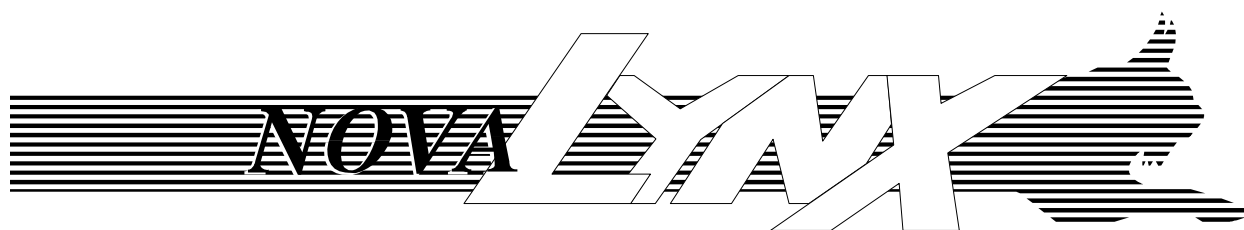


NOVALYNX CORPORATION

MODEL 225-5020-A
HYGROTHERMOGRAPH

INSTRUCTION MANUAL



REVISION DATE: MAR 1998

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.

Returns

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.

Warranty

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.

Address

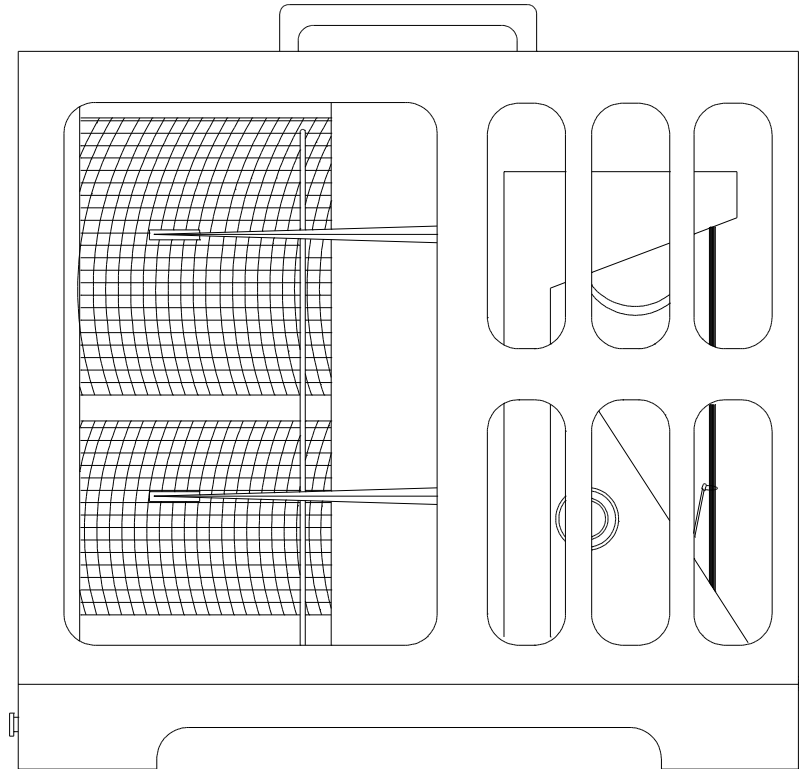
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TABLE OF CONTENTS

Section No.	Page No.
1.0 INTRODUCTION	1
2.0 SPECIFICATIONS	2
3.0 INSTALLATION	2
3.1 GENERAL UNPACKING	2
3.2 INSTRUMENT UNPACKING	3
3.3 CLOCK UNPACKING	3
3.4 CHART PAPER INSTALLATION	4
3.5 CLOCK INSTALLATION	5
4.0 OPERATION	6
4.1 TEMPERATURE	6
4.2 HUMIDITY	6
5.0 CALIBRATION	6
5.1 TEMPERATURE	6
5.2 HUMIDITY	7
6.0 MAINTENANCE	8
7.0 LIST OF CHART PAPER	10

MODEL 225-5020-A
EQUIPMENT CONFIGURATION AND IDENTIFICATION



NovaLynx Corporation

Model 225-5020-A Hygrothermograph Instruction Manual

1.0 INTRODUCTION

The Model 225-5020-A Hygrothermograph uses simple mechanisms for measuring both humidity and temperature of the surrounding air. Measurements are recorded onto a rotating paper chart. A rotating drum is driven by a precision electronic clock powered by two AA alkaline batteries. The Model 225-5020-A has been designed for use in sheltered areas. For outdoor use, to measure atmospheric conditions, the case must be located inside an instrument shelter such as the Cotton Region Style Shelter, NovaLynx Model 380-605.

The electronic clock includes a selector switch for switching drum rotation from one day (26 hours), to seven days (176 hours), or to 31 days. Additional time is provided in the clock rotation and on the chart paper to overlap the data whenever the chart is not replaced within the normal time period. Appropriate chart paper must be installed to match the setting on the clock. A list of available chart paper by model numbers is provided at the end of this manual.

The chart paper used on the drum recorder has two separate sections, an upper section for temperature and a lower section for humidity. Both sections have the zero or low-scale at the bottom edge of the scale and the full-scale or high-scale at the upper edge. The chart paper wraps around the clock drum and is marked by cartridge ink pens. The temperature ranges of the chart paper and the time base are selected at the time of purchase. One pack of charts is supplied with each instrument. Additional chart paper of the same type or with different ranges may be ordered at any time from NovaLynx. Some customers find that charts with a different temperature range or a different time base need to be used during different times of the year depending upon the use of the recorded information. The chart paper has space in the margin for station identification and date.

