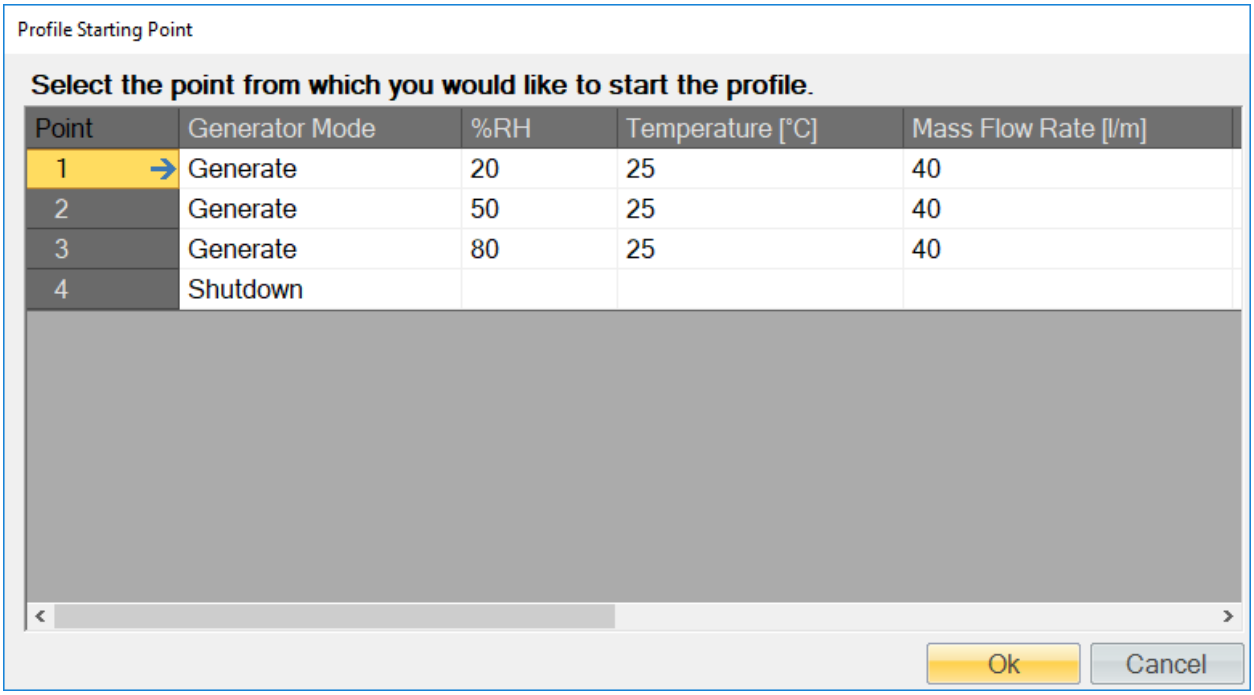
> **Note -** *While operating the system in the Auto Profile mode, manual setpoint and mode changes are not allowed.*



Or



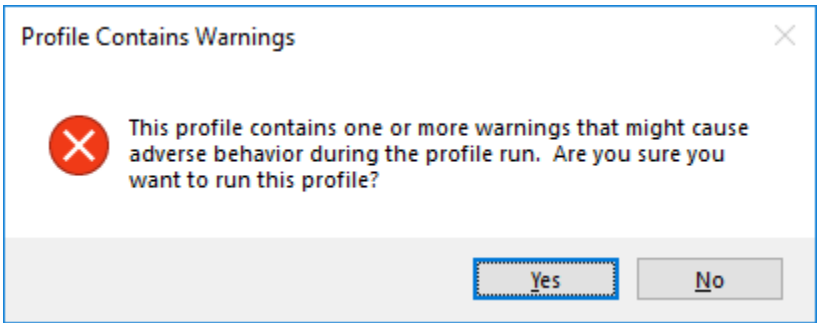
Selection will open the “Profile Starting Point” dialog which allows the user to select which point in the profile they would like to start the profile on. This feature provides more flexibility by allowing the user to skip ahead to a desired point within the auto profile.



If the profile contained errors, which were indicated by a red circle with an exclamation point on the profile, a warning message will appear when the user tries to run the profile.

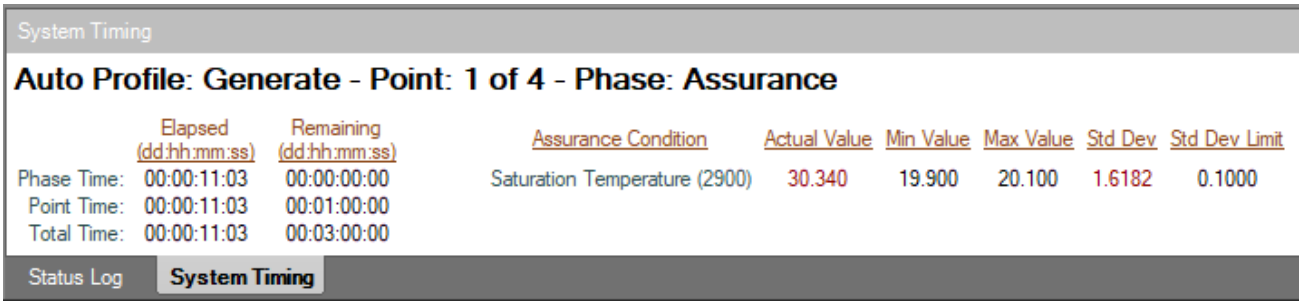
⚠ CAUTION!

RUNNING A PROFILE WITH ERRORS MAY CAUSE ADVERSE BEHAVIOR DURING THE PROFILE RUN. THE USER IS STRONGLY ENCOURAGED TO ADDRESS AND FIX ALL PROFILE ISSUES BEFORE ATTEMPTING TO RUN THE PROFILE.

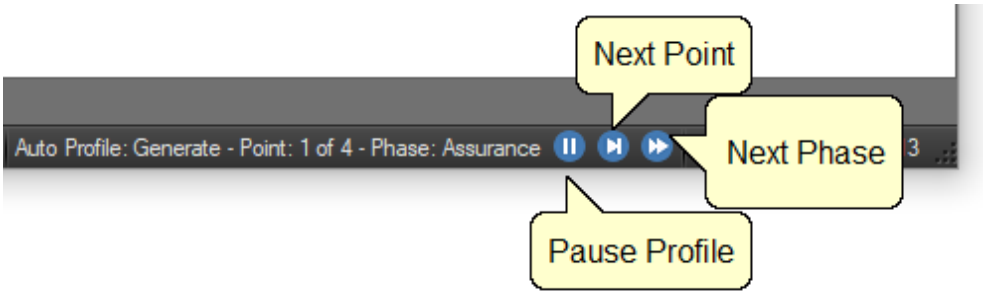


Once the auto profile begins, ControLog will begin sending the commands and setpoints for the starting profile point. The System Timing tab will be displayed in the information tab group and the Auto Profile Controls and Status will appear in the status bar.

The System Timing tab gives detailed information on the Auto Profile as it runs. The elapsed and remaining Phase, Point and Total time are listed along with the detailed assurance conditions values and tolerances.



The Auto Profile Controls and Status consist of the generator run state for the current profile point, the profile point the system is currently running and the phase of the current point. It also consists of three shortcut buttons to control the operation of the auto profile. There is a "Pause Profile" button, advance to "Next Point" button and advance to the "Next Phase" button. These are the same commands that are available in the profile menus.



9.4.1 Understanding Profile Phases

Each profile point consists of three distinct phases; Ramp, Assurance and Soak. Each phase accomplishes a specified task.

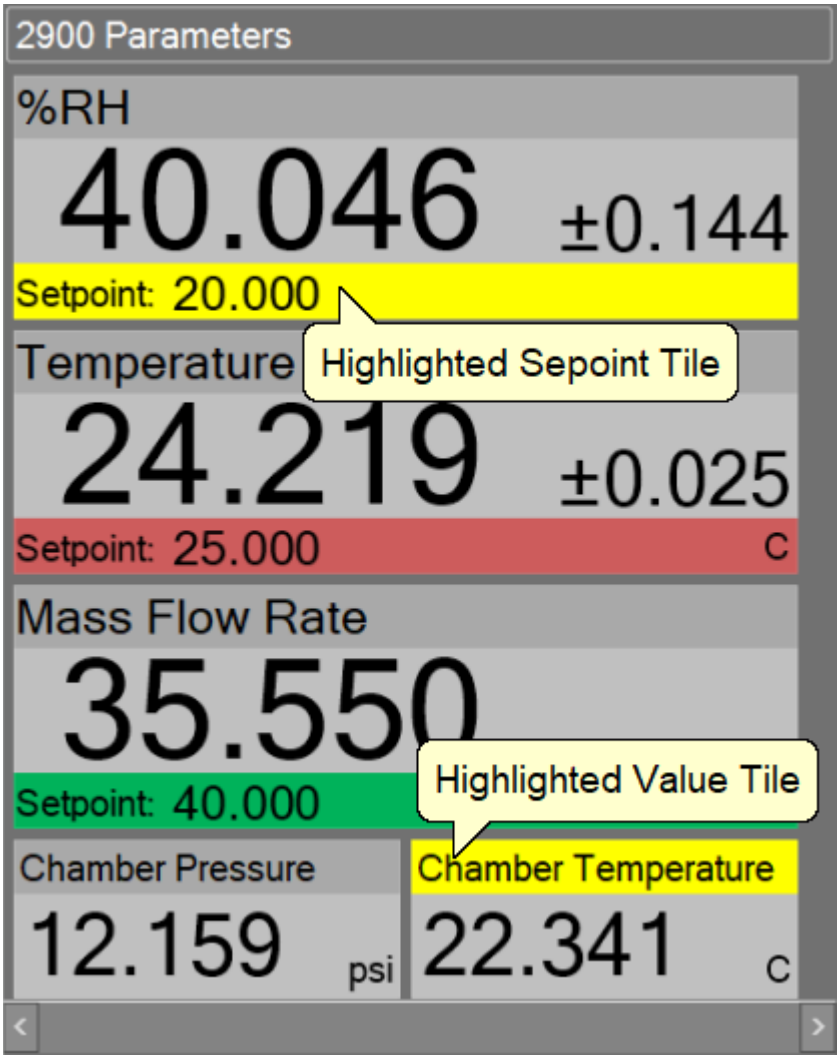
9.4.1.1 Ramp Phase

The Ramp Phase is used to linearly transition from one point to the next point in a given amount of time.

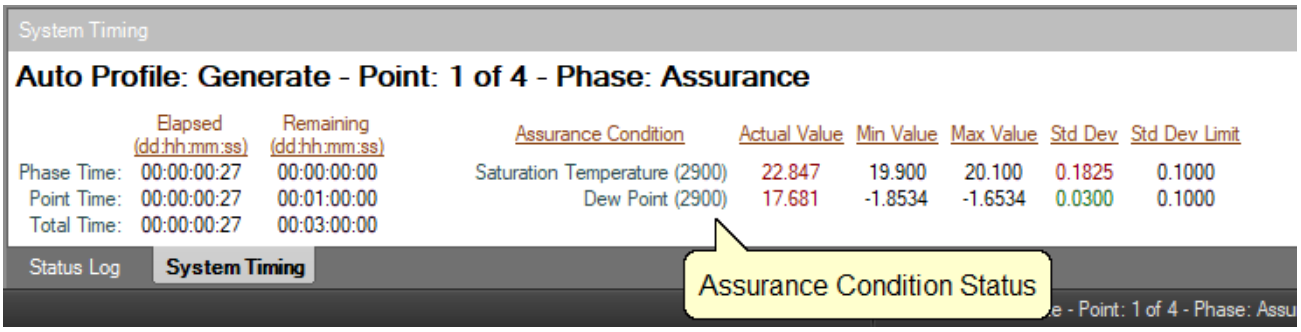
9.4.1.2 Assurance Phase

The Assurance Phase forces the system to wait until measured parameters and setpoint values are within a specified tolerance and/or stability before the computer starts the Soak Phase.

During the assurance phase, assurance conditions that have not been met will be displayed with a yellow footer block for Setpoint Tile and a yellow header block for Value Tile on the parameter tab of the device containing the condition.



The system timing tab provides a detailed view of each assurance condition for the current point. The actual value of each condition will be displayed in red if it has yet to be met and will be displayed in green once the condition has been met. The system timing tab also displays criteria the condition needs to meet for both tolerance and standard deviation.



Note - *The assurance phase will be active for a minimum of 30 seconds. This delay allows the 3920 to calculate setpoints before ControLog begins to assure each condition.*

9.4.1.3 Soak Phase

The Soak phase is the desired amount of time to generate at a particular point before proceeding to the next point.

9.4.1.4 Example 1

Point	Generator Mode	%RH	Temperature [°C]	Mass Flow Rate [l/m]	Ramp Time		Soak Time		Assurance
1	Generate	20	25	50	0	hours	1	hours	No

Example 1 causes the Soak phase to begin immediately at the start of the profile point, even though the 3920 may still be adjusting to the point. The next point will start after the 1-hour soak phase.

9.4.1.5 Example 2

Point	Generator Mode	%RH	Temperature [°C]	Mass Flow Rate [l/m]	Ramp Time		Soak Time		Assurance
1	Generate	20	25	50	0	hours	1	hours	Yes

Example 2 causes the Assurance phase to begin immediately at the start of the profile point. Measured values are continually compared with the setpoint values until they agree with the set tolerance and/or the measured values are stable to within the specified degree. Once assured (tolerances met) the Soak phase begins. Total time required for this point varies and depends upon the amount of time that is required for assurance (dictated by tolerances). Total time for example 2 is elapsed assurance time plus 1 hour.

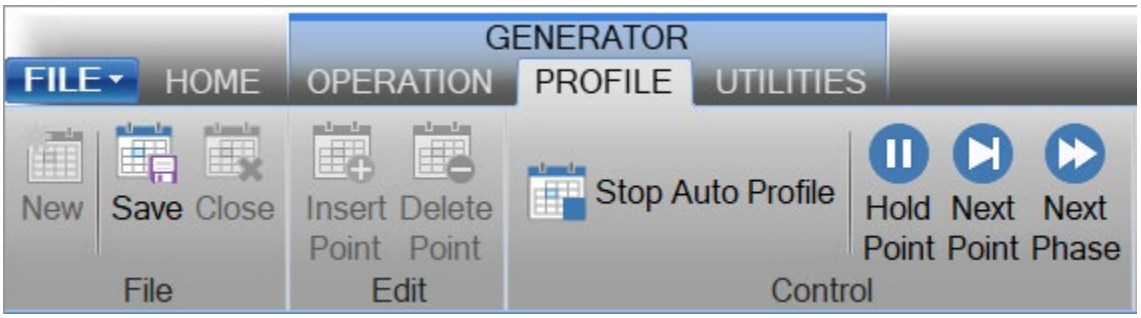
9.4.1.6 Example 3

Point	Generator Mode	%RH	Temperature [°C]	Mass Flow Rate [l/m]	Ramp Time		Soak Time		Assurance
2	Generate	30	25	50	15	minutes	1	hours	Yes

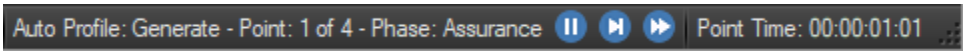
The Ramp phase (Ramp Timer) begins at the start of the point. The system adjusts slowly toward the setpoint, taking 15 minutes. Once the ramp time has elapsed, assurance starts and waits for tolerances to be met. When tolerances are met, the soak phase begins and lasts 1 hour. Total time for example 3 is 15 minutes, plus elapsed assurance time, plus 1 hour. Assurance time is a variable and depends on tolerances.

9.4.2 Manual Override of Profile

Although the system is operating automatically, some manual control is allowed using the Hold Point, Next Phase and Next Point menu items on the Run menu or Status Bar.

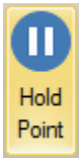


Or

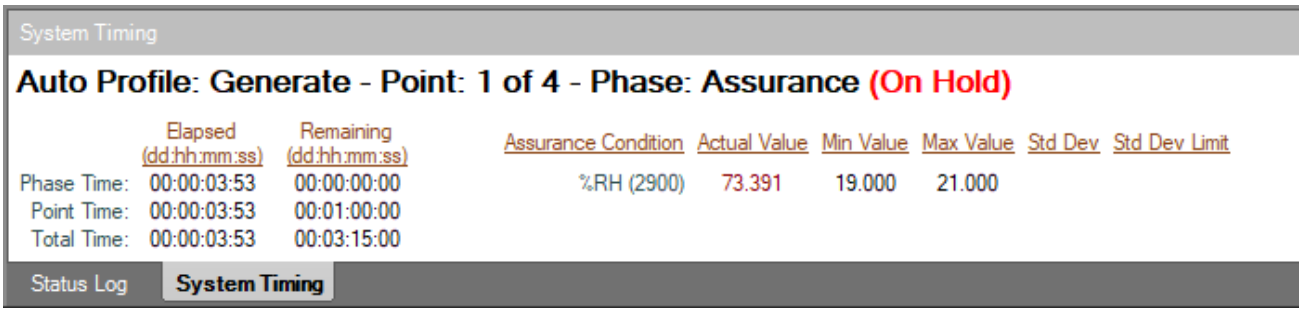


9.4.2.1 Holding the Profile

Selecting Hold Point from the profile menu or status bar will stop the current "Remaining Time" timers, allowing the system to remain indefinitely at the current point. While in a hold mode, the system is prevented from completing the ramp, assurance, or soak phases of a point.



When holding, a hold indicator appears in the System Timing tab and the hold menu buttons change into resume buttons.



To resume the profile point, select the Resume Point from the profile menu or status bar. This re-enables the timing functions and allows the profile to resume normal operation.

9.4.2.2 Advancing to the Next Point

Selecting Next Point from the Run menu or status bar manually duplicates the action which automatically occurs when the Point time counter reaches zero.



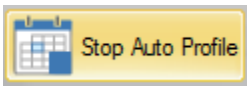
9.4.2.3 Advancing to the Next Phase

Selecting Next Phase from the profile menu or status bar manually duplicates the action which automatically occurs when a Remaining Ramp or Soak Time counter reaches zero, or when the assurance conditions are met. In other words, it causes Ramp Phase to proceed to the Assurance or Soak Phase, Assurance to proceed to Soak, or Soak to proceed to Ramp of the next profile point. This allows for early manual termination of any phase within a profile point.



9.4.2.4 Stopping the Auto Profile

Selecting Stop Auto Profile from the profile menu or context menu will terminate the profile at the current point and the generator will continue at its current setpoints for Saturation Pressure, Saturation Temperature and Flow. Another way to exit the Auto Profile is to switch from Auto Profile to Generate or Shutdown.

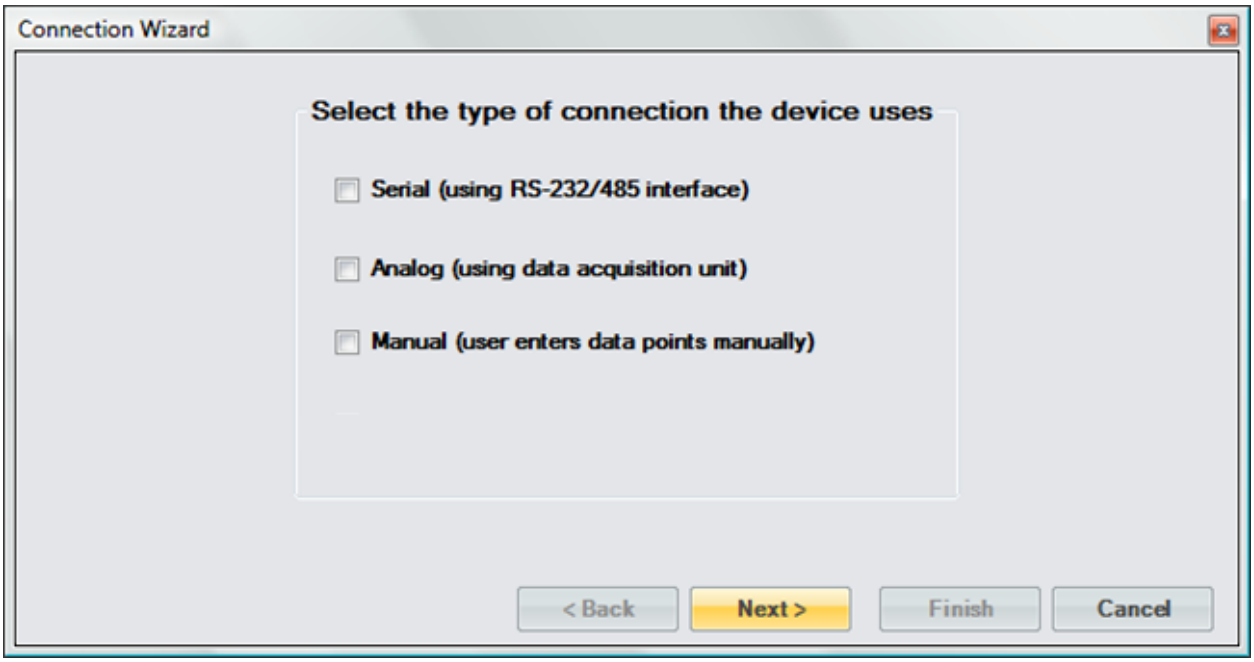


10 CONNECTIONS

ControLog supports a customizable interface that works with most devices. ControLog will allow the user to create a new device connection using the "Connection Wizard" or open previously saved connections. The wizard will open a separate dialog window containing various steps that will guide the user in defining the communication required to receive the desired data items from the device. The user can create as many (up to 60) or as few data items as they see fit for any one device. Each data item can be uniquely named and once connected will be recorded in its own parameter and data tab. ControLog also allows the user to save these interfaces for future use.

Note - *ControLog has a limit of eight devices connected at any given time.*

The "Connection Wizard" allows the user to step through the connection configuration. Using the "Next" and "Back" buttons, the user can progress through the connection configuration steps. At any time, the user may cancel the new connection or opening of a connection by selecting the "Cancel" button. Once the last step has been completed, the "Finish" button will be available to complete the new connection.



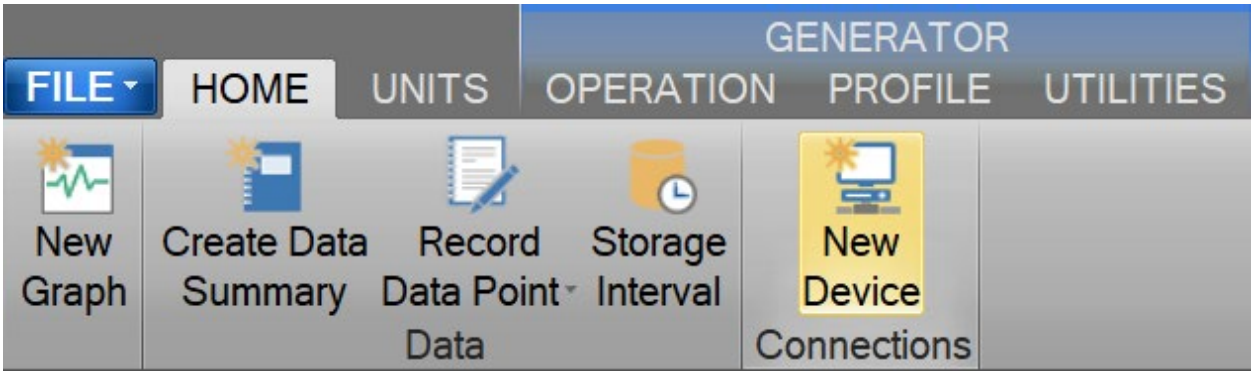
Note - *It is always recommended to have the manufacturer's documentation for the device being connected while creating the new connection. It is also recommended to use a terminal-based application to test the various commands before creating a new connection.*

10.1 SERIAL CONNECTION

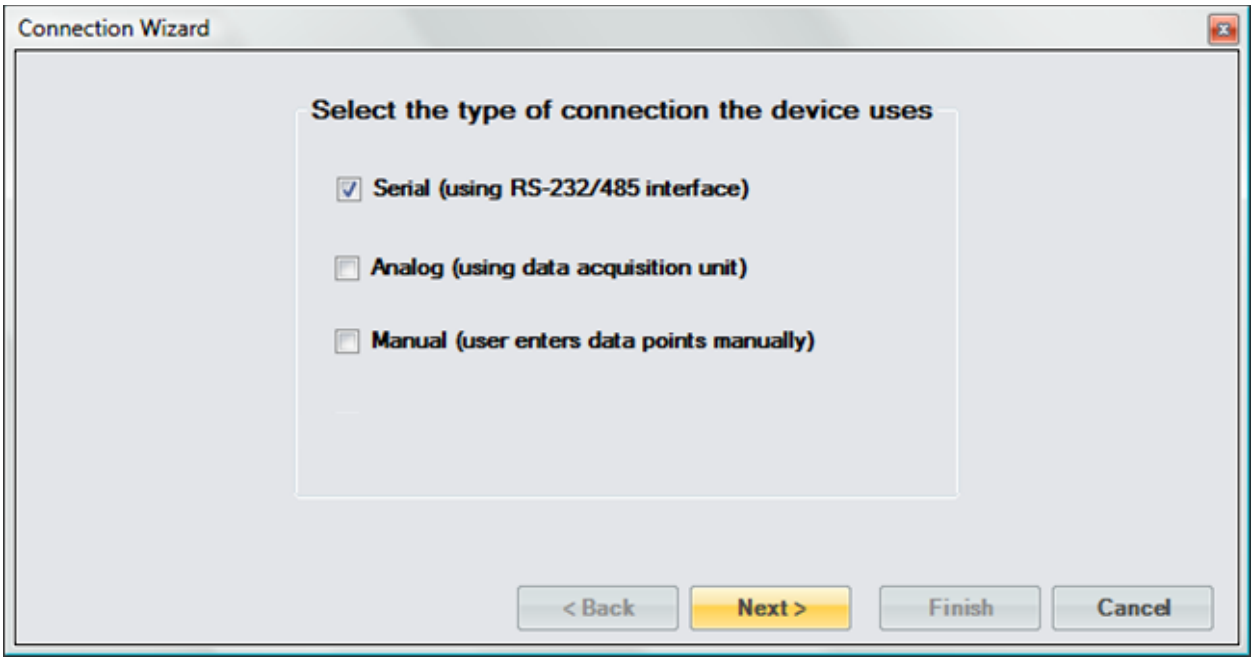
A Serial Connection uses either an RS-232 or RS-485 USB adapter to acquire data from a given ASCII based serial device. The customizable interface provided by ControLog allows the user to define the ASCII commands that are sent and/or received through the RS-232/485 interface to communicate with the serial device. The system supports both a "request to receive" type of communication as well as a "receive only" type of communication.

NOTE: MOXA® line of USB to serial adapters are pre-configured to work with the 3920. Contact Thunder Scientific support for more information. Refer to section 2.3.1 Technical Support.

To create a new serial connection, select "New Device" from the Home menu tab. This will open a "Connection Wizard" dialog that will step the user through the connection definition process.



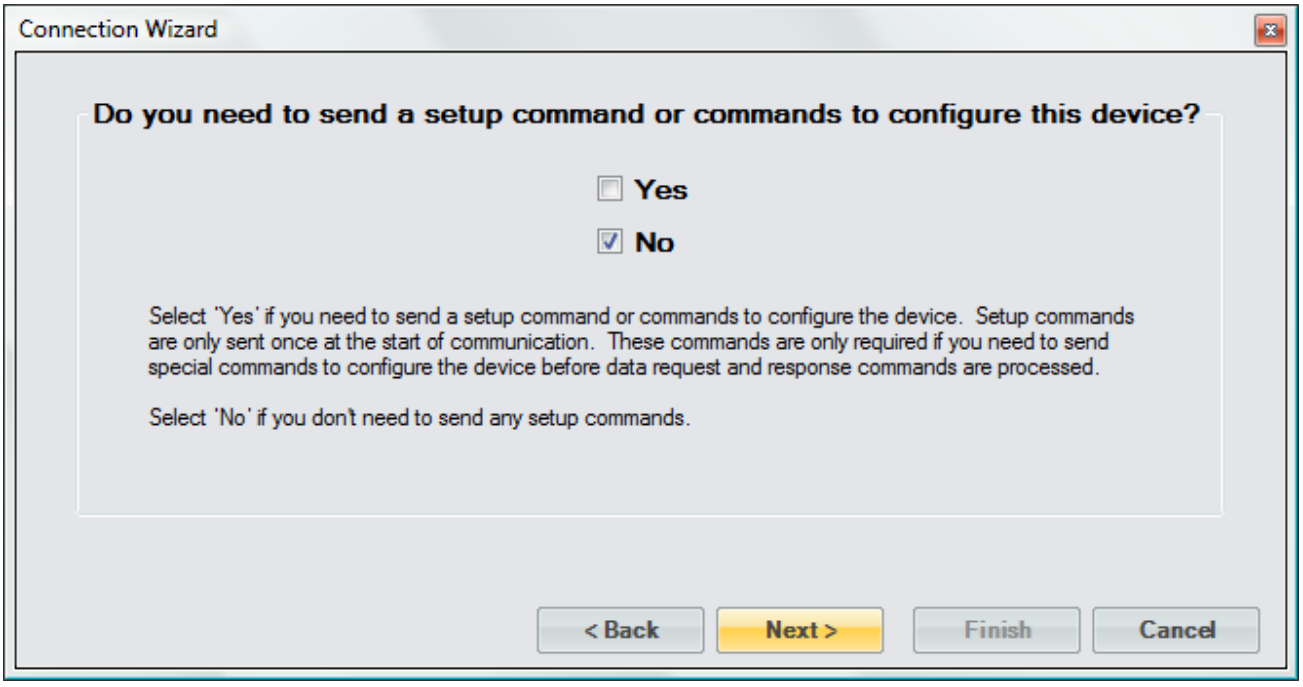
Select "Serial" as the type of connection the device uses.



Enter a unique name for the device.



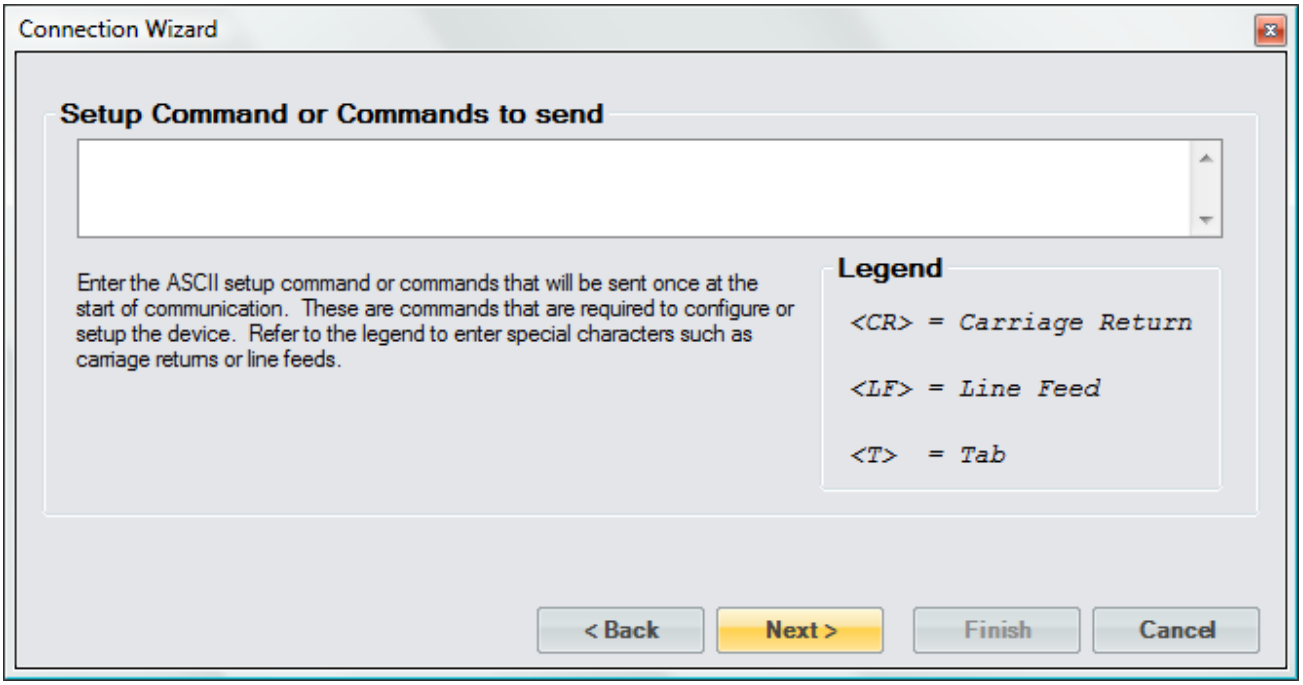
Select whether the device requires a setup command or commands. Setup commands are only sent once at the start of communication. These commands are only required if you need to send special commands to configure the device before data request and response commands are processed.



If setup commands are required, then enter the ASCII setup command or commands that will be sent at the start of communication. Refer to the legend to enter special characters such as carriage returns and/or line feeds.

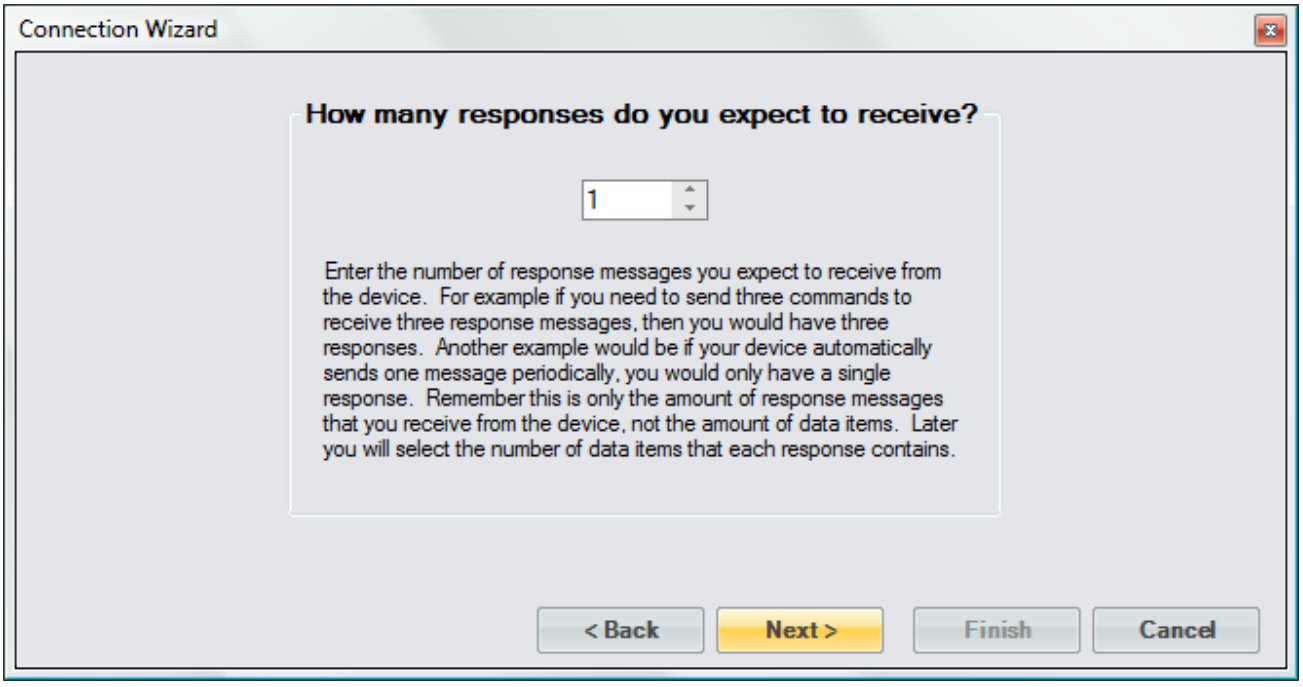
Note - *All commands are case sensitive.*

Note - *End of Line (EOL) or End of Transmission (EOT) characters such as carriage returns and/or line feeds are very important and are the leading cause of failed communication. Refer to the manufacturer's documentation for the device to verify the required EOL or EOT characters.*

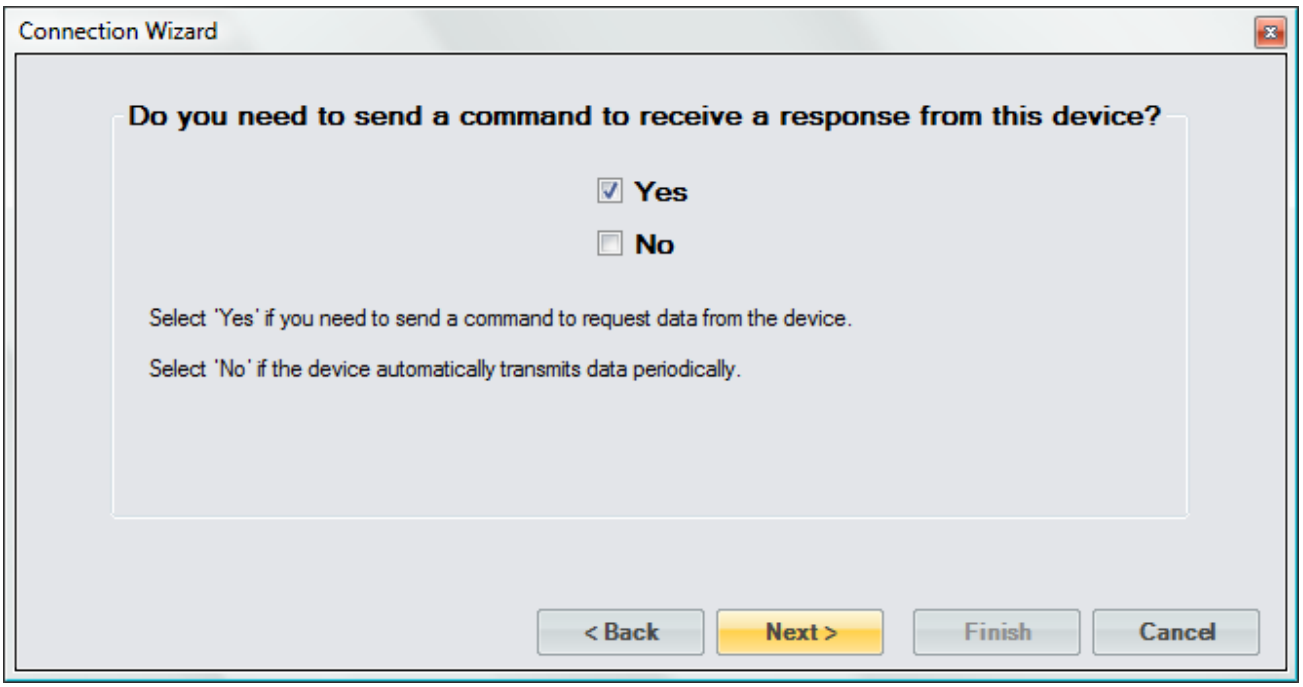


Enter the number of responses you expect to receive from the device. This is the amount of response messages that you will receive from the device, not necessarily the number of data items. A device response message could contain multiple data items. Later you will select the number of data items that each response message contains.

For example, if you need to send three commands to receive three response messages, then you would enter three. Or, if your device automatically sends one message periodically you would only have a single response and you would enter one.

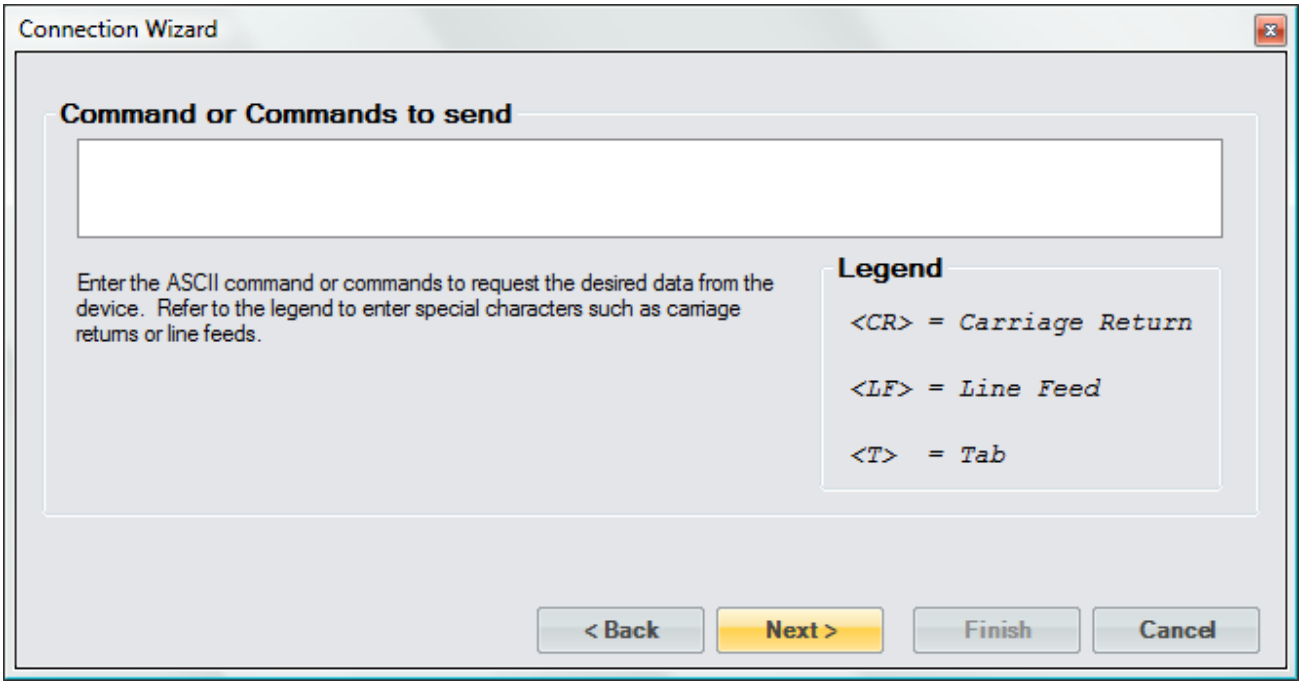


Select whether a command needs to be sent to request a response. If the device requires a command to be sent to receive a response, then select “Yes”. If the device automatically outputs data without any request, then select “No”.

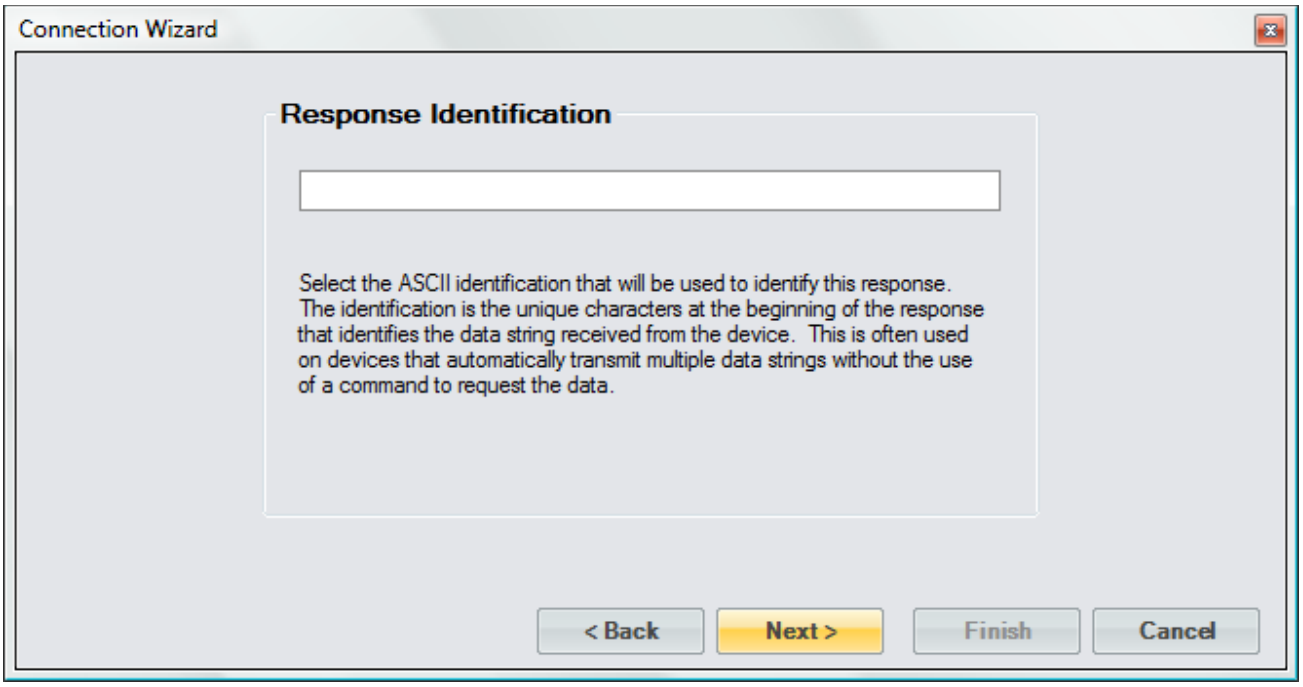


If a command was required, then enter the ASCII Command or Commands to request the desired data from the device. Refer to the legend to enter special characters such as carriage returns and/or line feeds.

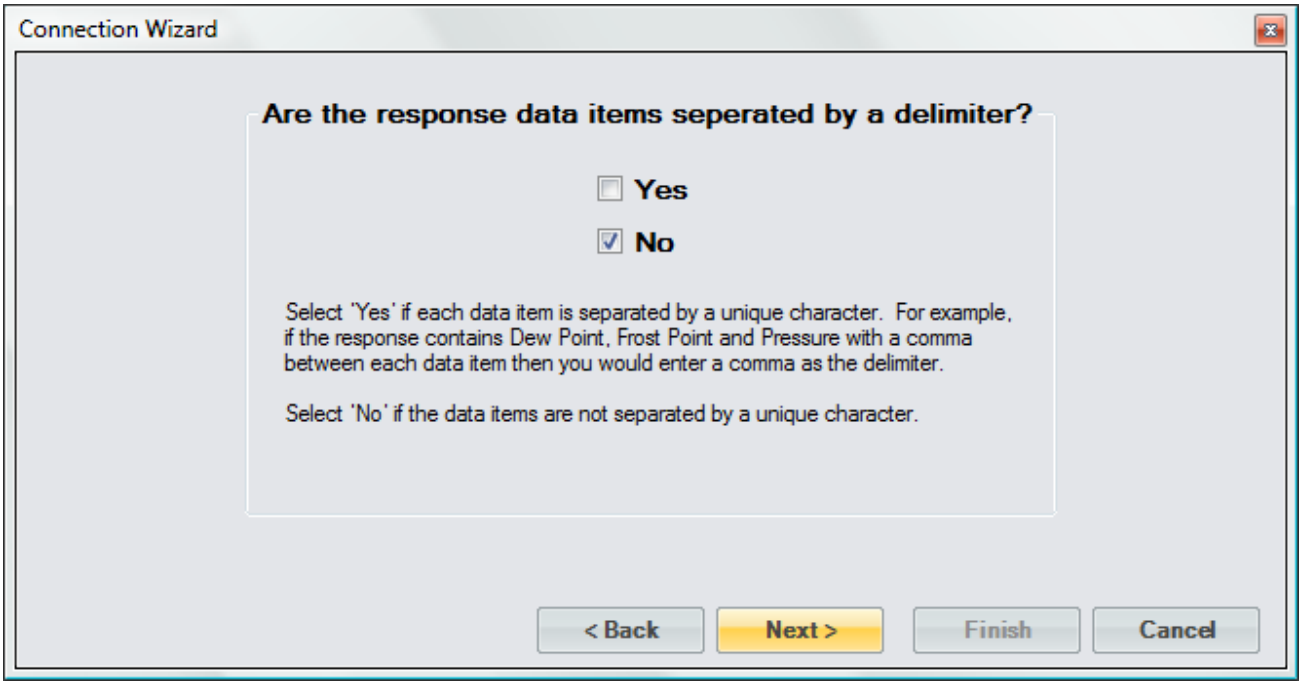
Note - *All commands are case sensitive.*



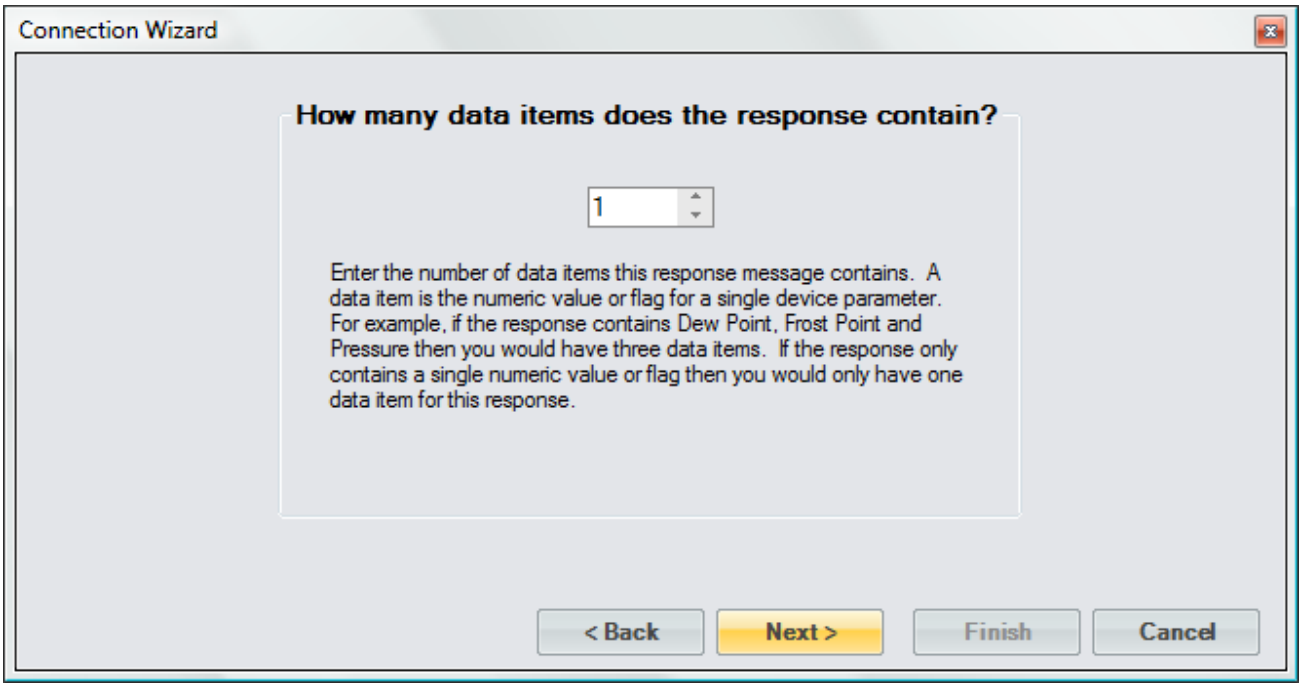
Select the ASCII identification that will be used to identify the response if no command is required but the device automatically sends messages periodically. The identification is the unique characters at the beginning of the message that identifies the response received. This is often used on devices that automatically transmit multiple data messages without the use of a command to request data.



Select whether the response has a delimiter that is separating each data item. For example, if the response contains Dew Point, Frost Point and Pressure with a comma between each data item then each item is separated by a comma delimiter.

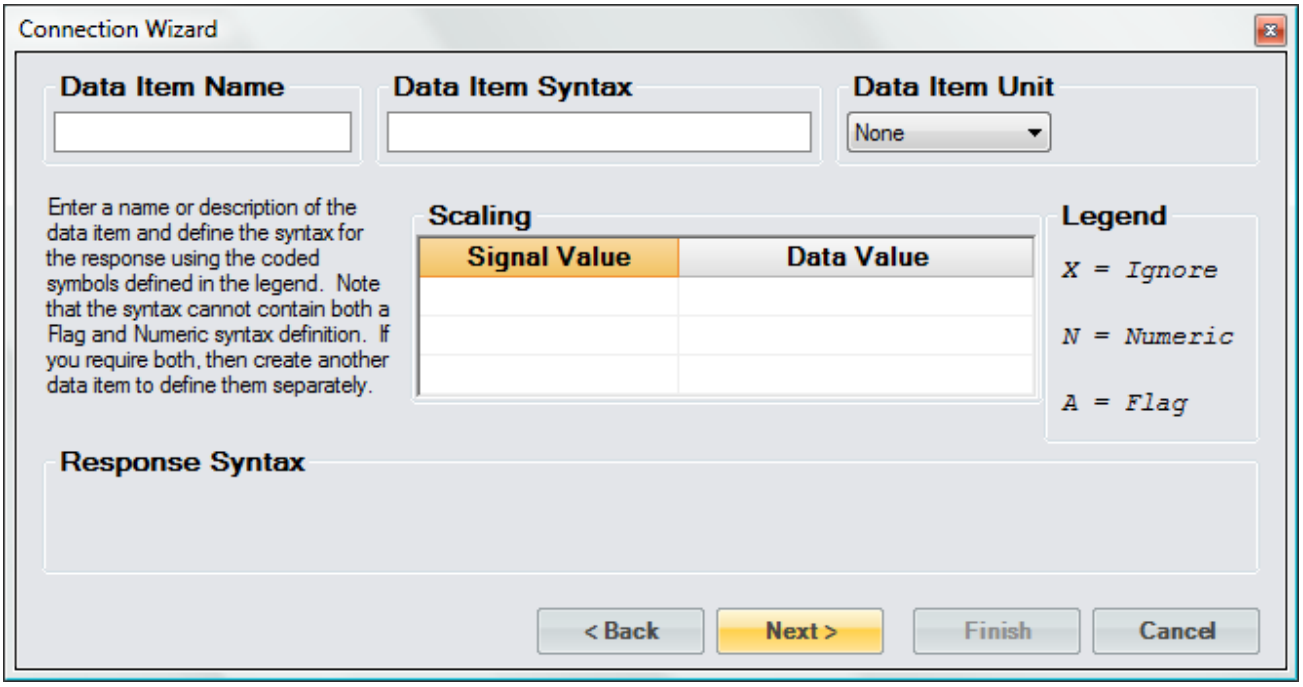


Enter the number of data items the response message contains. A data item is the numeric value or flag portion for a single device parameter within the response message. For example, if the response contains Dew Point, Frost Point and Pressure then you would have three data items. If the response only contains a single numeric value or flag, then you would only have one data item for this response.



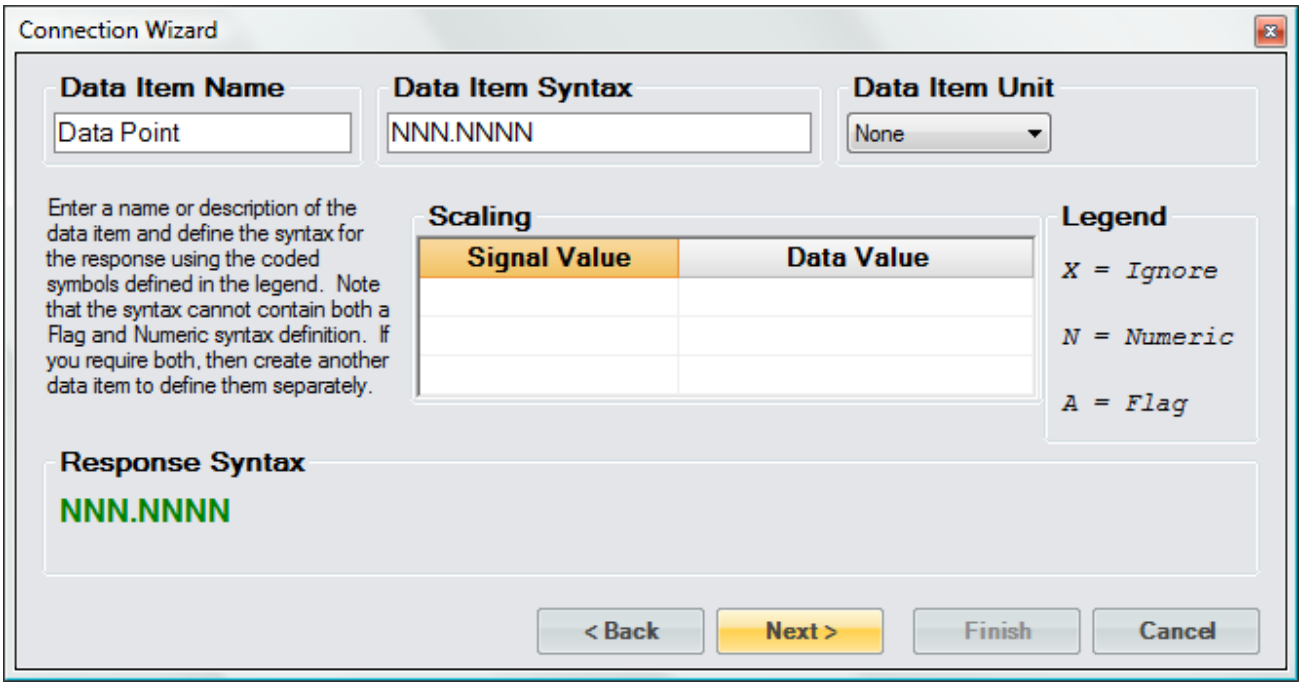
Enter a name or description for the data item and define the syntax, unit and scaling. The data item syntax is defined using the symbols in the Legend. Use the "X" symbol to indicate a character that should be ignored, use the "N" symbol to represent a numeric ASCII character and the "A" symbol to indicate a flag or any ASCII character. This dialog will repeat for each data item in the response.

