



Defence Equipment and Support

MINISTRY OF DEFENCE
Chemical, Biological, Radiological and Nuclear
Delivery Team,
Yew 3a, #1342,
MOD Abbey Wood
Bristol, BS34 8JH



Ministry of Defence Radiation Calibration Qualified Persons Committee (MRCQP)

Radiation Detection and Monitoring Equipment Calibration Protocols

[Contents](#)

Issue 4.3 Jan 09







Sponsor: - MRCQP Committee

Authors: - CBRN Delivery Team

Yew 3a, #1342
MOD Abbey Wood
Bristol, BS34 8JH

**INFORMATION ONLY COPY
FOR IRMF MEMBERS
NOT FOR REPRODUCTION OR COPY**

Record of Changes

Change number	Changes	Authority	Date of insertion	Signature
Issue 2		MDMS7b1	Jul 03	
Issue 3		MESH CBRN RAD	May 04	
Issue 4		MESH CBRN RAD	May 06	
Issue 4.1		MESH CBRN RAD	Sep 06	
Issue 4.2	Record Of Change Table of Content Chapter 1, Para 105, 106, 305, Table 1 Table 2, Protocols 9, 17,18,19, 25, 39, 41, 47& 54 Removed Protocols T1, T2, T4, T5, T6, 1, 2, 3, 3a, 4, 13, 14, 27, 46, 50, 50a, 55 & 77 updated Protocol 70, Para 1 MESH IPT changed to CBRN IPT & DRMS(M&C) changed to AWE Ltd throughout document	MESH CBRN INSTR	March 08	
Issue 4.3	Title page, Template T3, T4, T5, T6, Protocols 5, 6, 7, 8, 10, 11, 12, 15, 16, 20, 22, 23, 24, 26, 29, 30, 31, 32, 36, 52, 64 amended, Template T7, Protocol 83, 84, Annex 2 & Annex 3 added, Protocol 62 deleted	DES CBRN-PM15	Jan 09	

*Note: All changes since last publication are highlighted in grey.

Intentionally Blank

Contents

Contents	
Chapter 1	Introduction Definitions Health and Safety Instruments Operational Instruments
Chapter 2	RDME Test Protocols Introduction Normalising Instruments. Test of Contamination Monitors. Overload Testing of Dose Rate Monitors. Purchase of Calibration Sources.
Chapter 3	List of Radiation Detection and Monitoring Equipment in MOD Use Introduction Table 1 - List of RDME in MOD Use. (By Protocol Number) Table 2 - List of RDME in MOD Use.
Chapter 4	References
Chapter 5	Calibration Protocols Template Protocols Index Instrument Protocols Index
Protocol T1	Photon Dose Rate Meter Template
Protocol T2	Beta Photon Dose Rate Meter Template
Protocol T3	Neutron Dose Rate Meter Template
Protocol T4	Alpha Contamination Monitor Template
Protocol T5	Beta Contamination Monitor Template
Protocol T6	Photon Contamination Monitor Template
Protocol T7	Air Sampler Template
Protocol 1	(Accessory Kit Mk 29NV) - BGP100 Probe
Protocol 2	(Accessory Kit Mk 29NV) - BP100 Probe
Protocol 3	Alpha Contamination Probe Type MD35
Protocol 3a	Alpha Draw Kit Mk 12NHA / Mk 36NHA (Type MD35)
Protocol 4	Air Particle Detector Type IM239/WDQ
Protocol 5	Air Sampler Type 1651B
Protocol 6	Air Sampler Type L10B
Protocol 7	Air Sampler Type L50
Protocol 8	Air Sampler Type L60
Protocol 9	Alpha in Air Monitor Type Eberline Alpha 3
Protocol 10	Weapon Accident Monitoring Kit Mk 14NRM + AP100H-M Probe
Protocol 11	Weapon Accident Monitoring Kit Mk 14NRM + XP-100 Mod 1 Probe
Protocol 12	Weapon Accident Monitoring Kit Mk 14NRM + XP-110 Probe
Protocol 13	Counter Scaler Mk 4NCA (Electrical Calibration Only)
Protocol 14	Counter Scaler Mk 4NCA + Alpha Drawer Type 1320C Probe
Protocol 14a	Counter Scaler Mk 4NCA + Mk 5NHA Castle
Protocol 14b	Counter Scaler Mk 4NCA + Mk 5NHA Castle
Protocol 15	Doserate Meter Type NIS 295B
Protocol 16	Doserate Meter PDR1, IDR1, PDR1Sv and PDR1/R&G
Protocol 17	Doserate Meter PDR2, IDR2 and PDR2Sv
Protocol 18	Doserate Meter PDR3 and PDR3Sv
Protocol 19	Doserate Meter PDR4, PDR4Sv
Protocol 20	Doserate Meter RO2, RO2W and RO2A
Protocol 21	Gamma Alarm Type PNI 1248
Protocol 22	Doserate Meter Type ADM-300A(V1A)
Protocol 23	Contamination Probe Alpha, Beta, Gamma Type FHZ731
Protocol 24	Doserate Meter Type FAG FH40F2M
Protocol 25	Hot Spot Monitor Type Mk 8NRM
Protocol 26	SIRS Low Level Detector Head Mk 28NH
Protocol 27	SIRS High Level Detector Head Mk 29NH
Protocol 28	Contamination Monitor Low Energy X-ray Monitor Type IS610A
Protocol 29	Mini Instruments Type 6-80
Protocol 30	Mini Instruments Type 7-10G
Protocol 31	Mini Monitor Series 900 + 42b Probe
Protocol 32	Mini Monitor Series 900 + 44b Probe
Protocol 33	Mini Monitor Series 900 + 'E' Probe

Protocol 34	Mini Monitor Series 900 + 'EL' Probe
Protocol 35	Mini Monitor Series 900 + 'X' Probe (Contamination Response)
Protocol 35a	Mini Monitor Series 900 + 'X' Probe (Doserate Response)
Protocol 36	Neutron Doserate Meter Type Mk 7NRM
Protocol 37	Dosimeter Electronic Personal (PED) Type SAIC PD-12i / PD-2i (Submarine Reactor Compartment Emergency Response)
Protocol 37a	Dosimeter Electronic Personal (PED) Type SAIC PD-12i / PD-2i
Protocol 38	Harwell Pocket Dosimeter Type 975002
Protocol 39	Counting System Portable Harwell Type 0734 / 0744
Protocol 40	Potable Water Monitor Type Mk 25NRM
Protocol 41	Dosimeter Quartz Fibre (QFD)
Protocol 42	Radon Monitor Thomson & Nielson Type Radon WL Meter
Protocol 43	Contamination Probe Beta Type 1275C Probe
Protocol 44	Contamination Probe Alpha Type 1320C
Protocol 45	Contamination Probe Alpha Type AP2/4 or AP2R/4
Protocol 46	Contamination Probe Alpha Type AP3/4 or AP3R/4
Protocol 47	Contamination Probe Beta Type BP10
Protocol 48	Contamination Probe Beta Type BP4, BP4/4A, BP4/4B or BP4/4C
Protocol 49	Contamination Probe Beta Type BP7, BP7/4
Protocol 50	Ships Installed RADIAC System (SIRS) Mk 22NRS
Protocol 50a	Ships Installed RADIAC System Lightweight (LWSIRS)
Protocol 51	Contamination Monitor Alpha Solid State Type 995000
Protocol 52	Submarine Escape Monitor Type ADM300N
Protocol 53	Transportable Reactor Accident Monitoring System (TRAMS)
Protocol 54	Tritium Monitor Type Mk 4NRM
Protocol 55	Tritium Monitor Type TAM-73
Protocol 56	Weapon Accident Monitoring Kit Mk 3NRM + 1320C Alpha Probe
Protocol 57	Weapon Accident Monitoring Kit Mk 3 NRM + Mk 15NH X-ray Probe
Protocol 58	Doserate Meter Type RO10
Protocol 59	710C Lead Castle + BP4 Probe
Protocol 60	Doserate Meter RADIAC Type PDRM82C
Protocol 61	Doserate Meter RADIAC Type PDRM82D
Protocol 62	Doserate Meter RADIAC Type PDRM82M
Protocol 63	Doserate Meter Type Bicron Micro Sievert LE
Protocol 64	Contamination Probe Beta Type BSP100A
Protocol 65	710C Lead Castle with Type 47490 Probe
Protocol 66	RADIAC Detection Meter (RDM) Type SOR/T
Protocol 67	RADIAC Survey Meter (RSM) Type SVG2
Protocol 67a	ABG Contamination and Dose Rate Probe for use with the SVG2
Protocol 68	RADIAC Identification Equipment (RIE) Type GR-135
Protocol 69	3 Channel Scaler Mk5NCA
Protocol 70	Mk 5 NHA Lead Castle (POST-MOD)
Protocol 71	Victoreen 4000M
Protocol 72	Victoreen 4000+
Protocol 73	Keithley KvP Dividers
Protocol 74	Unfors Mult-O-Meter
Protocol 75	Thermo Electron Mini Rad 1000 RA
Protocol 76	Doserate Meter Type FH11
Protocol 77	Ship Installed Radiac System (S2) Detector Head Assembly
Protocol 78	NATO Submarine Rescue Service Intervention Remote Operated Vehicle Radiation Detection Equipment (NSRS IROV RDE)
Protocol 79	ABSP-100A
Protocol 80	Mini Monitor Series 900 Ratemeter with 42a Probe
Protocol 81	Mini Monitor Series 900 Ratemeter with 44a Probe
Protocol 82	ADM300SI Multipurpose Meter
Protocol 83	L60iF Air Sampler
Protocol 84	RAE 2000 – DoseRAE(P)
Annex 1	Correcting Response of under-reading ADM300's
Annex 2	ADM300N – Pressure Testing
Annex 3	ADMCOM Calibration Scale Factor Correction Instruction

Chapter 1 Introduction

101. The Ionising Radiation's Regulations 1999 requires employers who work with ionising radiation's to monitor the levels of ionising radiation's in controlled and supervised areas, and to arrange that certain tests and examinations of the equipment's used to carry out this monitoring are undertaken.
102. The requirement for traceability of all such tests is detailed in JSP 425. This is achieved by use of radiological standards whose traceability is / can be related to Primary National Radiation Standards held by the National Physical Laboratory (NPL).
103. JSP 425: Examination and Testing of Radiation Detection and Monitoring Equipment details the MOD policy on Radiation Detection and Monitoring Equipment calibration and the quality standards required to be maintained by a Defence Nucleonic Calibration facility.
104. This manual is a compilation of Radiation Detection and Monitoring Equipment calibration protocols for instruments used with in the Ministry of Defence. The individual protocols assume that the requirements of JSP 425 have been adopted.
105. This manual is sponsored, published and controlled on behalf of the MOD Radiation Calibration Qualified Persons (MRCQP) Committee by the Radiation Detection and Radiation Instrument Service within Dstl. Any comments on the contents of the manual are to be notified to the Secretary MRCQP (Project Support Technician, Dstl).
106. The Protocols published in this manual have been compiled from best practice protocols used within Defence Radiation Calibration Facilities. All protocols are vetted by peer review prior to publication.

Definitions

107. Two distinct categories of Radiation Detection and Monitoring Equipment exist.
108. Health and Safety – instruments used to provide data for the protection of personnel (Radiation Protection Instruments RPI)
109. Operational Instruments (Formerly known as RADIAC) – Instruments used for the alerting or monitoring of radioactive hazards in the military operational environment. It must be made clear that operational instruments are not maintained to the level required for Health and Safety instruments. Therefore they must not be used for the assessment of doses to an individual, they are to be used by the chain of command for the assessment of hazard in a military operation, within the scope of the military guidelines, in-order to successfully meet their military objectives.

Health and Safety Instruments

110. All instruments categorised as Health and Safety Instruments must be maintained and calibrated in accordance with the requirements of JSP 425, JSP 392 and this Protocol Manual at least annually.

Operational Instruments

111. For instruments categorised as Operational Instruments there is no legal requirement for the testing and examination of Radiation Detection and Monitoring Equipment provided they will not be used for the assessment of dose to personnel. It is therefore the recommendation of the MRCQP that the following strategy be adopted as best practice for testing and examination of Operational Instruments.
112. All Operational Instruments are tested and examined to the same standard as directed by IRR 1999.

113. Given that the majority of Operational Instruments are held in central storage in large numbers until required, often for extended periods. It is impractical and costly to test every instrument annually. Therefore it is recommended that as a minimum a sample percentage of these instruments are tested annually, on a rolling basis, to provide confidence in the stored instruments continued satisfactory operation. The MRCQP recommended 20% of the stored instruments be tested and examined annually on a 5 year rolling program.
114. It is also recommended that, where operational time-scales permit, operational instruments be tested and examined prior to deployment.
115. For operational instruments that are deployed on a permanent basis it is recommended that these instruments be calibrated annually as Health and Safety Instruments.

Chapter 2 RDME Test Protocols

Introduction

301. Chapters of the manual comprises a compilation of all the Test Protocols to be used by facilities when performing calibration / test routines on RDME. All new RDME not included in this chapter should be referred to the CBRN IPT, with full technical details of the instrument including, where available, test type data, to enable a test protocol to be written and published for inclusion in the manual. Any problems found with the published test protocols in this manual should be referred to CBRN IPT for resolution.
302. QP's are to adhere to these test protocols, for MOD owned equipment. This is to ensure that all RDME are tested to the same standards, which will enable comparison of results from various test houses. It is recognised that QP's may wish to do more extensive tests particularly the pre-radiation examination under certain circumstances. However, the test protocols in this manual represents the minimum that is required.
303. A series of templates are contained within this manual to guide in the production of new protocols. Templates for the following types of instruments and probes are as follows:

[Photon Dose Rate Meter Template](#)
[Beta Photon Dose Rate Meter Template](#)
[Neutron Dose Rate Meter Template](#)
[Alpha Contamination Monitor Template](#)
[Beta Contamination Probe Template](#)
[Photon Contamination Monitor Template](#)
[Air Sampler Template](#)

Normalising Instruments.

304. Much debate has been recorded over the need and correct nuclide to normalise instruments that respond to photons to, be ^{137}Cs or ^{60}Co . In order to provide consistency between the instruments and calibration facilities the capability managers for Radiation Detection and Monitoring Equipment within the MOD require that all instrumentation that respond to photons are to be normalised to ^{137}Cs . This however does not prevent instruments being calibrated with ^{60}Co where a suitable ^{137}Cs source is not available, provided that the Type Test data is available for the conversion of ^{60}Co response to the ^{137}Cs normalised response.
305. Although standardizing on a ^{137}Cs normalising for MOD wide RDME. The normalisation to ^{60}Co for specific applications such as nuclear facility operations. As required by the licensed operator is acceptable. RDME normalised to ^{60}Co should be clearly identified.
306. For instrumentation that respond to non-photon contamination the instrument should be calibrated against the nuclides of interest for the application that the instrument is to be used. These nuclides of interest should be identified at the outset of the equipment purchase project in the Capability Statement, and responses recorded during Type Testing, Cat 1 and Cat 2 tests.

Test of Contamination Monitors.

307. It is normal practice to calibrate a ratemeter and probe combination as a dedicated unit, because the response will not be identical if probes are subsequently changed. If this is not practical the following procedure shall be adopted; ratemeter and probes shall be individually tested to confirm satisfactory performance. When a probe is matched to a ratemeter in the field, its surface contamination response shall be determined with an appropriate emission rate standard and jig combination.
308. The independent final test i.e. contamination response, shall be deemed to be part of the statutory test and recorded and authorised to the satisfaction of the QP.

Overload Testing of Dose Rate Monitors.

309. Where possible, instruments should be overload tested at 10 times the maximum scale indication. It is recognised that for a number of test houses this is impracticable. In these instances instruments should be tested at 5 or 10 times the maximum credible dose rate to which the instrument could be exposed. These instruments shall be labelled "Limited Cal" and the calibration certificate shall clearly state the limits of the overload and range testing.

Purchase of Calibration Sources.

310. In-order to maintain suitable traceability of all calibration sources used in support of MOD sponsored RDME all procurement action taken for the provision of calibration sources is to be undertaken with the knowledge and support of CBRN IPT.
311. CBRN IPT require that AWE Ltd be consulted for advice on the suitability, particularly on the ability to recalibrate and re-certify all calibration sources used for MOD RDME prior to introduction in to service and inclusion as a recommended calibration source in this manual.
312. AWE Ltd is the primary facility contracted by CBRN IPT for the provision of a calibration source calibration / re-certification service for MOD owned and sponsored sources there involvement in the procurement of new or replacement sources is mandated.

Chapter 3 List of Radiation Detection and Monitoring Equipment in MOD Use

Introduction

201. This chapter comprises a compilation of all Radiation Detection and Monitoring Equipment (RDME) currently in service within the Ministry of Defence.

202. Two table have been compiled that detail all the instruments

[Table 1 - List of RDME in MOD Use. \(By Protocol Number\)](#)

[Table 2 - List of RDME in MOD Use \(By Use / Manufacturers Series\)](#)

203. All new RDME not included in this chapter should be referred to the MRCQP, with full technical details of the instruments, in-order that a suitable protocol can be amended to this manual.

