EXECUTIVE OFFICE OF THE PRESIDENT
FEDERAL CIVIL DEFENSE ADMINISTRATION

CIVIL DEFENSE RADIOLOGICAL MONITORING INSTRUMENTS

SPECIFICATIONS

December 6, 1950

EXECUTIVE OFFICE OF THE PRESIDENT

FEDERAL CIVIL DEFENSE ADMINISTRATION

Dear Governor:

The need for suitable civil defense radiological monitoring instruments led some time ago to initiation of a study by a special civil defense radiological committee which included representatives of the Atomic Energy Commission, the Armed Forces Special Weapons Project of the Department of Defense, the United States Public Health Service, the Bureau of Standards and the Federal Civil Defense Administration.

The problem presented to the committee was two-fold:

(1) to determine whether or not any instruments presently available are suitable for general civil defense operations; and

(2) to determine what currently available instruments are best suited for the training of radiological monitoring teams.

The committee determined that two types of radiological monitoring instruments are required for gamma ray detection:

(1) a high-intensity instrument for area survey operations immediately following an atomic attack. These instruments must have an upper range of 500 roentgens per hour (r/hr).

(2) a low-intensity instrument for special long-range survey work in the weeks following an attack. The data from surveys made by monitoring teams using these instruments, furnished by special State or Federal radiological teams, would be correlated by these special teams for evaluation of any continuing residual radiation hazard. Instruments used for this work require greater accuracy and more sensitivity than the high-intensity instruments. The range of these instruments need not exceed 500 milliroentgens per hour (mr/hr).

The committee has determined that while certain instruments now available would be suitable for the low-intensity radiation measurement in the weeks following a disaster, no instrument suitable for civil defense high-intensity survey work has yet been developed.

The committee has found, however, that the low-intensity instruments suitable for specialized measurements also are suitable for training pruposes.

In recommending instruments, the committee has given preference to those which have met military specifications, as these can be readily maintained, and will perform satisfactorily under operating conditions which might be encountered in civil defense.

One instrument meeting the three requirements of (1) military specifications, (2) suitability for immediate training and (3) usefulness for low-intensity civil defense monitoring work is the AN/PDR-T-1. This instrument has 5 ranges of sensitivity: 5, 50, 500, 5000, and 50,000 milliroentgens per hour. Instruments conforming to the military specifications and known as AN/PDR-T-1 are presently being manufactured by:

(1) The Kelley-Koett Manufacturing Company

(2) Tracerlab, Incorporated.

A copy of the military specifications for this instrument, annotated to exclude those portions not essential to a civil defense instrument, is appended as Enclosure A.

In addition, the following instruments, even though they do not meet the military requirements, are suitable for training purposes and may be suitable for some limited long-range low-intensity monitoring:

Manufacturer	Type No.	Ranges	Scale Ranges Gamma mr/hr	Beta * c/min
Ionization Chambers				
Victoreen Instrument Co.	247A	4	2.5 25.0 250.0 2500.0	
Victoreen Instrument Co.	247B	4	50.0 500.0 5000.0 50000.0	

Manufacturer	Type No.	Ranges	Scale Ranges Gamma mr/hr	Scale Ranges Beta * c/min
Victoreen Instrument Co.	247H	4	25.0 250.0 2500.0 25000.0	
Beckman Instrument, Inc.	MX-6	4	5.0 50.0 500.0 5000.0	
Geiger-Mueller Counters				
Victoreen Instrument Co.	263B	3	0.2 2.0 20.0	1000 10000 100000
Nuclear Instrument & Chemical Corp.	2610A	3	0.2 2.0 20.0	600 6000 60000
Eclipse Pioneer Div. Bendix Aviation Corp.	XD-793831-1	3	0.2 2.0 20.0	1000 10000 100000
Beckman Instrument, Inc.	MX-5	3	0.2 2.0 20.0	1000 10000 100000
Kelley-Koett Mfg. Co.	K-800	3	0.2 2.0 20.0	
El-Tronics, Inc.	SM-3 (AN/PDR-26)	3	0.2 2.0 20.0	1000 10000 100000
Precision Radiation Instruments	101	3	0.2 2.0 20.0	
Technical Associates	F-3B	3	0.2 2.0 20.0	
Tracerlab, Inc.	SU-5	4	0.02 0.2 2.0 20.0	100 1000 10000 100000

* Counts per minute (c/min)

The manufacturers listed above, as well as other manufacturers, may be interested in supplying instruments in accordance with the specifications given in Enclosure A.

As an interim measure to expedite the establishment of training programs, the Federal Civil Defense Administration will accept State orders for the AN/PDR-T-1 type of instrument. The Federal Civil Defense Administration will pool the State orders in order to obtain more favorable prices through procurement of the instruments in quantity. The National Bureau of Standards has agreed to make tests necessary to insure the quality and correct calibration of the instruments purchased.

The Federal Civil Defense Administration will not assume any responsibility for the purchase of instruments other than the AN/PDR-T-1. However, if other manufacturers than the two listed wish to design instruments to meet the specifications of Enclosure A, the Federal Civil Defense Administration will cooperate in every way, including submission of instrument models to the Bureau of Standards for suitable approval testing. When successful instruments are developed by other manufacturers conforming to the military specification Enclosure A, the Federal Civil Defense Administration will notify the States.

It is suggested that this initial procurement of low-intensity instruments be limited to immediate needs for state training. It is believed that 40 would be a reasonable number of instruments for most State needs.

States wishing to take advantage of the Civil Defense pool procurement arrangement should send their orders directly to the Federal Civil Defense Administration not later than January 15th, 1951. On this pool procurement arrangement it is estimated that the cost of each instrument will be less than $100.00. It should be emphasized that procurement of these instruments will be at State expense and that the role of the Federal Civil Defense Administration and the Bureau of Standards is limited to providing the coordination and testing services.

Apart from the low-intensity instruments, the special radiological committee has produced tentative specifications for a high-intensity survey instrument which should meet civil defense area monitoring needs. These specifications are appended as Enclosure B. They are being sent to all known manufacturers with request that they develop an instrument to meet this need. When such high-intensity instruments are developed and have conformed to Bureau of Standard tests, the States will be notified.

A number of States have queried the Federal Civil Defense Administration in regard to dosimeters or other personnel cumulative dosage indicators. These are devices worn by an individual to measure the total amount of radiation to which he has been exposed. While research projects are underway, no such device currently available is considered suitable for civil defense needs. As work progresses and satisfactory instruments are produced, the States will be kept fully informed.

Sincerely,

James J. Wadsworth
Federal Civil Defense Administration

Enclosures

RADIAC TRAINING SET AN/PDR-T1( )

1. SCOPE

1.1 This specification covers one type of equipment designated as Radiac Training Set AN/PDR-T1( ). The parenthesis in the nomenclature will be replaced by a letter identifying the particular design; for example: Radiac Training Set AN/PDR-T1W. As soon as possible after award of contract, the contractor should apply to the contracting officer for the exact nomenclature to be used on name-plate, etc.

2. APPLICABLE SPECIFICATIONS, OTHER PUBLICATIONS AND DRAWINGS

2.1 Specifications - The following specifications of the issue in effect on the date of invitation for bids, form a part of this specification:

FEDERAL:

QQ-M-151	Metals, General Specification for Inspection of
QQ-S-571	Solder; Soft (Tin, Tin-Lead, and Lead silver)

MILITARY:

JAN-R-11	Resistors, Fixed Composition
JAN-P-13	Plastic-Materials, Laminated Thermosetting, Sheets and Plates
JAN-P-14	Plastic-Materials, Molded Thermosetting
JAN-P-15	Plastic-Materials, Rigid Thermoplastic
*JAN-B-18	Batteries, Dry
JAN-C-76	Cable (Hook-Up Wire), Electric, Insulated, Radio and Instrument
JAN-P-77	Plastic-Materials, Cast, Thermosetting
JAN-C-91	Capacitors, Paper-Dielectric, Fixed (non-Metallic Cases)
JAN-R-94	Resistors, Variable, Composition
JAN-T-152	Treatment, Moisture-and Fungus-Resistant, of Communications, Electronic, and Associated Electrical Equipment: General Process for
JAN-C-173	Coating-Materials, Moisture-and Fungus-Resistant, for the Treatment of Communications, Electronic, and Associated Electrical Equipment
JAN-T-713	Twine, Lacing and Tying, Electrical and Electronic Equipment
JAN-V-1137	Varnish, Insulating, (Electrical)