> **Note** - *The syntax cannot contain both a Flag and a Numeric syntax definition. If the user requires both, then create another data item to define them separately.*



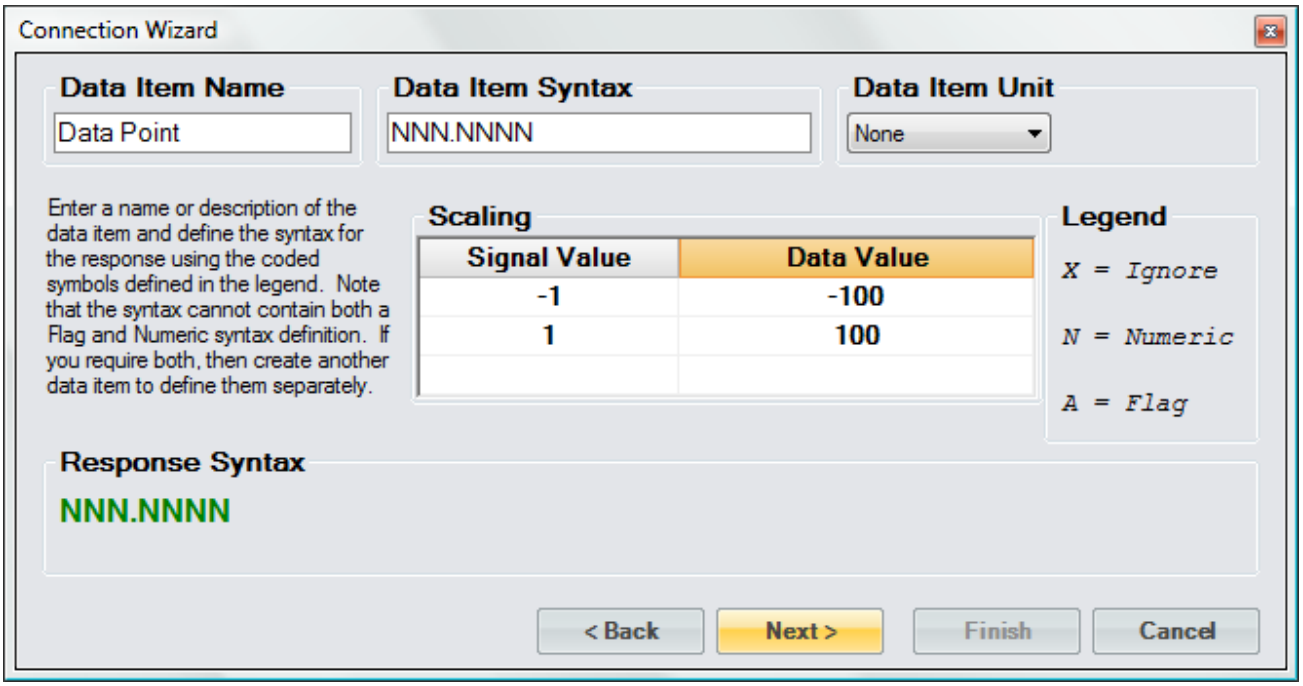
When defining a numeric syntax enter an "N" for each possible digit in the response. For example, if you know the device returns a six-digit numeric value you would enter "NNN.NNN". The decimal point is not required, and its location is not important. Decimal points, plus signs and minus signs are treated the same as an "N" and are allowed merely to help make the syntax resemble a number value.

> **Note** - *It is important to have sufficient numeric definition to assure all possible numeric responses will be covered, especially when a device responds with scientific notation or varying precession.*

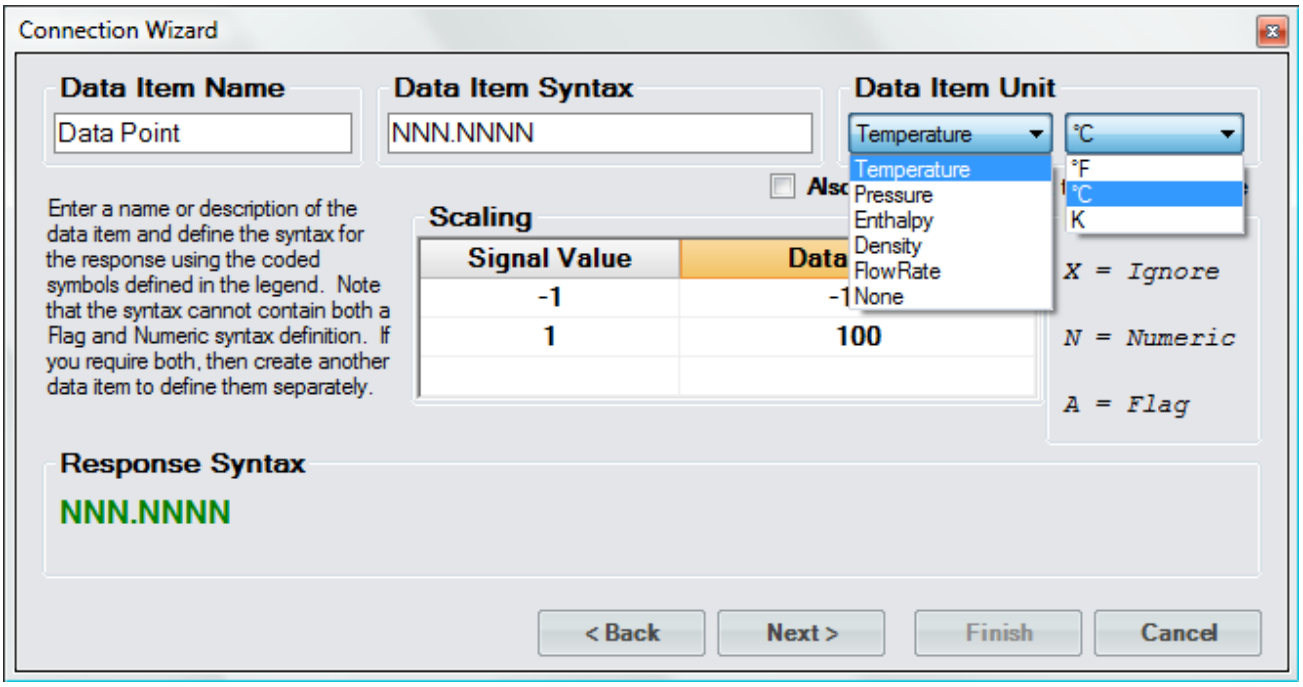


It is possible to scale a numeric data item response. The scaling consists of a two-point definition for a linear scaling or a three to five-point definition for polynomial fit scaling. The number of points determines the degree of the polynomial used to scale the data item response. A Singular Value Decomposition (SVD) algorithm is used to determine the coefficients of the polynomial. Each point definition consists of a signal value and a data value. The signal value represents the "raw" output signal from the device. The data value represents the actual value or real-world value at the given signal value.

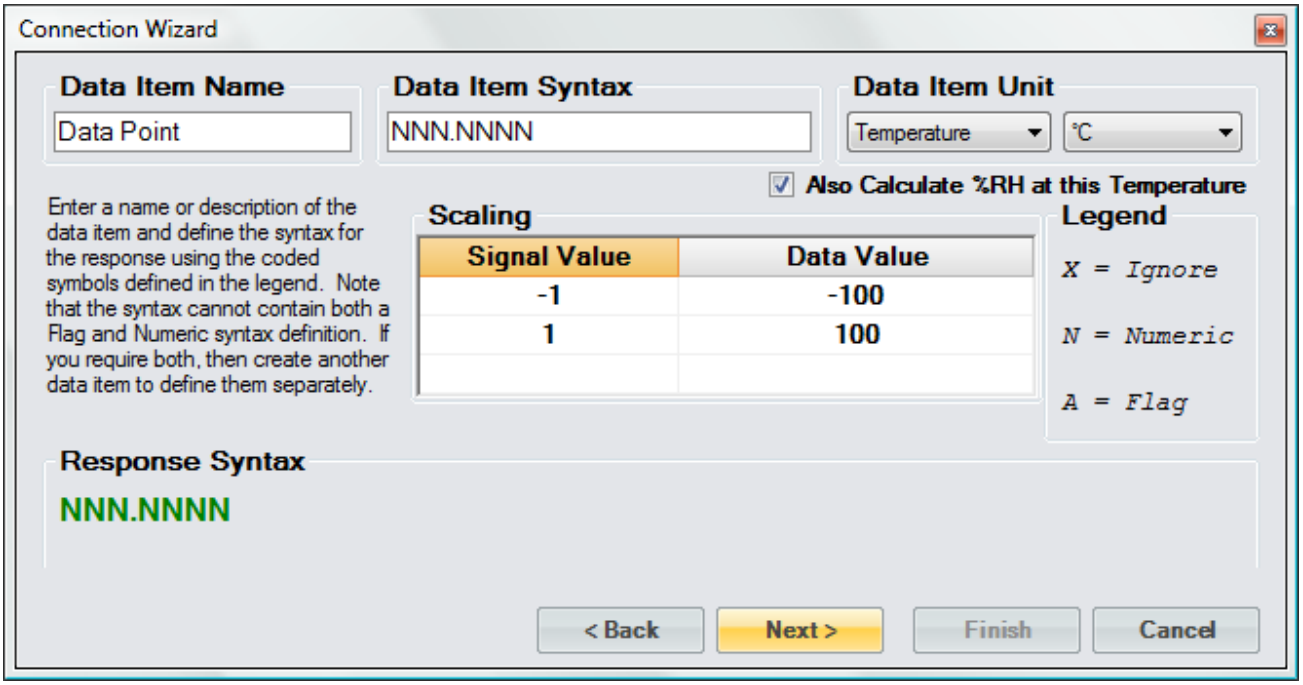
Scaling allows the user to scale a numeric data item response into a given humidity value. For example, if you have a numeric data item response that ranges from -1 to 1 and it is known that 0 corresponds to -100 and 1 corresponds to 100. The user can then enter these scaling values and ControLog will automatically apply the scaling to the data item whenever it is displayed or logged.



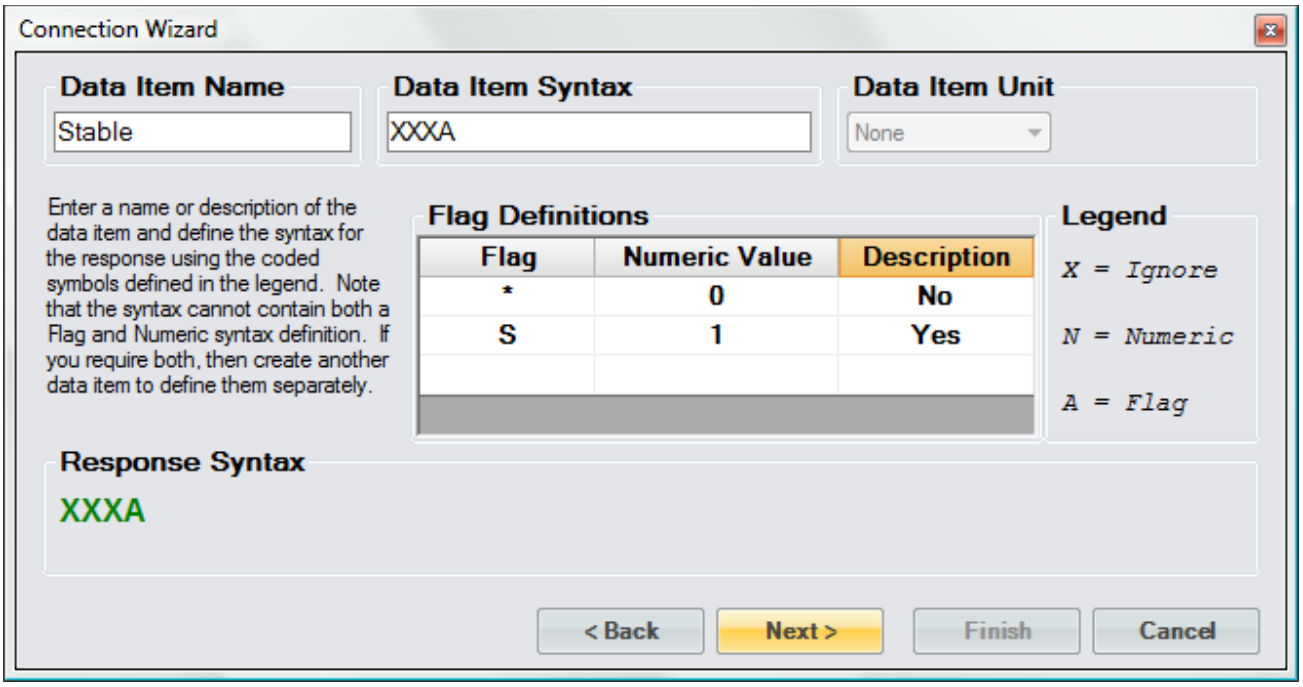
Selecting the unit for the data item will allow ControLog to convert the value to the selected system units for display in the parameter tab and record the value in the default SI units in the data tab. Remember this is the unit the device is sending the data item in, not the unit you wish to display the data item as. If “None” is selected, then ControLog will treat the data item as a simple number and will display and record the value exactly as it is received.



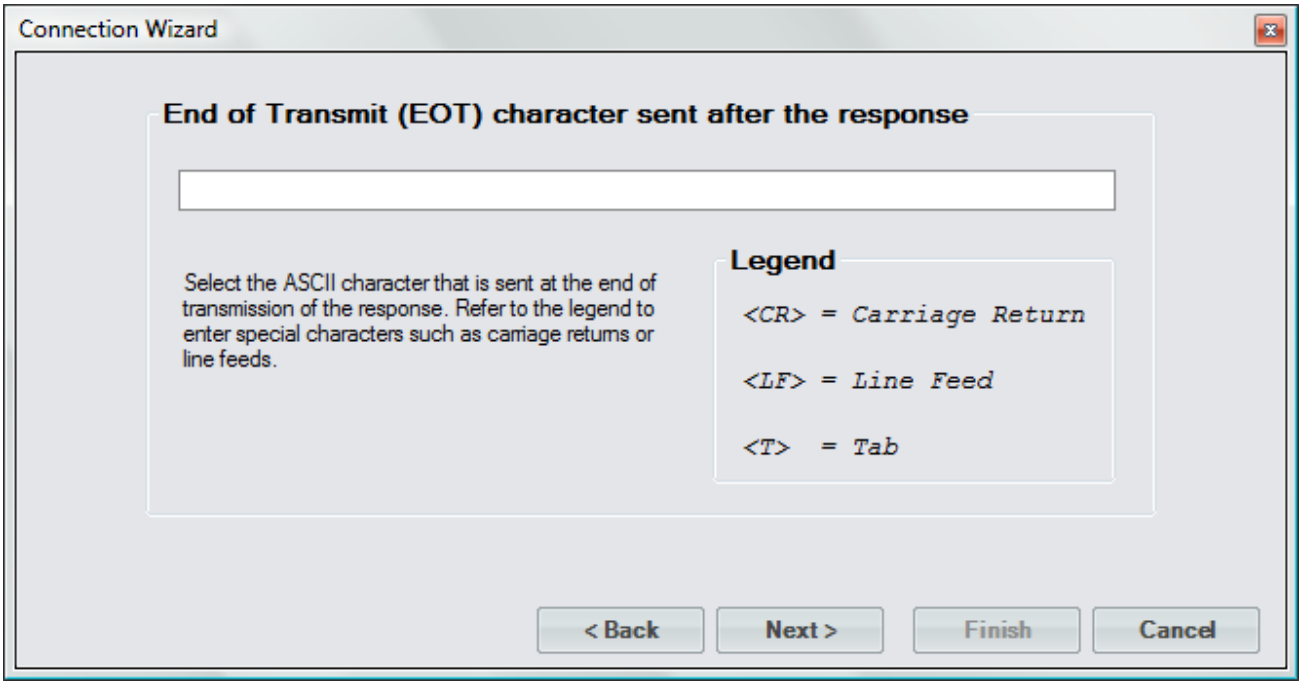
In addition to reading a temperature, ControLog can compute a percent relative humidity (%RH) at the temperature. This is useful when compensating for temperature gradients within the chamber. To have ControLog automatically calculate the relative humidity at the temperature, simply select the corresponding checkbox. The newly calculated %RH will have the same name as the specified Data Item Name but will be preceded by "%RH@". In the below example the calculated %RH will appear as "%RH@Data Point".



When defining flag type syntax, enter an “A” for each character in the response that represents the flag. The Flag Definitions define what each possible ASCII flag represents. The user must enter a numeric value for each flag definition which will be recorded in the data tab and a description for the flag that will be shown in the parameters tab.



Enter the End of Transmit (EOT) character that is sent after the response. This is the ASCII character that is sent at the end of transmission of the response. Refer to the legend to enter special characters such as carriage returns and/or line feeds.



Select the name and location to save the new serial connection. Selecting the “Browse” button will open a save file dialog that will allow the user to specify the name and browse to the desired location to save the file. All device connection files are saved in XML format with a (*.device) extension.



Next, the user can select whether to connect to the device now or to exit without connecting.

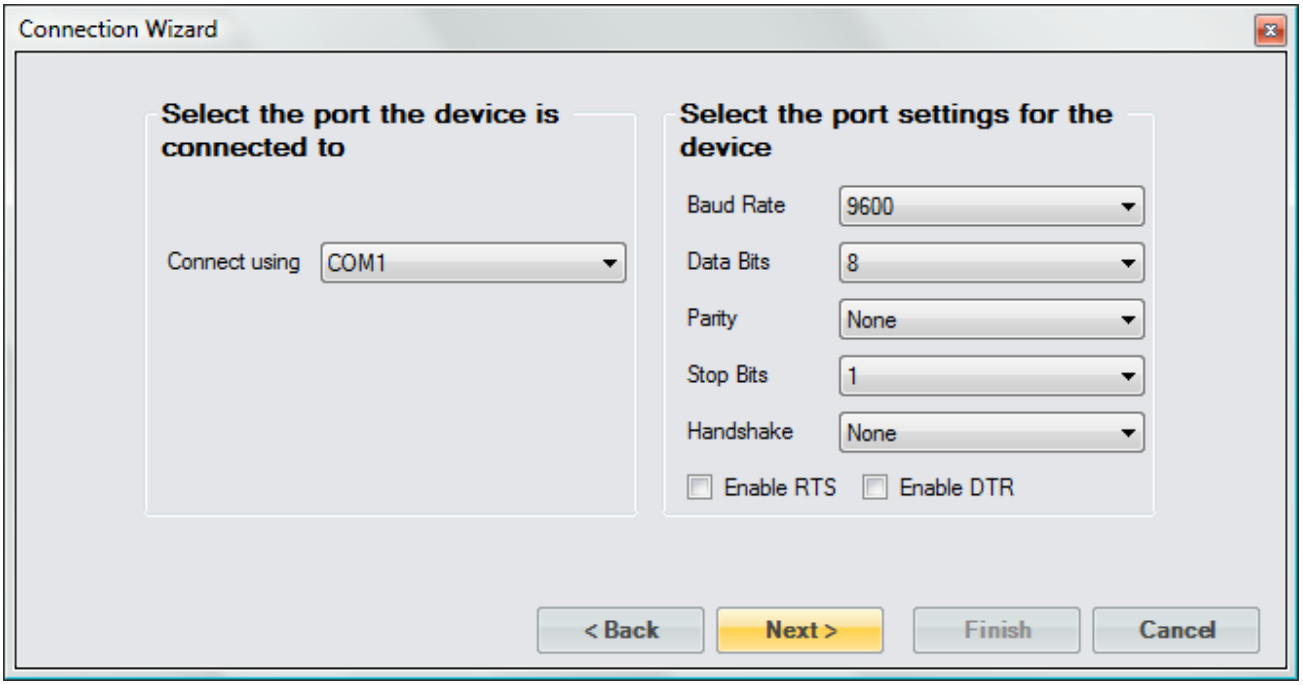
Note - *The user can connect at any time by loading the device from the Connections menu.*



Select the communication port that the device is connected to and select the port settings for the device.

⚠ CAUTION!

INCORRECT RTS AND DTR SETTINGS CAN PROHIBIT COMMUNICATION. REFER TO THE DEVICE MANUFACTURER'S DOCUMENTATION TO VERIFY ALL DEVICE PORT SETTINGS.

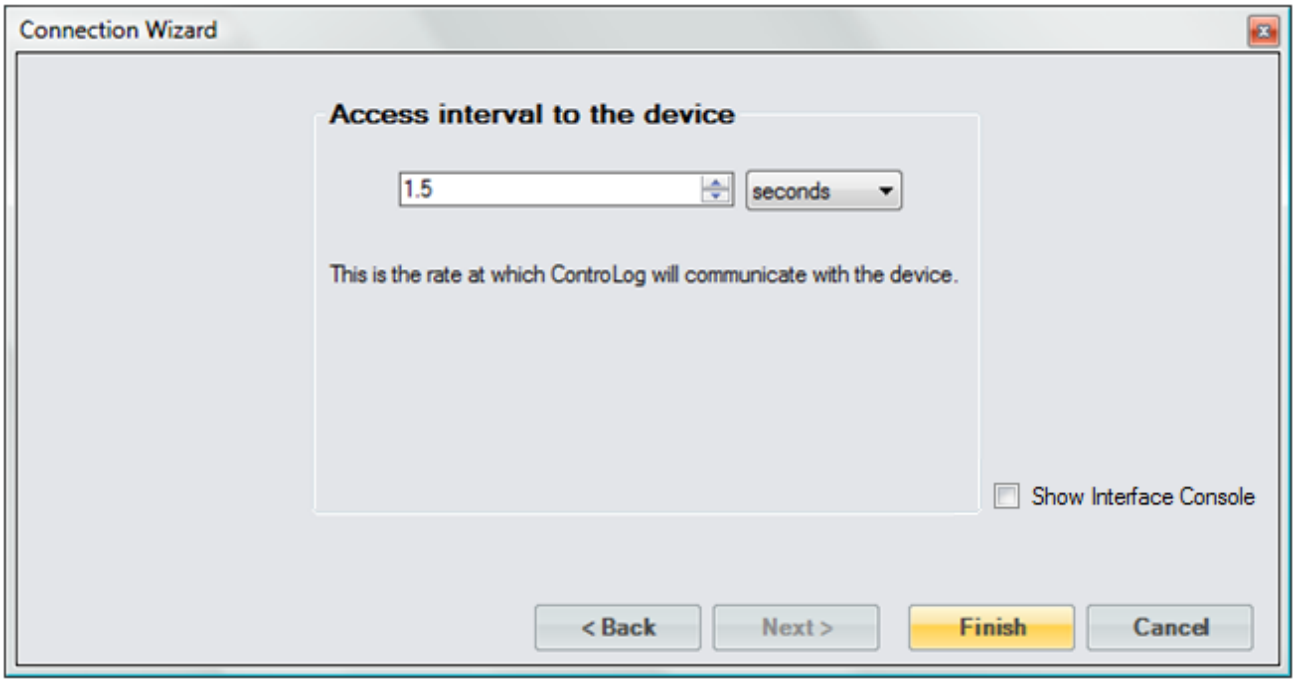


Select the access rate at which ControLog will communicate with the device.

Note - *It is always recommended to start with the default 1.5 second access interval and to modify later as needed.*

⚠ CAUTION!

DO NOT SET THE ACCESS INTERVAL TOO SMALL. IF THE DEVICE IS NOT CAPABLE OF COMMUNICATING AT THE SET INTERVAL THEN CONTROLOG MAY INADVERTENTLY THINK COMMUNICATION HAS BEEN LOST WHEN THE DEVICE DOES NOT REPLY WITHIN THE DESIRED ABOUT OF TIME.

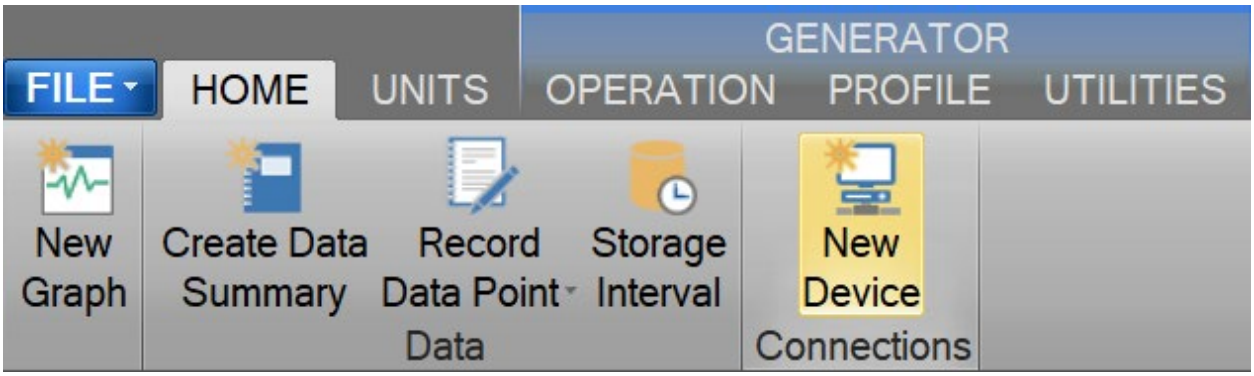


Select “Show Interface Console” to automatically open a Device Interface Console tab once communication has been established with the device.

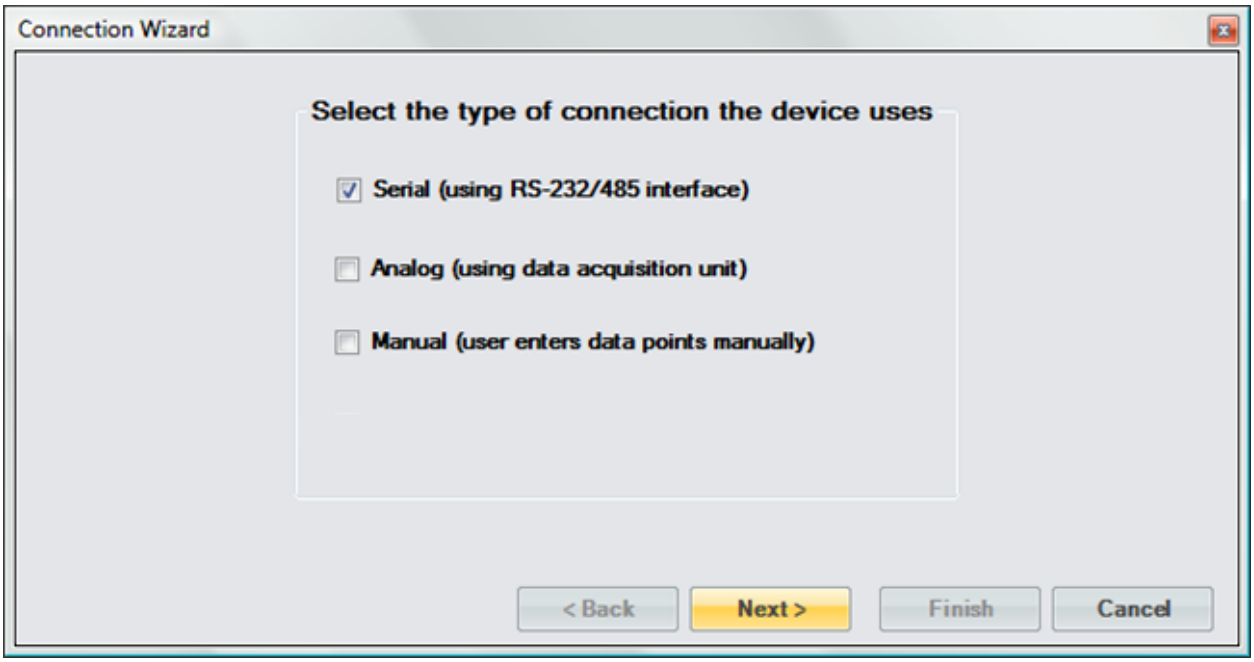
10.1.1 Serial Connection Example 1

This example will demonstrate the creation of a serial connection to an RH Systems® 373 Dew Point Mirror. We will request the Frost Point temperature and Atmospheric Pressure from the mirror as data items.

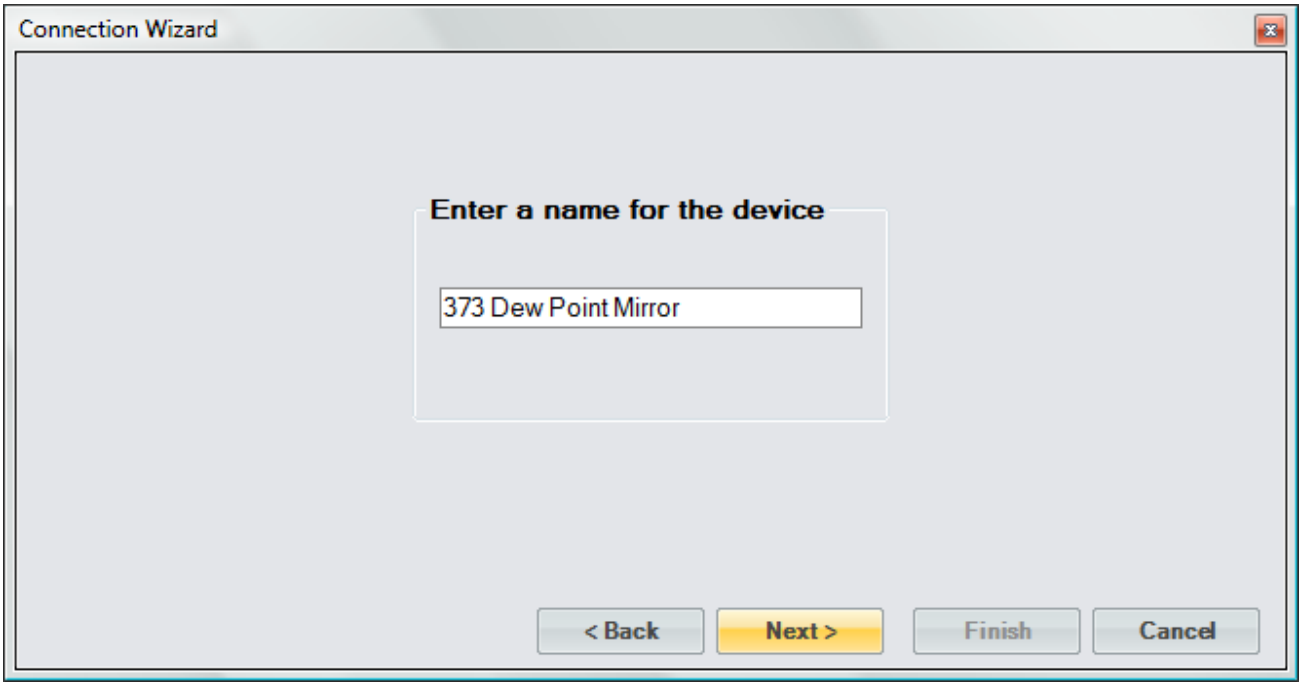
Start by selecting “New Device” from the Home menu tab.



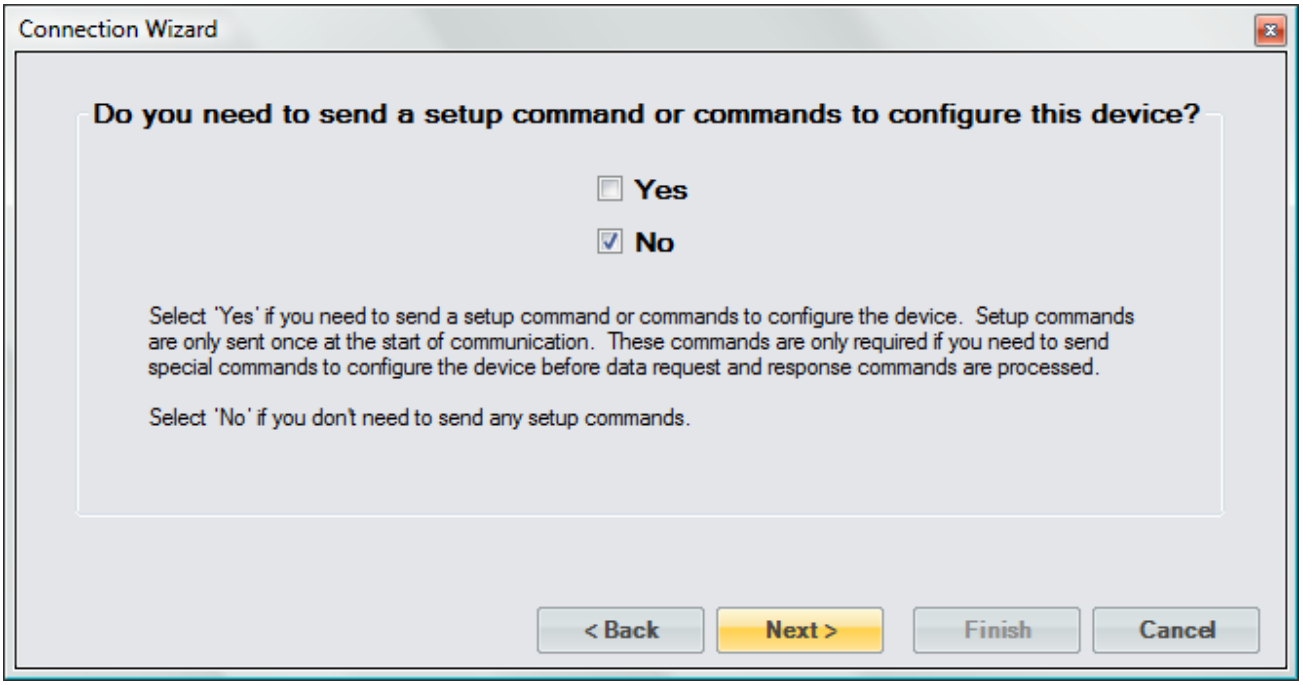
Select “Serial” as the type of device connection.



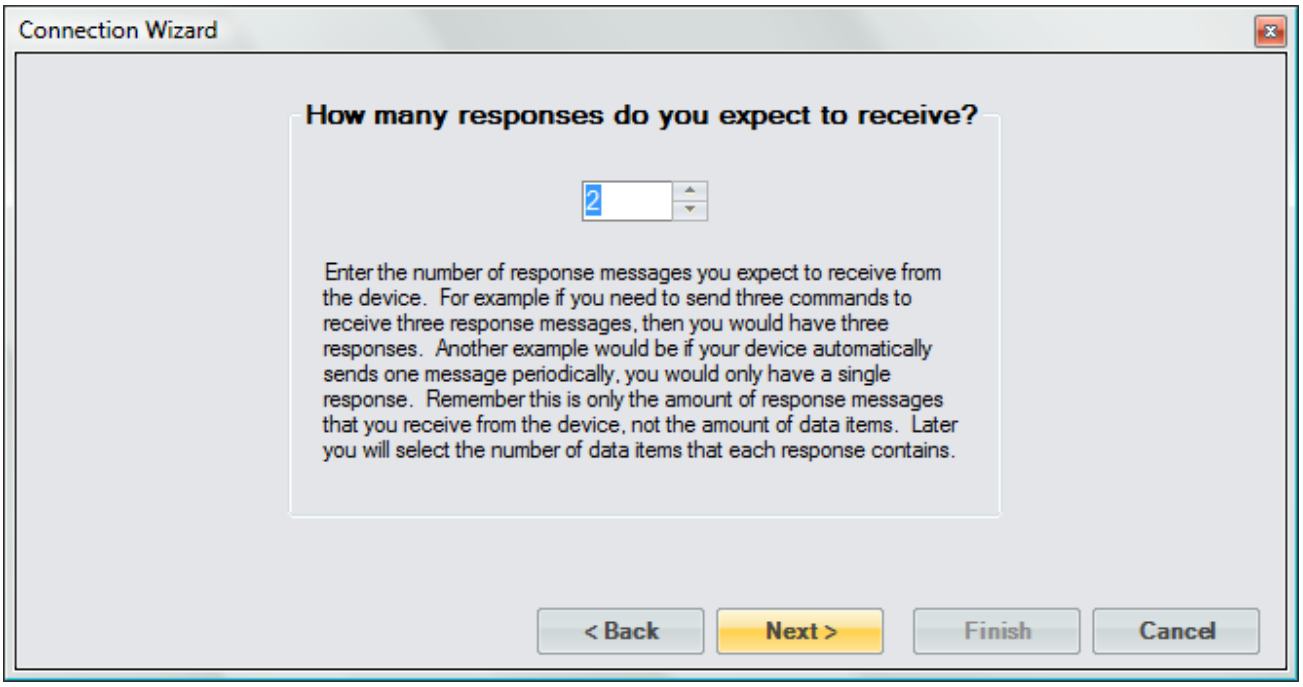
Enter “373 Dew Point Mirror” as the name for the device.



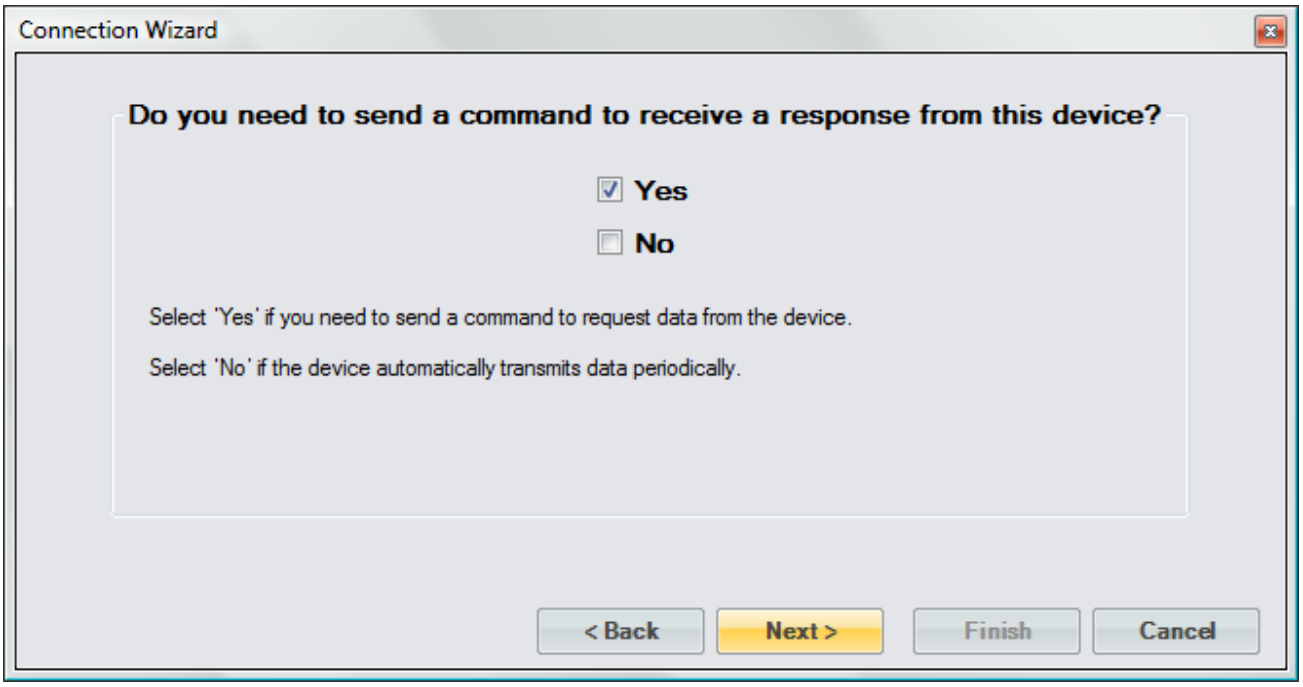
For the 373 we do not need to send any setup commands.



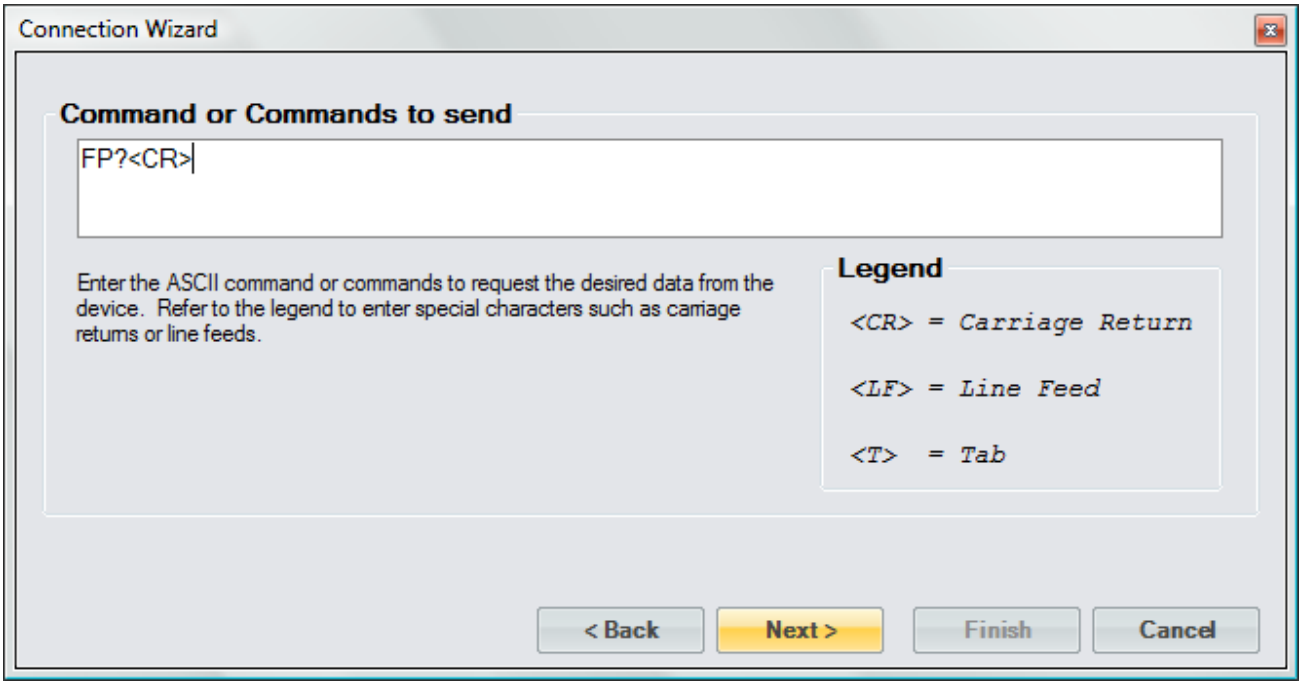
The 373 will send two responses; one with the requested Frost Point value and the other with the requested Atmospheric Pressure value.



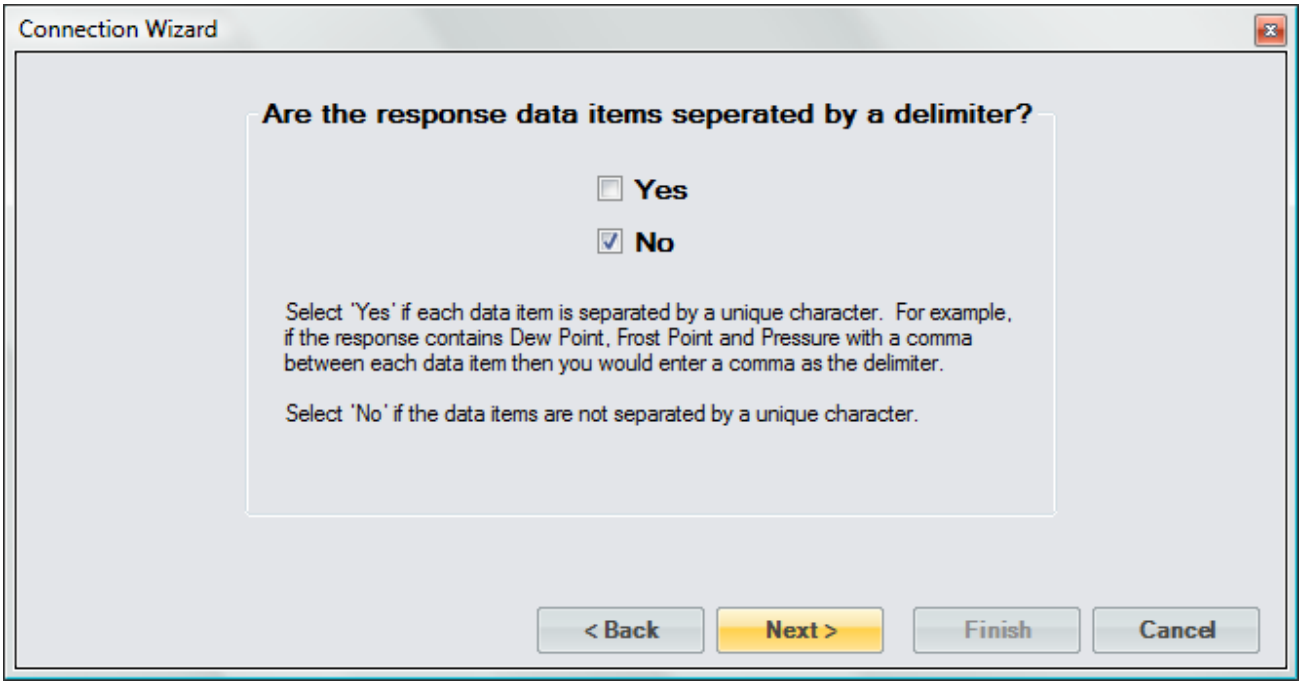
The 373 requires a request command to be sent to receive either the Frost Point value or the Atmospheric Pressure value.



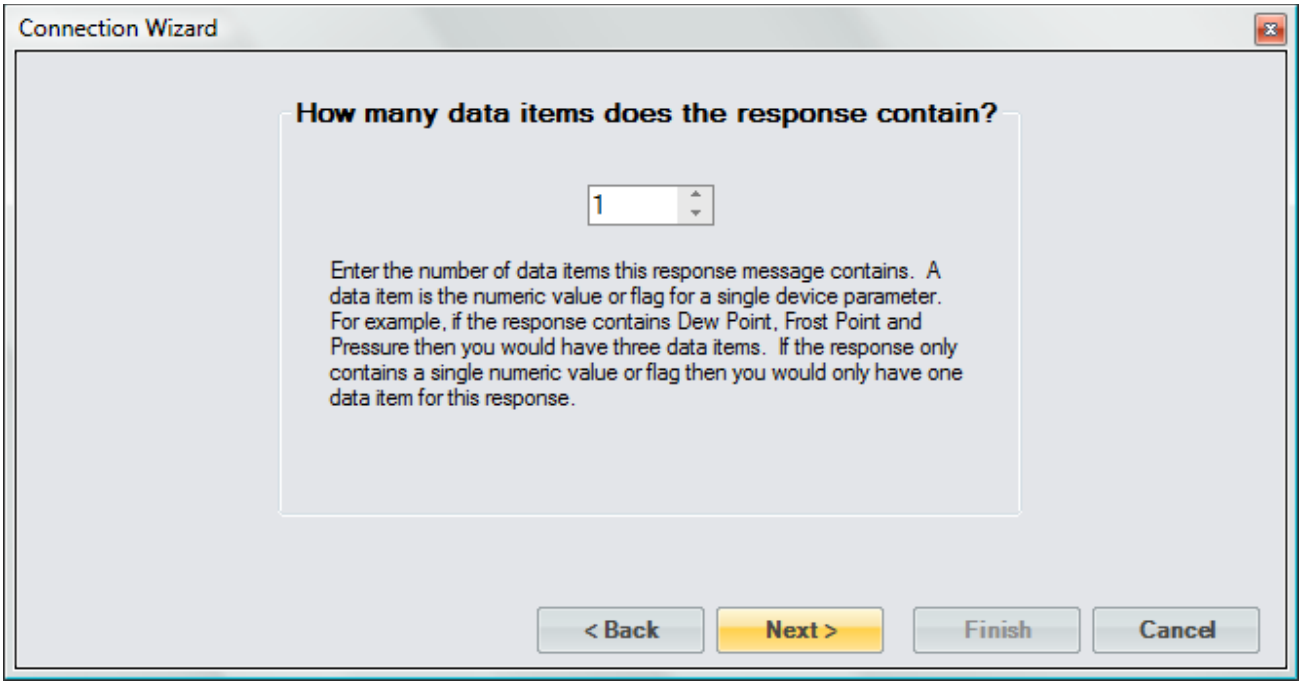
The 373 documentation tells us we need to send the frost point command to receive the Frost Point value. The documentation also states the command must be terminated with a carriage return or a carriage return line feed combination.



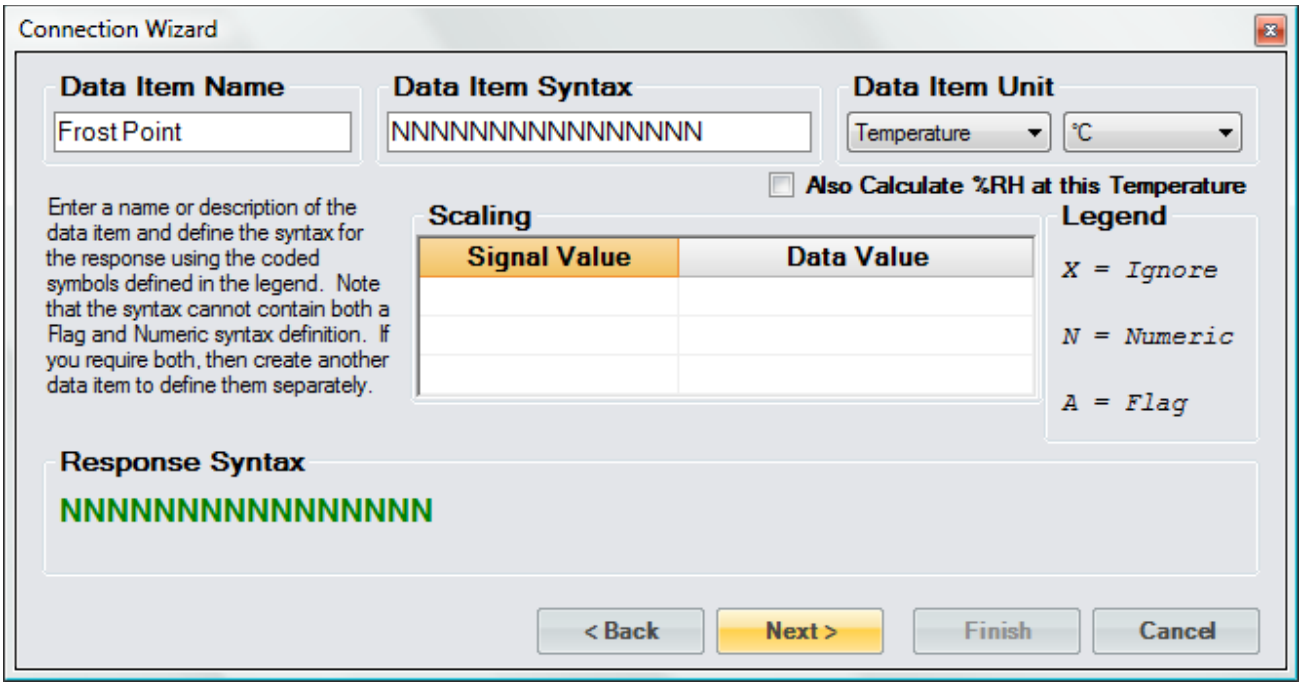
The 373 will respond to the frost point command with a single numeric value and therefore no delimiter is used.



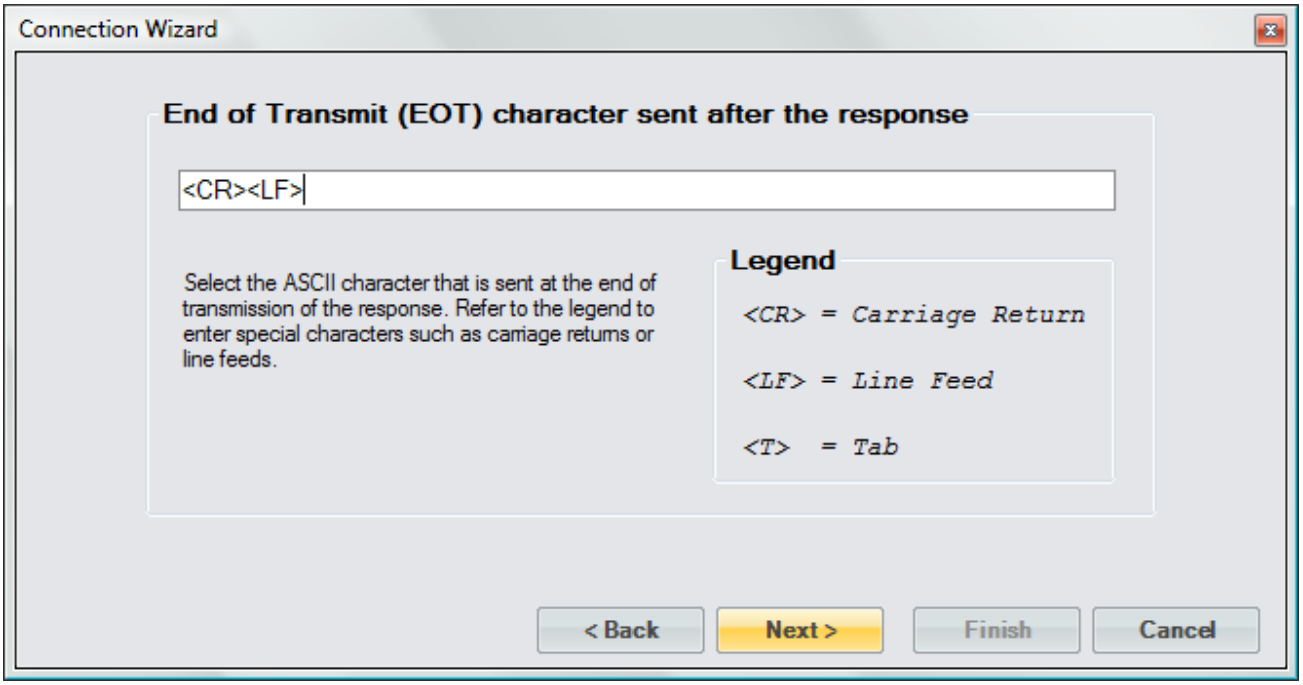
The response from the frost point command will only contain a single numeric value.



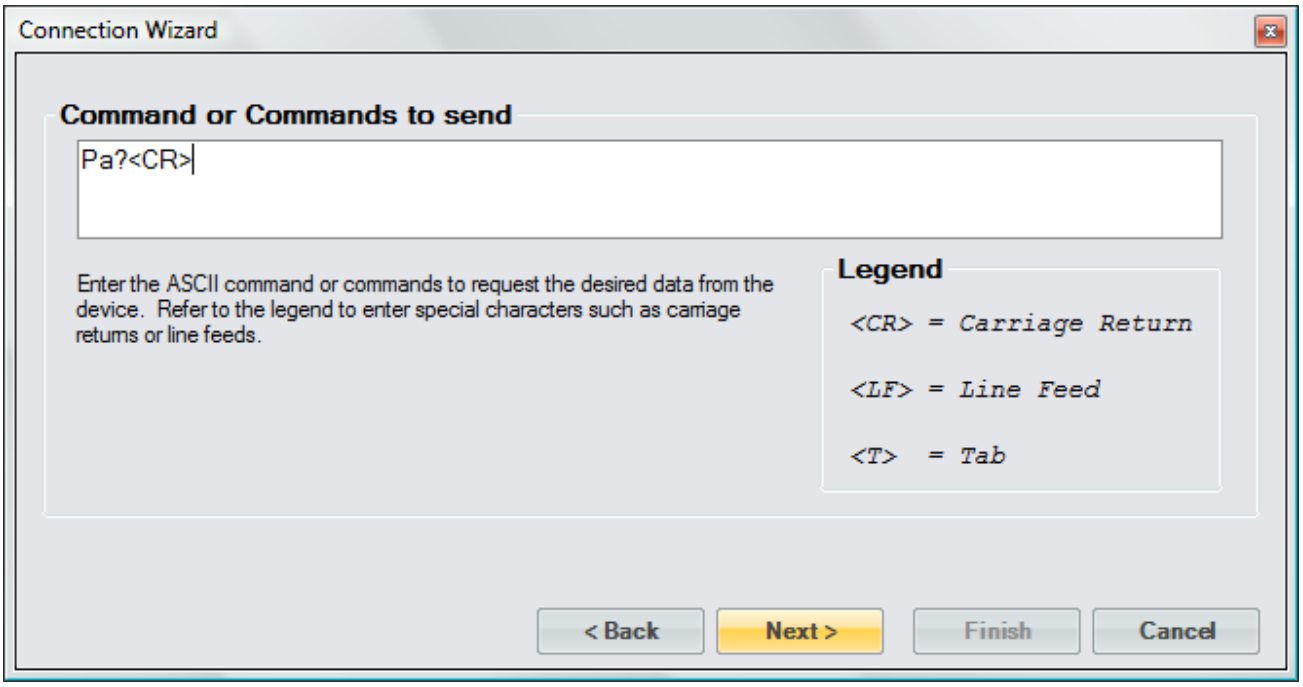
The first item is given the name Frost Point. The 373 can respond with a high precision numeric value so the Data Item Syntax was defined with the maximum digits possible that the 373 can respond with. The Data Item's Unit was defined as a temperature in degrees Celsius as stated in the documentation for the 373. The response value is the actual value so there is no need to define any type of scaling.



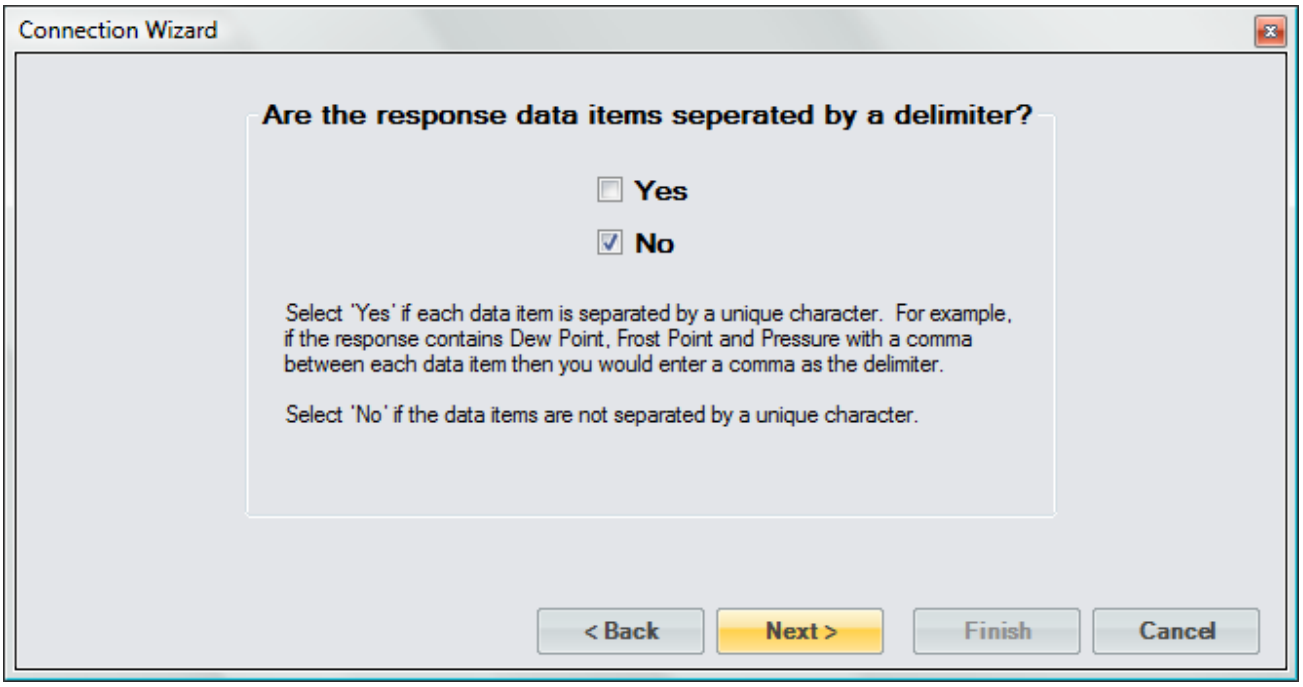
According to the 373 documentation, each response is terminated with a carriage return and line feed.