A properly maintained hygrothermograph will provide many years of useful service. Refer to the maintenance section of this manual for information regarding the care of the instrument. Contact NovaLynx for additional assistance and for repairs and replacement parts.

2.0 SPECIFICATIONS

Sensors

Temperature: Aged Bi-metal Assembly
Humidity: Human Hair Bundle

Measuring Range

Temperature: 110°F (60°C) Air Temperature
Humidity: 0-100% RH

Accuracy

Temperature: $\pm 1\%$
Humidity: $\pm 1\%$, between 20 and 80% RH
 $\pm 3\%$, 0 to 20% and 80 to 100% RH

Chart Resolution

Temperature: 2°F, 1°C typically
Humidity: 1%

Recording Method

Cartridge Ink Pen

Clock

Type: Precision Electronic Drive
Power: 3.0 Vdc, 2 each AA batteries
Rotation: 26 Hours, 176 Hours, 31 Days, Selectable

Case

Size: 12.5" L x 11.5" H x 6" W (318 x 292 x 152 mm)
Wiegth/Shipping: 10 lbs (5 kg)/16 lbs (7 kg)

3.0 INSTALLATION

3.1 GENERAL UNPACKING

NovaLynx will ship the hygrothermograph inside two cartons, an inner one and an outer one. Two cartons provide maximum protection of the instrument during shipping. Whenever more than one instrument is being shipped, several hygrothermograph cartons are packed into a large carton.

Immediately after opening the outer carton, inspect both cartons for shipping damage such as holes in the carton and dented or crushed corners and sides. Report any signs of damage to the carrier, preferably before he leaves the area. There may be hidden damage inside the instrument that may not become visible until everything has been opened and closely inspected.

Any claims against damaged equipment must be made immediately to the carrier. NovaLynx may be able to assist the customer in handling damaged equipment. It is the responsibility of the receiver of the goods to take care of any problems caused by the carrier.

The inside carton containing the hygrothermograph has been customized with styrofoam inserts to provide maximum protection for the instrument. Save the inside carton and the styrofoam inserts in case there is a need to ship the instrument to NovaLynx or to use during long term storage.

Lifting off the top section of styrofoam will expose the clock and the hygrothermograph. Carefully remove both items and place them onto a flat surface. Close up the carton and store it away.

3.2 INSTRUMENT UNPACKING

Open the hygrothermograph case by pressing the release button on the end of the case and, at the same time, lifting gently upward on the handle. The top of the case will swing upward and to the side away from the latch. The latch release button is opposite the sensing elements. With the window facing toward the operator, the latch should be on the left side and the sensors on the right side.

With the case open notice that the two pen arms are fastened to the upright bar by small clips. These clips keep the pen arms from moving during shipping and must be removed for normal operation. To remove the clips, press inward on the curved piece of the clip to open it. Slide the clip upward. Rotate the edge of the pen arm into the open part of the clip. Slide the clip down past the pen arm. The clips may be left on the bar or taken off and stored in the shipping carton. Notice that the upright bar has a knob that can be rotated. The bar is used to raise and lower the pens on and off the chart paper to avoid smearing the ink and to prevent extraneous marks on the chart.

3.3 CLOCK UNPACKING

The clock is shipped wrapped inside a plastic bag. Remove the clock from the bag. A nickel plated chart clip should be on one side of the drum. If the clip is not on the clock search the carton. The clip may become loose during shipping. If the clip is on the clock, slide it upward and remove it from the drum. The main shaft has been shipped inside the clock and not on the base of the hygrothermograph. Remove the shaft from the clock and install it onto the base. The shaft is removed from the clock by loosening and removing the brass thumb nut located inside the top of the clock drum. Slide the shaft down and out of the clock. Place the shaft onto the base. Be sure to put the aluminum spacer between the large gear and the base of the instrument. From below the case, install the lock washer and the two hex nuts. Tighten the hex nuts so that the shaft will not rotate or wobble.

Open the clock drum by grasping the bottom of the clock with one hand and the brass drum with the other hand. Look closely at the bottom edge of the clock drum. There

should be three small pins that hold the drum onto the bottom plate. Notice the position of each slot around the pins. Rotate the two clock pieces in opposite directions to separate them. Typically, the clock drum will be rotated in a counter-clockwise direction while the bottom plate rotates clockwise.

With the brass drum removed, the battery holder will be exposed. Insert the two AA batteries into the battery holders. Batteries are not normally supplied with the instrument. Notice the polarity markings on the plastic battery holders. Check to be sure that the batteries face correctly as they are being inserted.

Upon completion of the battery installation, look at the top of the clock assembly. One of the three LEDs should be flashing to indicate the clock is operating. If an LED is not flashing check the batteries to make certain that they have power and that they are facing correctly in the holders. If the clock does not appear to be working contact NovaLynx for assistance or for a replacement clock.

If the LED is flashing and the clock appears to be working properly, replace the clock drum onto the bottom plate. Notice that the chart clip notch in the drum must be in line with the slot in the bottom plate when the clock is put back together. Rotate the two pieces together until the pins are against the front edges of the slots.