U. S. ARMY:

**71-1578	Tabular List of Parts (For Signal Corps Equipment)
71-4944	Identification Marking of Ground Signal Equipment
72-53	Finishes (For Ground Signal Equipment)

* Listed for information of contractor

** Only the requirements on reference symbols and replaceable parts apply.

2.2 Other publications - The following publications, of the issue in effect on date of invitation for bids, form a part of this specification:

MILITARY STANDARD

JAN-STD-105	Sampling Inspection Tables for Inspection by Attributes

NATIONAL BUREAU OF STANDARDS PUBLICATION

H28	National Bureau of Standards Handbook H28, Screw-Thread Standards for Federal Services

ARMED SERVICES ELECTRO STANDARDS PREFERRED LISTS

ASESA List No. 100	Armed Services Index of Electro-Standards

2.3 Drawings - The following drawing, of the issue in effect on date of invitation for bids, form a part of this specification:

U. S. NAVY, BUREAU OF SHIPS PLAN

10-T-2145-L	Shock Testing

(Copies of Joint Army-Navy Specifications, Military specifications, (including this specification) Military standards, packaging instructions, and U. S. Army specifications may be obtained from the Signal Corps Procurement Agency, 2800 South 20th Street, Philadelphia 45, Pa. However, copies of specifications to be used for the purpose of bidding or manufacture should be obtained from the contracting officer or from firm soliciting bids.

Copies of Federal specifications and National Bureau of Standards publications may be obtained from Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Copies of Armed Services Electro-Standards Lists may be obtained from Armed Services Electro Standards Agency, Fort Monmouth, N. J.

Copies of BuShips plans may be obtained from Chief of BuShips, Radio Division, Navy Department, Washington 25, D. C.)

3. REQUIREMENTS

3.1.1 Functions and performance of the equipment - Unless otherwise specified or allowed, all functions shall be incorporated in the equipment furnished on contract. Performance of the equipment shall be detemined by the verification measurements described in 3.1.4.

3.1.2 Material and parts - Unless otherwise specified or allowed, materials and parts shall be standard materials and parts shall be used as required by 3.8.1.2.

3.1.3 Availability of model - A model will be available for inspection by prospective bidders. It will be lent to the contractor for the duration of the contract and shall be returned in good condition at the completion thereof. The right is reserved for authorized representatives of the contracting officer to check the model at any time while it is in the possession of the contractor or his sub-contractor.

3.1.4 Verification measurements - When the model is received by the contractor, he shall conduct all measurements necessary to verify its performance. Before making the measurements, the model shall be retuned and/or realigned by the contractor as necessary to obtain optimum performance. The contracting officer shall be notified sufficiently in advance so that his authorized representative can witness the measurements. The measurement data shall be recorded and 3 copies thereof shall be furnished to the contracting officer to serve thereafter as sufficient verification of the performance of the model. If the verification measurements indicate that the model does not meet specified performance, the contractor shall immediately notify the contracting officer.

3.2 Detection - This instrument shall detect gamma radiation and shall be wave length independent and air equivalent within 15 percent from 80 Kev up to and including 1.5 Mev quantum energy gamma radiation. The detecting element shall be of the ionization chamber type.

3.2.1 A minimum of 30 percent of the external area of the ionization chamber shall have no obstruction between the chamber surface and the instrument case. When the instrument is hand held in the normal reading position, this unobstructed area shall be on the end and end of the bottom nearest the plane in which the operator is facing.

3.3 Service conditions - The instrument shall be capable of meeting the performance and other requirements of this specification under the following conditions:

3.3.1 Extreme temperature - The instrument shall give satisfactory continuous operation within limits of battery life, with less than 15 percent change in calibration over a temperature range of -10 to +125 F. The instrument shall be capable of withstanding storage for long periods in temperatures ranging from -80 to +160 F after which it shall operate satisfactorily within the specified temperature range.

3.3.2 Elevation - The equipment shall operate satisfactorily from sea level to 36,000 feet.

3.3.3 Relative humidity - The equipment shall withstand relative humidity from 5 to 100 percent, including condensation caused by temperature changes, after which it shall operate satisfactorily.

3.3.4 Immersion - It shall be possible to immerse the instrument in water to a depth of 1 foot for a period of 30 minutes without leakage into the case.

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3.3.5 Vibration and shock - The equipment shall be constructed to withstand normal handling in service use and transportation in vehicles over rough terrain and in airplanes without damage. Tests of 4.7.1 and 4.9 shall determine compliance with these requirements.

3.3.6 Salt spray - The equipment shall be capable of withstanding normal ocean atmospheric corrosion. (See 4.9)

3.4 Physical characteristics.

3.4.1 Weight - The maximum allowable weight shall be 10 pounds.

3.4.2 Dimensions - The case dimensions shall be 10 inches long, 6 inches wide, and 5 inches deep.

3.4.3 Tilt from vertical required to tip over - The instrument shall be constructed so that standing on its base, it will withstand a 35 degree tilt from the vertical prior to tipping over.

3.4.4 Case finish.

3.4.4.1 Paint - The case shall have a smooth orange gloss baked enamel or similar hard finish material, and shall be constructed in such a manner that the external surfaces may be easily cleaned. The finish shall be able to withstand, without chipping the test of 4.8.1.

3.4.4.2 Surface - The corners of the case shall be slightly rounded (1/8 inch minimum radius).

3.4.5 Handle - The instrument shall have a handle for transportation in field operations when a shoulder strap is not desired. The handle, of either metal or strong plastic, shall be rigidly fixed to the top of the instrument case and shall be a rigid type with a smooth, shiny, hard surface involving no ornamentation or weight reducing grooves. The finish or the entire handle shall be easily replaceable for ease of decontamination. The material in the handle shall be non-porous.

3.4.6 Balance - The instrument when suspended by a string, tied to the handle at a point 5-1/2 inches from the front of the case, shall remain with the bottom of the case parallel to the surface of the earth with an allowable tilt in any direction of not more than 10 degrees.

3.4.7 Switch markings - The switch markings shall be placed on the instrument by engraving and filling the identations flush with the surface with contrasting non-porous paint or by silk screen or other similar process. Any paint markings must be able to withstand abrasion to a greater extent than the finish of the remainder of the case.

3.4.8 Base mountings - The instrument shall have suitable "feet" or glider surfaces at each of the four base corners which shall not cause scratches when pulled across a varnished wood surface. These "feet" shall be pressed out from the base surface so as to form a continuously smooth, easily cleaned surface.

3.5.9 Meter scales.

3.4.9.1 Length - The meter scale shall be not less than 2 inches in length and may be circular or straight.

3.4.9.2 Scale change - Only one scale shall appear on the face of the meter at one time. The scale shall be changed automatically with change in the range set knob. The scale changing device shall be so constructed that there is no opportunity for the introduction of foreign matter into the meter movement. The meter shall be a Roller Smith, Type FD, or equal.

3.4.9.3 Scale legibility - Markings, meter needle, etc. shall be easily read from a distance of 5 feet by a person having a minimum of 15/20 vision in both eyes. The meter dial face shall be white with black markings.

3.4.9.4 Marking - Markings shall be as follows: There shall be five heavy lines which shall correspond to the five numbers of the scale used (i.e. on the 5 mr/hr scale these shall be 1.0, 2.0, 3.0, 4.0, 5.0). Less heavy markings shall be used for the four divisions between the major numbered points.

3.4.9.5 Scale change colors - The scale changing device shall incorporate a color scheme as follows:

RANGE	COMMON NAME	MUNSELL NUMBER
50,000 mr/hr	Light Magenta	10RP6/10
5,000 mr/hr	Orange	10R6/10
500 mr/hr	Yellow	5Y8/12
50 mr/hr	White	
5 mr/hr	Green Yellow	5GY8/8

3.4.9.6 Meter illumination - The meter shall be illuminated for night operation. Illumination shall be at the discretion of the operator by means of a spring loaded switch.

3.4.9.7 Meter calibration - A meter calibration adjustment shall be incorporated.

3.4.9.8 Shunt - A shunt shall be placed across the meter when the instrument is turned off.

3.4.10 Loops for straps - The instrument shall be provided with loops for shoulder straps at or near the top of the case ends.

3.4.11 Case fastenings - The case fastenings shall be made so that it is impossible to open the case without the use of a screwdriver. Six screws, in place of the four used in the model shall be used in closing the case. Toggle and other similar trunk latches will not be acceptable.

