



PPR Application Guide for PMO Appendix H Section IV

THERMOMETER SPECIFICATIONS

Anderson-Negele Paperless Process Recorder (PPR) with Legendary™ software is intended to be used in PMO applications. The blue text of this document explains how the recording system and review software meet the 2019 PMO requirements for Temperature Recording applications (requirements shown in black text). The blue bullet points indicate where additional information on this topic can be found.

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Other Sections of Appendix H Section IV:

- INDICATING THERMOMETERS FOR BATCH PASTEURIZERS**
- INDICATING THERMOMETERS LOCATED ON PASTEURIZATION PIPELINES**
- AIRSPACE INDICATING THERMOMETER FOR BATCH PASTEURIZERS**

The PPR is not intended to be used as an indicating thermometer in PMO applications.

TEMPERATURE-RECORDING DEVICES FOR BATCH PASTEURIZERS

The PPR can be used with an Anderson-Negele CT8V temperature sensor to meet the requirements listed below for batch (vat) pasteurizer applications.

1. UTILIZING TEMPERATURES LESS THAN 71°C (160°F)

Case: Moisture proof under normal operating conditions in milk plants.

PPR is NEMA 4X rated and designed for use in washdown environments.

Chart Scale: Shall have a span of not less than eleven (11) Celsius degrees (twenty (20) Fahrenheit degrees), including pasteurization temperature, ± 2.5°C (± 5°F); and graduated in temperature-scale divisions of 0.5°C (1°F), spaced not less than 1.6 millimeter (0.0625 of an inch) apart between 60°C (140°F) and 69°C (155°F). Provided, that temperature-scale divisions of 0.5°C (1°F), spaced not less than 1 millimeter (0.040 of an inch) apart, are permitted when the ink line is thin enough to be easily distinguished from the printed line; graduated in time-scale divisions of not more than ten (10) minutes; and having a chord of straight-line length of not less than 6.3 millimeters (0.25 of an inch), between 63°C (145°F) and 66°C (150°F).



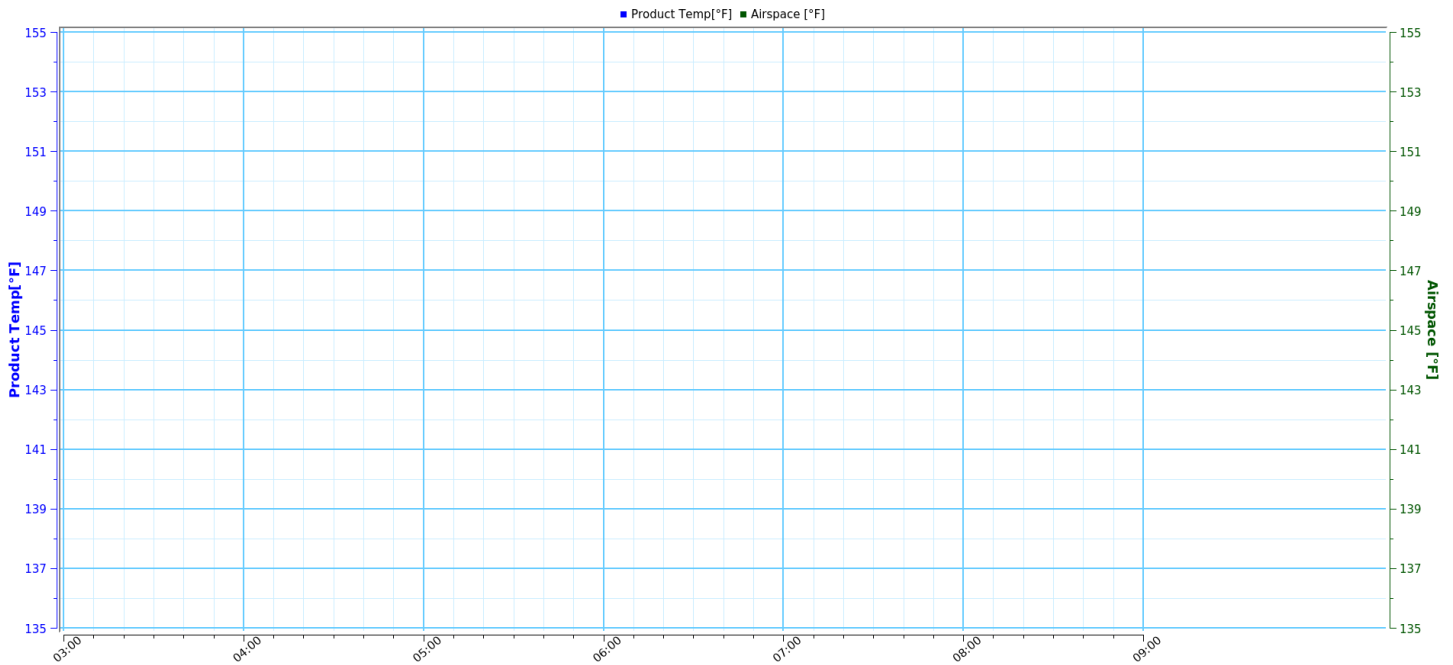
The Input recording scale (Y-Axis) and time scale (X-Axis) can be configured by the client to meet the requirements. Specific configuration will vary based on application and should be validated by the client and appropriate regulatory bodies. The following parameters are an example of how the requirements above can be achieved in an application where the pasteurization temperature is 145°F.

