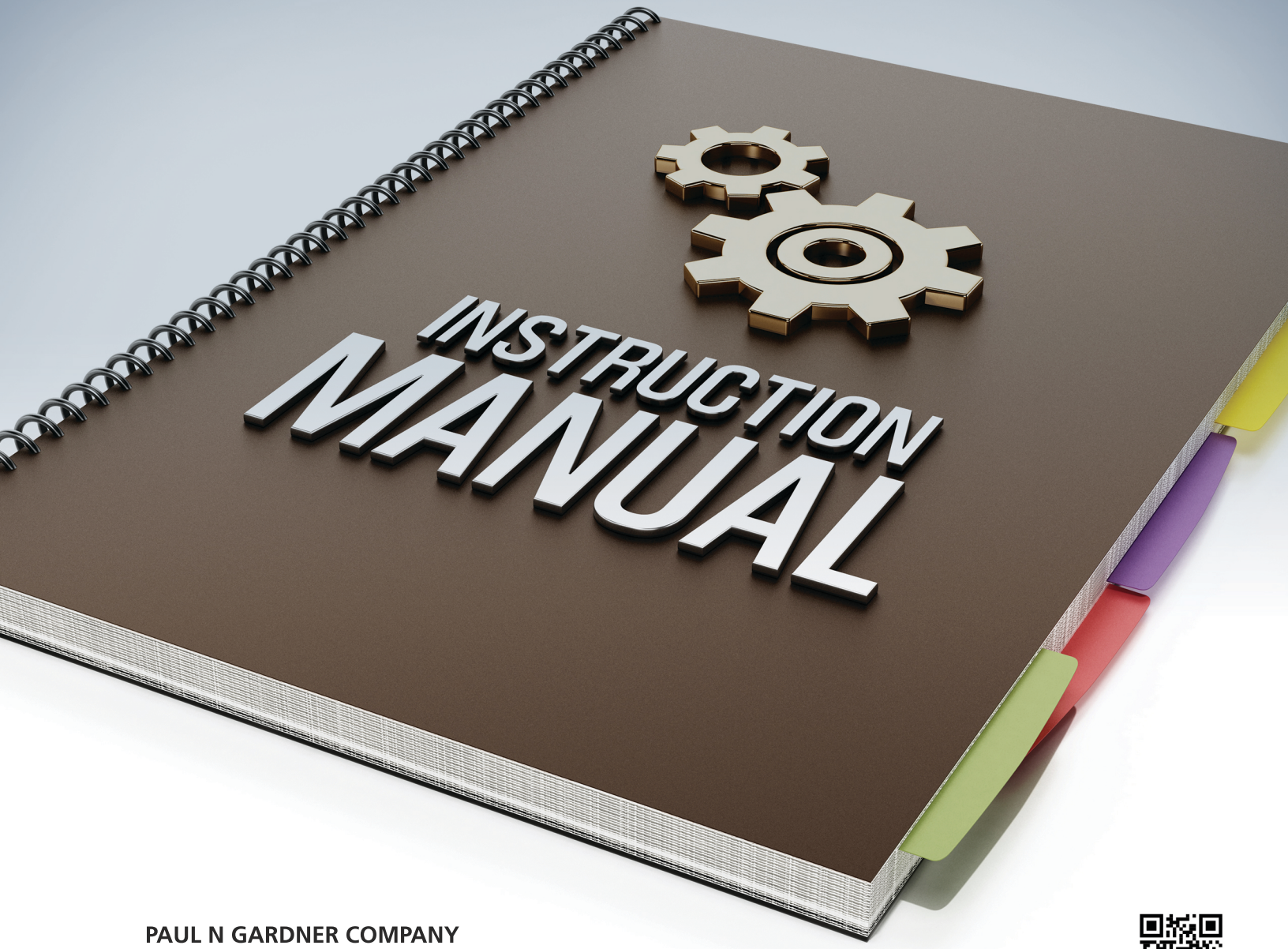

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INSTRUCTIONS

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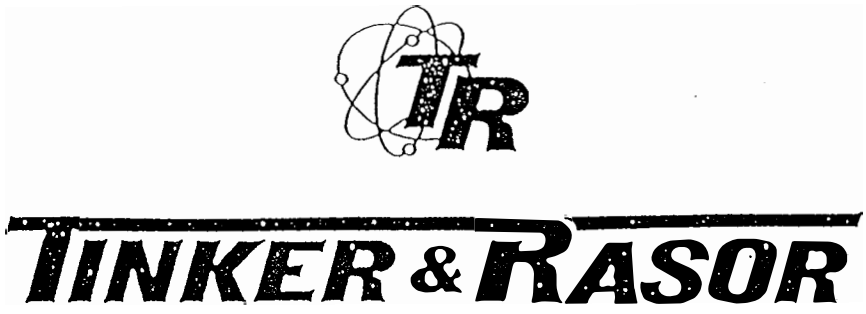

TR
TINKER & RASOR


Caution: High Voltage
Unintended electrical shock from this instrument may cause operators to injure themselves. Safety precautions should be observed. Read Instruction Manual.