3.5 Accessories.

3.5.1 Shoulder strap - The snap to attach the shoulder strap to the case shall be such that it will not come open under any turning or motion of the strap. The shoulder strap shall be 1-1/2 inch wide and adjustable in length from 26 to 40 inches. The strap shall be composed of a non-porous, smooth surface material to reduce collection of contamination. (Webb or leather straps are not acceptable.)

Strap and fittings shall be olive drab in color to match the case. Plastic vinal chloride strap material similar to that manufactured by the Exacto Industries Incorporated, 466 South Robertson Boulevard, Los Angeles, California, or equal is acceptable.

3.5.2 Each instrument shall be provided with one shoulder strap.

3.6 Electrical requirements.

3.6.1 Sensitivity - The ranges of sensitivity shall be 5, 50, 500, 5000, and 50,000 mr/hr.

3.6.1.1 Time constant - The instrument time constant, after the initial warm-up period, shall be such that 95 percent of the final reading is reached after a maximum period of eight seconds on the 5 mr/hr range, five seconds on the 50 mr/hr range, and two seconds on the higher ranges.

3.6.1.2 Order - The least sensitive range shall be the first range in order of switch rotation from the "off" position. The zero set position shall be interposed between "off" position and the first range.

3.6.1.3 Air pressure sensitivity - The calibration of the instrument shall not vary more than 15 percent when the external pressure of the instrument is varied from atmospheric pressure to 1/4 atmospheric pressure.

3.6.1.4 Calibration accuracy - The meter shall be calibrated at 4/5 full scale reading and other readings shall be accurate to within $\pm$ 15 percent of the 4/5 full scale reading.

3.6.1.5 Saturation effects - The instrument shall show no effects of saturation of the detector component until radiation intensities of at least 5 times the maximum reading of the instrument are encountered.

3.6.2 Ability to zero in field - The instrument circuit shall incorporate a zero set position to check the meter zero of the instrument; that is, the meter reading of the instrument when no current is being passed through the input resistor from the ionization chamber. This feature shall provide for the checking of the zero position when the instrument is located in gamma radiation fields greater than full scale deflection on the least sensitive range of the instrument. The range selector switch shall incorporate the zero set position.

3.6.3 Stability.

3.6.3.1 Microphonics - The instrument shall withstand a 2 inch drop to a hard surface with the meter not changing more than one-quarter the full scale reading and returning immediately to the original zero position.

3.6.3.2 Circuit noise - After a warm-up period of one minute, fluctuations from the zero point shall be less than 2 percent of the full scale reading.

3.6.3.3 Warm-up period - After a 30 second warm-up period the meter shall indicate greater than 90 percent of final reading and shall attain a zero drift of less than 15 percent of full scale per hour within one minute of the initial turn-on of the instrument.

3.6.4 Power supply - The equipment shall be powered by self-contained batteries.

3.6.4.1 Batteries - The contractor will not be required to supply any batteries.

3.6.4.2 Battery space - The battery compartment shall be as in the model. Space shall also be provided for 2 Battery BA-58 (not in the model) connected in parallel, which shall provide illumination for the dial light. These batteries shall be located in a suitable clip above the ionization chamber on the left side of the indicating meter.

3.6.4.3 Battery connections - The terminations on the leads for connection to the batteries shall be as in the model.

3.7 Standard, nonstandard, and unstandardized materials and parts.

3.7.1 Definitions - For the purpose of this specification, the following definitions shall apply:

3.7.1.1 Standard specifications - Standard specifications are those given in ASESA List No. 100 (Armed Services Index of Electro-Standards).

3.7.1.2 Standard materials and parts - A standard material or part is one that complies with a standard specification and, if so required by ASESA List No. 100, has tentative or final qualification approval as indicated by that list.

3.7.1.3 Nonstandard materials and parts - A nonstandard material or part is one for which a standard specification has been promulgated but which does not meet the standard specification in one or more of the following respects:

(Qualification approval is not applicable to Class II or III items.)

Class I. The material or part meets the standard specification but does not have qualification approval if such is required by ASESA List No. 100.

Class II. The material or part is nonstandard in one or more characteristics because of the peculiar electrical or mechanical requirements of the equipment in which it is used, but otherwise meets the requirements and tests of the standard specification.

Class III. The material or part is used in place of a standard one because the latter is not available.

3.7.2 Use of standard nonstandard and unstandardized materials and parts - The equipment shall utilize the minimum amount of unstandardized material and the minimum number and variety of unstandardized replaceable parts. Standard materials and parts shall be used wherever practicable and in any case non-standard materials and parts shall be used in preference to unstandardized ones.

3.7.2.1 Use of standard materials and parts - Standard materials and parts shall be of the types, grades, characteristics, tolerances, etc. stipulated in this specification or its subsidiaries. If the types, grades, characteristics, tolerances, etc. are not so determined, they shall be the least rigorous that will enable the equipment to meet specified performance and other requirements and tests. If the bidder or contractor desires to make such substitution he shall submit a statement to that effect, describing the proposed substitute and including data showing that it is at least equal, for the purpose intended, to the process or product which it may replace. At the discretion of the contracting officer, the bidder or contractor shall submit samples for test to demonstrate the suitability of the proposed substitute.

3.8 Substitutions - Substitutions for the following shall be subject to specific approval by the contracting officer;

Process, material, or part covered by specific requirements or designated by its commercial name in the specifications.

Process, material, or part designated as the specific process or product of a particular concern "or equal" in the specifications.

Material or part as required by 3.1.2. However, use of a specified product (such as a standard part for its non-standard equivalent is not a substitution as covered by this paragraph.

If the bidder or contractor desires to make such substitution, he shall submit a statement to that effect, describing the proposed substitute and including data showing that it is at least equal, for the purpose intended, to the process or product which it may replace. At the discretion of the contracting officer, the bidder or contractor shall submit samples for test to demonstrate the suitability of the proposed substitute.

3.9 Paper-dielectric capacitors in molded cases - Paper-dielectric fixed capacitors in molded cases shall be in accordance with Specification JAN-C-91.

3.10 Controls - The setting, position, or adjustment of controls shall not be affected by vibration encountered during normal use of the equipment.

3.10.1 Mechanical features - Knobs (handles) shall have high impact strength, and shall be firmly secured to its shaft by two slotted - or

recessed-hexagon-head set screws. (See 3.13.2 covering set screws.) Plastic knobs shall have metal inserts for the set screws. Play, backlash, and other excessive motion shall be reduced to the minimum necessary to prevent poor contact or inaccurate setting. Controls shall operate freely and smoothly, without binding, scraping, or cutting, and shall be properly lubricated where lubrication does not interfere with operation.

3.10.2 Direction of rotation - Except as otherwise specified, controls shall be so connected in the circuit that the controlled characteristic (sensitivity, voltage, etc.,) increases with clockwise rotation of the control as seen from the operating position.

3.10.3 Rotary switches - Rotary switches shall have a positive mechanical index at each position, such that no searching for contact will be necessary. The indexing means shall be such that the movable element will tend to come to rest only in the contact positions. The switch contacts shall be self-cleaning. Insultation for circuits shall be ceramic, or laminated thermosetting plastic which shall be Type LTS-E-4 (or better if necessary) conforming to Specification JAN-P-13.

3.11 Resistors and rheostats - Resistors and rheostats shall be such that the allowable maximum hot-spot temperature (as given in the applicable detail specification) will not be exceeded when the equipment in which they are used is subjected to specified service conditions. Resistors and rheostats shall be in accordance with one or more of the following subparagraphs.

3.11.1 Composition fixed resistors - Except as otherwise stated composition fixed resistors shall be characteristic BE or BF (insulated, and resistant to salt-water-immersion cycling and to humidity) in accordance with Specification JAN-R-11. Resistors R-1, R-2, R-3, R-4 and R-5 as used in the model are special resistors not covered by JAN approved lists. These resistors shall be of the same type, or equal, as in the model. All resistors shall have a maximum tolerance no greater than $\pm$ 5 percent.

3.11.2 Composition variable resistors - Composition variable resistors shall be in accordance with Specification JAN-R-94.