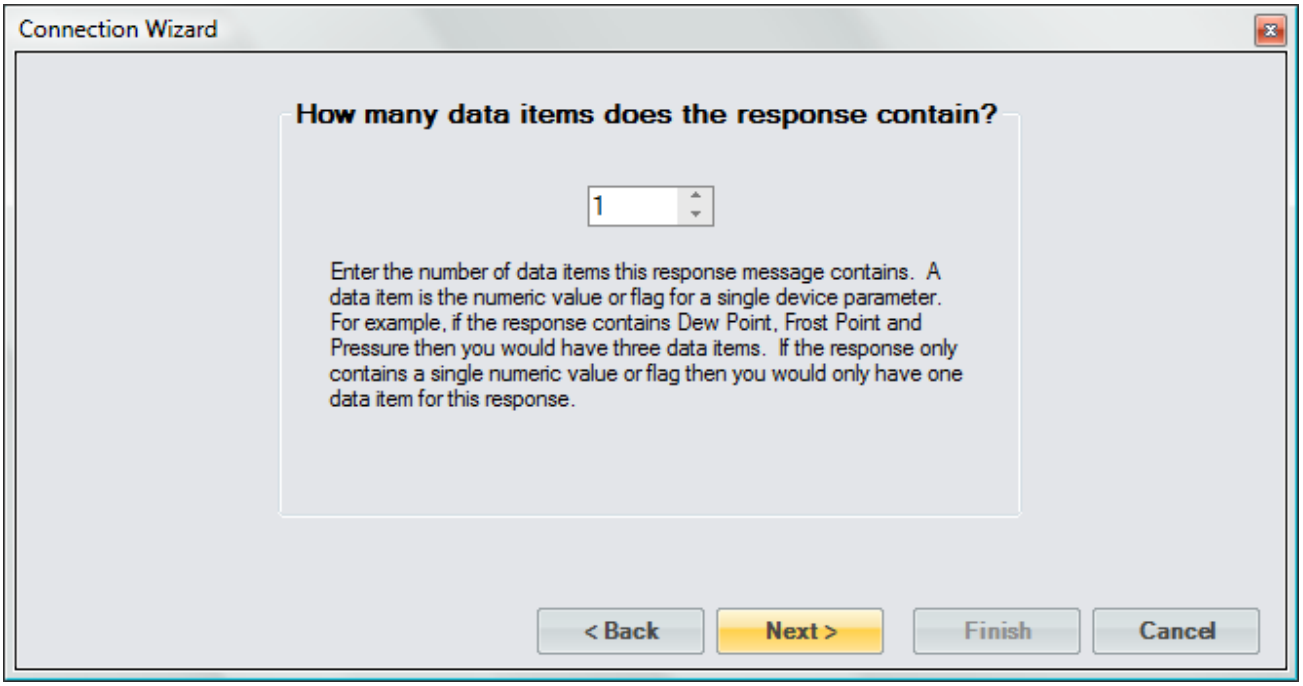
Next, we define the command for the second response. Referring to the 373 documentation we enter the command for atmospheric pressure. Again, the command must be terminated with a carriage return or carriage return line feed combination.



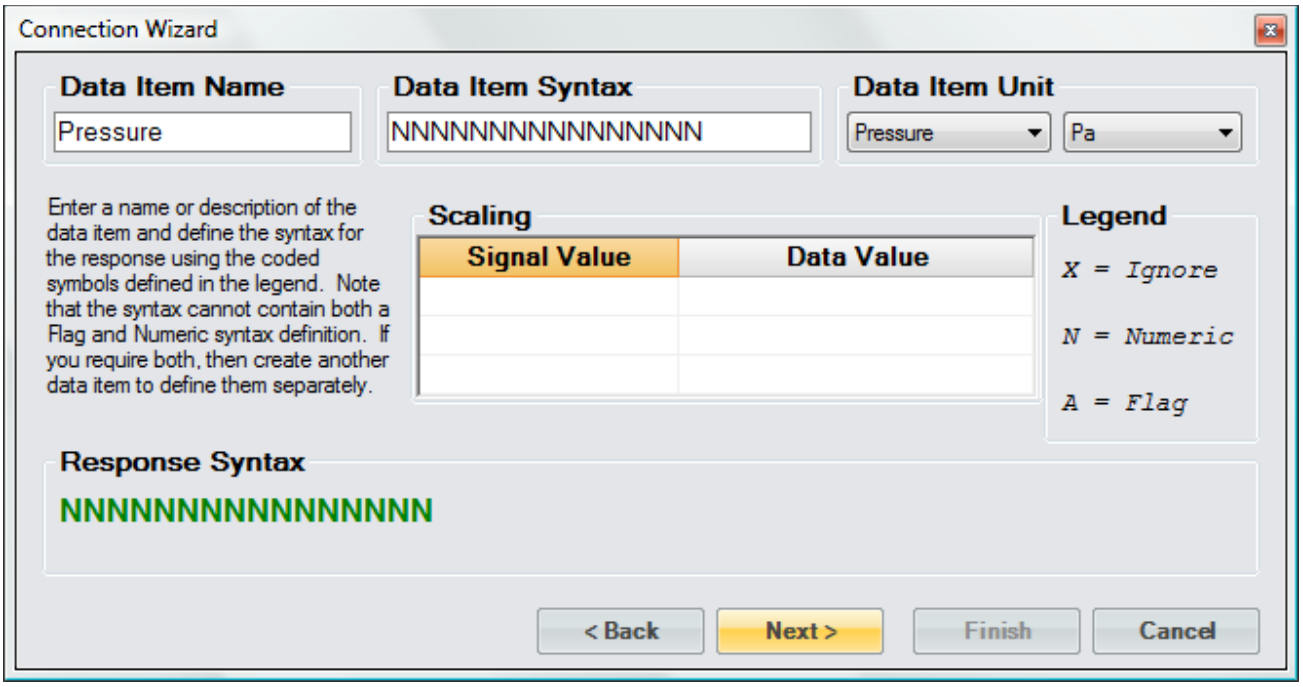
The 373 will respond to the atmospheric pressure command with a single numeric value and therefore no delimiter is used.



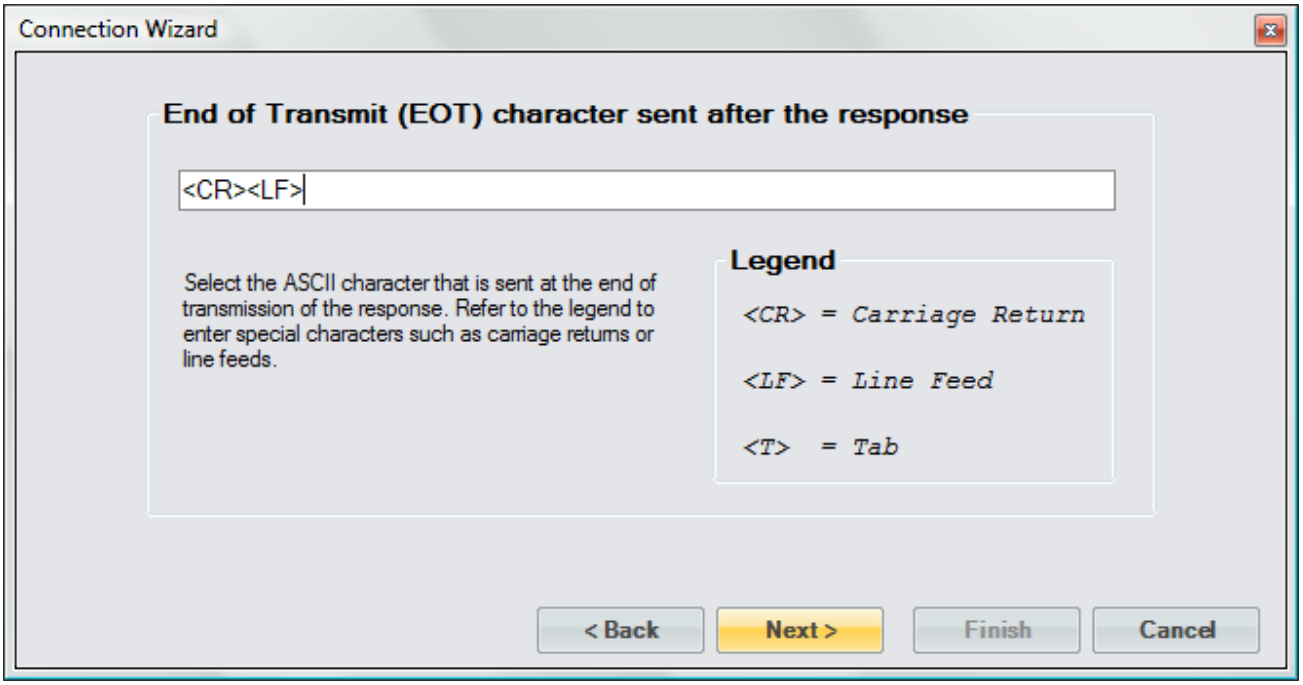
The response from the atmospheric pressure command will only contain a single numeric value.



The second item is given the name, Pressure. Again, the Data Item Syntax was defined with the maximum digits possible that the 373 can respond with. The Data Item's Unit was defined as a pressure in Pascal as stated in the documentation. The response value is the actual value so there is no need to define any type of scaling.



The response is terminated with a carriage return and line feed.



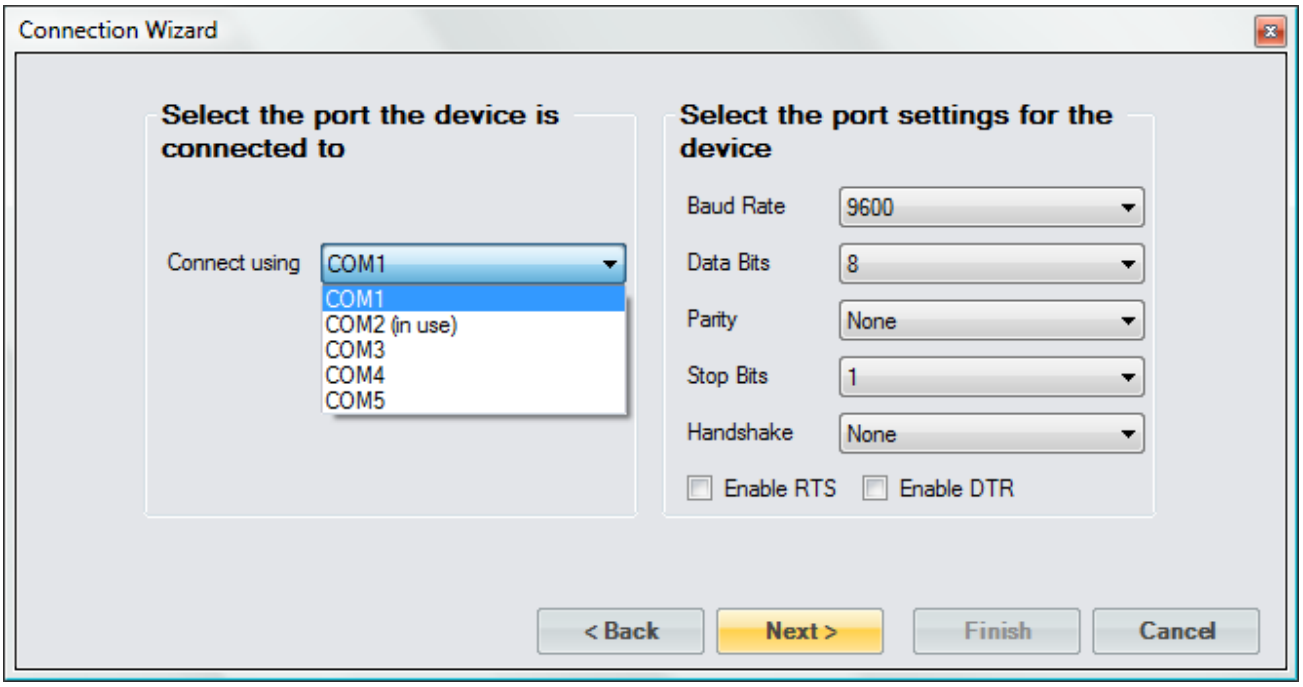
Save the newly created device to a file so that it can be recalled at a later time.



Select to connect to the device now.



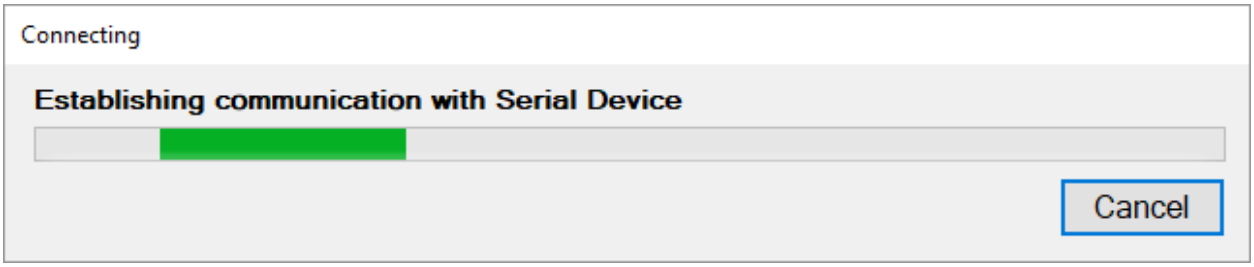
Select the port the 373 is connected to. Notice that ControLog indicates which ports are in use. Refer to the 373 documentation for specific port settings:



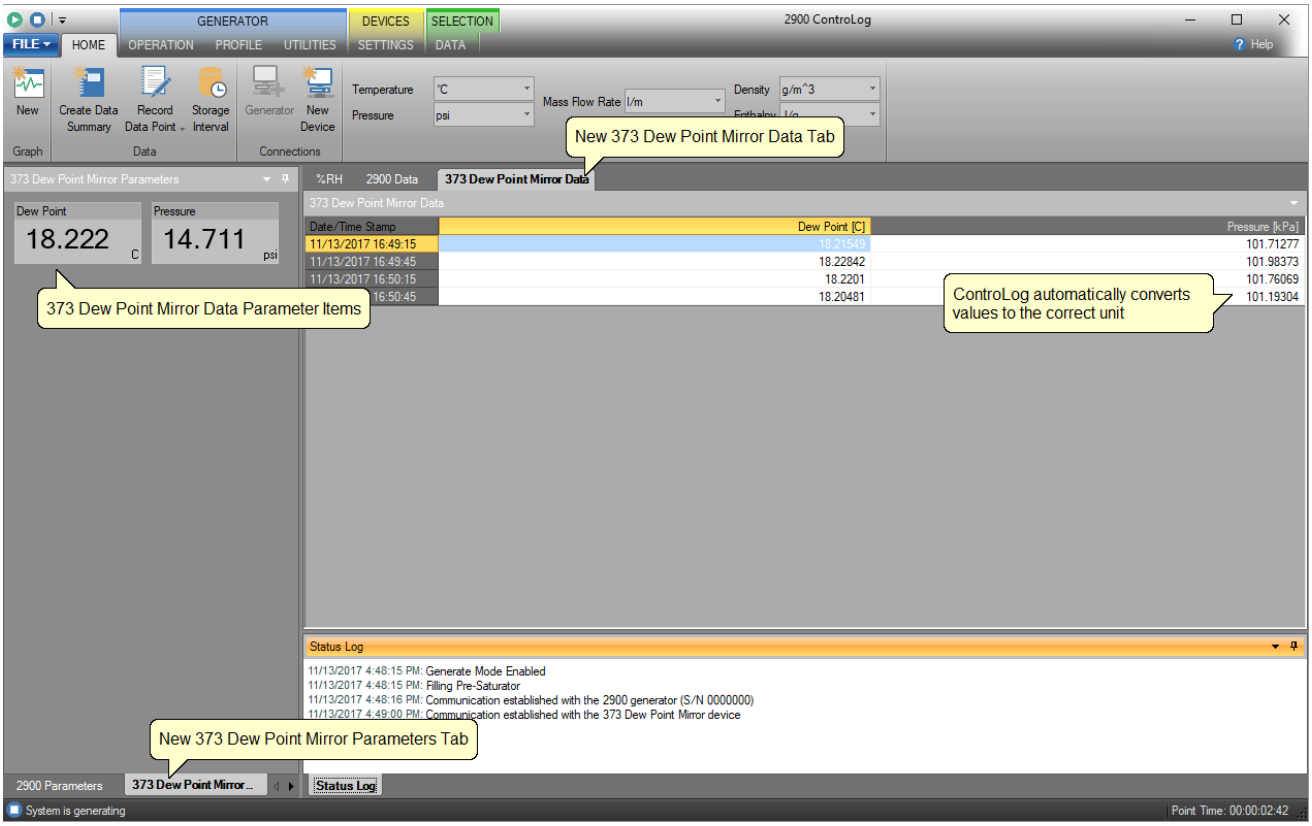
The default access interval of 1.5 seconds is entered.



Once completed, ControLog will attempt to establish communication with the 373.



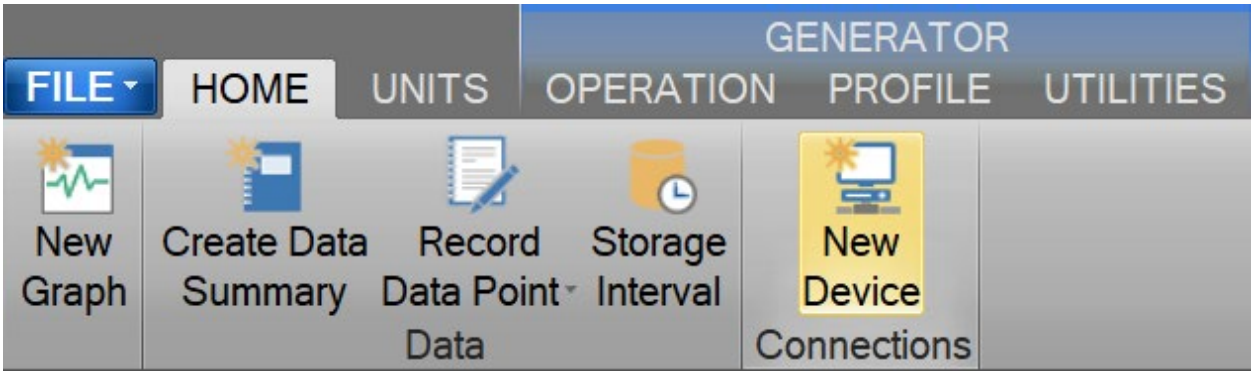
Once communication is successfully established with the 373, a new parameter tab and data tab will be created. Note that both the parameter tab and data tab have the two data items we defined. Notice that since we defined what unit the data items were received in, ControLog is able to convert the values into the selected units for easy reading.



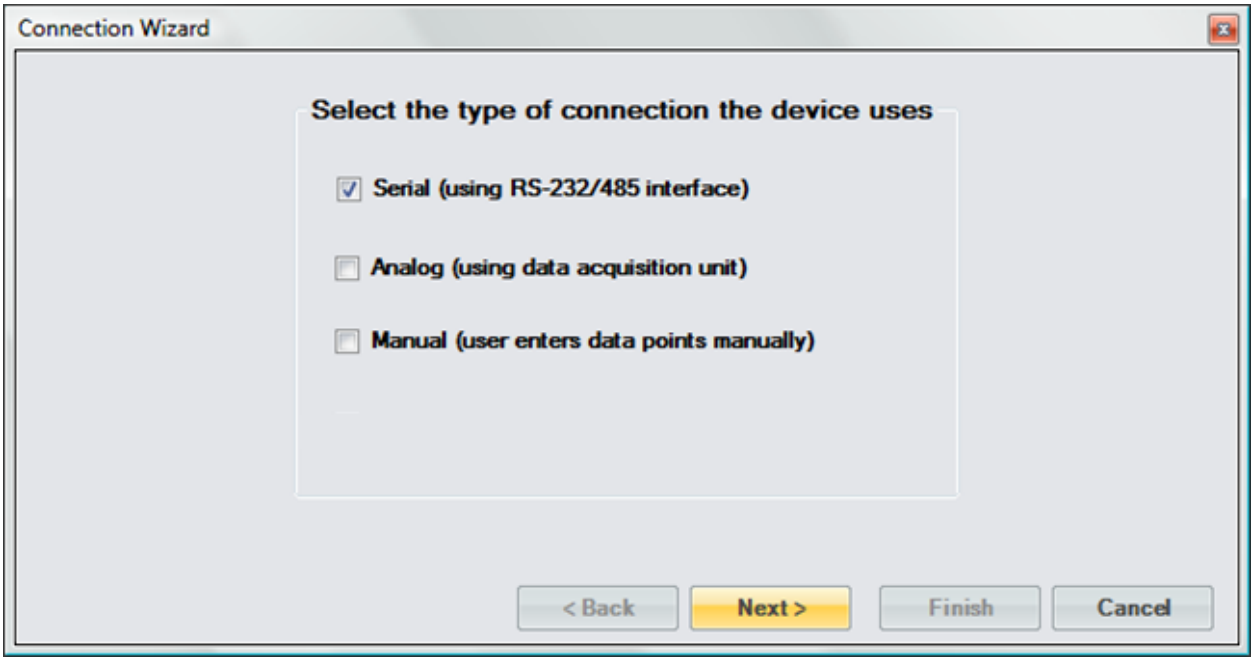
10.1.2 Serial Connection Example 2

This example will demonstrate the creation of a serial connection to an MBW® DP-30 Precision Dew Point Hygrometer. This example will be working with a DP-30 that has the temperature and pressure option. The DP-30 does not require any request to receive data. Instead, it constantly outputs three data messages at a periodic rate.

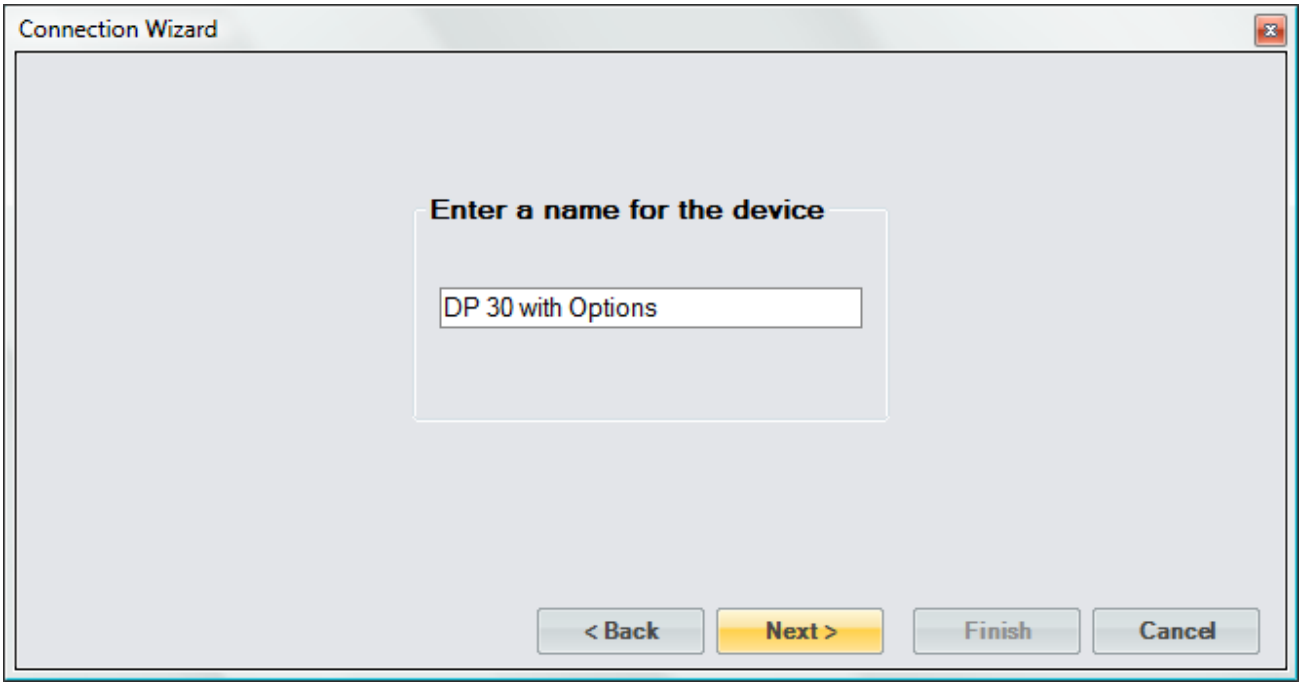
Start by selecting “New” from the Connections menu.



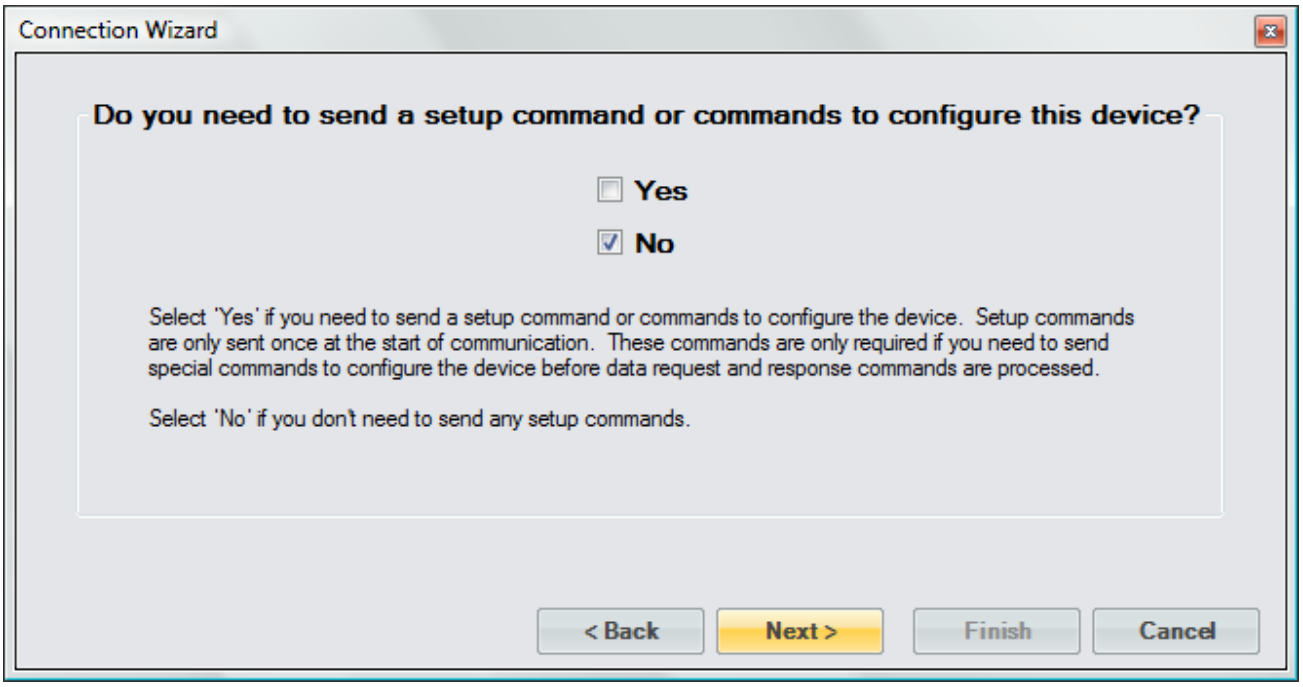
Select “Serial” as the type of device connection.



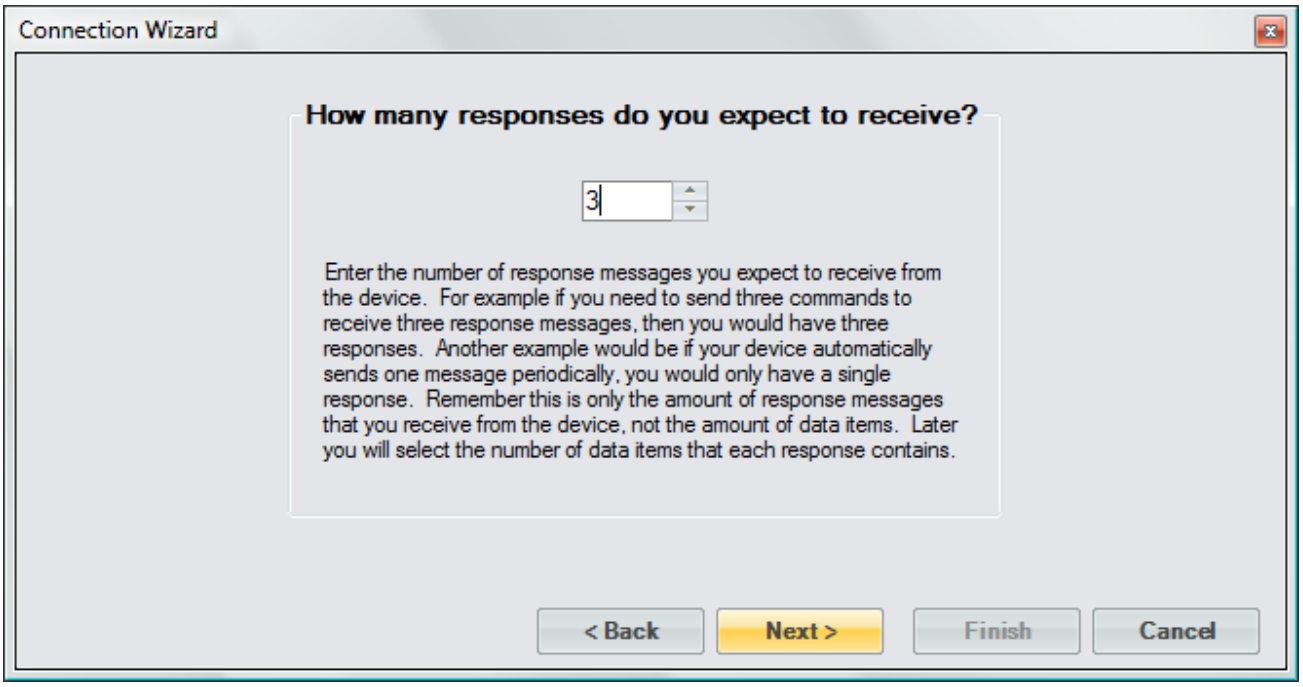
Enter “DP 30 with Options” as the name for the device.



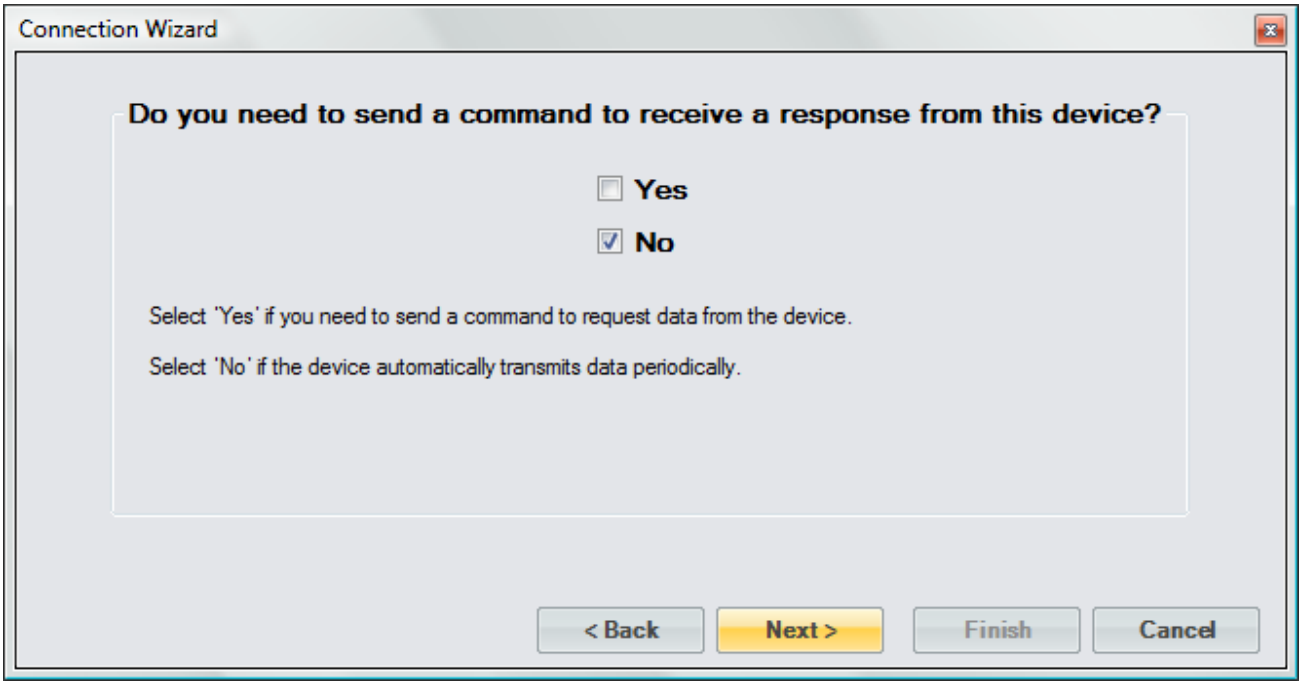
For the DP-30 we do not need to send any setup commands.



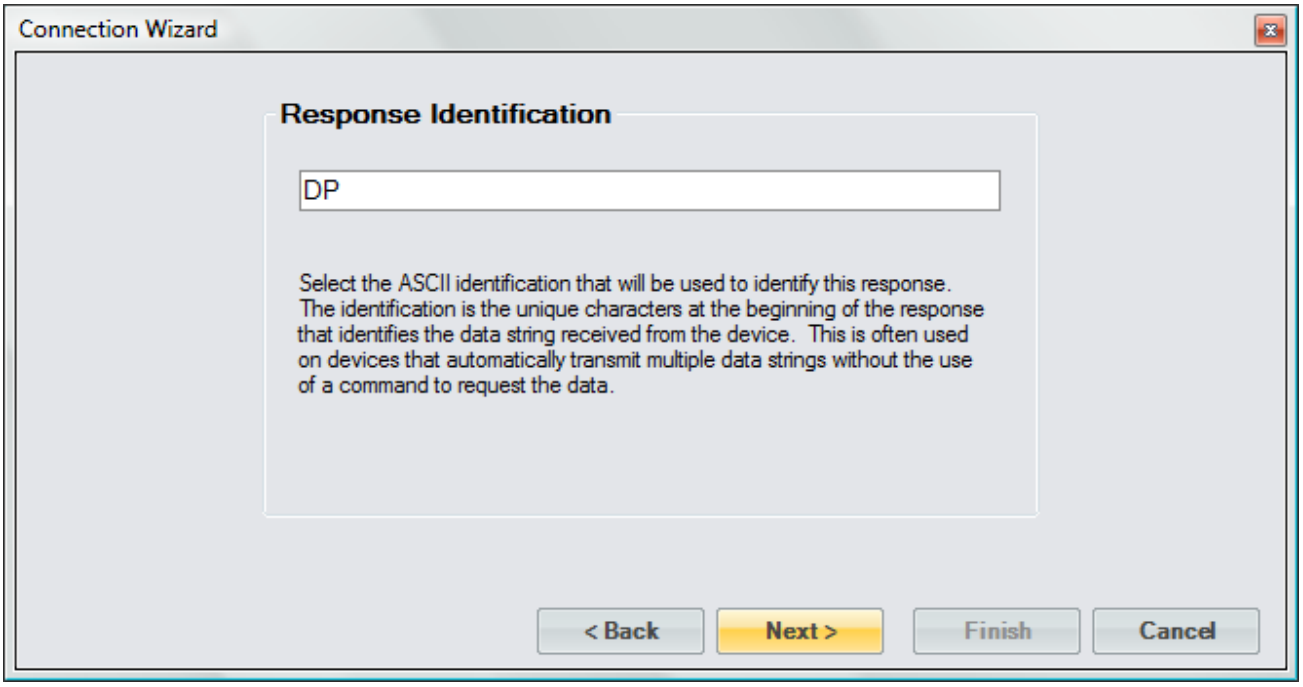
We will receive three responses from the DP-30; one with the Dew Point Temperature value and Status, one with the Dry Temperature value and one with the Pressure value.



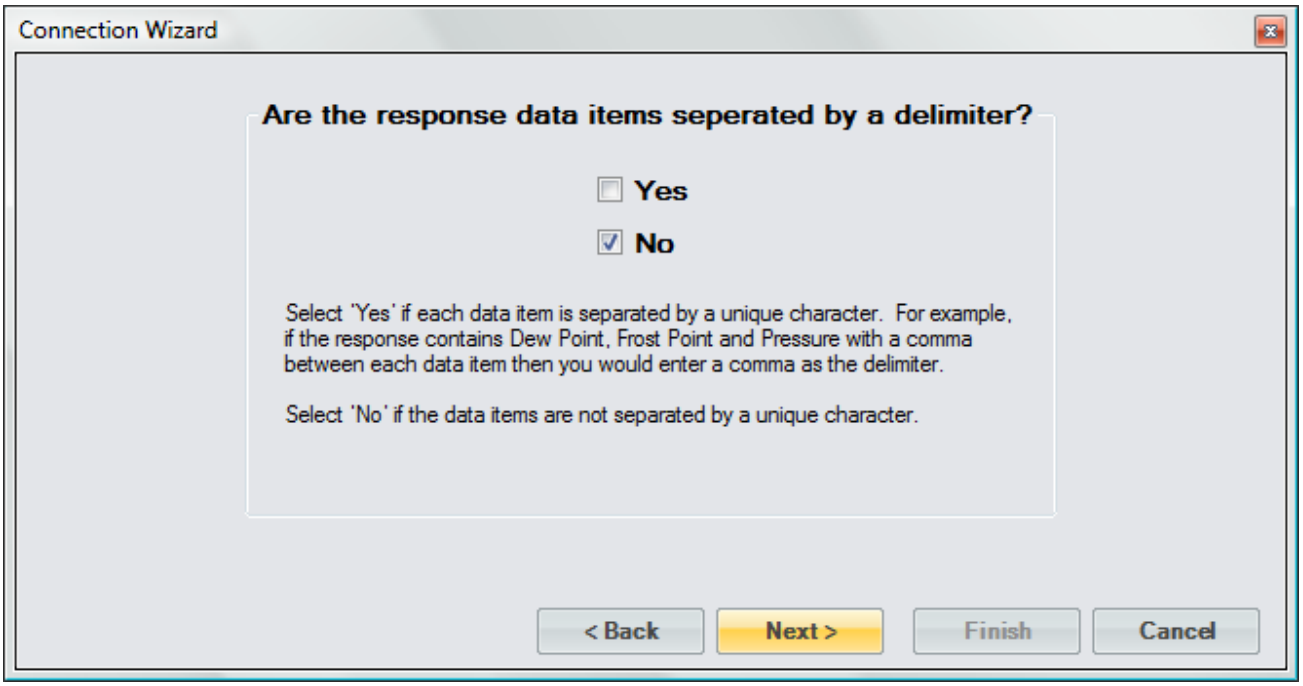
The DP-30 does not require any command to be sent to receive a response. The DP-30 automatically transmits the messages.



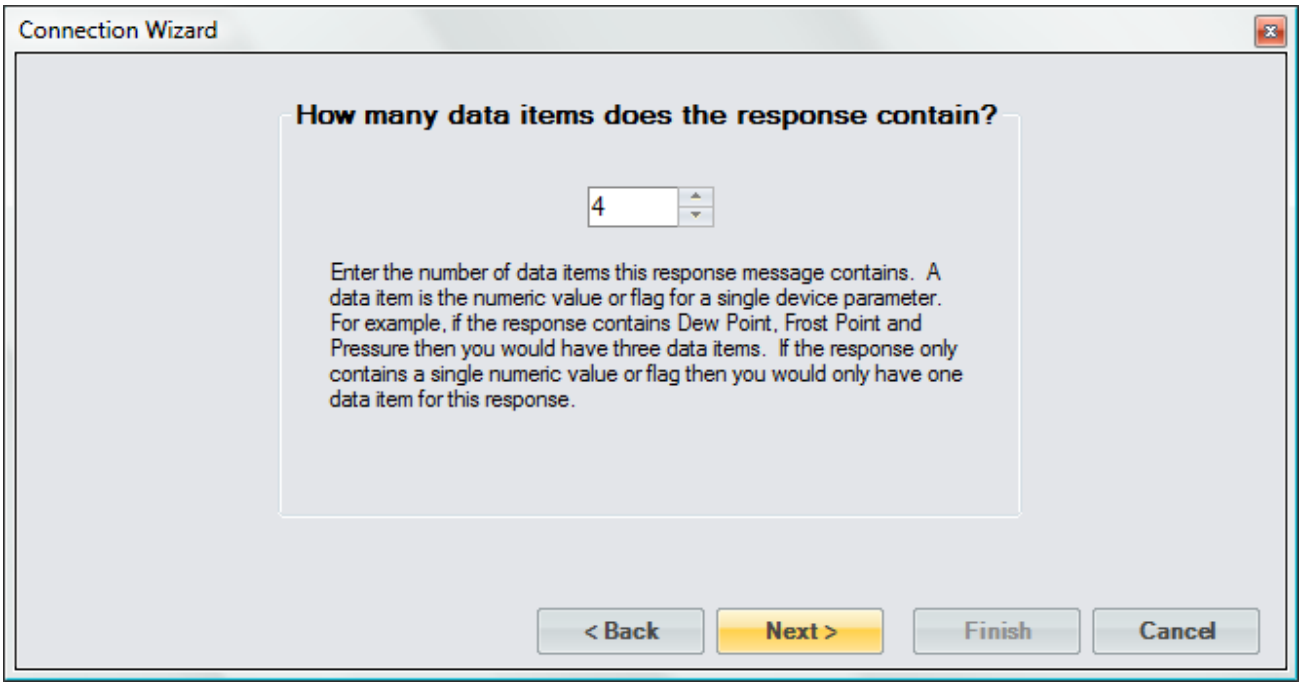
For the first message, we enter the response identification of the Dew Point Temperature message.



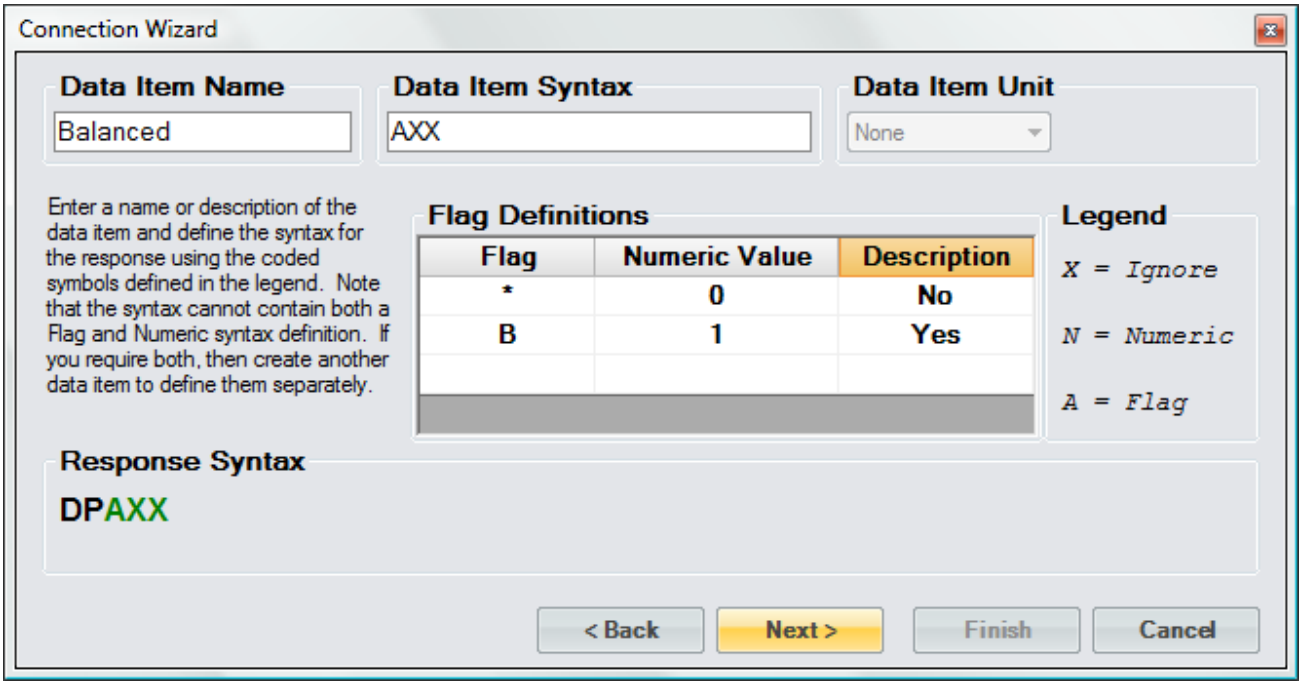
The DP-30 Dew Point Temperature message is of a fixed format and does not use any delimiter.



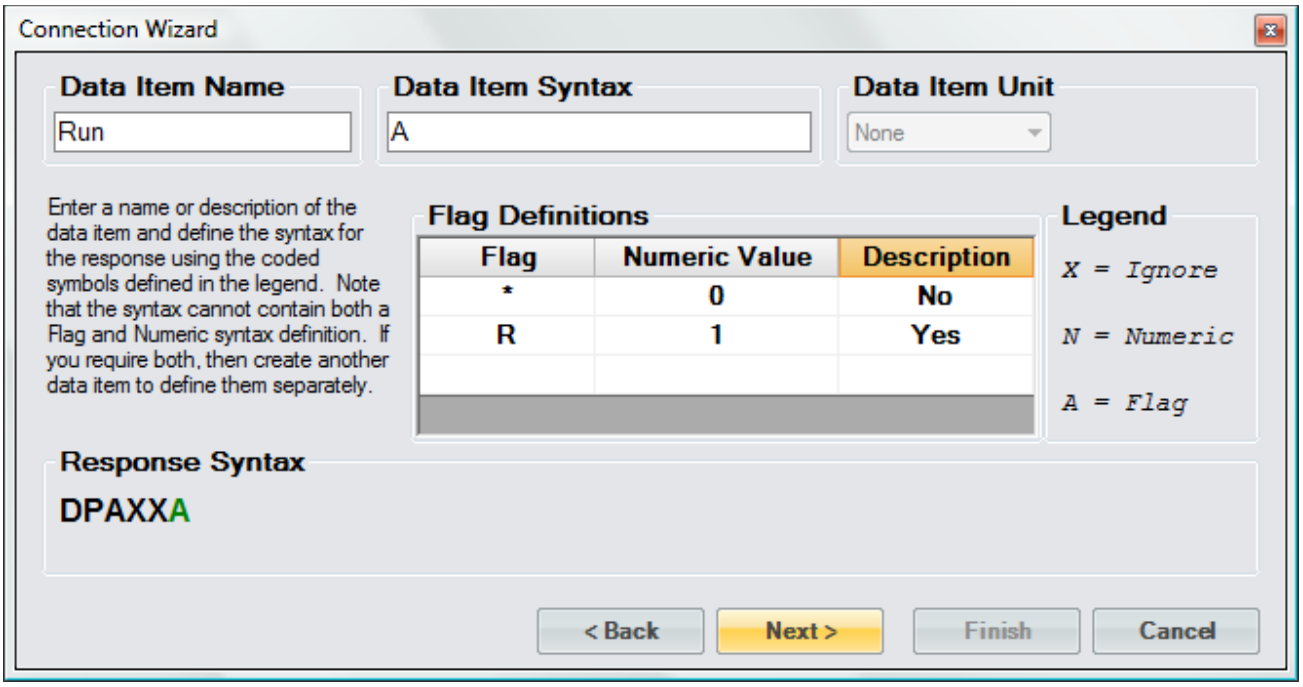
The Dew Point Temperature message contains three flags and one value that results in a total of four data items for this response.



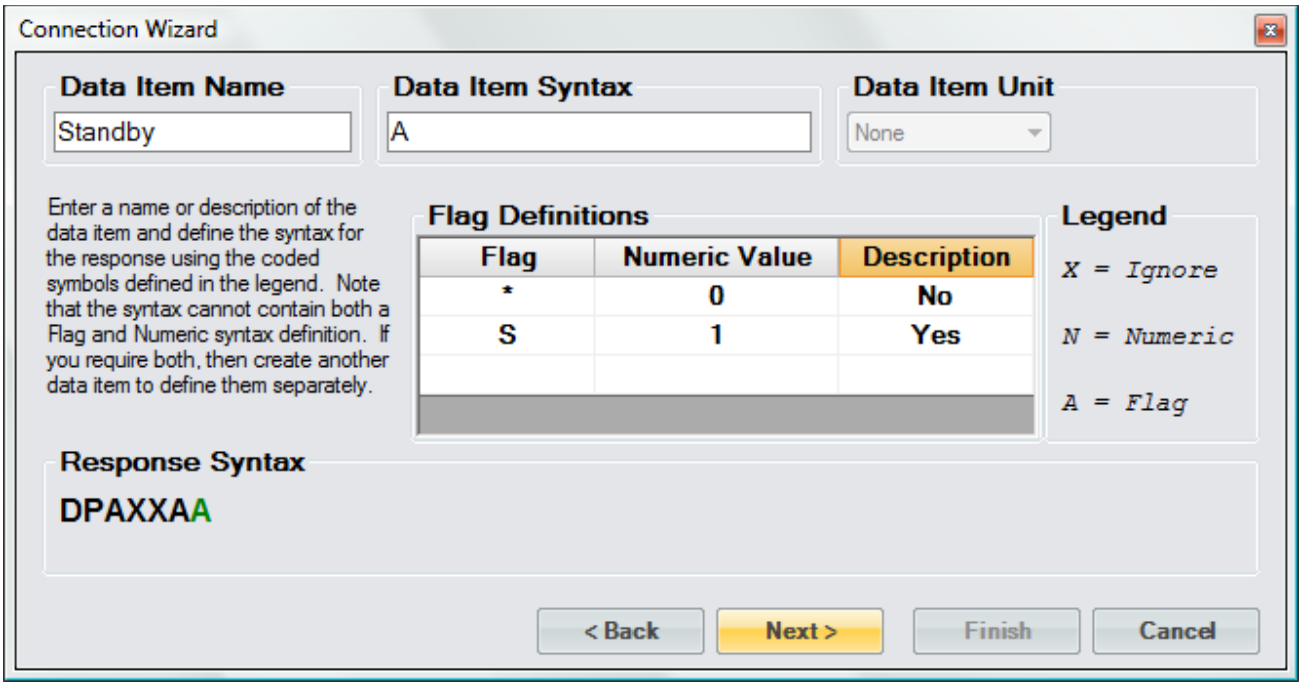
The first data item is a flag indicating whether the DP-30 is balanced. The DP-30 will send a "*" indicating that it is not balanced or a "B" indicating that it is balanced. Since we are not interested in the next two characters after this flag in the message we will tell ControLog to ignore them by adding two "X"s after the flag symbol. Next, we define these flag definitions and give them a simple "Yes" or "No" description to allow the user to easily determine their state in the parameter tab.



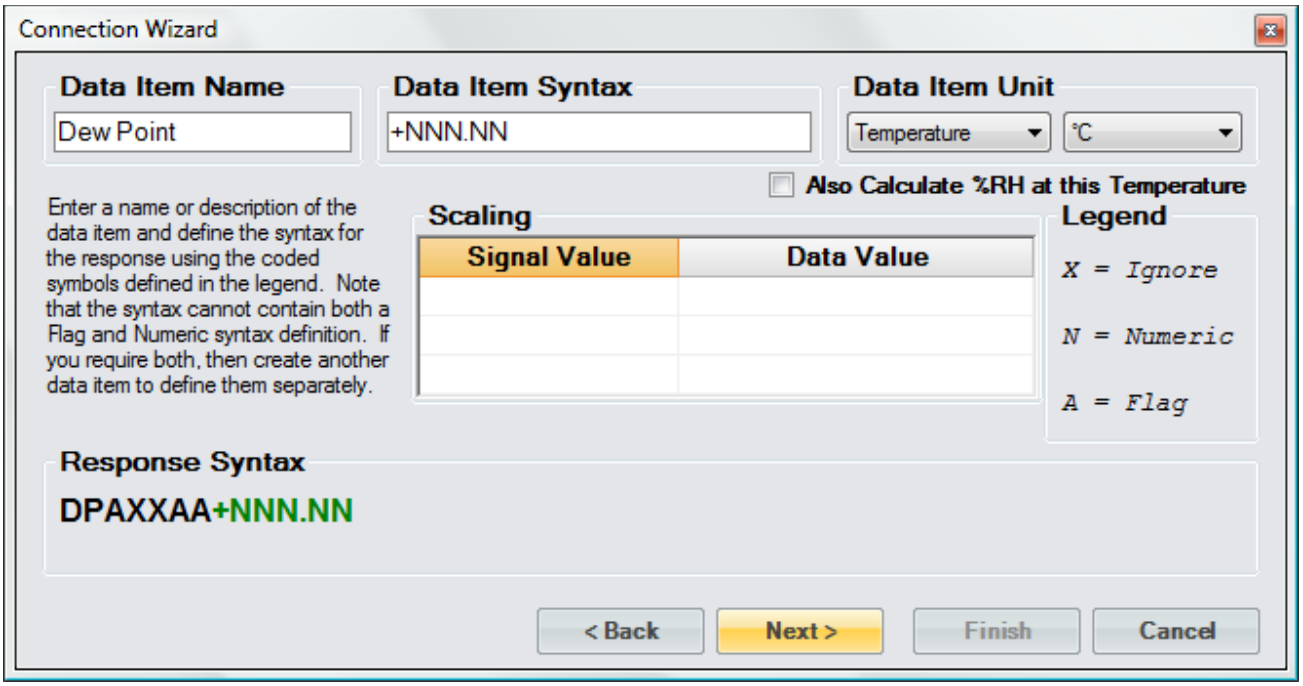
The second data item is a flag indicating whether the DP-30 is running. The DP-30 will send a "*" indicating that it is not running or an "S" indicating that it is running. We again define these flag definitions and give them a simple "Yes" or "No" description to allow the user to easily determine the state in the parameter tab.



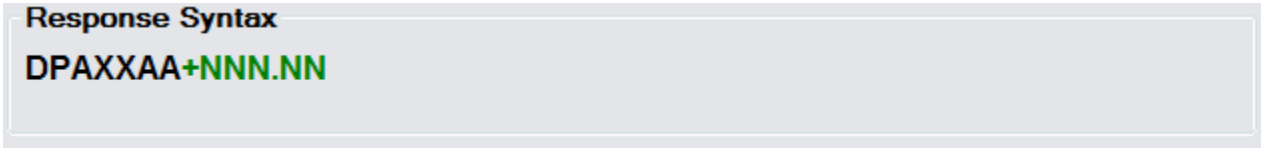
The third data item is a flag indicating whether the DP-30 is in standby. The DP-30 will send a "*" indicating that it is not in standby or an "S" indicating that it is in standby. We again define these flag definitions and give them a simple "Yes" or "No" description to allow the user to easily determine the state in the parameter tab.



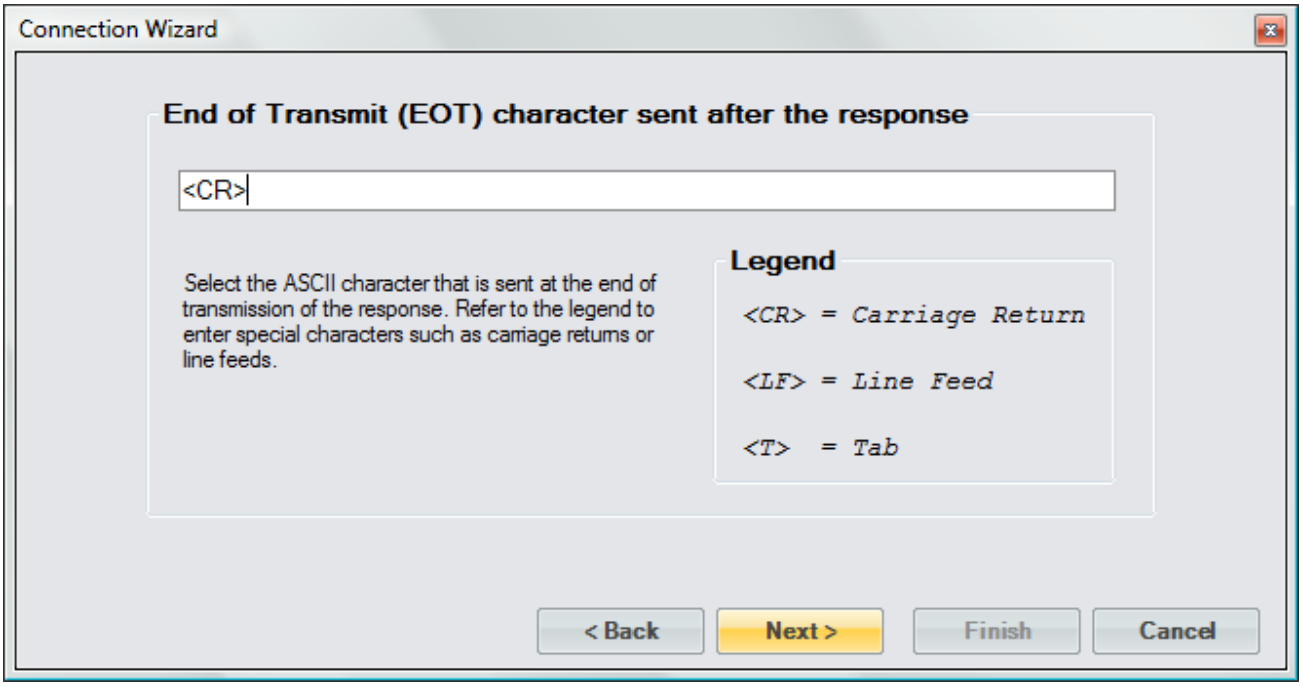
The fourth data item is the dew point temperature value. The DP-30 will send a numeric value indicating the dew point temperature in degrees Celsius. We define the syntax exactly as the DP-30 documentation specifies. The response value is the actual value so there is no need to define any type of scaling.



