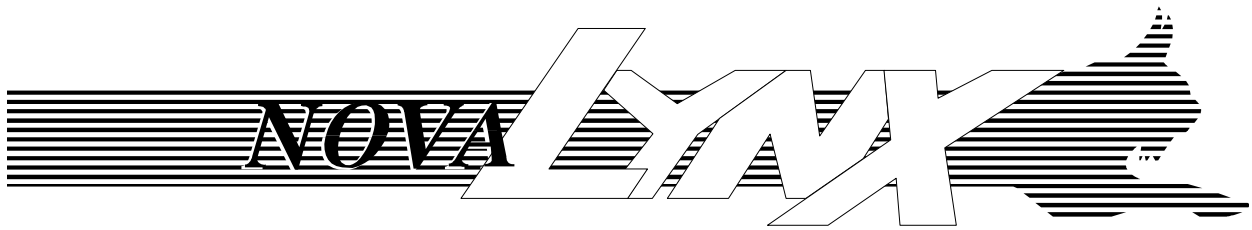


NOVALYNX CORPORATION

MINIMUM-MAXIMUM THERMOMETER SET
NATIONAL WEATHER SERVICE TYPE

INSTRUCTION MANUAL

210-4420 210-4421
210-4425 210-4426
210-4429 210-4430



EXTRACTED FROM THE NWS OBSERVING HANDBOOK NO. 2
REVISION DATE 12/98

Receiving and Unpacking

Carefully unpack all components and compare to the packing list. Notify NovaLynx Corporation immediately concerning any discrepancy. Inspect equipment to detect any damage that may have occurred during shipment. In the event of damage, any claim for loss must be filed immediately with the carrier by the consignee. Damages to equipment sent via Parcel Post or UPS require the consignee to contact NovaLynx Corporation for instructions.

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If equipment is to be returned to the factory for any reason, call NovaLynx between 8:00 a.m. and 4:00 p.m. Pacific Time to request a Return Authorization Number (RA#). Include with the returned equipment a description of the problem and the name, address, and daytime phone number of the sender. Carefully pack the equipment to prevent damage or additional damage during the return shipment. Call NovaLynx for packing instructions in the case of delicate or sensitive items. If packing facilities are not available take the equipment to the nearest Post Office, UPS, or other freight service and obtain assistance with the packaging. Please write the RA# on the outside of the box.

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NovaLynx Corporation warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from the date of shipment from the factory. NovaLynx Corporation's obligations under this warranty are limited to, at NovaLynx's option: (i) replacing; or (ii) repairing; any product determined to be defective. In no case shall NovaLynx Corporation's liability exceed product's original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by NovaLynx Corporation, or that has been subjected to misuse, negligence, or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

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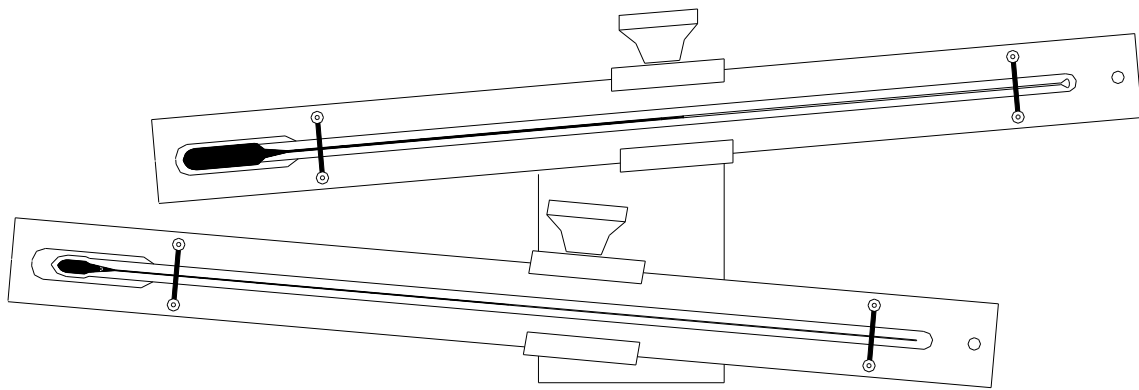
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**MODELS 210-4420 & 210-4421
EQUIPMENT CONFIGURATION AND IDENTIFICATION**



MINIMUM - MAXIMUM THERMOMETER SET

NovaLynx Corporation

Model 210-4420 & 210-4421 Minimum-Maximum Thermometer Set Instruction Manual

1.0 INTRODUCTION

The temperature readings, as defined in the following paragraphs, are taken from the minimum-maximum thermometers. The readings consist of temperature readings taken at temperature stations.