Recorder Setup Configuration

- Record Duration Period: Time Based
- Time Period of Record (Hours): 6
- Y Axis Major Divisions: 10
- Y Axis Minor Divisions: 2
- X Axis Major Divisions: 6
- X Axis Minor Divisions: 6

Record 1 Configuration

- Input X - Recording Lower Range Value: 135°F
- Input X - Recording Upper Range Value: 155°F



Name: **Batch Low Temp_2022_05_10_03_00_00AM_Rec1_001**

System Name: **PPR-Test**

Chart Revision: **1**

Plant Name: **Legendary Dairy Plant**
 156 Auriesville Rd. Fultonville, NY 12072
 Plant ID: **12-345**

Start Date: **05/10/2022 03:00:00 AM**

End Date: **05/10/2022 09:00:00 AM**

Figure 1: Batch Pasteurization - Low Temp



Temperature Accuracy: Within $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$), between 60°C (140°F) and 69°C (155°F). (Refer to Appendix I., Test 2 of this Ordinance.)

PPR meets the Temperature Accuracy requirement, clients and regulators may perform Appendix I Test 2 to verify as desired.

Time Accuracy: The recorded elapsed time, as indicated by the chart rotation, shall not exceed the true elapsed time, as compared to an accurate watch, over a period of at least thirty (30) minutes at pasteurization temperature. Temperature-recording devices for batch pasteurizers may be equipped with spring operated or electrically operated clocks. (Refer to Appendix I., Test 3 of this Ordinance.)

PPR meets the Time Accuracy requirement, clients and regulators may perform Appendix I Test 3 to verify as desired.

Pen-Arm Setting Device: Easily accessible and simple to adjust.

This requirement is not applicable to electronic recorders.

Temperature Sensing Device:

1. *Mercury Actuated: Bulb, tube, and spring, protected against damage at a temperature of 105°C (220°F).*

This requirement is not applicable to electronic recorders.

2. *Digital:*

The PPR can be used with an Anderson-Negele CT8V temperature sensor to meet the requirements listed below.

a. *No more than 0.5°C (1.0°F) drift over three (3) months use on a batch pasteurizer compared to a certified temperature source.*

PPR and CT8V can be used together to meet this Temperature Accuracy “Drift” requirement.

b. *Self-diagnostic circuitry, which provides constant monitoring of all sensing, input and conditioning circuits. The diagnostic circuitry should be capable of detecting “open” circuits, “short” circuits, poor connections and faulty components. Upon detection of failure of any component, the device shall blank, become unreadable or go visibly out of range.*

PPR and CT8V can be used together to meet the self diagnostic circuitry requirements. *Sensor Break Recording* defines how PPR will display and record data when Input errors occur. Input errors may include disconnected sensor, shorted sensor, open resistance measurement or other out-of-range conditions measured by the PPR Input microcontroller. When any of these input error conditions occur, the PPR software will record the error with an annotation on the record and record the input trendline as defined by this parameter for the duration of the input error condition.

c. *The electromagnetic compatibility of this device for this use shall be documented and available to the Regulatory Agency. The device shall be tested to determine the effects of electrostatic discharge, power fluctuation, conductive*



emission and susceptibility, and radiative emission and susceptibility. The device shall comply with the requirements for performance level characteristics of industrial devices.

PPR has been tested to CE 61010, applicable safety and usage information can be found in the PPR Operating Manual.

- PPR Operating Manual Section 1.2: Important Safety Information

d. The effect of exposure to specific environmental conditions shall be documented. The device shall be tested to determine the effects of low and high temperatures, thermal shock, humidity, physical shock and salt fog.

PPR environmental limitations can be found in the PPR Operating Manual.

- PPR Operating Manual Section 1.2: Important Safety Information
- PPR Operating Manual Section 2.4: Product Specifications

e. Both the probe and the display case shall be constructed so that they may be sealed by the Regulatory Agency.

PPR must be ordered with matrix option "S" to receive provisions for Tamper Evident Sealing Covers.

- PPR Operating Manual Section 2.3: Order Matrix/Model Number

f. Calibration of the device shall be protected against unauthorized changes.

The PPR is equipped with a movable shunt jumper "J9" to allow toggling between RUN and PROGRAM modes of operation. While in RUN mode, calibration is inhibited by PPR. Tamper evident sealing covers can be used to ensure that the J9 jumper remains in RUN mode between inspections.

- PPR Operating Manual Section 2.1.5: Run / Program Jumper

g. The device shall be protected against unauthorized component or sensing element replacement. Replacement of any component or sensing element shall be regarded as a replacement of the indicating thermometer and subject to Regulatory Agency inspection and all application tests under Appendix I. of this Ordinance.

CT8V and PPR with Tamper Evident Sealing Covers meet this requirement.

h. The sensing element shall be encased in appropriate material constructed in such a way that the final assembly meets the conditions of Item 11p of this Ordinance.

CT8V temperature sensor meet this requirement and the conditions of Item 11p.

Submerged Stem Fitting: A pressure-tight seat against the inside wall of the holder; no threads exposed to milk and/or milk products; and the distance from the underside of the ferrule to the sensitive portion of the bulb to be not less than 76 millimeters (3 inches).