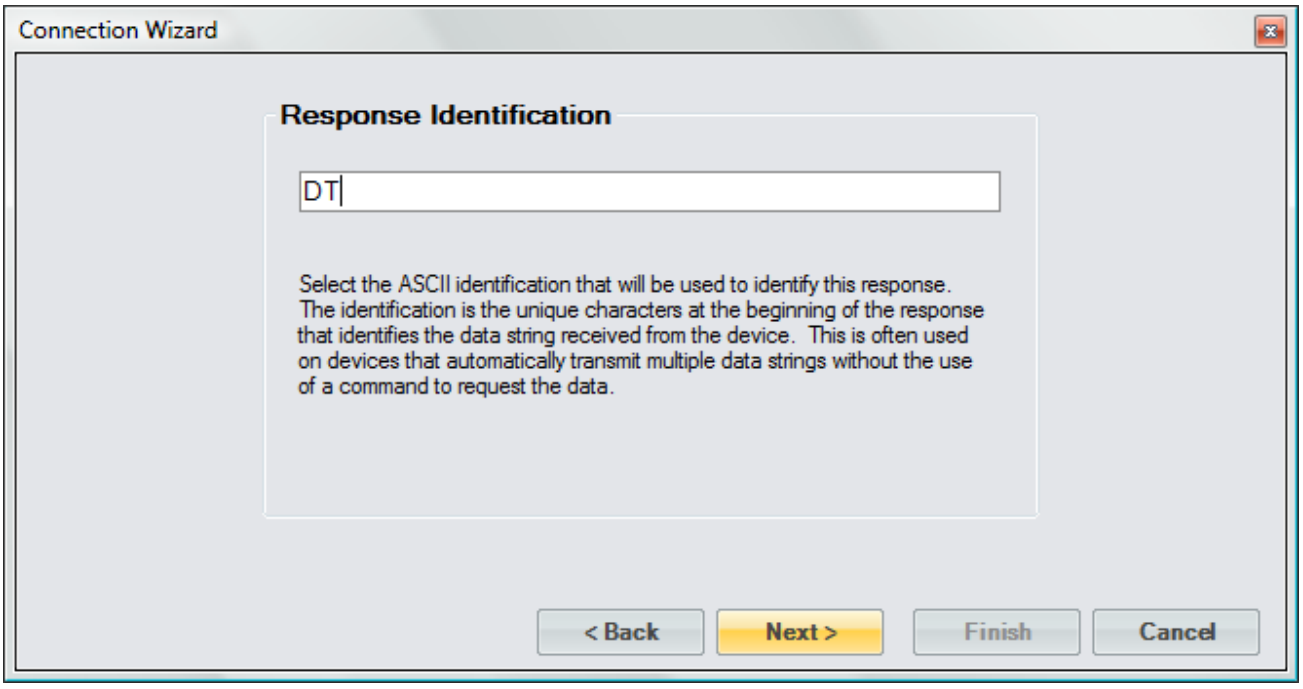
Notice that ControLog shows the combined response syntax for this message at the bottom of the form. This syntax will closely resemble the syntax defined in the DP-30 documentation for the dew point temperature message. The Green portion of the syntax is the current data item's syntax within the response message.



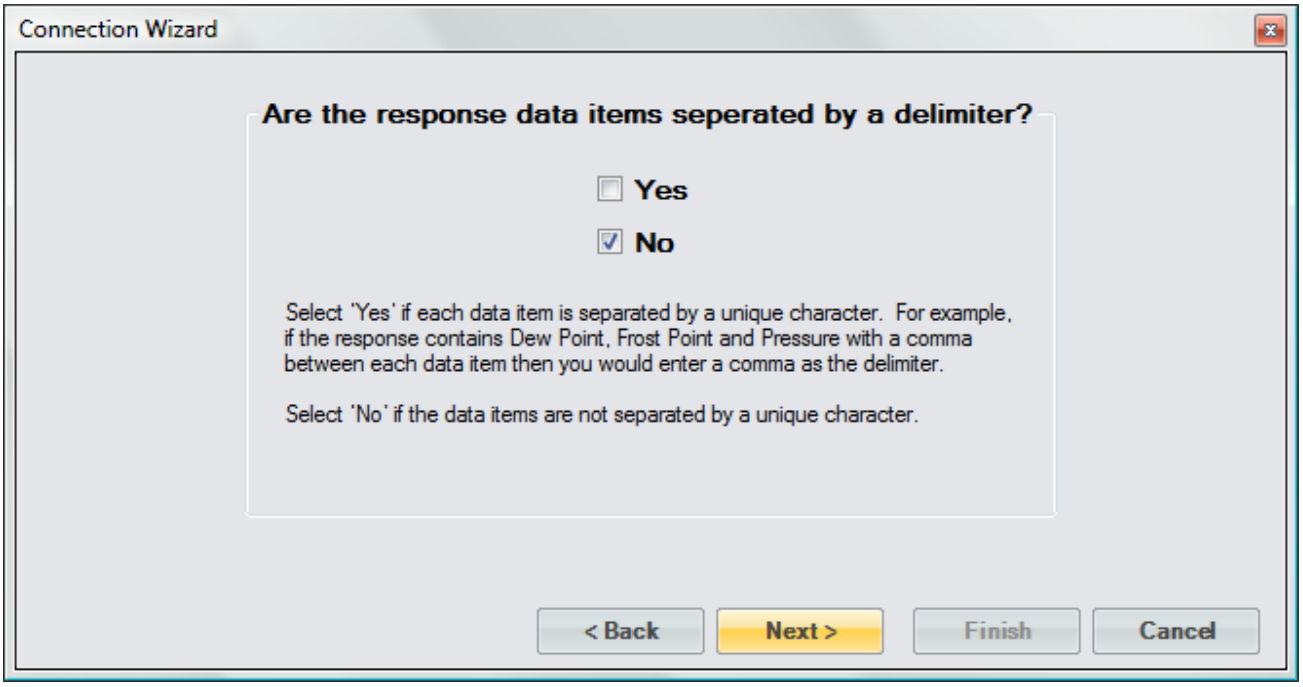
The Dew Point Temperature message is terminated with a carriage return.



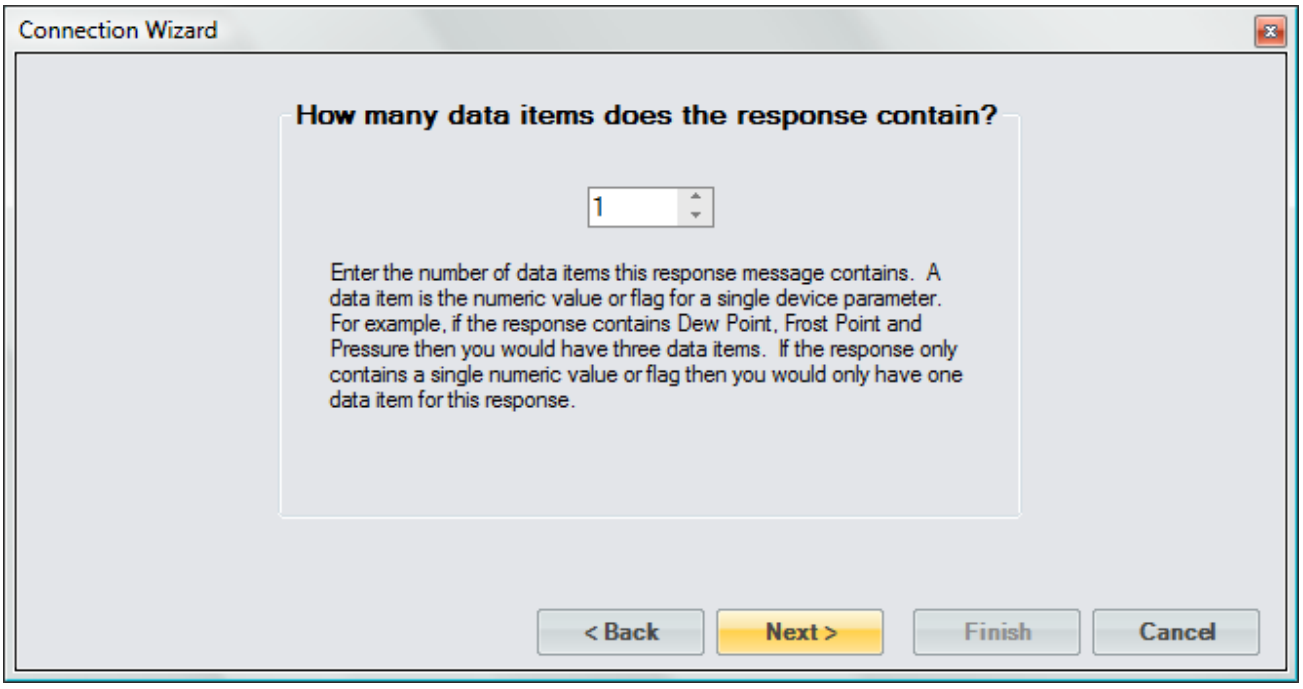
Next, we define the response identification for the second message. Referring to the DP-30 documentation we enter the identification for the Dry Temperature message.



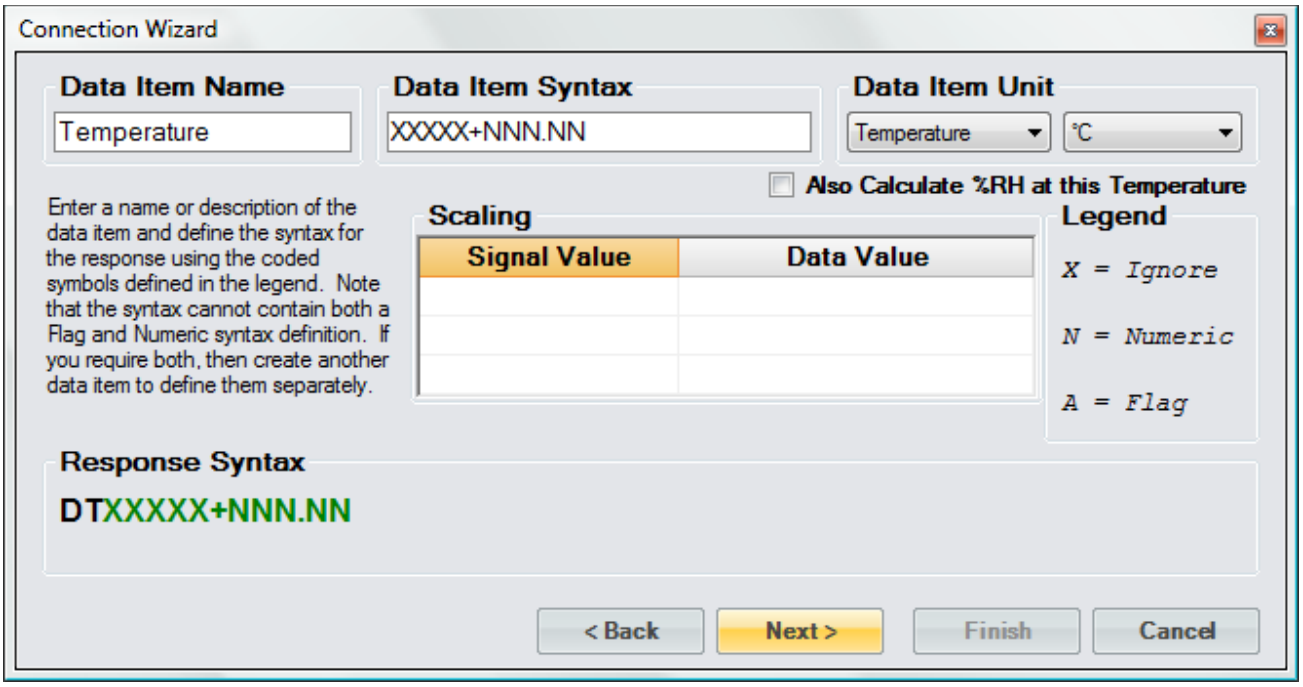
The DP-30 Dry Temperature message is of a fixed format and does not use any delimiter.



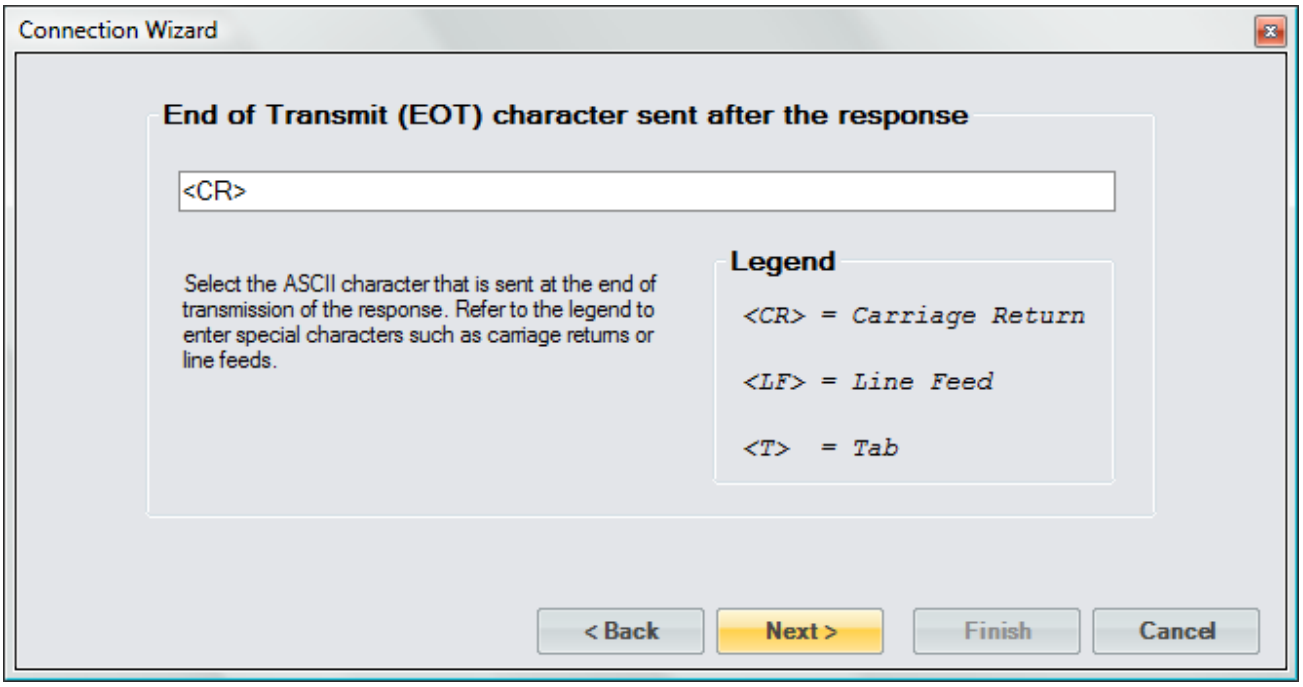
The Dry Temperature message contains only one numeric value; therefore, there is only one data item for this response.



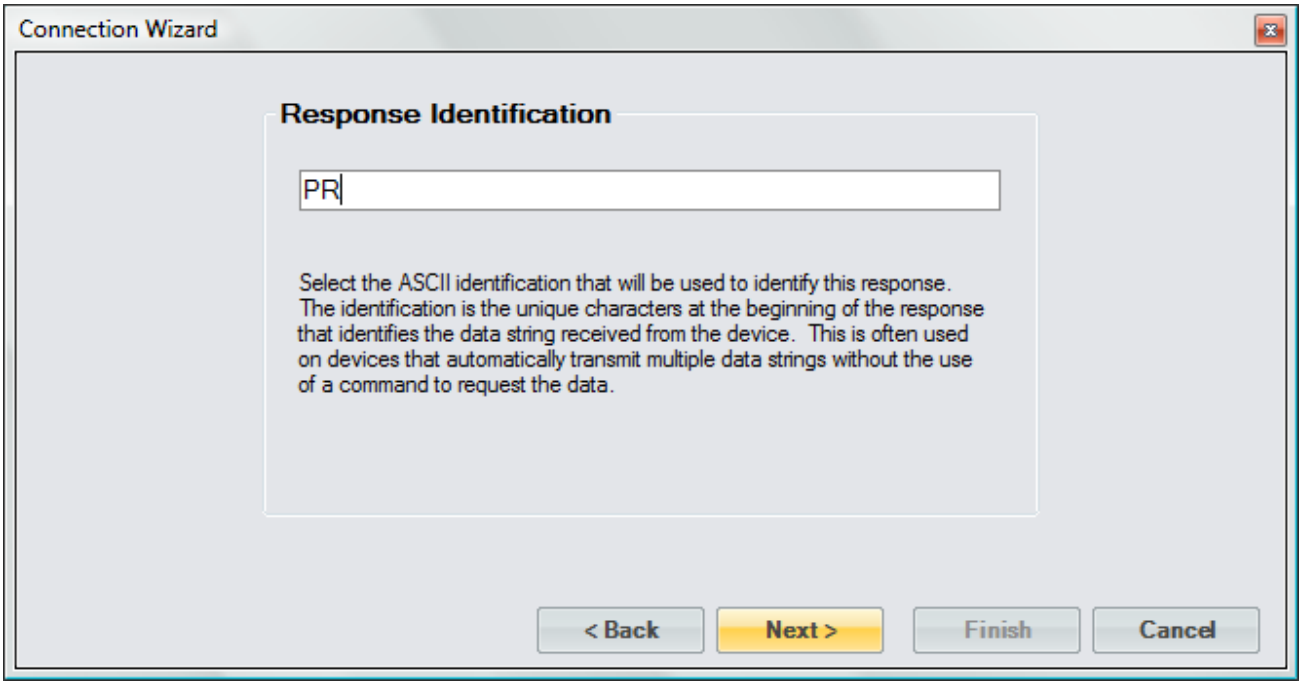
The message is led by a number of ASCII characters that we do not have any interest in. We will tell ControLog to ignore these leading characters by defining the syntax with five "X" characters then the numeric syntax. We define the numeric syntax exactly as the DP-30 documentation specifies. Again, the response value is the actual value so there is no need to define any type of scaling.



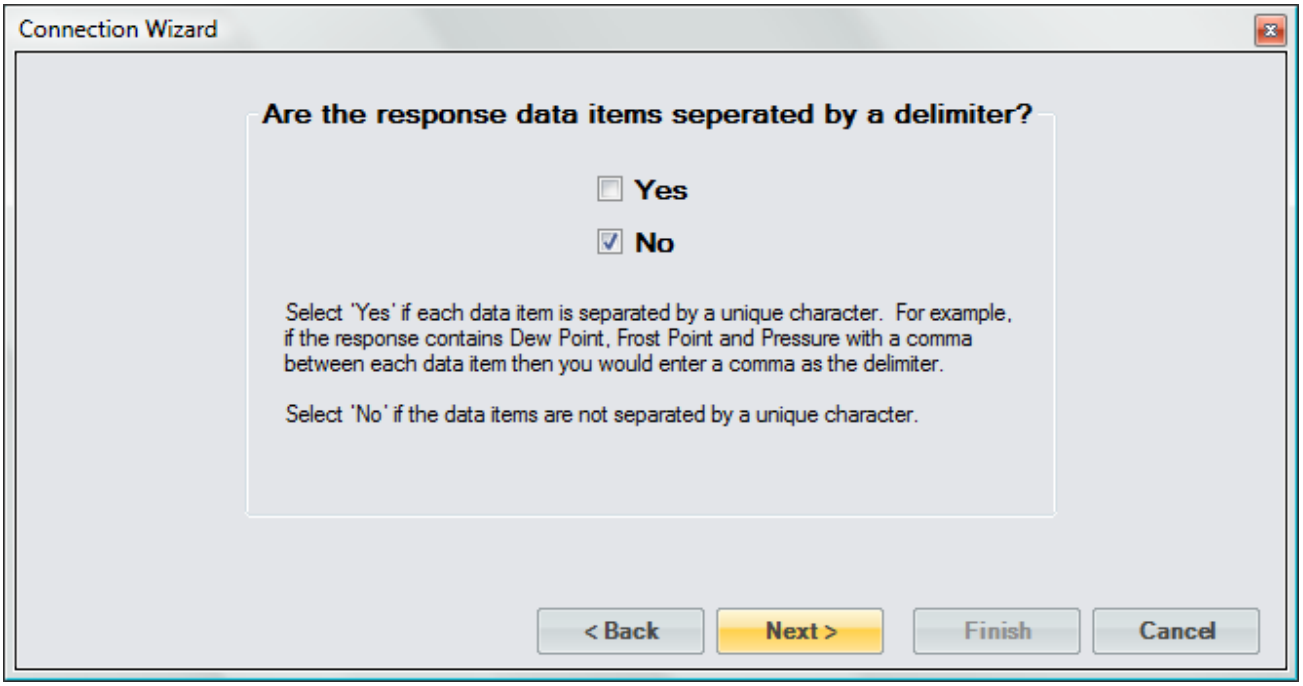
The Dry Temperature message is terminated with a carriage return.



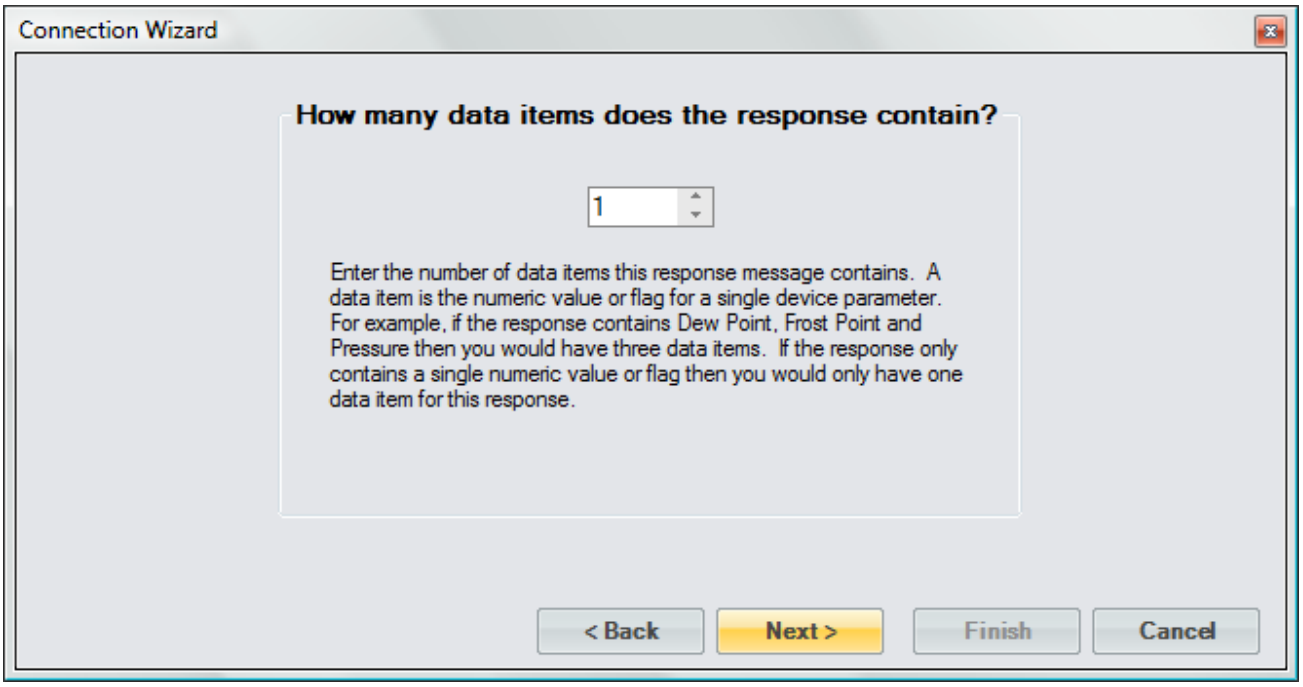
We now define the response identification for the third and last message. Referring to the DP-30 documentation we enter the identification for the Pressure message.



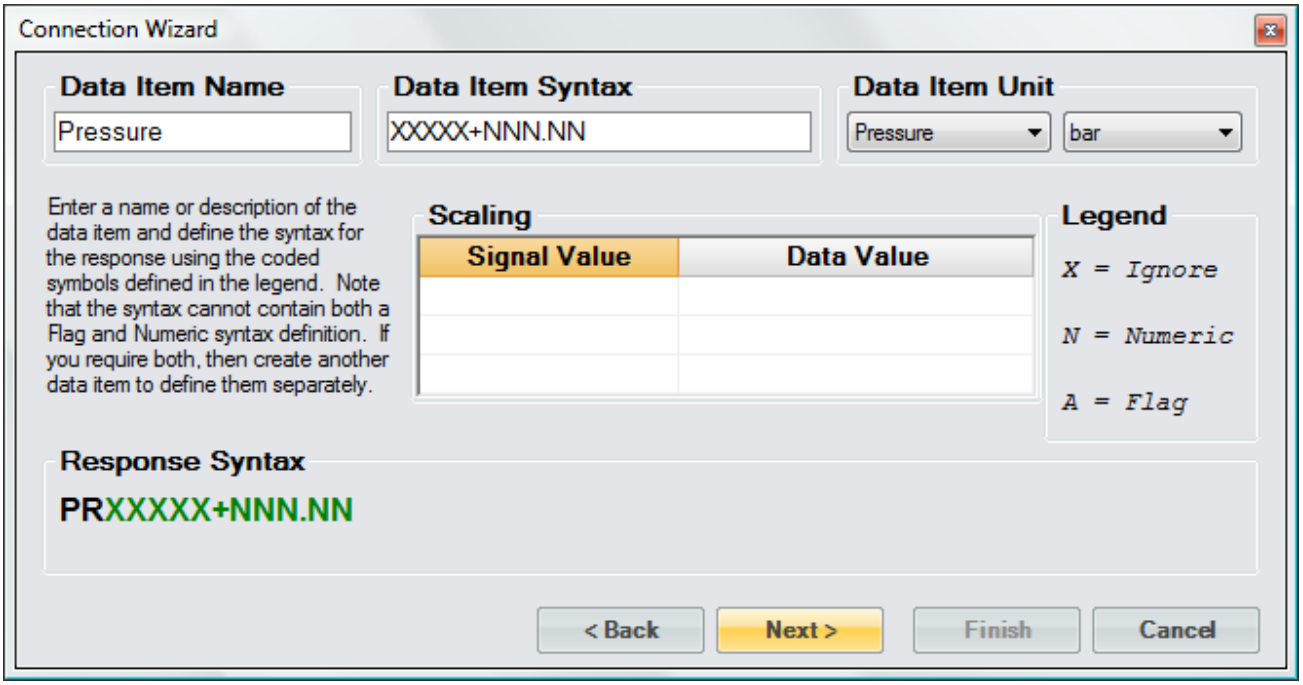
The DP-30 Pressure message is of a fixed format and does not use any delimiter.



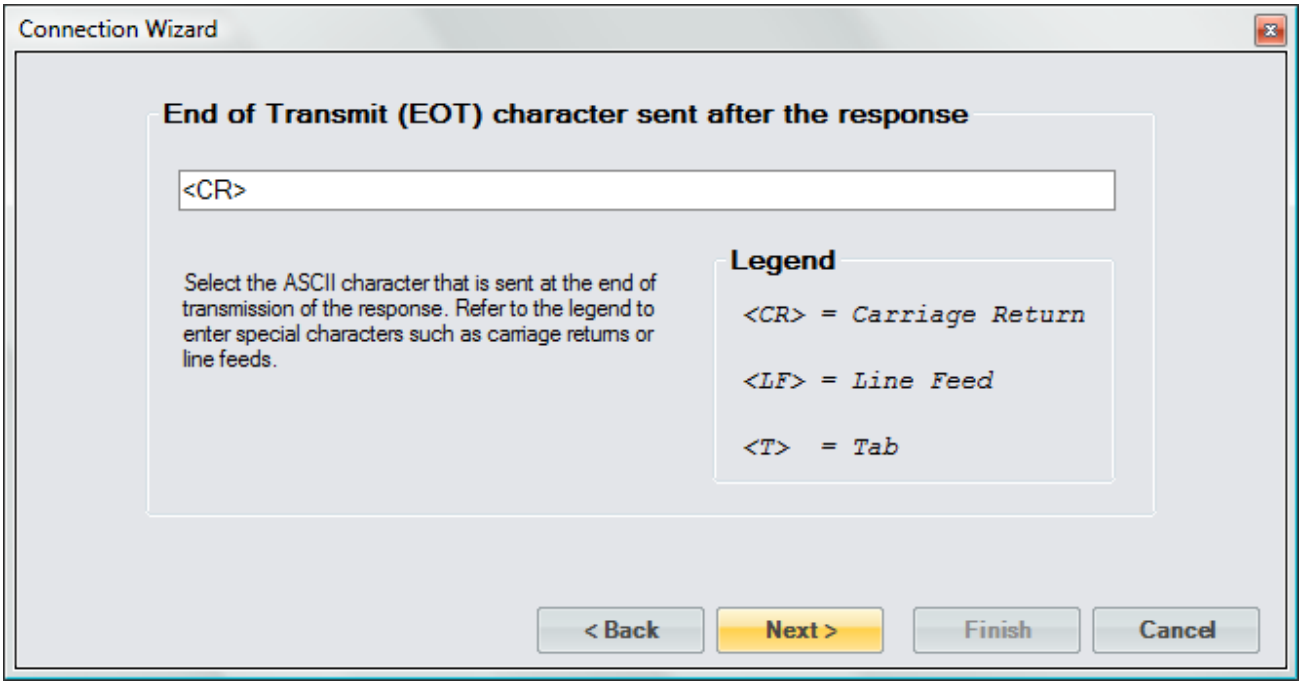
The Pressure message contains only one numeric value therefore there is only one data item for this response.



Again, the message is led by a number of ASCII characters that we do not have any interest in. We will tell ControLog to ignore these leading characters by defining the syntax with five "X" characters then the numeric syntax. We define the numeric syntax exactly as the DP-30 documentation specifies. Note that we set the data item unit to the unit specified in the DP-30 documentation. This allows ControLog to convert the reading into a more desired unit if needed. Again, the response value is the actual value so there is no need to define any type of scaling.



The Pressure message is terminated with a carriage return.



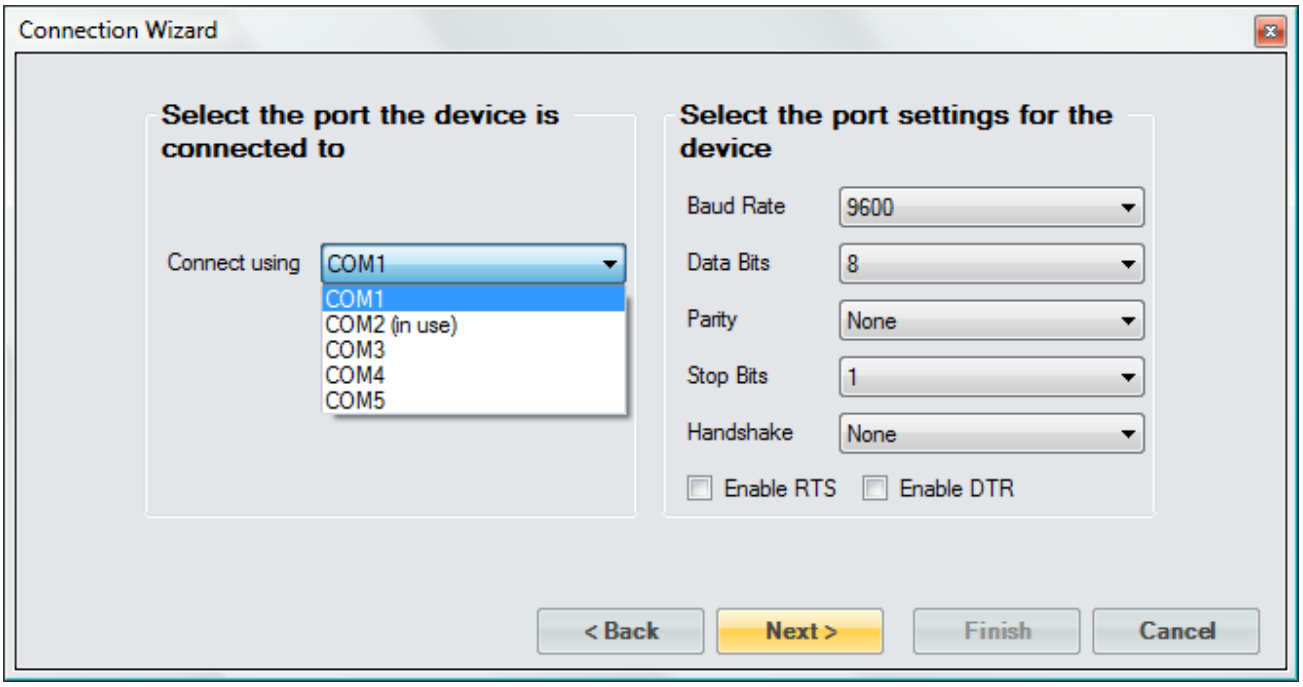
Save the newly created device to a file so that it can be recalled at a later time.



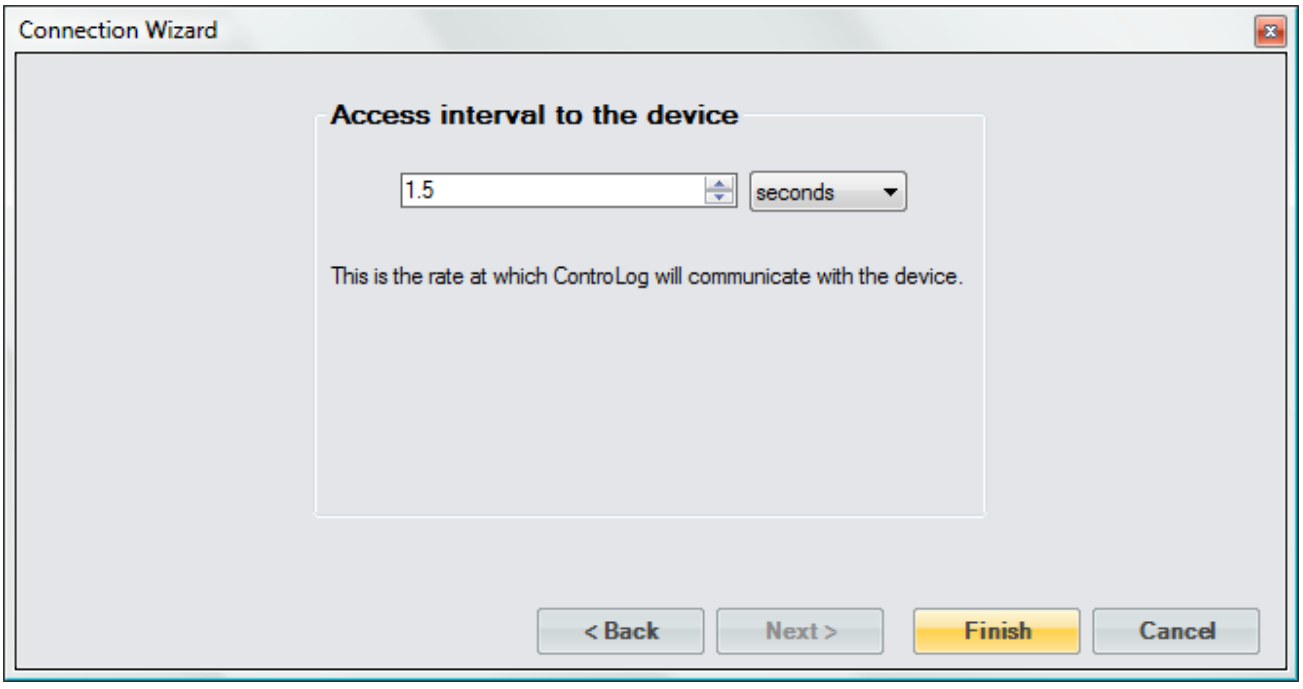
Select to connect to the device now.



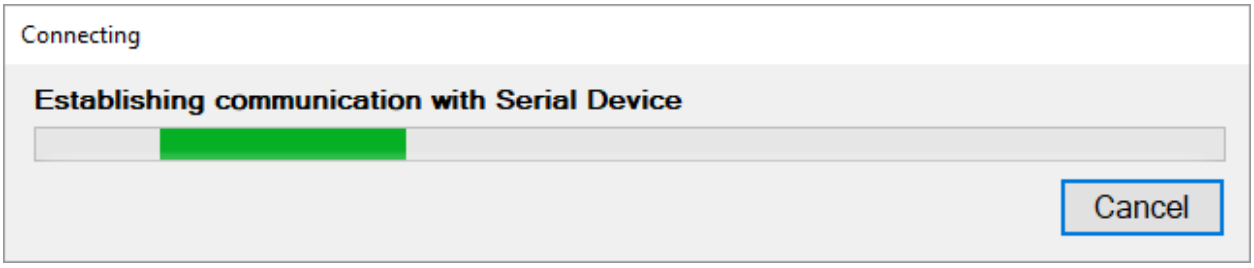
Select the port the DP-30 is connected to. Notice that ControLog indicates which ports are in use. Refer to the DP-30 documentation for the RS-232 port settings:



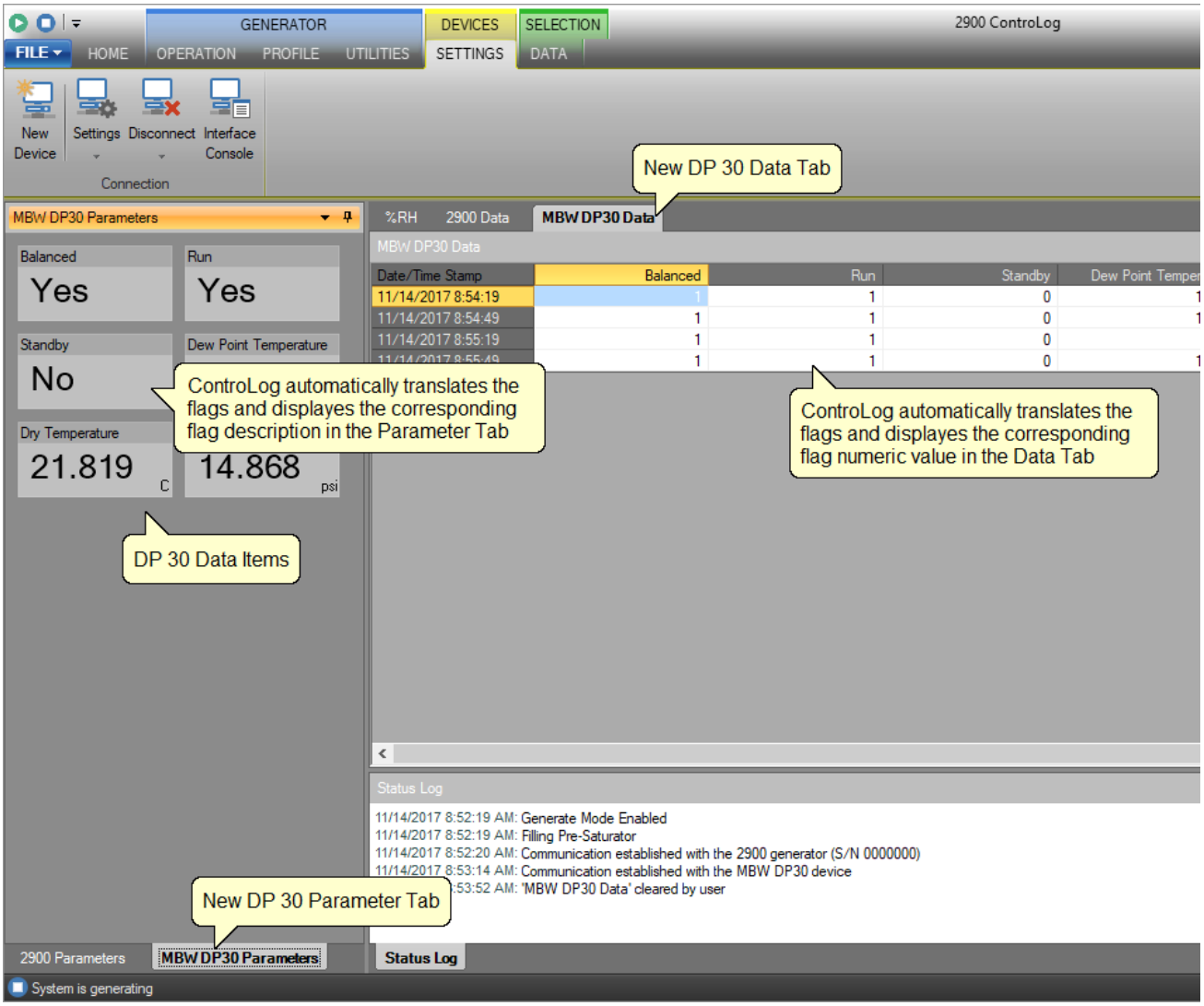
Use the default access rate of 1.5 seconds.



Once completed, ControLog will attempt to establish communication with the DP-30.



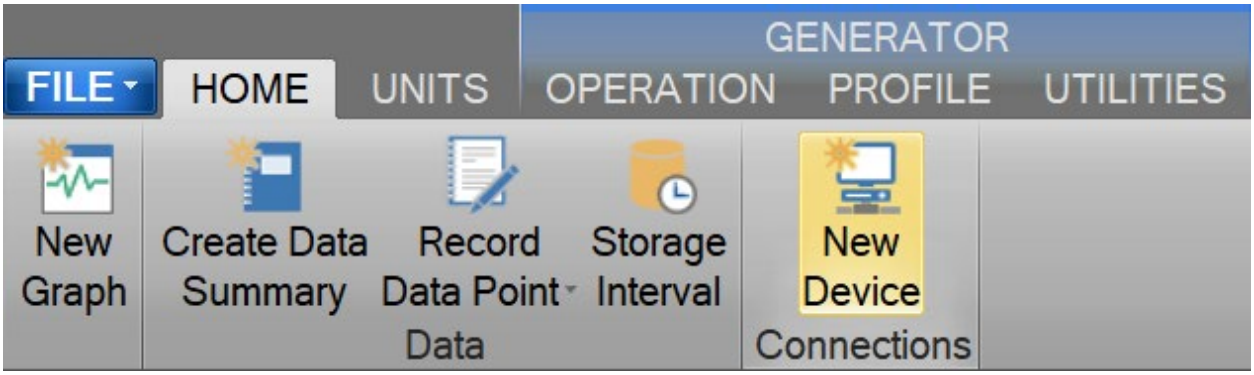
Once communication is successfully established with the DP-30, a new parameter tab and data tab will be created. Notice that ControLog automatically translates the ASCII flags based on the definitions described when creating the data items for the connection.



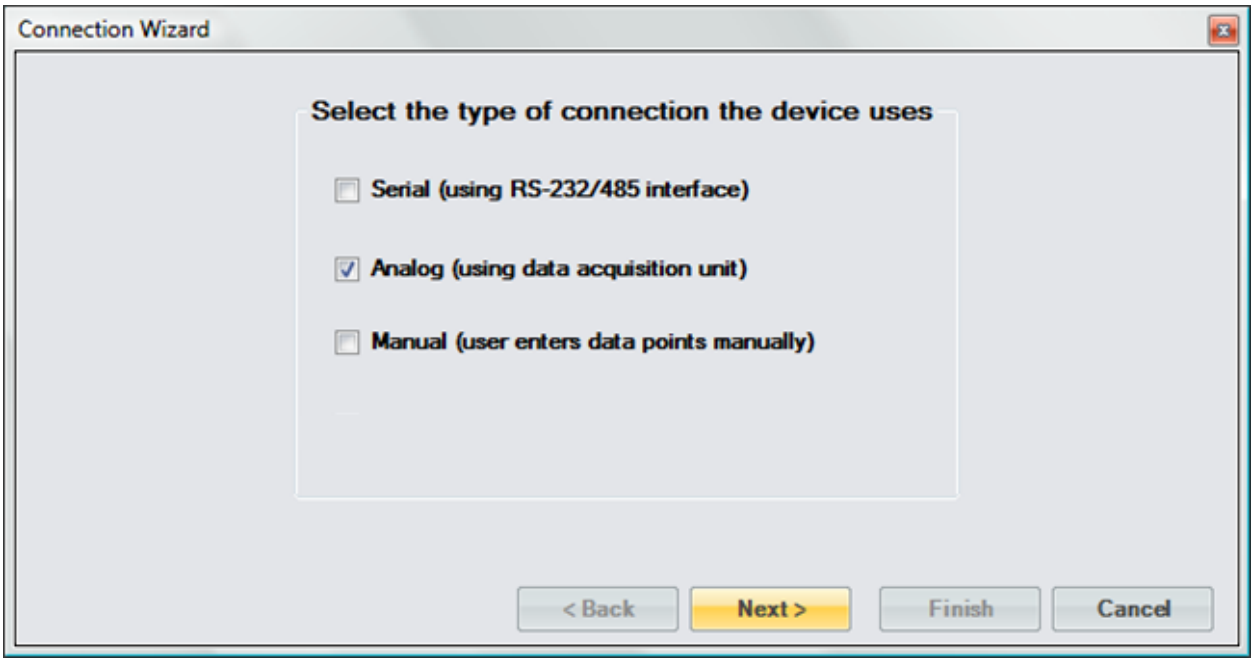
10.2 Analog Connection

An Analog Connection uses the Agilent® 34970A Data Acquisition/Switch Unit to acquire data from single or multiple analog devices. The customizable interface provided by ControLog allows the user to define different analog types and scales to read various analog signals. Refer to the Agilent® documentation for more information on connecting analog devices to the Data Acquisition Unit.

To create a new analog connection, select "New" from the Connections menu. This will open a "Connection Wizard" dialog that will step the user through the connection definition process.



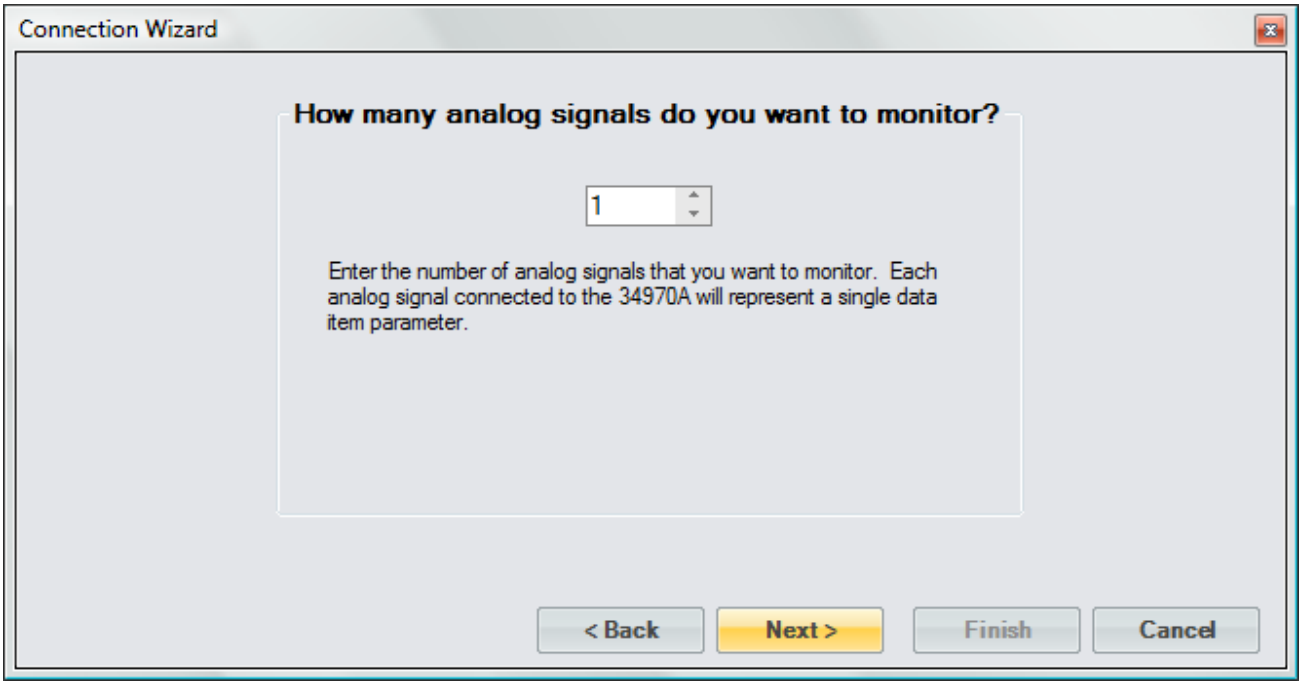
Select "Analog" as the type of connection the device uses.



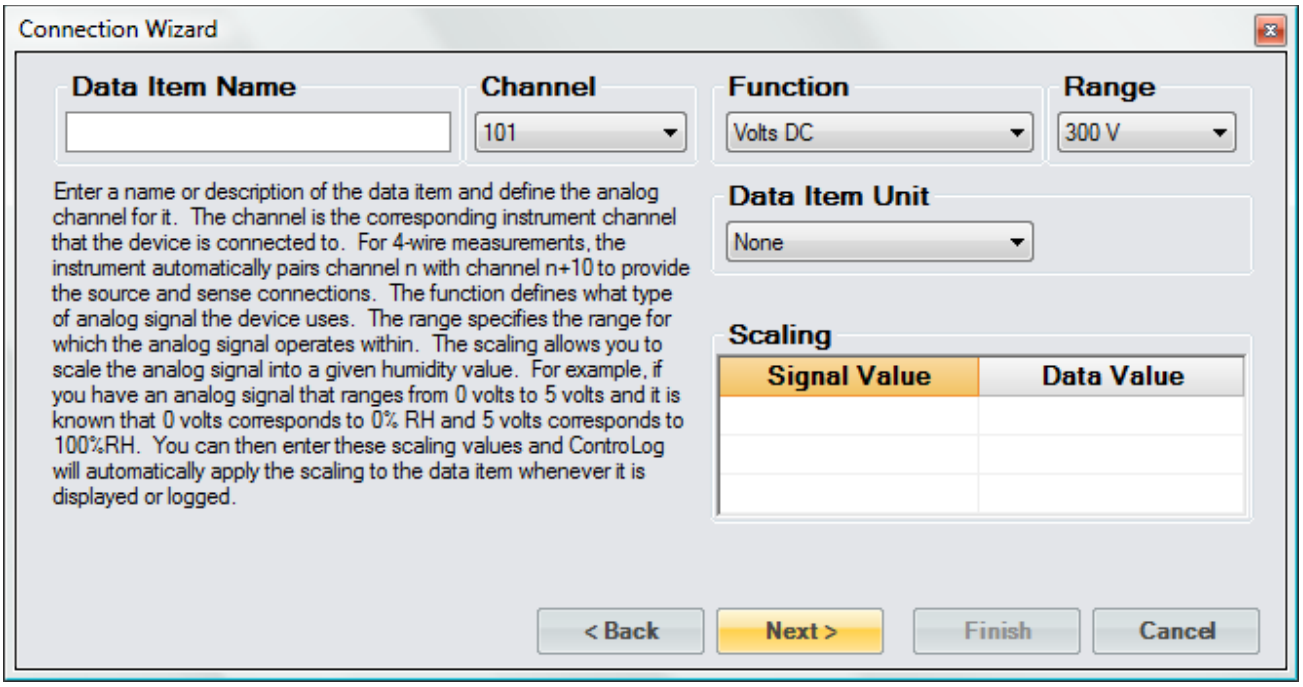
Enter a unique name for the analog device or devices.



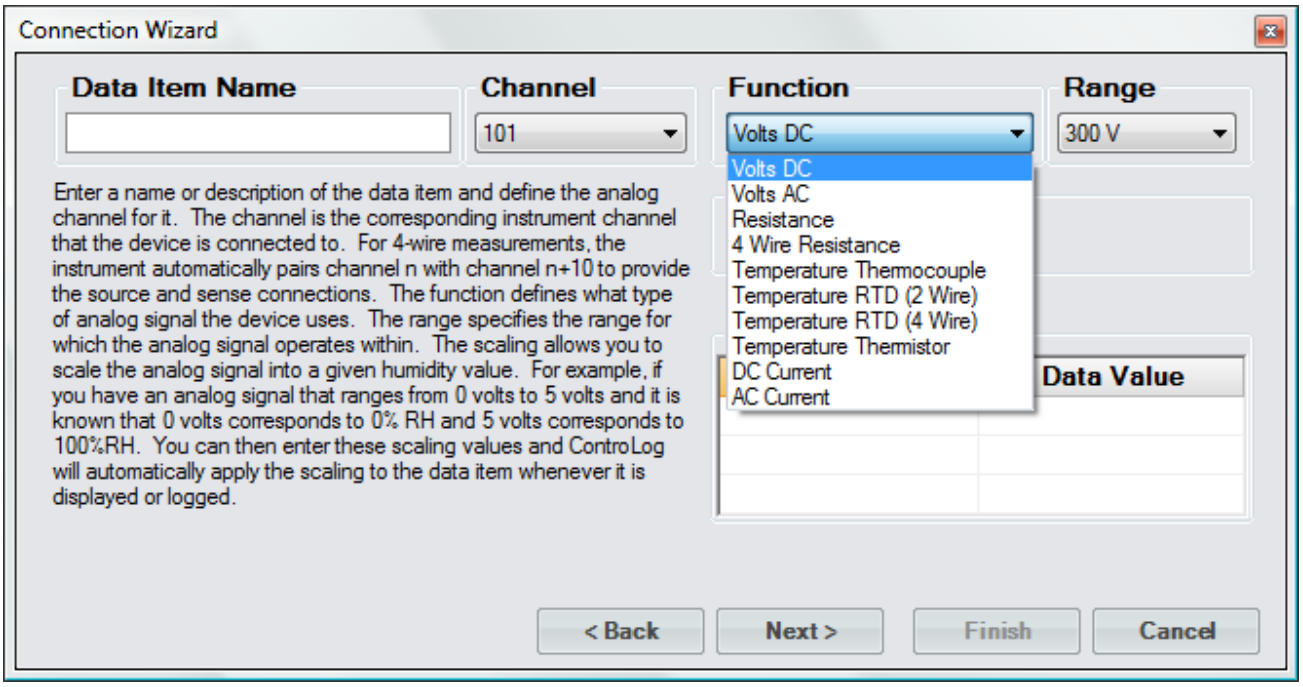
Enter the number of analog signals you want to monitor. This is the combined number of analog signals from each device you wish to monitor. Each analog signal connected to the 34970A will represent a single data item parameter.



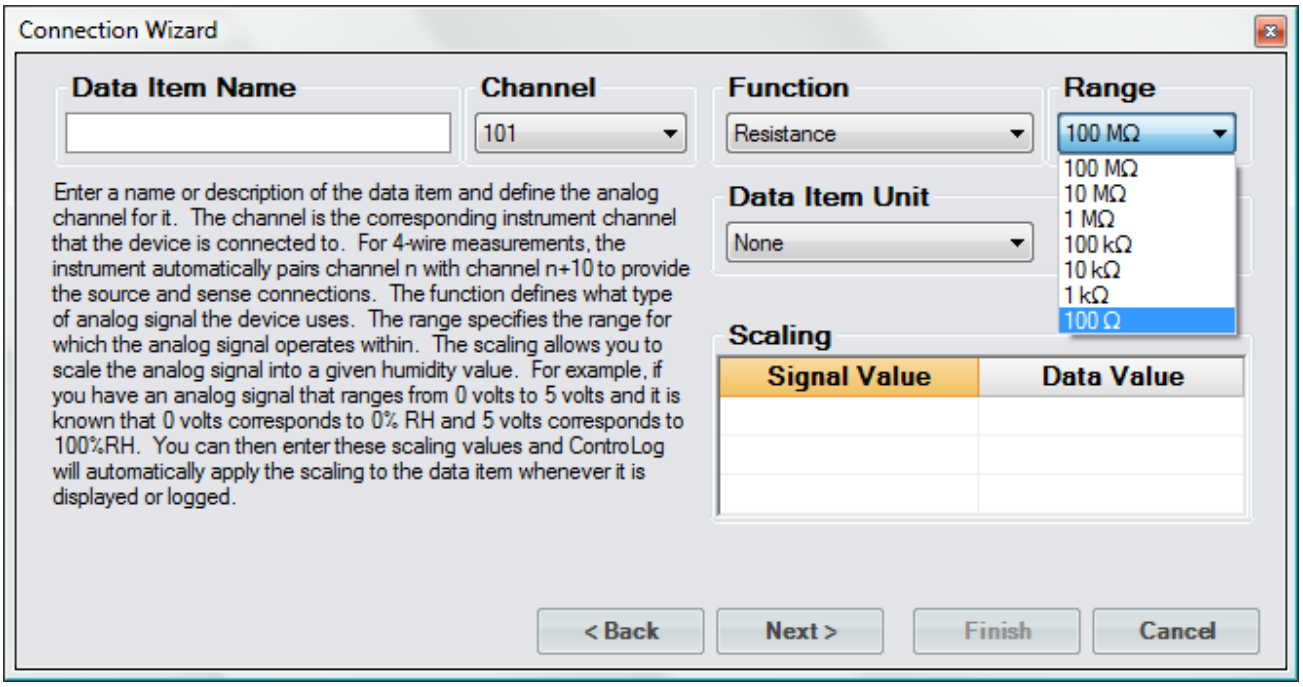
Enter a name or description of the data item and define the analog channel for it. The channel is the corresponding instrument channel the device is connected to. For 4-wire measurements, the instrument automatically pairs channel n with channel n+10 to provide the source and sense connections. This dialog will repeat for each monitored signal.



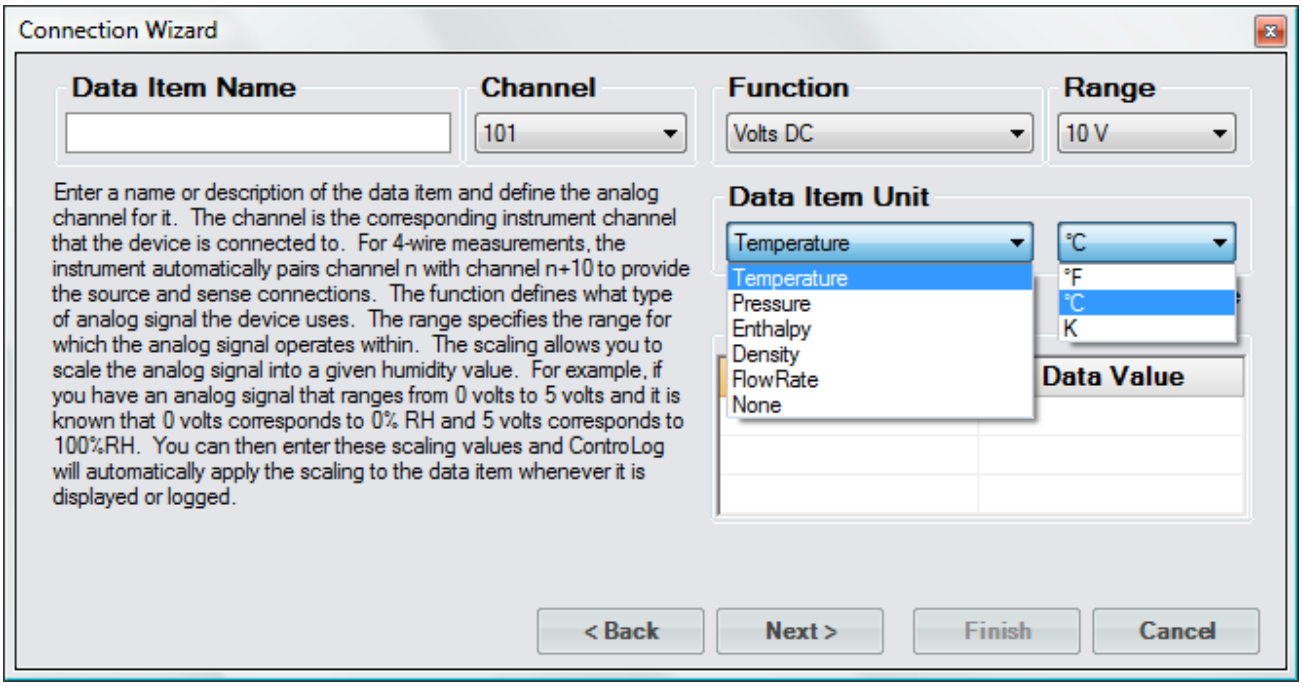
The function defines what type of analog signal the device uses.