The minimum air temperature is the lowest temperature that has occurred since the previous reading and setting of the minimum thermometer.

The maximum air temperature is the highest temperature that has occurred since the maximum thermometer was read and reset.

The current air temperature is the temperature indicated by the thermometer at the time the reading is taken.

Proper exposure of the thermometers inside a suitable shelter and in a proper location is a basic requirement for obtaining representative air temperature readings. At temperature stations where minimum, maximum, and current temperatures are observed, liquid-in-glass thermometers are generally used.

2.0 SHELTERS

The shelter used most often for housing minimum and maximum thermometer sets is the National Weather Service (NWS) medium-sized type (NovaLynx Model 380-601) with louvered sides, a doubled roof. The purpose of the shelter is to protect the thermometers from precipitation, condensation, and solar radiation. The louvered construction allows air to circulate freely through the shelter providing good exposure of ambient air to the thermometers. The shelter should provide a center cross board or a vertical post for mounting the thermometers.

The shelter should be located above ground that is representative of the area. A level, open space or clearing is desirable to provide adequate, unobstructed airflow around the shelter. Avoid using locations where there are steep slopes or sheltered hollows unless these are the types of areas being studied. Whenever possible, the shelter should not be any closer to the nearest obstruction by at least four times the height of the obstruction (trees, fence, buildings). There should be a space of at least 100 feet between the shelter and surfaces with extensive amounts of concrete or pavement.

2.1 Shelter Installation

The shelter should be installed with the bottom at least four feet above the ground surface. Position the door so that it faces towards North (Northern Hemisphere) to prevent the sun from shining on the thermometers whenever the door is opened for readings during the day.

The shelter should be mounted rigidly to minimize movement and vibrations. For example, vibrations from strong winds will displace the index inside the liquid-in-glass thermometers resulting in erroneous readings. For locations subject to frequent vibrations, the thermometers may require mounting onto a separate post that enters the shelter through a hole in the floor.

2.2 Shelter Maintenance

Accumulation of dust inside the shelter will coat the thermometers. Wipe off any dust using a dry, clean cloth or a soft brush. Regularly inspect the shelter mounting supports to insure that the shelter remains secured to its foundation and to the support legs. Report or repair any defects in the shelter, the shelter supports, and the foundation.

For locations where there is severe weather, an annual repainting of the shelter exterior may be necessary to help maintain the insulating properties of the shelter. Use a white, highly reflective, latex paint. Apply more than one coat of paint if necessary.

3.0 LIQUID-IN-GLASS THERMOMETERS

3.1 Minimum Thermometer

The minimum thermometer of the liquid-in-glass design features an alcohol-filled bulb sensing element. The thermometer is exposed in a nearly horizontal position. Graduations are at one degree intervals and are etched onto the stem of the thermometer. The alcohol is often colored to facilitate reading the thermometer. The bore of the thermometer contains a dark, barbell shaped piece of glass referred to as the "index." As the temperature rises, the alcohol expands and flows around the index without displacing it. As the temperature decreases, the alcohol shrinks. As the top of the alcohol column shrinks and touches the top of the index, the index will move towards the bulb with the alcohol column. Later on, as the alcohol begins to expand with rising temperature, the index is left in place giving a reading of the lowest temperature sensed by the alcohol. Note that an index that becomes trapped within a broken alcohol column will give erroneous readings until the alcohol column is reunited.