204. Any comments on the list published in this manual should be referred to the Secretary MRCQP.

Intentionally Blank

Table 1 - List of RDME in MOD Use. (By Protocol Number)

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Protocol Sponsor	Instrument Type	Comments	Date Last Review	Review Due
Accessory Kit Mk 29NV + BGP100 Probe	99-453-8131	ADM300A(V1A)	01-418-8038	BGP100	01-440-9003	1	Dstl	Beta/Gamma Doserate Monitor	Protocol Included	07/01/08	02/08/10
Accessory Kit Mk 29NV + BP100 Probe	99-453-8131	ADM300A(V1A)	01-418-8038	BP100	01-440-8993	2	Dstl	Beta Contamination Monitor	Protocol Included	07/01/08	02/08/10
Alpha Contamination Probe Type MD35	99-083-4155	ADM300A(V1A)	01-418-8038	MD35	01-440-8996	3	Dstl	Alpha Contamination Monitor	Protocol Included	04/02/08	01/11/10
Alpha Draw Kit Mk 12NHA / Mk 36NHA (Type MD35)	99-083-4155	ADM300A(V1A)	01-418-8038	MD35	01-440-8996	3a	Dstl	Alpha Contamination Monitor	Protocol Included	04/02/08	06/12/10
Air Particle Detector Type IM239/WDQ	01-164-9938	N/A		N/A		4	CBRN	Submarine Air contamination Monitor	Protocol Included	07/01/08	06/09/10
Air Sampler Type 1651B	99-659-5818	N/A		N/A		5	Dstl	Dust Sampler	Protocol Included	07/05/08	02/08/10
Air Sampler Type L10B	99-448-5862	N/A		N/A		6	Dstl	10L Portable Air Sampler	Protocol Included	07/05/08	02/08/10
Air Sampler Type L50	99-924-3721	N/A		N/A		7	Dstl	L50 Portable Air Sampler	Protocol Included	07/05/08	04/04/11
Air Sampler Type L60	99-924-3732	N/A		N/A		8	Dstl	L60 Portable Air Sampler	Protocol Included	07/05/08	04/04/11
Alpha in Air Monitor Type Eberline Alpha 3	01-012-4446	Alpha 3	01-012-4446	N/A		9	Dstl	Real Time Alpha in air contamination Monitor	Obsolete Equipment Protocol Removed		N/A
Weapon Accident Monitoring Kit Mk 14NRM + AP100HM Probe	99-258-0566	ADM300A(V1A)	01-418-8038	AP100H	01-440-8995	10	Dstl	Hard faced Alpha Contamination Monitor	Protocol Included	17/07/08	07/03/11
Weapon Accident Monitoring Kit Mk 14NRM + XP100 Probe	99-258-0566	ADM300A(V1A)	01-418-8038	XP100	01-360-7277	11	Dstl	Small area X-ray monitor	Protocol Included	17/07/08	04/04/11
Weapon Accident Monitoring Kit Mk 14NRM + XP110 Probe	99-258-0566	ADM300A(V1A)	01-418-8038	XP110	01-440-8997	12	Dstl	Large Area X-ray Monitor	Protocol Included	16/09/08	02/05/11
Counter Scaler Mk 4NCA (Electrical Calibration Only)	99-541-4983	Mk 4NCA	99-541-4984	N/A		13	Clyde	Counter Scaler Electrical Set-up and Calibration	Protocol Included	07/01/08	06/09/10
Counter Scaler Mk 4NCA + Alpha Drawer Type 1320C Probe	99-541-4983	Mk 4NCA	99-541-4984	1320C	99-949-1324	14	Clyde	Submarine Reactor Alpha Monitoring System	Protocol Included	07/01/08	04/10/10

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Protocol Sponsor	Instrument Type	Comments	Date Last Review	Review Due
Counter Scaler Mk 4NCA + Mk 5NHA Castle (On-Board Use Calibration)	99-541-4983	Mk 4NCA	99-541-4984	MX167	99-118-2888	14a	Clyde	Submarine Reactor Monitoring System Beta/Gamma (On-Board use Calibration)	Protocol Included		04/02/08
Counter Scaler Mk 4NCA + Mk 5NHA Castle (Shore Side Use Calibration)	99-541-4983	Mk 4NCA	99-541-4984	MX167	99-118-2888	14b	Clyde	Submarine Reactor Monitoring System Beta/Gamma (Shore Side Use Calibration)	Protocol Included		04/02/08
Doserate Meter Type NIS 295B	99-111-6865	NIS295B	99-111-6865	N/A	N/A	15	Dstl	Beta/Gamma Doserate Meter	Protocol Included	18/07/08	02/05/11
Doserate Meter PDR1, IDR1, PDR1Sv and PDR1/R&G	99-726-3084	PDR1	99-726-3084	N/A	N/A	16	Dstl	Gamma Doserate Meter	Protocol Included	05/09/08	04/07/11
Doserate Meter PDR2, IDR2 and PDR2Sv	99-282-5356	PDR2	99-282-5356	N/A	N/A	17	Dstl	Gamma Doserate Meter	Obsolete Equipment Protocol Removed		N/A
Doserate Meter PDR3 and PDR3Sv	99-477-4181	PDR3	99-477-4181	N/A		18	Dstl	Gamma Doserate Meter	Obsolete Equipment Protocol Removed		N/A
Doserate Meter PDR4, PDR4Sv	99-317-6031	PDR4	99-317-6031	N/A		19	Dstl	Gamma Doserate Meter	Obsolete Equipment Protocol Removed		N/A
Doserate Meter RO2, RO2W and RO2A	01-243-5942	RO2/R02W/R02A	01-243-5942	N/A		20	Dstl	Beta/Gamma Doserate Meter	Protocol Included	09/10/08	04/07/11
Gamma Alarm Type PNI 1248	99-538-9196	PNI 1248	99-538-9196	N/A		21	Clyde	Submarine Installed Gamma Alarm	Protocol Included		03/03/08
Doserate Meter Type ADM300A(V1A)	01-418-8038	ADM300A(V1A)	01-418-8038	N/A		22	Dstl	Beta/Gamma Doserate Monitor	Protocol Included	16/09/08	01/08/11
General Purpose Beta / Gamma Monitoring Kit Mk 28NV	99-126-2410	ADM300A(V1A)	01-418-8038	N/A		22	Dstl	Beta/Gamma Doserate Monitor	Use Protocol 22 ADM300A(V1A)	16/09/08	01/08/11
Contamination Probe Alpha, Beta, Gamma Type FHZ731	12-326-4538	FH40F2M		FHZ731	99-363-2107	23	Dstl	Beta, Gamma, Alpha Monitor	Protocol Included	09/10/08	01/08/11
Doserate Meter Type FAG FH40F2M	12-326-4538	FH40F2M		N/A		24	Dstl	Beta/Gamma Doserate Monitor	Protocol Included	09/10/08	05/09/11

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Protocol Sponsor	Instrument Type	Comments	Date Last Review	Review Due
Hot Spot Monitor Type Mk 8NRM	99-736-4918	Mk 8NRM	99-736-4923	N/A		25	Clyde	Gamma Monitor	Obsolete Equipment Protocol Removed		N/A
SIRS Low Level Detector Head Mk 28NH				MK 28NH	99-733-1142	26	Rosyth	Gamma Monitor	Protocol Included	30/04/08	07/02/11
SIRS High Level Detector Head Mk 29NH				Mk 29NH	99-733-5339	27	Rosyth	Gamma Monitor	Protocol Included	07/01/08	04/10/10
Contamination Monitor Low Energy X-ray Monitor Type IS610A	99-083-1929	IS610A		N/A		28	Dstl	Weapon Accident Contamination Monitor	Protocol Included		01/09/08
Mini Instruments Type 6-80	Non-Codified	6-80	Non-Codified	MC70/M C71	Non-Codified	29	Dstl	Environmental Monitor	Protocol Included	09/10/08	05/09/11
Mini Instruments Type 7-10G	Non-Codified	Series 700	Non-Codified	Type G	Non-Codified	30	Dstl	Installed Gamma Doserate Alarm	Protocol Included	09/10/08	03/10/11
Mini Monitor Series 900 + 42b Probe	99-570-5736	Series 900	Non-Codified	42b	99-495-8120	31	Dstl	Photon Contamination Monitor	Protocol Included	09/10/08	03/10/11
Mini Monitor Series 900 + 44b Probe	99-801-3983	Series 900	Non-Codified	44b	99-250-6513	32	Dstl	Photon Contamination Monitor	Protocol Included	09/10/08	07/11/11
Mini Monitor Series 900 + 'E' Probe	99-147-2262	Series 900	Non-Codified	E	Non-Codified	33	Dstl	Contamination Monitor	Protocol Included		03/11/08
Mini Monitor Series 900 + 'EL' Probe	99-147-2262	Series 900	Non-Codified	EL / DN212	Non-Codified	34	Dstl	Contamination Monitor	Protocol Included		01/12/08
Mini Monitor Series 900 + 'X' Probe (Contamination Response)	99-234-2483	Series 900	Non-Codified	X	Non-Codified	35	Dstl	Contamination Monitor	Protocol Included		01/12/08
Mini Monitor Series 900 + 'X' Probe (Doserate Response)	99-234-2483	Series 900	Non-Codified	X	Non-Codified	35a	Dstl	Contamination Meter	Protocol Included		05/01/09
Neutron Doserate Meter Type Mk 7NRM	99-721-2702	Mk 7 NRM		N/A		36	BAE	Neutron Monitor	Protocol Included	12/05/08	07/03/11
Dosimeter Electronic Personal (PED) Type SAIC PD-12i / PD-2i (Submarine Reactor Compartment Emergency Response)		N/A		PD12i	01-445-0591	37	Dstl	Personal Alarming Dosimeter	Protocol Included		05/01/09

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Protocol Sponsor	Instrument Type	Comments	Date Last Review	Review Due
Dosimeter Electronic Personal (PED) Type SAIC PD-12i / PD-2i (Non Destructive Testing & Health Physics Use)		N/A		PD2i	TBC	37a	Dstl	Personal Alarming Dosimeter	Protocol Included		02/02/09
Dosimeter Electronic Personal (PED) Harwell Type 975002		N/A		975002	99-015-5023	38	Dstl	Personal Alarming Dosimeter	Protocol Included		02/02/09
Counting System Portable Harwell Type 0734 / 0744	99-659-5815	0744		0745	99-659-5816	39	Dstl	Alpha Contamination Monitor	Obsolete Equipment Protocol Removed		N/A
Potable Water Monitor Type Mk 25NRM	99-736-4761	ADM300A(V3A)		M2NA	99-118-2880	40	Dstl	Beta Gamma Drinking Water Contamination Monitor	Protocol Included		02/03/09
Dosimeter Quartz Fibre (QFD) (0-2000µSv)		N/A		0-2000µSv	99-778-8896	41	BVT	Quartz Fibre Dosimeter	Obsolete Equipment Protocol Removed		N/A
Dosimeter Quartz Fibre (QFD) (0-5000µSv)		N/A		0-5000µSv	99-721-4780	41	BVT	Quartz Fibre Dosimeter	Obsolete Equipment Protocol Removed		N/A
Dosimeter Quartz Fibre (QFD) (0-500mSv)		N/A		0-500mSv	99-721-4782	41	BVT	Quartz Fibre Dosimeter	Obsolete Equipment Protocol Removed		N/A
Dosimeter Quartz Fibre (QFD) (0-50mSv)		N/A		0-50mSv	99-721-4781	41	BVT	Quartz Fibre Dosimeter	Obsolete Equipment Protocol Removed		N/A
Radon Monitor Thomson & Nielson Type Radon WL Meter	21-907-4098			N/A		42	Dstl	Radon Area Monitor	Protocol Included		02/03/09
Contamination Probe Beta Type 1275C Probe	Various	Various		1275C	99-911-0260	43	Dstl	Beta Contamination Monitor	Protocol Included		06/04/09
Contamination Probe Alpha Type 1320C	Various	Various		1320C	99-949-1324	44	Dstl	Alpha Contamination Monitor	Protocol Included		06/04/09
Contamination Probe Alpha Type AP2/4 or AP2R/4	Various	Various		AP2/4, AP2R/4	Non-Codified	45	Dstl		Protocol Included		04/05/09
Contamination Probe Alpha Type AP3/4 or AP3R/4	Various	Various		AP3/4, AP3R/4	Non-Codified	46	Rosyth		Protocol Included	04/02/08	06/12/10
Contamination Probe Beta Type BP10	Various	Various		BP10	99-640-0349	47	Clyde	Beta Contamination Monitor	Obsolete Equipment Protocol Removed		N/A

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Protocol Sponsor	Instrument Type	Comments	Date Last Review	Review Due
Contamination Probe Beta Type BP4, BP4/4A, BP4/4B or BP4/4C	Various	Various		BP4, BP4/4A, BP4/4B, BP4/4C	99-765-7402	48	Dstl	Beta Contamination Monitor	Protocol Included		04/05/09
Contamination Probe Beta Type BP7, BP7/4	Various	Various		BP7, BP7/4A	99-640-9733	49	Dstl	Beta Contamination Monitor	Protocol Included		01/06/09
Ships Installed RADIAC System (SIRS) Mk 22NRS						50	Rosyth	Complete System	Protocol Included	04/02/08	03/01/11
Ships Installed RADIAC System Lightweight (LWSIRS) Mk 23NRS						50a	Rosyth	Complete System	Protocol Included	03/03/08	07/02/11
Contamination Monitor Alpha Solid State Type 995000	99-138-0231	SSAM		N/A		51	Dstl	Alpha Contamination Monitor	Protocol Included		01/06/09
Submarine Escape Monitor Type ADM300N	99-083-2988	ADM300N		N/A		52	Dstl	Submarine Escape Gamma Monitor	Protocol Included	18/07/08	06/06/11
Transportable Reactor Accident Monitoring System (TRAMS)	99-373-0322 99-781-1307	Mk 11NHA Mk 12NVA		MK 28NH Mk 29NH	99-733-1142 99-733-5339	53	Dstl	Reactor Accident Gamma Monitor	Protocol Included		06/07/09
Tritium Monitor Type Mk 4NRM	99-199-8508	Mk 4NRM		N/A		54	Clyde	Tritium in Air Contamination Monitor	Obsolete Equipment Protocol Removed		N/A
Tritium Monitor Type TAM-73 and TAM-73D	99-317-1071 99-315-2214	TAM-73 TAM-73D		N/A		55	CBRN	Tritium in Air Contamination Monitor	Protocol Included	07/01/08	01/11/10
Weapon Accident Monitoring Kit Mk 3NRM + 1320C Alpha Probe	99-736-2885	Mk 3NRM		1320C	99-949-1324	56	Dstl	Alpha contamination Monitor	Use Protocol 44		N/A
Weapon Accident Monitoring Kit Mk 3 NRM + Mk 15NH X-ray Probe	99-736-2885	Mk 3NRM		Mk 15NH	99-462-3970	57	Dstl	X-ray surface contamination monitor	Protocol Included		06/04/09
Doserate Meter Type RO10	Non-Codified	RO10		N/A		58	Dstl	Beta Gamma Monitor	Protocol Included		06/07/09
710C Lead Castle + BP4 Probe	Various	Various		BP4	99-765-7402	59	Dstl	Beta Contamination Monitor installed in 710C Lead Castle	Protocol Included		03/08/09
Doserate Meter RADIAC Type PDRM82C	TBC	DPRM82C		N/A		60	Dstl	RADIAC Doserate Meter	Protocol Included		03/08/09

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Protocol Sponsor	Instrument Type	Comments	Date Last Review	Review Due
Doserate Meter RADIAC Type PDRM82D	TBC	DPRM82D		N/A		61	Dstl	RADIAC Doserate Meter	Protocol Included		07/09/09
Doserate Meter RADIAC Type PDRM82M		DPRM82M		N/A		62	Dstl	RADIAC Doserate Meter	Obsolete Equipment Protocol Removed		N/A
Doserate Meter Type Bicron Micro Sievert LE	Non-Codified	Bicron		N/A		63	Dstl	Doserate Meter	Protocol Included		05/10/09
Contamination Probe Beta Type BSP100A		ADM300A(V1A)	01-418-8038	BSP-100A	01-508-6171	64	Dstl	Beta Contamination Monitor	Protocol Included	19/09/08	07/02/11
Contamination Monitoring Kit Beta Mk 26NRM	99-135-0840	ADM300A(V1A)	01-418-8038	BSP-100A	01-508-6171	64	Dstl	Beta Contamination Monitor	Use Protocol 64		N/A
Contamination Probe Kit Beta Mk 37NH	99-230-0183	ADM300A(V1A)	01-418-8038	BSP-100A	01-508-6171	64	Dstl	Beta Contamination Probe	Use Protocol 64		N/A
710C Lead Castle with Type 47490 Probe	01-508-6173 01-508-6174	AMD300A(V1A)	01-418-8038	47490	01-508-6173 01-508-6174	65	Dstl	Beta Contamination Probe installed in 710C Lead Castle	Protocol Included	16/09/08	06/06/11
RADIAC Detection Meter (RDM) Type SOR/T	99-212-5467	SOR/T		N/A		66	VTplc	Part of TRaME equipment	No Protocol		27/06/08
RADIAC Survey Meter (RSM) Type SVG2	12-359-7708	SVG2	TBC	N/A		67	VTplc	Part of TRaME equipment	No Protocol		27/06/08
ABG Contamination and Dose Rate Probe for Use with the SVG2	TBC	SVG2	TBC	ABG	TBC	67a	VTplc	Part of TRaME equipment	No Protocol		27/06/08
RADIAC Identification Equipment (RIE) Type GR-135	99-260-8520	GR-135		N/A		68	VTplc	Part of TRaME equipment	No Protocol		27/06/08
ADM 3 Channel Scaler	99-212-7931	ADM300		N/A		69	Dstl	Submarine Reactor Monitoring System Beta/Gamma	Protocol Included		04/01/10
Mk 5 NHA Beta Castle fitted with ADM Beta Detection Module				TBC	TBC	70	Dstl	Submarine Reactor Monitoring System Beta/Gamma	Protocol Included		04/01/10
Victoreen 4000M	TBC	4000M		N/A		71	Dstl	Medical & Dental Quality Assurance	No Protocol		01/02/10