CT8V temperature sensor meet this requirement



Chart Speed: A circular chart shall make one (1) revolution in not more than twelve (12) hours. Two (2) charts shall be used if operations extend beyond twelve (12) hours in one (1) day. Circular charts shall be graduated for a maximum record of twelve (12) hours. Strip charts may show a continuous recording over a twenty-four (24) hour period.

This requirement is met any time the *Time Period of Record* is configured to less than or equal to 24 hours.

2. UTILIZING TEMPERATURES GREATER THAN 71°C (160°F)

Batch pasteurizers used solely for thirty (30) minute pasteurization of milk and/or milk products at temperature above 71°C (160°F) may use temperature-recording devices that comply with 1., with the following options:

Chart Scale: Graduated in temperature scale divisions of 1°C (2°F), spaced not less than 1 millimeter (.040 of an inch) apart between 65°C (150°F) and 77°C (170°F); graduated in time-scale divisions of not more than fifteen (15) minutes; and having a chord of straight-line length of not less than 6.3 millimeters (0.25 of an inch) between 71°C (160°F) and 77°C (170°F).

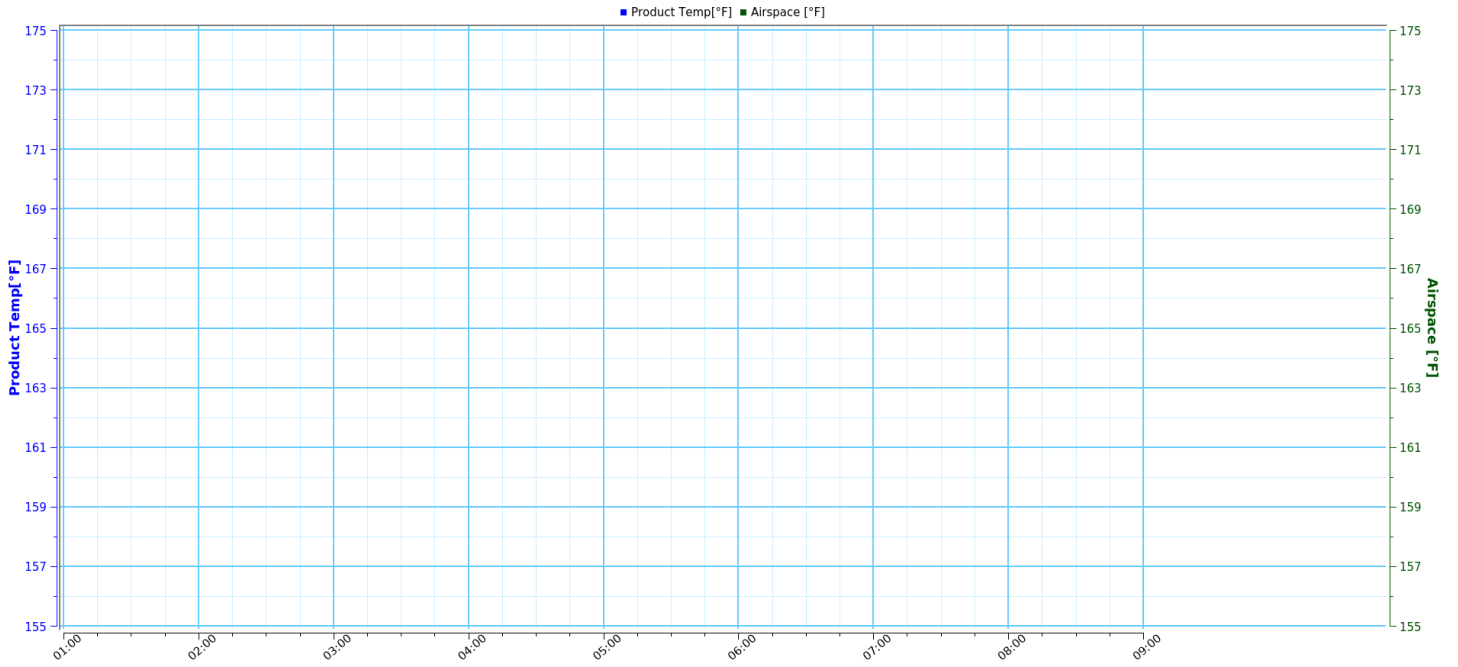
The Input recording scale (Y-Axis) and time scale (X-Axis) can be configured by the client to meet the requirements. Specific configuration will vary based on application and should be validated by the client and appropriate regulatory bodies. The following parameters are an example of how the requirements above can be achieved in an application where the pasteurization temperature is 165°F.

Recorder Setup Configuration

- Record Duration Period: Time Based
- Time Period of Record (Hours): 8
- Y Axis Major Divisions: 10
- Y Axis Minor Divisions: 2
- X Axis Major Divisions: 8
- X Axis Minor Divisions: 4

Record 1 Configuration

- Input X - Recording Lower Range Value: 155°
- Input X - Recording Upper Range Value: 175°



Name: **Batch High Temp_2022_05_10_01_00_00AM_Rec1_001**

System Name: **PPR-Test**

Chart Revision: **1**

Plant Name: **Legendary Dairy Plant**
156 Auriesville Rd. Fultonville, NY 12072

Start Date: **05/10/2022 01:00:00 AM**

Plant ID: **12-345**

End Date: **05/10/2022 09:00:00 AM**

Figure 2: Batch Pasteurization - High Temp.