Tinker & Rasor

OPERATING INFORMATION

for

HOLIDAY DETECTORS

MODELS AP & AP/W

EIGHT SECTIONS OF QUICK INFORMATION

National Association of Corrosion Engineers

NACE Standard RP0490-90
Item No. 53074

Standard
Recommended Practice

Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 10 to 30 Mils (0.25 to 0.76 mm)

Approved April 1990
National Association of Corrosion Engineers
P.O. Box 218340
Houston, Texas 77218
713/492-0535

Foreword

Detection and correction of defects in protective coatings are important factors in an effective corrosion control program. High voltage electrical inspection of pipeline coatings prior to installation is one method in general use. Prior to issuance of this NACE standard, there has been no U.S. standard for electrical inspection of fusion-bonded epoxy pipeline coatings. Although several specifications have been written by operating companies for high voltage electrical inspection of protective coatings, they apply only to specific coatings.

This standard recommended practice was prepared by NACE Work Group T-10D-9c on Electrical Inspection and its parent, Task Group T-10D-9 on Coating Inspection, a component of Unit Committee T-10D on Protective Coating Systems. This standard, issued by NACE under the auspices of Group Committee T-10 on Underground Corrosion Control, was developed through the joint efforts of representatives of coating manufacturers and applicators, holiday detector equipment manufacturers, corrosion specialists, and others concerned with the construction of underground pipeline facilities, as represented in NACE Unit Committee T-10D. The recommendations contained herein apply only to fusion-bonded epoxy pipeline coatings, which generally are applied to a dry film thickness of 10 to 30 mils (0.25 to 0.76 mm). For other types of patching materials and joint wrap, please consult the appropriate manufacturer of the material for holiday detection voltages. Adherence to the principles of this standard will improve methods of holiday detection and, therefore, the effectiveness of the coating.

Section 1: General

1 1 This recommended practice presents accepted techniques in the use of holiday detector equipment currently used on fusion-bonded epoxy pipeline coatings prior to on-site installation of the pipeline. It also presents recommended voltages for various coating thicknesses (see Table 1).

1.2 Electrical inspection (holiday detection) is a test of the continuity of a protective coating. This type of inspection is not intended to provide information on coating resistivity, bond, physical characteristics, or the overall quality of the coating. It will detect voids, cracks, foreign inclusions, or contaminants in the coating that are of such a size, number, or conductivity as to significantly lower the electrical resistance or dielectric strength of the coating.

1.3 Use of a holiday detector shall be under the direction of a qualified coating inspector, such as an NACE Certified Coating Inspector. An initial holiday detector inspection, performed as soon as practical after the application of the coating, will assist in verifying adherence to specifications for the materials and the application procedures. A final electrical coating inspection, before the coated pipe is placed in the ground, will disclose coating discontinuities or damage that may have occurred during the shipping, storage, or construction period.

TABLE 1
Recommended Test Voltages for Various (FBE) Coating Thicknesses
"K" (Constant) = 525

Coating Thickness (Mils)	Test Voltages
10 (0.25 mm)	1650 V
11 (0.28 mm)	1750 V
12 (0.30 mm)	1800 V
13 (0.33 mm)	1900 V
14 (0.36 mm)	1950 V
15 (0.38 mm)	2050 V
16 (0.41 mm)	2100 V
20 (0.51 mm)	2350 V
25 (0.64 mm)	2600 V
30 (0.76 mm)	2900 V

Rounded off to the nearest 50 V

Section 2: Definitions

Continuous DC Voltage Holiday Detector: A holiday detector that supplies a continuous DC test voltage. The continuous DC-type holiday detector is often used in very arid, sandy, or rocky areas and in coating plants where moisture and contamination conditions are controlled. The continuous DC test voltage-type holiday detector cannot be used where there is continuous moisture present on the surface of the coating. For proper inspection using continuous DC output test voltage, other than in coating plant operations, the fusion-bonded epoxy coating surface must be dry.

Generated Test Voltages: With two types commercially available, generated output test voltages are used for the electrical inspection of fusion-bonded epoxy pipeline coatings. They are commonlydescribed as the pulse DC- and the continuous DC-type test voltages.

Holiday: A discontinuity of the coating that exposes the metal surface to the environment or exhibits electrical conductivity when exposed to a predetermined test voltage.

Holiday Detector: An electrical device that locates discontinuities in the protective coating.

Pulse DC Voltage Holiday Detector: A holiday detector that supplies a high DC voltage pulse of a very short duration (such as 0.0002 seconds at a rate of 30 pulses or more per second). The pulse-type holiday detector is the most common type used in the industry, and it can be used on damp or dry coatings.

Section 3: Testing Voltages

3.1 All holiday detector output test voltages in this standard refer to pulse DC and continuous DC values.

3.2 The minimum effective applied output test voltage is dependent on coating thickness, atmospheric conditions, electrode configuration, and grounding conditions. Therefore, the applied test voltage will vary from case to case.