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Protocol Sponsor	Instrument Type	Comments	Date Last Review	Review Due
Victoreen 4000+	99-215-9899	4000+		N/A		72	Dstl	Medical & Dental Quality Assurance	No Protocol		01/02/10
Keithley KvP Dividers	99-535-6460	35080A		N/A		73	Dstl	Medical & Dental Quality Assurance	No Protocol		01/03/10
Unfors Mult-O-Meter	01-486-2937	Mult-O-Meter		N/A		74	Dstl	Medical & Dental Quality Assurance	No Protocol		01/03/10
MiniRad Type R1000	99-728-9785	R1000		N/A		75	Dstl	Doserate Meter	Protocol Included		05/04/10
Doserate Meter Type FH11	Non-Codified	FH11				76	Dstl	Digital Gamma Survey Meter	No Protocol		05/04/10
Ships Installed Radiation Detection System (SIRS2)	TBC					77	Dstl	Complete System	Protocol Included	04/02/08	03/01/11
NATO Submarine Rescue Service Intervention Remote Operated Vehicle Radiation Detection Equipment (NSRS IROV RDE)	Non-Codified			TBC	Non-Codified	78	BAE	High Energy Gamma Probe	No Protocol		01/07/08
Contamination Probe Type ABSP100A	TBC	ADM300SI	TBC	ABSP 100A	TBC	79	Dstl	Alpha / Beta Contamination Probe	Protocol Included		03/05/10
Mini Monitor Series 900 + 42A Probe	Non-Codified	Series 900	99-701-0161	42A	Non-Codified	80	Dstl	Contamination Monitor	Protocol Included		07/06/10
Mini Monitor Series 900 + 44A Probe	Non-Codified	Series 900	99-701-0161	44A	Non-Codified	81	Dstl	Contamination Monitor	Protocol Included		07/06/10
Doserate Meter Type ADM300SI	TBC	ADM300SI	TBC	N/A		82	Dstl	Beta Gamma Doserate Meter	Protocol Included		05/07/10
L60iF Air Sampler	99-134-9075 99-391-2306 99-551-6099	L60iF		N/A	N/A	83	Dstl	Air Sampler	Protocol Included		05/12/11
RAE 2000 – DoseRAE(P)	01-548-5037	N/A		N/A	N/A	84	Dstl	Personal Alarming Dosimeter	Protocol Included		05/12/11
Annex 1 - Correcting Response of under-reading ADM300's	N/A	N/A	N/A	N/A	N/A	Annex 1	Dstl	N/A	Annex Included		05/07/10
Annex 2 – ADM300N – Pressure Testing	N/A	N/A	N/A	N/A	N/A	Annex 2	Dstl	N/A	Annex Included		01/01/12

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Protocol Sponsor	Instrument Type	Comments	Date Last Review	Review Due
Annex 3 - ADMCOM Calibration Scale Factor Correction Instruction	N/A	N/A	N/A	N/A	N/A	Annex 3	Dstl	N/A	Annex Included		

Equipment	Parent Equipment NSN	Meter	Meter NSN	Probe	Probe NSN	Protocol Number	Type		Use															
							Portable	Installed	Dose rate Meter	Contamination Monitor	Tritium Detector	Radon Monitor	Neutron Detection	Air Samplers / Sampling	Dosimetry	Scaler	Submarine Equipment	NARO	RADIAC	Medical & Dental QA	High Energy Gamma			
General Purpose Beta / Gamma Monitoring Kit Mk 28NV	99-126-2410	ADM300A(V1A)	01-418-8038	N/A		22	x		x								x	x						
Keithley KvP Dividers	99-575-6460	35080A		N/A		73	x																	x
Mini Instruments Type 6-80	Non-Codified	6-80	Non-Codified	MC70 / MC71	Non-Codified	29	x			x														
Mini Instruments Type 7-10G	Non-Codified	Series 700	Non-Codified	Type G	Non-Codified	30	x			x														
Mini Monitor Series 900 + 'E' Probe	99-147-2262	Series 900	99-701-0161	E	Non-Codified	33	x			x														
Mini Monitor Series 900 + 'EL' Probe	99-234-2483	Series 900	99-701-0161	EL / DN212	Non-Codified	34	x			x														
Mini Monitor Series 900 + 'X' Probe (Contamination Response)	Non-Codified	Series 900	99-701-0161	X	Non-Codified	35	x			x														
Mini Monitor Series 900 + 'X' Probe (Doserate Response)	Non-Codified	Series 900	99-701-0161	X	Non-Codified	35a	x			x														
Mini Monitor Series 900 + 42A Probe	Non-Codified	Series 900	99-701-0161	42a	Non-Codified	80	x			x														
Mini Monitor Series 900 + 42b Probe	99-570-5736	Series 900	99-701-0161	42b	99-495-8120	31	x			x														
Mini Monitor Series 900 + 44A Probe	Non-Codified	Series 900	99-701-0161	44a	Non-Codified	81	x			x														
Mini Monitor Series 900 + 44b Probe	99-801-3983	Series 900	99-701-0161	44b	99-250-6513	32	x			x														
NATO Submarine Rescue Service Intervention Remote Operated Vehicle Radiation Detection Equipment (NSRS IROV RDE)	Non-Codified	TBC		TBC	Non-Codified	78	x																	x
Neutron Doserate Meter Type Mk 7NRM	99-721-2702	Mk 7 NRM	99-721-2702	N/A		36	x							x										
Potable Water Monitor Type Mk 25NRM	99-736-4761	ADM300A(V3A)	99-613-9627	M2NA	99-118-2880	40	x										x							
RADIAC Detection Meter (RDM) Type SOR/T	99-212-5467	SOR/T	99-212-5467	N/A		66	x										x						x	
RADIAC Identification Equipment (RIE) Type GR-135	99-260-8520	GR-135	99-260-8520	N/A		68	x		x														x	
RADIAC Survey Meter (RSM) Type SVG2	12-359-7708	SVG2	12-359-7708	N/A		67	x																x	

Intentionally Blank

Chapter 4 References

IRR 99	Ionising Radiation Regulations 1999
BS/EN/ISO17025	General Requirements For The Competence Of Testing and Calibration Laboratories.
JSP 425	Joint Service Publication 425 Examination and Testing of Radiation Protection Instruments
NPL GPG 14	National Physical Laboratory Good Practice Guide No. 14 The Examination, Testing & Calibration of Portable Radiation Protection Instruments.
NPL GPG 29	National Physical Laboratory Good Practice Guide No. 29 The Examination, Testing & Calibration of Installed Radiation Protection Instruments.
NRPB R326	National Radiological Protection Board, Guidance on the Choice, Use and Maintenance of Hand-held Radiation Monitoring Equipment.
SRS No. 16	International Atomic Energy Agency, Safety Reports Series No.16, Calibration of Radiation Protection Monitoring Instruments.
NRPB R333	National Radiological Protection Board Report R333 – Response Characteristics of Neutron Survey Instruments
IEC 61005	Radiation Protection Instruments – Neutron Ambient Dose Equivalent (Rate) Meters
ICRP 74	Conversion coefficients for use in radiological protection against external radiation.

Intentionally Blank

Chapter 5 Calibration Protocols

Template Protocols Index

Protocol T1	Photon Dose Rate Meter Template
Protocol T2	Beta Photon Dose Rate Meter Template
Protocol T3	Neutron Dose Rate Meter Template
Protocol T4	Alpha Contamination Monitor Template
Protocol T5	Beta Contamination Monitor Template
Protocol T6	Photon Contamination Monitor Template
Protocol T7	Air Sampler Template

Instrument Protocols Index

Protocol 1	Accessory Kit Mk 29NV + BGP100 Probe
Protocol 2	Accessory Kit Mk 29NV + BP100 Probe
Protocol 3	Alpha Contamination Probe Type MD35
Protocol 3a	Alpha Draw Kit Mk 12NHA / Mk 36NHA (Type MD35)
Protocol 4	Air Particle Detector Type IM239/WDQ
Protocol 5	Air Sampler Type 1651B
Protocol 6	Air Sampler Type L10B
Protocol 7	Air Sampler Type L50
Protocol 8	Air Sampler Type L60
Protocol 9	Alpha in Air Monitor Type Eberline Alpha 3
Protocol 10	Weapon Accident Monitoring Kit Mk 14NRM + AP100HM Probe
Protocol 11	Weapon Accident Monitoring Kit Mk 14NRM + XP100 Mod 1 Probe
Protocol 12	Weapon Accident Monitoring Kit Mk 14NRM + XP110 Probe
Protocol 13	Counter Scaler Mk 4NCA (Electrical Calibration Only)
Protocol 14	Counter Scaler Mk 4NCA + Alpha Drawer Type 1320C Probe
Protocol 14a	Counter Scaler Mk 4NCA + Mk 5NHA Castle
Protocol 14b	Counter Scaler Mk 4NCA + Mk 5NHA Castle
Protocol 15	Doserate Meter Type NIS 295B
Protocol 16	Doserate Meter PDR1, IDR1, PDR1Sv and PDR1/R&G
Protocol 17	Doserate Meter PDR2, IDR2 and PDR2Sv
Protocol 18	Doserate Meter PDR3 and PDR3Sv
Protocol 19	Doserate Meter PDR4, PDR4Sv
Protocol 20	Doserate Meter RO2, RO2W and RO2A
Protocol 21	Gamma Alarm Type PNI 1248
Protocol 22	Doserate Meter Type ADM300A(V1A)
Protocol 23	Contamination Probe Alpha, Beta, Gamma Type FHZ731

Protocol 24	Doserate Meter Type FAG FH40F2M
Protocol 25	Hot Spot Monitor Type Mk 8NRM
Protocol 26	SIRS Low Level Detector Head Mk 28NH
Protocol 27	SIRS High Level Detector Head Mk 29NH
Protocol 28	Contamination Monitor Low Energy X-ray Monitor Type IS610A
Protocol 29	Mini Instruments Type 6-80
Protocol 30	Mini Instruments Type 7-10G
Protocol 31	Mini Monitor Series 900 + 42b Probe
Protocol 32	Mini Monitor Series 900 + 44b Probe
Protocol 33	Mini Monitor Series 900 + 'E' Probe
Protocol 34	Mini Monitor Series 900 + 'EL' Probe
Protocol 35	Mini Monitor Series 900 + 'X' Probe (Contamination Response)
Protocol 35a	Mini Monitor Series 900 + 'X' Probe (Doserate Response)
Protocol 36	Neutron Doserate Meter Type Mk 7NRM
Protocol 37	Dosimeter Electronic Personal (PED) Type SAIC PD-12i / PD-2i (Submarine Reactor Compartment Emergency Response)
Protocol 37a	Dosimeter Electronic Personal (PED) Type SAIC PD-12i / PD-2i
Protocol 38	Harwell Pocket Dosimeter Type 975002
Protocol 39	Counting System Portable Harwell Type 0734 / 0744
Protocol 40	Potable Water Monitor Type Mk 25NRM
Protocol 41	Dosimeter Quartz Fibre (QFD)
Protocol 42	Radon Monitor Thomson & Nielson Type Radon WL Meter
Protocol 43	Contamination Probe Beta Type 1275C Probe
Protocol 44	Contamination Probe Alpha Type 1320C
Protocol 45	Contamination Probe Alpha Type AP2/4 or AP2R/4
Protocol 46	Contamination Probe Alpha Type AP3/4 or AP3R/4
Protocol 47	Contamination Probe Beta Type BP10
Protocol 48	Contamination Probe Beta Type BP4, BP4/4A, BP4/4B or BP4/4C
Protocol 49	Contamination Probe Beta Type BP7, BP7/4
Protocol 50	Ships Installed RADIAC System (SIRS) Mk 22NRS
Protocol 50a	Ships Installed RADIAC System Lightweight (LWSIRS)
Protocol 51	Contamination Monitor Alpha Solid State Type 995000
Protocol 52	Submarine Escape Monitor Type ADM300N
Protocol 53	Transportable Reactor Accident Monitoring System (TRAMS)
Protocol 54	Tritium Monitor Type Mk 4NRM
Protocol 55	Tritium Monitor Type TAM-73 and TAM-73D
Protocol 56	Weapon Accident Monitoring Kit Mk 3NRM + 1320C Alpha Probe

Protocol 57	Weapon Accident Monitoring Kit Mk 3 NRM + Mk 15NH X-ray Probe
Protocol 58	Doserate Meter Type RO10
Protocol 59	710C Lead Castle + BP4 Probe
Protocol 60	Doserate Meter RADIAC Type PDRM82C
Protocol 61	Doserate Meter RADIAC Type PDRM82D
Protocol 62	Doserate Meter RADIAC Type PDRM82M
Protocol 63	Doserate Meter Type Bicron Micro Sievert LE
Protocol 64	Contamination Probe Beta Type BSP100A
Protocol 65	710C Lead Castle with Type 47490 Probe
Protocol 66	RADIAC Detection Meter (RDM) Type SOR/T
Protocol 67	RADIAC Survey Meter (RSM) Type SVG2
Protocol 67a	ABG Contamination and Dose Rate Probe for use with the SVG2
Protocol 68	RADIAC Identification Equipment (RIE) Type GR-135
Protocol 69	3 Channel Scaler Mk5NCA
Protocol 70	Mk 5 NHA Lead Castle (POST-MOD)
Protocol 71	Victoreen 4000M
Protocol 72	Victoreen 4000+
Protocol 73	Keithley KvP Dividers
Protocol 74	Unfors Mult-O-Meter
Protocol 75	Thermo Electron Mini Rad 1000 RA
Protocol 76	Doserate Meter Type FH11
Protocol 77	Ships Installed Radiation Detection System (SIRS2)
Protocol 78	NATO Submarine Rescue Service Intervention Remote Operated Vehicle Radiation Detection Equipment (NSRS IROV RDE)
Protocol 79	ABSP-100A
Protocol 80	Mini Monitor Series 900 Ratemeter with 42a Probe
Protocol 81	Mini Monitor Series 900 Ratemeter with 44a Probe
Protocol 82	ADM300SI Multipurpose Meter
Protocol 83	Air Sampler Type L60iF
Protocol 84	RAE 2000 – DoseRAE(P)
Annex 1	Correcting Response of under-reading ADM300's
Annex 2	ADM300N – Pressure Testing
Annex 3	ADMCOM Calibration Scale Factor Correction Instruction

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol T1 Photon Dose Rate Meter Template

Function Photon Dose Rate Meter

Publications A: BR / AP – *Provide formal MoD Document reference*
B: Manufactures Manual

NSN XXXX-XX-XXX-XXXX – *Obtain NSN from support IPT*

Required Reference Standards

Note to Protocol Authors: Review the operational capability of the instrument and consider the energy levels required to competently test the instrument.

Gamma Reference Standards - All Sources shall offer traceability to national standards.

Note to Protocol Authors: Quote sources required i.e. Am-241, Cs-137, Co-60

X-radiations - All irradiations shall offer traceability to national standards.

Note to Protocol Authors: Quote radiation energies and qualities (if required), i.e. Low Air Kerma rate series, Narrow Series,

Check Source *Insert check source name here*

Note to Protocol Authors: Where the author is uncertain about check source availability, contact should be made with the support IPT.

Equipment Overview *This section should contain the following information*

Description and Use: (overview, NOT role specific)

Physical Construction:

Detector Type:

Doserate Range:

Energy Range:

Picture to be inserted

Controls

- A comprehensive summary of the instrument functions is contained within Publications Reference A & B.

Standard Test Protocol

- All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

- The following tests must be undertaken prior to both Category 1 and 2 tests.

- Battery tests.**

Ensure batteries are in good order and provide the necessary voltage for operation.
Replace as necessary.

Note to Protocol Authors: If the unit offers a battery test facility, refer to the indication provided by the unit.

b. **Mechanical checks.**

Check the mechanical integrity of instrument.
Replace defective parts as necessary.

Note to Protocol Authors: Where equipment comprises items which could naturally fail or are easily broken specify what should be checked i.e. cables, cable connections, fragile window assemblies, keypads and switches etc.

c. Energise the unit and check operation of all controls

Radiation Tests

9. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

Note to Protocol Authors: Prior to documenting the radiological test procedure it maybe beneficial to prescribe detector positioning.

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background doserate on the calibration certificate.

(i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a doserate >10 times scale maxima for at least thirty seconds.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high doserate testing at a level >10 times the maximum credible doserate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

Note to Protocol Authors: Authors may not be fully aware of every role the unit is expected to undertake, when specifying a maximum credible doserate the author should contact the supporting IPT.

(i) Acceptance / Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Note to Protocol Authors: Use the following procedure for digital auto-ranging or 'wide' range single logarithmic scale instrumentation

Expose the UUT to at least one doserate per decade of operation listed in the table below (example min/max ranges have been provided such that errors up to $\pm 30\%$ will NOT pull the unit into a lower/higher decade. Where decades cannot be tested due to facility restrictions, the limit of the calibration should be covered by the statement defining the limit of calibration on the calibration certificate.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Note to Protocol Authors: Authors should review the operational range of the instrument and the detectors used to provide the dynamic range. Where a combination of detectors are employed it maybe necessary to specify more than one irradiation in the switch over decade.

Decade of Operation	Example Min/Max ¹³⁷ Cs Doserates
H*(10)	H*(10)
1 – 10 $\mu\text{Sv.h}^{-1}$	1.5 – 7.5 $\mu\text{Sv.h}^{-1}$
10 – 100 $\mu\text{Sv.h}^{-1}$	15 – 75 $\mu\text{Sv.h}^{-1}$
100 – 1000 $\mu\text{Sv.h}^{-1}$	150 – 750 $\mu\text{Sv.h}^{-1}$
1 – 10 mSv.h^{-1}	1.5 – 7.5 mSv.h^{-1}
10 – 100 mSv.h^{-1}	15 – 75 mSv.h^{-1}
100 – 1000 mSv.h^{-1}	150 – 750 mSv.h^{-1}
1 – 10 Sv.h^{-1}	1.5 – 7.5 Sv.h^{-1}
10 – 100 Sv.h^{-1}	15 – 75 Sv.h^{-1}

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of delivered reference rates.