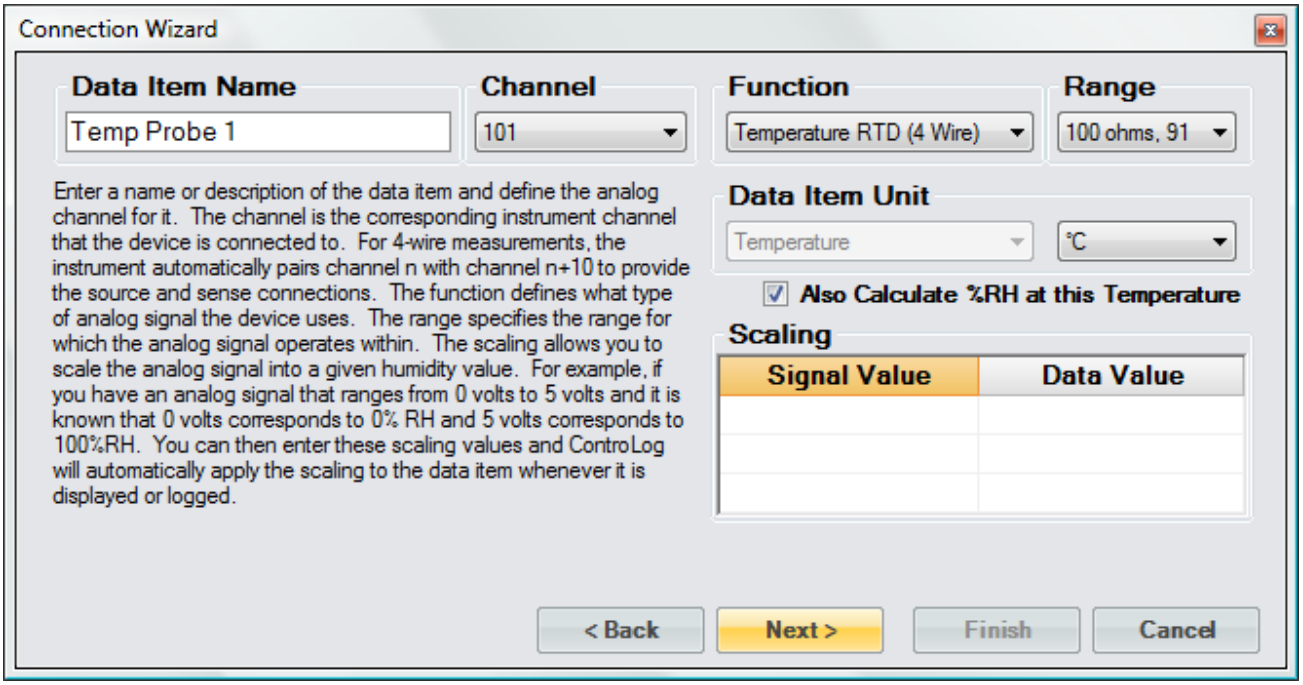
The range specifies the range for which the analog signal operates within. The available range selection changes automatically to reflect what is available for the selected function. For example, the Resistance function has a Range from 100 Ohms to 100 Mega Ohms.



Selecting the unit for the data item will allow ControLog to convert the value to the selected system units for display in the parameter tab and record the value in the default SI units in the data tab. Remember, this is the unit the device is sending the data item in, not the unit you wish to display the data item as. If “None” is selected, then ControLog will treat the data item as a simple number and will display and record the value exactly as it is received.

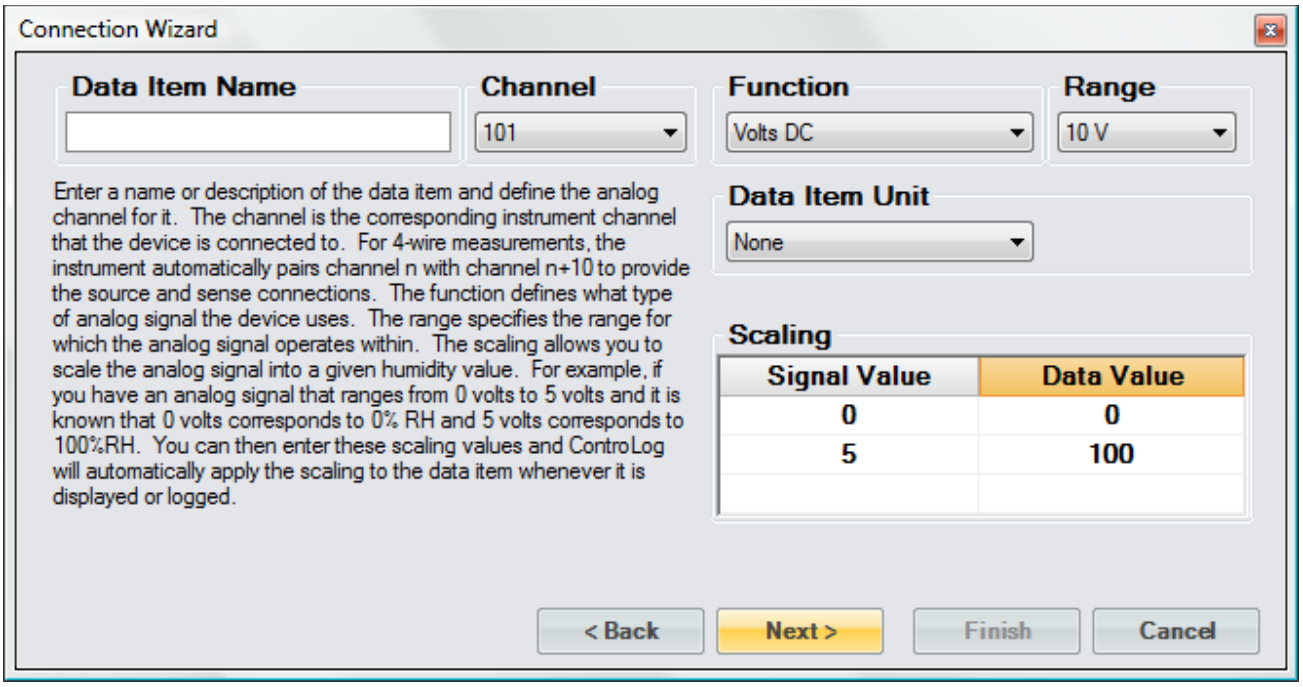


In addition to reading a temperature, ControLog can compute a percent relative humidity (%RH) at the temperature. This is useful when compensating for temperature gradients within the chamber. To have ControLog automatically calculate the relative humidity at the temperature, simply select the corresponding checkbox. The newly calculated %RH will have the same name as the specified Data Item Name but will be preceded by "%RH@". In below example the calculated %RH will appear as "%RH@Temp Probe 1".



It is possible to scale an analog signal. The scaling consists of a two-point definition for a linear scaling or a three to five-point definition for polynomial fit scaling. The number of points determines the degree of the polynomial used to scale the analog signal. A Singular Value Decomposition (SVD) algorithm is used to determine the coefficients of the polynomial. Each point definition consists of a signal value and a data value. The signal value represents the "raw" analog signal. The data value represents the actual value or real-world value at the given signal value.

Scaling allows the user to scale an analog signal into a given humidity value. For example, if you have an analog signal that ranges from 0 volts to 5 volts and it is known that 0 volts corresponds to 0 %RH and 5 volts corresponds to 100 %RH. The user can then enter these scaling values and ControLog will automatically apply the scaling to the data item whenever it is displayed or logged.



Select the name and location to save the new analog connection. Clicking the "Browse" button will open a save file dialog that will allow the user to specify the name and browse to the desired location to save the file. All device connection files are saved in XML format with a (*.device) extension.



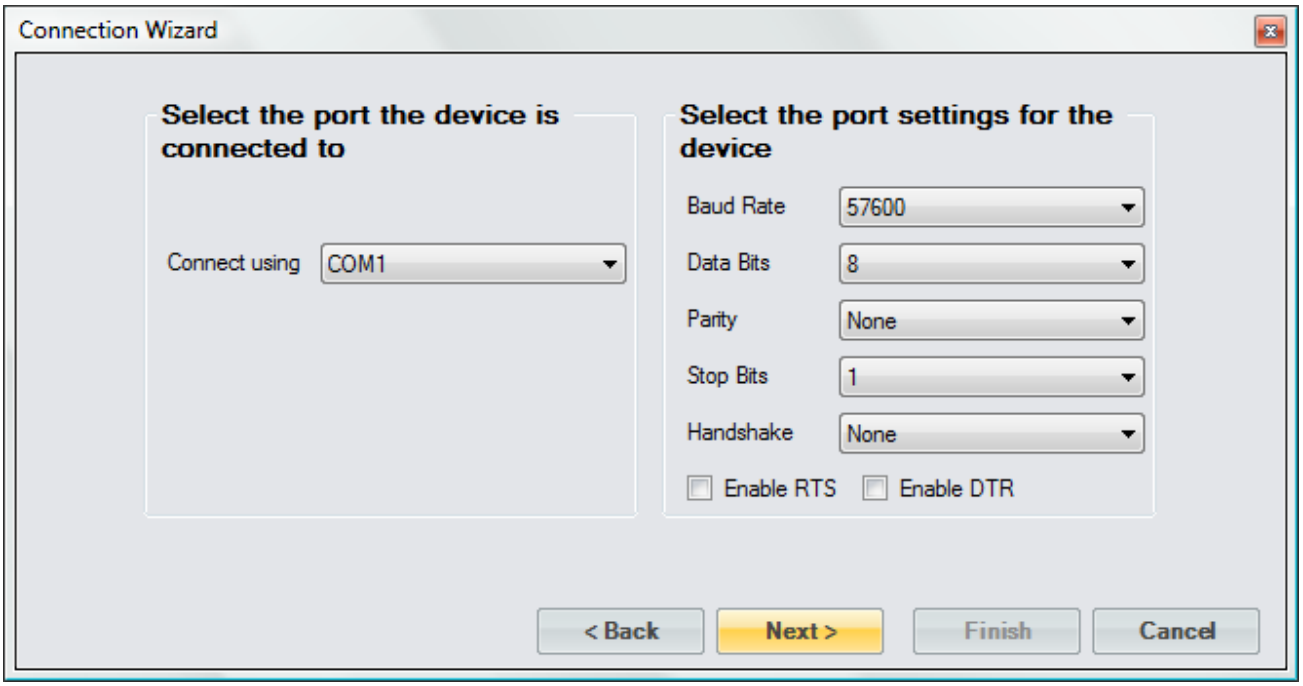
Next, the user can select whether to connect to the device now or to exit without connecting.

Note - *The user can connect at any time by loading the device from the Connections menu.*



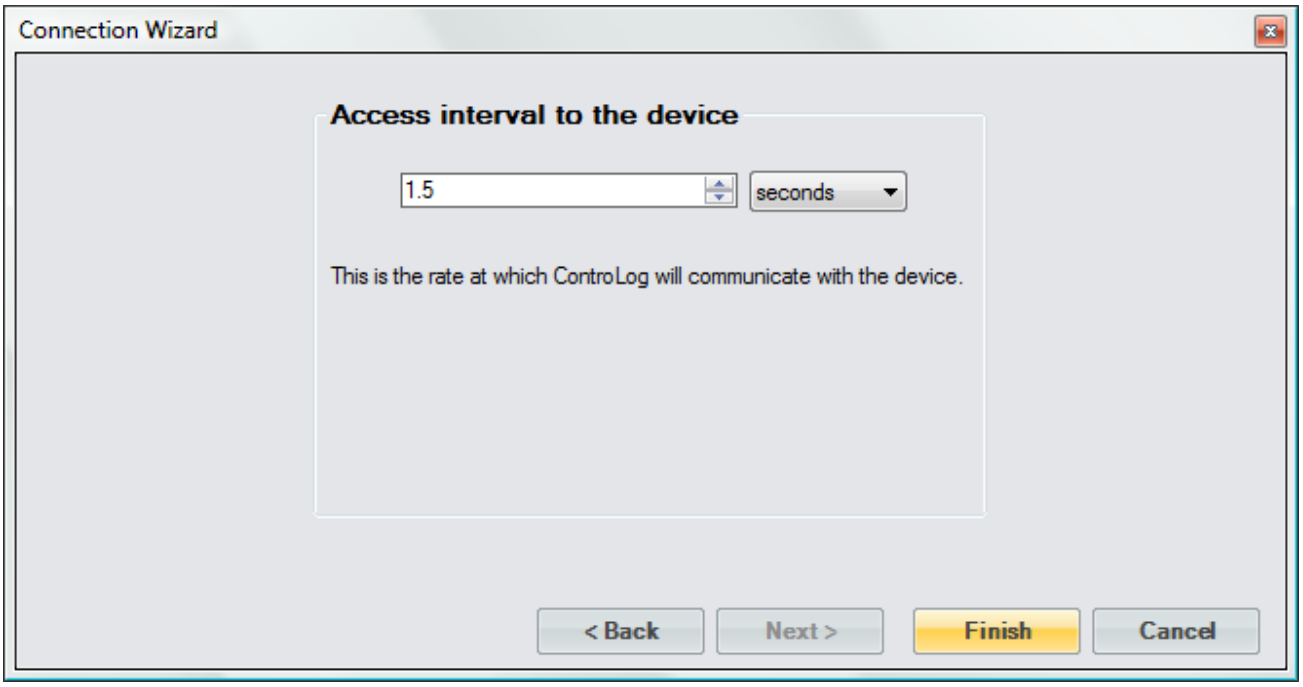
Select the communication port that the Agilent® 34970A Data Acquisition/Switch Unit is connected to and select the port settings for the 34970A.

> **Note -** *ControLog defaults to the default port settings for the Agilent® 34970A Data Acquisition/Switch Unit. Refer to the Agilent® documentation for instructions on viewing or setting the Data Acquisition RS-232 settings.*



Select the access rate to communicate with the Agilent® 34970A Data Acquisition/Switch Unit.

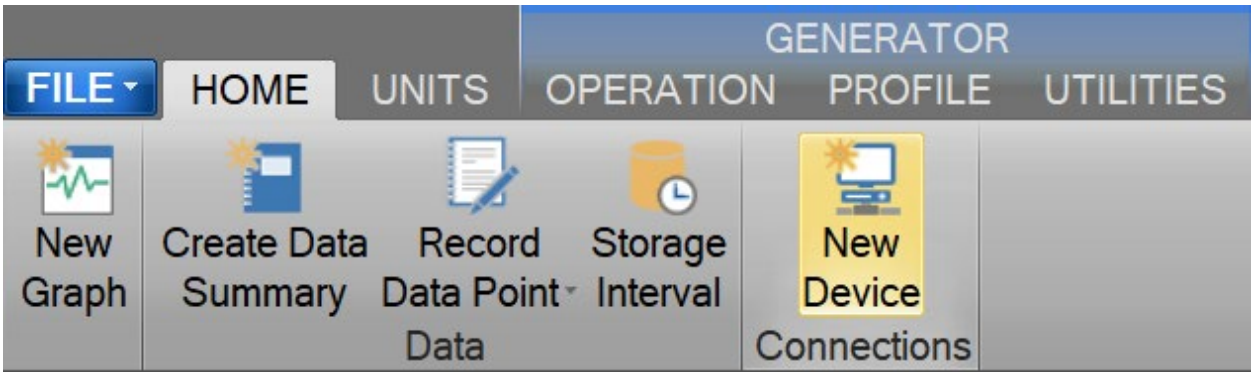
> **Note** - *Because of the nature of the 34970A and how it operates it is critical to specify an access interval that is long enough to allow the 34970A to complete its scan list within the specified interval. As a general rule of thumb, use 1.5 seconds per every 10 signals connected to the Data Acquisition Unit with a minimum access interval of 1.5 seconds.*



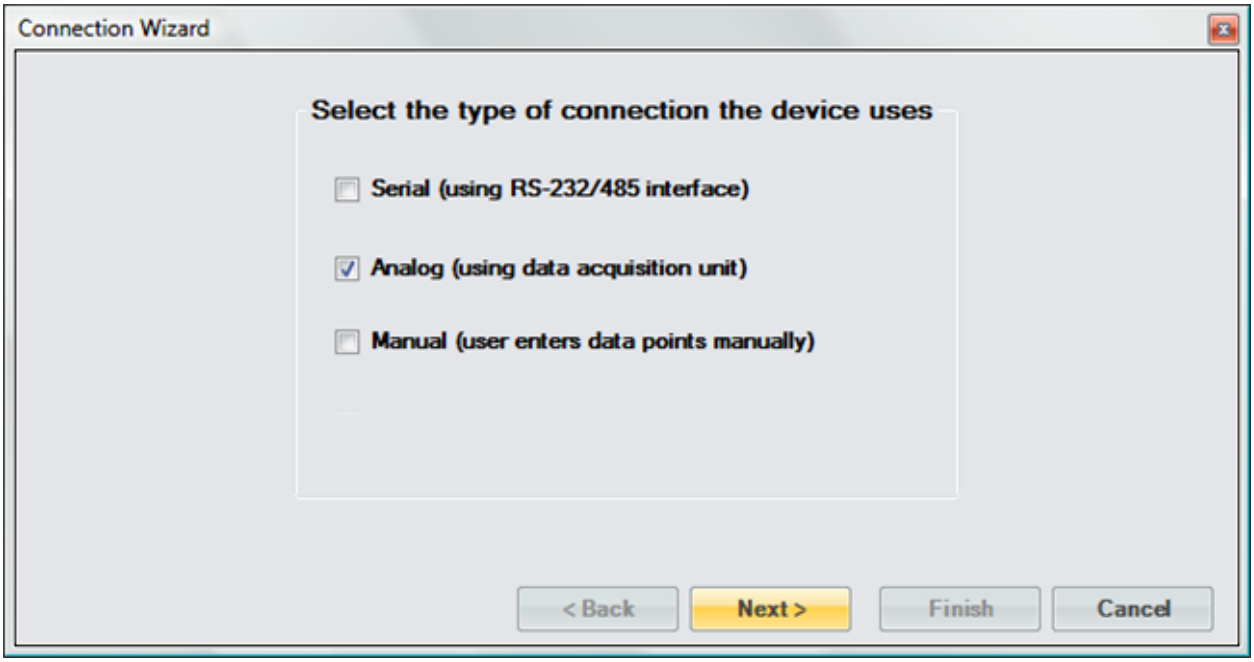
10.2.1 Analog Connection Example

This example will demonstrate the creation of an analog connection. This example will be working with a -10 to +10V input signal that we will scale to a Dew Point/Frost Point Temperature, a Temperature Thermistor and a 4-wire Temperature RTD.

Start by selecting “New” from the Connections menu.



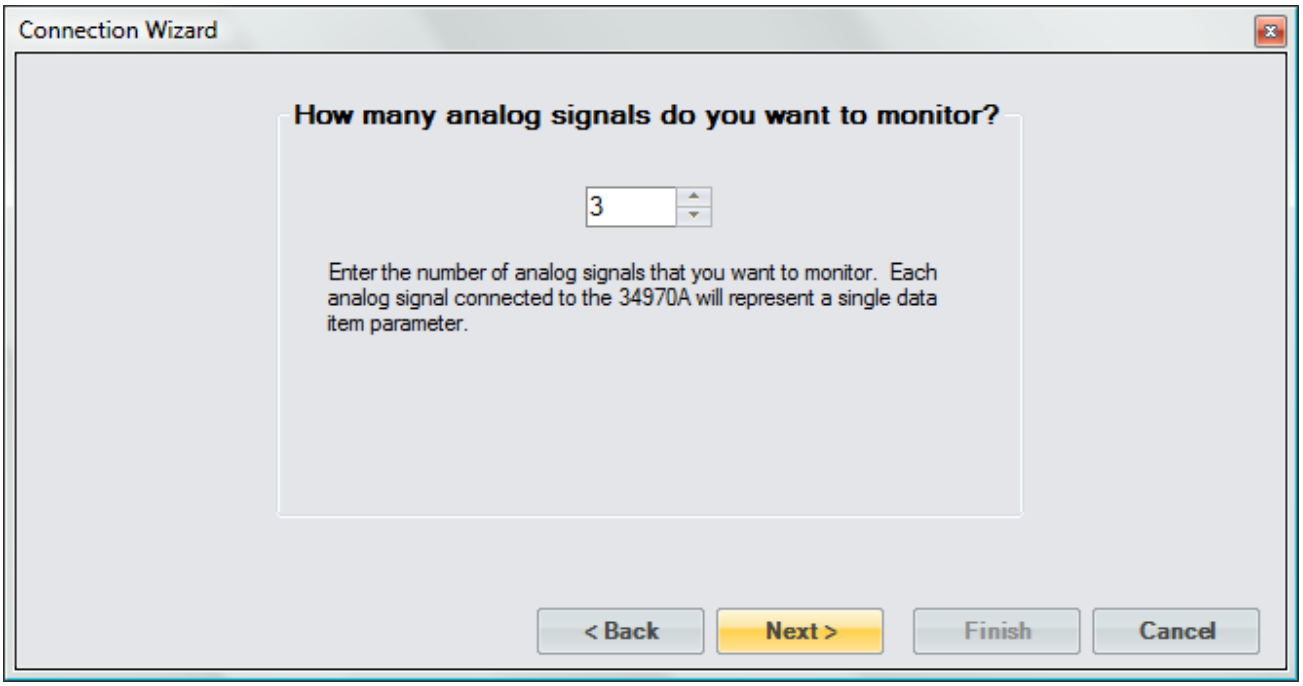
Select “Analog” as the type of device connection.



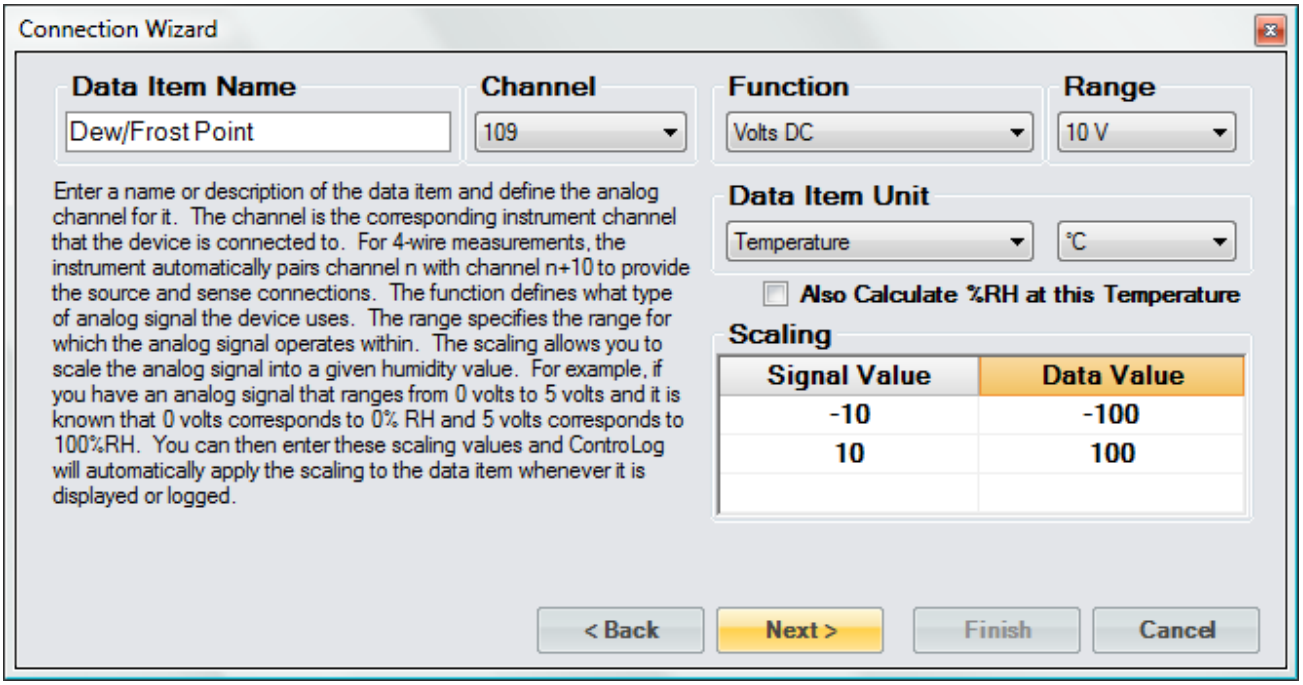
Enter “Analog Dew Point Device” as the name for the device.



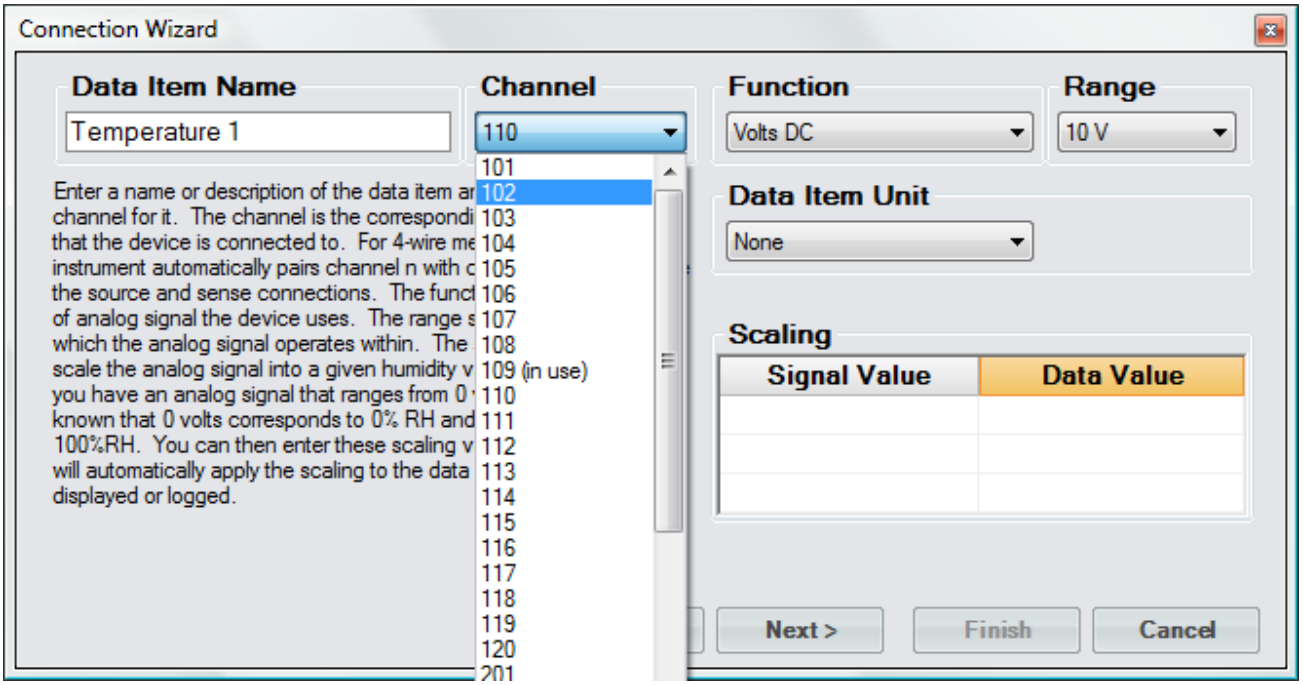
In this example we have three signals that we want to monitor; a voltage, thermistor and an RTD.



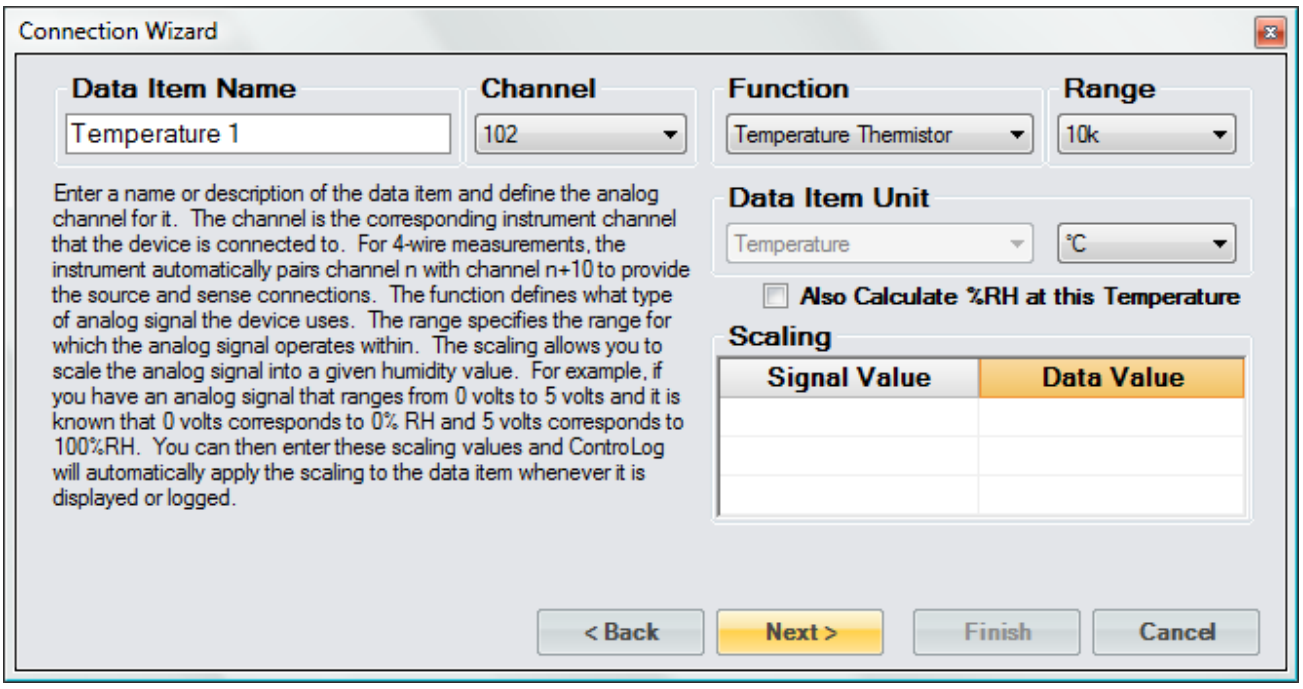
The first item is given the name “Dew/Frost Point”. We select the Channel number that the signal is connected to and since the signal is a voltage we select “Volts DC” as the function. The range is set to “10V” and we know the signal corresponds to a temperature in degrees Celsius. We also scale the value since we know -10V corresponds to a Frost Point temperature of -100 °C and +10V corresponds to a Dew Point temperature of +100 °C. By entering scaling ControLog will automatically scale the signal for display in the parameter tab and when recorded in the data tab.



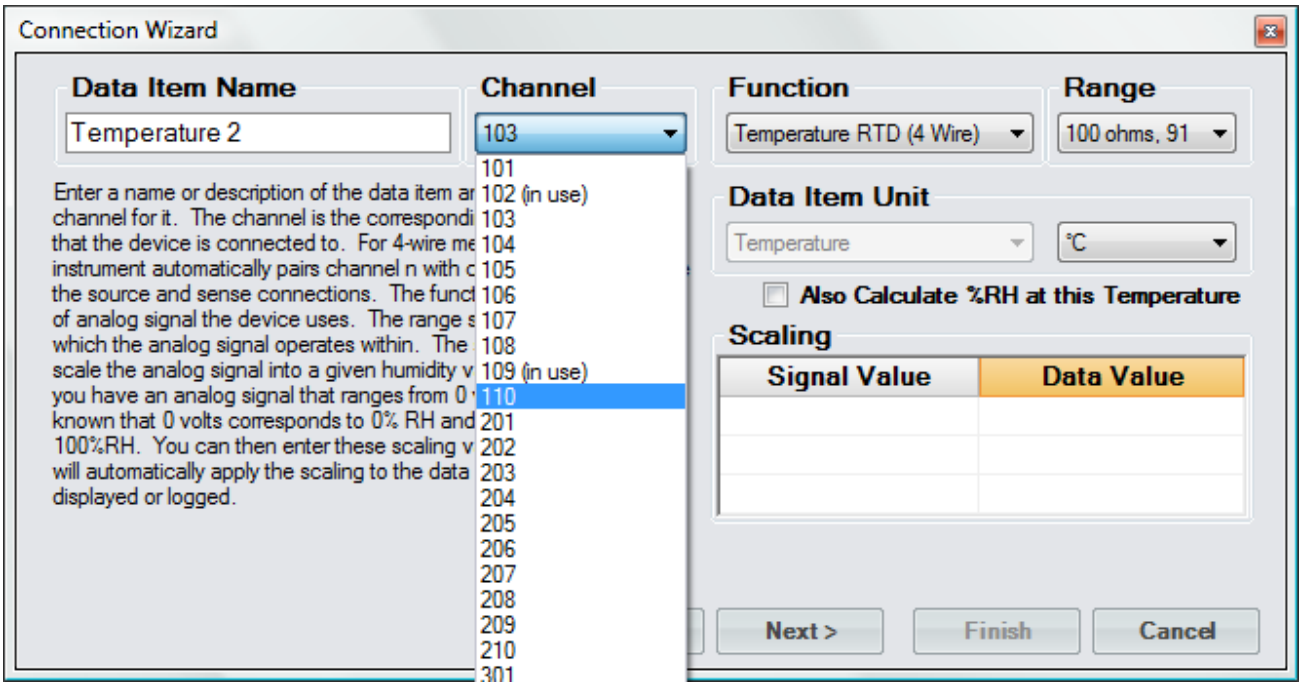
The second item is given the name “Temperature 1”. We select the Channel number that the signal is connected to. Notice ControLog indicates which channels have already been configured and are in use.



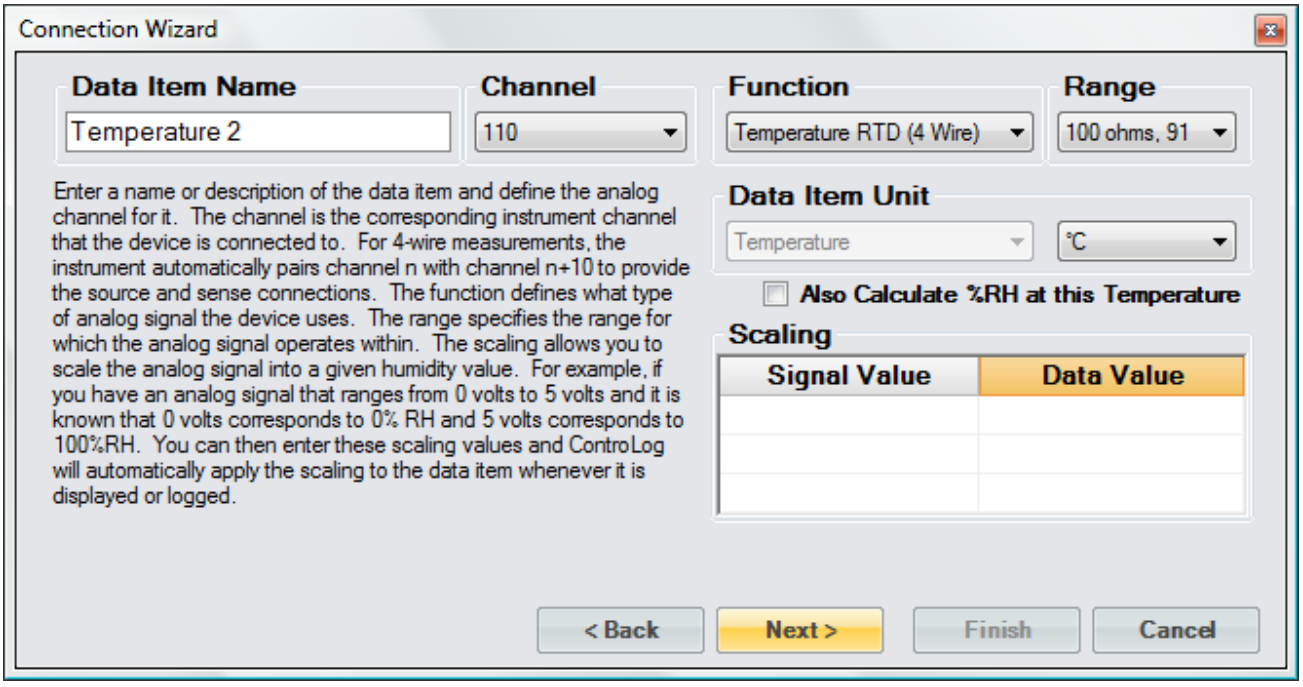
The function is set to “Temperature Thermistor” and we set the Range to “10k” based on the type of Thermistor we are connecting. Notice that ControLog automatically selects temperature as the unit type but allows the user to select the desired temperature unit. Since the signal value is the actual temperature value, no scaling is required for this data item.



The third item is given the name “Temperature 2”. The function is set to “Temperature RTD (4 Wire)” and we set the Range to “100 ohms, 85” based on the type of RTD we connected. Next, select the Channel number the RTD is connected to. Notice the channel list is smaller because 4-wire signals are automatically paired with the selected channel plus 10 to provide the source and sense connections for an RTD. Given this, the RTD in this example will occupy both channel 110 and 120 to complete its 4-wire connection.



Again, notice that ControLog automatically selects temperature as the unit type but allows the user to select the desired temperature unit. Since the signal value is the actual temperature value, no scaling is required for this data item.



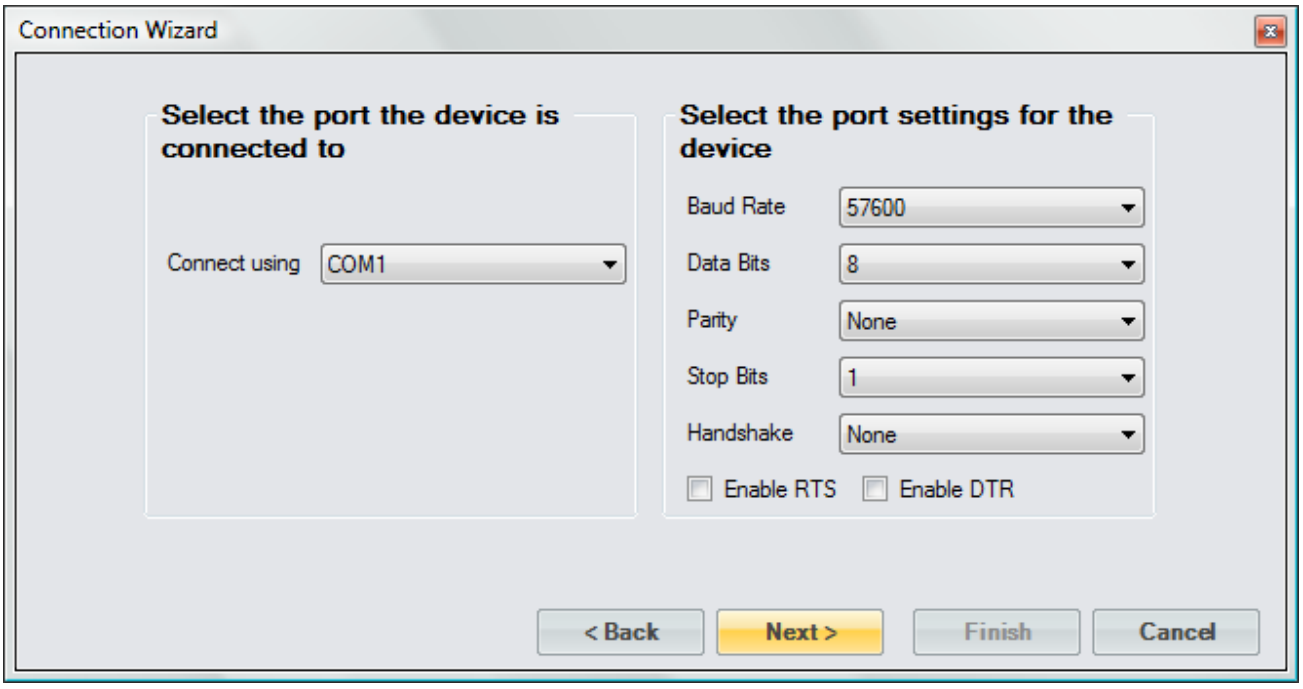
Save the newly created device to a file so it can be recalled at a later time.



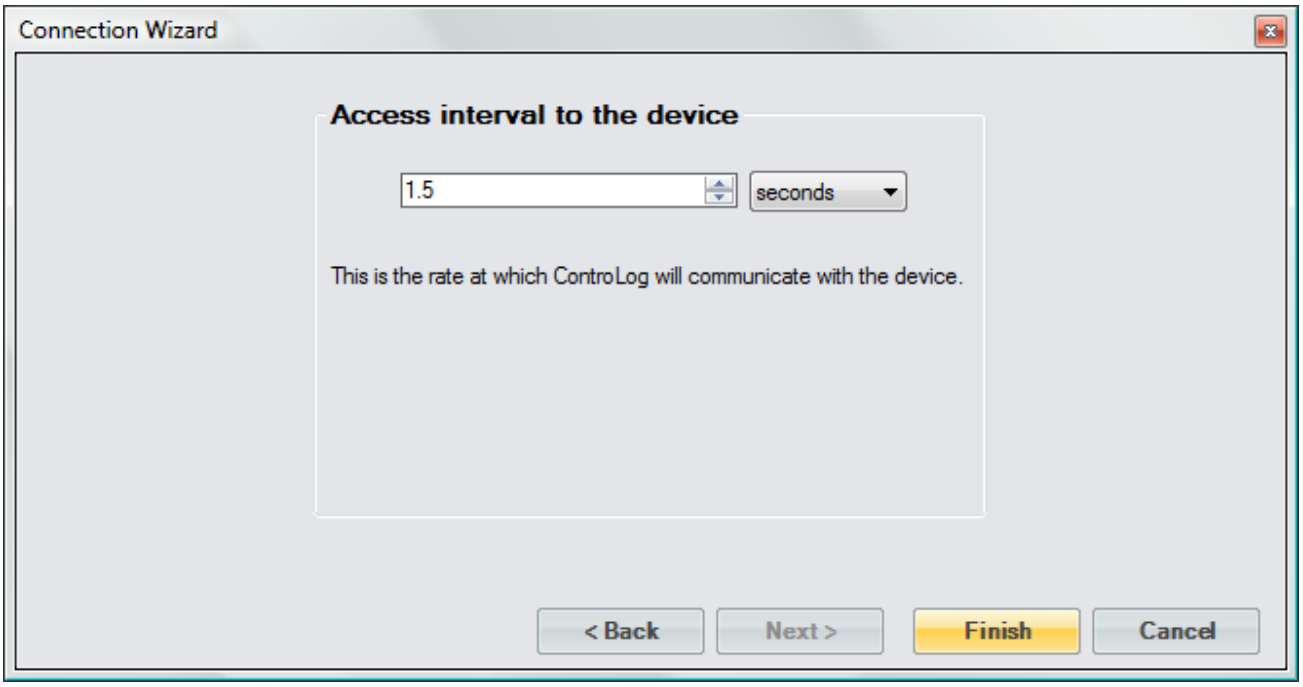
Select to connect to the device now.



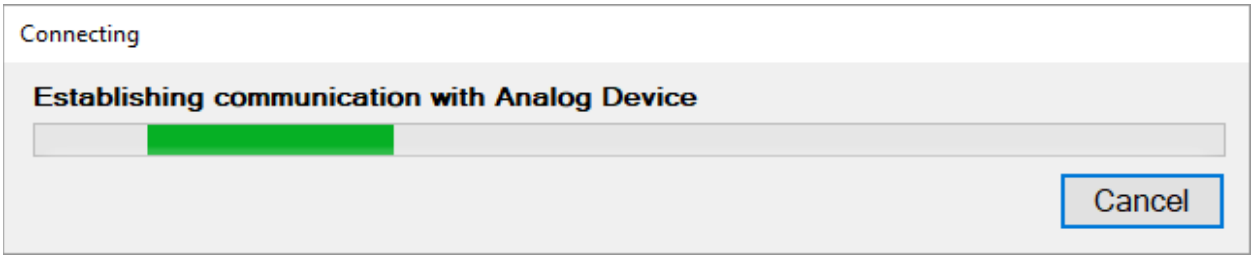
Select the communication port that the Agilent® 34970A Data Acquisition/Switch Unit is connected to and select the port settings for the 34970A.



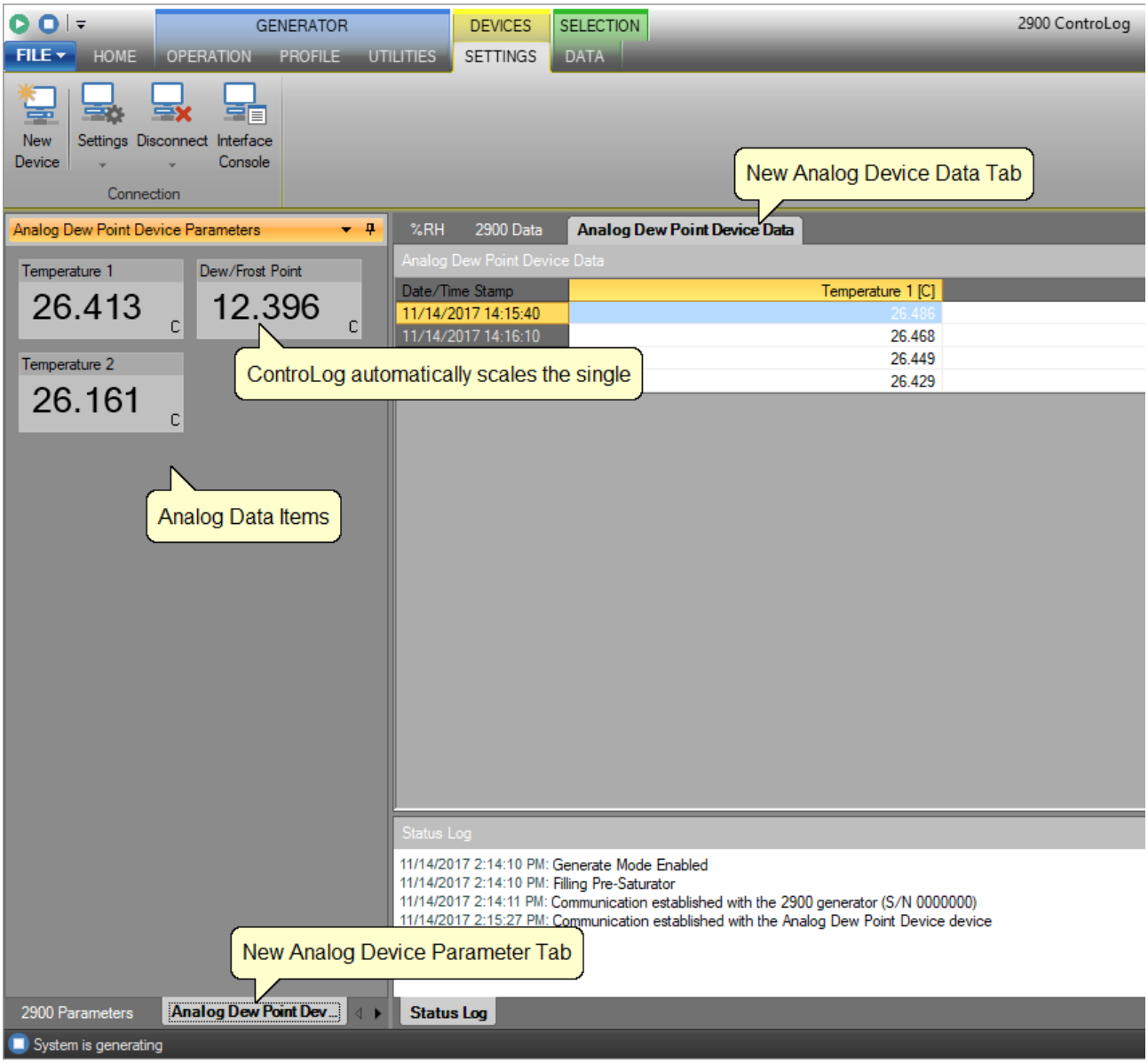
Enter a sufficient access interval for the number of signals being monitored. In this example we have less than 10 signals, so we can start with the minimum access interval of 1.5 seconds.



Once completed, ControLog will attempt to establish communication with the Agilent® 34970A Data Acquisition/Switch Unit.



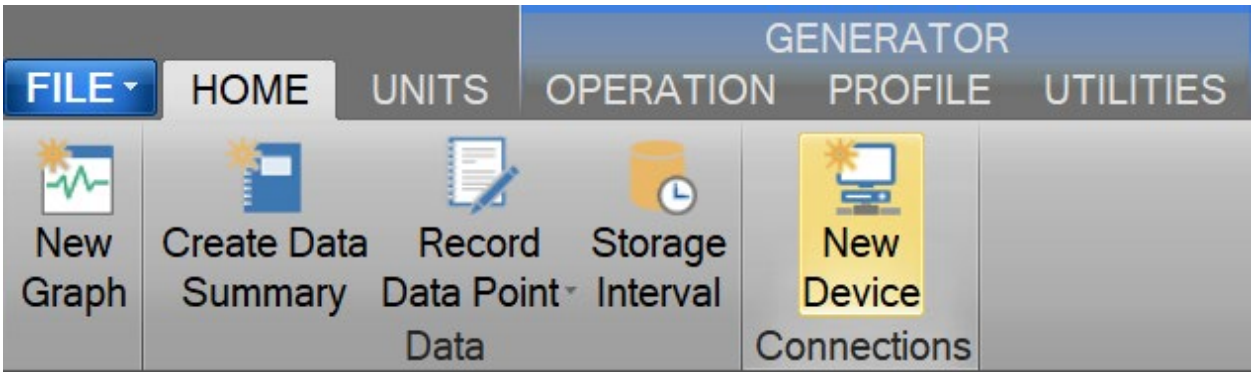
Once communication is successfully established with the 34970A, a new parameter tab and data tab will be created. Notice that ControLog automatically scales the voltage signal based on the definitions described when defining the data item.



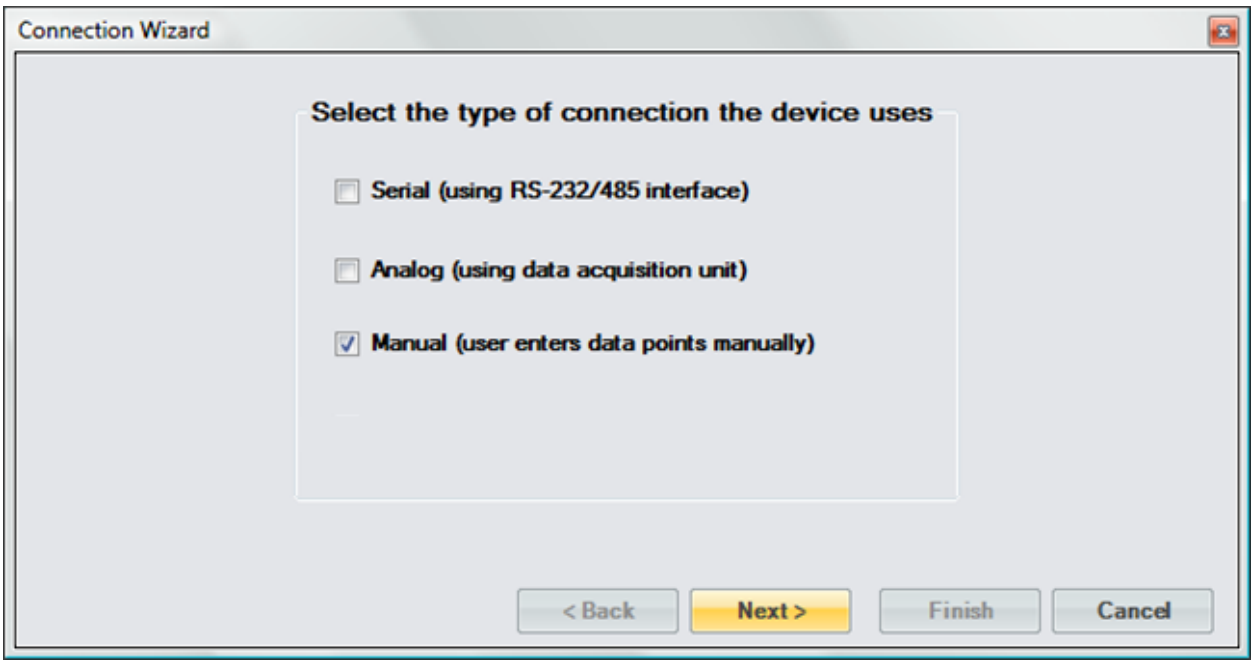
10.3 MANUAL CONNECTION

A Manual Connection allows the user to manually record data items for a device that either has no interface or has an interface that is not supported by ControLog. Manual devices still have their own parameter and data tab, but the data values are manually entered by the user. When the user wants to record values they simply click on the value tile for the data item in the parameter tab and enter the value. Once all data items for the device have been entered, ControLog will record the values into the data tab for the device.

To create a manual connection, select "New" from the Connections menu. This will open a "Connection Wizard" dialog that will step the user through the connection definition process.



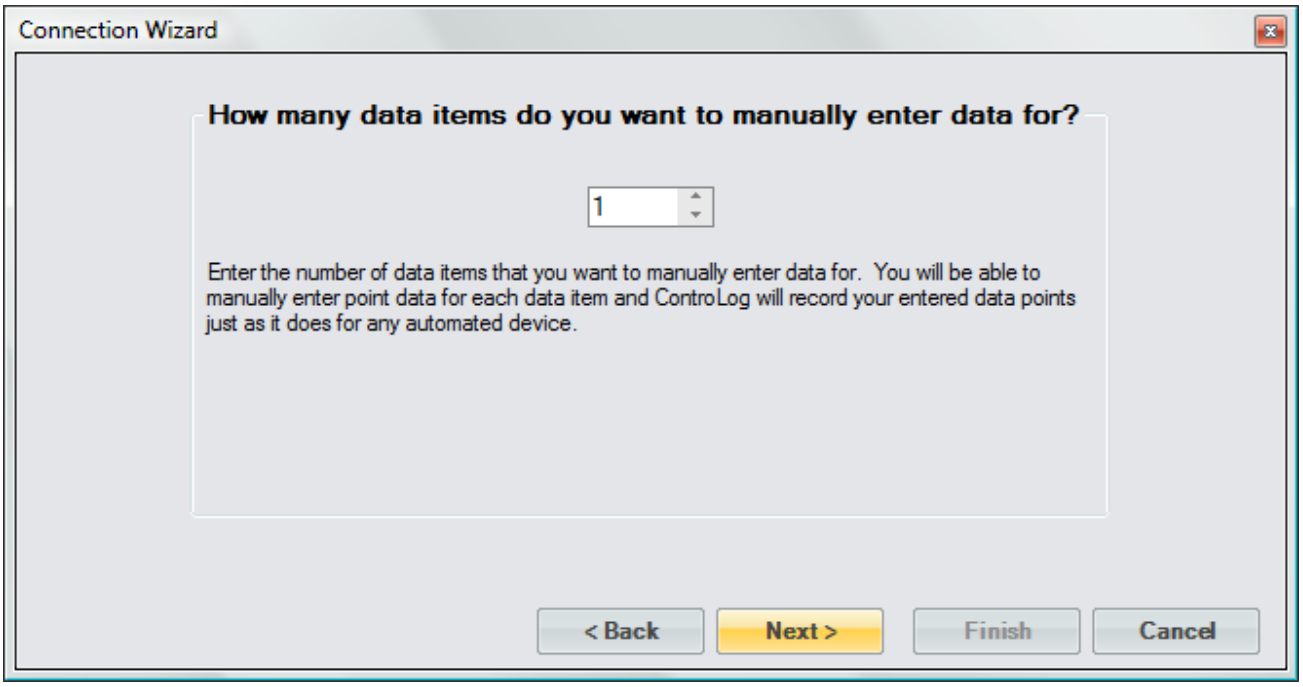
Select "Manual" as the type of connection the device uses.



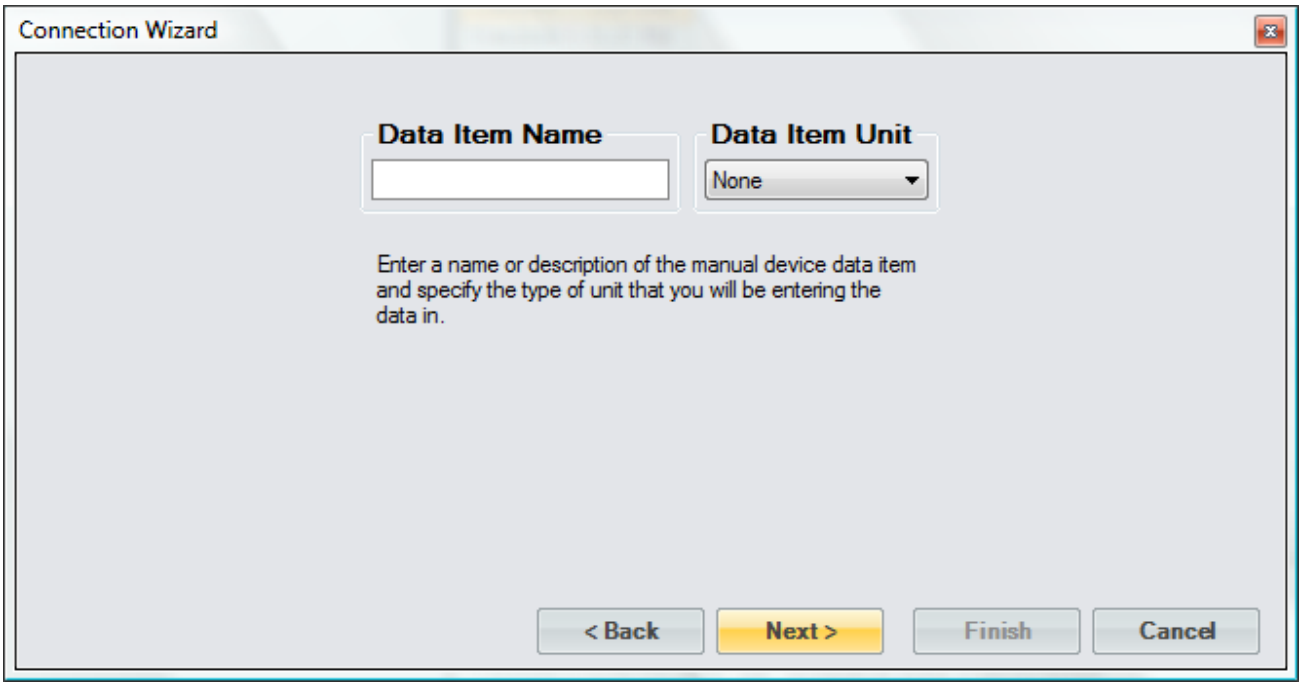
Enter a unique name for the device.