3.3 To determine the minimum effective applied test voltage for a given set of field conditions, the following field calibration should be performed daily:

3.3.1 Make a pinhole 1/32 in. (0.0625 in. in diameter) through the fusion-bonded epoxy coating. Ensure that the hole extends completely through the coating to the metal substrate.

3.3.2 Start with the lowest test voltage setting of the holiday detector, and slowly increase test voltage until the manufactured holiday can be positively detected at normal operating speeds (see Paragraphs 5.3 and 9.2 and Section 6).

3.3.3 This method of test voltage adjustment shall be performed while the exploring electrode and grounding are in the expected operating positions. If the above conditions change, it may be necessary to readjust the test voltage setting.

3.4 Alternatively, the pipe-to-electrode test voltage can be adjusted to the minimum test voltages described in Paragraph 3.5, which are commonly used in the pipeline industry. Qutput test voltages may be somewhat higher than these test voltages settings; the differential depends on grounding conditions and detector type.

3.5 The minimum testing voltage for a particular coating thickness shall be within 10% of the value determined from the following formula:

$$\text{Testing voltage} = V = K \setminus T$$

V = Peak voltage in volts

T = Nominal coating thickness in mils

K = Constant 525

Table 1 gives calculated voltages for coating thicknesses of 10 to 30 mils (0.25 to 0.76 mm).

3.5.1 The test voltage should be verified periodically (see Paragraph 3.3.3).

3.5.2 If an outerwrap is applied over the primary coating, the thickness and dielectric strength of the outerwrap material must be considered when determining or specifying the test voltage. Certain outerwrap materials may have electrical insulating properties equal to or greater than the coating.

3.5.3 Consumer specified test voltages used at point (time) of coating application shall not be exceeded during the on-site electrical inspection of the coating.

Section 4: Grounding

4.1 Proper electrical grounding of the holiday detector to the coated pipe under inspection is necessary to complete the electrical circuit.

4.1.1 The coated pipe metal must have electrical contact to earth at one or more points. An electrical ground of the pipe can be effected by electrically connecting the pipe metal to a metal grounding rod driven into the earth to a depth of 2 to 3 ft (0.6 to 0.9 m).

4.1.2 The holiday detector can, in most cases, be effectively grounded electrically by the use of a flexible ground wire of approximately 30 ft (9 m) in length, which is connected to the ground terminal of the holiday detector and trailed along the surface of the earth. The first 4 to 5 ft (1 to 1.5 m) of the ground wire extending from the ground terminal of the holiday detector must be adequately insulated to prevent possible electrical shock to the operator. In some instances, the bare end of the ground wire must be attached to an independent driven earth rod to ensure adequate electrical grounding.

4.1.3 In arid, sandy or rocky areas where earth resistivity prevents effective holiday detection by creating high circuit resistivity, a direct wire connection between the pipe metal and holiday detector ground terminal shall be maintained. Additional ground wire of any length (22 gauge, minimum) may used in making connections between the holiday detector ground terminal and the pipe metal.

Section 5: Exploring Electrode

5.1 The exploring electrode is the means by which the electrical potential is applied to the surface of the coating.

5.1.1 Typically, electrical holiday detector exploring electrodes are manufactured in two basic forms. The most common electrode is the full circle wire spring type, which, when placed around the coated pipe in operating position, allows for complete circumference inspection with one pass by rolling the spring electrode over the coated surface. The second type is in the form of a brush, made of conductive rubber or brass bristles

5.2 The construction of the exploring electrode shall be such that there will be no more than 10 mils (0.25 mm) lateral distance between

the spring coils or brass bristles at the area where the electrode contacts the coated surface.

5.3 The exploring electrode shall maintain contact with the coated surface at all times.

5.4 The exploring electrode shall be kept clean and free of coating material and/or rough surfaces that might damage the coating.

Section 6: Travel Speed of Exploratory Electrode

6.1 Pulse-type holiday detector: The output test voltage pulse rate must be considered in determining the travel speed of the exploring electrode over the coated surface. Faster pulse rates will allow a higher speed of travel of the exploring electrode over the coated surface.

6.2 The proper travel speed of a particular set of conditions shall be determined by making holidays in the coating and attempting to detect the holidays at various electrode travel speeds (see Section 3, particularly Paragraph 3.3.2).

Section 7: Test Voltage Measurements

7.1 Test voltage measurements of pulse-type holiday detectors shall be made with a peak reading kilo voltmeter or with a capacitance or resistance voltage divider and suitable indicator such as an oscilloscope or voltmeter.

7.2 Test voltage measurements of continuous DC-type detectors shall be made with a high resistance DC voltmeter.

7.3 The exploring electrode must be in the normal operating position on the coated surface in a holiday-free area.

7.4 The holiday detector and the coated pipe must be grounded electrically (see Section 4).

7.5 The test voltage shall be measured between the electrode and the pipe metal.

Section 8: Condition of Coating Surface

8.1 Electrically conductive material (contaminated moisture) in or on the surface of the coating system can cause appreciable DC current leakage, which may lower the effective test voltage or falsely indicate holidays.