Note to Protocol Authors: Where non conforming responses can be corrected through use of internal correction factors or external calibration software the author should provide a reference to the procedure (the instructions maybe documented in an annex to the protocol manual).

Note to Protocol Authors: Use the following procedure for linear scaled multi range instrumentation

Expose the UUT to at least one doserate in each range of operation, the selected rate should be between 50% and 75% of scale maxima for each range tested.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of delivered reference rates.

Note to Protocol Authors: Use the following procedure below for single scale logarithmic instruments with 'short' dynamic ranges.

Expose the UUT to at least two doserates per decade of operation, representing values greater/less than 40% of the decade under test. Test guidance has been provided in the table below (example Min – Max ranges have been provided such that errors up to 30% will NOT pull the unit into a lower/higher decade).

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	% of Decade	Example Min/Max ¹³⁷ Cs Doserates
H*(10)	H*(10)	H*(10)
1 - 10 $\mu\text{Sv.h}^{-1}$	<40% of Decade	1.5 – 3.5 $\mu\text{Sv.h}^{-1}$
1 - 10 $\mu\text{Sv.h}^{-1}$	>40% of Decade	6.6 – 7.6 $\mu\text{Sv.h}^{-1}$
10 - 75 $\mu\text{Sv.h}^{-1}$	<40% of Decade	14.3 – 27.5 $\mu\text{Sv.h}^{-1}$
10 - 75 $\mu\text{Sv.h}^{-1}$	>40% of Decade	52 – 57.6 $\mu\text{Sv.h}^{-1}$

Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of delivered reference rates.

d. **Dose Test (If Req'd). (¹³⁷Cs)**

Reset the accumulated dose following instructions documented in publications A & B, expose the instrument to a doserate/time combination enabling dose accumulation to the target levels below. On completion of the tests, record the results on the calibration certificate.

¹³⁷ Cs Dose Target	¹³⁷ Cs Permitted Range
H*(10)	H*(10)
TBA	Quote acceptable range
TBA	Quote acceptable range

- (i) Acceptance / Pass criteria – Instrument response shall reflect conformity to within ±30% of the target dose value.

e. Energy Response Test (quote Isotope/energy to be used)

Note to Protocol Authors: Care should be taken to select a suitable energy for undertaking the test, where equipments offer a low energy capability and unit operation depends on this capability the lower energy threshold should be tested, this may require X-radiation. For equipment with a lower energy response of/or near to 65 keV, Am-241 maybe used.

Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ¹³⁷Cs value.

- (i) Acceptance / Pass criteria – The ¹³⁷Cs: 'Tested energy' response shall indicate a ratio of 1:TBA (±30%) when exposed to the same ADE rate, an example is provided below.

Example ¹³⁷ Cs Response	Example 'Tested Energy' Permitted Range
H*(10)	H*(10)
25 µSv.h ⁻¹	TBA – TBA µSv.h ⁻¹

f. Directional Dependency

Expose the instrument in the -90° and +90° orientation (as shown below) to the same doserate/energy combination used during the 'Energy Response Test', record the observed reading and calculate a response ratio using the frontal response obtained during the 'Energy Response Test'.

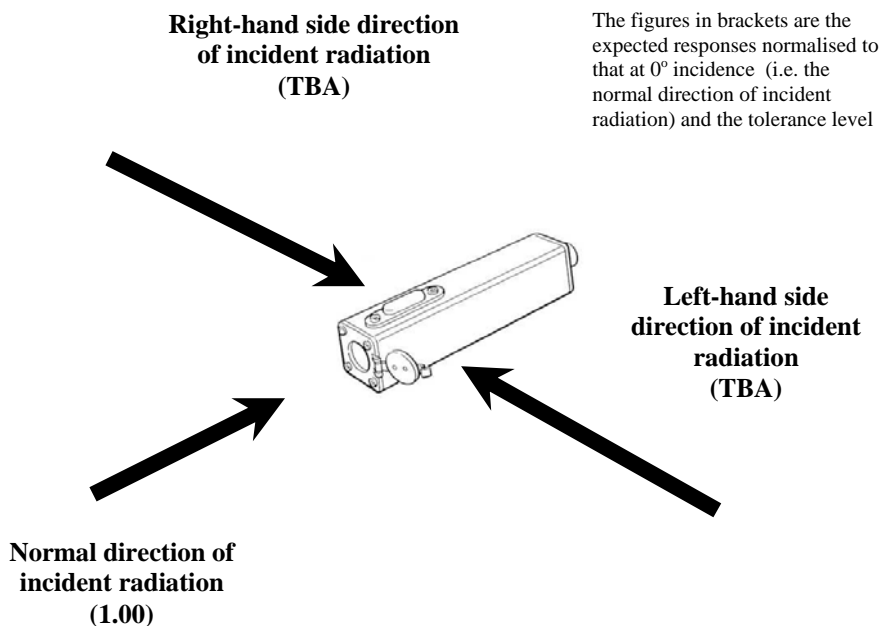


Figure 1. **Expected Directional Dependency**

- (i) Acceptance / Pass criteria – The responses shall reflect the responses detailed in Figure 1.

g. Check Source Response.

Note to Protocol Authors: Due to the low activity of the check sources, care taken to dictate the exact position in which the source should be placed to obtain this response. Batch testing maybe required determining the final position.

Place the check source centrally (define the designated check source position). Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

10. Category 2: Annual Test.

Complete all Category 1 tests except Directional Dependency Test 4.f.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

11. Category 3: Test before Operational Use.

Complete Category 1 test “Check Source Response” at paragraph 4.g.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

- 12. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol T2 Beta Photon Dose Rate Meter Template

Function Beta Dose Rate Meter

Publications A: BR / AP – *Provide formal MoD Document reference*
B: Manufactures Manual

NSN XXXX-XX-XXX-XXXX – *Obtain NSN from support IPT*

Required Reference Standards

Note to Protocol Authors: Review the operational capability of the instrument and consider the energy levels required to competently test the instrument.

Beta Reference Standards - All Sources shall offer traceability to national standards.

Note to Protocol Authors: Quote sources required i.e. Pm-147, Kr-85, Sr-90/Y-90

Gamma Reference Standards - All Sources shall offer traceability to national standards.

Note to Protocol Authors: Quote sources required i.e. Am-241, Cs-137, Co-60

X-radiations - All irradiations shall offer traceability to national standards.

Note to Protocol Authors: Quote radiation energies and qualities (if required), i.e. Low Air Kerma rate series, Narrow Series,

Check Source *Insert check source name here*

Note to Protocol Authors: Where the author is uncertain about check source availability, contact should be made with the support IPT.

Equipment Overview *This section should contain the following information*

Description and Use: (overview, NOT role specific)

Physical Construction:

Detector Type:

Doserate Range:

Energy Range:

Picture to be inserted

Controls

1. A comprehensive summary of the instrument functions is contained within Publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery tests.**
Ensure batteries are in good order and provide the necessary voltage for operation.

Replace as necessary.

Note to Protocol Authors: If the unit offers a battery test facility, refer to the indication provided by the unit.

b. **Mechanical checks.**

Check the mechanical integrity of instrument.
Replace defective parts as necessary.

Note to Protocol Authors: Where equipment comprises items which could naturally fail or are easily broken specify what should be checked i.e. cables, cable connections, fragile window assemblies, keypads and switches etc.

c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

Note to Protocol Authors: Prior to documenting the radiological test procedure it maybe beneficial to prescribe detector positioning.

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background doserate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a doserate >10 times scale maxima for at least thirty seconds.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high doserate testing at a level >10 times the maximum credible doserate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

Note to Protocol Authors: Authors may not be fully aware of every role the unit is expected to undertake, when specifying a maximum credible doserate the author should contact the supporting IPT.

- (i) Acceptance / Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Use the following procedure for digital auto-ranging or 'wide' range single logarithmic scale instrumentation

Expose the UUT to at least one doserate per decade of operation listed in the table below (example min/max ranges have been provided such that errors up to $\pm 30\%$ will NOT pull the unit into a lower/higher decade. Where decades cannot be tested due to facility restrictions, the limit of the calibration should be covered by the statement defining the limit of calibration on the calibration certificate.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Note to Protocol Authors: Authors should review the operational range of the instrument and the detectors used to provide the dynamic range. Where a combination of detectors are employed it maybe necessary to specify more than one irradiation in the switch over decade.

Decade of Operation	Example Min/Max ¹³⁷ Cs Doserates
H*(10)	H*(10)
1 – 10 $\mu\text{Sv.h}^{-1}$	1.5 – 7.5 $\mu\text{Sv.h}^{-1}$
10 – 100 $\mu\text{Sv.h}^{-1}$	15 – 75 $\mu\text{Sv.h}^{-1}$
100 – 1000 $\mu\text{Sv.h}^{-1}$	150 – 750 $\mu\text{Sv.h}^{-1}$
1 – 10 mSv.h^{-1}	1.5 – 7.5 mSv.h^{-1}
10 – 100 mSv.h^{-1}	15 – 75 mSv.h^{-1}
100 – 1000 mSv.h^{-1}	150 – 750 mSv.h^{-1}
1 – 10 Sv.h^{-1}	1.5 – 7.5 Sv.h^{-1}
10 – 100 Sv.h^{-1}	15 – 75 Sv.h^{-1}

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of delivered reference rates.

Note to Protocol Authors: Where non conforming responses can be corrected through use of internal correction factors or external calibration software the author should provide a reference to the procedure (the instructions maybe documented in an annex to the protocol manual).

Use the following procedure for linear scaled multi range instrumentation

Expose the UUT to at least one doserate in each range of operation, the selected rate should be between 50% and 75% of scale maxima for each range tested.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of delivered reference rates.

Use the following procedure below for single scale logarithmic instruments with ‘short’ dynamic ranges.

Expose the UUT to at least two doserates per decade of operation, representing values greater/less than 40% of the decade under test. Test guidance has been provided in the table below (example Min – Max ranges have been provided such that errors up to 30% will NOT pull the unit into a lower/higher decade).

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	% of Decade	Example Min/Max ¹³⁷ Cs Doserates
H*(10)	H*(10)	H*(10)
1 - 10 $\mu\text{Sv.h}^{-1}$	<40% of Decade	1.5 – 3.5 $\mu\text{Sv.h}^{-1}$
1 - 10 $\mu\text{Sv.h}^{-1}$	>40% of Decade	6.6 – 7.6 $\mu\text{Sv.h}^{-1}$
10 - 75 $\mu\text{Sv.h}^{-1}$	<40% of Decade	14.3 – 27.5 $\mu\text{Sv.h}^{-1}$
10 - 75 $\mu\text{Sv.h}^{-1}$	>40% of Decade	52 – 57.6 $\mu\text{Sv.h}^{-1}$

Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of delivered reference rates.

d. **Dose Test (If Req'd). (¹³⁷Cs)**

Reset the accumulated dose following instructions documented in publications A & B, expose the instrument to a doserate/time combination enabling dose accumulation to the target levels below. On completion of the tests, record the results on the calibration certificate.

¹³⁷ Cs Dose Target	¹³⁷ Cs Permitted Range
H*(10)	H*(10)
TBA	Quote acceptable range
TBA	Quote acceptable range

- (i) Acceptance / Pass criteria – Instrument response shall reflect conformity to within ±30% of the target dose value.

e. Energy Response Test (quote energy to be used)

Note to Protocol Authors: Care should be taken to select a suitable energy for undertaking the test, where equipments offer a low energy capability and unit operation depends on this capability the lower energy threshold should be tested, this may require X-radiation. For equipment with a lower energy response of/or near to 65 keV, Am-241 maybe used.

Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ¹³⁷Cs value.

- (i) Acceptance / Pass criteria – The ¹³⁷Cs: 'Tested energy' response shall indicate a ratio of 1:TBA (±30%) when exposed to the same ADE rate, an example is provided below.

Example ¹³⁷ Cs Response	Example 'Tested Energy' Permitted Range
H*(10)	H*(10)
25 µSv.h ⁻¹	TBA – TBA µSv.h ⁻¹

f. Directional Dependency

Expose the instrument in the -90° and +90° orientation (as shown below) to the same doserate/energy combination used during the 'Energy Response Test', record the observed reading and calculate a response ratio using the frontal response obtained during the 'Energy Response Test'.

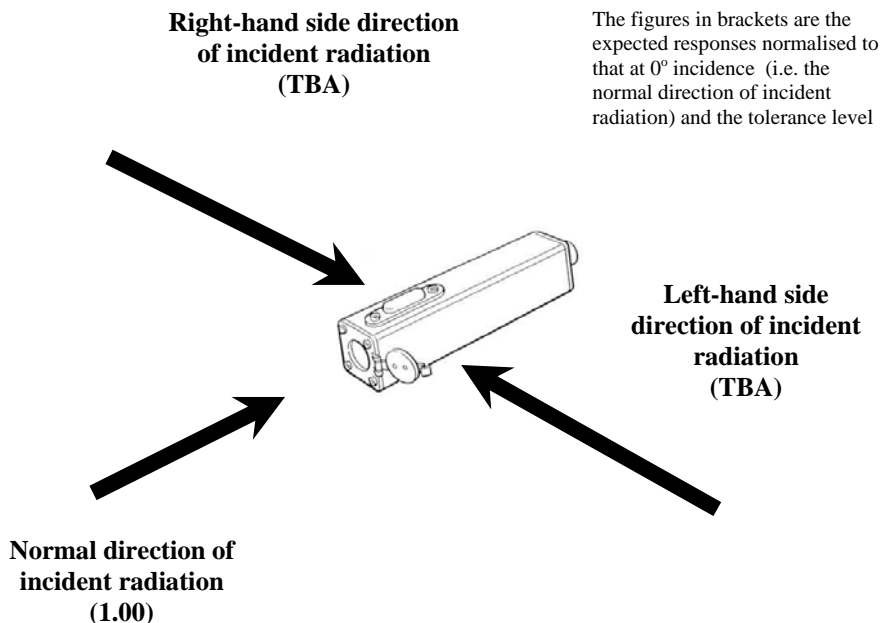


Figure 2. **Expected Directional Dependency**

- (i) Acceptance / Pass criteria – The responses shall reflect the responses detailed in Figure 1.

g. Confirmation of Beta Response

Note to Protocol Authors: Care should be taken to select suitable beta reference sources for undertaking the test.

Expose the instrument to a beta dose rate reflecting one of the dose rates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ^{137}Cs value.

- (i) Acceptance / Pass criteria – The ^{137}Cs :Beta response shall indicate a ratio of 1:TBA ($\pm 30\%$) when exposed to the same ADE rate, an example is provided below.

Example ^{137}Cs Response

H*(10)

25 $\mu\text{Sv.h}^{-1}$

Example Beta Permitted Range

H*(10)

TBA – TBA $\mu\text{Sv.h}^{-1}$

h. Check Source Response.

Note to Protocol Authors: Due to the low activity of the check sources, care taken to dictate the exact position in which the source should be placed to obtain this response. Batch testing may be required determining the final position.

Place the check source centrally (define the designated check source position). Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. Category 2: Annual Test.

Complete all Category 1 tests except Directional Dependency Test 4.f.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. Category 3: Test before Operational Use.

Complete Category 1 test "Check Source Response" at paragraph 4.g.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol T3 Neutron Dose Rate Meter Template

Function Neutron Dose Rate Meter

Publications **Type Reference documents here**

NSN **Type Number here, if applicable**

Required Reference Standards

Calibration Source Reference Standards

Detail Reference Standards here

Check Source Reference Standard **Detail Check Source Reference Standards here**

Equipment Overview *This section should contain the following information*

Description and Use: (overview, NOT role specific)

Physical Construction:

Detector Type:

Doserate Range:

Energy Range:

Picture to be inserted

Controls

1. **Detail instrument controls here.**

Standard Test Protocol

2. This protocol has been produced in accordance with the guidelines detailed within References **[Detail references here]**. All tests should be recorded for Qualified Person inspection and certificate production. This protocol should only be used in conjunction with calibrated reference standards.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests unless stated otherwise.
 - a. **Battery test.** **Detail battery check here**
 - b. **Mechanical checks.** **Detail mechanical checks here**
 - c. **Functionality.** **Detail functional checks here**
 - d. **Electrical Set-up.** **Detail electrical set-up here**

Radiation Tests

Detail any relevant information here.

The tests that are required for each category are detailed below: -

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.
 - a. **Background Dose Rate.** Detail Background Doserate test here
 - (i) Detail Acceptance Criteria here
 - b. **Response to High Dose Rates.** Detail High Doserate test here
 - (i) Detail Acceptance Criteria here
 - c. **Gamma Rejection.** Detail Gamma Rejection test here
 - (i) Detail Acceptance Criteria here
 - d. **Sensitivity.** Detail Sensitivity test here
 - (i) Detail Acceptance Criteria here
 - e. **Linearity of Response.** Detail Linearity tests here
 - (i) Detail Acceptance Criteria here
 - f. **Energy Dependency.** Detail Energy Dependence test here
 - (i) Detail Acceptance Criteria here
 - g. **Directional Dependency.** Detail Directional Dependency test here
 - (i) Detail Acceptance Criteria here
 - h. **Check Source Response.** Detail Check Source Response test here
 - (i) Detail Acceptance Criteria here
5. **Category 2: Annual Test.** Complete all Category 1 tests with the exception of the Directional Dependency Test 5.g.
 - (i) Acceptance / Pass criteria are the same as Category 1 tests.
6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.h.
 - (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.g.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 test protocols.