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RECORDER/CONTROLLERS FOR CONTINUOUS PASTEURIZERS

The PPR can be used with an Anderson-Negele SB temperature sensor to meet the requirements listed below for continuous pasteurizer applications. e.g. HTST & HHST

Case: Moisture proof under normal operating conditions in milk plants.

PPR is NEMA 4X rated and designed for use in washdown environments.

Chart Scale: Shall have a span of not less than seventeen (17) Celsius degrees (thirty (30) Fahrenheit degrees), including the temperature at which diversion is set, $\pm 7^{\circ}\text{C}$ ($\pm 12^{\circ}\text{F}$); graduated in temperature scale divisions of 0.5°C (1°F), spaced not less than 1.6 millimeter (0.0625 of an inch) apart at the diversion temperature, $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$). Provided, that temperature-scale divisions of 0.5°C (1°F), spaced not less than 1 millimeter (0.040 of an inch) apart, are permitted when the ink line is thin enough to be easily distinguished from the printed line; graduated in timescale divisions of not more than fifteen (15) minutes; and having an equivalent fifteen (15) minute chord or straight-line length of not less than 6.3 millimeters (0.25 of an inch) at the diversion temperature, $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$).

The Input recording scale (Y-Axis) and time scale (X-Axis) can be configured by the client to meet the requirements. Specific configuration will vary based on application and should be validated by the client and appropriate regulatory bodies. The following parameters are an example of how the requirements above can be achieved in an application where the pasteurization diversion temperature is 165°F. See Figure 3 for sample record.

Recorder Setup Configuration

- Record Duration Period: Time Based
- Time Period of Record (Hours): 8
- Y Axis Major Divisions: 10
- Y Axis Minor Divisions: 10
- X Axis Major Divisions: 8
- X Axis Minor Divisions: 4

Record 1 Configuration

- Input X - Recording Lower Range Value: 140°
- Input X - Recording Upper Range Value: 190°