3.12 Screws, nuts, and other threaded parts - Screw threads shall be in accordance with National Bureau of Standards Handbook H28 covering Screw-Thread Standards for Federal Services, and shall be Class 2 fit unless otherwise specified. Wherever practicable, screw threads shall be commercial standard sizes. Threads in soft material shall be in the American National Coarse-Thread Series; Threads in other material shall be in either the American National Coarse-Thread or Fine-Thread Series, as suitable for the particular application. (Small screws, except where used in soft material, usually require fine threads in order to withstand vibration.) Only slotted head type of screws shall be used.

3.12.1 Length and engagement of threads - Thread engagement shall be at least 3 complete threads. Where permitted by design of the equipment, screws and bolts shall extend at least 1-1/2 thread beyond the nuts or equivalent engaging parts.

3.12.2 Set screws - Set screws shall be of the hardened type with slotted head except where Allen head screws are used. Cone-pointed set screws may be used where the engaging surfaces are properly counter-sunk to receive the point, otherwise cup-point set screws shall be used. Flat surfaces shall be provided for engagement of cup-pointed screws wherever the part does not have to be adjustable in angular relationship to the shaft on which it is secured. Where 2 set screws are used, the angle between the major axes shall be not less than 90 degrees and not more than 120 degrees.

3.12.3 Securing of threaded parts - Threaded parts shall be properly secured to withstand specified vibration, and shock test without loosening. If retaining compound is used in addition to other means of securing a threaded part, the part shall be capable of withstanding the tests before the compound is applied. Except where disassembly will not be necessary during field use of the equipment or its maintenance, threaded parts shall be capable of repeated disassembly and reassembly. Wherever practicable, each threaded part shall be secured by one or more of the following means:

(1) Lockwashers
(2) Staking: Shall not be used where the parts will be disassembled and reassembled.

3.13 Springs - Except as otherwise specified, springs shall be made of beryllium-copper, phosphor bronze, nickel-silver, or stainless steel. Springs shall be fabricated in accordance with good manufacturing practice for the intended application. Beryllium-copper springs, after forming, shall be heat-treated to the proper temper. Other materials, unless heat-treated after forming, shall have the direction of the grain within 0 to 45 degrees of the longitudinal center line of the spring.

3.14 Terminals - Terminals such as lugs and binding posts shall properly support the wires connected to them, and shall be so secured to the mounting surfaces as to prevent them from turning or becoming loose during connection of wires, soldering, or under specified service conditions.

3.15 Tube clamps - Suitable tube clamps shall be provided where necessary to enable the equipment to withstand specified conditions of vibration, and shock without loosening of tubes.

3.16 Electron tubes - Electron tubes shall be as in the model except that a Ratheon CK 571AX electrometer tube, or equal, if desired may be used for the first amplifier.

3.17 Materials.

3.17.1 Material, general - The material for each application shall be entirely suitable for the purpose intended.

3.17.2 Fiber - Fiber shall not be used in the equipment, unless explicitly required or allowed in this or a subsidiary specification.

3.17.3 Insulation material - Insulation material shall not support rapid combustion. The material used shall be sufficiently rigid and free from cold flow to maintain its function during exposure of the equipment to specified service conditions and to the tests specified in Section 4.

3.17.4 Plastic material - Where not machined, plastic material shall have the original smooth or polished surface. All surfaces that have been sawed, cut, punched, or otherwise machined shall be as smooth as practicable in accordance with good manufacturing practice for the kind of material used and the intended application.

3.17.5 Thermoplastic material, rigid - Rigid thermoplastic material shall be in accordance with Specification JAN-P-15. The flow temperature of the material shall be sufficiently high to enable the material to maintain its shape and function during exposure of the equipment to specified service conditions. Where low dielectric loss is essential, Type RTP-E2, or RTP-EH-1 shall be used.

3.17.6 Thermosetting material cast - Cast thermosetting plastic material shall be in accordance with Specification JAN-P-77.

3.17.7 Thermosetting material, laminated - Laminated thermosetting sheets and plates shall be in accordance with Specification JAN-P-13. No linen - or cotton-base laminated thermosetting plastic material shall be used.

3.17.8 Thermosetting material, molded - Molded thermosetting plastic material shall be in accordance with Specification JAN-P-14. Where low dielectric loss is necessary, Type MTS-E-3 or MTS-E-4 shall be used.

3.17.9 Solder, soft - Soft solder shall be in accordance with Specification QQ-S-571, and where used for electrical connections shall have a minimum tin content of 39.0 percent by weight unless a lower percentage is approved by the contracting officer for the specific application.

3.17.10 Soldering flux and cleaning agents - Flux for soldering shall be rosin or rosin and alcohol. No acid or acid salts shall be used in preparation for or during soldering. However, exception to the above requirements is permitted for preliminary tinning of electrical connections and for tinning or soldering of mechanical joints not used to complete electrical circuits, but in no case shall acid or acid salts come in contact with insulation. Where such materials are used, as allowed above or as other wise permitted by the contracting officer, they shall be completely neutralized and removed immediately afterward.

3.17.11 Wire hookup - Wherever practicable, hookup wire shall be stranded. The cross-sectional area of the conductor shall be sufficient to carry the necessary current.

3.17.11.1 Bare hookup wire - Bare hookup wire shall not be used except where insulated wire is impracticable because of circuit characteristics or shortness of the wire run. Bare hookup wire shall be of sufficient cross-sectional area and so supported that the equipment will be capable of withstanding specified vibration and shock tests without permanent displacement or deformation of the wire.

3.17.11.2 Insulated hookup wire - Insulated hookup wire shall be Type WL per JAN-C-76.

3.18 Adjustment and repair - The equipment shall be so constructed that all parts, terminals, and wiring are accessible for circuit checking, adjustment,

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maintenance, and repair with a minimum of disturbance to the other parts and with the use of the minimum number and variety of special tools, particularly those required for tuning or adjusting.

3.19 Circuit diagram - A circuit diagram shall be supplied per model.

3.19.1 Mounting - The circuit diagram in the form of a label shall be securely and permanently mounted on the inside of the bot om of the case by means of a suitable adhesive. The mounted label shall be covered with a coat of clear lacquer.

3.20 Finish protective - Except as otherwise specified or allowed, the equipment shall be given protective finish in accordance with U. S. Army Specification 72-53.

3.20.1 Mounted hardware - Before being mounted on the equipment, hardware shall be treated as required by U. S. Army Specification 72-53. After hardware such as hinges, catches, screws, nuts, and the like has been mounted, any break in the film of paint (either on the hardware or the mounting surface) shall be touched up to provide a continuous, protective coating. Only a reasonably exact color match between the painted surfaces and the touch-up coating will be required.

3.21 Interchangeability.

3.21.1 Replaceable parts - Replaceable parts (as defined in U. S. Army Specification 71-1578) and the equipment in which they are used shall be such that the parts are mechanically and electrically interchangeable and replaceable, to the extent listed below, without modification of the part or the equipment and without causing the equipment to deviate from specification requirements:

a. Any part within the limiting dimensions, tolerances characteristics, ratings, etc. prescribed by the applicable detail specification or drawings shall be capable of being substituted for a corresponding replaceable part in the equipment.

b. If the replaceable part is not covered by a detail specification or drawing, it shall be possible to interchange all such (corresponding parts used in the equipment on contract)

3.21.2 Components - All components of the same type shall be mechanically and electrically interchangeable.

3.22 Marking.

3.22.1 Nomenclature - The equipment shall bear identification marking in accordance with Specification furnished by contracting agency. No metal nameplates shall be used on the exterior of the instrument. Markings on the exterior of the instrument case shall be made in a manner similar to the switch markings (3.4.7).

3.22.2 Marking of standard parts - Parts covered by standard specifications shall be marked as required by those specifications. (See 3.7.1 for definition of standard parts.)

3.22.3 Other identification marking - Identification marking of components and parts, except those covered in 3.22.1 or 3.22.2 shall be in accordance with 3.22.1 or 3.22.3.2. The size of the markings shall provide maximum legibility commensurate with the size of the component or part and the space available for marking.

3.22.3.1 Electrical components and parts - These shall be marked with the manufacturer's name or trademark, catalog or other identification number, value and rating (if practicable), and other pertinent information. If space is limited, as much as practicable of the required information shall be included, preference being in the order given above. Subassemblies that are replaceable as a unit shall be marked in the same manner, but the marking shall be such as not to be confused with the marking on any replaceable part thereof.