3.2 Maximum Thermometer

The maximum thermometer of the liquid-in-glass style thermometers features a mercury-filled sensing bulb. The thermometer is exposed in a nearly horizontal position. The bore of the bulb is constricted at a point that is between the bulb reservoir and the graduated portion of the stem. The stem is graduated in one degree intervals that are etched onto the glass. With a rising temperature, some of the mercury is forced to pass through the constriction and into the graduated stem. As the temperature begins to decrease, the column of mercury inside the graduated stem remains in place. The thermometer is lowered into a horizontal position for taking the reading. The top of the mercury column inside the graduated stem will indicate the highest temperature sensed by the thermometer. Whenever the thermometer is reset there will appear to be a small air bubble between the column of mercury inside the graduated stem and the mercury inside the bulb. The bubble is suppose to be there and it is what allows the thermometer to measure the maximum temperature. If the two sections of mercury were completely joined together, the mercury column would not stay in place inside the stem and the maximum temperature would not be indicated, only current temperature would be given.

3.3 Thermometer Mounting

The two thermometers are mounted inside a wooden shelter using a mounting fixture that allows reading and resetting of the thermometers with a minimum of handling. The mounting support also holds the thermometers in the correct positions between readings. The mount is generally a machined, metal fixture with tubes and rotating holders for the thermometers. The thermometers are clamped into place on the mounting fixture. One tube is higher than the other and is designed to hold the maximum thermometer. By releasing a catch, the maximum thermometer can be rotated rapidly along with its mounting base in order to reset the mercury column. The shorter tube that holds the minimum thermometer is designed so that it can move only one quarter turn (90°).

The thermometer mounting support is usually bolted onto the shelter cross board or center post using wood screws. The thermometers should be as close as possible to the center of the shelter. The maximum thermometer should be at the bottom of the mount when it is correctly installed. The sides of the mount should be vertical. A properly installed thermometer mount will place the bulb end of the minimum thermometer about 5° below horizontal and the bulb of the maximum thermometer about 5° above horizontal.

Thermometers should be installed inside the shelter in such a manner as to allow air to move freely around the bulbs. There should be no part of either thermometer touching the shelter, cross board, or touching any other instruments inside the shelter during or after the thermometers have been set.

The thermometers are constructed with metal frames for support and protection. The metal frame of the maximum thermometer should be clamped into the lower mounting fixture bracket at a point that is about 3 1/2 inches from the top end of the thermometer. The bulb will be to the left when the thermometer is fixed into position on the mounting bracket.

The metal frame of the minimum thermometer is clamped into the upper, and shorter mounting tube and bracket. Place the frame into the bracket so that slightly less than one-half of the thermometer extends to the right of the bracket and the sensing bulb is on the left side when the bracket is in the fixed position.

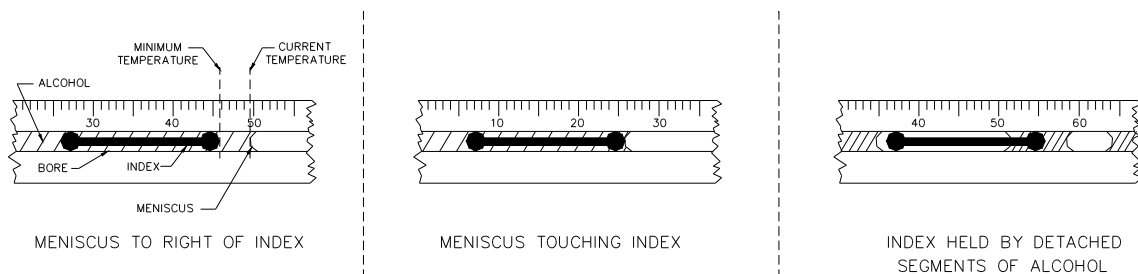
3.4 Thermometer Maintenance

Maintenance of the mounting fixture is limited to occasional oiling of the rotating tubes and inspection of the fastening hardware for loose or missing parts. Tighten any loose screws and clamps. Replace any missing screws. Wipe off any excess oil from the surfaces of the mounting fixture. Check to determine that the maximum thermometer mounting bracket and tube rotate freely.

Defective thermometers must be replaced. If there has been a slight change in the accuracy of the thermometer reading, keep a record of the change and correct the readings by adding or subtracting the changed amount.