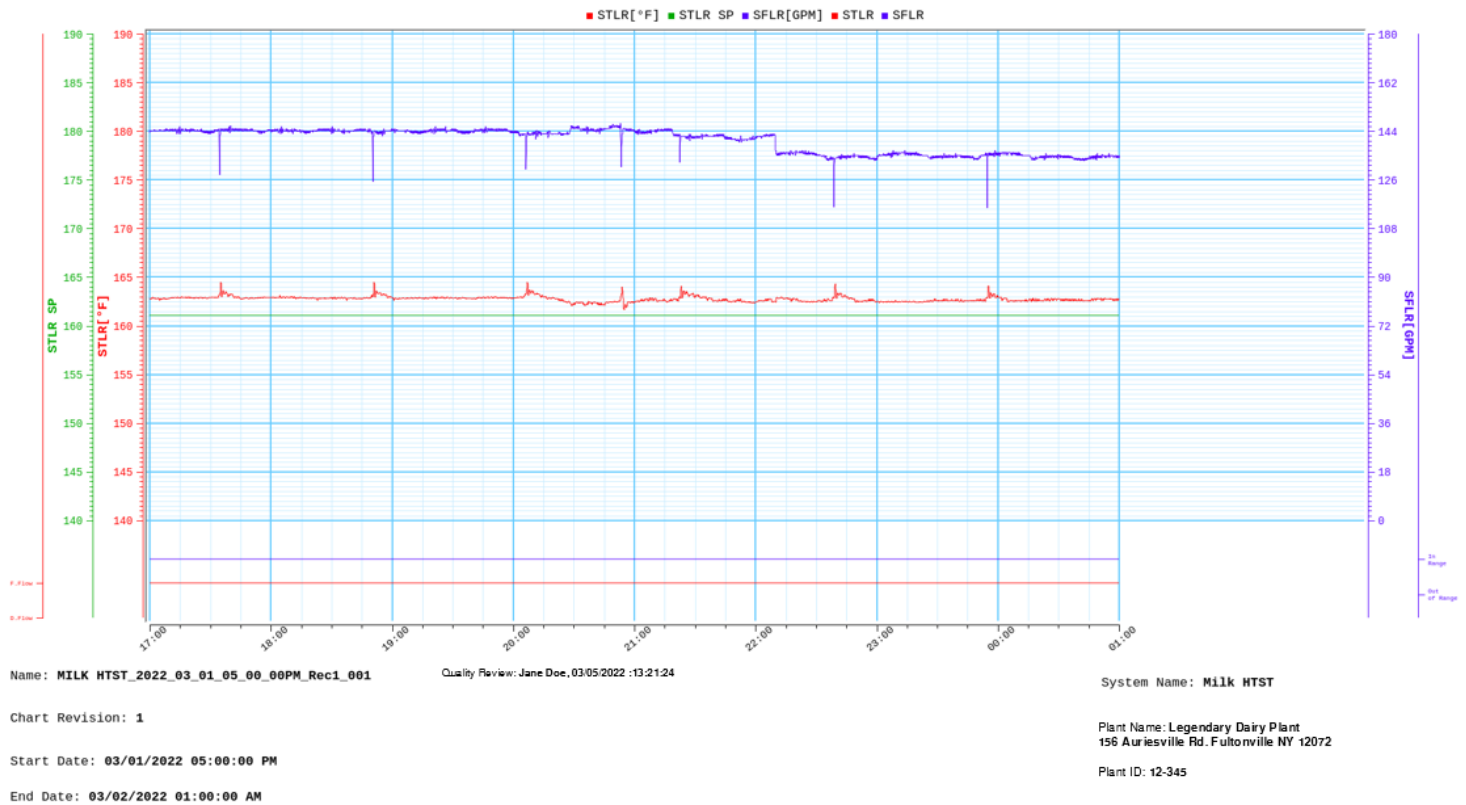


Figure 3: Continuous Pasteurization Sample Record

Temperature Accuracy: Within $\pm 0.5^{\circ}\text{C}$ ($\pm 1^{\circ}\text{F}$), at the temperature, $\pm 3^{\circ}\text{C}$ ($\pm 5^{\circ}\text{F}$), at which the controller is set to divert. (Refer to Appendix I., Test 2 of this Ordinance.)

PPR meets the Temperature Accuracy requirement, clients and regulators may perform Appendix I Test 2 to verify as desired.

Power Operated: All recorder/controllers for continuous pasteurization shall be electrically operated.

PPR is an electronic recorder/controller and meets this requirement.

Pen-Arm Setting Device: Easily accessible and simple to adjust for mercury-actuated recording thermometer. (Refer to Appendix I., Test 4 of this Ordinance.)

This requirement is not applicable to electronic recorders.

Pen and Chart Paper: Pen designed to give a line not over .07 millimeters (0.025 of an inch) wide and easy to maintain.

This requirement is not applicable to electronic recorders.



Temperature Sensing Device:

1. Mercury Actuated: Bulb, tube and spring protected against damage at a temperature of 105°C (220°F). Provided, that the recorder/controller temperature sensing devices, used on HHST pasteurization systems, shall be protected against damage at temperatures of 149°C (300°F).

This requirement is not applicable to electronic recorders.

2. Digital:

The PPR can be used with an Anderson-Negele SB temperature sensor to meet the requirements listed below.

a. No more than 0.5°C (1.0°F) drift over three (3) months use compared to a certified temperature source.

PPR and SB can be used together to meet this Temperature Accuracy “Drift” requirement.

b. Self-diagnostic circuitry, which provides constant monitoring of all sensing, input and conditioning circuits. The diagnostic circuitry should be capable of detecting “open” circuits, “short” circuits, poor connections and faulty components. Upon detection of failure of any component, the device shall blank or become unreadable.

PPR and SB can be used together to meet the self diagnostic circuitry requirements. *Sensor Break Recording* defines how PPR will display and record data when Input errors occur. Input errors may include disconnected sensor, shorted sensor, open resistance measurement or other out-of-range conditions measured by the PPR Input microcontroller. When any of these input error conditions occur, the PPR software will record the error with an annotation on the record and record the input trendline as defined by this parameter for the duration of the input error condition.

c. The electromagnetic compatibility of this device for this use shall be documented and available to the Regulatory Agency. The device shall be tested to determine the effects of electrostatic discharge, power fluctuation, conductive emission and susceptibility, and radiative emission and susceptibility. The device shall comply with the requirements for performance level characteristics of industrial devices.

PPR has been tested to CE 61010, applicable safety and usage information can be found in the PPR Operating Manual.

- PPR Operating Manual Section 1.2: Important Safety Information

d. The effect of exposure to specific environmental conditions shall be documented. The device shall be tested to determine the effects of low and high temperatures, thermal shock, humidity, physical shock and salt fog.

PPR environmental limitations can be found in the PPR Operating Manual.

- PPR Operating Manual Section 1.2: Important Safety Information
- PPR Operating Manual Section 2.4: Product Specifications

e. Both the probe and the display case shall be constructed so that they may be sealed by the Regulatory Agency.



PPR must be ordered with matrix option “S” to receive provisions for Tamper Evident Sealing Covers.

- PPR Operating Manual Section 2.3: Order Matrix/Model Number

f. Calibration of the device shall be protected against unauthorized changes.

The PPR is equipped with a movable shunt jumper “J9” to allow toggling between RUN and PROGRAM modes of operation. While in RUN mode, calibration is inhibited by PPR. Tamper evident sealing covers can be used to ensure that the J9 jumper remains in RUN mode between inspections.

- PPR Operating Manual Section 2.1.5: Run / Program Jumper

g. The device shall be protected against unauthorized component or sensing element replacement. Replacement of any component or sensing element shall be regarded as a replacement of the indicating thermometer and subject to Regulatory Agency inspection and all applicable tests under Appendix I. of this Ordinance.

SB and PPR with Tamper Evident Sealing Covers meet this requirement.

h. The sensing element shall be encased in appropriate material constructed in such a way that the final assembly meets the conditions of Item 11p of this Ordinance.

SB temperature sensor meet this requirement and the conditions of Item 11p.

i. The device shall be tested from the sensing probe through the final output.

PPR allows for this system level testing.