3.22.3.2 Mechanical components and parts - Mechanical components shall be marked with the manufacturer's name or trademark, catalog or other identification number, and other pertinent information. Parts such as screws, nuts, and washers need not be marked but larger or more complicated replaceable parts shall be marked (if practicable) as specified for mechanical components. Subassemblies that are replaceable as a unit shall be marked in the same manner but the marking shall be such as not to be confused with any replaceable part thereof.

3.22.4 Reference symbols - Reference symbols, assigned in accordance with U. S. Army Specification 71-1578, shall be marked on the equipment as required by 3.22.4.1 through 3.22.7. The same reference symbol shall be used on the equipment, on diagrams, and in the tabular list of parts (U. S. Army Specification 71-1578) to identify respective parts. Spare parts shall not be marked with reference symbols.

3.22.4.1 Electrical parts - Except as otherwise required or allowed by 3.22.5, the appropriate reference symbol for each part having electrical circuits or connections shall be marked on an adjacent surface but if space is not available the reference symbol shall be marked on the part itself.

3.22.4.2 Mechanical parts - The appropriate reference symbol for each replaceable mechanical part (except screws, nuts, washers, bushings, and similar small hardware) shall be marked immediately adjacent to the part but if space is not available the reference symbol shall be marked on the part itself.

3.22.4.3 Electron tubes - Reference symbols shall not be marked on electron tubes. Type numbers of tubes shall be as marked on the tubes themselves.

3.22.5 Method of application - Nomenclature markings shall be applied in accordance with U. S. Army Specification 71-4944. Markings on standard parts shall be applied in accordance with the standard specifications covering the parts. Other identification markings (3.23.3) and reference symbols (3.23.4) shall be applied by one or more of the following means, in such a manner as to be legible and permanent:

Molding	Die Stamping	*Glyceryl-Phthalate Paint
Engraving	*Rubber Stamping	*Permanent Ink
Etching		*Stencilling
Steel Stamping		

*These markings shall be protected by a coat of clear lacquer or varnish complying with Specification JAN-C-173, except that markings applied with lacquer-base material need not be so protected if the material meets the applicable requirements of that specification.

3.22.6 Visibility - Reference symbols shall be so located that they are readily visible with the minimum removal of cases, covers, shields, or adjacent parts. Wherever practicable, parts shall be so mounted that their markings will be readily visible with the minimum disassembly of the equipment.

3.22.7 Connectors and controls - Binding posts, connectors, switches, other controls, etc. shall be suitably designated by permanent and legible markings on the surface on which they are mounted. The markings shall be such that the function of the part can be readily identified by the operator of the equipment.

3.23 Microphonics - In order to reduce microphonic tendencies to a minimum, any part that may contribute to microphonic effects shall be stiffened or effectively cushioned.

3.24 Tropicalization - The assembled equipment shall be treated in accordance with Specification JAN-T-152. Before being assembled into the equipment, materials and parts shall be treated as required by the following sub-paragraphs.

3.24.1 Plastic material, thermoplastic - Thermoplastic material covered by Specification JAN-P-15 shall be treated prior to overall treatment of the assembled equipment (3.24). Thermoplastic material used for optical or low-loss purposes shall be masked during the overall treatment of the component in which it is mounted.

3.24.2 Plastic material, thermosetting - Thermosetting plastic material, unless hermetically sealed inside of parts, shall be treated in accordance with the following list:

MATERIAL	TREATMENT
Used for arc resistance	None. Mask during overall treatment of assembled equipment.
LTS-E-4, LTS-E-5, or LTS-E-6; per JAN-P-13. MTS-E-3 or MTS-E-4, per JAN-P-14 CTS-E-2 per JAN-P-77 Nylon-base phenolic laminate	No treatment required, but the material need not be masked during treatment of the assembled equipment.
All unmachined, molded materials except those listed above.	Treatment with varnish, not lacquer, conforming to Specification JAN-C-173.
All machined, molded materials except those listed above. All laminated materials, except those listed above.	Treat all surfaces with insulating varnish, Type M, Grade CB, conforming to Specification JAN-V-1137, and bake for the time and at the temperature specified by the manufacturer of the varnish.

3.25 Cleaning - After metal parts have been fabricated they shall be cleaned in accordance with commercial practice. The cleaning process shall have no deleterious effect on the equipment. All traces of corrosive compounds shall be removed to prevent subsequent corrosion of the parts themselves or of other parts adjacent thereto. Chassis, cases, and wired parts shall be thoroughly cleaned and shall be free from superfluous particles of solder or other foreign material. If necessary, cleaning shall be performed both before and after final assembly.

3.26 Soldering - Soldered connections shall be neat. There shall be no sharp points or rough surfaces resulting from insufficient heating. The solder shall feather out to a thin edge, indicating proper flowing and wetting action, and shall not be crystallized, overheated, or underheated. The minimum necessary amount of flux and solder shall be used for electrical connections. Wherever practicalbe, excess rosin shall be removed by the use of a wire brush and then a dry cloth; any resulting loose flakes of rosin shall be carefully removed from the inside of the equipment. Insulation material that has been subjected to heating during the soldering operation shall be undamaged and parts fastened thereto shall not have become loosened.

3.27 Wiring and cabling - Wiring and cabling shall be neat, sturdy and as short as practicable except that sufficient slack shall be provided (1) to prevent undue stress on cable forms, wires, and connections, (2) to facilitate field repair of broken or cut wires, and (3) to enable parts to be removed and replaced during servicing without disconnecting other parts. Wires and cables shall be suitably protected against abrasion at points where they are secured to the frame or chassis and at other points necessary to enable the equipment to withstand specified vibration, and shock tests without damage to the wire or cable. Wiring and cabling shall be properly supported and secured to prevent undue stress on the conductors and terminals and to prevent permanent change of position of the wires or cables such that (1) after servicing, performance of the equipment might be reduced below specified requirements, and (2) the equipment would not comply with paragraphs covering vibration and shock.

3.27.1 Wire and cable runs - Wires in a continuous cable run between two terminals shall not be spliced during assembly of the equipment. Wires and cables shall be so located that inductive and capacitive effects, except where used as a design feature of the equipment, will be the minimum practicable.

3.27.2 Insulating sleeving - Unless specifically required or allowed, insulating sleeving shall not be used unless prior approval from the contracting officer is received for each specific application.

3.27.3 Terminations - Wire terminations shall be soldered. Joints shall be mechanically secured before soldering by crimping the terminal firmly upon the wire (including insulation where practicable), or the wire upon the terminal, or by other equally effective means. All textile insulation ends shall be treated where necessary to prevent fraying, unless they are securely clamped by the terminals. This treatment may be accomplished when the assembled equipment is tropicalized in accordance with 3.24. Soldering leads, lugs, and terminals shall be tinned, silverplated, or lead-alloy coated.

3.27.4 Grounding - Ground connections to shields and other mechanical parts except the chassis shall be made only for the purpose of eliminating high-potential a-c points and not for the purpose of completing electrical circuits. Ground connections to the chassis shall be made mechanically secure by soldering to a spotweld terminal lug, or by using a terminal on the ground wire and securing the terminal by a screw, flatwasher, and lockwasher. The screw shall either fit in a tapped hole in the chassis or shall be held in a through-hole by a nut. If the chassis is of steel, the metal around the screw hole shall be plated or tinned to provide a corrosion-resistant connection. If the chassis is of aluminum, the metal around the screw hole shall be masked when the chassis is given the specified protective finish.

3.28 Identification of wiring - Wiring shall be identified by suitable coloring.

3.28.1 Color coding - So far as practicable, color-coding of wiring shall be in accordance with Table A and shall conform to one of the following two plans:

a. Base (body) colors as listed in Table A. At the contractor's option, single tracers superimposed on the specified base colors may be used to identify particular leads.

b. White base (body) color with a single tracer colored as listed in Table A, except that Number 9 shall be solid white without tracer.

TABLE A COLOR-CODING OF WIRING

Number	Lead	Color
0.	Ground or Grounded Element	Black
1.	Heater or Filament, off ground	Brown
2.	Power Supply B plus	Red
3.	Screen Grid	Orange
4.	Cathode	Yellow
5.	Control Grid	Green
6.	Plate	Blue
7.	Miscellaneous	Violet
8.	A-C Power	Gray
9.	Above- or Below-Ground Return (AVC, AFC, etc.)	White
10.	Detector Lead	Blue-Red Tracer

3.29 Cabling - Insulated wires shall be formed into cables except where operation of the equipment would be adversely affected thereby or where it is mechanically impracticable as in the case where the resulting cables would be excessively large and would interfere with operation or maintenance of the equipment. Twine used for cabling shall be in accordance with Specification JAN-T-713.