Standard Radiological Monitoring Instrument Statutory Test

Protocol T4 Alpha Contamination Monitor Template

Function Alpha Surface Contamination Monitor

Publications A: BR / AP – *Provide formal MoD Document reference*
 B: Manufactures Manual

NSN XXXX-XX-XXX-XXXX – *Obtain NSN from support IPT*

Required Reference Standards

Note to Protocol Authors: Review the operational capability of the instrument and consider the energy levels required competently test the instrument.

Extended area - All sources shall offer traceability to national standards and must be emission rate calibrated

²⁴¹Am **Isotrak** code AMR 07032 or AMR 06032;

²³⁸Pu **Isotrak** code PPR 07022 or PPR 06022;

²³⁰Th **Isotrak** code TZR 07022 or TZR 06022;

^{NAT}U **Isotrak** code UAR 07022 or UAR 06032;

⁹⁰Sr/Y **Isotrak** code SIR 07032 or SIR 06032.

Small area (16mm Active Diameter) - All sources shall offer traceability to national standards and must be emission rate calibrated

²⁴¹Am **Isotrak** code AMR 01011, AMR 01021 and AMR 01031.

Check Source *Insert check source type here*

Note to Protocol Authors: Where the author is uncertain about check source availability, contact should be made with the support IPT.

Equipment Overview *This section should contain the following information*

Description and Use: (overview, NOT role specific)

Physical Construction:

Detector Type:

Alpha Energy Range:

Detector Active Area:

Picture to be inserted

Controls

1. A comprehensive summary of instrument functionality is contained within Publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: Calibration shall only be undertaken when supported by a calibrated ratemeter.

Note to Protocol Authors: Where equipment cannot be interchanged between rate-meters i.e. smart operation, a statement should be made raising the calibrators awareness to the issue.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. **Battery tests.**

Ensure batteries are in good order and provide the necessary voltage for operation.
Replace as necessary.

Note to Protocol Authors: If the unit offers a battery test facility, refer to the indication provided by the unit.

b. **Mechanical checks.**

Check the mechanical integrity of instrument.
Replace defective parts as necessary.

Note to Protocol Authors: Where equipment comprises items which could naturally fail or are easily broken specify what should be checked i.e. cables, cable connections, fragile window assemblies, keypads and switches etc.

c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.

a. Determination of Operating Voltage.

Note to Protocol Authors: Use the following statement for equipment where the EHT setting is accessible via the parent ratemeter without disassembling the equipment.

Following guidelines provided in publications A & B, determine the correct operating voltage for the unit.

Note to Protocol Authors: Use the following statement for equipment where the operating voltage has been preset by the manufacturer and cannot be accessed without disassembling the equipment.

The operating voltage of the equipment is preset cannot be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.

b. **Background Count Rate.**

Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.

(i) Acceptance / Pass criteria - The background level should be less than 'Quote an achievable value' in a field of $< 0.25 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.

c. **Light Sensitivity. (With Light Source Only)**

The probe should be exposed to an appropriate light source, any significant change in background should be observed.

(i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.

d. **Light Sensitivity. (With Radioactive Source)**

Position one of the small area alpha sources (listed in 'Required Reference Standards') on the face of the detector and record the probe's response with and without the presence of the light source.

- (i) Acceptance / Pass criteria - The response to the source should remain unaffected by the presence of the light source.

e. **Response To Alpha Contamination.**

The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3 mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	TBA	± 30%	TBA	-± 30%
²³⁸ Pu	TBA	± 30%	TBA	± 30%
²³⁰ Th	TBA	± 30%	TBA	-± 30%
^{NAT} U	TBA	± 30%	TBA	± 30%

- (i) Acceptance / Pass criteria – The instrument response should be within ±30% of the mean efficiencies reported above.

f. **Linearity of Response.**

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within ± 30%.

g. **Uniformity of Response.**

Note to Protocol Authors: Use the following statement for equipment where the detector active area is <40cm².

Due to the small window area a uniformity test is NOT required on this unit.

Note to Protocol Authors: Use the following procedure where the detector active area is >40cm².

Each 10 cm² area of the detector window must be tested by placing one of the small area sources listed in 'Required Reference Standards' (preferably the item with the highest activity) in turn in the 'insert required number of positions' indicated in the figure below, for each position, record the instrument response.

Note to Protocol Authors: Incorporate a suitable drawing numbering each uniformity position such that each calibration laboratory can achieve repeatable positioning.

- (i) Acceptance / Pass criteria – No more than 30% of the total probe area should have a response which is less than 30% of the mean.

h. **Beta Rejection.**

Place the ⁹⁰Sr/Y extended area reference source as listed in 'Required Reference Standards' in the appropriate contamination response jig and record the beta response.

- (i) Acceptance / Pass criteria – Monitor response should be < 1% of the equivalent ²⁴¹Am or ²³⁸Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be < 0.4% for beta radiation.

i. **Check Source Response.**

Note to Protocol Authors: Due to the low activity of the check sources, care taken to dictate

the exact position in which the source should be placed to obtain this response. Batch testing maybe required determining the final position.

Place the check source centrally (define the designated check source position). Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. **Category 2: Annual Test.** Complete all Category 1 tests noting the asterisk marked sources in the 'Response to Alpha Contamination' tests.
 - (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 4.i.
 - (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol T5 Beta Contamination Monitor Template

Function Beta Surface Contamination Monitor

Publications A: BR / AP – *Provide formal MoD Document reference*
B: Manufactures Manual

NSN XXXX-XX-XXX-XXXX – *Obtain NSN from support IPT*

Required Reference Standards

Note to Protocol Authors: Review the operational capability of the instrument and consider the energy levels required competently test the instrument, specific instrumentation may require low energy beta radiation such as Ni-63 or H-3.

Extended area - All sources shall offer traceability to national standards and must be emission rate calibrated

³ H	Isotrak code TRR 17061 or TRR16061;
⁶³ Ni	Isotrak code NBR 07021 or NBR06021;
¹⁴ C	Isotrak code CFR 07032 or CFR 06032;
¹⁴⁷ Pm	Isotrak code PHR 07022 or PHR 06022;
⁹⁹ Tc	Isotrak code TRC 07032 or TRC 06032;
⁶⁰ Co	Isotrak code CKR 07032 or CKR 06032;
¹³⁷ Cs	Isotrak code CDR 07032 or CDR 06032;
³⁶ Cl	Isotrak code CIR 07032 or CIR 06032;
⁹⁰ Sr/Y	Isotrak code SIR 07032 or SIR 06032.

Small area (16mm Active Diameter) - All sources shall offer traceability to national standards and must be emission rate calibrated

⁹⁰ Sr/Y	Isotrak code SIR 01011, SIR 01021 and SIR 01031.
--------------------	--

Check Source *Insert check source type here*

Note to Protocol Authors: Where the author is uncertain about check source availability, contact should be made with the support IPT.

Equipment Overview *This section should contain the following information*

Description and Use: (overview, NOT role specific)

Physical Construction:

Detector Type:

Beta Energy Range:

Detector Active Area:

Picture to be inserted

Controls

1. A comprehensive summary of instrument functionality is contained within Publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: Calibration shall only be undertaken when supported by a calibrated ratemeter.

Note to Protocol Authors: Where equipment cannot be interchanged between rate-meters i.e. smart operation, a statement should be made raising the calibrators awareness to the issue.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

- d. **Battery tests.**

Ensure batteries are in good order and provide the necessary voltage for operation.

Replace as necessary.

Note to Protocol Authors: If the unit offers a battery test facility, refer to the indication provided by the unit.

- e. **Mechanical checks.**

Check the mechanical integrity of instrument.

Replace defective parts as necessary.

Note to Protocol Authors: Where equipment comprises items which could naturally fail or are easily broken specify what should be checked i.e. cables, cable connections, fragile window assemblies, keypads and switches etc.

- f. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.

- a. Determination of Operating Voltage.

Note to Protocol Authors: Use the following statement for equipment where the EHT setting is accessible via the parent ratemeter without disassembling the equipment.

Following guidelines provided in publications A & B, determine the correct operating voltage for the unit.

Note to Protocol Authors: Use the following statement for equipment where the operating voltage has been preset by the manufacturer and cannot be accessed without disassembling the equipment.

The operating voltage of the equipment is preset cannot be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.

- b. **Background Count Rate.**

Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.

- (i) Acceptance / Pass criteria - The background level should be less than 'Quote an achievable value' in a field of $< 0.25 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.

- c. **Light Sensitivity. (With Light Source Only)**

The probe should be exposed to an appropriate light source, any significant change in background should be observed.

- (i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.

d. **Response To Beta Contamination.**

The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2 π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
³ H	TBA	± 30%	TBA	± 30%
⁶³ Ni	TBA	± 30%	TBA	± 30%
¹⁴ C	TBA	± 30%	TBA	± 30%
¹⁴⁷ Pm	TBA	± 30%	TBA	± 30%
⁹⁹ Tc	TBA	± 30%	TBA	± 30%
⁶⁰ Co	TBA	± 30%	TBA	± 30%
¹³⁷ Cs	TBA	± 30%	TBA	± 30%
³⁶ Cl	TBA	± 30%	TBA	± 30%
⁹⁰ Sr/Y	TBA	± 30%	TBA	± 30%

- (i) Acceptance / Pass criteria – The instrument response should be within ±30% of the mean efficiencies reported above.

e. **Linearity of Response.**

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within ± 30%.

f. **Uniformity of Response.**

Note to Protocol Authors: Use the following statement for equipment where the detector active area is <40cm².

Due to the small window area a uniformity test is NOT required on this unit.

Note to Protocol Authors: Use the following procedure where the detector active area is >40cm².

Each 10 cm² area of the detector window must be tested by placing one of the small area sources listed in 'Required Reference Standards' (preferably the item with the highest activity) in turn in the 'insert required number of positions' indicated in the figure below, for each position, record the instrument response.

Note to Protocol Authors: Incorporate a suitable drawing numbering each uniformity position such that each calibration laboratory can achieve repeatable positioning.

- (i) Acceptance / Pass criteria – no more than 30% of the total probe area should have a response which is less than 30% of the mean.

g. **Check Source Response.**

Note to Protocol Authors: Due to the low activity of the check sources, care taken to dictate the exact position in which the source should be placed to obtain this response. Batch testing maybe required determining the final position.

Place the check source centrally (define the designated check source position). Allow 30

seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. **Category 2: Annual Test.** Complete all Category 1 tests noting the asterisk marked sources in the 'Response to Alpha Contamination' tests.
 - (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 4.g.
 - (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol T6 Photon Contamination Monitor Template

Function Photon Surface Contamination Monitor

Publications A: BR / AP – *Provide formal MoD Document reference*
B: Manufacturer's Manual

NSN XXXX-XX-XXX-XXXX – *Obtain NSN from support IPT*

Required Reference Standards

Note to Protocol Authors: Review the operational capability of the instrument and consider the energy levels required competently test the instrument.

Extended area - All sources shall be suitably filtered to remove alpha/beta emissions and must be emission rate calibrated, offering traceability to national standards.

⁵⁵ Fe	Photon Reference Source Isotrak code IERB 4536;
²³⁸ Pu	Photon Reference Source Isotrak code PPRB 4472;
¹²⁹ I	Photon Reference Source Isotrak code ISRB 4474;
²⁴¹ Am	Photon Reference Source Isotrak code AMRB 4473;
⁵⁷ Co	Photon Reference Source Isotrak code CTRB 3504;
¹³⁷ Cs	Photon Reference Source Isotrak code CDRB 4475;
⁶⁰ Co	Photon Reference Source Isotrak code CKRB 4476.

Small area (16mm Active Diameter) - All sources shall offer traceability to national standards and must be emission rate calibrated

⁹⁰Sr/Y **Isotrak** code SIR 01011, SIR 01021 and SIR 01031.

Check Source *Insert check source type here*

Note to Protocol Authors: Where the author is uncertain about check source availability, contact should be made with the support IPT.

Equipment Overview *This section should contain the following information*

Description and Use: (overview, NOT role specific)

Physical Construction:

Detector Type:

Beta Energy Range:

Detector Active Area:

Picture to be inserted

Controls

1. A comprehensive summary of instrument functionality is contained within Publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: Calibration shall only be undertaken when supported by a calibrated ratemeter.

Note to Protocol Authors: Where equipment cannot be interchanged between rate-meters i.e. do not support smart operation, a statement should be made raising the calibrators awareness to the issue.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. **Battery tests.**

Ensure batteries are in good order and provide the necessary voltage for operation.
Replace as necessary.

Note to Protocol Authors: If the unit offers a battery test facility, refer to the indication provided by the unit.

b. **Mechanical checks.**

Check the mechanical integrity of instrument.
Replace defective parts as necessary.

Note to Protocol Authors: Where equipment comprises items which could naturally fail or are easily broken, specify what should be checked i.e. cables, cable connections, fragile window assemblies, keypads and switches etc.

- c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.

- a. Determination of Operating Voltage.

Note to Protocol Authors: Use the following statement for equipment where the EHT setting is accessible via the parent ratemeter without disassembling the equipment.

Following guidelines provided in publications A & B, determine the correct operating voltage for the unit.

Note to Protocol Authors: Use the following statement for equipment where the operating voltage has been preset by the manufacturer and cannot be accessed without disassembling the equipment.

The operating voltage of the equipment is preset and cannot be quantitatively altered without disassembling the probe; therefore no operating voltage plateau can be measured for this instrument.

- b. **Background Count Rate.**

Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.

- (i) Acceptance / Pass criteria - The background level should be less than 'Quote an achievable value' in a field of $< 0.25 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.

- c. **Light Sensitivity. (With Light Source Only)**

The probe should be exposed to an appropriate light source, any significant change in background should be observed.

- (i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.

d. **Response To Beta Contamination.**

The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3 mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
⁵⁵ Fe	TBA	± 30%	TBA	± 30%
²³⁸ Pu	TBA	± 30%	TBA	± 30%
¹²⁹ I	TBA	± 30%	TBA	± 30%
²⁴¹ Am	TBA	± 30%	TBA	± 30%
⁵⁷ Co	TBA	± 30%	TBA	± 30%
¹³⁷ Cs	TBA	± 30%	TBA	± 30%
⁶⁰ Co	TBA	± 30%	TBA	± 30%

- (i) Acceptance / Pass criteria – The instrument response should be within ±30% of the mean efficiencies reported above.

e. **Linearity of Response.**

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within ± 30%.

f. **Uniformity of Response.**

Note to Protocol Authors: Use the following statement for equipment where the detector active area is <40cm².

Due to the small window area a uniformity test is NOT required on this unit.

Note to Protocol Authors: Use the following procedure where the detector active area is >40cm².

Each 10 cm² area of the detector window must be tested by placing one of the small area sources listed in 'Required Reference Standards' (preferably the item with the highest activity) in turn in the 'insert required number of positions' indicated in the figure below, for each position, record the instrument response.

Note to Protocol Authors: Incorporate a suitable drawing numbering each uniformity position such that all calibration laboratories can achieve repeatable positioning.

- (i) Acceptance / Pass criteria – no more than 30% of the total probe area should have a response which is less than 30% of the mean.

g. **Check Source Response.**

Note to Protocol Authors: Due to the low activity of the check sources, care taken to dictate the exact position in which the source should be placed to obtain this response. Batch testing maybe required determining the final position.

Place the check source centrally (*define the designated check source position*). Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. **Category 2: Annual Test.** Complete all Category 1 tests noting the asterisk marked sources in the 'Response to Alpha Contamination' tests.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 4.g.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

- 7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol T7 Air Sampler Template**Function** Air Sampler**Publications** A: BR / AP – Provide formal MoD Document reference
B: Manufactures Manual**NSN** XXXX-XX-XXX-XXXX – Obtain NSN from support IPT**Required Support Equipment**

Note to Protocol Authors: Review the operational capability of the equipment and consider the flow rate coverage required from the flow bench to competently test the instrument. Also consider filters and restriction devices.

Equipment Overview This section should contain the following information**Description and Use:** (overview, NOT role specific)**Physical Construction:****Filter Type:****Power Supply:****Flow Rate:**

Picture to be inserted

Controls

1. A comprehensive summary of sampler functionality is contained within 'Publications' reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

- a. **Mechanical Checks.**

Check the mechanical integrity of instrument.
Replace defective parts as necessary.

Note to Protocol Authors: Where equipment comprises items which could naturally fail or are easily broken specify what should be checked i.e. cables, cable connections, fragile window assemblies, keypads and switches etc. Always replace batteries (if battery powered) as degraded batteries can slow motor and thus reduce flow.

- b. Energise the unit and ensure the motor spins freely. Friction related noise should be investigated.

Flow Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each unit prior to introduction into service, the test regime must also be employed where major repairs/modifications may have altered flow response.

Note to Protocol Authors: Prior to documenting the flow test procedure it maybe beneficial to determine the dynamic range of flow and the resolution offered by the unit.

a. Max Flow Test.

Connect the Flow meter in line with the natural draw of the air sampler assembly (reflected in the diagram below), energise the unit allowing the motor/flow meter time to stabilise (approx. X mins).