Stem Fitting: A pressure-tight seat against the inside wall of the pipe; no threads exposed to milk and/or milk products; and the distance from the underside of the ferrule to the sensitive portion of the bulb is to be not less than 76 millimeters (3 inches).

SB temperature sensor meet this requirement

Chart Speed: A circular chart shall make one (1) revolution in not more than twelve (12) hours. Two (2) charts shall be used if operations extend beyond twelve (12) hours in one (1) day. Circular charts shall be graduated for a maximum record of twelve (12) hours. Strip charts may show a continuous recording over a twenty-four (24) hour period.

This requirement is met any time the *Time Period of Record* is configured to less than or equal to 24 hours.

Frequency Pen: The recorder/controller shall be provided with an additional pen-arm located on the outer edge of the chart, for recording the time at which the FDD is in the forward or diverted flow position. The chart time line shall correspond with the reference arc, and the recording pen shall rest upon the time line matching the reference arc.

When PPR is purchased with STLR configuration, the applicable hardware and software to measure and record FDD position will automatically be included. An example of the Frequency pen can be found in the bottom of Figure 3 above.



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- [PPR Operating Manual Section 2.3: Order Matrix/Model Number](#)
- [PPR Operating Manual Section 2.1.3.2: Viewing PPR STLR/SFLR Event Pens on Records](#)

Controller: Actuated by the same sensor as the recorder pen, however the cut-in and cut-out response shall be independent of pen-arm movement.

PPR uses the SB temperature sensor to record the STLR temperature and control the process.

Controller Adjustment: A mechanism for the adjustment of the response temperature. It shall be designed so that the temperature setting cannot be altered or the controller manipulated without detection.

PPR allows for configuration of the STLR setpoint while the recorder is in the Program mode, and selection of the active diversion setpoint while in the Run mode.

- [PPR Operating Manual Section 2.1.5: Run / Program Jumper](#)

Thermometric Response: With the recorder/controller bulb at room temperature and then immersed in sufficiently agitated water or oil bath at 4°C (7°F) above the cut-in point, the interval between the moment when the recording thermometer reads 7°C (12°F) below the cut-in temperature and the moment of power cut-in shall be not more than five (5) seconds. (Refer to Appendix I., Test 8 of this Ordinance.)

PPR meets the Thermometric response requirements listed above, clients and regulators may perform Appendix I Test 8 to verify as desired.

Chart Support Drive: The rotating chart support drive shall be provided with a pin to puncture the chart in a manner to prevent its fraudulent rotation.

This requirement is not applicable to electronic recorders.



TEMPERATURE-RECORDING DEVICES USED IN STORAGE TANKS

The PPR can be used with various Anderson-Negele temperature sensors to meet the requirements listed below for storage tank applications.

Case: Moisture proof under operating conditions in milk plants.

PPR is NEMA 4X rated and designed for use in washdown environments.

Chart Scale: Shall have a scale span of not less than twenty-eight (28) Celsius degrees (fifty (50) Fahrenheit degrees) including normal storage temperature, $\pm 3^{\circ}\text{C}$ ($\pm 5^{\circ}\text{F}$), graduated in not more than 1°C (2°F) divisions. Lines spaced not less than 1 millimeter (0.040 of an inch) apart, are permitted when the ink line is thin enough to be easily distinguished from the printed line. They shall be graduated in time scale divisions of not more than one (1) hour, having a chord of straight-line length of not less than 3.2 millimeters (0.125 of an inch) at 5°C (41°F). These charts shall be capable of recording temperatures up to 83°C (180°F). Span specifications do not apply to extensions beyond 38°C (100°F).

The Input recording scale (Y-Axis) and time scale (X-Axis) can be configured by the client to meet the requirements. Specific configuration will vary based on application and should be validated by the client and appropriate regulatory bodies. The following parameters are an example of how the requirements above can be achieved in an application where the normal storage temperature is 40°F .

Recorder Setup Configuration

- Record Duration Period: Time Based
- Time Period of Record (Hours): 84
- Y Axis Major Divisions: 15
- Y Axis Minor Divisions: 5
- X Axis Major Divisions: 14
- X Axis Minor Divisions: 6

Record 1 Configuration

- Input X - Recording Lower Range Value: 30°
- Input X - Recording Upper Range Value: 180°