3.4 CHART PAPER INSTALLATION

The chart paper is installed easiest with the clock removed from the hygrothermograph. To install the chart paper, first remove the chart clip from the clock drum. Select the chart paper that is to be installed onto the drum. Check to see that the blank lines for the station ID number and the start date of the chart have been filled in as required. After the chart information has been written onto the end of the chart, fold down the end margin exactly along the end line of the calibrated portion of the chart. The fold will place the station ID and the date under the chart.

Slide the chart clip between the folds of the chart. The edge of the clip must sit in the crease of the fold. Hold this end of the chart in one hand. With the other hand, take the left hand edge of the chart paper and wrap it around the clock drum. The paper should be positioned so that the end of the chart will line up with and slightly overlap the chart clip slot located on the bottom plate of the clock.

Holding the end of the chart paper against the drum, slide the chart clip into the slot on the bottom plate and insert the top of the clip into the notch on the upper edge of the drum. Notice that when inserting the chart clip, the edge of the chart with the clip will overlap the end of the chart being held against the drum. Press firmly on the free end of the chart to prevent it from slipping out as the chart clip is put into place. Several attempts at loading the chart paper may be necessary until familiarity with the procedure is attained.

A properly loaded chart paper will be tightly wrapped around the drum of the clock. The folded edge of the paper will be seated against the chart clip. The free end of the paper

will be underneath the chart clip and aligned with the overlapping portion of the chart paper. If the chart paper slips or moves during the insertion of the chart clip, it may be necessary to start over in order to properly align the edges of the chart. The bottom edge of the chart paper, the zero side of the humidity chart, must be touching the bottom plate of the clock. With the chart paper properly installed, the ink pens will be able to write on all of the chart and will travel easily over the chart on top of the chart clip.

3.5 CLOCK INSTALLATION

The clock is placed over the shaft located on the base of the hygrothermograph. First, the brass nut at the top of the shaft must be removed. There is a spacer located between the shaft and the case. The spacer must be in place and the shaft must be securely fastened to the case in order for the clock to properly operate. If the spacer appears to be missing notify NovaLynx for a replacement. Check the shaft to make certain that it does not rotate or move. If it appears to be loose, tighten the nuts located underneath the instrument case. If everything appears to be correctly placed, slide the clock over the shaft and secure it to the shaft on the top side using the brass thumb nut. Do not over-tighten the brass nut. Finger-tight should provide plenty of force to keep the clock on the shaft. The clock should rotate freely around the shaft.

Check at this point to ensure that the pens are lifted away from the chart paper surface. To begin recording data, rotate the clock in a clockwise direction until the correct time line appears beneath the ink pens. For weekly and monthly charts check to ensure that the day of the week has been correctly selected.

Before placing the ink pens onto the chart notice that each pen has a white plastic protective cap covering the pen tip. Remove the caps to expose the fiber tips of the pens. Save the caps and recover the pens whenever they are not being used to extend pen life.

Lower the pens onto the chart paper by rotating the pen lifter bar. Move the pens gently by hand, up and down a small distance to make marks on the chart paper. Look at the marks to see whether they have been written on top of the correct timing mark. If necessary move the clock to correct the position until the pens are at the timing mark. Rotate the clock only in a clockwise direction. Due to back lash in the clock gear mechanism, there will be some loss of time if the clock is moved in a counter-clockwise direction. The clock will not move until the back lash slack is recovered.

For initial set-up of the hygrothermograph, let the instrument operate for some time to ensure that the clock is operating properly and to see that the ink pens are writing properly. For weekly and monthly charts, the clock will rotate very slowly and it will take at least one or two days to check the clock operation. Try to do the clock operation test before permanently installing the hygrothermograph and before trying to collect critical data. During the clock operation test, also check the humidity and temperature readings to ensure that the calibration settings are proper. If the calibration needs adjusting, refer to the steps for making those adjustments.

Final installation of the hygrothermograph involves placing the instrument into an outdoor instrument shelter or onto an indoor shelf or table. The instrument should be as level as possible. Water should never splash onto the humidity and temperature sensing elements. Avoid placing the instrument in locations where there may be direct sunlight exposure the direct sunlight temperature is being measured.

4.0 OPERATION

4.1 TEMPERATURE

The hygrothermograph measures temperature by using dissimilar metals. A curved, bi-metal element bends and straightens as the air temperature around it changes. The bending of the curved element moves the temperature pen arm and results in the recording on the chart paper. The bi-metal element is able to make measurements over a range of 110°F (60°C). The 110 degree span may be shifted up or down providing a variety of calibrated ranges to cover different applications. An adjustment knob enables the span to be shifted to match the chart paper range. Fine tune the temperature calibration by using the adjustment knob.

4.2 HUMIDITY

Relative humidity measurements are made with a human hair sensing element. Changes in the moisture content of the air causes the length of the hair to change. The hair is attached firmly to the frame of the hygrothermograph so that the expansion and contraction of the hair can be translated into the movement of the pen arm. Hair will increase approximately 3% over a range of 0 to 100% RH. The hair has some non-linear response to humidity changes that must be corrected by the use of two opposing quadrants. The humidity calibration adjustment is much more complicated than that of the temperature. There is no adjustment knob provided for adjusting the humidity reading. Refer to the calibration section for details regarding the adjustment. Notice that touching the hair bundle will deposit oil from the skin onto the hair causing a loss in response to humidity. Avoid touching the hair bundle and use tweezers or wear rubber gloves if the hair bundle must be handled.