8.2 All foreign materials that cause an increase in the distance between the exploring electrode and the coated surface must be removed prior to electrical inspection (see Section 5).

8.3 Moisture on the coating may cause appreciable electrical current leakage through the holiday detector circuit (causing false signals) and must be removed or allowed to dry prior to electrical inspection.

8.4 The maximum temperature at which fusion-bonded epoxy coatings shall be electrically inspected is 195°F (90°C).

Section 9: Care of Equipment

9.1 All parts of the holiday detector shall be kept clean at all times.

9.1.1 The electrode shall be kept free of coating material and in suitable mechanical condition to maintain contact with the coated surface at all times.

9.1.2 All electrical contacts and connectors on the holiday detector shall be kept clean and free of corrosion.

9.1.3 Trailing ground wire shall be kept free of coating material and kinks and shall be in suitable condition to maintain intimate contact with the earth. The ground wire shall be of sufficient length to ensure proper grounding (see Paragraph 4.1).

9.2 Batteries should be in full charge condition at the start of the inspection day. Maintain batteries in accordance with manufacturer's recommendations.

I. HOLIDAY DETECTOR FUNCTION

The Tinker & Rasor Models AP & AP/W Holiday Detectors are portable, all purpose electrical inspection instruments. They are adaptable for use on both large and small diameter pipe as well as flat surfaces when such surfaces are coated with a high electrical resistant material and the surface beneath the coating is electrically conductive. The Models AP and AP/W Detectors work equally well on damp or dry surfaces; they are especially desirable when humid conditions exist or when it has recently rained.

II. INSTRUCTIONS for UNPACKING & INSPECTION

A. Upon opening the carrying case, notice where the various components are located; repack them in the same manner when not in use. Then remove all components from the carrying case.

B. INSPECTION should be performed upon receipt. If damage has occurred in shipment, file a claim with the carrier immediately. Check components (against packing slip) to be sure that nothing is missing.

C. If it is necessary to contact your supplier or Tinker & Rasor concerning damaged or missing items, be sure to include all information such as serial number, purchase order number and invoice number.

III. CHECK-OUT INSTRUCTIONS

A. Assure that Holiday Detector "ON-OFF" switch is in the "OFF" position.

B. Using the Battery Tester, insert test plug (on Battery Tester) into Holiday Detector "charge plug" receptacle. Press test button on Battery Tester and observe meter reading. If meter reads "recharge", follow instructions on Battery Charger. (NOTE: A more accurate reading can result from holding the test button depressed for 20 to 30 seconds.) Remove Battery Tester plug from Detector.

FOR MODEL AP HOLIDAY DETECTOR (ONLY)

C. Turn output voltage selection switch (on Detector) to desired voltage. (Voltages are listed on the inside and outside of Detector back cover.)

D. Insert leather belt into slide loops on back of Detector if beltmounted method is to be used.

III. CHECK-OUT INSTRUCTIONS (Cont'd.)

FOR MODEL AP HOLIDAY DETECTOR (ONLY)

E. Uncoil ground wire and plug connector end into Detector port marked "ground". (The ground wire will trail on bare earth.)

F. Uncoil High Voltage cable and plug the long connector (3" collar) into one end of adapter and screw wand handle onto other end of adapter; plug the short connector (1-1/2" collar) into the Detector "High Voltage" port.

G. Assembly the desired electrode to the wand assembly and apply to the pipe, tank, or other structure to be inspected. An inspection electrode should always make an intimate contact with the surface to be inspected.

H. Turn "ON-OFF" switch to "ON" position. (NOTE: When the switch is "ON", a bussing sound may be heard coming from the Detector.)

I. The Holiday Detector is now ready to operate.

FOR MODEL AP/W HOLIDAY DETECTOR (ONLY)

J. Turn output voltage selection switch (on Detector) to desired voltage. Voltages are listed on the individual powerpaks in ascending order, left-to-right.

K. Insert leather belt into slide loops on back of Detector if belt mounted method is to be used.

L. Uncoil ground wire and plug connector end into Detector port marked "ground". (The ground wire will trail on bare earth.)

M. Attach wand to threaded, male end of powerpak. Insert powerpak cable (female connector) into male connector of powerpak. Insert other end of powerpak cable into "High Voltage" port on Detector.

N. Assembly the desired electrode to the wand assembly and apply to the pipe, tank, or other structure to be inspected. An inspection electrode should always make an intimate contact with the surface to be inspected.

O. Turn "ON-OFF" switch to "ON" position. (Note: When the switch is "ON", a buzzing sound may be heard coming from the Detector.)

P. The Detector is now ready to operate.

IV. OPERATING METHODS

A. Grounding: A good ground system will always give the best and most reliable inspection. The structure to be inspected must be grounded to earth at some point.

1. Pipe: If individual joints of pipe are to be inspected which are not electrically connected, each joint must be grounded.

B. Inspection Speed: Speed of the electrode travel over the inspection surface should be moderate. Moving the electrode at an excessive speed can result in a faulty inspection.

C. Operating Checks:

1. Occasional checks of the Detector can be made if no holidays are being found. Move the inspection electrode to the coating's edge (where the bare conductive surface is); note that spark and signal should both occur.