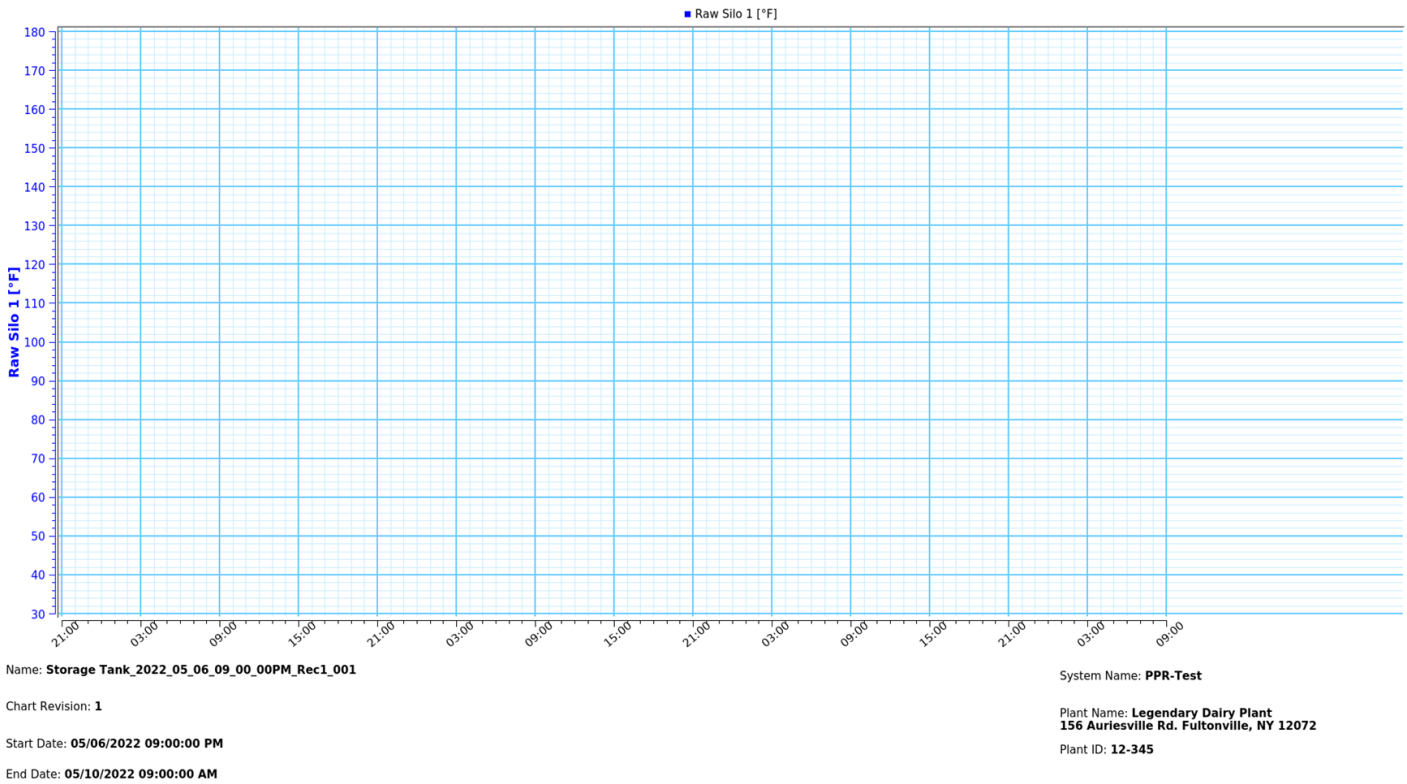


Figure 4: Storage Tank Sample Record

Temperature Accuracy: Within $\pm 1^{\circ}\text{C}$ ($\pm 2^{\circ}\text{F}$), between the specified range limits.

PPR meets the Temperature Accuracy requirement.

Pen-Arm Setting Device: Easily accessible and simple to adjust.

This requirement is not applicable to electronic recorders

Pen and Chart Paper: Designed to make a line not over .635 millimeters (0.025 of an inch) wide when in proper adjustment and easy to maintain.

This requirement is not applicable to electronic recorders

Temperature Sensor: Protected against damage at 100°C (212°F).

All temperature sensors manufactured by Anderson-Negele for use in food and beverage applications have a minimum operating temperature $> 212^{\circ}\text{F}$.

Stem Fittings: A pressure-tight seat or other suitable sanitary fitting with no threads exposed.



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All temperature sensors manufactured by Anderson-Negele for use in food and beverage applications are capable of meeting this requirement.

Chart Speed: The circular chart shall make one (1) revolution in not more than seven (7) days and shall be graduated for a maximum record of seven (7) days. Strip chart shall move not less than 2.54 centimeters (1 inch) per hour and may be used continuously for one (1) calendar month.

This requirement is met any time the *Time Period of Record* is configured to less than or equal to 168 hours.



TEMPERATURE-RECORDING DEVICES ON CLEANING SYSTEMS

The PPR can be used with various Anderson-Negele temperature sensors to meet the requirements listed below for cleaning system applications.

Location: Temperature sensor is in the return solution line downstream from the process.

The client is responsible for ensuring this requirement is met upon equipment installation.

Case: Moisture proof under operation conditions.

PPR is NEMA 4X rated and designed for use in washdown environments.

Chart Scale: Shall have a range from 16°C (60°F) to 83°C (180°F), with extensions of scale on either side permissible and graduated in time-scale divisions of not more than fifteen (15) minutes. The chart is to be graduated in temperature divisions of not more than 1°C (2°F), spaced not less than 1.6 millimeters (0.0625 of an inch) apart, above 44°C (110°F). Provided, that temperature-scale divisions of 1°C (2°F), spaced not less than 1 millimeter (0.040 of an inch) apart, are permitted when the ink line is thin enough to be easily distinguished from the printed line.

The Input recording scale (Y-Axis) and time scale (X-Axis) can be configured by the client to meet the requirements. Specific configuration will vary based on application and should be validated by the client and appropriate regulatory bodies. The following parameters are an example of how the requirements above can be achieved in an application where the normal cleaning process happens at 180°F.