5.0 CALIBRATION

5.1 TEMPERATURE

The calibrated span of the temperature element is set at the time of manufacture of the instrument. For most customers, there should be no need to adjust the span after receiving the instrument. If, however, the sensing element has been replaced then the span will need to be corrected. The following steps describe the span adjustment. A dramatic loss of temperature span may be the result of a sensor element failure requiring replacement of the element.

5.1.1 Verify the temperature span setting by varying the temperature of the air around the sensor. A temperature difference of at least 50°F must be used to accurately check the temperature operation. After each temperature change, allow 15 to 30 minutes for the sensor to stabilize. Use an accurate mercurial thermometer to verify the temperature of the air. The thermometer should be placed near the sensing element of the hygrothermograph. A room or a chamber with a controlled, stable temperature is best for testing the temperature of the hygrothermograph.

5.1.2 If the span is out of adjustment or out of the range needed, adjust the pen arm linkage. The horizontal arm of the pen arm linkage may be shortened or lengthened. Shortening the arm increases the span and lengthening the arm will decrease the span. Only slight adjustments should be attempted at first. Movement of the linkage by 0.012 inches changes the span by 1°F. After changing the position of the arm, measure and keep a record of the arm length.

5.1.3 After adjusting the span, the pen position must be set to correspond to the chart paper range. Pen adjustment will not affect the span setting and can be done under ambient conditions if necessary. Again, use an accurate thermometer to verify the reading of the hygrothermograph. The pen position is adjusted using the large knob located on the side of the sensing element frame. A slight rotation of the knob produces a considerable displacement of the pen arm. Make small adjustments and verify the new reading after waiting for at least 15 minutes for stabilization. Adjust the knob until the pen reading is within 1 degree of the thermometer reading.

5.2 HUMIDITY

As with the temperature, the humidity portion of the hygrothermograph is factory set and should not need any adjustment except fine tuning of the pen position after the instrument has been prepared for operation. Whenever the hair bundle has been replaced or cleaned, the span should be verified and adjusted if necessary. Verification of the humidity readings is made using either a wet-dry psychrometer or a hand held electronic humidity meter. NovaLynx can provide either type of humidity measuring instrument to use as a calibration tool for the hygrothermograph. It is important to note that the two curved quadrant arms and springs should not be disturbed during calibration adjustments. If the quadrant arms and springs appear to be out of place, disconnected, or damaged notify NovaLynx for assistance.

5.2.1 Place the hygrothermograph into a stable or controlled atmosphere if possible, along with the instrument being used to verify the calibration. If a test chamber is not available, a large plastic bag may be substituted. Using the plastic bag, place wet cloths inside to raise the humidity in the bag. Avoid getting water directly on the hair bundle to prevent errors in the measurement. Low humidity measurements are usually made inside a test chamber using saturated salt solutions to control the amount of humidity. If a low humidity test is not possible, make adjustments for an elevated humidity and for ambient and verify both adjustments several times. Test for 100% RH using the plastic bag or chamber and wet towels or salt solutions for 98% RH. Wait for the recorder pen

to stabilize, 15 to 30 minutes. Record the indicated value. This reading will be the 100% RH point.

5.2.2 If the span is incorrect or the error is large, adjustment of the span is necessary. Place the instrument into a dry humidity chamber with an R.H. level less than 50 % R.H. Wait for stabilization. Verify the chamber humidity using the psychrometer or RH meter. Record the readings of both the calibration instrument and the hygrothermograph. Subtract the Hygrothermograph reading from the elevated RH reading of step 5.2.1. Subtract the calibration instrument reading from 100 % R.H. Compare the two computed values. If the two numbers disagree, adjust the span of the Hygrothermograph. The humidity linkage lever must be shortened to increase the span or lengthened to decrease the span.

Make only small adjustments noting the lever length after each adjustment. The humidity linkage lever is the upright post with the loop of wire that wraps around the hair bundle near the middle of the hair bundle. A small screw in line with the lever holds the lever in place. Use caution whenever loosening or tightening the small screw as it can be easily damaged by using too much force or by using improper tools. Verify the humidity readings after each lever adjustment. Repeat steps 5.2.1 and 5.2.2 until the readings are within $\pm 1\%$ of the calibrator readings.

5.2.3 After setting the span, the only adjustment needed is the fine tuning of the pen tip on the chart paper. Verify the setting under ambient conditions using the same calibration instrument used during the span adjustments. The pen position adjustment is made using the square pin located on the top of the sensor mounting frame. Use a plier or wrench to turn the pin. Customers with older instruments may wish to keep the spring wound clock keys to use to turn the pin.

6.0 MAINTENANCE

The hygrothermograph is typically used outdoors to measure atmospheric conditions. Even when installed inside a louvered shelter, the instrument tends to get dirty with time and in the case of high humidity will become corroded. General maintenance is relatively simple and when performed regularly can extend the life of the instrument.

The chart paper will require changing at specific intervals, based upon the time base of the chart, daily, weekly or monthly. It is during the chart changing that general maintenance should be done. Simply brush off any dust or dirt, spider webs, leaves, and any other debris that have settled onto the case of the hygrothermograph. If there is excessive moisture, take some dry cloths and dry off the case. At least once every 6 months, 3 months in harsh environments, clean all pivots and bearing points with a solvent. Apply a light coating of instrument oil to the pivots and bearings. Use a small brush to apply one or two drops of the oil.