2. If the signal does not sound when the spark jumps, the "ground return" resistance is exceptionally high. (Example: very dry soil or very large diameter pipe.) To improve the "ground" make a direct connection between the structure under inspection and the Detector's ground wire.

V. SPECIAL INFORMATION ABOUT YOUR HOLIDAY DETECTOR

A. Sensitivity Switch: The sensitivity of the Holiday Detector may be adjusted by turning the 4-position switch; access to switch is by screwdriver through the porthole located on the back panel in the belt recess. (see paragraph VI - 3).

B. Output voltages are measured direct-connected, "open circuit" by Jennings Model J-1005 Voltmeter 0 to 100 Kilovolts.

C. **CAUTION:** Before disassembly of components, turn "ON-OFF" switch to "OFF" position.

VI. INSTRUMENT SERVICING INSTRUCTIONS

A. Cleaning: Keep instrument clean and dry. Clean instrument case with soft cloth dampened with kerosene, then wipe dry. Do not use solvents such as lacquer thinners, Methyl-Ethyl-Keytone, etc.

B. Voltage Output Checks:

1. Low Output Voltage:

   a. Check Position of voltage selector switch.

   b. Check battery condition using Battery Tester. (See later comments on Battery.)

   c. Check for "parted" conductor in wand and ground wire.

2. No Output Voltage:

   a. Check battery condition using Battery Tester. (See later comments on Battery.)

   b. Check fuse located on printed circuit board inside instrument. If fuse blown, look for shorted wire in primary circuit. Replace fuse with 2. amp fuse, type 3AG.

   c. Check battery leads and the power switch for open circuit. Proper input current is .7 to .9 amperes.

C. False Signal Indication Check:

1. Adjust 4-position rotary signal sensitivity switch through porthole provided on back panel in the belt recess.

   a. Electrical "load" conditions vary greatly through pipe sizes, coating thickness and climatic conditions. The counter-clockwise position is the most "signal sensitive". Coated concrete pipes would use this position. In other cases, it is best to start out using position 2, or the next position in a clockwise direction.

   b. Check for "parted" conductor in wand and ground wire.

D. No signal with Spark Discharge

1. Check position of signal sensitivity switch.
2. Read item 3 - c under "Instrument Servicing".
3. Refer to paragraph on "Operating Checks".

VII BATTERY CHARGING INSTRUCTIONS

CAUTION: Detector "ON-OFF" Switch in "OFF" position while charging battery.

A. Use Battery Charger provided (Part 031-005).
B. Recharge battery in the instrument. Ventilation holes in front and back of instrument case should be kept open.

C. Plug Charger into polarized receptacle of instrument. (Note: Battery cannot be tested or charged if instrument power switch is in "ON" position.)

D. Plug AC Power Cord into any 120 volt 60 HZ outlet.

E. Charge Battery for 14 hours.

F. Charge at temperatures above 45 degrees F for best results.

G. If Charger pilot light "out": (indicates Charger is not operating).

1. Check position of power switch.
2. Check for shorted battery cell.

H. Disconnect Charger from battery and AC outlet when not in use.

VIII BATTERY MAINTENANCE INFORMATION

A. When instrument fails to operate in normal manner, battery is fully discharged. Recharging before this happens can extend the useful life of the battery considerably.