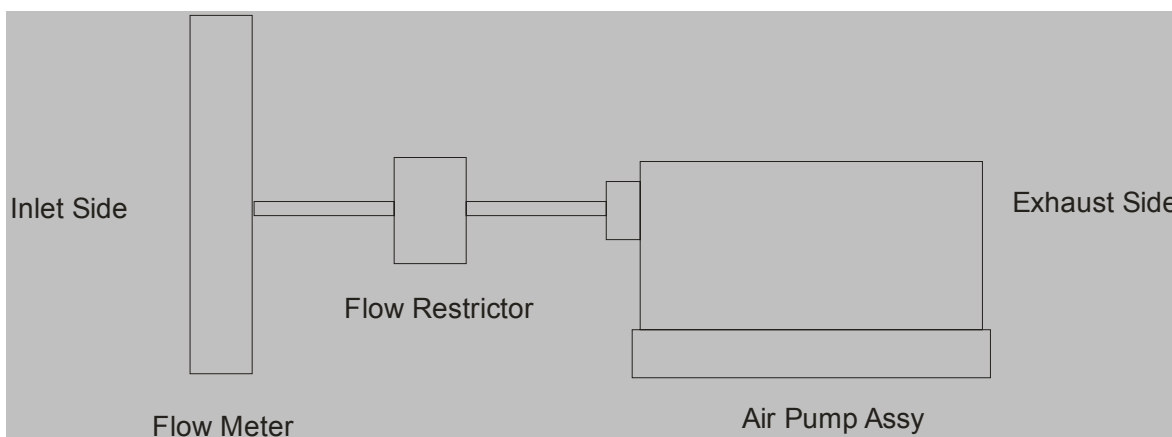
Note to Protocol Authors: Dependant on the style of device being calibrated the stabilisation time may be significantly protracted; advice should be sought from the user manual.

Regulate the flow using a suitable flow restriction device such that no resistance exists in the intake tract, thus providing maximum draw through the sampler.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

- (i) Acceptance / pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.



b. Restricted Flow Test.

Note to Protocol Authors: Dependant on the dynamic range of the unit and the resolution provided by the on board flow meter it maybe necessary to check flow at a number of points (i.e. $\frac{3}{4}$ Scale max and/or $\frac{1}{2}$ Scale max).

Regulate the flow using a suitable flow restriction device to provide an indicated flow rate of XX lpm on the sampler mounted flow meter.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

- (i) Acceptance / pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

c. Flow Rate with Filter Fitted.

Fit a suitable filter paper to the unit (as listed in Required Support Equipment).

Connect the unit as per paragraph 4a.

Regulate the flow using a suitable flow restriction device such that no resistance exists in the intake tract, thus providing maximum draw through the sampler.

Energise the unit allowing the motor/flow meter time to stabilise (approx. X mins).

Note to Protocol Authors: Dependant on the style of device being calibrated the stabilisation time may be significantly protracted; advice should be sought from the user manual.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.
After taking the readings switch the unit off and disconnect all pipe works.

(i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

5. Category 2: Annual Test.
Complete Category 1 tests

(i) Acceptance / Pass criteria - Reflects those noted for Category 1 tests.

6. Category 3: Test before Operational Use.

Fit a suitable filter paper to the unit (as listed in Required Support Equipment), energise the unit allowing the motor/flow meter time to stabilise (approx. X mins). Once the unit has stabilised record the reading on the instrument flow meter.

Note to Protocol Authors: Dependant on the style of device being calibrated the stabilisation time may be significantly protracted; advice should be sought from the user manual.

(i) Acceptance / Pass criteria – The reading should be within $\pm 10\%$ of that noted at paragraph 4c.

7. Certification (Qualified Person authorisation required)

Certificate all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 1 (Accessory Kit Mk 29NV) - BGP100 Probe

Function Gamma / X-ray / Beta Doserate Probe

Publications A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
B: BR 2053(119) Multi-Function Survey Meter

NSN 6625-01-440-9003

Required Reference Standards

Gamma Reference Standards Am-241 & Cs-137 sources shall offer traceability to national standards.

Check Source $^{90}\text{Sr}/\text{Y}$ Mk 13 NJ Check Source NSN 6665-99-733-5728

Equipment Overview

Description and Use: The BGP100/ADM300 combination provides a general purpose X/gamma dose rate monitoring capability.

Physical Construction: The BGP100 unit consists of a metallic box section chassis capped with two end plates accommodating an aluminium window assembly and input connector

Detector Type: 2 energy compensated GM Tubes (low internal GM, High blister mounted GM)

Doserate Range: 0.01 $\mu\text{Sv/h}$ - 100Sv/h (dynamic)

0.01 $\mu\text{Sv/h}$ - 50mSv/h (approx.) Low Range
30mSv/h (approx.) - 100Sv/h High Range

Energy Range: 80keV – 3MeV (manufacturers Data).



BGP 100 Probe

Controls

1. A comprehensive summary of ratemeter functionality is contained within 'Publications' A and B.

Standard Test Protocol

2. Tests should be recorded for Qualified Person inspection/certificate production.

Note: BGP100 calibration shall only be undertaken when supported by a calibrated ADM300 ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.**
Ensure ratemeter batteries are in good order and provide the necessary voltage for BGP operation. Replace as necessary.
 - b. **Mechanical checks.**
Ensure the probe case (including machine screws), beta shutter, internal window; beta shutter hinge, input socket and high GM housing are free from damage. Replace as necessary.
 - c. **Ancillary Equipment.**
Ensure the interconnection cable maintains pin to pin continuity and is free from damage. Replace as necessary.

Ensure Radioactive Source (if supplied) is free from damage, where sources are damaged or missing, report at once to the local RSO and CBRN IPT.

- d. Connect and energise the unit, checking operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where repairs/modifications may have altered detector response. Irradiations (excluding directional dependency) should be undertaken using the orientation illustrated in Figure 2 (located at the end of the protocol).

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background doserate on the calibration certificate.

- (i) Acceptance/Pass criteria – Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a doserate >10 times scale maxima, for at least thirty seconds.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high doserate testing at a level >10 times the maximum credible doserate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance/Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery is NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Expose the UUT to at least one doserate per decade of operation listed in the table following (example Min – Max ranges have been provided such that errors up to 30% will NOT pull the unit into a lower/higher decade).

Note: Two readings are required for decade $10 - 100 \text{ mSv.h}^{-1}$ as both detectors operate in this decade.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	Detector Tested	Example Min/Max ^{137}Cs Doserates
$\text{H}^*(10)$	$\text{H}^*(10)$	$\text{H}^*(10)$
$1 - 10 \mu\text{Sv.h}^{-1}$	Low	$1.5 - 7.5 \mu\text{Sv.h}^{-1}$
$10 - 100 \mu\text{Sv.h}^{-1}$	Low	$15 - 75 \mu\text{Sv.h}^{-1}$
$100 - 1000 \mu\text{Sv.h}^{-1}$	Low	$150 - 750 \mu\text{Sv.h}^{-1}$
$1 - 10 \text{ mSv.h}^{-1}$	Low	$1.5 - 7.5 \text{ mSv.h}^{-1}$
$10 - 100 \text{ mSv.h}^{-1}$	Low	$15 - 38 \text{ mSv.h}^{-1}$
$10 - 100 \text{ mSv.h}^{-1}$	High	$72 - 76 \text{ mSv.h}^{-1}$
$100 - 1000 \text{ mSv.h}^{-1}$	High	$150 - 750 \text{ mSv.h}^{-1}$
$1 - 10 \text{ Sv.h}^{-1} *$	High	$1.5 - 7.5 \text{ Sv.h}^{-1}$
$10 - 100 \text{ Sv.h}^{-1} *$	High	$15 - 75 \text{ Sv.h}^{-1}$

*Facilities incapable of generating doserates in these decades shall include the limit of the testing within the "Limited Cal" statement on the calibration certificate.

- (i) Acceptance/pass criteria – Responses shall reflect conformity to within $\pm 30\%$ of the delivered reference rates.

Note: Non conforming responses may be corrected through application of the procedure documented in protocol manual Annex 1, following adjustment a full calibration is required.

d. **Dose Test.**

A dose test is NOT required on this unit as the accumulated dose is a function of the ratemeter and NOT the probe.

e. **Energy Response Test at 60 keV (60 keV ^{241}Am).**

Expose the instrument to a ^{241}Am doserate reflecting one of the doserates used during the Linearity of Response testing. Record the observed reading.

- (i) Acceptance/Pass criteria – The $^{137}\text{Cs}:\text{}^{241}\text{Am}$ response shall indicate a ratio of 1:0.37 ($\pm 30\%$) when exposed to the same ADE rate, an example is provided below.

Example ^{137}Cs Response

$H^*(10)$
25 $\mu\text{Sv}\cdot\text{h}^{-1}$

Example ^{241}Am Permitted Range

$H^*(10)$
6.48 – 12.03 $\mu\text{Sv}\cdot\text{h}^{-1}$

f. **Directional Dependency at 60 keV (60 keV ^{241}Am).**

Expose the instrument in the -90° and -180° orientation (as shown below) to the same ^{241}Am doserate used during the Energy Response Test, record the observed reading for each position.

Note: The Beta Window MUST remain closed during testing.

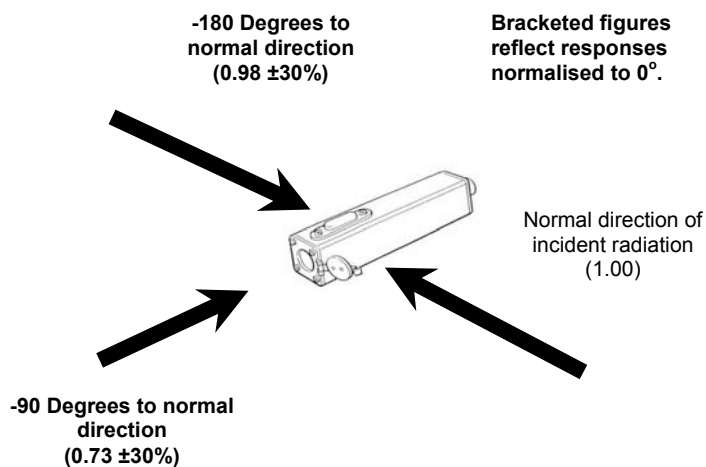


Figure 1: **Expected Directional Dependency**

- (i) Acceptance/Pass criteria – The ^{241}Am response shall reflect the responses detailed in Figure 1.

g. **Check Source Response.**

With the beta shutter in the open position, place the $^{90}\text{Sr}/\text{Y}$ Mk 13 NJ Check Source centrally over the beta window. Allow 30 seconds for the reading to stabilize, record the response on the instrument calibration certificate.

5. **Category 2: Annual Test.**

Complete all Category 1 tests with the exception of the directional dependency test, paragraph 4.f.

- (i) Acceptance/Pass criteria – Criteria reflects those noted for Category 1 tests.

6. Category 3: Test before Operational Use.

Complete Category 1 test "Check Source Response" at paragraph 5.c.

- (i) Acceptance/Pass criteria – Response should be $\pm 20\%$ of the response recorded at Para. 4.g.

Certification (Qualified Person authorisation required).

- 7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.



Figure 2: **Calibration Orientation**

Standard Radiological Monitoring Instrument Statutory Test

Protocol 2 (Accessory Kit Mk 29NV) - BP100 Probe**Function** Beta Surface Contamination Monitor**Publications** A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
B: BR 2053(119) Multi-Function Survey Meter**NSN** 6625-01-440-8993**Required Reference Standards**

All must be emission rate calibrated except Mk 13 NJ Check Source:

Extended area

- ¹⁴C Type WRS 7/E Amersham code CFR 07032 or CFR 06032;
- ³⁶Cl Type WRS 7/E Amersham code CIR 07032 or CIR 06032;
- ¹⁴⁷Pm Type WRS 7/E Amersham code PHR 07032 or PHR 06032;
- ⁹⁰Sr/Y Type WRS 7/E Amersham code SIR 07032 or SIR 06032;
- ⁶⁰Co Type WRS 7/E Amersham code CKR 07032 or CKR 06032;
- ¹³⁷Cs Type WRS 7/E Amersham code CDR 07032 or CDR 06032.

Small area (16mm Active Diameter)

- ⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source

- ⁹⁰Sr/Y Mk 13 NJ Check Source NSN 6665-99-733-5728

Equipment Overview**Description and Use:** The BP100/ADM300 combination provides a general purpose beta surface contamination monitoring capability.**Physical Construction:** The BP100 unit consists of a cylindrical metallic detector head welded to a tubular metallic handle assembly accommodating the input connector.**Detector Type:** Halogen quenched pancake GM tube.**Beta Energy Range:** 156keV (¹⁴C) – 2.28MeV (⁹⁰Sr/Y)**Detector Active Area:** 15.5 cm²**BP 100 Probe****Controls**

1. A comprehensive summary of ratemeter functions is contained within 'Publications' A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: BP100 calibration shall only be undertaken when supported by a calibrated ADM300 ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both category 1 and 2 tests.
 - a. **Battery test.**
Ensure ratemeter batteries are in good order and provide the necessary voltage for BP operation. Replace as necessary.
 - b. **Mechanical checks.**
Ensure the probe case (particularly the join between handle and probe head), grille assembly, Mylar window, handle grip and input socket are free from damage. Replace as necessary.
 - c. **Ancillary Equipment.**
Ensure the interconnection cable maintains pin to pin continuity and is free from damage. Replace as necessary.

Ensure Radioactive Source (if supplied) is free from damage, where sources are damaged or missing, report at once to the local RSO and CBRN IPT.
 - d. Connect and energise the unit, checking operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.

Note: The operating voltage of the BP-100 is preset by the manufacturer and can not be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.

- a. **Background Count Rate.**
Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.
 - (i) Acceptance / pass criteria – The background level should be < 0.5 cps in a field of $< 0.25 \mu\text{Sv}\cdot\text{h}^{-1}$.
- b. **Light Sensitivity. (With Light Source Only)**
The probe should be exposed to an appropriate light source, any significant change in background should be observed.
 - (i) Acceptance / pass criteria - The background level should remain unaffected by the presence of the light source.
- c. **Light Sensitivity. (With Radioactive Source)**
Position one of the small area beta sources (listed in 'Required Reference Standards') on the face of the detector and record the probe's response with and without the presence of the light source.
 - (i) Acceptance / pass criteria - The response to the source should remain unaffected by the presence of the light source.
- d. **Response to Beta Contamination.**
The responses detailed below are for the specified extended area reference standards, with a source to detector grille separation of 3 mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per $\text{Bq}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
¹⁴ C	0.57	0.40 – 0.74	7.3	5.1 – 9.5
³⁶ Cl	2.94	2.06 – 3.82	37.1	26.0 – 48.2
¹⁴⁷ Pm	0.94	0.66 – 1.22	12.1	8.5 – 15.7
⁹⁰ Sr/Y	3.36	2.35 – 4.37	43.3	30.0 – 56.3
⁶⁰ Co	1.75	1.23 – 2.28	19.8	13.9 – 25.7
¹³⁷ Cs	2.66	1.86 – 3.45	32.0	22.4 – 41.6

- (i) Acceptance / pass criteria – The instrument response should be within ±30% of the mean efficiencies reported above.

e. **Linearity of Response.**

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / pass criteria – Each individual ratio should agree with the mean of all three ratios to within ± 30%.

f. **Uniformity of Response.**

A uniformity check is not required on this probe due to its small active area.

g. **Check Source Response.**

Place the ⁹⁰Sr/Y Mk 13 NJ Check Source centrally on the probe grid; allow 30 seconds for the reading to stabilize, record the response on the instrument calibration certificate.

5. **Category 2: Annual Test.**

Complete all Category 1 tests.

- (i) Acceptance / pass criteria – Reflects those noted for Category 1 tests.

6. **Category 3: Test before Operational Use.**

Complete Category 1 test "Check Source Response" at paragraph 4.g.

- (i) Acceptance / Pass criteria – The check source response should be ± 20% of the response recorded at Para. 4.g.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 3 Alpha Contamination Probe Type MD35

Function Alpha Surface Contamination Monitor

Publications A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
 B: BR 2053(119) Multi-Function Survey Meter

NSN 6665-99-770-0501

Required Reference Standards

All must be emission rate calibrated:

Extended area

²⁴¹Am Type WRS 7/E Amersham code AMR 07032 or WRS 6/E AMR 06032;

²³⁸Pu Type WRS 7/E Amersham code PPR 07022 or WRS 6/E PPR 06022;

^{Nat}U Type WRS 7/E Amersham code UAR 07032 or WRS 6/E UAR 06032;

⁹⁰Sr/Y Type WRS 7/E Amersham code SIR 07031 or WRS 6/ SIR 06031.

Small area (16mm Active Diameter)

²⁴¹Am Type WRS 1/E Amersham code AMR 01011, AMR 01021 and AMR 01031.

Equipment Overview

Description and Use: The MD-35/ADM300 ratemeter combination provides a general purpose alpha surface contamination monitoring capability. The probe comprises a thin alpha phosphor coupled to a photomultiplier tube. High voltages for the PM tube are generated within the probe, triggered by a control voltage supplied by the ADM300. Additional ratemeter and scaler functions are supplied by the ADM300. The Type test data shown in paragraph 5.d refers to the manufacturers preset threshold/operating voltage.

Physical Construction: The probe is constructed of a cylindrical pressed aluminium outer case with thin Mylar window enclosing a photomultiplier tube and thin alpha phosphor.

Alpha Energy Range: 4.199MeV (^{Nat}U) – 5.499MeV (²³⁸Pu)

Detector Active Area: 18.1 cm²



MD35 Probe

Controls

1. A comprehensive summary of the ratemeter functions is contained within the Publications, Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: MD-35 calibration shall only be undertaken when supported by a calibrated ADM300 ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.**
Ensure ratemeter batteries are in good order and provide the necessary voltage for ADM operation. Replace as necessary.
 - b. **Mechanical checks.**
Inspect the probe to ensure all screws are intact and flush (where countersunk), ensure the gasket between the end window mount and probe body does not excessively protrude. Ensure the Mylar window; casing and input socket are free from damage. Replace as necessary.
 - c. **Ancillary Equipment.**
Ensure the interconnection cable maintains pin to pin continuity and is free from damage. Replace as necessary.