Check the clock batteries for corrosion and if possible test them for power left to help avoid battery failure between visits. If rechargeable batteries are being used, exchange

the batteries regularly, keeping fresh batteries in the clock whenever possible. If standard alkaline batteries are being used in the clock, they should be replaced at least every 6 months.

Be sure to brush dust and dirt off the temperature sensing element.

The hair bundle should be kept as clean as possible. Periodic cleaning of the hair bundle is accomplished using either distilled water or ether. The hair bundle should be removed from the instrument during the cleaning process. Do not touch the hair bundle with bare skin. Notice that the ends of the hair bundle are clamped in place in the hygrothermograph.

Loosen the screws on the face of the clamps and slide the hair bundle out of the clamps and the linkage lever loop. Washing of the hair bundle with water helps eliminate creeping of the zero point. Especially when the hygrothermograph has been exposed to low humidity. If the hair bundle has become contaminated by oil or grease it must be soaked in ether to remove all of the contaminants. Use caution since ether is highly flammable. Carry the hair bundle by its ends, keeping the hairs together and parallel to each other. Replacement of the hair bundle is recommended at least every two years.

Reinstall the hair bundle by sliding it through the clamps and linkage lever loop. Replace the clamp screws and attempt to tighten the screws to the same position as before the hair bundle was removed.

The humidity portion of the hygrothermograph should be recalibrated if there is an error in magnification of 5% or more; it reads low at high humidity and high at low humidity.

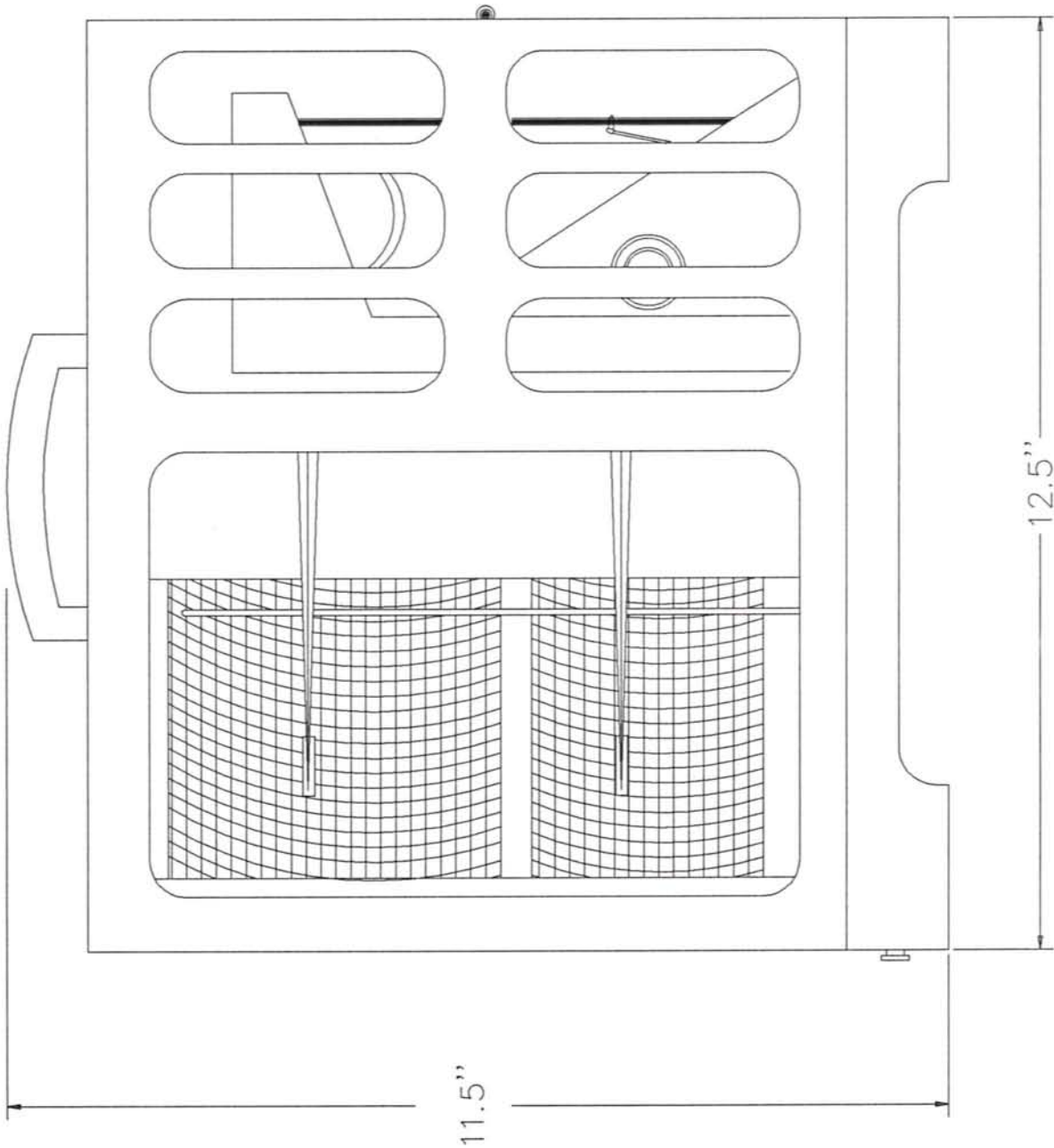
Pen traces become faint as the pen cartridge approaches the end of its life. It is recommended that at least two additional pen tips be kept as spares for replacement as needed. The old pen is slid off the end of the pen arm and the new one is slid on in its place. When replacing pens, grasp the pen arm without bending it and carefully but forcefully pull the old pen off and push the new pen on. If the pen arm becomes bent, carefully bend it back into its original shape. Severely damaged pen arms should be replaced. The pen arms are held in place by a small circular plate and two screws. The pen arm is clamped onto a small post by the plate and screws.