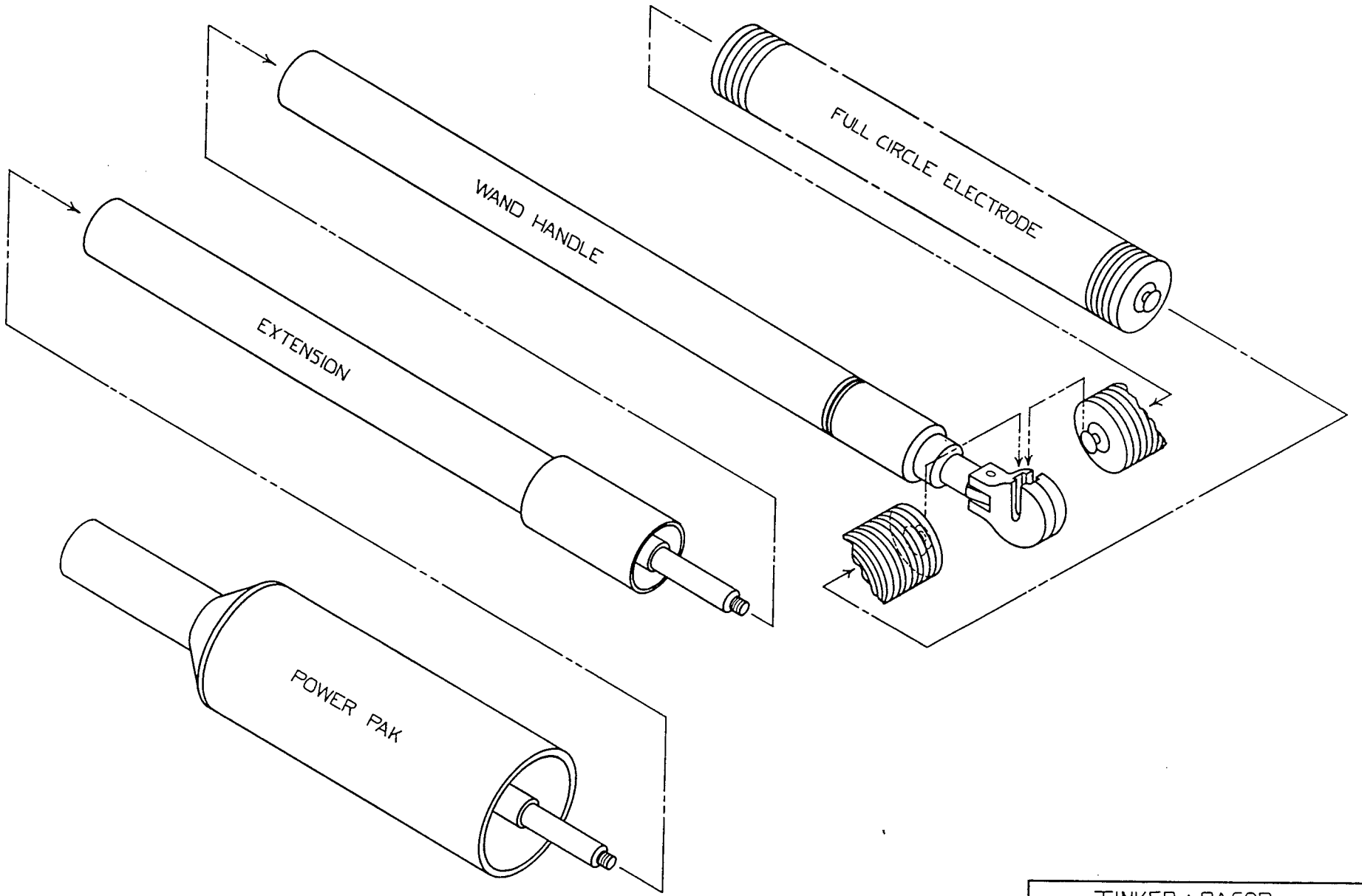
B. Store at normal room temperature when not in use.

C. If battery has not been used for six months or more, recharge for 14 hours.

NOTE: IF HOLIDAY DETECTOR FAILS TO OPERATE IN NORMAL MANNER, THE FIRST "STEP" IS TO TEST THE BATTERY CONDITION.

* * * * * * * * * * * * * * * *

When ordering replaceable parts for your Holiday Detector, refer to the Instrument Model and Serial Number.



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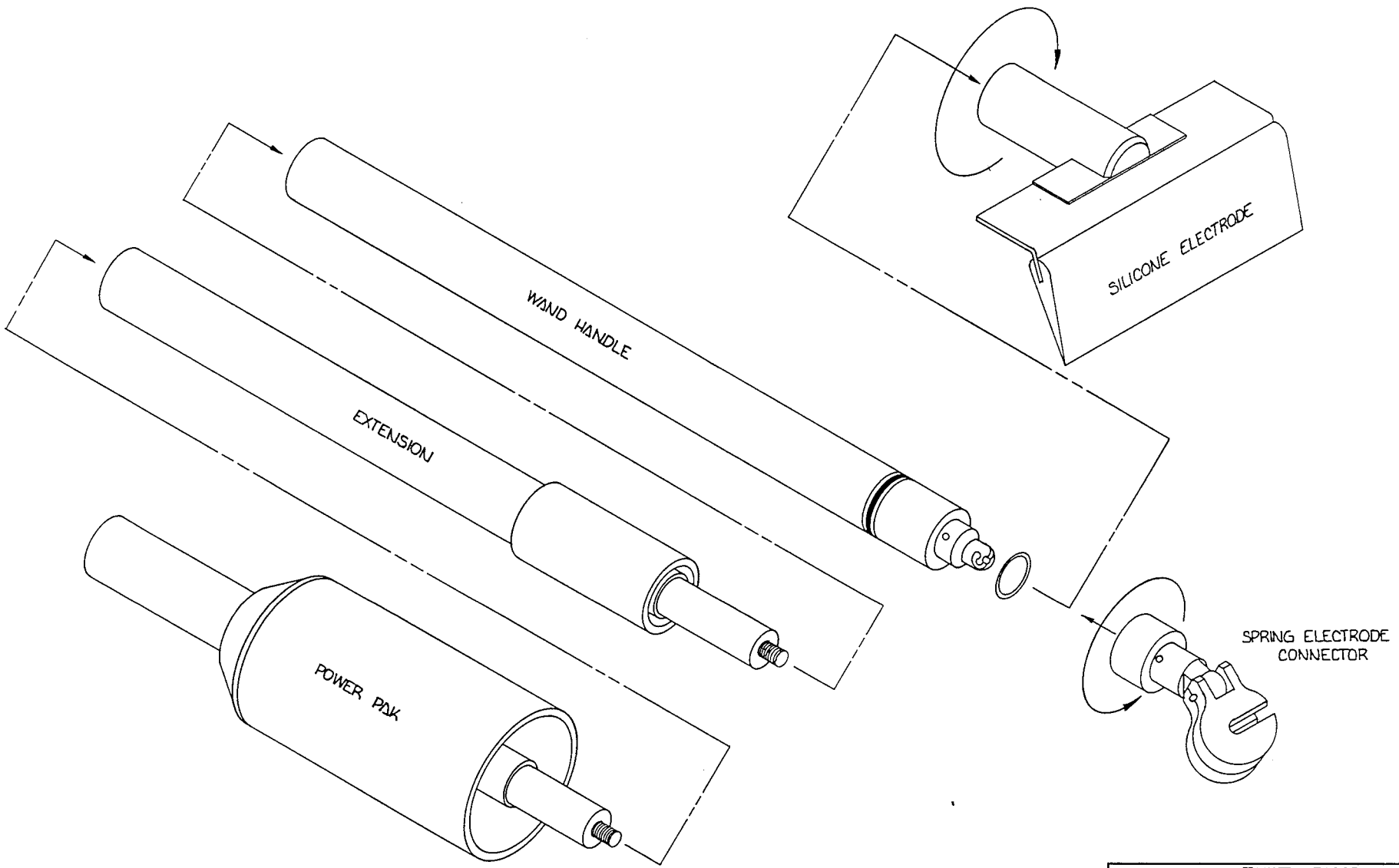
		DRAWING NUMBER