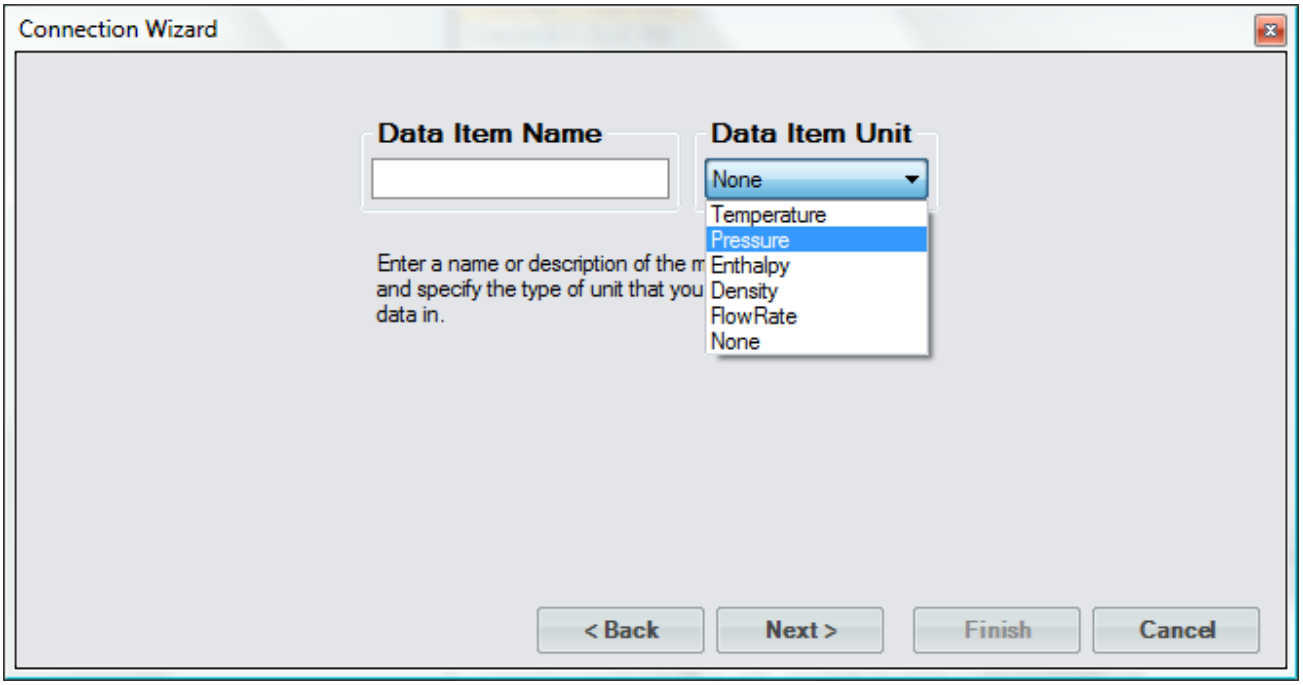
Select the number of manual data entries.



Enter a name or description of the manual device data item and specify the type of unit that you will be entering the data in.



The user only selects the type of unit because all manual entries are entered in the currently selected system unit. For example, if the user creates a manual data item that is a temperature and has the system units set to degrees Celsius, then the user will enter manual values in degrees Celsius. If the system units are set to degrees Fahrenheit, then the user will be required to enter manual values in degrees Fahrenheit.



Select the name and location to save the new manual connection. Clicking the “Browse” button will open a save file dialog that will allow the user to specify the name and browse to the desired location to save the file. All device connection files are saved in XML format with a (*.device) extension.



Last, the user selects whether to connect to the device now or to exit without connecting.

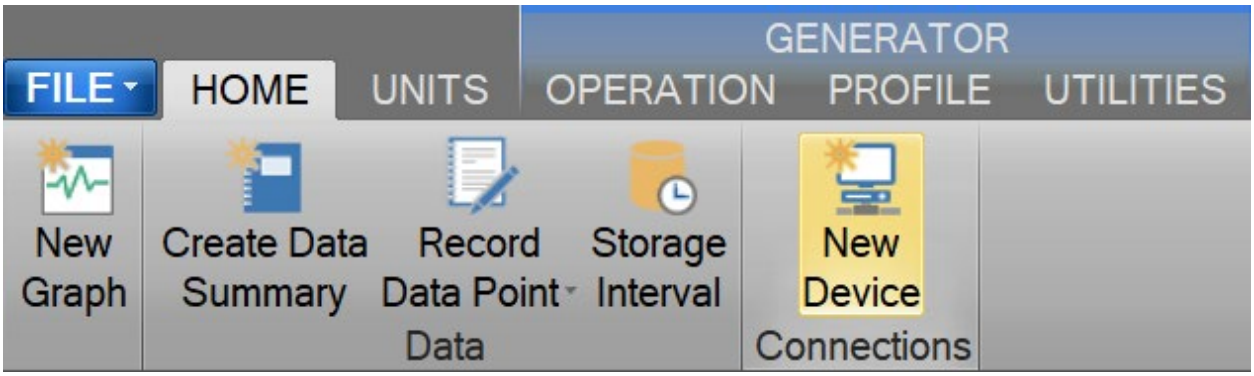
> **Note -** *The user can connect at any time by loading the device from the Connections menu.*



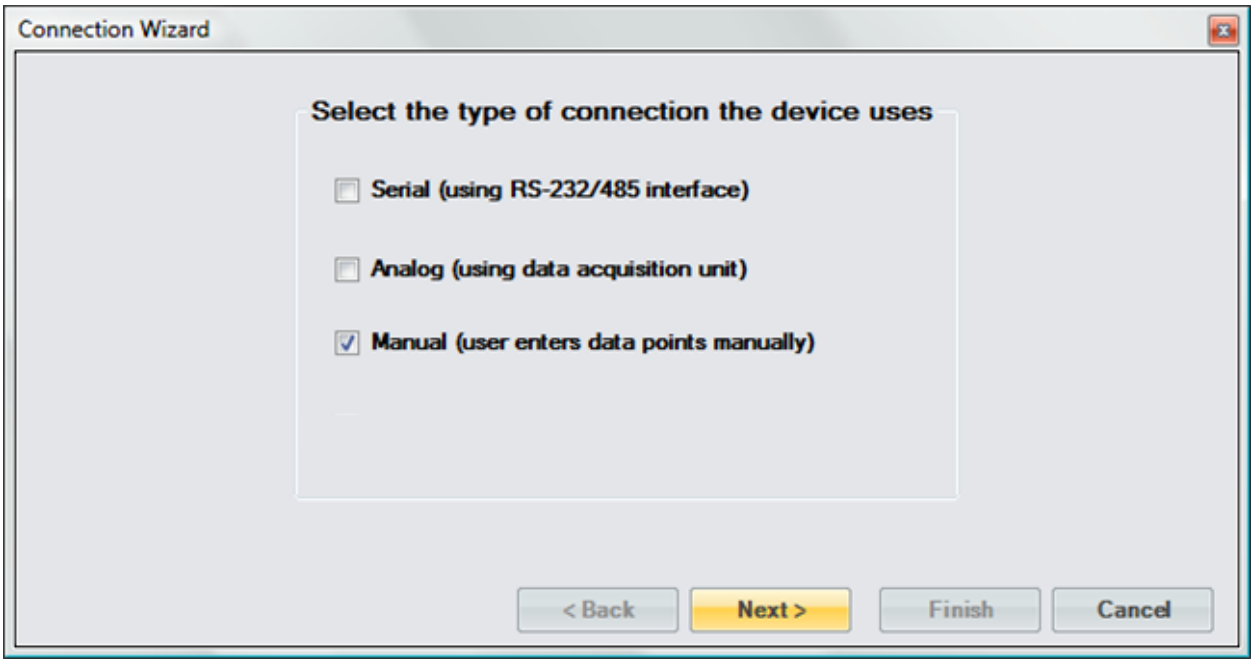
10.3.1 Manual Connection Example

This example will demonstrate the creation of a Manual connection that will consist of three data items: Frost Point, Test Pressure and Test Temperature.

Start by selecting “New” from the Connections menu.



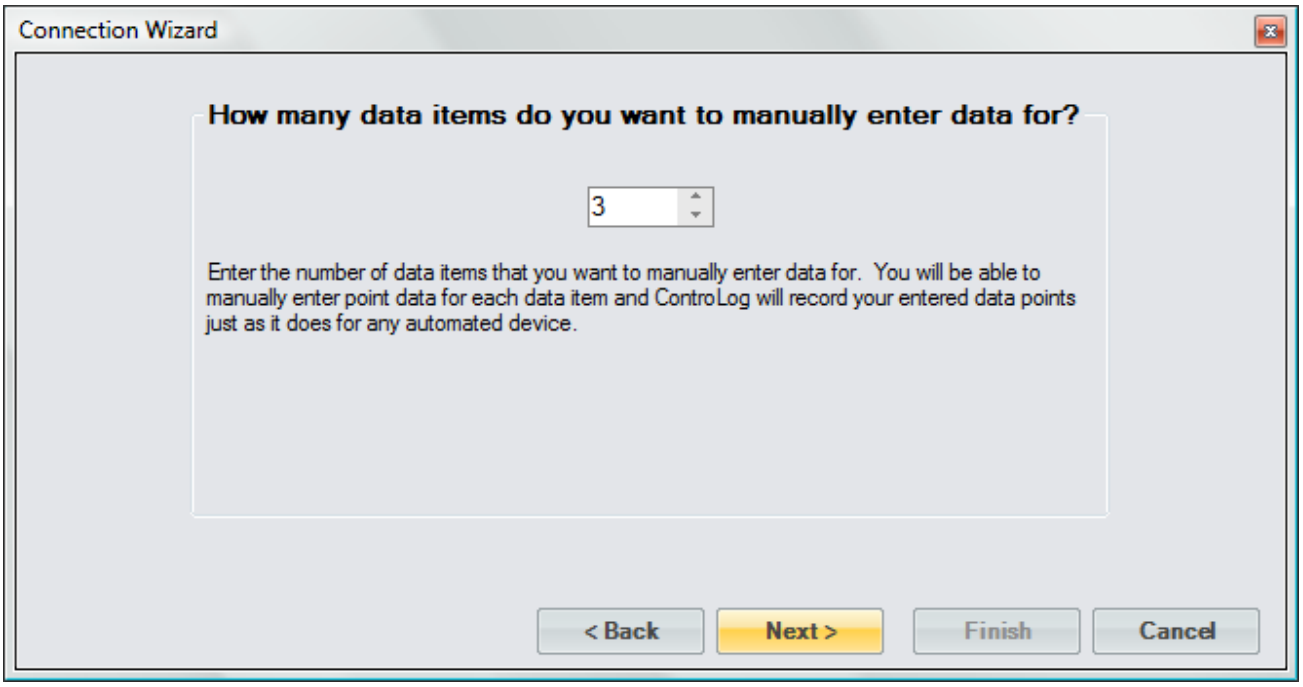
Select “Manual” as the type of connection the device uses.



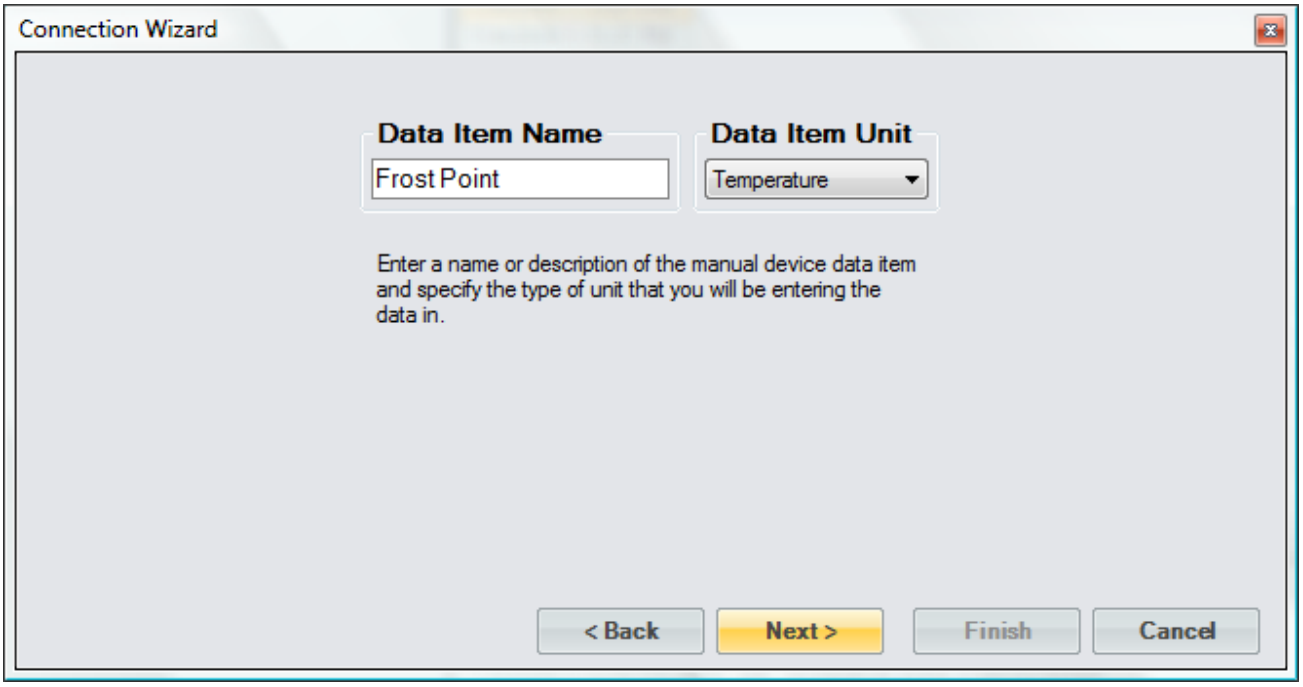
Enter “Manual Device” as the name for the device.



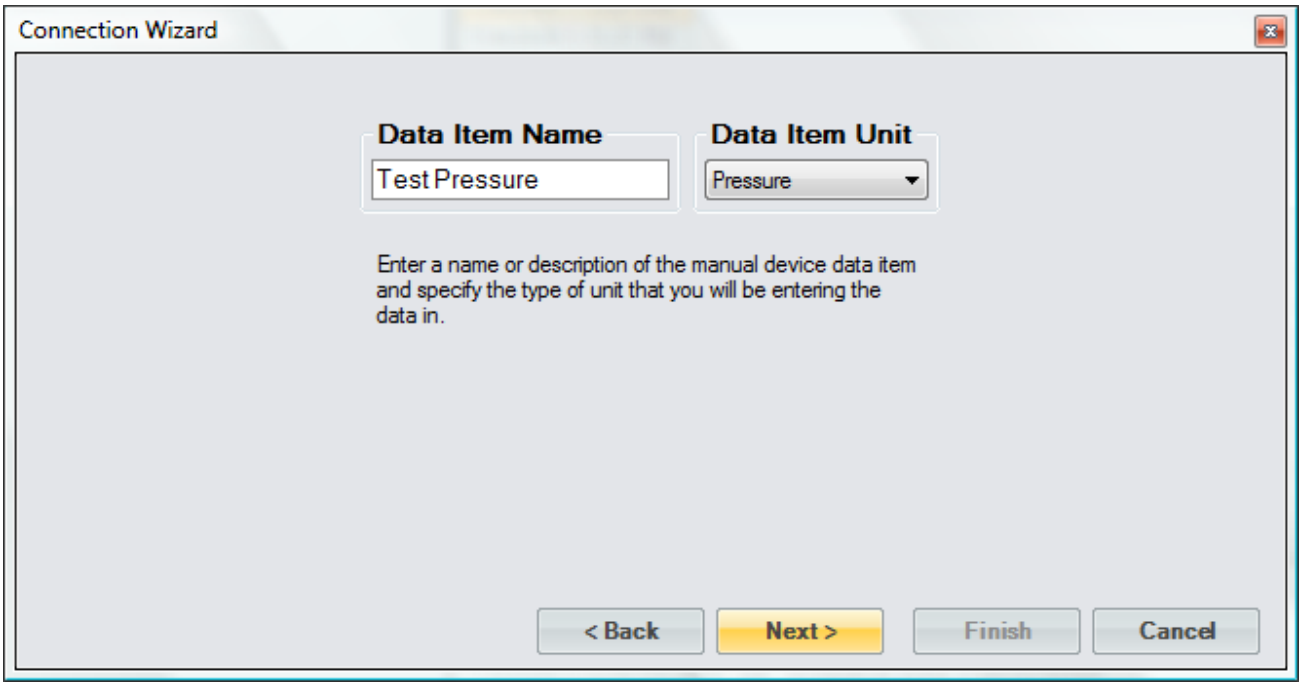
We have three data items that we want to manually enter for this device.



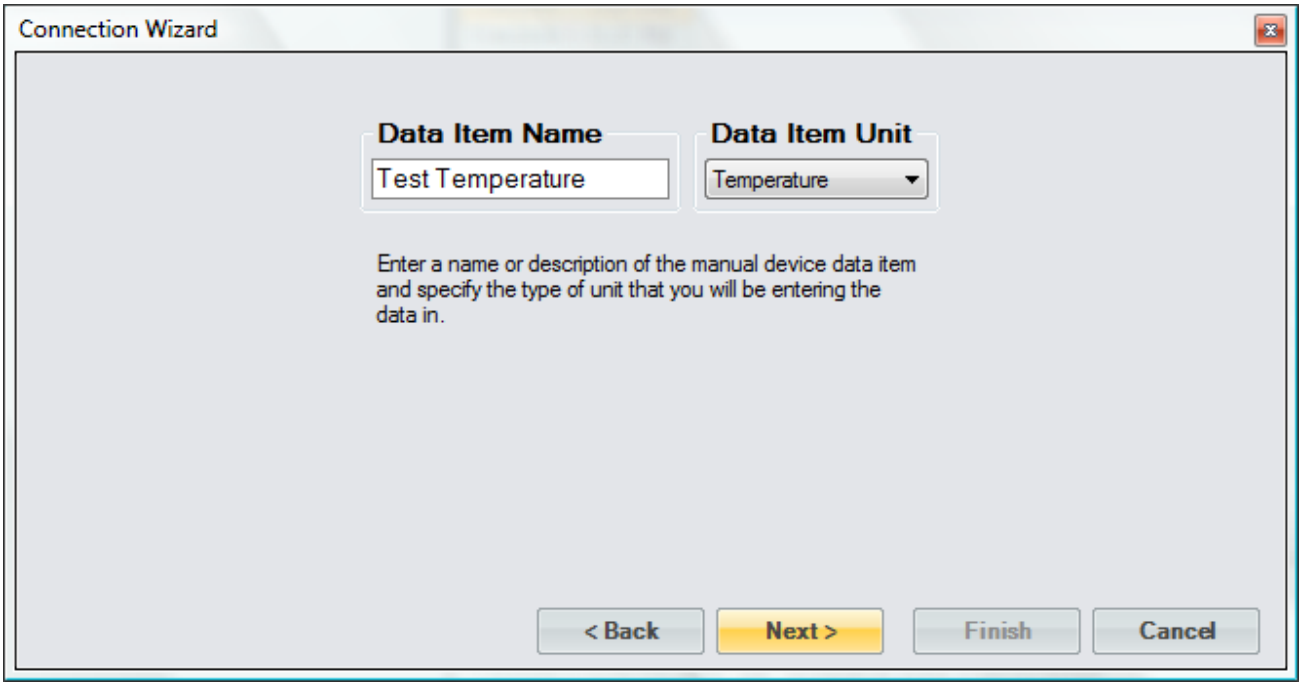
The first point is Frost Point and it will be of the temperature unit type.



The second point is Test Pressure and it will be of the pressure unit type.



The third point is Test Temperature and it will be of the temperature unit type.



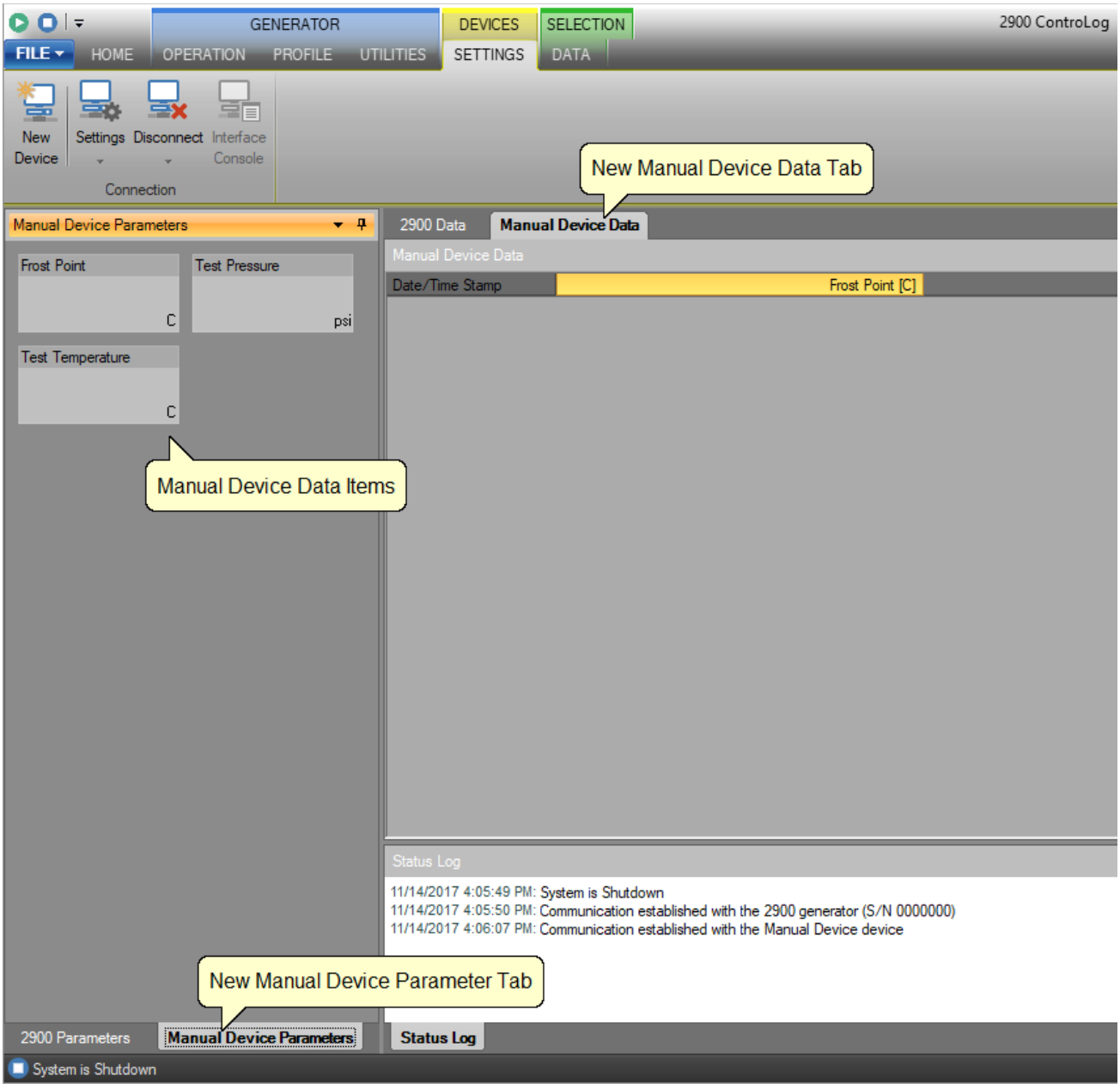
Save the newly created device to a file so that it can be recalled at a later time.



Select to connect to the device now.

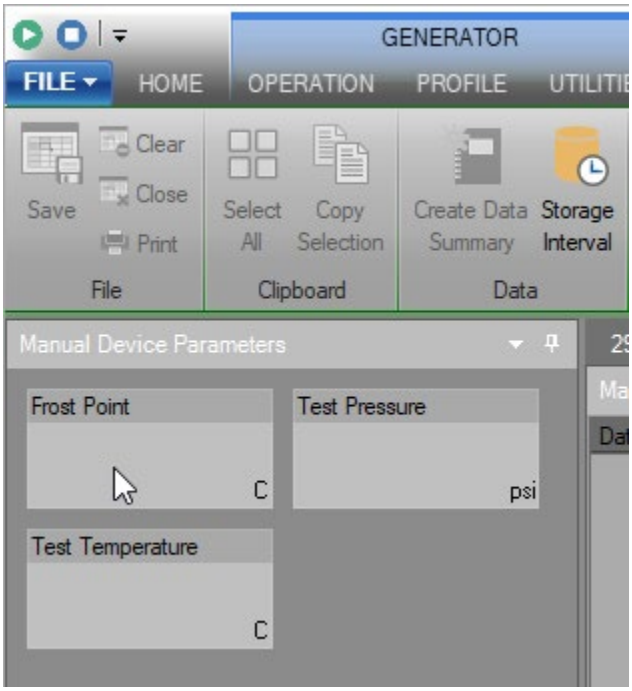


Once completed, a new parameter tab and data tab will be created.

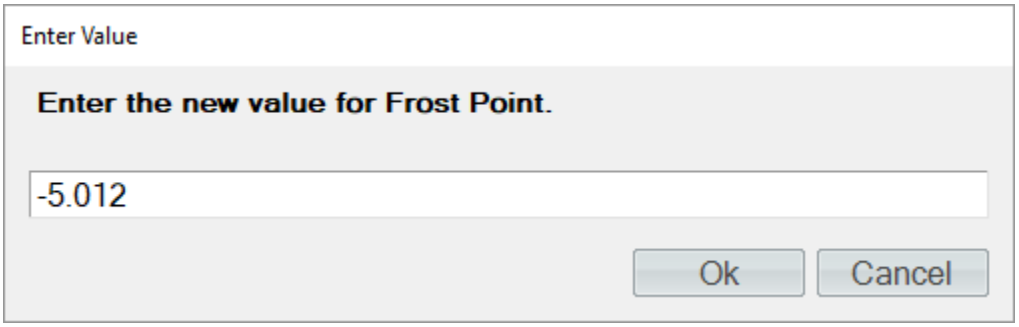


To manually enter a value, click on the value tile you would like to enter. A Manual Entry box will appear, and the title of the manual item being entered will be underlined. For example, to enter a manual value for the Frost Point item click on the Frost Point value tile.

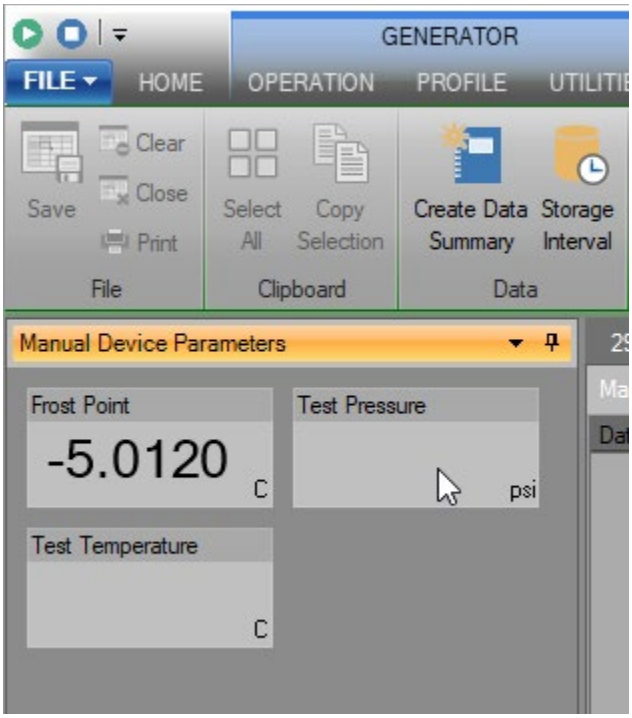
> **Note -** *The manual entries will not be recorded in the data tab until all data item values have been manually entered.*



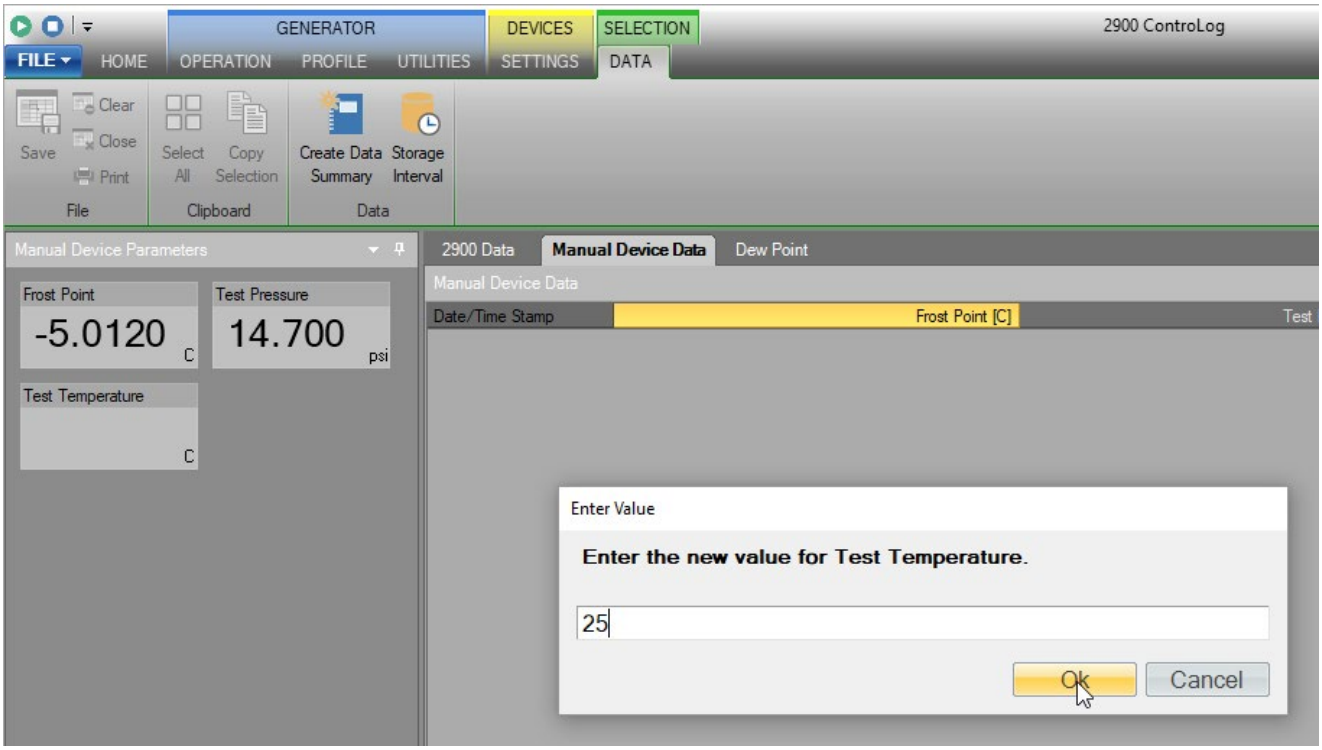
Enter the manual value into the Manual Entry box and select Ok.



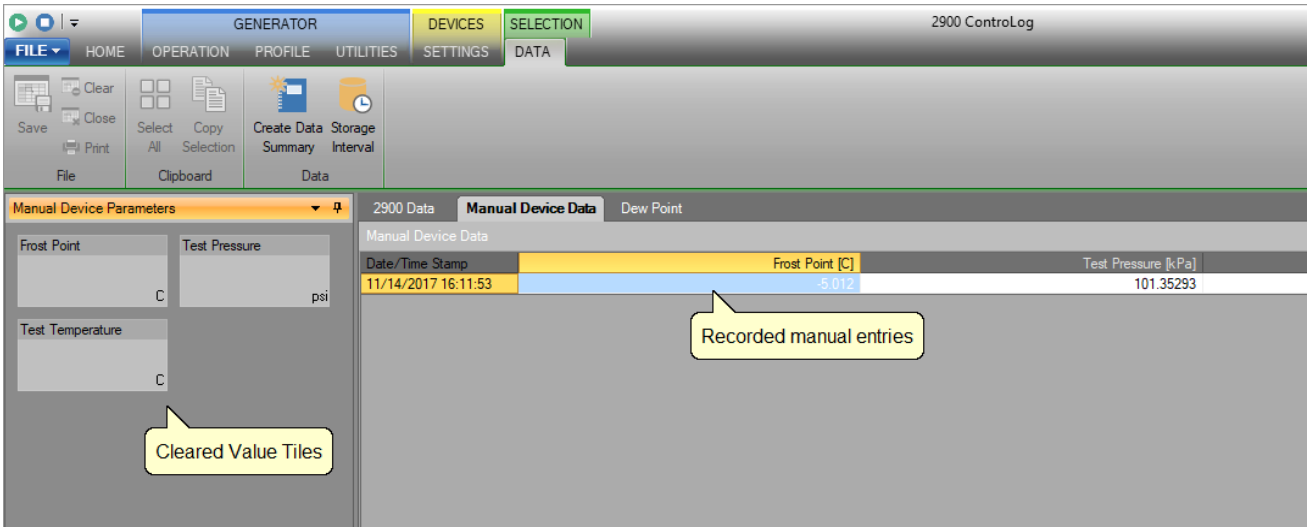
The manual entry will now be displayed in the value tile of the parameter tab.



Repeat the process for the remaining data items.



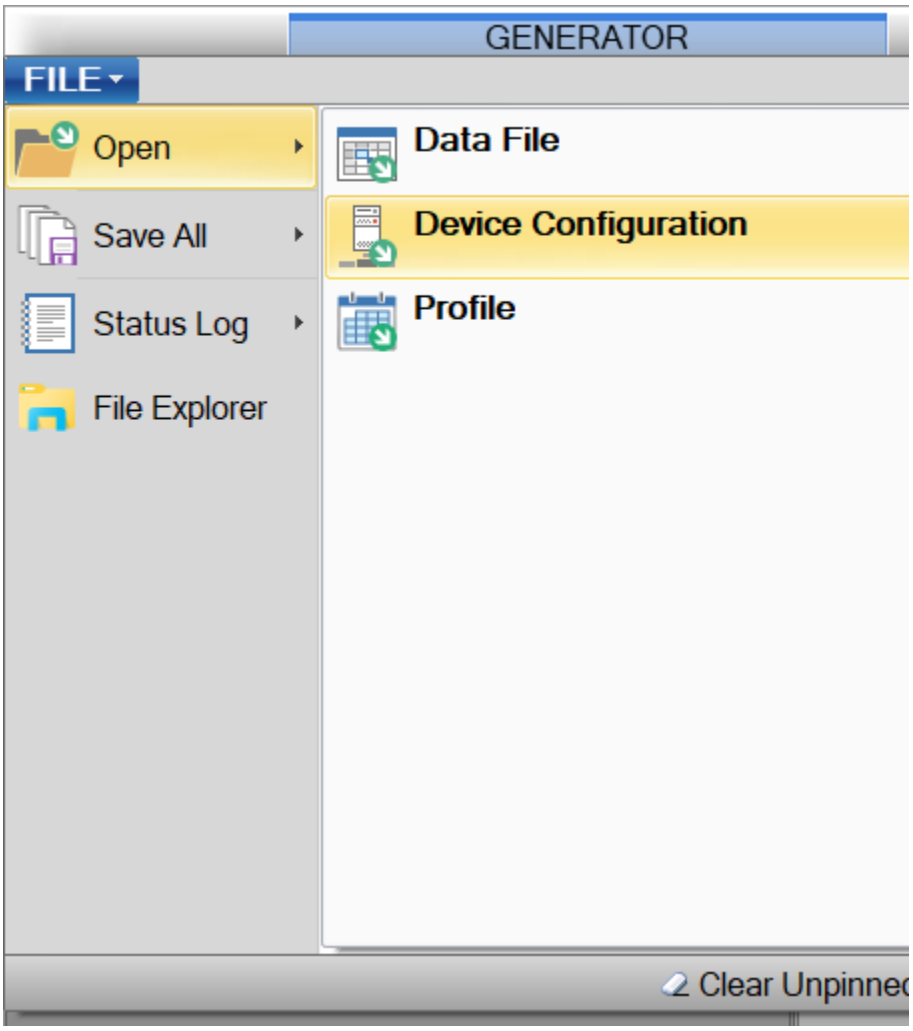
Once all data items have been manually entered, ControLog will record the values and clear out the value tiles in preparation for the next set of manual entries.



10.4 Opening a Device Connection

Saved device connections can be loaded from previously saved device configuration files.

To perform the open, select “Open” from the file menu and select Device Configuration.



11 DATA BACKUP

ControLog does not require any direct backup of its operating files. It is recommended to perform a periodic backup on any user generated files such as uncertainty solutions for the generator, profiles, device setups data files and/or calibration reports or coefficients.

The default location for user data is under the follow directory:

…Documents\Thunder Scientific

Note - *The user has full control as to where to save data and the above directory may not be the location they choose.*

12 SYSTEM

The System is comprised of several sub systems, each with individual yet cooperative functions that operate the Model 3920 Low Humidity Generation System.

12.1 CONTROL SYSTEM

The Control System handles all the control functions needed for humidity generation. It consists of several main components, each with individual yet cooperative functions. The Human Machine Interface (HMI) Computer is the primary interface for the user and communicates setpoints and data to and from the control application. The control application manages the parameters needed to generate the humidity setpoints, pulsing heaters, and operating valves accordingly.

12.1.1 Control Computer

The Model 3920 leverages a NI cDAQ-9174 chassis (DAQ), and dedicated application running on the HMI computer to control the humidity generation process.

12.1.1.1 NI 9216 24-Bit, 100 Ohm RTD Analog Input Module

The NI 9216 resistance temperature detector (RTD) analog input module features eight channels and 24 bits of resolution for PT100 Ω RTD measurements with built-in 50/60 Hz noise rejection. The NI 9216, compatible with 3- and 4-wire RTD measurements, automatically detects the type of RTD (3- or 4-wire) connected to the channel and configures each channel for the appropriate mode. The module provides 1 mA of current excitation per channel.

The Model 3920 is equipped with the DSUB-connector version of the NI 9216 module.

12.1.1.2 NI 9209 ±10 V, 24-Bit Analog Input Module

The NI 9209 voltage input module has 16 differential channels of ±10 V that can be configured as 32 single-ended channels of ±10 V input with built-in 50/60 Hz rejection for noise rejection.

12.1.1.3 NI 9403 TTL Digital Input/Output Module

The NI 9403 is a 32-channel, 7 µs bidirectional digital I/O module. Each channel is compatible with 5 V/TTL signals and features 1,000 Vrms transient isolation between the I/O channels and the backplane. The NI 9403 also features ±30 V overvoltage protection and can source up to 2 mA output current per channel.

12.1.1.4 NI 9401 TTL Digital Input/Output Module

The NI 9401 is an 8-channel, 100 ns bidirectional digital I/O module. The NI 9401 generates 4 separate hardware timed pulse width modulation (PWM) signals. Each channel is compatible with 5 V/TTL signals and features 1,000 Vrms transient isolation between the I/O channels and the backplane.

12.1.2 HMI Computer

The Human Machine Interface (HMI) computer is an embedded PC with a Multi-Point Touch LCD display. It provides the main two user interface components: visual and touch. The visual component provides the operator with a rich data experience, including real-time data values, graphs, uncertainty, and status.

The touch component provides the operator with an intuitive interface to control the operation of the system. The HMI computer runs the ControLog and HumiCalc with Uncertainty software applications.

12.1.3 ControLog® Software

ControLog is an embedded software application that fully automates the operation of the Model 3920 Low Humidity Generation System and allows various device connections through several different interfaces. The ControLog software provides the primary interface to the operator via the multi-point touch LCD and keyboard. Data from the generator and attached devices is automatically retrieved and stored for viewing in either numerical or graphical format in real time or post process. Data can be transferred off the system via a USB drive for further viewing, post processing and printing. Using an external Windows PC (not included) running the desk-top version of ControLog software, the 3920 can be operated remotely/externally. Key features of the of the ControLog software are:

- ControLog stores data into individual data sheets. Each data sheet contains a spreadsheet type view that consists of a date/time stamp and the measured data items corresponding to that date/time stamp. Data sheets consist of three similar but different types: Device Data, File Data and Data Summary. Each type has the same spreadsheet type view and operation, but all three have different data sources.

- Graphing is a powerful tool used to view previously recorded data or to monitor the current data in real-time. The graph works hand in hand with the data sheets. While the generator is in operation, data sheets store the most recent data points from the generator and or connected devices at the desired interval. A graph can be used to create a visual picture of this stored data.

- The Auto Profiling feature is very similar to the Generate mode with the main exception that profiling relies on a predefined list of setpoints referred to as a profile. The user configurable profile is used as ControLog's road map during Auto Profile operation. It defines which setpoint values to go to, at what rate to go from one setpoint to another, and how long to stay at a specific setpoint before moving to the next setpoint.

- ControLog supports a customizable interface that works with most devices. ControLog will allow the user to create a new device connection using the “Connection Wizard” or open previously saved connections. The wizard will open a separate dialog window containing various steps that will guide the user in defining the communication required to receive the desired data items from the device. The user can create as many (up to 60) or as few data items as they see fit for any one device. Each data item can be uniquely named and once connected will be recorded in its own data sheet. ControLog also allows the user to save these interfaces for future use. The “Connection Wizard” allows the user to step through the connection configuration. Using the “Next” and “Back” buttons the user is allowed to progress through the connection configuration steps. At any time, the user may cancel the new connection or opening of a connection by selecting the “Cancel” button. Once the last step has been completed the “Finish” button will be available to complete the new connection.

12.1.4 HumiCalc with Uncertainty® Software

HumiCalc with Uncertainty is an embedded software application that operates in conjunction with ControLog. All humidity calculations, based on the temperature and pressure measurements from the generator, are calculated in real-time using HumiCalc with Uncertainty. This does not stop at calculations as HumiCalc with Uncertainty has the ability to calculate complex humidity uncertainties with ease. This allows the software to calculate real-time uncertainty for the 3920 Humidity Generation System. Key features of the HumiCalc with Uncertainty software are:

Highly accurate formulas that replace charts and tables:

- Automatically applies enhancement factors and temperature and pressure corrections.
- Ability to calculate uncertainty and as found error.
- Each known item now contains an uncertainty field that you can expand to enter individual uncertainty components.

Once the calculation is performed, the newly calculated values are displayed along with the expanded uncertainty values at the desired confidence level. Each calculated result can also be expanded to see the individual components that made up the final expanded uncertainty value.

12.2 ELECTRICAL SYSTEM

Power is applied at the Power Entry Module (PEM) and switched to TB-1. From TB-1 power is applied to the +12 Vdc (DC1) and +24 Vdc (DC2) power supplies and solid-state relays SSR-AC0 (fluid heater H1), SSR-AC1 (refrigeration compressor C1), and SSR-AC2 (refrigeration compressor C2). These solid-state relays are activated by +5 Vdc control signals which will be discussed later.

The +12Vdc power supply (DC1) provides power to the human machine interface computer (HMI), control computer, serial ports, pressure transducers, and supply transducer.

The +24 Vdc power supply (DC2) provides power for the fluid pump (FP1), stepper motors, solenoid valves, expansion valve/tube heat and refrigeration condenser fans (FAN1).

The +5 Vdc power supply (DC3) provides power to the refrigeration pressure transducers, solid state relay boards, flow switch and the fluid pump control signal (thru SSR-DC8).

The +/-15 Vdc power supply (DC4) provides power to the mass flow transducer.

Refer to drawings: 19D3920901-1, 19D3920901-8, 19S3920911

12.2.1 Solid State Relays

The solid-state relays are located within the electrical enclosure. Each SSR controls the operation of specific pneumatic solenoids, refrigeration compressors, fluid heater, and the fluid pump control signal.

12.2.1.1 Condenser Fans

The Condenser Fans (FAN1), activated by SSR-DC7, allows console ventilation and refrigerant condenser (COND) cooling.

12.2.1.2 Fluid Cool Solenoid Valve

The Fluid Cool Solenoid Valve (SOL6), activated by SSR-DC2, allows refrigerant to be injected into the refrigeration evaporator (EX1).

12.2.1.3 Gas Supply Diaphragm Valve

The Gas Supply Diaphragm Valve (DV1), activated by solenoid valve (SOL1) energized by SSR-DC3, allows supply pressure input to the system.

12.2.1.4 Generate Diaphragm Valve

The Generate Diaphragm Valve (DV2), activated by solenoid valve (SOL2) energized by SSR-DC4, allows gas to flow from the flow control valve (V1) through the saturator to the expansion valve.

12.2.1.5 Purge Diaphragm Valve

The Purge Diaphragm Valve (DV3), activated by solenoid valve (SOL3) energized by SSR-DC5, allows reverse gas flow from the flow control valve (V1) through the saturator outlet, through the saturator and through the Pressure Vent Solenoid Valve (SOL5).

12.2.1.6 Pressure Vent Solenoid Valve

The Pressure Vent Solenoid Valve (SOL5), activated by SSR-DC6, vents system pressure. It vents pressure during all SHUTDOWN procedures, and whenever the saturator pressure exceeds 110% of its controlled value due to system malfunction.

12.2.1.7 Fluid Heater

The Fluid Heater (H1) is an AC resistive heating element, activated by a dual solid-state relay SSR-AC0. Heat limit switch (HL1) must be in the normally closed position, indicating that fluid heat is within allowable limits (i.e., below 30 °C).

12.2.1.8 Expansion Valve Heater

The Expansion Tube Heater (H2), is a +24 Vdc heating element, activated by SSR-DC1. It is used to warm the gas in the section of pipe just prior to the expansion valve body. The Expansion Valve Heater (H3), is a +24 Vdc heating element, activated by SSR-DC0. It is used to warm the expansion valve body itself, offsetting the cooling effects due to gas expansion as well as to eliminate condensation on the valve body.

12.2.1.9 Refrigeration Compressor

The Refrigeration Compressor (C1) is connected to AC power through SSR-AC1.

12.2.1.10 Refrigeration Compressor

The Refrigeration Compressor (C2) is connected to AC power through SSR-AC2.

12.2.1.11 Fluid Circulation Pump

The Fluid Pump (FP1) is powered by +24 Vdc. The speed control signal is connected to +5 Vdc power through SSR-DC8.

12.3 PNEUMATIC SYSTEM

The pneumatic system of the Model 3920 is designed as an open loop two-pressure system. Gaseous nitrogen enters the generating system at the gas inlet and is admitted through the line filter (LF1) to the pressure regulator (REG). Supply pressure is regulated to 250 psiG or less as measured by the supply pressure transducer (T3). After regulation, the gas stream is admitted through the gas supply valve (DV1/SOL1), through the mass flow meter(T4) to the flow control valve (V1).

A) Generate Mode:
The gas flows from the flow control valve (V1), through the activated Generate Valve (DV2/SOL2) and passes through the saturator. As the gas passes through the saturator the gas is saturated with water vapor as the gas establishes thermal equilibrium within the saturator. The saturation pressure, Ps (T1), and saturation temperature, Ts (RTD1), of the gas are then measured near the exit of the saturator. Upon exiting the saturator, the saturated gas encounters the Expansion Valve (V2) and the saturation pressure is reduced to test pressure. The gas stream, at the desired humidity, test pressure Pt (T2) and test temperature Tt (RTD2) conditions, enters the device under test from the fitting located on the countertop. The gas flows through the device under test and is then vented to the atmosphere.

B) Purge Mode:
The gas flows from the flow control valve (V1), through the activated Purge Valve (DV3/SOL3), through the Saturator then through the Pressure Vent solenoid valve (SOL5) and exits at the vent fitting. By reversing the normal gas flow path in this manner, it is possible to purge the saturator outlet and associated tubing of any condensation and/or water vapor.

Refer to drawings: 19D3920901-1, 19S3920918-1, 19S3920918-2, 19S3920318-3

12.3.1 Pressure Measurement

There are seven pressure transducers in the system. T1 is used for control and measurement of the saturation pressure and T2 is used for the measurement of the test pressure. T3 is used for measurement of the supply pressure. T5 and T6 are used for control of the first stage refrigeration system (C1). T7 and T8 are used for control of the second stage refrigeration system C2.

T1 = SATURATOR PRESSURE
T2 = TEST PRESSURE
T3 = AIR/GAS SUPPLY
T5 = C1 REFRIGERATION LOW-SIDE
T6 = C1 REFRIGERATION HIGH-SIDE
T7 = C2 REFRIGERATION LOW-SIDE
T8 = C2 REFRIGERATION HIGH-SIDE

12.3.2 Mass Flow Rate Measurement

The mass flow meter is used for feedback control of the water vapor corrected mass flow rate through the system.

T4 = MASS FLOW METER

12.3.3 Saturator

Saturation of the gas stream with water vapor, upstream of the expansion valve, is accomplished in a multi-plate type heat exchanger. This assembly is located within the insulated area under the countertop. The gas is made to flow through the saturator, while temperature-controlled fluid flows around the saturator in the opposite direction of the gas stream. As the gas flows through the saturator, the gas establishes thermal equilibrium ensuring that the gas is fully saturated with water vapor at saturation temperature. The Saturation Pressure (T1) and Saturation Temperature (RTD1) are monitored as the gas exits the saturator. These measurements are used in the calculation and control of the desired humidity parameter.

12.3.4 Flow Control Valve

The Flow Control Valve (V1) is a 1/4 turn diaphragm valve actuated by a gear reduced intelligent hybrid stepper motor and is used to control mass flow rates through the generating system. The computer-controlled flow control valve allows the mass flow rate to be controlled by varying the orifice of the flow control valve from nearly closed to fully open depending upon the required, water vapor corrected, mass flow rate.

12.3.5 Expansion Valve

After exiting the saturator, the saturated high-pressure airstream is reduced to test pressure after the expansion valve. The Expansion Valve (V2) is a 1/4 turn diaphragm valve actuated by a gear reduced intelligent hybrid stepper motor and allows the saturated high-pressure gas stream to be reduced to Test Pressure (T2) by varying the orifice of the expansion valve from nearly closed to fully open depending upon the required saturator pressure and water vapor corrected mass flow rate. This valve is heated and thermally controlled by RTD3 to maintain the valve body and associated tubing to near ambient temperature.

12.3.6 Test Pressure

Test pressure (T2) is normally ambient barometric pressure. Manual control of test pressure can be performed by using a back-pressure regulator at the exit of the device under test.

12.4 SATURATOR FLUID SYSTEM

Temperature conditioning of the saturator employs a thermal fluid circulation system in conjunction with a cascade refrigeration system. In this closed loop non-pressurized system, temperature conditioned methanol is circulated by a magnetically coupled centrifugal pump (FP1) at approximately two gallons per minute. The fluid is piped from the circulation pump outlet and enters the immersion heater housing, flows over the immersion heater (H1) and into the R-23 refrigeration evaporator (EX1) where excess heat is removed. The fluid is then pumped into the saturator fluid jacket where the saturation temperature (RTD1) is measured and controlled. The fluid is pumped around the saturator (SAT) and then exits to the circulation pump intake, completing the saturator fluid circuit.

Refer to drawings: 19D3920901-1, 19D3920901-7, 19S3920917

12.4.1 Fluid Heating

The saturator fluid system is heated by a 500-watt, stainless steel immersion heater (H1). This heater is installed into a copper heater housing located in the main fluid path, between the circulation pump (FP1) outlet and the refrigeration evaporator (EX1) inlet. Primary power to the immersion heater is switched by a solid-state relay (SSR-AC0). Over-temperature disconnect of the immersion heater is provided for by a temperature sensing element (HL1) that disconnects the primary power to the immersion heater.

12.4.2 Fluid Refrigeration

The saturator fluid system is cooled by two hermetic refrigeration systems in cascade.

The high stage refrigeration system utilizes Refrigerant 513A. This refrigerant is compressed from a low-pressure vapor into a high-pressure vapor by compressor (C1). The high-pressure vapor flows to the air-cooled condenser (COND) where the vapor is condensed to a high-pressure liquid as heat is removed. The condensed refrigerant passes through the filter drier (FD1) to the thermo-expansion valve (EXV1). Refrigerant is metered into the intercooler (EX2), heat is removed, and the heat laden vapor is piped back to the compressor and the cycle is repeated.

The low stage refrigeration system utilizes Refrigerant 23, which has a boiling point of -81.4°C. The refrigerant is compressed from a low-pressure vapor to a high-pressure vapor by compressor (C2). The high-pressure vapor flows to the intercooler (EX2) where heat is removed, and the vapor is condensed to a high-pressure liquid. Upon cooling demand, refrigerant is metered from the cool solenoid valve (SOL6) into the saturator fluid heat exchanger/R-23 evaporator (EX1). The refrigerant expands and changes to a low-pressure vapor as it absorbs heat from the saturator fluid circuit. The vapor is then piped back to the suction side of the compressor and the cycle is repeated.

12.4.3 Temperature Measurement

There are four 100Ω Platinum Resistance Thermometer probes in the system. The probes are used for the control and measurement of the Saturation Temperature (RTD1), Test Temperature (RTD2), Expansion Valve Temperature (RTD3), and Cabinet Temperature (RTD4).

12.4.4 Fluid Flow Pressure Switch

The fluid flow pressure switch (FS1) is used to indicate that the circulation pump is running, and that the thermal transfer fluid is circulating within the system.

13 MAINTENANCE

The Model 3920 Low Humidity Generation System requires only periodic maintenance. Following the proper operating procedures as given in this manual will help assure trouble-free operation of this system.

⚠ CAUTION!

ALWAYS USE THE FILE>TURN OFF COMMAND TO PROPERLY EXIT THE SOFTWARE AND SHUTDOWN THE COMPUTERS SO THAT THE MAIN POWER SWITCH CAN BE SWITCHED OFF.

13.1 HEAT TRANSFER FLUID

Interval: **Yearly**

⚠ Warning!

USE CAUTION WHEN HANDLING METHANOL.
METHANOL IS FLAMMABLE AND POISONOUS
KEEP AWAY FROM SPARKS, FLAMES, OR OTHER
IGNITION SOURCES. AVOID PROLONGED OR REPEATED
BREATHING OF VAPORS OR CONTACT WITH SKIN. **SEE SECTION 2.3 FOR IMPORTANT SAFETY INFORMATION.**

Check fluid level yearly. Refer to section *2.11.3.1 Saturator Fluid Filling Procedure*

Refer to drawing: 19D3920920

13.2 CLEANING

Interval: **Yearly or as needed**

Wipe down countertop and powder-coated surfaces with a mild, non-abrasive cleaner. Dispose of used cleaning materials properly.

Clean refrigeration condenser of dust and lint or any debris.

Refer to drawings: 19D3920901-3, 19D3920901-7

13.3 CLEAN REFRIGERATION CONDENSER

Interval: **Yearly**

Clean refrigeration condenser of dust and lint or any debris.

Refer to drawings: 19D3920901-3, 19D3920901-7

13.4 3920 Fluid Flow Pressure Switch Adjustment

Interval: **If required**

The fluid flow pressure switch (FS1) is used to indicate that the circulation pump is running, and that the thermal transfer fluid is circulating within the system. This switch is only used to detect possible issues or failures of the circulation system. If you receive the "No Fluid Flow - Check Fluid Circulation System" error message and you can confirm the fluid pump is running, then it is possible the fluid flow pressure switch (FS1) needs to be adjusted.

Tools required:

- Phillips screwdriver.
- Flat head screwdriver.
- 5/64 Allen wrench.
- Voltmeter.

1. View the Saturation Temperature and if the Saturation Temperature is below 0 °C, then adjust the dew point to 2 °C or warmer and adjust the saturation temperature to 5 °C or warmer. Allow the Saturation Temperature to warm above 0 °C and stabilize before proceeding to allow all ice in the saturator to completely melt.

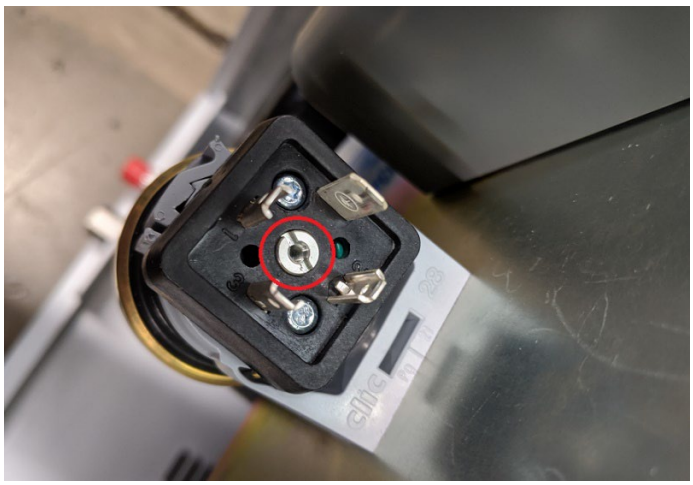
2. Shutdown the generator by selecting Shutdown from the run menu. (leave power on)

3. Remove rear panel.

4. Using a Phillips screwdriver loosen the retainer screw from fluid flow pressure switch and
5. remove the electrical connector.

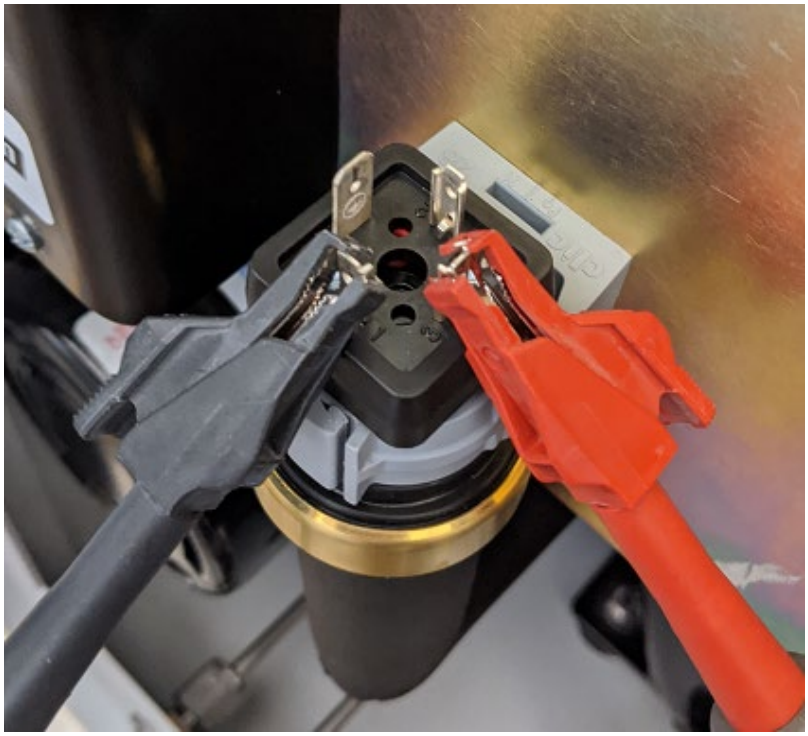


6. Remove the connector nut in the middle of the switch to gain access to the adjuster.





7. Place voltmeter probes on pin 1 and pin 3 of the switch.



8. Switch voltmeter to continuity check.



9. Use a 5/64 Allen wrench to adjust the switch.



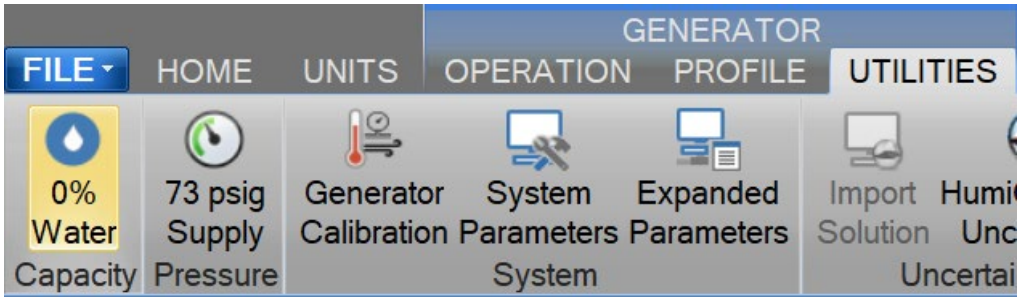
- If the voltmeter shows no continuity, then turn the adjustment screw clockwise until the voltmeter shows continuity. Once continuity is found then slowly turn counterclockwise until the voltmeter shows no continuity.