For locations experiencing high humidity, the chart paper can become acclimated by storing the chart paper in the shelter next to the hygrothermograph. This method of storage helps keep the chart paper from changing size rapidly after it is placed onto the clock drum. The amount of ink absorbed by the paper will also be affected since a drier chart paper will take more ink than does a more moist paper.

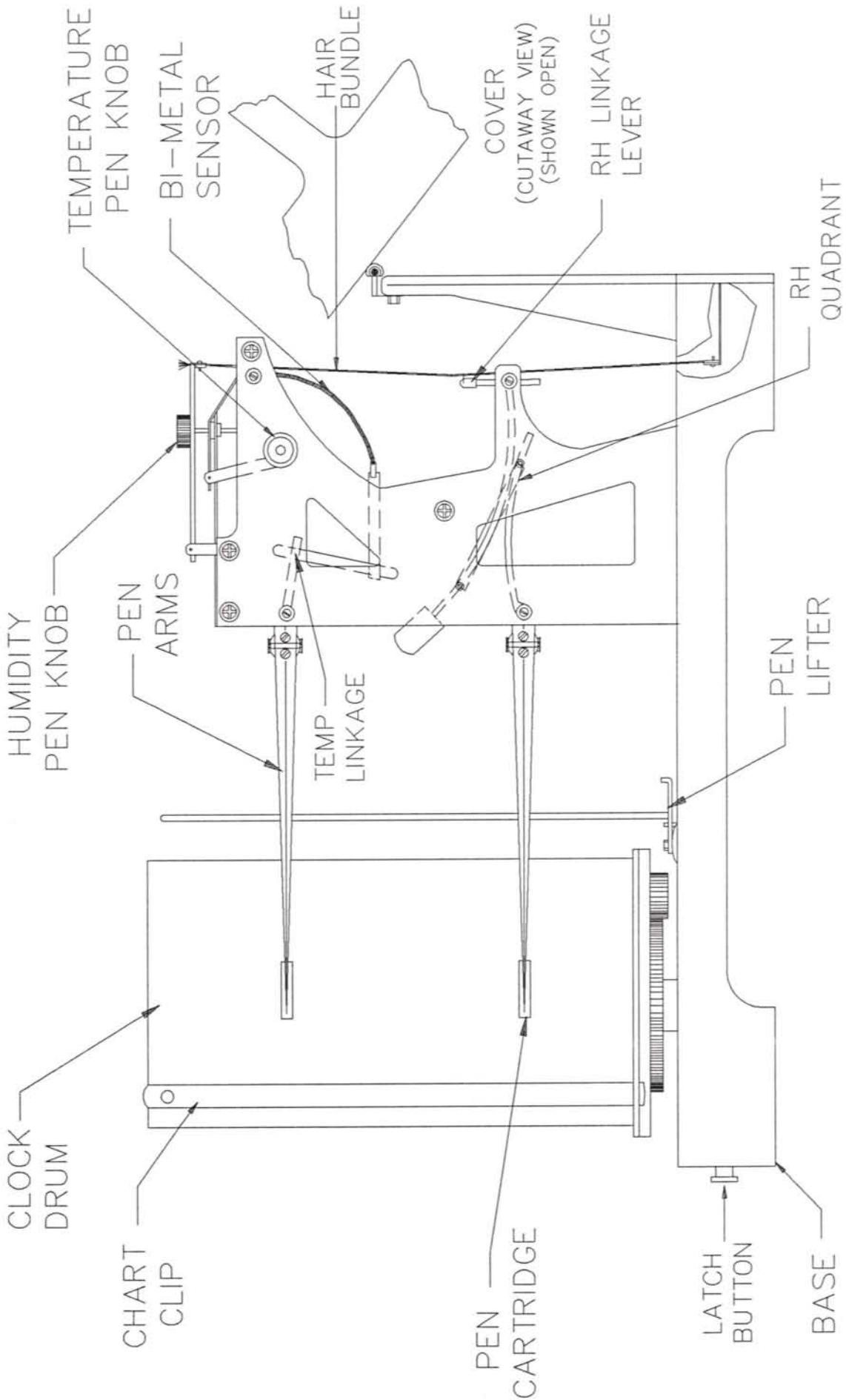
Drawings are provided with this manual to assist in the identification of major parts. Should a replacement part be required that is not shown in detail please contact NovaLynx for assistance or send a sketch showing the part and its general location.