3.4.1 Minimum Thermometers

The column of alcohol within the minimum thermometer may become fragmented, resulting in erroneous readings. The separations in the alcohol may appear as small bubbles. These bubbles will make the alcohol column too long and may cause the index to become trapped. Segments of the column may separate completely from the principal column and remain in the upper portion of the bore. In this last situation, the column will be too short, resulting in readings that are too low.



Inspect the thermometer regularly to detect problems with the alcohol column. Use one of the corrective methods described below to fix the alcohol column in the minimum thermometer. The method selected may need to be repeated several times before the column segments are recombined. In extreme situations, it may take at least twenty minutes of working with the thermometer before the alcohol column is recombined. No method of repair should be continued too long nor too forcefully to risk damaging or breaking the thermometer. After repeated attempts to restore the alcohol column have failed, replace the thermometer with a new one. An alcohol thermometer should be kept vertical for several hours after restoring the alcohol column to permit any additional alcohol that is clinging to the bore to drain back down.

3.4.2 Corrective Procedures

The following procedures may be used to recombine a segmented column of alcohol or to dislodge a trapped index. Some of the methods may work better than others. All methods must be tried to discover which one works best for each situation and each thermometer.

- a. Grasp the thermometer tightly just below the middle of the metal frame with the bulb pointing downward. Strike the edge of the metal frame sharply against the palm of the free hand. Repeat the striking several times. Inspect the column of alcohol to see whether the segments have rejoined the main column. If the column is still segmented repeat the procedure. Avoid holding the metal frame by pressing the fingers or any part of the hand against the thermometer stem. Otherwise, the stem may break.
- b. Use a brisk, short swing of the fore-arm to shock the thermometer. This method often works well to dislodge a trapped index as well as to recombine a segmented column of alcohol. Grasp the metal frame of the thermometer slightly above the mid-point. As in process A avoid pressing against the glass stem of the thermometer. With the arm extended upward, quickly swing the arm downward, through an arc of 3 to 4 feet, coming to an abrupt stop. Repeat this movement several times. Inspect the thermometer to determine whether or not the index has become freed or the alcohol column segments have recombined. Repeat the procedure if necessary.
- c. This corrective method is a modification of B. Whirl the thermometer rapidly on the end of a short cord. The short length of cord is firmly attached to the metal frame of the thermometer using the hole located in the metal frame. The cord must be strong. Use nylon rope if available. Firmly grasp the cord at a point that is about 8 inches away from the thermometer. Check the length of the cord with the thermometer attached to ensure that the thermometer will not strike any nearby objects or hit the floor when the cord is twirled. Inspect the metal frame to prevent the metal from cutting into the cord as it is twirled around. Swing the thermometer rapidly for a couple of minutes and then bring it to a safe stop. Slowing the swing and then catching the thermometer with the free hand will safely end the procedure. Practice may be required to be able to perform this

procedure successfully. If possible experiment and practice this method using a damaged thermometer that is beyond repair so that any mistakes will not be disastrous. This method often works best for correcting both the trapped index and the segmented column.

3.4.3 Maximum Thermometers

For the maximum thermometer, there are sometimes defects in the constriction that fails to prevent the mercury from being drawn into the bulb. This type of defect is presented as a decrease in the length of the column as it rests on the constriction with the thermometer in a vertical position. Improper handling of the thermometer may also produce this problem. Thermometers with this defect must be replaced.

In contrast, some maximum thermometers may have a constriction that is too small causing difficulty in returning mercury into the bulb at low temperatures. These thermometers must also be replaced.

In some thermometers, a short segment of mercury will become lodged in the upper end of the bore. To recover this mercury, hold the thermometer vertical with the bulb at the top and gently tap the metal frame until the column merges with the segment. Lower the thermometer, allowing the column to slide slowly down the bore and back to the constriction. If the segment does not reunite with the column of mercury, remove the thermometer from the mounting fixture and whirl it briskly. If neither method is successful, replace the thermometer.

4.0 TEMPERATURE OBSERVATIONS

4.1 Thermometer Readings

Thermometers are read and the readings are recorded to the nearest whole degree. Below-zero temperatures are recorded using a minus (-) sign prefix. A temperature of 1° below zero will be recorded as **-1**, a temperature of 5° below zero will be recorded as **-5**, etc. A temperature of zero degrees will be recorded as **0**.