Recorder Setup Configuration

- Record Duration Period: Time Based
- Time Period of Record (Hours): 12
- Y Axis Major Divisions: 12
- Y Axis Minor Divisions: 6
- X Axis Major Divisions: 12
- X Axis Minor Divisions: 4

Record 1 Configuration

- Input X - Recording Lower Range Value: 60°
- Input X - Recording Upper Range Value: 180°

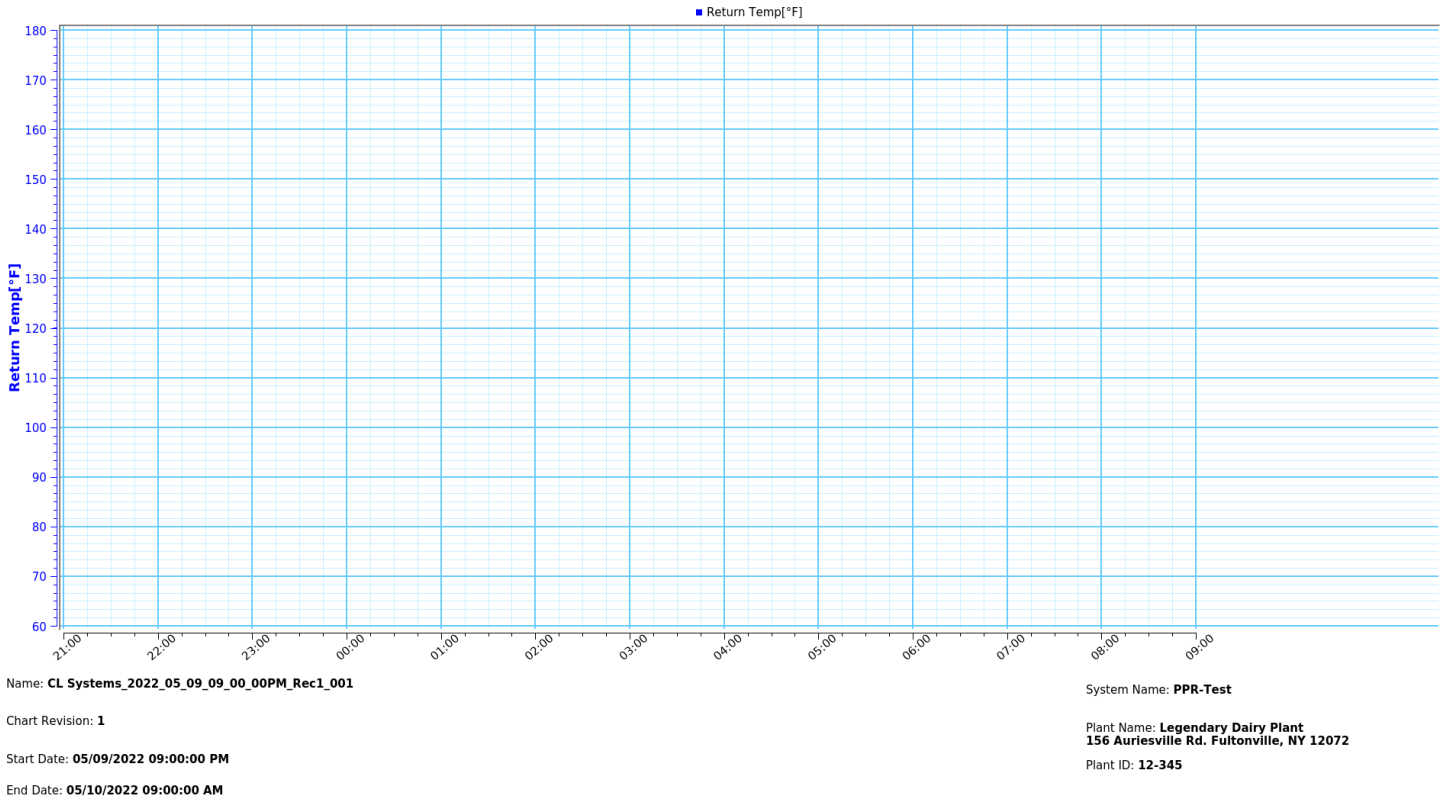


Figure 5: Cleaning System Sample Record

Temperature Accuracy: Within $\pm 1^{\circ}\text{C}$ ($\pm 2^{\circ}\text{F}$), above 44°C (110°F).

PPR meets the Temperature Accuracy requirement.

Pen-Arm Setting Device: Easily accessible and simple to adjust.

This requirement is not applicable to electronic recorders

Pen and Chart Paper: Designed to make a line not over .635 millimeters (0.025 of an inch) wide and easy to maintain.

This requirement is not applicable to electronic recorders

Temperature Sensor: Protected against damage at 100°C (212°F).

All temperature sensors manufactured by Anderson-Negele for use in food and beverage applications have a minimum operating temperature $> 212^{\circ}\text{F}$.

Stem Fitting: A pressure-tight seat against the inside wall of the pipe with no threads exposed to solution.



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All temperature sensors manufactured by Anderson-Negele for use in food and beverage applications are capable of meeting this requirement.

Chart Speed: Circular charts shall make one (1) revolution in not more than twenty-four (24) hours. Strip charts shall not move less than 25 millimeters (1 inch) per hour. More than one (1) record of the cleaning operation shall not overlap on the same section of the chart for either circular or strip charts.

This requirement is met any time the *Time Period of Record* is configured to less than or equal to 24 hours.