3.30 Workmanship - All components and parts shall be manufactured in a thoroughly workmanlike manner.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Contractors inspection - Materials, parts components, and complete equipments before being offered for acceptance on contract, shall be inspected by the contractor for compliance with the specifications. Materials and parts before being assembled into the components, shall be inspected to the extent necessary to insure compliance with the applicable specifications. Items covered by subsidiary specifications shall be inspected and tested in accordance therewith. Inspection of materials, parts, components, and complete equipments shall take place at the point of manufacture or of assembly, as stipulated in the proposal request and contract or by the contracting officer. If a Government inspector is not assigned to observe such inspection, the contractor may be required to furnish satisfactory evidence of proper inspection (such as certificates of compliance or certified test data).

4.1.1 Government inspectors - Authorized Government inspectors shall be privileged to observe the fabrication, processing, and assembly of all materials, parts, components, and completed equipments used on the contract and to witness and participate in the contractor's inspection of such items.

4.2 Government inspection - The right is reserved for Government inspectors to conduct inspection of equipment after it has been submitted for acceptance on the contract, such inspection being in addition to that performed by the contractor (paragraph 4.1).

4.2.1 Unspecified tests - Government personnel may perform such tests as are considered necessary to determine compliance with the specifications, even though the tests are not required by the specifications. Such tests will normally be performed at a Government laboratory. The right is reserved, however, for Government inspectors to withdraw materials, parts, or components from production and conduct non-destructive tests after which the items will be returned to production. For these tests the contractor shall provide such testing equipment as may be necessary, if the testing equipment is available.

4.3 Inspection facilities - The contractor shall provide the following special facilities for testing.

5 milligram radium source (39.4 r/hr/cm)
50 milligram radium source
250 milligram radium source

4.4 Gages - Testing equipment shall include all gages necessary to insure that all corresponding components and replaceable parts will be mechanically interchangeable in all equipments on the contract. Gages shall be made of durable material and shall be so dimensioned that gaged parts or components will be rejected if they are not within specified tolerances; if tolerances are not specified, suitable tolerances shall be established by the contractor and submitted for approval to the contracting officer. Gages shall be checked before start of inspection and at suitable intervals thereafter, to insure that they have not become unduly worn or otherwise unsatisfactory.

4.5 Production inspection - The contractor shall subject each article of production (100 percent of production) to the following inspection and tests:

Test	Paragraph
1. Sensitivity and calibration check.	4.10
2. Time constant.	4.11
3. Zeroing.	4.12
4. Microphonics.	4.13
5. Circuit noise.	4.14
6. Air pressure sensitivity.	4.15
7. Waterproofness test.	4.16
8. Visual and mechanical inspection	4.17

4.6 Tests on preproduction samples - The Government will subject the preproduction samples to the tests of 4.7 and 4.18 and all other tests deemed necessary to determine compliance with this specification.

4.7 Service conditions tests.

4.7.1 Vibration test - The sample equipments shall be subjected to the test of 4.7.1.5. During vibration the equipment shall be clamped, in its normal mounting position, on a vibration table that can be controlled within 10 percent of the specified frequencies and amplitudes. The vibration table shall be designed to provide sinusoidal vibration at all specified frequencies and amplitudes. Internal batteries shall be in place in the equipment.

4.7.1.1 Directions of vibration - The equipment shall be vibrated successively, over the specified ranges of applied frequencies, in 3 mutually perpendicular directions. These directions shall be parallel to the edges of the equipment.

4.7.1.2 Rate of changes of vibration frequency - The frequency of applied vibration shall be varied uniformly at a rate of approximately one cycle per second per minute.

4.7.1.3 Amplitude of applied vibration - The amplitude (1/2 total excursion) of the vibration shall be 0.020 inches in the horizontal and 0.030 inches in the vertical plane.

4.7.1.4 Amplitude of component, sub-assembly, or part - There shall be no evidence of collision between any parts of the equipment during the test.

4.7.1.5 90-minute test - The equipment shall be vibrated for at least 30 minutes in each of the 3 directions specified in 4.7.1.1 (total of at least 90 minutes). The range of applied frequencies shall be from 10 to 33 cycles per second. Shock mounts shall not be blocked or removed.

4.7.2 Shock test - The equipment shall be subjected to the following shock test. This test shall be conducted on a shock testing machine constructed in accordance with U. S. Navy Bureau of Ships Plan 10-T-2145-L. The component shall be secured to the test plate of the shock testing machine, in a position consistent

with normal carrying means. The equipment shall be securely fastened to the test plate with not less than 4 bolts. The test shall consist of a total of nine blows; one each 1 foot, 3 foot, and 5 foot blows on the back, side and top respectively of the test plate. The equipment shall be energized during the test. After each blow, the equipment shall continue to operate satisfactorily without interval adjustments and without replacement of any part. There shall be no evidence of collision between any parts of the instrument.

4.7.3 Case, impact - The case shall not assume a permanent deformity of more than 1/16 inch when subjected to the impact of a one-pound steel ball dropped from a height of three feet.

4.7.4 Immersion test - The instrument shall be tested for immersion and shall meet the requirements of 3.4.4.

4.7.5 Humidity test - One preproduction sample shall be subjected to the following test. If the contract requires that production samples be forwarded to a Government Laboratory for environmental and life test, such samples shall be selected from the stipulated portions of production and shall be marked and shipped by the contractor as required by the contract. Such production samples shall be subjected to the following test.

4.7.5.1 Test procedure - The equipment shall be tested as follows:

(1) Dry the sample at 130 ± 5F for 24 hours.
(2) Measure performance and readjust if necessary to meet specification requirements.
(3) Subject Radiac Training Set AN/PDR-T1( ) to five continuous humidity cycles in accordance with Drawing No. SC-D-15914. At the conclusion of the cycling the water drops and film shall be removed from the surface of the outside of the equipment.

4.7.5.2 Procedure in case of failure - If the preproduction sample fails, additional samples will be required until satisfactory samples have been furnished. If a production sample fails, the cause of failure shall be ascertained and corrective measures determined. The corrective measures shall be introduced immediately in production and also shall be applied to completed and partially completed equipment in the contractor's plant. The contracting officer, however, may allow immediate acceptance of completed equipment and may allow the necessary changes in production to be made at a later date if he determines that it is to the advantage of the Government to accept the equipment without delay. In such case, the contracting officer will set the date when the change in production is to become effective.

4.7.5.3 Performance - The equipment shall meet all specification requirements of performance during or following the humidity test.

4.7.6 Extreme temperature test - Sample equipments shall be subjected to the following temperature test. It will be considered that a stabilization of the equipments temperature has been reached when three consecutive temperature

readings (at 10-minute intervals) taken at suitable points within the equipment show no more than ±5 degrees F differential. During the temperature cycle outlined below, the temperature shall be raised or lowered in steps of approximately 35 degrees F. Stabilization shall be effected at each step.

(1) Start at room temperature (70 to 90 F); take necessary measurements to establish a standard of performance.
(2) Raise the temperature to 125 ±5 F and repeat the measurements taken in (1).
(3) Raise temperature to 160 ±5 F and hold for 4 hours - equipment non-operating.
(4) Reduce temperature to 125 ± F; repeat measurements taken in (1).
(5) Reduce to room temperature; repeat measurements taken in (1).
(6) Reduce to -10 ±5 F; repeat measurements taken in (1).
(7) Reduce to -80 ±5 F and hold for 4 hours equipment non-operating.
(8) Raise to -10 ±5 F; repeat measurements taken in (1).
(9) Raise to room temperature and repeat measurements taken in (1).

The equipment shall give satisfactory performance throughout all steps of this test. Batteries may be removed during steps (3) and (7).

4.8 Production sampling of instrument cases - The finish test for instrument cases (see 4.8.1) shall be conducted on a statistical quality control basis. The Government inspector shall determine the sampling procedure, based on JAN-STD-105, such that 94 percent AQL (acceptable quality level) shall be assured before the cases are assembled with the instruments on contract.

4.8.1 Test on finishes - Instrument cases selected at random by the Government inspector shall be subjected to the following test in the Hart Impact Tester, made by the H. A. Garner Laboratories, Bethesda, Md., or equal. The finish of the case shall be subjected to one blow from the 500 gram chisel-face hammer head swung through 90 degrees on a ten inch arm. Chipping of the instrument case finish during this test shall be considered failure.