7.0 LIST OF CHART PAPER

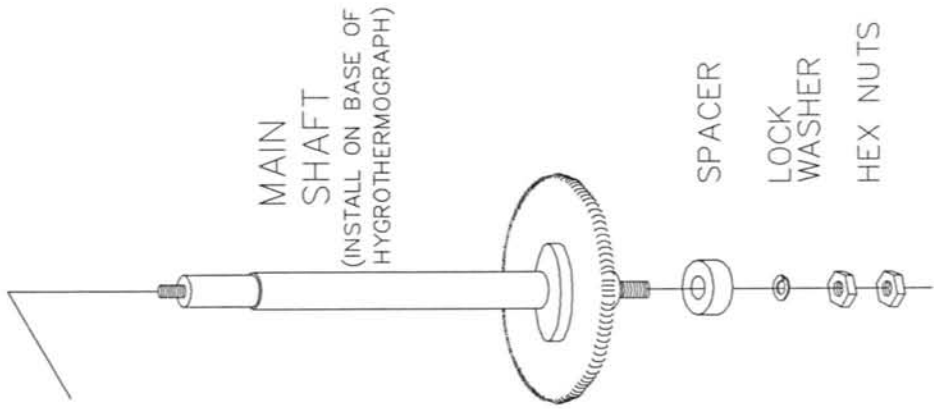
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225-50201	-20 to +40°C, 0-100%RH	7 days	55
225-50202	+10 to +120°F, 0-100%RH	7 days	55
225-50203	-30 to +80°F, 0-100%RH	7 days	55
225-50204	-20 to +40°C, 0-100%RH	1 day	400
225-50205	+10 to +120°F, 0-100%RH	1 day	400
225-50206	-30 to +80°F, 0-100%RH	1 day	400
225-50207	-20 to +40°C, 0-100%RH	31 days	25
225-50208	+10 to +120°F, 0-100%RH	31 days	25
225-50209	-30 to +80°F, 0-100%RH	31 days	25
225-50212	-10 to +50°C, 0-100%RH	7 days	55
225-50213	-5 to +55°C, 0-100%RH	31 days	25
225-50214	-10 to +50°C, 0-100%RH	1 day	400
225-M699120	-10 to +50°C, 0-100%RH	31 days	25



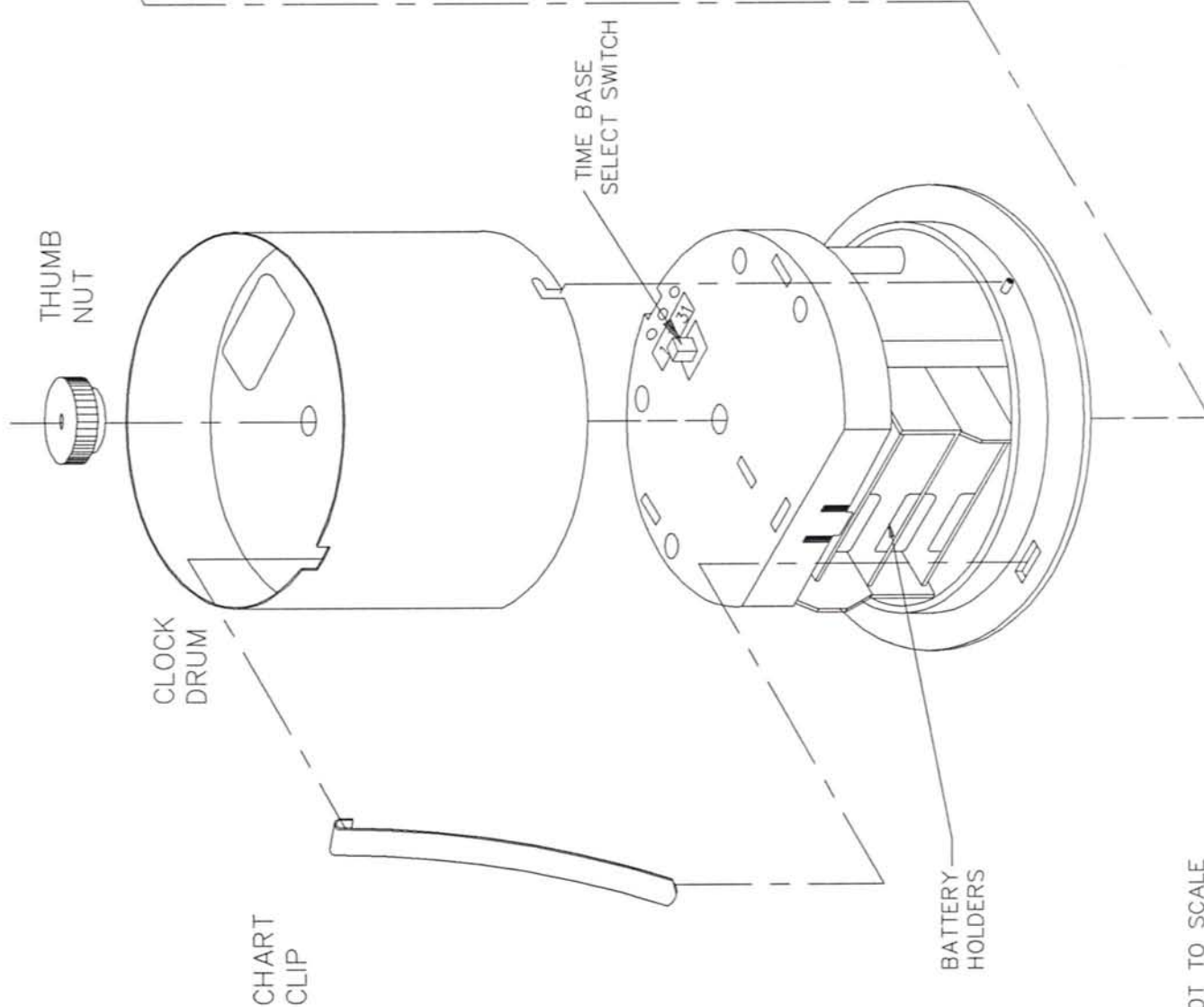
		C
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MODEL USAGE 225-5020-A	SHEET 1 OF 1	BY: RCN
DATE 10-27-94	SCALE: FULL	DWG. NO. 941037