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SAN GABRIEL, CALIFORNIA

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NACE Standard RP0274-93
Item No. 21010

NACE INTERNATIONAL
Informing the World on Corrosion Control

Standard
Recommended Practice

High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

Approved August, 1974
Reaffirmed 1993
NACE International
P.O. Box 218340
Houston, Texas 77218-8340
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Foreword

Detection and correction of defects in protective coatings are important factors in an effective corrosion control program. High-voltage electrical inspection of pipeline coatings prior to installation is one method in general use. Previous to the first issuance of this NACE International recommended practice, there had been no national standard for electrical inspection of pipeline coatings other than AWWA[1] Standard C 203-66,[2] Section 3.13, which is applicable to coal-tar coatings only.

Although several specifications have been written by operating companies for high-voltage electrical inspection of protective coatings, they apply only to specific coatings.

The recommendations contained herein do not apply to thin-film coatings (i.e., coating materials normally classified as plastic polymers and usually applied by a fusion bonding process). The thin-film pipeline coatings are generally applied to a dry film thickness less than 0.5 mm (20 mils).

Adherence to the principles of this recommended practice will improve holiday detection of pipeline coatings prior to installation.

This NACE International recommended practice was originally prepared in 1974 by NACE International Task Group T-10D-9 on Coating Inspection and Work Group T-10D-9a on Electrical Inspection, components of Unit Committee T-10D on Protective Coating Systems, and was issued by NACE International under the auspices of Group Committee T-10 on Underground Corrosion Control. This recommended practice was developed through the joint efforts of representatives of coating manufacturers, coating applicators, holiday detector equipment manufacturers, corrosion specialists, and other people concerned with the construction of underground pipeline facilities who are members of NACE International Unit Committee T-10D. This recommended practice was reaffirmed with editorial revisions in 1993.

[1]American Water Works Association, 6666 W. Quincy Avenue, Denver, Colorado 80235.
[2]AWWA Standard C 203-66, "Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied" (Denver, CO: AWWA, 1966).

NACE International
Standard
Recommended Practice

High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

Contents

Section 1: General

1.1 Electrical inspection (holiday detection) is a test of the continuity of a protective coating. This type of inspection does not provide information concerning coating resistance, bond, physical characteristics, or the overall quality of the coating, nor is it intended to do so. It will detect bubble or blister-type voids, cracks, thin spots, and foreign inclusions or contaminants in the coating that are of such size, number, or conductivity as to significantly lower the electrical resistance or dielectric strength of the coating.

1.2 Use of a holiday detector should be at the discretion of the coating inspector. An initial holiday inspection, performed as soon after the application of the coating as practicable, serves to check the materials and the application procedures. A final coating inspection, performed before the coated pipe is placed in the ditch, will disclose any defect or damage to the coating, except disbonding, that has occurred during the construction period.

1.3 This recommended practice presents acknowledged techniques in the use of holiday detector equipment currently used on pipeline coatings prior to lowering-in operations and presents a table of recommended voltages for various coating thicknesses. The recommendations contained herein do not apply to thin-film coatings (i.e., coating materials normally classified as plastic polymers and usually applied by a fusion-bonding process). The thin-film pipeline coatings are generally applied to a dry film thickness less than 0.5 mm (20 mils).

Section 2: Definitions

Holiday: Any discontinuity or bare spot in a coated surface.

Holiday detector: A device for locating discontinuities in the coating.

Pulse-type detector: A type of holiday detector which supplies a high-voltage pulse of very short duration (e.g., a pulse duration of 0.0002 seconds at a rate of 30 pulses per second).