- If the voltmeter shows continuity, then slowly turn the adjustment screw counterclockwise until the voltmeter shows no continuity.

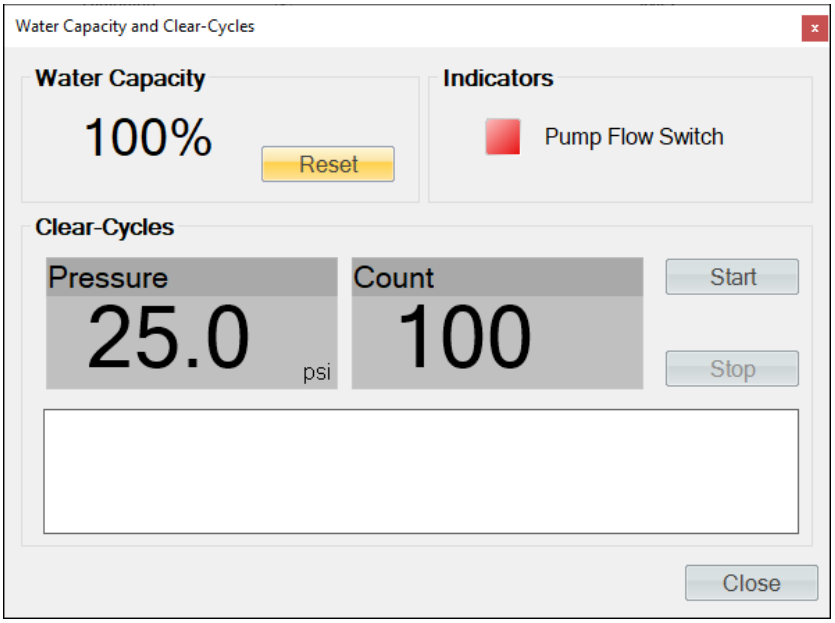
10. Replace connector nut.

11. Replace electrical connector and tighten retainer screw.

12. To test the switch operation, access the Water Capacity and Clear-Cycle dialog by selecting Water Capacity from the Generator Utilities menu.

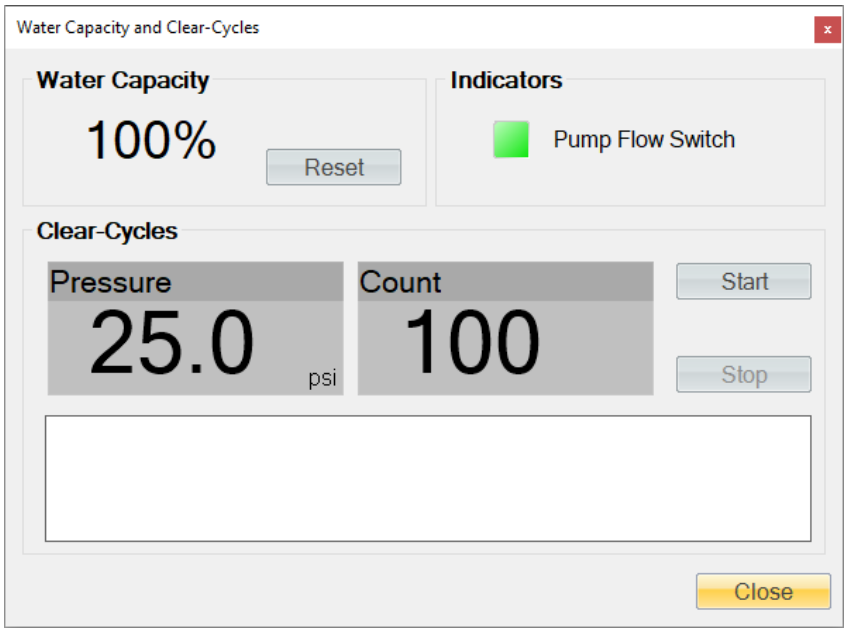


13. Assure the Pump Flow Switch indicates Red as the generator is shutdown and the fluid pump is not running.



14. Press the red square or “Pump Flow Switch” text to start the fluid pump test. The pump will run for 30 seconds.

15. Assure that during the 30 second test the Pump Flow Switch indicates Green.



16. Once the test completes and the pump stops assure the Pump Flow Switch indicates Red. Note this may take several seconds as the fluid pressure on the switch slowly equalizes.

17. Replace rear panels.

13.5 Warning and Error Messages

Prior to system start-up, and during humidity generation, the system monitors itself for warnings, errors and sources of possible malfunction. All warning and error messages are automatically logged in the status log and displayed in the 3920 Reported Errors tab. Catastrophic errors will result in an automatic shutdown. While it is not necessary to understand the error message, it is important to write down the error message exactly as it appears when contacting Thunder Scientific for technical support.

13.5.1 Saturation Temperature at Minimum Limit

This error indicates the saturation temperature probe (RTD1) is reading below its minimum value for a specific amount of time. A failed probe or incorrect calibration are the most common causes of this error.

13.5.2 Saturation Temperature Over Range or at Maximum Limit

This error indicates the saturation temperature probe (RTD1) is reading above its maximum limit value for a specific amount of time or has reached its over range point. A failed probe or incorrect calibration are the most common causes of this error, but other causes are also possible such as a faulty heater control component.

13.5.3 Test Temperature at Minimum Limit

This error indicates the test temperature probe (RTD2) is reading below its minimum value for a specific amount of time. A failed probe or incorrect calibration are the most common causes of this error.

13.5.4 Test Temperature Over Range or at Maximum Limit

This error indicates the test temperature probe (RTD2) is reading above its maximum limit value for a specific amount of time or has reached its over range point. A failed probe or incorrect calibration are the most common causes of this error.

13.5.5 Expansion Valve Temperature at Minimum Limit

This error indicates the expansion valve temperature probe (RTD3) is reading below its minimum value for a specific amount of time. A failed probe is the most common cause of this error. It is also possible to receive this error if the generator is being operated in an environment that is outside the generator's operating temperature range.

For more information, refer to section 2.10 Facility Requirements

13.5.6 Expansion Valve Temperature Over Range or at Maximum Limit

This error indicates the expansion valve temperature probe (RTD3) is reading above its maximum limit value for a specific amount of time or has reached its over range point. A failed probe is the most common cause of this error. It is also possible to receive this error if the generator is being operated in an environment that is outside the generator's operating temperature range.

For more information, refer to section 2.10 Facility Requirements

13.5.7 Cabinet Temp Over Range or at Min/Max Limit - Check Condenser Fans

This warning indicates the cabinet temperature probe (RTD4) is reading below its minimum value or above its maximum value for a specific amount of time. Insufficient floor space around the generator, obstruction within the refrigeration condenser such as lint and condenser fans not operating are the most common cause of this warning. It is also possible to receive this warning if the generator is being operated in an environment that is outside the generators operating temperature range.

For more information, refer to section 2.10 Facility Requirements

13.5.8 Saturation Pressure at Minimum Limit

This error indicates the test pressure transducer (T1) is reading below its minimum value for a specific amount of time. A failed transducer or incorrect calibration are the most common causes of this error.

13.5.9 Saturation Pressure Over Range or at Maximum Limit

This error indicates the saturation pressure transducer (T1) is over range or has been at its maximum limit value for a specific amount of time. A failed transducer or incorrect calibration are the most common causes of this error. Also, if fittings, tubing and the instrument under test are connected to the Test Port, assure that the UUT can pass the generated flow rate and is not causing any back pressure or blockage.

13.5.10 Saturation Pressure Transducer Not Responding

This error indicates the saturation pressure transducer (T1) is not responding to commands from the computer. A failed transducer is the most common cause of this error, but a disconnected or damaged serial cable or serial adapter could also be the cause.

13.5.11 Test Pressure at Minimum Limit

This error indicates the test pressure transducer (T2) is reading below its minimum value for a specific amount of time. A failed transducer or incorrect calibration are the most common causes of this error.

13.5.12 Test Pressure Over Range or at Maximum Limit

This error indicates the test pressure transducer (T2) is over range or has been at its maximum limit value for a specific amount of time. A failed transducer or incorrect calibration are the most common causes of this error.

13.5.13 Test Pressure Transducer Not Responding

This error indicates the pressure transducer (T2) is not responding to commands from the computer. A failed transducer is the most common cause of this error, but a disconnected or damaged serial cable or serial adapter could also be the cause.

13.5.14 Insufficient Supply Pressure to Generate or Purge

This error indicates there is insufficient supply pressure to start generating or purging or to continue generating or purging. Ensure the gas supply is on and meets the supply pressure requirements for the generator. Ensure all values in the supply line are open.

For more information, refer to section 2.10 Facility Requirements

13.5.15 Low Supply Pressure

This warning indicates there is a low supply pressure and that the user should check the gas supply. It is quite common to operate the system from a non-permanent gas source such as compressed bottled gas or a LN2 Dewar. These gas sources eventually become depleted and require changing.

For more information, refer to section 4.1.6.2.1 Changing Gas Supply

13.5.16 Supply Pressure Over Range or at Maximum Limit

This error indicates the supply pressure transducer (T3) is over range or has been at its maximum limit value for a specific amount of time. Check the supply pressure regulators to assure the incoming supply pressure is regulated to the supply pressure requirements for the generator.

For more information, refer to section 2.10 Facility Requirements

13.5.17 Mass Flow Rate at Minimum Limit

This error indicates the flow transducer (T4) is reading below its minimum value for a specific amount of time. A failed flow meter is the most common cause of this error.

13.5.18 Mass Flow Rate Over Range or at Maximum Limit

This error indicates the flow transducer (T4) is over range or has been at its maximum limit value for a specific amount of time. A failed flow meter is the most common cause of this error.

13.5.19 Refrigeration Compressor C1 Low Side Pressure at Minimum Limit

This error indicates the pressure transducer (T5) is reading below its minimum value for a specific amount of time. A refrigeration leak or failure is the most common cause of this error. Other causes are a failed timer relay (TR5), failed +5 VDC power supply (DC3), or a failed transducer (T5).

13.5.20 Refrigeration Compressor C1 Low Side Pressure Over Range or at Maximum Limit

This error indicates the pressure transducer (T5) is over range or has been at its maximum limit value for a specific amount of time. A refrigeration system failure is the most common cause of this error. It is also possible to receive this error if the generator is being operated in an environment that is outside of the generator's operating temperature range.

13.5.21 Refrigeration Compressor C1 High Side Pressure at Minimum Limit

This error indicates the pressure transducer (T6) is reading below its minimum value for a specific amount of time. A refrigeration leak or failure is the most common cause of this error. Other causes are a failed timer relay (TR5), failed +5 VDC power supply (DC3), or a failed transducer (T6).

13.5.22 Refrigeration Compressor C1 High Side Pressure Over Range or at Maximum Limit

This error indicates the pressure transducer (T6) is over range or has been at its maximum limit value for a specific amount of time. A refrigeration system failure is the most common cause of this error. It is also possible to receive this error if there is insufficient floor space around the generator or if the cabinet fans are not operating.

13.5.23 Refrigeration Compressor C2 Low Side Pressure at Minimum Limit

This error indicates the pressure transducer (T7) is reading below its minimum value for a specific amount of time. An inoperative Bath Cool Solenoid Valve (SOL1) or a failed +5 VDC power supply (DC3) is the most common cause of this error. Other causes include a refrigeration system failure/leak, a failed timer relay (TR5), or a failed transducer (T7).

13.5.24 Refrigeration Compressor C2 Low Side Pressure Over Range or at Maximum Limit

This error indicates the pressure transducer (T7) is over range or has been at its maximum limit value for a specific amount of time. A refrigeration system failure is the most common cause of this error. It is also possible to receive this error if the generator is being operated in an environment that is outside of the generator's operating temperature range.

13.5.25 Refrigeration Compressor C2 High Side Pressure at Minimum Limit

This error indicates the pressure transducer (T8) is reading below its minimum value for a specific amount of time. A refrigeration leak or failure is the most common cause of this error. Other causes are a failed timer relay (TR5), failed +5 VDC power supply (DC3), or a failed transducer (T8).

13.5.26 Refrigeration Compressor C2 High Side Pressure Over Range or at Maximum Limit

This error indicates the pressure transducer (T8) is over range or has been at its maximum limit value for a specific amount of time. A refrigeration system failure is the most common cause of this error. It is also possible to receive this error if there is insufficient floor space around the generator or if the cabinet fans are not operating.

13.5.27 Flow Valve Reported Error:

This error indicates the stepper motor for the flow valve (V1) is reporting an internal error. A failed stepper motor or a jammed flow valve are the most common causes of this error. It is important to relay the number displayed after this error when contacting Thunder Scientific for technical support.

13.5.28 Flow Valve Failed to Find Home Position

This error indicates the stepper motor for the flow valve (V1) is unable to find its home position. A failed stepper motor or a jammed flow valve are the most common causes of this error.

13.5.29 Flow Valve at Minimum Limit

This error indicates the flow valve (V1) has been at its minimum position for a specific amount of time. A wet flow meter is the most common cause of this error.

13.5.30 Flow Valve at Maximum Limit - Possible ice build up

This error indicates the valve flow (V1) has been at its maximum position for a specific amount of time. Insufficient supply pressure source for the given flow setpoint, or an ice blocked saturator inlet are the most common causes of this error. Other causes include a frozen saturator caused by an internal ice blockage. To clear this problem: Operate the generator with a flow setpoint of 0.0 and a saturation temperature setpoint above freezing for a few hours.

13.5.31 Expansion Valve Reported Error:

This error indicates the stepper motor for the expansion valve (V2) is reporting an internal error. A failed stepper motor or a jammed expansion valve are the most common causes of this error.

13.5.32 Expansion Valve Failed to Find Home Position

This error indicates the stepper motor for the expansion valve(V2) is unable to find its home position. A failed stepper motor or a jammed expansion valve are the most common causes of this error.

13.5.33 Expansion Valve at Minimum Limit - Check for air leaks

This warning indicates the expansion valve (V2) has been at its minimum position for a specific amount of time. A leak in the pneumatic system before the expansion valve is the most common cause of this error, such as an incorrectly tightened saturation pressure transducer.

13.5.34 Expansion Valve at Maximum Limit - Reduce Mass Flow Rate

This warning indicates the expansion valve (V2) has been at its maximum position for a specific amount of time. If fittings, tubing and the instrument under test are connected to the Test Port, be sure that the device under test can pass the generated flow rate and is not causing any back pressure or blockage.

13.5.35 Please Add Water Now.

This is only a warning that indicates the system is almost out of water and will need to be filled soon

For more information on adding water, refer to section 5.4 Saturation Filling

13.5.36 System is Low on Water

This is only a warning that indicates the estimated water capacity has reached zero. It is recommended to add pure water (HPLC and Spectrophotometry grade) as soon as possible.

For more information on adding water, refer to section 5.4 Saturation Filling

13.5.37 No Fluid Flow - Check Fluid Circulation System

This error indicates no coolant flow was detected (FS1) within the fluid circulation system. Make sure the fluid system has been filled with methanol. Other causes include a failed fluid pump, or the solid-state relay (SSR-DC8) has failed.

For more information, refer to section 2.12.3.1 Fluid Filling Procedure

13.5.38 No Saturation Fluid Heat

This warning indicates the fluid heater (H1) has been running at full power without any increase in temperature for a given amount of time. Possible causes include a failed heater (H1) or a tripped heat limit switch (HL1).

13.5.39 No Expansion Valve Heat

This warning indicates the expansion valve heater (H2) has been running at full power without any increase in temperature for a given amount of time. Possible causes include a failed heater (H2) or a tripped heat limit switch (HL2).

13.5.40 System Failed to Vent Pressure

This warning indicates the system failed to vent off pressure after a shutdown or during a mode switch within a given amount of time. An ice blockage in the pressure vent tubing prior to the pressure vent solenoid valve is the most common cause of this warning. The saturation temperature must be raised above 0 °C for a few hours. Also, a failed fuse at solid state relay SSR-DC6 or failure of state relay SSR-DC6 or a failed pressure vent solenoid (SOL5).

13.5.41 Insufficient Supply Pressure to reach setpoint

This warning occurs when the system is set to generate a humidity value that requires more pressure than the supply has available. This can occur if the user changes temperature and humidity at the same time. If this warning does not clear once the system has stabilized at its temperature setpoint then check the supply pressure as it might be insufficient for the desired humidity setpoint.

14 DRAWINGS AND DIAGRAMS

This section contains drawings and diagrams of the Model 3920 Low Humidity generator to assist the user in better understanding the operation and location of components of the system.

> **Note** – *All drawings and diagrams contained within this manual are proprietary information which are protected by copyright. All rights are reserved. No part of these drawings and diagrams may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose without the prior written consent of Thunder Scientific Corporation.*

REVISIONS

DWN	REV.	DESCRIPTION	DATE	APP. BY
BRH	D	SHOW WIRING CHANGES FOR PUMP UPDATE & POWER SUPPLY UPDATES	01/07/2025	BB
BRH	E	ADD WARNING SYMBOLS TO SHEET 4	03/31/2026	BB
BAR	F	ADDED BALLOON FOR ITEM 44 PG 6 AND ITEM 29 PG 9 ; CORRECTED PORT LABELS FOR PORTS 1-4 AND HMI USB PORT 2 AND USB 4 PORT HUB	10/12/2026	BB

ITEM NO.	FIND #	TSC STOCKCODE	DESCRIPTION	QTY.
63	V1 - 2	D18A3920022	DIAPHRAGM VALVE ASSEMBLY	2
62	TXV1	FJ-1/2-C	1/2 TON THERMOSTATIC EXPANSION VALVE	1
61	TR5	D24A00352	TIMER RELAY ASSEMBLY	1
60	TM1	D95A00187	METHANOL EXPANSION TANK ASSY	1
59	TE2	D95A00193	R-23 EXPANSION TANK ASSY	1
58	T6, T7, T8	P528-500	0 - 500 PSI PRESSURE SENSOR	3
57	T5	P528-100	0 - 100 PSI PRESSURE SENSOR	1
56	T4	BK5860E-VCR	MASS FLOW METER - VCR	1
55	T3	D19A3920072	SUPPLY PRESSURE HARNESS	1
54	T2	D20A3920091	T2 - TEST PRESSURE ASSEMBLY	1
53	T1	CPT6020-250	0-250 PSIA PRECISION TRANSDUCER	1
52	SSR-DC8	EL100D5-05	5 AMP SS RELAY, 3-100VDC	1
51	SSR-DC7	G4DC5	G4ODC5 OPTO 22 SSR (60 VDC / 3 A)	1
50	SSR-DC0-6	G4DC5A	G4ODC5A OPTO 22 SSR (200 VDC / 1 A)	7
49	SSR-AC1-2	EL240A10-05	5 AMP SS RELAY	2
48	SSR-AC0	UPD2415DF	15 AMP SS RELAY	1
47	SOL6	REFSOL2W & 23A3920329	TWO WAY SOLENOID VALVE & COIL	1
46	SOL5	A2012	2WNC 1/16 ORIFICE 24V SOLENOID VALVE	1
45	SOL1-4	390707	3/2 WAY DIRECT ACTING 24 VDC SOLENOID	4
44	RV1	S4C-150	1/4" MALE NPT ADJUSTABLE RELIEF VALVE	1
43	RTD4	S17624	CABINET TEMPERATURE PROBE	1
42	RTD3	S102619PD3S48	EXP VALVE TEMP PROBE	1
41	RTD2	D19A3920075	RTD2 TEST TEMP ASSEMBLY	1
40	RTD1	4551348-6	6" - 100 Ω PROBE -200 TO 350°C	1
39	REG2	KCP1GJA2P30000	0 - 500 PSI REGULATOR	1
38	REG1	KPR1JJAX12A20000	0 - 500 PSI REGULATOR	1
37	RECR	BT-RECR	REFRIGERATION RECEIVER	1
36	RECEPT	PC83011340	IEC 320 PANEL MOUNT POWER INLET	1
35	NI9403	N779787	TTL DIGITAL I/O MODULE (32 CH)	1
34	NI9401	N779351	TTL DIGITAL I/O MODULE (8 CH)	1
33	NI9216	NI783863-02	24-BIT 100 Ω RTD ANALOG INPUT MODULE, DSUB	1

ITEM NO.	FIND #	TSC STOCKCODE	DESCRIPTION	QTY.
32	NI9209	N783729	±10V, 24-BIT ANALOG INPUT MODULE	1
31	NI9174	N781157	CDAQ-9174 4 SLOT USB CHASSIS	1
30	MUFFLER	MU002A	1/4" 80 MICRON MUFFLER	1
29	MOXA	UPORT1450	USB - SERIAL HUB (4 PORT)	1
28	MOV1	MOV1	250V RMS METAL OXIDE VARISTOR	3
27	LF1	SS-4F-VCR-7	1/4" SWAGELOK 7 MICRON INLINE FILTER	1
26	KB	KEYBD-CUST-42USB	42 KEY KEYBOARD	1
25	HMI	UTC-510GP	UTC-510 10.1" TOUCH COMPUTER	1
24	HLS1	A19AAF-12	TEMP LIMIT SWITCH	2
23	H3	HK5537	7.8 OHM FOIL HEATER	3
22	H2	HK5161	22.0 OHM FOIL HEATER	5
21	H1	N9N-1560	220 VAC 500 W CARTRIDGE HEATER	2
20	G4PB4	G4PB4	4 CHANNEL MOUNTING RACK	2
19	G1	PG200-18N-LM-15D	0-200 PSI GAUGE	1
18	FS1	PS11	PRESSURE SWITCH	1
17	FP1	D19A3920034	FLUID PUMP ASSEMBLY	1
16	FD1 / FD2	C-032-S	REFRIGERATION FILTER / DRYER	2
15	FB1	FERSPLTCORE	EMI FERRITE SUPPRESSION CORE (SPLIT)	1
14	FAN2	FN624N	24 VDC FAN	1
13	FAN1	FAN100CFM	HIGH AIR FLOW Ø 6.0" 24 VDC AXIAL FAN	6
12	EX2	D95A00186	INTERCOOLER ASSEMBLY	1
11	EX1	D95A00185	R23 EVAPORATOR ASSEMBLY	1
10	DV1 - 3	6LVV-DPVR4-P-C	UHP DIAPHRAGM SEALED VALVE	3
9	DC4	DTJ1524D15	±15VDC POWER SUPPLY	1
8	DC3	DTJ1524S05	+5VDC POWER SUPPLY	1
7	DC2	UHP-200-24	24V 200W AC-DC POWER SUPPLY	1
6	DC1	UHP-200-12	12V 200W AC-DC POWER SUPPLY	1
5	CV1	S4C-1/3	1/4" SWAGELOK INLINE CHECK VALVE	1
4	CON	BT-COND	CONDENSER ASSEMBLY	1
3	CBS1	PWRSW-2P	220V AC/2-POLE CIRCUIT BREAKER 10A	1
2	C2	D19A3920023	REFRIGERATION COMP - R-23	1
1	C1	D19A3920023	COMPRESSOR PREPARATION, R-134A / R23	1

DO NOT SCALE FROM DRAWING

	3920
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APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES

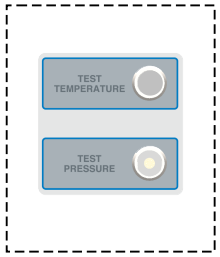
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

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APPROVED	BB	11/27/2019
ISSUED	DWF	11/27/2019

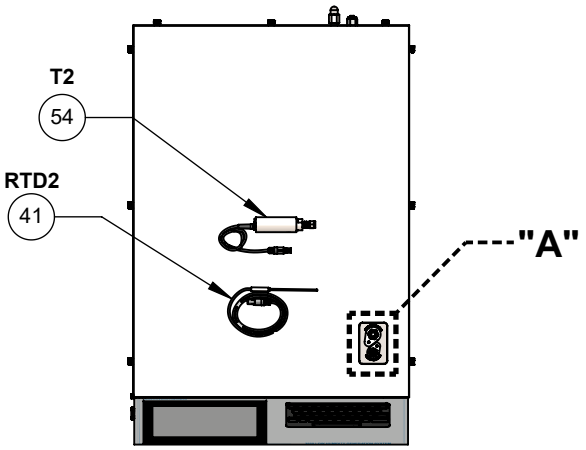
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623 Wyoming S.E. Albuquerque, NM 87123

3920 Components

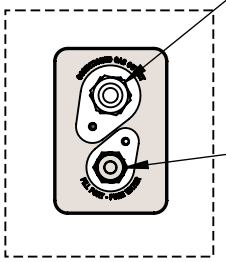
SIZE	DWG. NO.	REV
A	19D3920901	F
	WT. 522.32 lb	SHEET 1 OF 9



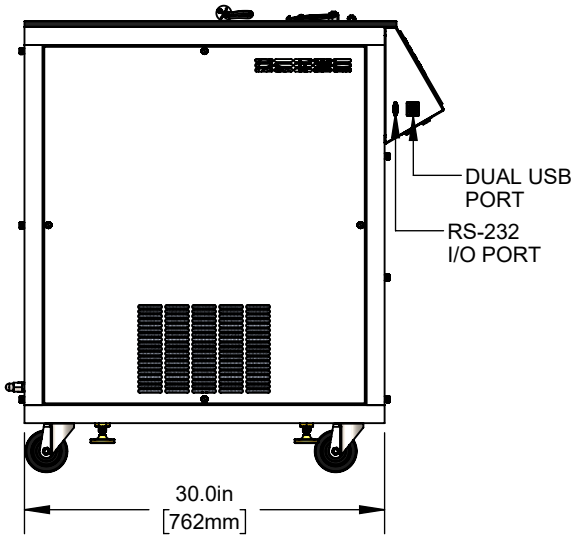
DETAIL "B"



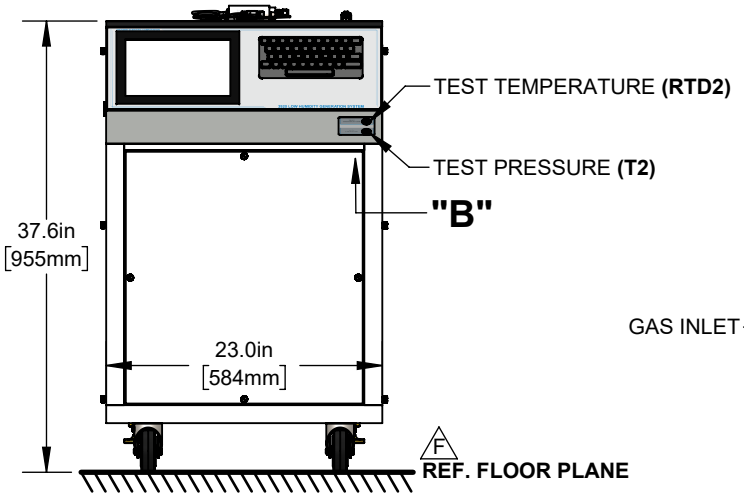
TOP VIEW



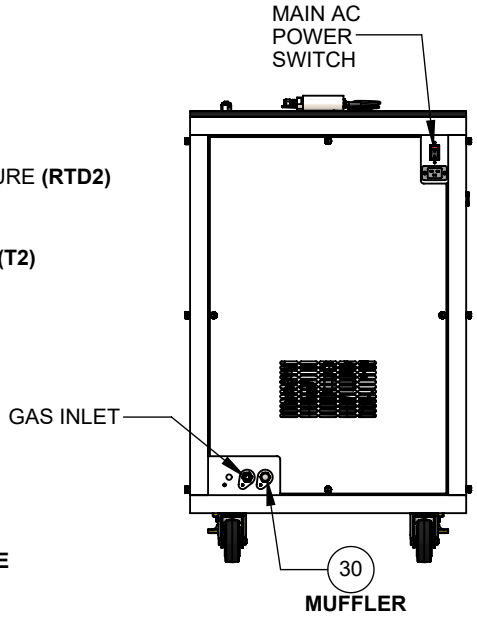
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LEFT VIEW

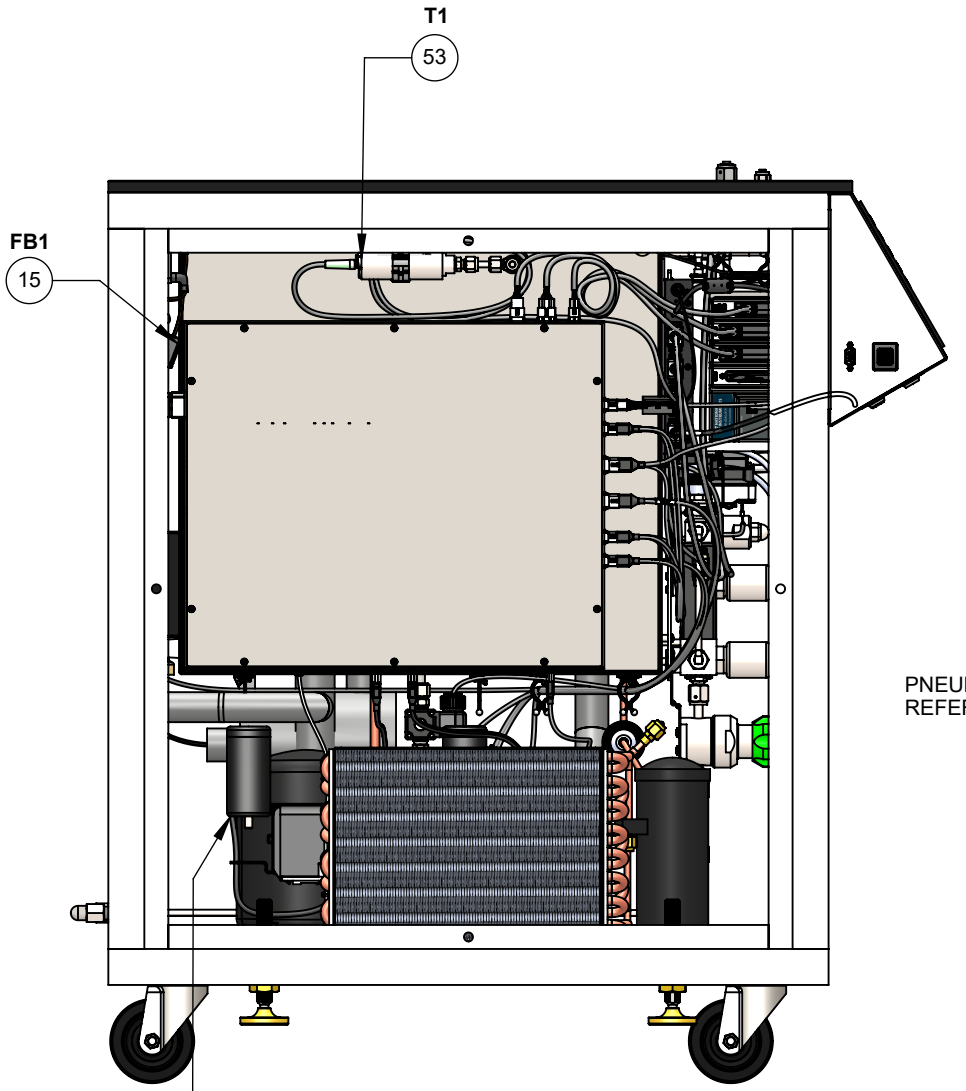


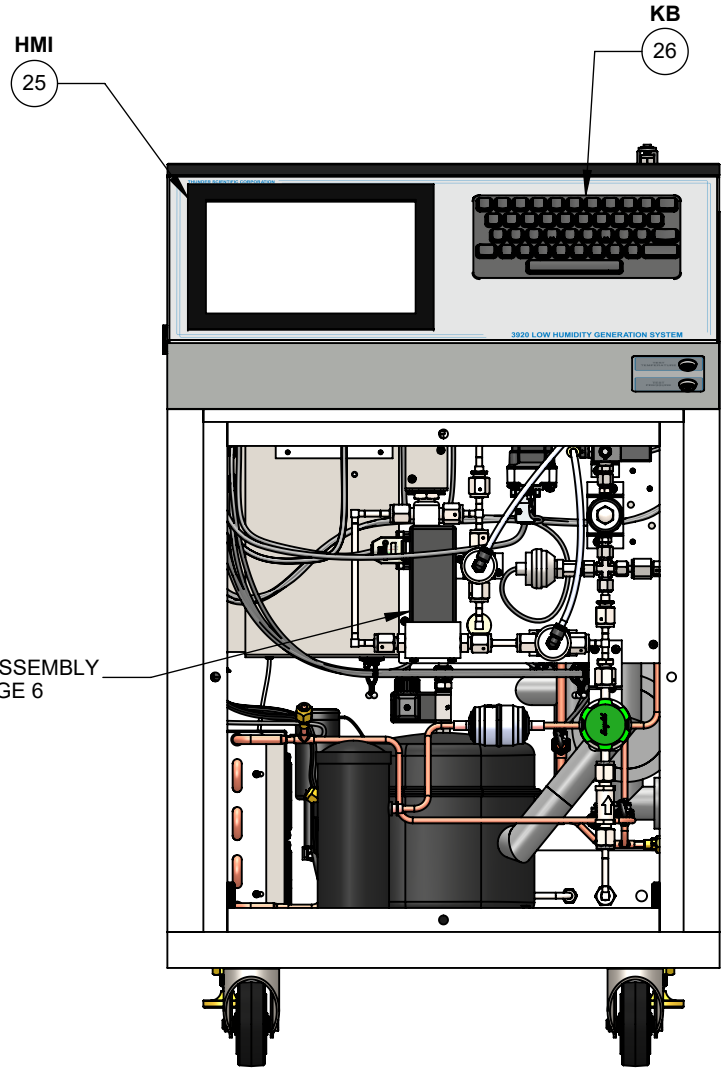
FRONT VIEW



REAR VIEW

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				3920 Exterior Views	
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NEXT ASSY	USED ON		APPROVED BB 11/27/2019		
APPLICATION			ISSUED DWF 11/27/2019	WT. 522.32 lb	SHEET 2 OF 9





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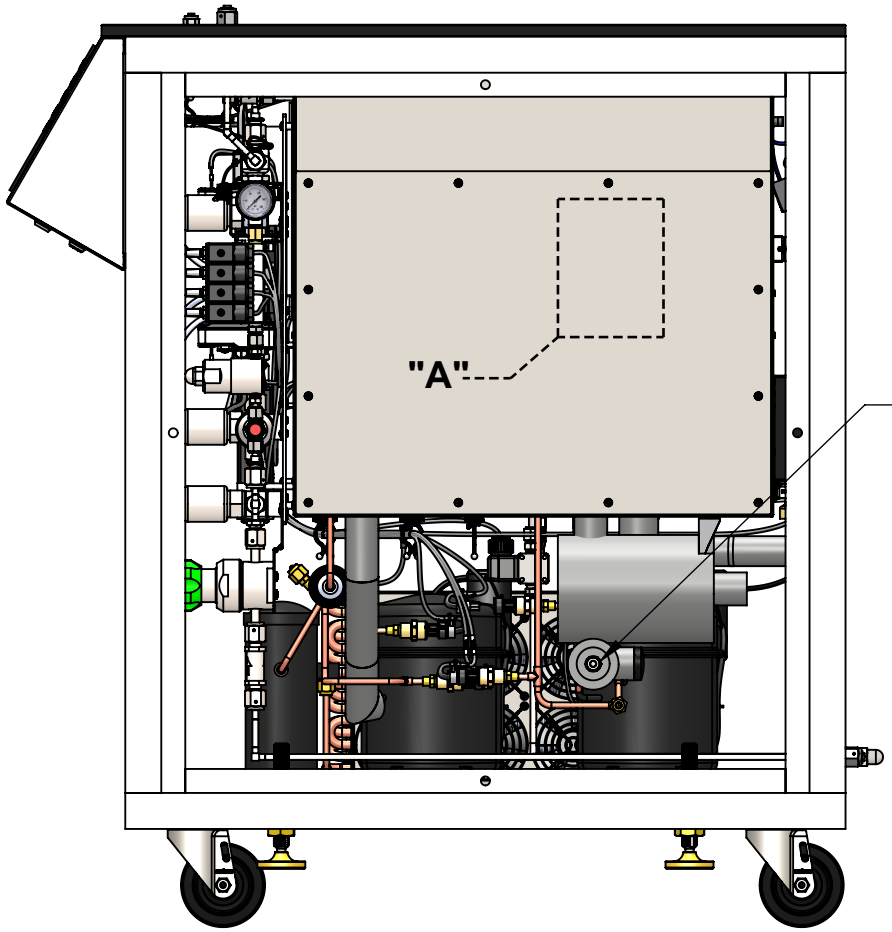
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∠ ±.50°
UNLESS NOTED OTHERWISE

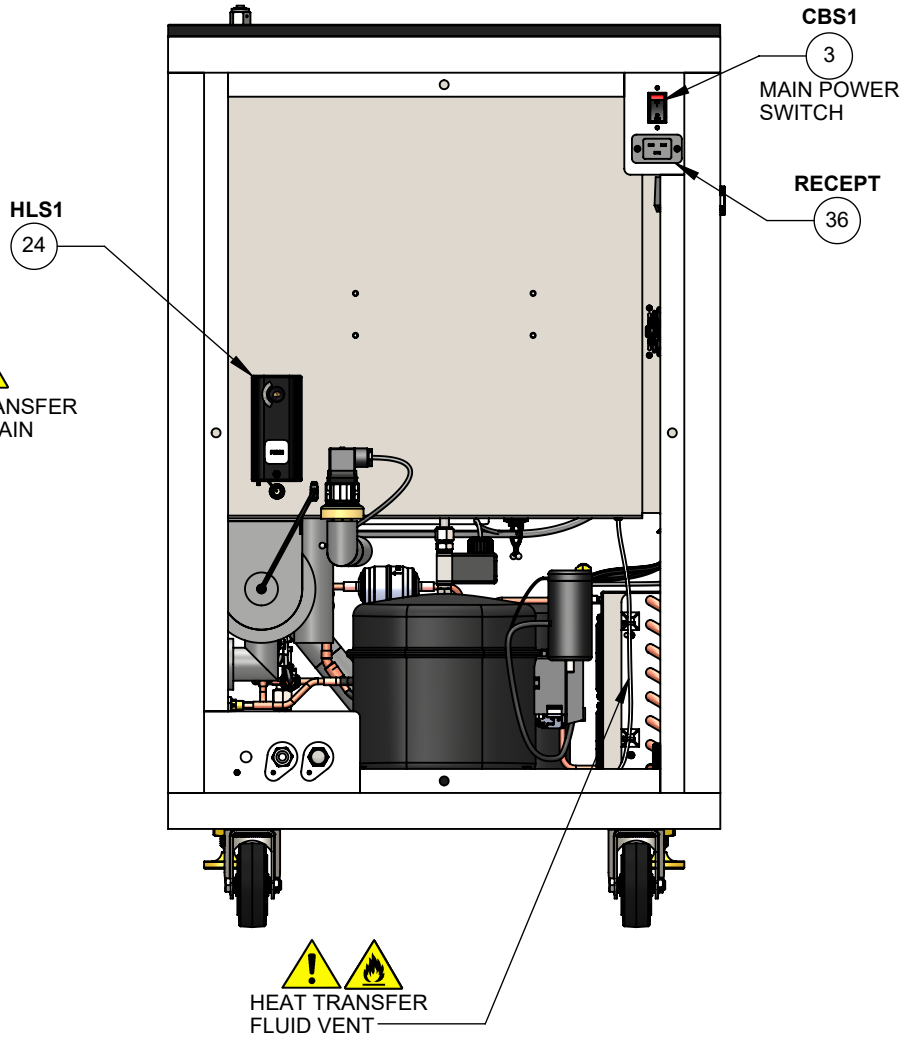
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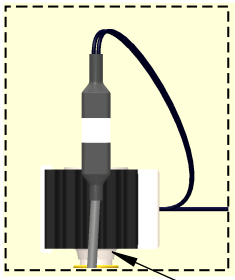
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3920 Left & Front Views

SIZE	DWG. NO.	REV
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	WT. 522.32 lb	SHEET 3 OF 9





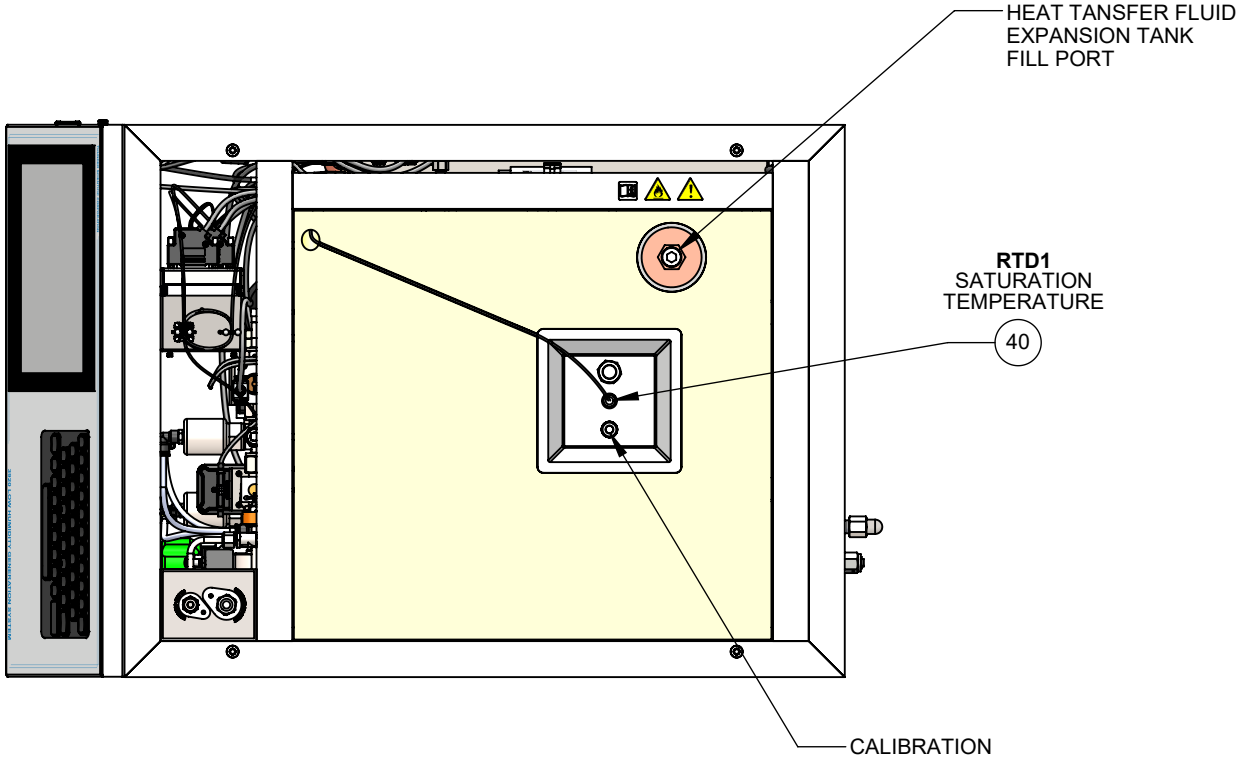


DETAIL "A"
(BEHIND ACCESS PANEL)

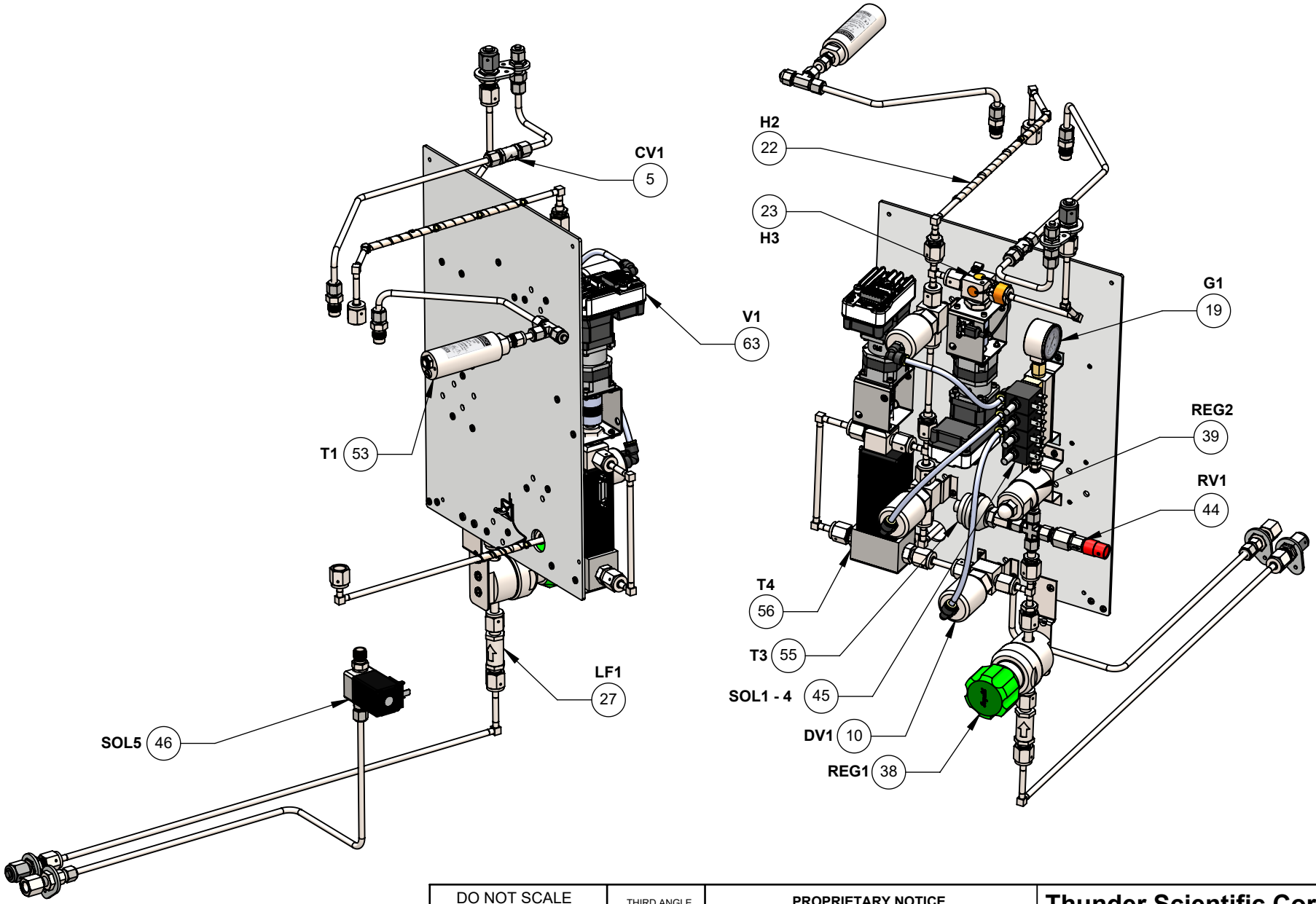
Warning!

USE CAUTION WHEN HANDLING METHANOL.
METHANOL IS FLAMMABLE AND POISONOUS
KEEP AWAY FROM SPARKS, FLAMES, OR OTHER IGNITION SOURCES.
AVOID PROLONGED OR REPEATED BREATHING OF VAPORS OR CONTACT WITH SKIN.
SEE SECTION 2.3 FOR IMPORTANT SAFETY INFORMATION.

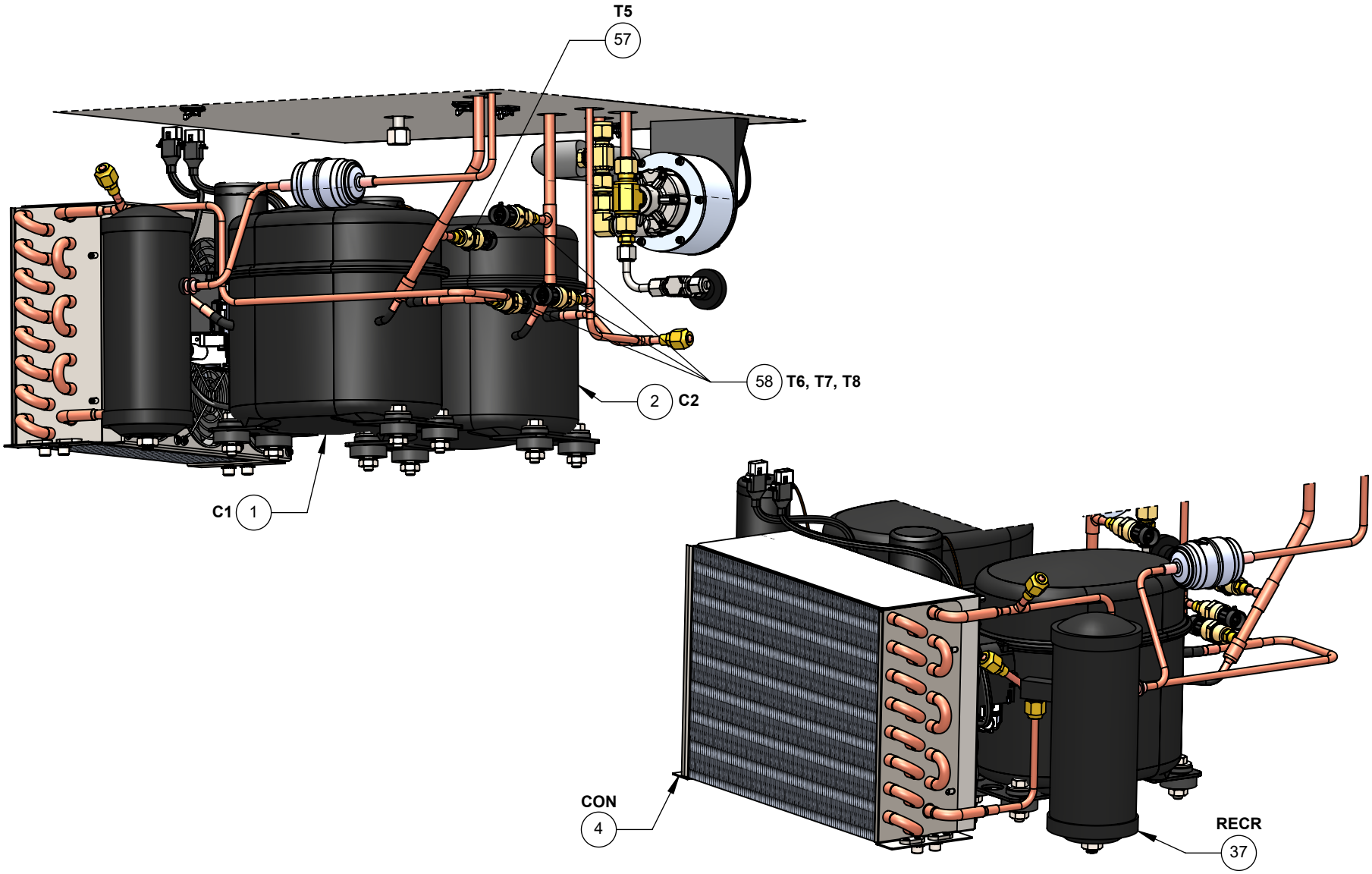
DO NOT SCALE FROM DRAWING		THIRD ANGLE PROJECTION	**PROPRIETARY NOTICE** THIS DRAWING AND INFORMATION CONTAINED WITHIN IS PROPRIETARY TO THUNDER SCIENTIFIC AND CANNOT BE COPIED OR REPRODUCED WITHOUT SPECIFIC WRITTEN PERMISSION	**Thunder Scientific Corporation** 623 Wyoming S.E. Albuquerque, NM 87123	
				3920 Right & Rear Views	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 9/26/2019	SIZE A	DWG. NO. 19D3920901 REV F
NEXT ASSY	USED ON		APPROVED BB 11/27/2019		WT. 522.32 lb SHEET 4 OF 9
APPLICATION			ISSUED DWF 11/27/2019		



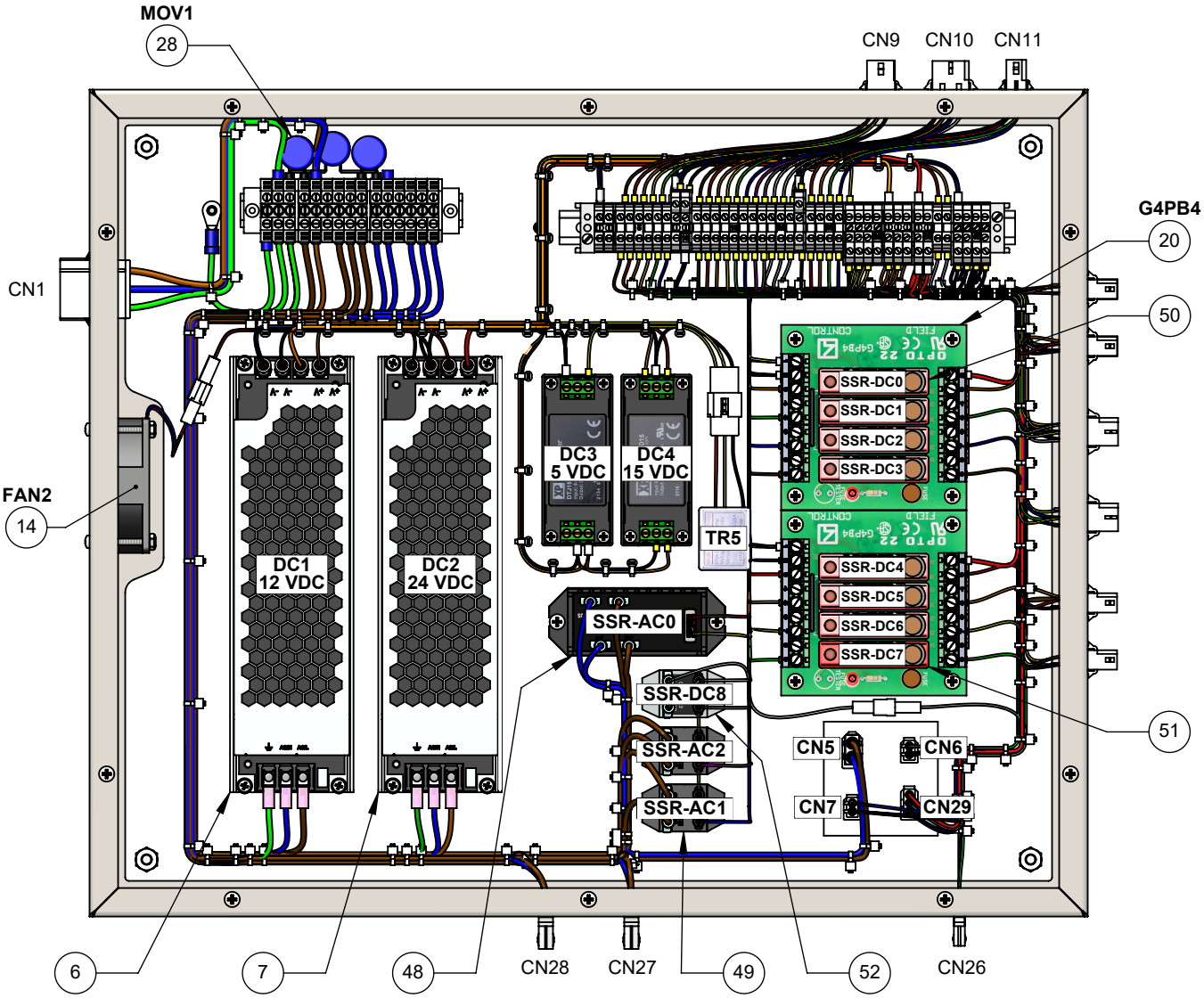
DO NOT SCALE FROM DRAWING		THIRD ANGLE PROJECTION	**PROPRIETARY NOTICE** THIS DRAWING AND INFORMATION CONTAINED WITHIN IS PROPRIETARY TO THUNDER SCIENTIFIC AND CANNOT BE COPIED OR REPRODUCED WITHOUT SPECIFIC WRITTEN PERMISSION	**Thunder Scientific Corporation** 623 Wyoming S.E. Albuquerque, NM 87123	
				3920 Top View	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 9/26/2019	SIZE A	DWG. NO. 19D3920901 REV F
NEXT ASSY	USED ON		APPROVED BB 11/27/2019		
APPLICATION			ISSUED DWF 11/27/2019		WT. 522.32 lb SHEET 5 OF 9

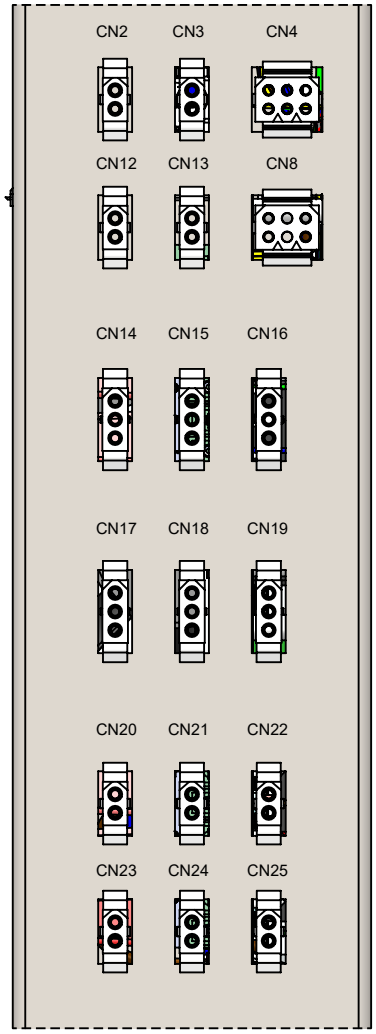


DO NOT SCALE FROM DRAWING		THIRD ANGLE PROJECTION	**PROPRIETARY NOTICE** THIS DRAWING AND INFORMATION CONTAINED WITHIN IS PROPRIETARY TO THUNDER SCIENTIFIC AND CANNOT BE COPIED OR REPRODUCED WITHOUT SPECIFIC WRITTEN PERMISSION	**Thunder Scientific Corporation** 623 Wyoming S.E. Albuquerque, NM 87123	
				3920 Pneumatic Components	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 9/26/2019	SIZE A	DWG. NO. 19D3920901 REV F
NEXT ASSY	USED ON		APPROVED BB 11/27/2019		
APPLICATION			ISSUED DWF 11/27/2019	WT. 522.32 lb	SHEET 6 OF 9