TITLE ASSEMBLY, HYGROTHERMOGRAPH MODEL 225-5020-A			
MODEL USAGE	BY	SCALE	SHEET 1 OF 1
	RGN	DWG. NO.	941038
DATE 10-27-94	NONE		



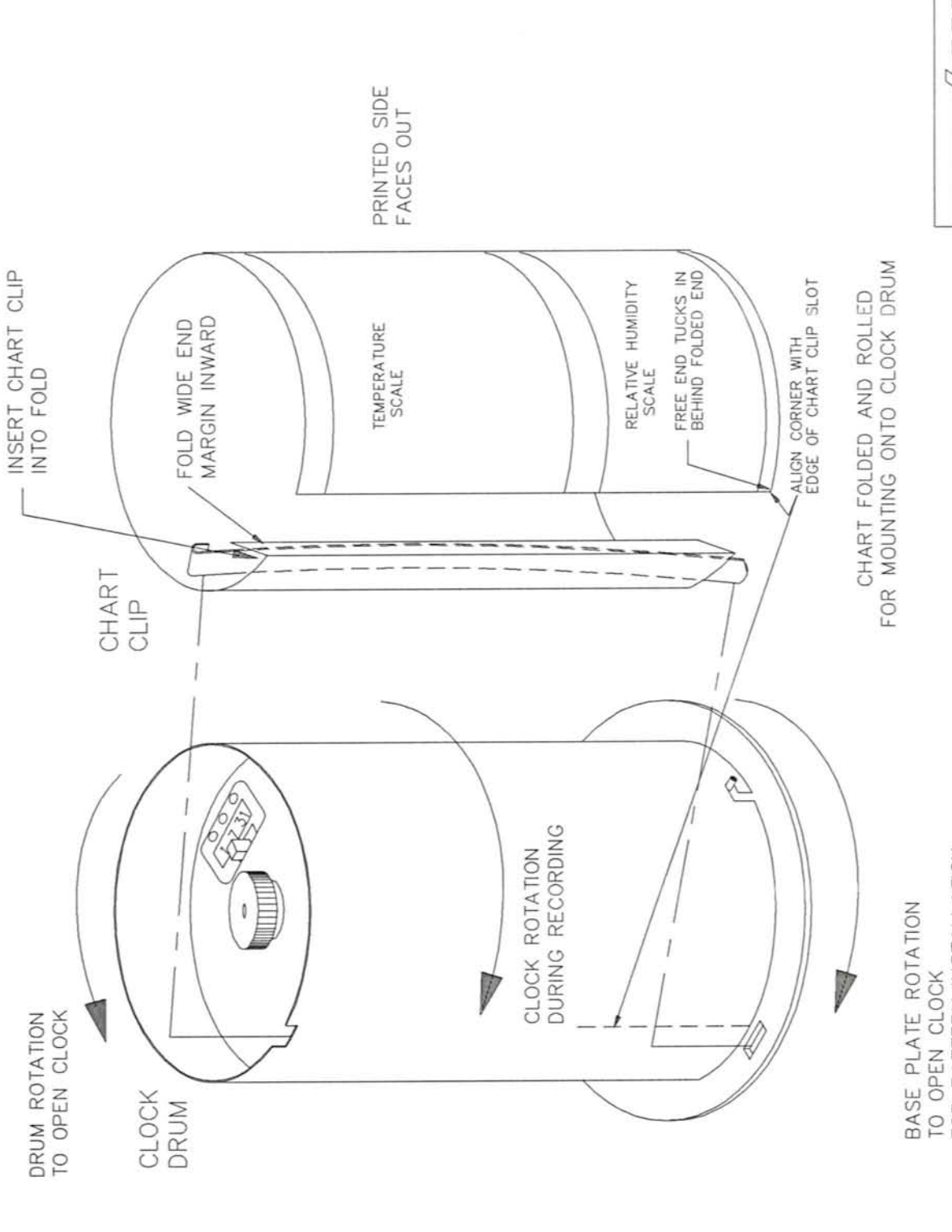
SPACER IS INSTALLED BETWEEN MAIN SHAFT & INSTRUMENT CASE.



		SHEET 1 OF 1	
		MODEL USAGE 225-5020-A	SCALE DWG. NO. 941039
BY	RCN	DATE 10-27-94	HOME

TITLE ASSEMBLY, ELECTRONIC CLOCK

DRAWING NOT TO SCALE



TITLE OUTLINE, ELECTRONIC CLOCK CHART, PAPER LOADING	
MODEL USAGE 225-5020-A	SHEET 1 OF 1
BY RCN	SCALE DWG. NO.
DATE 10-27-94	NONE
941040	

DRAWING NOT TO SCALE