Section 3: Testing Voltages

3.1 All testing voltages in this standard refer to DC or peak AC values.

3.2 The minimum testing voltage for a particular coating thickness shall be within 20% of the value determined from one of the following formulas or as shown in Table 1:

$$\text{Testing Voltage} = 7900\sqrt{T}$$

where T = average coating thickness in mm;

$$\text{Testing Voltage} = 1250\sqrt{T}$$

where T = average coating thickness in mils.

3.3 The testing voltage should be verified periodically as described in Section 7.

3.4 If a nonperforated outerwrap is applied over the primary coating, the thickness and dielectric strength of the outerwrap material must be considered when determining or specifying the testing voltage. Certain outerwrap material may have electrical insulating properties equal to or greater than the coating.

TABLE 1

Minimum Testing Voltage for Various Coating Thicknesses[A]

Coating Thickness (mm)	Coating Thickness (32nd inch)	Coating Thickness (mils)	Testing Voltage
0.40	0.5	16	5,000
0.79	1	31	7,000
1.6	2	62	10,000
2.4	3	94	12,000
3.2	4	125	14,000
4.0	5	156	16,000
4.8	6	188	17,000
13	16	500	28,000
16	20	625	31,000
19	24	750	34,000

[A]Thin-film coatings (plastic polymers) are not covered by this recommended practice.

Section 4: Grounding

4.1 Grounding both the pipe metal and the ground terminal of the holiday detector is necessary to complete the circuit. This should be done through a direct wire connection or by connecting both to earth as a common ground. If not in contact with the earth, the pipe metal should be connected to the earth by a driven ground rod or metal pin. In most cases, the holiday detector can be effectively grounded by the use of a flexible bare wire of approximately 9 m (30 ft) in length that is connected to the ground terminal of the holiday detector and trailed along the earth.

4.2 In arid, sandy, or rocky areas of high electrical resistivity, a direct wire connection between the pipe metal and detector ground terminal shall be maintained.

Section 5: Exploring Electrode

5.1 The electrode of the holiday detector is the means by which the electrical testing potential is applied to the surface of the coating.

5.2 The construction of the electrode shall be such that there will be no more than 0.25 mm (10 mils) lateral distance between the points where the electrode contacts the coated surface for each 1,000 volts of testing potential.

5.3 The electrode shall maintain contact with the coated surface at all times.

5.4 The electrode should not adversely distort the coating.

5.5 To prevent causing a decrease in the coating thickness, the electrode should not be moved back and forth excessively on a soft coating.

5.6 The electrode should always be in motion whenever the testing voltage is applied.

Section 6: Speed of Travel

6.1 Pulse-type detector: The pulse rate should be considered in determining the speed of travel of the electrode over the coated surface. Higher pulse rates will allow a higher speed of travel.

6.2 Nonpulse-type detector: The speed of travel is limited by the mechanics of application and the response time of the detector.

6.3 The proper travel speed for a particular set of conditions should be determined by making holidays in the coating and attempting to detect the holidays at various electrode travel speeds.

Section 7: Voltage Measurements

7.1 Voltage measurements of nonpulse-type detectors shall be made with a high-resistance kilovolt meter or with a high-resistance voltage divider in conjunction with a high-resistance voltmeter.

7.2 Voltage measurements of pulse-type detectors shall be made with a high-impedance peak-reading kilovolt meter or with a high-impedance capacitance or resistance voltage divider and suitable indicator such as an oscilloscope or voltmeter.

7.3 The electrode must be in the normal operating position on the coated surface in a holiday-free area.

7.4 All components must be properly grounded.

7.5 The voltage shall be measured between the electrode and the pipe.

7.6 In the absence of a suitable means of voltage measurement, the operation of the holiday detector (but not necessarily the proper testing voltage) should be determined by making a small holiday in the thickest portion of the coating to be inspected. The holiday detector voltage should then be adjusted to locate this holiday at normal travel speeds (see Paragraph 6.3).

Section 8: Condition of Coating Surface

8.1 Excessive moisture or any electrically conductive material in or on the surface of the coating system can cause appreciable leakage currents, which may lower the effective testing voltage or cause erroneous holiday indication. Drying and cleaning of the coated surface may be necessary (see Section 9).

8.2 Any surface condition that causes an increase in the distance between the electrode and the metal must be corrected (see Paragraphs 5.3 and 9.2).

Section 9: Care of Equipment

9.1 All parts of the holiday detector shall be kept clean and free of moisture at all times.

9.2 The electrode shall be kept free of coating material and in such mechanical condition as to maintain contact with the coated surface at all times.

9.3 All electrical contacts shall be kept clean and free of corrosion.

9.4 Trailing ground wire shall be kept free of coating material and in such condition as to maintain contact with the earth. The ground wire shall be of sufficient length to assure proper grounding (see Paragraph 4.1).

9.5 Batteries shall be maintained in accordance with manufacturer's recommendations.

9.6 Test-meter batteries and zero setting shall be maintained in accordance with the manufacturer's specifications.