Ensure Radioactive Source (if supplied) is free from damage, where sources are damaged or missing, report at once to the local RSO and MESH IPT.
 - d. Energise the unit, checking operation of all controls.

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.

Note: The operating voltage of the MD-35 is preset by the manufacturer and can not be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.

- d. **Background Count Rate.**
Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.
 - (i) Acceptance / pass criteria - The background level should be < 0.5 cps in a field of $< 0.25 \mu\text{Sv.h}^{-1}$.
- e. **Light Sensitivity. (With Light Source Only)**
The probe should be exposed to an appropriate light source, any significant change in background should be observed.
 - (i) Acceptance / pass criteria - The background level should remain unaffected by the presence of the light source.
- f. **Light Sensitivity. (With Radioactive Source)**
Position one of the small area alpha sources (listed in 'Required Reference Standards') on the face of the detector and record the probe's response with and without the presence of the light source.
 - (i) Acceptance / pass criteria - The response to the source should remain unaffected by the presence of the light source.
- g. **Response to Alpha Contamination.**
The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per Bq.cm^2) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed.

Note: Calibration of the probe using ^{238}Pu is required because of very degraded alpha emissions from filter paper smears and it is essential to confirm that the energy response of the probe does not deteriorate.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
^{241}Am	4.40	3.08 – 5.71	48.7	34.1 – 63.3
^{238}Pu	4.91	3.44 – 6.38	53.8	37.7 – 69.9
$^{\text{NAT}}\text{U}$	3.83	2.68 – 4.98	42.5	29.8 – 55.3

- (i) Acceptance / pass criteria – The instrument response should be within $\pm 30\%$ of the mean efficiencies reported above.

h. Linearity of Response.

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / pass criteria – Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.

i. Uniformity of Response.

A uniformity check is not required on this probe due to its small active area.

j. Beta Rejection.

Place the $^{90}\text{Sr}/\text{Y}$ extended area reference source as listed in Required Reference Standards in the appropriate contamination response jig and record the beta response.

- (i) Acceptance / pass criteria – The monitor response should be $< 1\%$ of the equivalent ^{241}Am or ^{238}Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be $< 0.4\%$ for beta radiation.

k. Check Source Response.

There is currently no check source assigned to a stand alone MD-35.

5. Category 2: Annual Test. Complete all Category 1 tests.

- (i) Acceptance / pass criteria – Reflects those noted for Category 1 tests.

6. Category 3: Test before Operational Use. Complete Category 1 test "Check Source Response" at paragraph 5.e.

- (i) Acceptance / Pass criteria – The check source response should be $\pm 20\%$ of the response recorded at Para. 5.h.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 3a Alpha Draw Kit Mk 12NHA / Mk 36NHA (Type MD35)

Function Alpha Drawer Assembly

Publications A: BR 2053(119) NRC ADM-300 Multi-Function Survey Meter Operators Manual

NSN 6665- 99-083-4155

Required Reference Standards

All must be emission rate calibrated except ^{241}Am Mk 7 NXS check source:

Extended area ^{241}Am Amersham code AMR 05022;

^{239}Pu Amersham code PPR 05012;

$^{\text{Nat}}\text{U}$ Amersham code UAR 05022;

$^{90}\text{Sr/Y}$ Amersham code SIR 05022

Small area (16mm Active Diameter)

^{241}Am Type WRS 1/E Amersham code AMR 01011, AMR 01021 and AMR 01031.

Check Source ^{241}Am Mk 7 NXS check source NSN: 6665-99-736-2887

Equipment Overview

Description and Use: The MD-35 alpha probe and ADM300 ratemeter combination is used in conjunction with the alpha drawer assembly (type number 1355B) and probe mounting fixture (model ASD-100). It is used to carry out alpha activity measurements on filter paper smears; this instrument is therefore not a radiological protection instrument. The calibration of this instrument requires sources, which are shaped to fit into the drawer assembly and efficiencies can be obtained from using them. The process of interpreting alpha activity from count rate measurements obtained amenable to direct calibration, the procedure for carrying out this conversion is detailed separately.

Physical Construction: Both constituent parts of this assembly are constructed of pressed aluminium.

Alpha Energy Range: >4.2 MeV (Alpha)

Probe Active Area: 18.1 cm²



MD-35 as Alpha Drawer System

Controls

1. A comprehensive summary of the ratemeter functions is contained within the Publications, Reference A and B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: This protocol should only be carried out using a calibrated ratemeter IAW protocol 22.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.**
Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.**
Check mechanical integrity of drawer assembly, cables, cable connections and probe case. Replace as necessary.
 - c. Check operation of drawer assembly and all controls on the instrument.

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The operating voltage of the MD35 is preset by the manufacturer and can not be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.

- a. **Background Count Rate.**
Remove any sources from the drawer assembly, take a 100 second integrated count and record the monitor background count.
 - (i) Acceptance / pass criteria - 0.1 cps in a field of $< 0.25 \mu\text{Sv.h}^{-1}$.
- b. **Light Sensitivity.** Owing to the nature of the enclosure it is difficult to carry out a light sensitivity check, any elevation of background could be put down to being either contamination of the drawer assembly or light leakage into the enclosure.
 - (i) Acceptance / pass criteria - The background count should not be elevated by the presence of light with the drawer in its open position.
- c. **Response to Alpha Contamination.**
The responses detailed below are for the specified reference standards, the readings are taken with the sources placed in the drawer with the drawer shut. Details of the derivation of contamination responses (cps per Bq.cm^2) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Calibration of the probe using ^{235}U is required because alpha emissions from filter paper smears are typically very degraded and it is essential to confirm that the energy response of the probe does not deteriorate. All readings should be taken over a period of 100 seconds integration time.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	4.76	3.33-6.19	51.9	36.3-67.5
²³⁹ Pu	5.00	3.50-6.50	55.4	38.8-72.0
^{NAT} U	3.23	2.26-4.20	34.8	24.4-45.3

- (i) Acceptance / pass criteria - Instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.
- (ii) Acceptance / Pass criteria - Check source response should be $\pm 20\%$ type test data response.

Note: Insufficient units have been seen to provide type test data for check source response to the Mk 7 NXS check source. Therefore recorded responses should be compared with any previous reading recorded.

d. **Linearity of Response.**

Place the small area sources listed in Required Reference Standards centrally in turn in the drawer assembly. Take a 100 second count for each of the sources; record the net response (cps) for each planar disc source.

- (i) Acceptance / pass criteria - The ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.

e. **Uniformity of Response.**

A uniformity check is not required on this probe due to its small active area.

f. **Beta Rejection.**

Place the $^{90}\text{Sr/Y}$ reference source SIR 05022 in the drawer assembly, close the drawer and take a 100 second integrated count and record the beta response.

- (i) Acceptance / pass criteria - The monitor response should be $< 1\%$ of the equivalent ^{241}Am or ^{238}Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be $< 0.4\%$ for beta radiation.

g. **Check Source Response.**

Place the ^{241}Am Mk 7 NXS check source in the drawer assembly, close and take a 100 second integrated count and the record the response on the calibration certificate.

5. **Category 2: Annual Test.** Complete all Category 1 tests.

- (i) Acceptance / pass criteria - The same as Category 1 tests.

6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.g.

- (i) Acceptance / Pass criteria - Check source response should be $\pm 20\%$ of the response recorded at Para. 5.g.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 4 Air Particle Detector Type IM239/WDQ

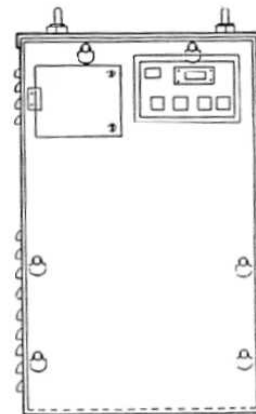
Function Installed Beta in Air Monitor

Publications A: BRF 2053(17) Issue 2 (1995)
B: SAIC Production Acceptance Test Procedure TP UK301550-2 for UK IM239/WDQ RADIACMETER

NSN 6665014155123

Equipment Overview

Description and Use: The Air Particulate Detector (APD) IM239 is a detection and monitoring system for Beta radioactive particles suspended in the air and is used within nuclear submarines. The equipment provides a continuous and accurate measurement of radioactive air particles to provide a warning when the measured radiation levels exceed the established safe and acceptable limits. The APD is designed to have greater sensitivity to Beta radiation while discriminating against a Gamma background.



Air Particulate Detector IM239

Controls

1. A comprehensive summary of the instrument functions is contained within Publication Reference A.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical checks.**
These checks are to be carried out in accordance with Reference A
 - b. Check operation of all controls and switches as detailed at Reference A
4. **Category 1 Test: Test before First Use.** The Air Particulate Detector (APD) is an instrument which requires calibration procedures over and above that of the ability of the majority of calibration facilities, it is with this in mind that all tests before first use are carried out IAW the procedures laid down in publication, Reference B.
5. **Category 2: Annual Test.** Complete all Category 1 tests
 - (i) Acceptance / pass criteria is that laid down in publication, Reference B.
6. **Category 3: Test before Operational Use.** The equipment is in continuous operation. There is a weekly Calibration Check carried out by ships staff as laid down in publication, Reference A.
 - (i) Acceptance / pass criteria is that laid down in publication, Reference A.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 5 Air Sampler Type 1651B**Function** Portable Dust Sampler**Publications** A: AP112G-1320-0 – Air Sampler Type 1651B**NSN** 6665-99-659-5818**Equipment Overview**

All measurement equipment must be traceable to national standards

Flow meter (Scaled in L/Min)

Stopwatch

Whatman Filters Type GF/A 1820-060 NSN: 6640-99-448-5863

Power supply capable of supplying 12V DC at 13 Amps

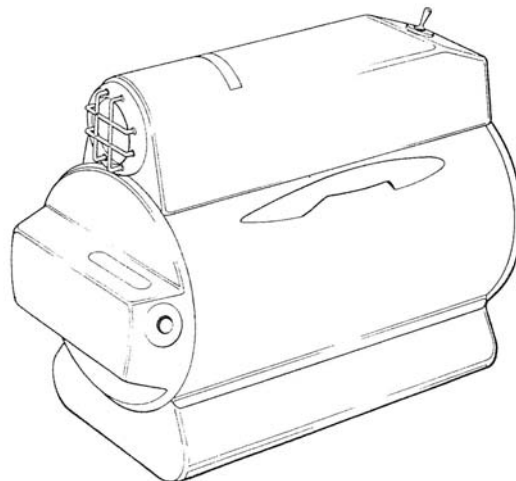
Description and Use: The Rotheroe and Mitchell 1651B is an air sampling unit capable of drawing 50 lpm through a filter media. On completion of a sample the filter is monitored in a counting assembly enabling assessment of airborne contamination. The sampler utilizes a 12V DC supply and can be run from a stand alone power source (i.e. vehicle battery). The unit provides a substantial weight burden and care should be taken when handling.

Physical Construction: The pump is housed in a cylindrical steel case with aluminium end panels, a mechanical counter used to determine sampled volume is mounted on the filter end of the unit.

Detector Type: Sampled air is drawn through a filter paper and the volume is determined by multiplying the counter reading by 5 to provide an indication of litres.

Doserate Range: N/A

Energy Range: N/A

**1651B Dust Sampler****Controls**

1. A comprehensive summary of the sampler functions is contained within the Air Publication, Publications Reference A.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for standard samplers. Where testing of additional snorkel and other fitments are required, appropriate subsidiary tests should be completed, to confirm suitability of replacement nozzles. These tests may be derived from those detailed in this protocol.

Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical Checks.**
Inspect the complete assembly to ensure all fixings, handles remain intact
Ensure the "12V ON/OFF" toggle switch and associated cabling remains fit for purpose, checking operation and integrity of solder connections where appropriate.

Inspect the mechanical flow gauge and inspection window, ensuring they are free from damage.

Replace components as necessary.

- b. Connect the unit to a suitable power supply and ensure the unit spins freely when energised.

Any friction related noise should be investigated as the unit may not be correctly centred in the yoke assembly.

Flow Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each unit prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered flow response.

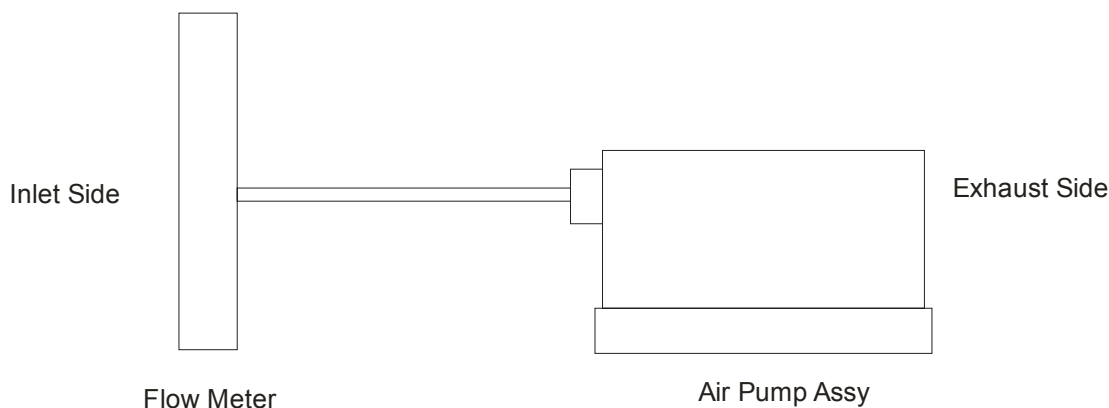
- a. **Max Flow Test (without filter fitted).**

Connect the 1651B to a suitable 12V power supply

Connect the flow meter in line with the natural draw of the air sampler assembly (as reflected in the diagram below), switch on the power supply and let the motor and flow meter settle into normal running state (approximately 2 minutes running).

Record the reading provided by the reference flow meter on the calibration/test certificate, after taking the reading switch the 1651B off.

- (i) Acceptance / Pass criteria – The reading provided by the reference flow meter 50 lpm \pm 10%.



- b. **Flow Rate with Filter Fitted.**

Fit a 60mm diameter GFA filter paper as listed in Required Equipment to the 1651B and connect the unit as per paragraph 4a, switch on the power supply, allow the motor and flow meter to settle into a normal running state (approximately 2 minutes running).

Record the reading provided by the reference flow meter on the calibration/test certificate, after taking the reading switch the 1651B off.

Note: From experience it has been calculated that with a Whatman filter fitted to the instrument the draw rate will be reduced by approximately 5 lpm

- c. **Counter Check (10 minute run).**

With the unit connected as per paragraph 4b switch on the power supply and allow the unit to stabilise (approximately 2 minutes running), once stabilised record the reading on the instrument counter and start the stop watch, after 10 minutes has passed stop the watch and record the instrument counter reading.

Subtract the first counter reading from the second and note the result.

- (i) Acceptance / Pass criteria – The calculated reading should be 100 \pm 20%.

5. **Category 2: Annual Test.**
Complete Category 1 tests.

- (i) Acceptance / Pass criteria – Reflects those noted for Category 1 tests.

6. Category 3: Test before Operational Use.

With a Whatman 60mm diameter GFA filter fitted to the unit start the unit and allow it to stabilise (approximately 2 minutes running), once stabilised record the reading on the instrument counter and start a stop watch, after 1 minute has passed stop the watch and record the counter reading.

Subtract the first counter reading from the second and note the result.

- (i) Acceptance / Pass criteria – The calculated reading should be $10 \pm 20\%$.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 6 Air Sampler Type L10B**Function** Portable Air Sampler**Publications** A: AP112G-1312-0 – Monitor, Air Sampling Type L10B**NSN** 6665-99-448-5862**Equipment Overview**

All equipment must be traceable to national standards

Flow meter (scaled in L/Min)

Flow restriction device

Whatman Filters Type GF/A 1820-060 NSN: 6640-99-448-5863

Batteries, dry, 6V NSN: 5J/6135-99-106-9853, 2 off

Description and Use: The L10B is a portable air sampler capable of drawing a known volume of air (10 lpm) through a filter media. During monitoring the filter will become dust loaded such that on completion of sampling the filter can be analyzed using a counting assembly to determine levels of airborne contamination. The sampler runs from two 6V DC dry batteries and utilizes 60mm diameter filter papers for its operation.

Physical Construction: The sampler incorporates a dry vane displacement pump coupled to a small DC motor housed in a steel case.

Detector Type: A floating ball flow meter calibrated in litres per minute is mounted above the filter housing and provides an indication of flow rate.

Doserate Range: N/A

Energy Range: N/A

**Air Sampler L10B****Controls**

2. A comprehensive summary of the sampler functions is contained within the Air Publication, Publications Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for standard samplers. Where testing of additional snorkel and other fitments are required, appropriate subsidiary tests should be completed, to confirm suitability of replacement nozzles. These tests may be derived from those detailed in this protocol.

Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical Checks.**

Release the two side mounted thumbscrews and remove the battery compartment top cover. Inspect the internals of the unit paying particular attention to the battery contact plate. Insert the necessary batteries and refit the top cover.

Check the external condition of the unit ensuring the handle, ON/OFF switch, flow meter and filter mount assembly remain intact and fit for purpose.

Replace items as necessary.
 - b. Connect the unit to a suitable power supply and ensure the unit spins freely when energised.

Any friction related noise should be investigated.