4.9 Salt spray test - A number of samples, as directed by the Government inspector, of case material finished so as to be a representative sample of the case shall be given a 50 hour salt spray test in accordance with Specification QQ-M-151.

4.10 Sensitivity and calibration check.

4.10.1 Equipment requirement.

1. 5 milligram radium source (39.4 r/hr/cm.)

4.10.2 Test procedure - Sensitivity check.

1. The instrument under test shall be placed 37 inches from 5 milligram source (distance measured from center of source to front case of instrument.)
2. Set scale change switch to position marked "set" and zero meter needle by means of zero adjust knob.
3. Set scale change switch to position marked 5 mr/hr.

4.10.3 Results.

1. Indication on meter shall be 4 mr/hr.

4.10.4 Test procedure - Calibration check.

1. Remove instrument from any radiation field and turn scale change switch to each position in turn.

4.10.5 Results.

1. Scale change switch in off position - there shall be no indication on meter.
2. Scale change switch in "batt" position needle on meter shall move to position on white line on meter face.
3. Scale change switch in "set" position needle on meter shall be able to zero by turning knob marked "zero adjust".
4. Scale change switch set to each of the following in turn 50 M, 5M, 500, 50 and 5, from each position the needle on meter shall return to zero within 5 percent of full scale in 30 seconds.
5. Push button on top of handle and light in dial face shall light.
6. There shall be no deflection of meter needle.

4.11 Time constant.

4.11.1 Equipment required.

1. 5 milligram radium source.
2. Stop watch.

4.11.2 Test procedure.

1. Turn instrument on for a minimum warm-up period of ten minutes.
2. Set the scale change switch to position marked 5 mr/hr.
3. Move source toward instrument until meter indicates full scale.
4. Quickly remove source from vicinity of instrument at the same time starting stop watch - stop the stop watch when needle has reached 5 percent of full scale.
5. This test shall be repeated on ranges listed in 4.11.3 under results.

4.11.3 Results.

1. On the 5 mr/hr range, there shall be a 95 percent return on the meter needle in a maximum of 8 seconds.
2. On the 50 mr/hr range, there shall be a 95 percent return of the meter needle in a maximum of 5 seconds.
3. On the remaining rantes, there shall be a 95 percent return of the meter needle in a maximum of 2 seconds.

4.12 Ability to zero in radiation field.

4.12.1 Equipment required.

1. 5 milligram radium source.

4.12.2 Test procedure.

1. Turn the instrument on and allow aminimum period of 10 minutes for warming up.
2. Turn the range switch to the "set" position.
3. Place a 5 milligram radium source against the front and each side of the case in turn.

4.12.3 Results.

1. The meter shall still indicate zero.

4.13 Microphonics.

4.13.1 Equipment required.

1. Two inch cube block.

4.13.2 Test procedure.

1. Set scale-change switch to 50 mr/hr.
2. Place block under leading edge of instrument, then quickly pull out block.

4.13.3 Results.

1. The meter deflection shall not exceed 1/4 full scale.

4.14 Circuit noise.

4.14.1 Equipment required.

1. Instrument to be tested.

4.14.2 Test procedure.

1. Turn on instrument and allow to warm up for one minute.
2. Set range scale to 5 mr/hr.

4.14.3 Results.

1. Fluctuations of the meter needle shall be less than 2 percent of full scale.

4.15 Air pressure sensitivity.

4.15.1 Equipment required.

1. 5 milligram radium source.
2. Pressure chamber capable of obtaining 1/4 atmosphere.

4.15.2 Test procedure.

1. Turn instrument on and allow to warm up for a 10 minute period.
2. Set range scale to 5 mr/hr; place instrument in pressure chamber, place radium source close enough to obtain an indication of 4 mr/hr.
3. Decrease pressure chamber to 1/4 atmosphere and note meter indication.
4. Allow air in test chamber to return gradually to atmospheric pressure over a period of approximately two minutes.

4.15.3 Results.

1. Meter indication shall not have changed by more than 15 percent.

4.16 Waterproofness test.

4.16.1 Take cover off instrument and remove batteries.

4.16.2 Equipment required.

1. Tank large enough to immerse the instrument, and arranged so that the temperature of the water can be maintained at 98 ±10 F.

4.16.3 Test procedure.

1. Immerse the instrument in the water for a period of one minute.

4.16.4 Results.

1. The component shall not show repetitive bubbling during immersion. (Bubbles of air adhereing to external surfaces shall not be considered failure to pass the test.)

4.17 Visual and mechanical inspection - The equipment shall be given a thorough inspection for mechanical fit, loose nuts and screws, poor workmanship. Controls and fastening devices shall be inspected for proper mechanical operation. Wiring soldered connections, ground connections, welds, finishes, and the like shall be inspected for satisfactory workmanship.

NOTE: Extreme caution must be exercised when inspecting the high value resistors; they must not be touched by hand.

4.18 Detection - The instrument shall be checked for wave length independence by means of 80 Kev X-rays and 1.2 Mev gamma rays from a radium source on the 5, 50, and 500 mr/hr ranges. The tests shall be conducted such that readings are obtained at 3/5 and 4/5 of full scale on each of the latter ranges. A standard ion chamber will be used as a comparison to determine the intensity of radiation. The equipment shall meet the requirements of 3.3.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging.

5.1.1 For domestic shipment - Commercial preservation and packaging will be acceptable

5.1.2 Technical literature - Package technical literature individually, in accordance with procedures specified for Method 1A-9, as follows: Inclose technical literature within a close fitting Type III, waterproof bag, conforming to the requirements of Specification JAN-P-117. Properly seal closure.

5.1.3 Shoulder strap.- Package shoulder strap for mechanical and physical protection only, as follows: Wind each strap into a bundle of proportionate dimensions and tie with cotton tape. Cushion each bundled strap by wrapping in flexible corrugated paper, securing the cushioning with gummed Kraft tape. Stow the cushioned strap, within the battery compartment of the radiac set.

5.2 Packing.

5.2.1 For domestic shipment - Radiac Set AN/PDR-T1( ), shall be packed in substantial containers of the type, size and kind commonly used for the purpose, in such a manner as to insure acceptance and safe delivery to the designated point by common or other carriers at the lowest rate.

5.3 Marking for shipment.

5.3.1 Packages.- For Army purchases, packages shall be marked as specified by procuring service; for Air Force, in accordance with Specification 40985; and for the Navy in accordance with the requirements of the Navy Shipment Marking Handbook.

5.3.2 Shipping containers. - In addition to any special marking required by the contract or order, shipping containers for the Army shall be marked in accordance with the requirements of U.S.Army Specification No. 100-2; for the Air Force, in accordance with the requirements of U.S.Army Specification 94-40645; and for the Navy, in accordance with the requirements of the Navy Shipment Marking Handbook.

6. NOTES

6.1 Intended use - Radiac Training Set AN/PDR-T1( ) will be used for training purposes to train personnel in methods of measuring radiation intensities.

6.2 Copies of applicable specifications, drawings and other documents - Copies of specifications, drawings and other documents to be used for the purpose of bidding or manufacture should be checked carefully to insure that they are of the issue listed in the invitation for bids and contract or order. (Documents are frequently provided by the contracting officer with the invitation for bids and contract or order, but such action does not relieve the contractor of the responsibility for checking the issues against those listed in the invitation for bids and order or contract.)

NOTICE: When Government drawings, specifications or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished or in any way supplied the said drawings, specifications, or other data is not to be regarded

by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

ENCLOSURE B

TENTATIVE SPECIFICATIONS FOR A CIVIL DEFENSE HIGH-INTENSITY RADIATION SURVEY METER

I. Purpose

To establish performance requirements for a small, lightweight, rugged field instrument for measuring gamma radiation which may result from atomic disaster. The instrument will be used by relatively inexperienced personnel and should provide ease of operation, maximum operating life and require a minimum of maintenance.

II. General Performance Requirements

A. The detector component shall be a Geiger-Müeller counter tube, ionization chamber, scintillation counter, or any other sensing device capable of responding to gamma radiation over the energy and intensity ranges specified below.

B. The detector element shall be so constructed and mounted as to be sensitive only to gamma radiation external to the instrument. It shall not respond to infra red, visible or ultraviolet light.

C. Self-Calibration. An integral self-calibrating device shall be provided for checking the overall instrument performance at one scale value. Any radioactive material used in the calibrating device shall have a half-life in excess of 10 years.