4.1.1 Reading Accuracy

Observe the following precautions whenever making thermometer readings to prevent errors:

- a.** Stand away from the thermometer to prevent body heat from changing the indicated readings. This precaution is especially critical in cold weather.
- b.** Do not touch the temperature sensing bulbs of the thermometers. Observe this precaution especially from the time the Thermometers have been set until they have been read at the time of the next observation.

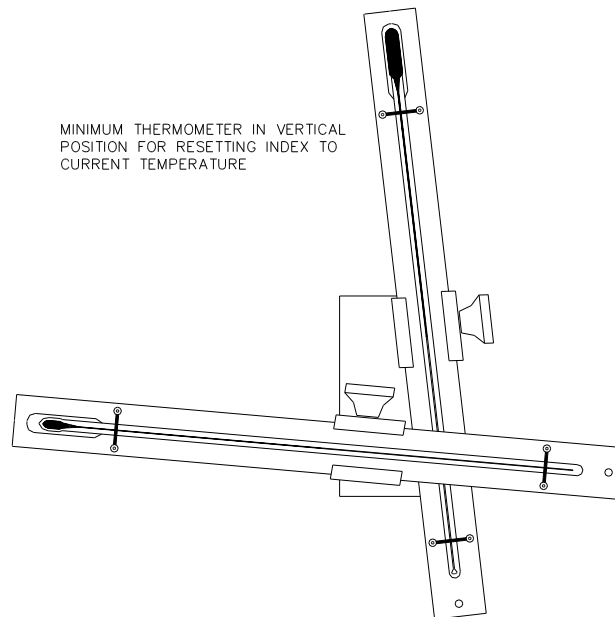
- c. Make sure that the line of sight between the eye of the observer and the thermometer liquid level and scale is perpendicular. Where liquid-in-glass thermometers are used, the line of sight to the end of the liquid column farthest from the sensing bulb should make an angle of 90° with respect to the glass stem.

4.1.2 Minimum Thermometers

The liquid-in-glass minimum thermometer is read in its "set" position. "Set position" refers to the position fixed by the mounting fixture described previously.

4.1.3 Minimum Temperatures

The minimum temperature is the scale reading of the minimum thermometer at the end of the index farthest from the sensing bulb. The reading is made before moving the thermometer from the position in which it had been set at the time of the previous minimum temperature observation.



4.1.4 Setting Minimum Thermometers

To SET a minimum thermometer mounted into a standard support fixture, rotate the metal frame clockwise into a vertical position until the sensing bulb is at the top. Allow the index to fall until it reaches the end of the alcohol column. Rotate the metal frame counter-clockwise until the support tube stops against the pin of the mounting fixture. At this point, the sensing bulb should be inclined about 5° below horizontal.

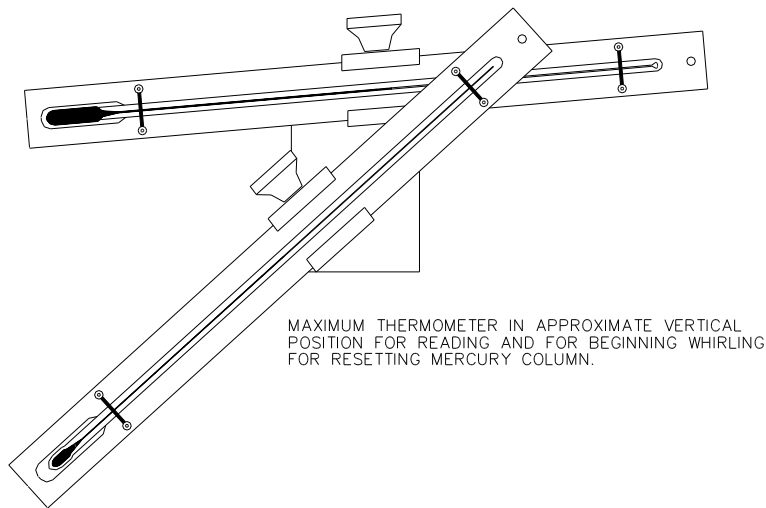
4.1.5 Maximum Thermometers

The maximum thermometer is read after the column of mercury has been allowed to settle back down in the bore.