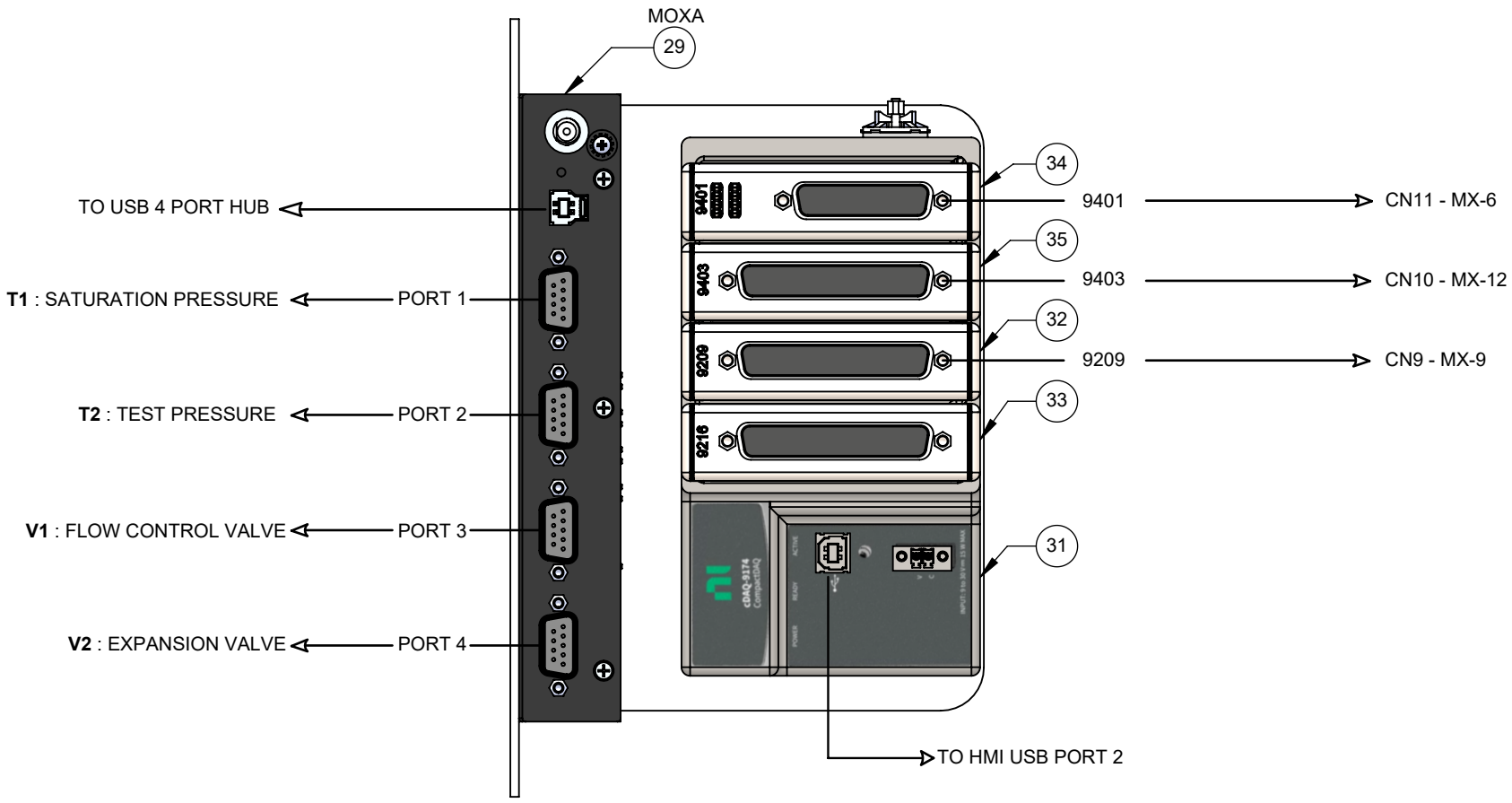


DO NOT SCALE FROM DRAWING		THIRD ANGLE PROJECTION	**PROPRIETARY NOTICE** THIS DRAWING AND INFORMATION CONTAINED WITHIN IS PROPRIETARY TO THUNDER SCIENTIFIC AND CANNOT BE COPIED OR REPRODUCED WITHOUT SPECIFIC WRITTEN PERMISSION	**Thunder Scientific Corporation** 623 Wyoming S.E. Albuquerque, NM 87123	
				3920 Refrigeration Components	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 9/26/2019	SIZE A	DWG. NO. 19D3920901 REV F
NEXT ASSY	USED ON		APPROVED BB 11/27/2019		
APPLICATION			ISSUED DWF 11/27/2019	WT. 522.32 lb	SHEET 7 OF 9





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				3920 Electrical Components	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 9/26/2019	SIZE A	DWG. NO. 19D3920901 REV F
NEXT ASSY	USED ON		APPROVED BB 11/27/2019		
APPLICATION			ISSUED DWF 11/27/2019	WT. 522.32 lb	SHEET 8 OF 9

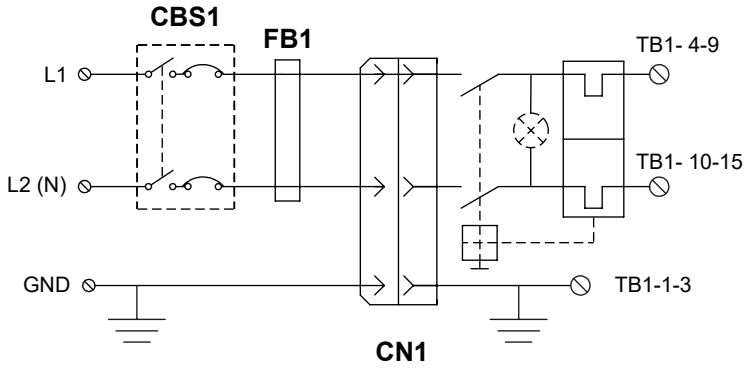


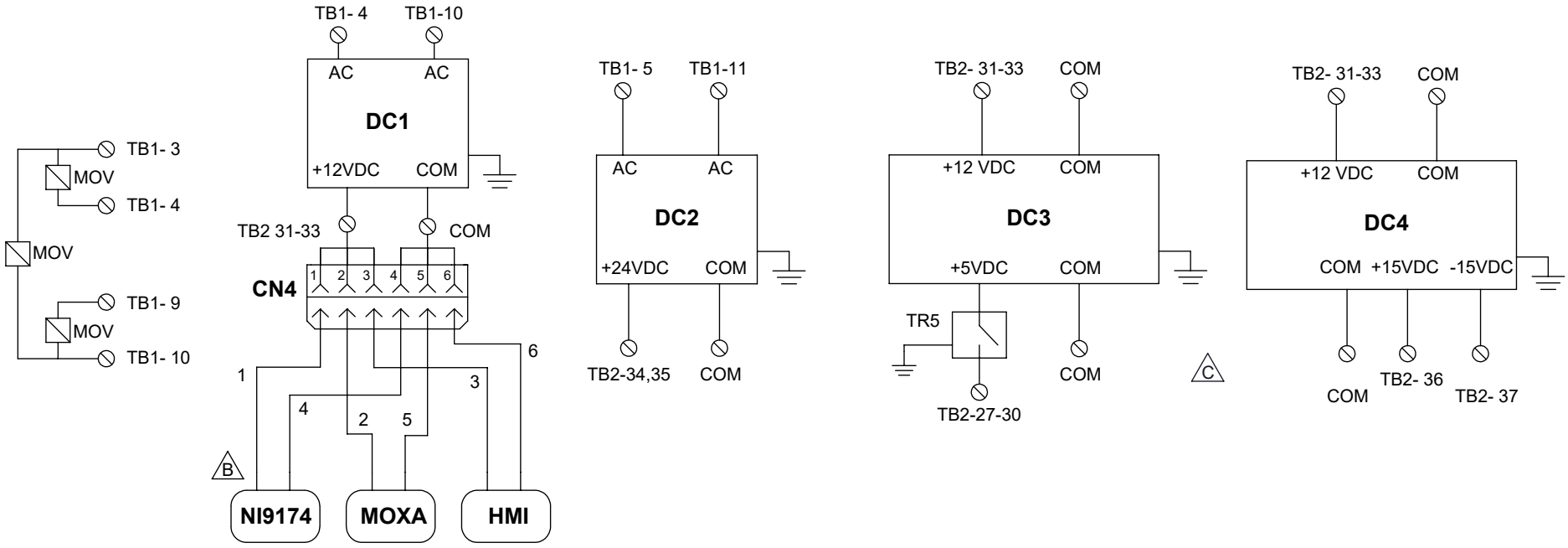
MOXA
UPORT-1450

NI9174

DO NOT SCALE FROM DRAWING		THIRD ANGLE PROJECTION	**PROPRIETARY NOTICE** THIS DRAWING AND INFORMATION CONTAINED WITHIN IS PROPRIETARY TO THUNDER SCIENTIFIC AND CANNOT BE COPIED OR REPRODUCED WITHOUT SPECIFIC WRITTEN PERMISSION	**Thunder Scientific Corporation** 623 Wyoming S.E. Albuquerque, NM 87123	
				3920 Data Acq. Components	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 9/26/2019	SIZE **A**	DWG. NO. 19D3920901 REV **F**
NEXT ASSY	USED ON		APPROVED BB 11/27/2019		
APPLICATION			ISSUED DWF 11/27/2019	WT. 522.32 lb	SHEET 9 OF 9

REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY
BRH	B	CHANGE FROM NI9136 (cDAQ UPDATE)	07/01/2024	BB
SLC	C	Drawing was updated to reflect new power supply configuration. Block "DC4" was added	1/7/2025	BB





TB1 - 1-3	GND
TB1 - 4-9	L1 (200/240 VAC)
TB1 - 10-15	L2 (NEUTRAL)
TB2 - 27-30	+5 VDC
TB2 - 31-33	+12 VDC
TB2 - 34,35	+24 VDC
TB2 - 36	+15 VDC
TB2 - 37	-15 VDC
TB2 - 1,2,9,10,22,38-41	COMMON

DO NOT SCALE FROM DRAWING	
	3920
NEXT ASSY	USED ON
APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

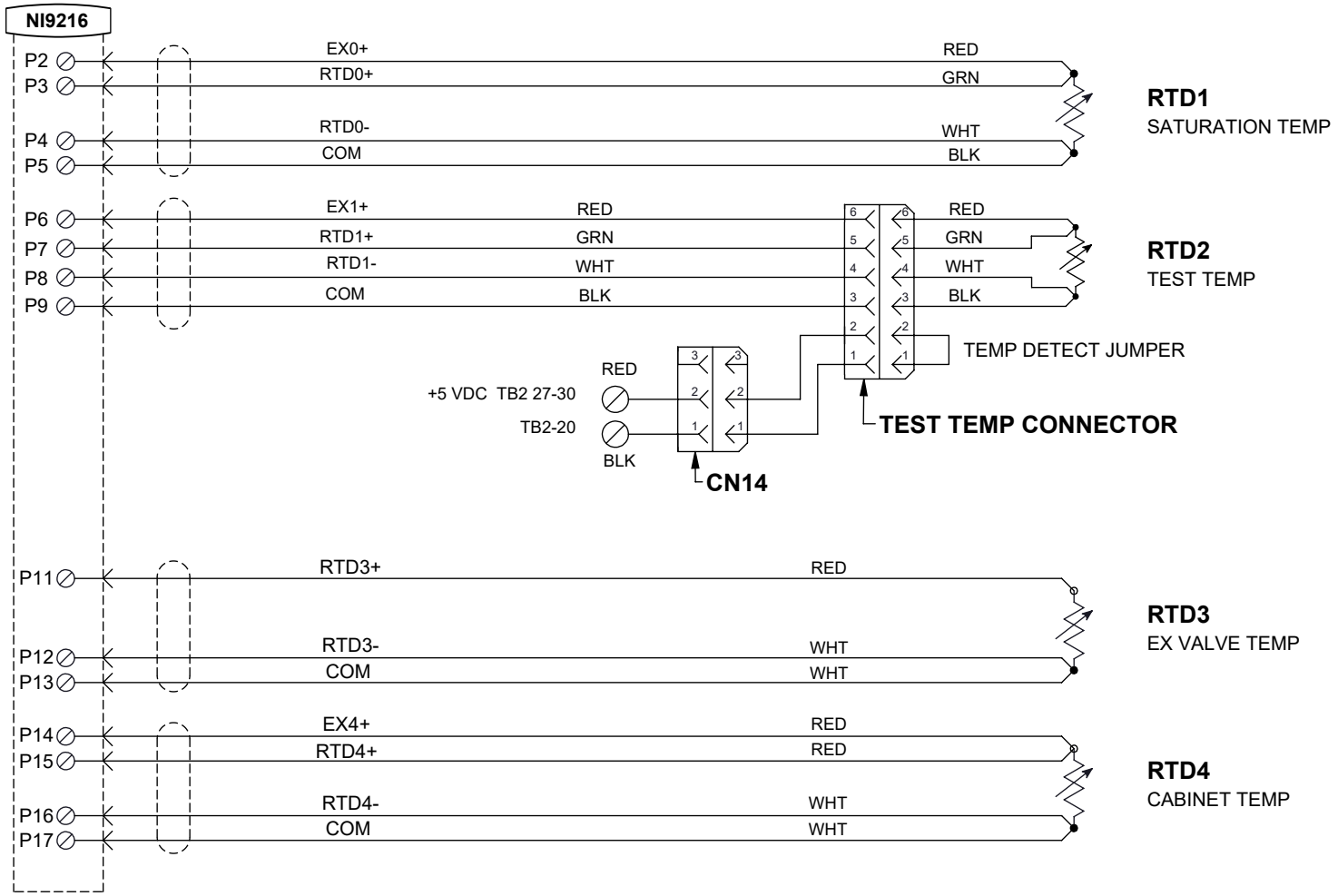
DRAWN	FURRY	07/25/2019
APPROVED	BB	10/16/2019
ISSUED	DWF	10/16/2019

Thunder Scientific Corporation
623 Wyoming S.E. Albuquerque, NM 87123

AC / DC Power Distribution

SIZE	DWG. NO.	REV
A	19S3920911	C
	WT. N / A	SHEET 1 OF 1

REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY



DO NOT SCALE FROM DRAWING	
	3920
NEXT ASSY	USED ON
APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

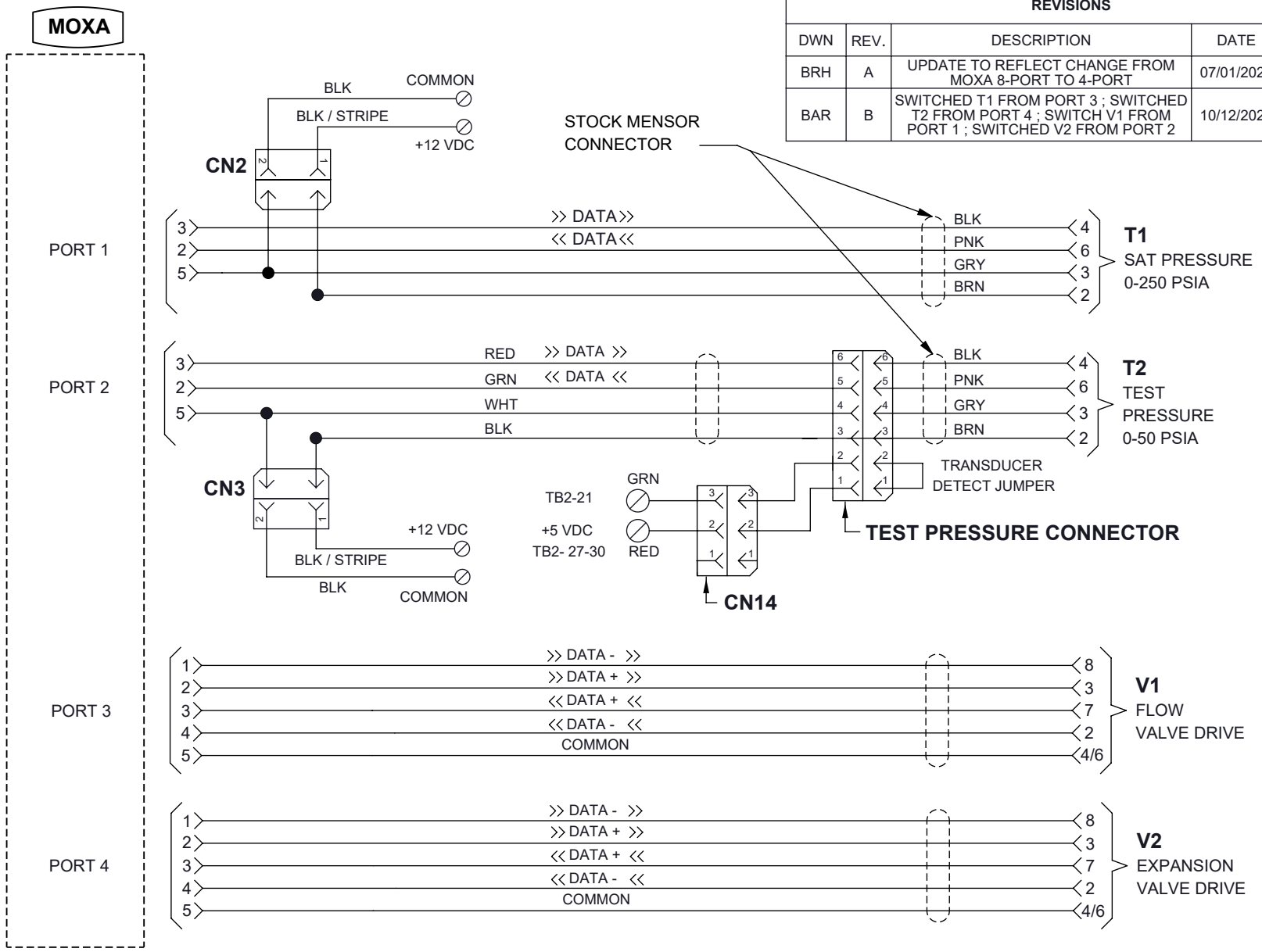
DRAWN	FURRY	07/25/2019
APPROVED	BB	10/16/2019
ISSUED	DWF	10/16/2019

Thunder Scientific Corporation
623 Wyoming S.E. Albuquerque, NM 87123

NI-9216 RTD Module

SIZE	DWG. NO.	REV
A	19S3920912	-
	WT. N / A	SHEET 1 OF 1

REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY
BRH	A	UPDATE TO REFLECT CHANGE FROM MOXA 8-PORT TO 4-PORT	07/01/2024	BB
BAR	B	SWITCHED T1 FROM PORT 3 ; SWITCHED T2 FROM PORT 4 ; SWITCH V1 FROM PORT 1 ; SWITCHED V2 FROM PORT 2	10/12/2026	BB



TB2 - 27-30 +5 VDC
TB2 - 31-33 +12 VDC
TB2 - 1,2,9,10,22,38-41 COMMON

DO NOT SCALE FROM DRAWING	
	3920
NEXT ASSY	USED ON
APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

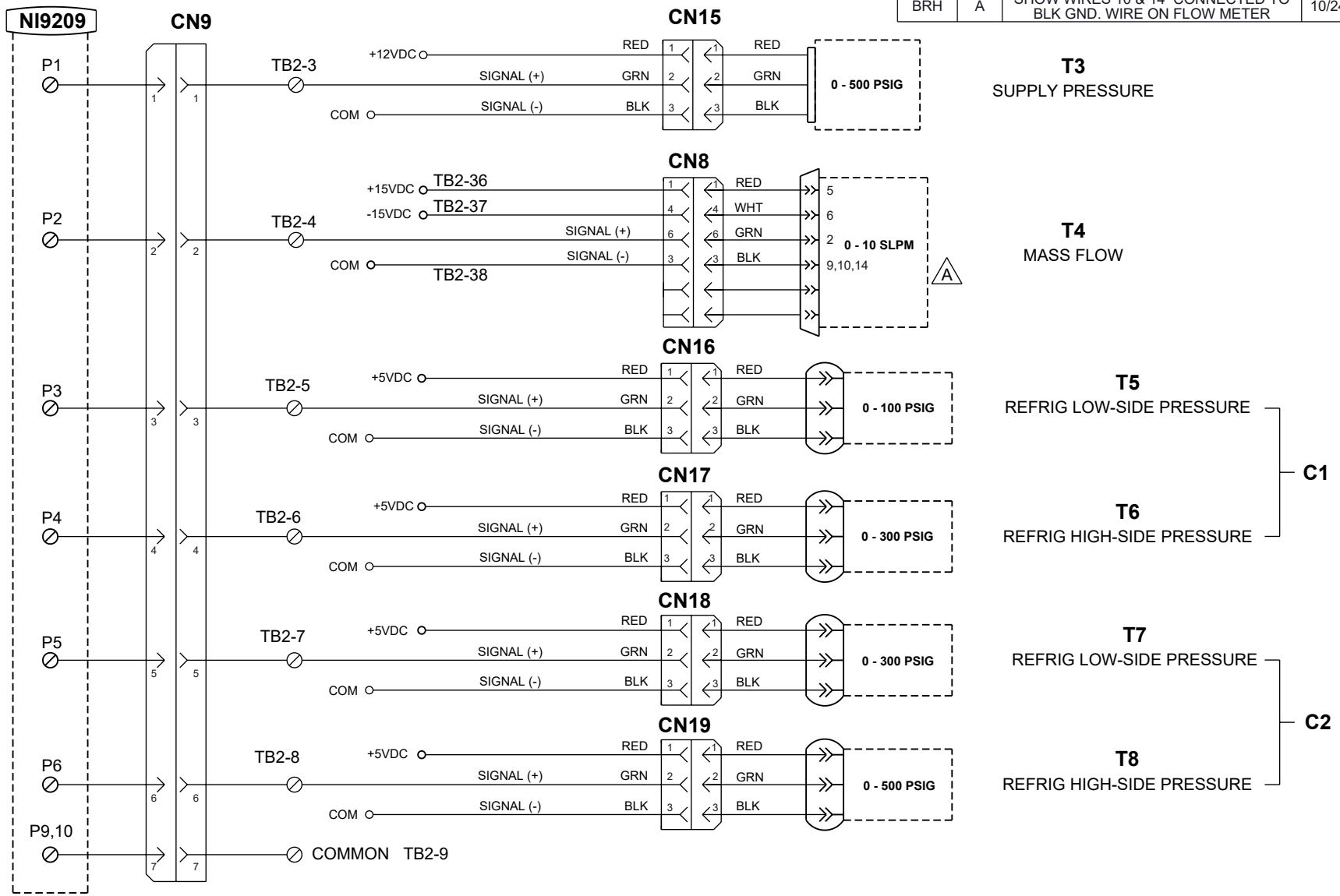
DRAWN	FURRY	07/25/2019
APPROVED	BB	10/16/2019
ISSUED	DWF	10/16/2019

Thunder Scientific Corporation
623 Wyoming S.E. Albuquerque, NM 87123

Pres Tran/Stepper Drive Schematic

SIZE	DWG. NO.	REV
A	19S3920913	B
	WT. N / A	SHEET 1 OF 1

REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY
BRH	A	SHOW WIRES 10 & 14 CONNECTED TO BLK GND. WIRE ON FLOW METER	10/24/2022	BB



P20 - P25 ARE STRAPPED TO P28

TB2 - 27-30	+5 VDC
TB2 - 31-33	+12 VDC
TB2 - 36	+15 VDC
TB2 - 37	-15 VDC
TB2 - 1,2,9,22,38-41	COMMON

DO NOT SCALE FROM DRAWING

	3920
NEXT ASSY	USED ON
APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

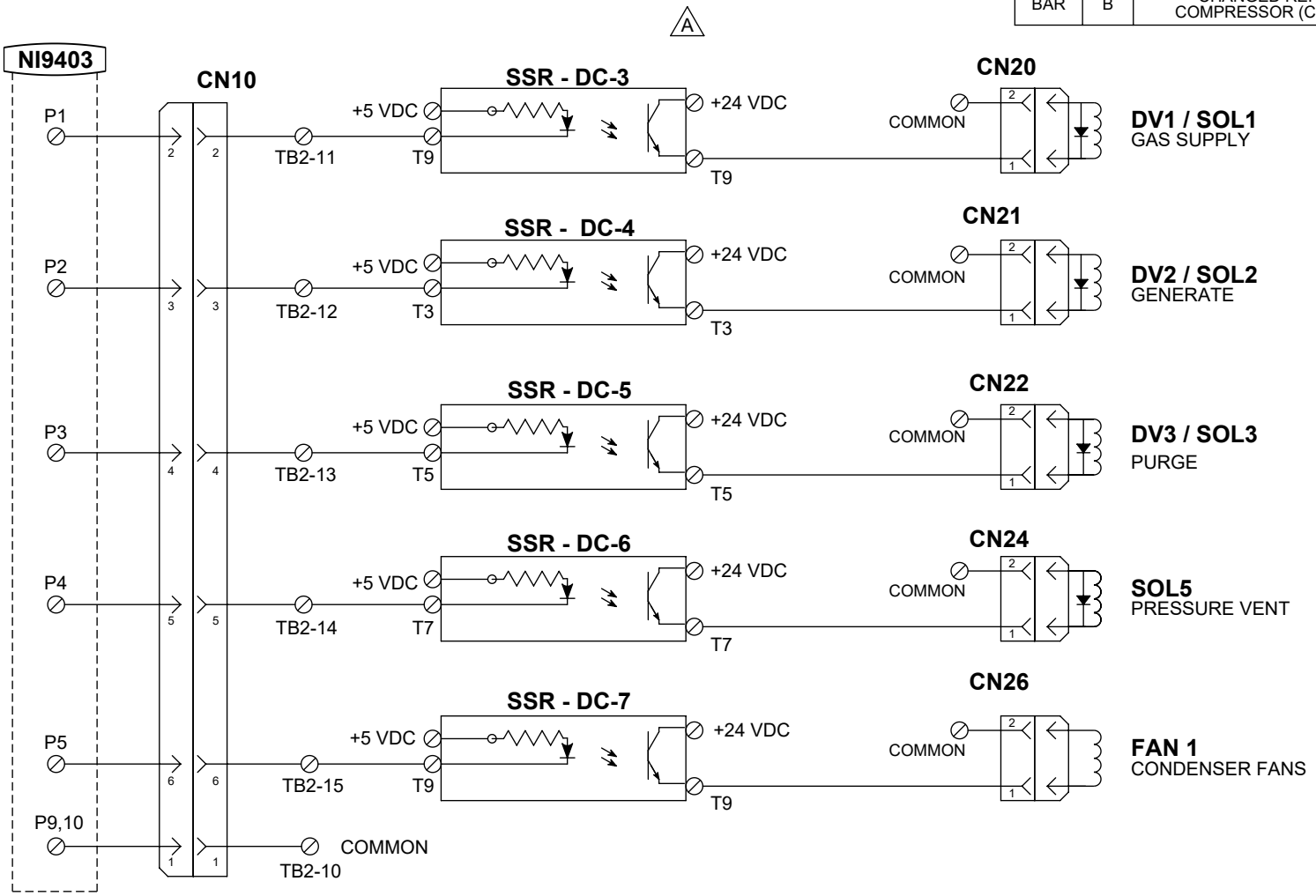
DRAWN	FURRY	7/25/2019
APPROVED	BB	10/16/2019
ISSUED	DWF	10/16/2019

Thunder Scientific Corporation
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NI-9209 Analog Input Module

SIZE	DWG. NO.	REV
A	19S3920914	A
	WT. N / A	SHEET 1 OF 1

REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY
SLC	A	SOLENOID 4 REMOVED; CHANGE TO SSR ANNOTATED	01/07/2025	BB
BAR	B	CHANGED REFRIGERATION COMPRESSOR (C1) FROM R-134A	09/22/26	BB



TB2 - 27-30 +5 VDC
TB2 - 34,35 +24 VDC
TB2 - 1,2,9,10,22,38-41 COMMON

DO NOT SCALE FROM DRAWING

	3920
NEXT ASSY	USED ON
APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

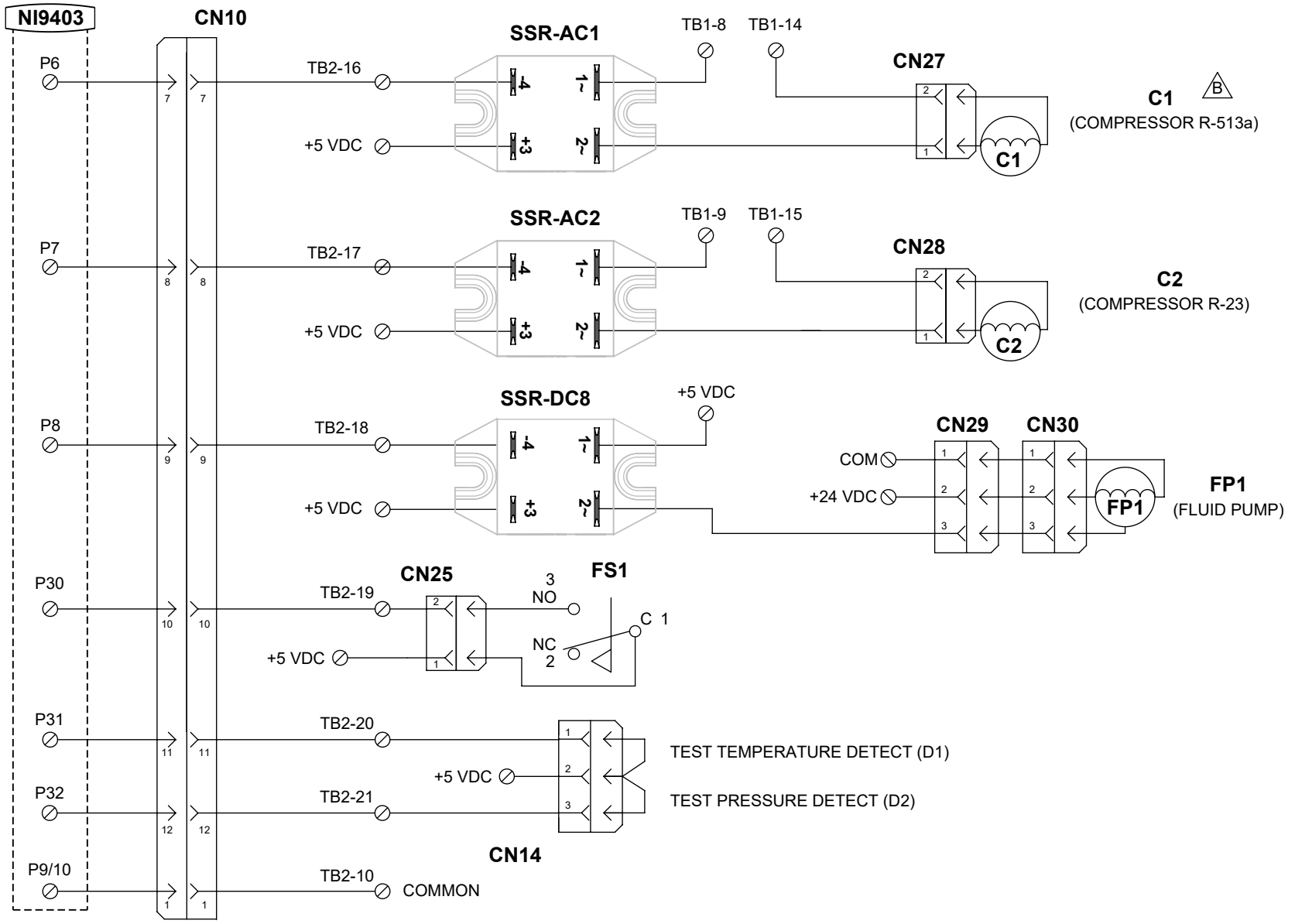
DRAWN	FURRY	07/25/2019
APPROVED	BB	10/16/2019
ISSUED	DWF	10/16/2019

Thunder Scientific Corporation
623 Wyoming S.E. Albuquerque, NM 87123

NI-9403 Digital I/O Module

SIZE **A** | DWG. NO. 19S3920915 | REV **B**

WT. lb | SHEET 1 OF 2



TB1 - 4-9
TB1 - 10-15
TB2 - 27-30
TB2 - 1,2,9,10,22,38-41

L1 (208/240 VAC)
L2 (NEUTRAL)
+5 VDC
COMMON

DO NOT SCALE FROM DRAWING	
	3920
NEXT ASSY	USED ON
APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

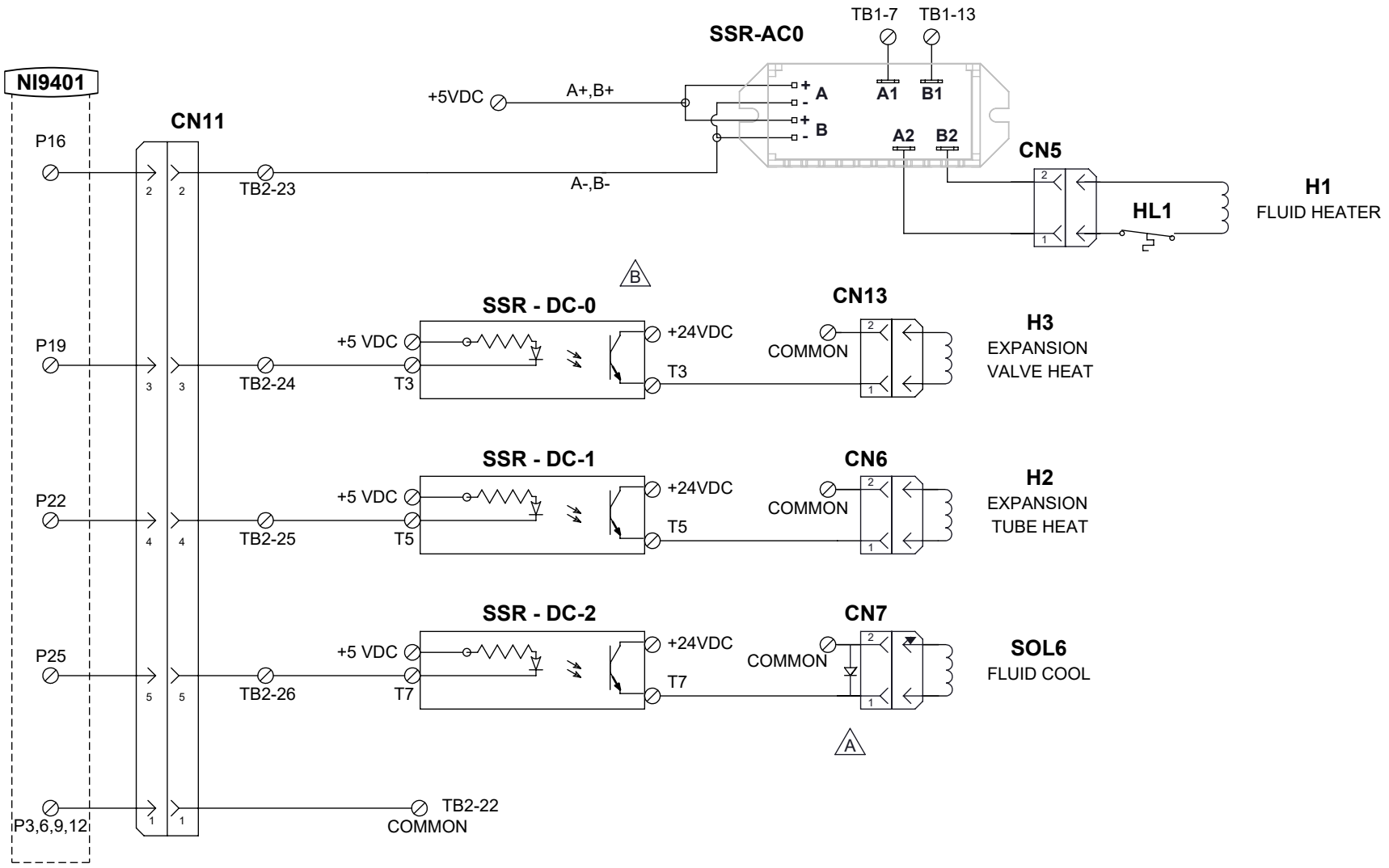
DRAWN	FURRY	07/25/2019
APPROVED	BB	10/16/2019
ISSUED	DWF	10/16/2019

Thunder Scientific Corporation
623 Wyoming S.E. Albuquerque, NM 87123

NI-9403 Digital I/O Module

SIZE	DWG. NO.	REV
A	19S3920915	B
	WT. N / A	SHEET 2 OF 2

REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY
CRB	A	MOVE DIODE	7/26/2021	BB
SLC	B	Change to SSR annotated	01/07/2025	BB



TB1 - 4-9 L1 (208/240 VAC)
TB1 - 10-15 L2 (NEUTRAL)
TB2 - 27-30 +5 VDC
TB2 - 34,35 +24 VDC
TB2 - 1,2,9,10,22,38-41 COMMON

DO NOT SCALE FROM DRAWING

	3920
NEXT ASSY	USED ON
APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

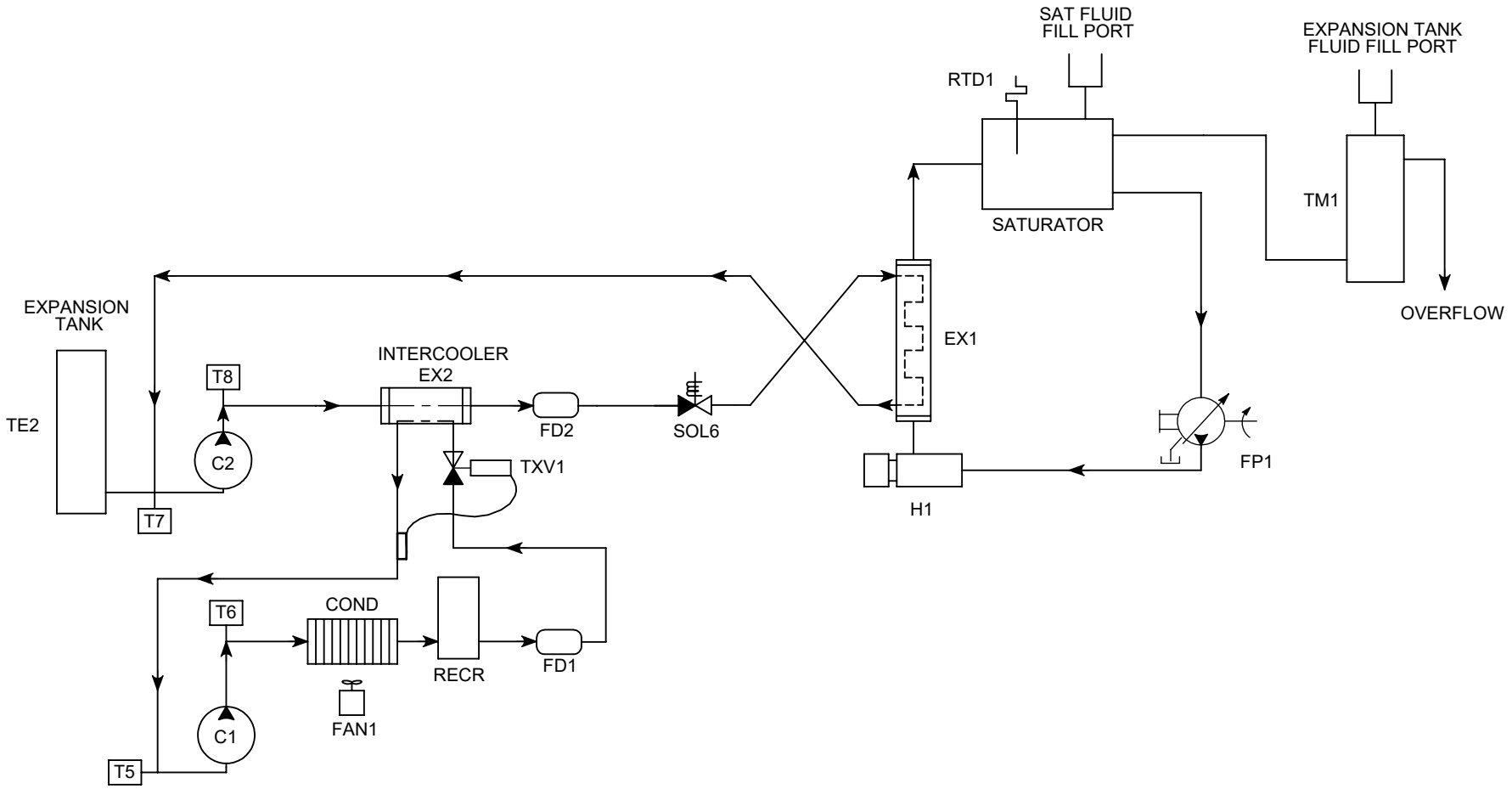
DRAWN	FURRY	07/25/2019
APPROVED	BB	10/16/2019
ISSUED	DWF	10/16/2019

Thunder Scientific Corporation
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NI-9401 Digital I/O Module

SIZE	DWG. NO.	REV
A	19S3920916	B
	WT. N / A	SHEET 1 OF 1

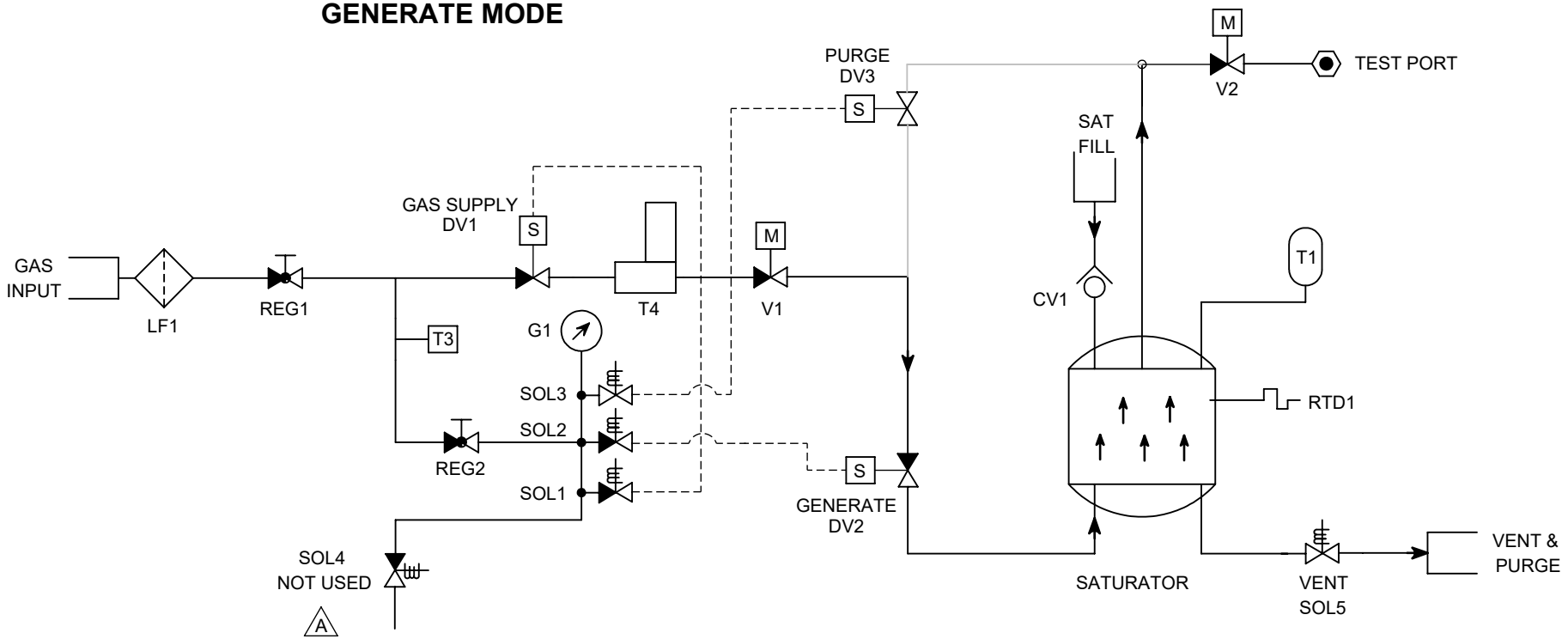
REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY



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				Saturator Refrig. & Fluid Flow	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 07/25/2019	SIZE A	DWG. NO. 19S3920917 REV -
NEXT ASSY	USED ON		APPROVED BB 10/16/2019		WT. N/A SHEET 1 OF 1
APPLICATION			ISSUED DWF 10/16/2019		

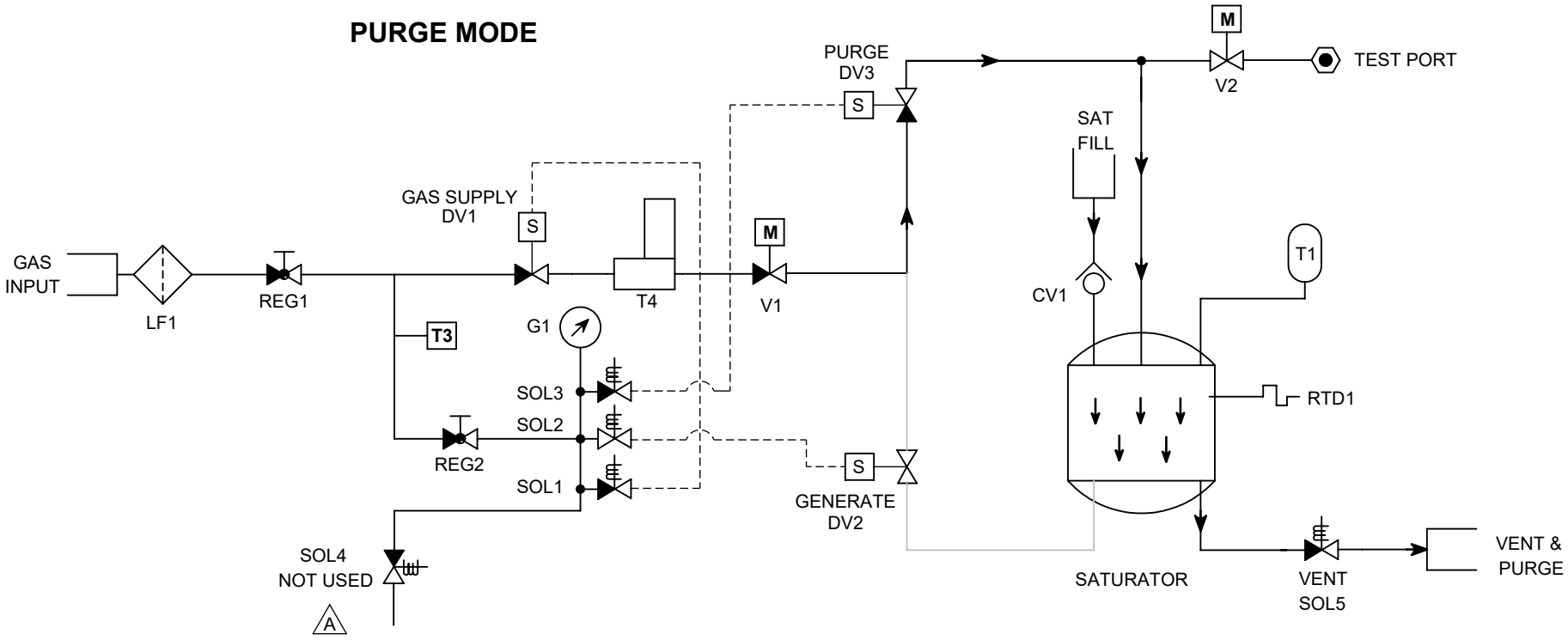
REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY
SLC	A	ANNOTATED THAT SOLENOID 4 IS NOT USED	1/7/2025	BB

GENERATE MODE

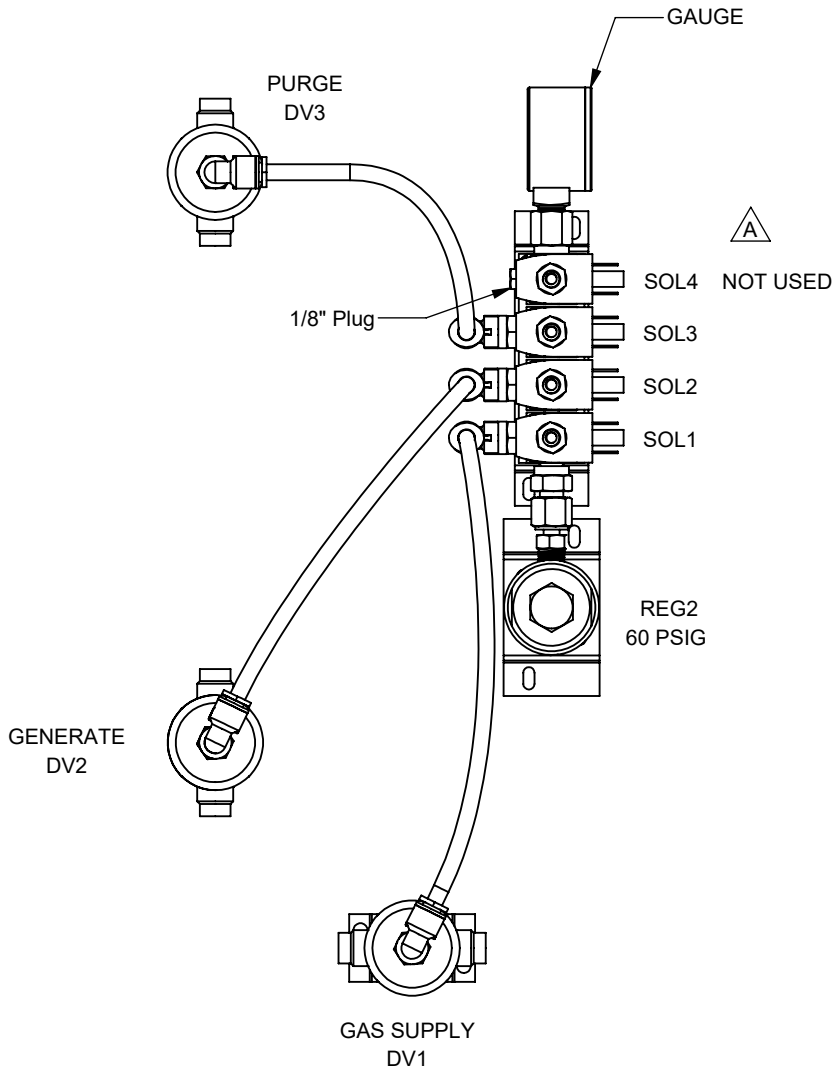


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		TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 07/25/2019	Pneumatic System	
	3920		APPROVED BB 10/16/2019	SIZE A	DWG. NO. 19S3920918 REV A
NEXT ASSY	USED ON		ISSUED DWF 10/16/2019		WT. N/A lb SHEET 1 OF 3
APPLICATION					

PURGE MODE

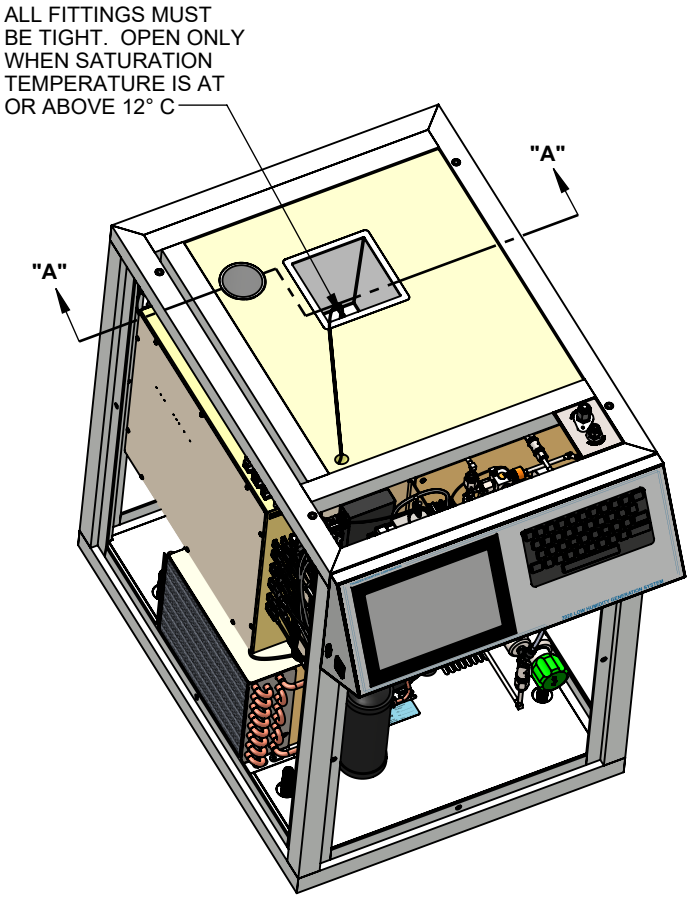


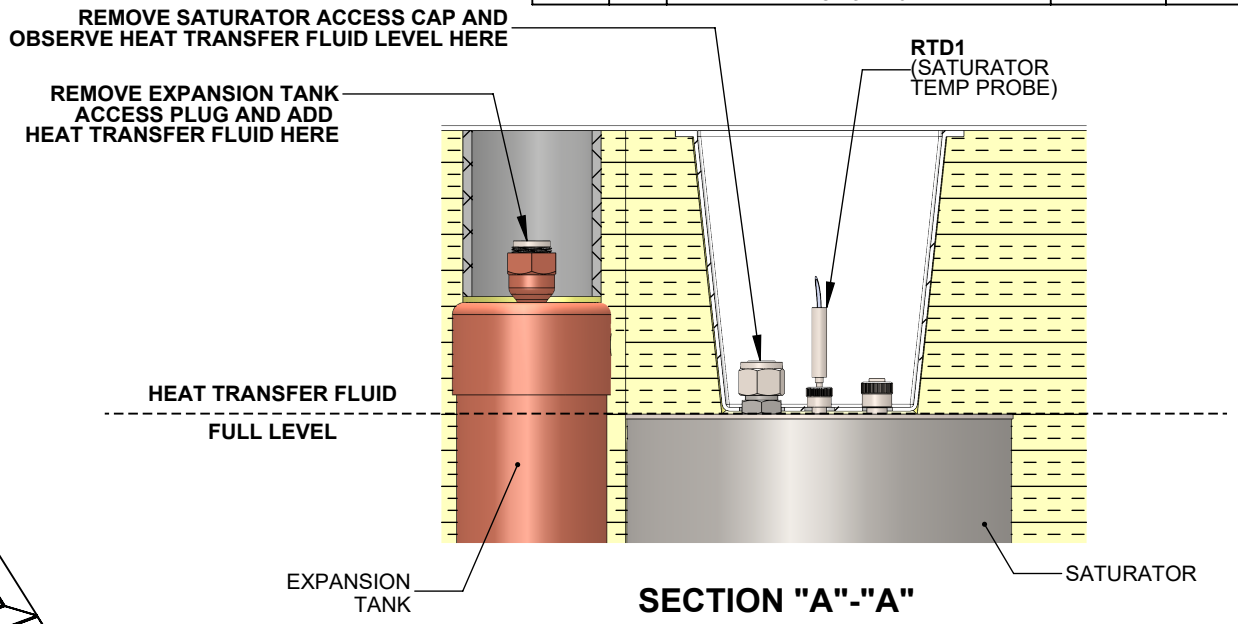
DO NOT SCALE FROM DRAWING		THIRD ANGLE PROJECTION	**PROPRIETARY NOTICE** THIS DRAWING AND INFORMATION CONTAINED WITHIN IS PROPRIETARY TO THUNDER SCIENTIFIC AND CANNOT BE COPIED OR REPRODUCED WITHOUT SPECIFIC WRITTEN PERMISSION	**Thunder Scientific Corporation** 623 Wyoming S.E. Albuquerque, NM 87123	
				Pneumatic System	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 07/25/2019	SIZE **A**	DWG. NO. 19S3920918 REV **A**
NEXT ASSY	USED ON		APPROVED BB 10/16/2019		WT. N/A lb SHEET 2 OF 3
APPLICATION			ISSUED DWF 10/16/2019		



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				Pneumatic System	
	3920	TOLERANCES .XXX ±.010 .XX ±.015 ∠ ±.50° UNLESS NOTED OTHERWISE	DRAWN FURRY 07/25/2019	SIZE **A**	DWG. NO. 19S3920918 REV **A**
NEXT ASSY	USED ON		APPROVED BB 10/16/2019		WT. 59.08 lb SHEET 3 OF 3
APPLICATION			ISSUED DWF 10/16/2019		

REVISIONS				
DWN	REV.	DESCRIPTION	DATE	APP. BY
BRH	A	ADDED WARNING STATEMENT FROM SECTION 2.3.2	03/31/2026	BB





SECTION "A"-"A"

1. ADD HEAT TRANSFER FLUID ONLY WHEN SYSTEM IS AT 12° C OR ABOVE

2. SLOWLY ADD HEAT TRANSFER FLUID TO THE EXPANSION TANK UNTIL FLUID IS OBSERVED IN THE SATURATOR ACCESS PORT.

A

Warning!

USE CAUTION WHEN HANDLING METHANOL.
METHANOL IS FLAMMABLE AND POISONOUS
KEEP AWAY FROM SPARKS, FLAMES, OR OTHER IGNITION SOURCES.
AVOID PROLONGED OR REPEATED BREATHING OF VAPORS OR CONTACT WITH SKIN.
SEE SECTION 2.3 FOR IMPORTANT SAFETY INFORMATION.

MODEL 3920
LOW HUMIDITY
GENERATOR

DO NOT SCALE FROM DRAWING

	3920
NEXT ASSY	USED ON
APPLICATION	

THIRD ANGLE PROJECTION

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TOLERANCES
.XXX ±.010
.XX ±.015
∠ ±.50°
UNLESS NOTED OTHERWISE

DRAWN	FURRY	12/9/2019
APPROVED	FURRY	12/12/2019
ISSUED	DWF	12/9/2019

Thunder Scientific Corporation
623 Wyoming S.E. Albuquerque, NM 87123

Heat Transfer Fluid Fill Instructions

SIZE	DWG. NO.	REV
A	19D3920920	A
	WT. 523.02 lb	SHEET 1 OF 1