D. Battery Check. Means shall be provided for a voltage check on the battery power supply under a resistive load drawing 100 ma.

E. Zeroing. Means shall be provided for zeroing the instrument in the presence of a gamma ray intensity of at least 5.0 roentgens per hour.

F. Means shall be provided for illuminating the dial of the indicating meter.

G. A maintenance manual acceptable to the procuring agency shall be supplied with each instrument.

III. Circuit Requirements

A. Indication

1. The method of indication shall be a meter with a scale calibration which may be linear or some other suitable function.

2. Scale Dimensions. A single scale instrument shall have a meter scale radius not less than 1 1/8 inches and shall have a scale length greater than 5 inches. A multi-scale instrument shall have a meter scale radius not less than 1 inch and a scale length not less than 1 3/4 inches.

3. Scale Marking. Meter scale faces shall be white with black graduations and the meter needle shall be black. All scale numbering shall be along the inner radius of the scale graduations. The scale markings shall not deviate substantially from the samples exhibited as a part of these specifications.

4. Scale Legibility. The scale markings shall be of sufficient size to be read at a distance of 3 feet in normal daylight by a person with 15/20 vision.

5. The meter shall be illuminated for night operation to meet the legibility conditions of III, A, 4. Radioactive luminous compounds are not acceptable.

6. Meter Shunt. When the instrument switch is in the OFF position the meter shall be short-circuited.

B. Sensitivity

1. Sensitivity Range. The instrument shall be capable of detecting and measuring radiation intensities from 0.025 roentgens per hour to 500 roentgens per hour.

2. The sensitivity range may be covered by a single scale or by four scales having maximum values of 500, 50, 5, and 0.5 roentgens per hour.

3. The instrument shall read correctly within $\pm$ 30% at 5, 50, and 500 roentgens per hour.

4. Duplicate Instruments. Duplicate instruments of the same design and exposed to equal radiation fields shall show duplicate readings within $\pm$ 5% of the mean value at 5, 50, and 500 roentgens per hour.

5. Spectral Dependence. The instrument shall measure gamma radiation of energies from 80 Kev. to 1.2 Mev. within the accuracy specified in III, B, 3.

6. Time Constant. The time constant of the instrument response after warm-up shall not be greater than 5 seconds on any scale.

7. Meter Damping. The indicating meter movement shall be so damped that overshooting is not more than 10% of the steady state reading.

C. Stability of Circuits

1. Warm-up. For operation the instrument shall require not more than 5 seconds of warm-up at normal (65-75°F.) temperature.

2. Fluctuations. After warm-up, transient fluctuations due to circuit and component instabilities shall be less than $\pm$ 2% of full scale.

3. Microphonics. With the instrument in operation a 2 inch drop onto a hard surface shall not change the meter reading by more than 1/4 of full scale and the pointer shall return promptly to its original position.

D. Jamming

1. When exposed to radiation intensities from 500 roentgens per hour to 2,500 roentgens per hour the instrument shall read off scale on the high end.

E. Hysteresis

1. The instrument reading 25 roentgens per hour and exposed for at least one minute to a radiation intensity of at least 500 roentgens per hour shall return to the original reading within 15 seconds within the accuracy specified in III, B, 3, when the radiation field is returned to its original value.

IV. Operating Conditions

A. Temperature

1. Operation. The instrument shall operate over a temperature range of - 10°F. to +125°F. within the accuracy specified in III, B, 3.

2. Storage. The instrument exclusive of batteries shall withstand without damage prolonged storage over a temperature range of -55°F. to +160°F.

B. Humidity

1. The instrument shall be operable within the accuracy specified in III, B, 3, when subjected to the humidity conditions of Navy Department General Specification 16-E-4.

C. Immersion

1. The instrument shall be capable of immersion in water to a minimum depth of 3 feet for 30 minutes without leakage or impairment of proper operation.

D. Atmospheric Corrosion

1. The instrument shall be capable of withstanding without damage corrosion tests conducted in accordance with Navy Department General Specification 16-E-4.

E. Atmospheric Pressure

1. Operation. The instrument shall operate within the accuracy specified in III, B, 3, from sea level up to altitudes of 10,000 feet above sea level.

2. Transport. The instrument shall withstand without damage transportation at elevations of 40,000 feet above sea level.

F. Tropiclization

1. The instrument shall be moisture and fungus proofed as completely as possible in accordance with the requirements of JAN Specifications T-152 and C-173

G. Vibration and Shock

1. The equipment shall conform to the requirements of Navy Department General Specification 40-T-9.

H. Operating Life

1. The instrument shall be capable of operating continuously within the accuracy specified in III, B, 3, for 500 hours at a radiation intensity of 500 roentgens per hour without the replacement of any components except batteries.

V. Power Supply

A. Battery Type

1. The instrument shall be powered by no more than four dry cells, size D, flashlight type, which conform to JAN Specification B-18.

B. Battery Life

1. Operation. The battery shall provide continuous operation within the accuracy specified in III, B, 3, for at least 25 hours with the meter scale illuminated for 25% of the time.

2. Shelf Life. Shelf life of batteries shall conform to JAN Specification B-18.

C. Battery Replacement

1. Connections. The battery connections shall be of a positive pressure type requiring no tools for battery replacement.

2. Replacement. The batteries shall be replaceable without exposing other circuit components.

VI. Components

A. The choice of components should consider operating life and the criticality of characteristics with respect to their effect on the operation and maintenance of the instrument under the conditions of use required by these specifications.

B. The replacement of batteries shall not change the calibration within the accuracy specified in III, B, 3.

C. Components shall meet JAN specifications where applicable.

VII. Dimensions

A. Size

1. The instrument shall be as small as possible consistent with design requirements but shall not exceed a volume of 100 cubic inches.

B. Shape

1. The shape of the instrument shall be such as to facilitate its transport and use.

2. The shape of the instrument and the layout of the controls shall be such that the controls will be subject to accidental movement.

3. In carrying position the instrument shall present a minimum amount of interference with the bodily movement of the operator.

4. The corners of the case shall be rounded to a radius of not less than 1/8 inch.

C. Weight

1. The weight shall be as small as possible and in no case shall exceed 5 pounds.

VIII. Internal Construction

A. When the instrument is opened the components should be readily accessible or removable.

B. Common tools shall be required to expose the circuit components and means of sealing shall be provided to indicate unauthorized opening.

C. The provisions of VIII, B, do not apply to battery replacement.

3. Selection. The order of selection shall be BATTERY CHECK, OFF, ZERO where required, ON. In the case of multiple scale instruments the ON position shall be replaced by four positions X100, X10, X1, X1/10, in this order.

4. Dial Light Switch. The control for the dial illumination shall be a spring loaded push button making contact when depressed. This switch shall be located for convenient operation and shall conform to the requirements of VII, B, 2.

D. Battery Access

1. Cover. Access to the batteries shall be by a cover removable without tools and meeting the immersion requirements of IV, C, 1.

E. Exterior Finish

1. Color. The case of the instrument shall be bright yellow in color (Munsell No. 5Y8/12).

2. Paint. All paint applied to the surface shall be a baked gloss enamel which shall conform to Navy Department specifications.

3. Switch Positions. All switch positions shall be legibly marked in black. These markings shall not be removed by operations incidental to the normal storage, operation and maintenance of the instrument.

4. Markings. No dial plates or name plates shall be used. All markings shall be flush-filled indentations or enamel baked in a manner similar to that used for other paint finish.

F. Zero Adjustment

1. An externally operated circuit zero adjustment is to be used if the design of the instrument so requires.

G. Self-Calibration

1. Control. An external control for the self-calibration device shall be provided.

2. Type. This control shall be of the spring loaded push button type and shall be so interlocked with the range switch, if any, that the self-calibration can only be carried out on the proper range.

H. Sensitivity Adjustment

1. Sensitivity adjustment controls, if provided, shall not be accessible from the outside of the instrument.

I. Carrying Devices

1. A shoulder or neck strap of smooth surface, non-porous material and a belt clip or loop, or other means of securing the instrument to the operator's person shall be provided. Any fittings used to attach the strap to the instrument shall be such that the strap will not become detached with any turning or motion of the strap.

2. A handle of smooth surface, non-porous material shall be provided if needed. Any fittings used to attach the handle to the instrument shall be such that the handle will not become detached with any turning or motion of the handle.

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