Carefully release the catch on the mounting fixture support tube of the maximum thermometer. Slowly lower the thermometer sensing bulb until the thermometer is vertical. The column of mercury should be resting against the constricted part of the bore just above the bulb.

- a. DO NOT allow the sensing bulb part of the thermometer to be lowered rapidly, especially in warm weather. The weight of the column of mercury will force some mercury back through the constriction with rapid movements resulting in erroneous readings.
- b. Avoid touching the stem and the bulb of the thermometer while moving the thermometer into its reading position. Body heat will cause changes in the readings.

The maximum temperature occurring since the maximum thermometer was previously set is the scale reading located at the top of the mercury column and taken with the bulb lowered to the reading position.



4.1.6 Setting Maximum Thermometers

To set a maximum thermometer from a reading position, whirl the thermometer rapidly. With the bulb end positioned downward to avoid damaging the constriction, start the whirling motion by grasping the end of the metal frame and spinning the frame. Quickly release the frame to avoid being hit as the frame comes back around. Allow the thermometer to spin rapidly and freely until it comes to rest. Repeat the spinning until the mercury column does not retreat any further into the bulb. The mercury column will no longer be separated at or below the constricted part of the bore. Move the catch on the longer shaft of the mounting fixture and carefully elevate the bulb end of the thermometer until the catch locks the shaft of the tube in to its fixed position. The thermometer is now SET and ready to indicate the maximum temperature that occurs before it is again set using the same methods.

4.2 Current Temperature Readings

The current temperature reading is taken using the maximum thermometer while the thermometer is still in the vertical position and after it has been whirled. The current temperature is indicated by the scale reading at the top of the mercury column farthest from the sensing bulb. Current temperature can only be read from the maximum thermometer after the maximum temperature reading has been taken and the thermometer has been whirled for resetting.

In order to take current temperature readings between observations, use the minimum thermometer and take the reading by observing the top of the alcohol column. DO NOT move the thermometer to take the reading.

4.3 Order of Thermometer Readings and Settings

At the time of minimum and maximum temperature observations, read and reset the thermometers and record the readings to the nearest whole degree. Use WS Form F-7 or other appropriate forms required.

For liquid-in-glass thermometers installed onto a standard mounting fixture perform these operations in the following order:

- a. Read the right end of the index in the minimum thermometer.
- b. Unlock and lower the maximum thermometer. Read the top of the mercury column.
- c. Whirl the maximum thermometer until its reading agrees within 1 degree of the reading of the minimum thermometer. A difference of more than 1 degree between the two thermometers may require replacing one of both thermometers with ones that agree more closely.
- d. Read this temperature from the maximum thermometer after it has been twirled.
- e. Raise and lock the maximum thermometer into its SET position.
- f. Invert the minimum thermometer until the index falls to the end of the alcohol column.
- g. Return the minimum thermometer to its SET position.
- h. Check to make sure all latches are secure and then close the shelter.

4.4 Permanent Record Forms

Due to the risk of exposure to jolting, vibration, or unauthorized resetting, the thermometers are more likely to have errors associated with the minimum and maximum readings than with the current temperature readings. Therefore, note the current temperature reading at the preceding observation and compare it with the minimum, maximum, and current temperature readings of the present observation. The present maximum temperature should be as high or higher than the current temperature at the preceding observation. Similarly, the present minimum temperature should be as low or lower than the current temperature reading at the previous observation. The minimum and maximum data are recorded on the date read even though the recorded reading may actually have occurred on the preceding day.

EXAMPLE

Current temp reading yesterday	67° F
Max temp reading today	65°
Min temp reading today	39°
Current temp reading today	61°
Max temp recorded on form for today (the highest of the values)	67°
Min temp recorded on form for today (the lowest of the values)	39°

Thermometer readings that are in error due to vibration of the shelter may require a new shelter location or some other correction.

Thermometers that differ by more than 1 degree in the current temperature measurement may need to be replaced by thermometers with better agreement.