Flow Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each unit prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered flow response.

a. **Max Flow Test.**

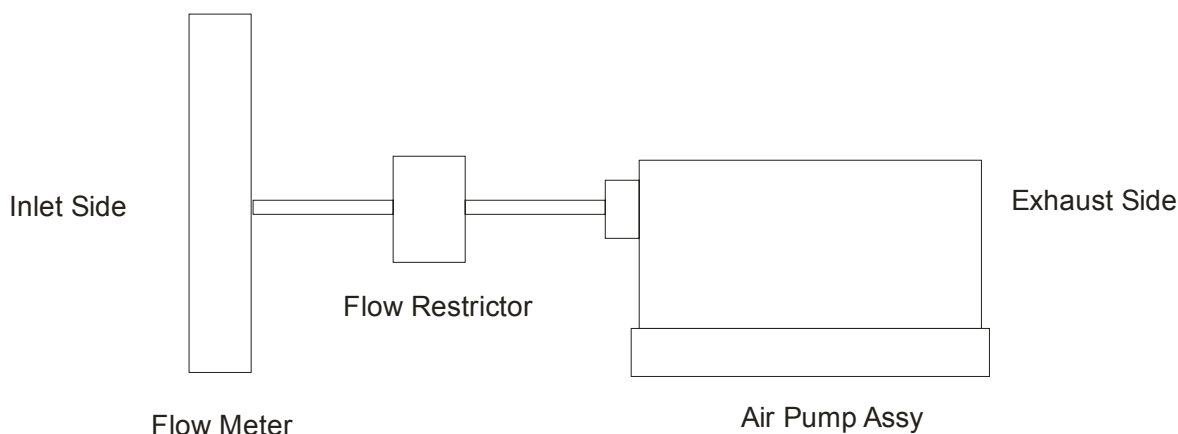
Connect the Flow meter in line with the natural draw of the air sampler assembly (as reflected in the diagram below), switch on the power supply and allow motor and flow meter time to stabilise (approximately 2 minutes running).

Regulate the flow through the flow meter using a suitable flow restriction device so as to provide no resistance to the airflow and thus give maximum draw through the sampler.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

- (ii) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.



b. **Half Scale Flow Test.**

Regulate the flow through the flow meter using a suitable flow restriction device to provide an indicated flow rate of 7.5 lpm on the sampler mounted flow meter.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

- (i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

c. **Flow Rate with Filter Fitted.**

Fit a Whatman 60mm diameter GFA filter as listed in Required Equipment to the L10B.

Connected as per paragraph 4.a.

Regulate the flow through the flow meter using a suitable flow restriction device so as to provide no resistance to the airflow and thus give maximum draw through the sampler.

Switch on the power supply and let the motor and flow meter settle into normal running state (approximately 2 minutes running).

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

After taking the readings switch the unit off and disconnect all pipe works.

- (i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

6. **Category 2: Annual Test.**
Complete Category 1 tests.

- (i) Acceptance / Pass criteria - Reflects those noted for Category 1 tests.

7. **Category 3: Test before Operational Use.**

Fit a 60mm Diameter Whatman GFA filter to the unit start the unit and allow it to stabilise (approximately 2 minutes running). Once the unit has stabilised record the reading on the instrument flow meter.

- (i) Acceptance / Pass criteria – The reading should be within $\pm 10\%$ of that noted at paragraph 4.c.

Certification (Qualified Person authorisation required)

- 8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 7 Air Sampler Type L50

Function Portable Air Sampler

Publications A: BR2053 (114)

NSN 6665-99-924-3721

Required Support Equipment

All equipment must be traceable to national standards

12V DC Power Supply

Calibrated flow meter with flow restriction capability

Flow restriction device

Maypack

Equipment Overview Description

The L50 is a portable air sampler capable of drawing a known volume of air (50 lpm) through a Maypack assembly to extract airborne dust for monitoring. Filters are analysed with a counting assembly such that true assessments of airborne contamination can be calculated. The sampler is available in a number of variants depending on requirement.

On all variants a floating ball flow meter is provided, calibrated in litres per minute (lpm), providing users with an indication of the instantaneous flow rate of the unit.

Physical Construction: The sampler incorporates a dry vane displacement pump coupled to a small DC motor housed in a steel case.

Filter Type: Maypack with 55mm dia. filter paper

Power Supply: 12 Volt DC Power Supply

Flow Rate: 50 Litres per minute



Air Sampler Type L50

Controls

1. A comprehensive summary of the sampler functions is contained within the book of reference, Publication Reference A.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for standard samplers. Where testing of additional snorkel and other fitments are required, appropriate subsidiary tests should be completed, to confirm suitability of replacement nozzles. These tests may be derived from those detailed in this protocol.

Electrical and Physical Examination

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical checks**
Inspect the complete assembly to ensure all fixings and the handle remain intact.

Ensure the “ON/OFF” toggle switch, reset trip and associated cabling remain fit for purpose.
Inspect the flow gauge and nozzle assembly, ensuring they are free from damage.
Replace components as necessary.

- b. Connect the unit to a suitable power supply and ensure the unit spins freely when energised.
Check operation of all controls/switches.

Any friction related noise should be investigated as the unit may not be correctly centred in the yoke assembly.

Flow Tests

4. **Category 1 Test: Test before First Use:** These tests must be undertaken on each unit prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered flow response.

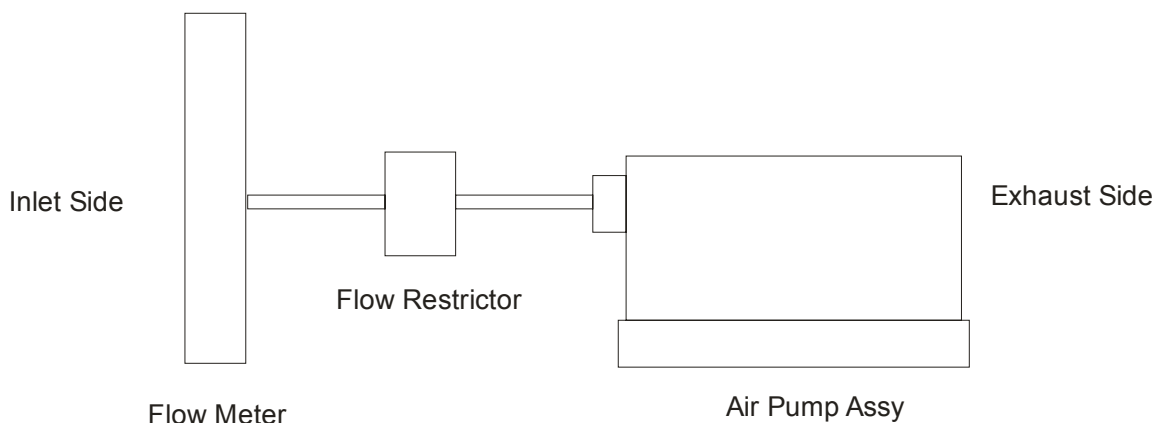
- a. **Max Flow Test**

Connect the L50 to a suitable 12V power supply.

Connect the flow meter in line with the natural draw of the air sampler assembly (as reflected in the diagram below), switch on the power supply and let the motor and flow meter settle into normal running state (approximately 2 minutes running).

Record the reading provided by the reference flow meter on the calibration/test certificate, after taking the reading switch the unit off.

- (i) Acceptance / Pass criteria – The reading provided by the reference flow meter should be 50 lpm \pm 10%.



- b. **Restricted Flow Test**

Regulate the flow through the flow meter using a suitable flow restriction device to provide an indicated flow rate of 25 lpm on the sampler mounted flow meter.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

- (i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within \pm 10% of the figure reported by the reference flow meter.

- c. **Flow Rate with Maypack Fitted**

Fit a Maypack as listed in Required Support Equipment to the L50.

Regulate the flow through the flow meter using a suitable flow restriction device so as to provide no resistance to the airflow and thus give maximum draw through the sampler.

Switch on the power supply and let the motor and flow meter settle into normal running state (approximately 2 minutes running).

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

After taking the readings switch the unit off and disconnect all pipe works.

- (i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

5. Category 2: Annual Test: Complete all Category 1 tests.

- (i) Acceptance / Pass criteria – The same as Category 1 tests.

6. Category 3: Test Before Operational Use: With a Maypack fitted to the unit, start the unit and allow it to stabilise (approximately 2 minutes running). Once the unit has stabilised, record the reading on the instrument flow meter.

- (i) Acceptance / Pass criteria – This reading is the same as that noted at paragraph 4.c.

7. Certification (Qualified Person authorisation required)

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 8 Air Sampler Type L60**Function** Portable Air Sampler**Publications** A: Manufacturers Handbook**NSN** 6665-99-924-3732**Required Support Equipment**

All equipment must be traceable to national standards

Power Supply

Calibrated flow meter with flow restriction capability

Flow restriction device

Whatman Filters Type GF/A 1820-060 NSN: 6640-99-448-5863

**Equipment Overview
Description**

The L60 is a portable air sampler capable of drawing a known volume of air (60 lpm) through a filter paper or Maypack assembly (with attachment) to extract airborne dust for monitoring. Filters are analysed with a counting assembly such that true assessments of airborne contamination can be calculated. The sampler is available in a number of variants depending on requirement. On all variants a floating ball flow meter is provided, calibrated in litres per minute (lpm), providing users with an indication of the instantaneous flow rate of the unit.

Physical Construction: The sampler incorporates a sliding vane displacement pump coupled to a small DC motor housed in a steel case.

Filter Type: 55mm dia. filter paper or Maypack

Power Supply: 110/240 Volt 50Hz Power Supply

Flow Rate: 60 Litres per minute

**Air Sampler Type L60****Controls**

1. A comprehensive summary of the sampler functions is contained within the manufacturer's handbook, Publication Reference A.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for standard samplers. Where testing of additional snorkel and other fitments are required, appropriate subsidiary tests should be completed, to confirm suitability of replacement nozzles. These tests may be derived from those detailed in this protocol.

Electrical and Physical Examination

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical checks**
Inspect the complete assembly to ensure all fixings and the handle remains intact. Ensure the "ON/OFF" toggle switch and associated cabling remain fit for purpose. Inspect the flow gauge and nozzle assembly, ensuring they are free from damage.

Replace components as necessary.

- b. **Electrical checks:** Owing to the fact that the unit is supplied by mains voltage, before any work is carried out on the L60, it will be necessary to carry out an electrical safety/Portable Appliance Test (PAT) on the unit. This will ensure that the equipment is in a safe electrical state. A suitably competent person trained in the practice of testing equipment should carry out these tests.
- c. Check operation of all controls/switches, connect the unit to a suitable power supply and ensure the unit spins freely when energised. Any friction related noise should be investigated as the unit may not be correctly centred in the yoke assembly.

Flow Tests

4. **Category 1 Test: Test before First Use:** These tests must be undertaken on each unit prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered flow response.

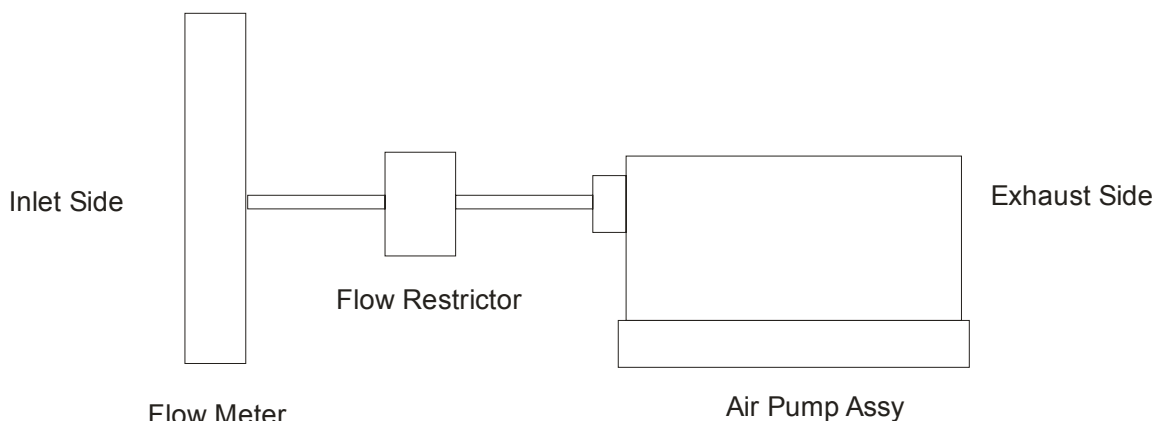
- a. **Max Flow Test**

Connect the L60 to a suitable power supply.

Connect the flow meter in line with the natural draw of the air sampler assembly (as reflected in the diagram below), switch on the power supply and let the motor and flow meter settle into normal running state (approximately 2 minutes running).

Record the reading provided by the reference flow meter on the calibration/test certificate, after taking the reading switch the unit off.

- (ii) Acceptance / Pass criteria – The reading provided by the reference flow meter should be 60 lpm \pm 10%.



- b. **Reduced Flow Test (40 lpm)**

Regulate the flow through the flow meter using a suitable flow restriction device to provide an indicated flow rate of 40 lpm on the sampler mounted flow meter.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

- (ii) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within \pm 10% of the figure reported by the reference flow meter.

- c. **Flow Rate with Filter Fitted**

Fit a filter as listed in Required Equipment to the L60.

Regulate the flow through the flow meter using a suitable flow restriction device so as to provide no resistance to the airflow and thus give maximum draw through the sampler.

Switch on the power supply and let the motor and flow meter settle into normal running state (approximately 2 minutes running).

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

After taking the readings switch the unit off and disconnect all pipe works.

- (i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

5. **Category 2: Annual Test:** Complete all Category 1 tests.

- (i) Acceptance / Pass criteria – The same as Category 1 tests.

6. **Category 3: Test before Operational Use:** With a filter fitted to the unit, start the unit and allow it to stabilise (approximately 2 minutes running). Once the unit has stabilised record the reading on the instrument flow meter.

- (i) Acceptance / Pass criteria – This reading is the same as that noted at paragraph 4.c.

Certification (Qualified Person authorisation required)

- 7. Certificate test results as appropriate: Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 9 Alpha in Air Monitor Type Eberline Alpha 3

Function Real Time Alpha in Air Monitor

Publications A: AP112G-1321-1 Eberline Alpha 3 and Pump RAP 1

NSN 6665-01-012-4446

Equipment Declared Obsolete under DIN number to be confirmed.

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 10 Weapon Accident Monitoring Kit Mk 14NRM + AP100H-M Probe

Function Alpha Surface Contamination Monitor

Publications A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
B: BR2053 (119) Multi-Function Survey Meter

NSN 6665-99-623-9137

Required Reference Standards

All must be emission rate calibrated except ^{232}Th NRC check source:

Extended area

^{241}Am Isotrak code AMR 07032.

^{238}Pu Isotrak code PPR 07032.

NatU Isotrak code UAR 07032.

$^{90}\text{Sr/Y}$ Isotrak code SIR 07031.

Small area (16mm Active Diameter)

^{241}Am Isotrak code AMR 01011, AMR 01021 and AMR 01031.

Check Source

^{232}Th Type Mk 10 NXS, NSN 6665-99-840-3182.

Equipment Overview

Description

The AP100H-M/ADM300A combination provides an alpha surface contamination monitoring capability. High voltages for the photomultiplier tube are generated within the probe from a control voltage supplied by the ADM300A. Additional alarm and scaler functions are supplied by the ADM300A.

Physical Construction: The probe comprises a zinc sulphide scintillator coupled to a photomultiplier tube housed within a stainless steel light tight enclosure. The detector face is protected by a Mylar foil and a hexagonal section grille.

Energy Range: > 4.2 MeV (Alpha)

Detector Active Area: 128 cm²



AP100H-M Probe

Note: This probe is calibrated for the specific purpose of weapon accident monitoring, therefore Pass/Fail criteria is only provided for ^{241}Am and ^{238}Pu . Figures obtained for Natural Uranium should be reported on an 'as observed' basis.

Controls

1. A comprehensive summary of the ratemeter functions is contained within the Publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: AP-100H-M calibration shall only be undertaken when supported by a calibrated ADM300A ratemeter.

Pre-radiation Tests, Electrical and Physical Examination

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery Test**
Ensure ratemeter batteries are in good order and provide the necessary voltage for operation. Replace as necessary.
 - b. **Mechanical Checks**
Ensure the probe case, grille assembly; Mylar window and input socket are free from damage. Replace as necessary.
 - c. **Ancillary Equipment**
Ensure the interconnection cable maintains pin to pin continuity and is free from damage. Replace as necessary.

Ensure Radioactive Source (if supplied) is free from damage, where sources are damaged or missing, report at once to the local RSO and CBRN IPT.
 - d. Check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.
 - a. **Determination of Operating Voltage**
The operating voltage of the AP100H-M is preset by the manufacturer and cannot be quantitatively altered without disassembling the probe, therefore no operating voltage plateau can be measured for this instrument.
 - b. **Background Count Rate**
Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.
 - (ii) Acceptance / Pass criteria – The background level should be < 0.5 cps in a field of $< 0.15 \mu\text{Sv.h}^{-1}$.
 - c. **Light Sensitivity. (With Light Source Only)**
The probe should be exposed to an appropriate light source, any significant change in background should be observed.
 - (i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.
 - d. **Light Sensitivity (With Radioactive Source)**
Position one of the small area alpha sources (listed in 'Required Reference Standards') on the face of the detector and record the probe's response with and without the presence of the light source.
 - (i) Acceptance / Pass criteria - The response to the source should remain unaffected by the presence of the light source.
 - e. **Response to Alpha Contamination**
The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per Bq.cm^2) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	20	14 – 26	29	21 - 38
²³⁸ Pu	20	14 - 26	31	22 - 40

^{NAT}U **Natural Uranium readings should be recorded as observed and are only to be used as a guide to the user.**

- (i) Acceptance / Pass criteria – The instrument response should be within ±30% of the mean efficiencies reported above.

f. Linearity of Response

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within ± 30%.

g. Uniformity of Response

Each 10 cm² area of the detector window must be tested by placing one of the small area sources listed in 'Required Reference Standards' (preferably the item with the highest activity) in turn in the twelve measurement positions indicated in the table below, for each position, record the instrument response.

1	2
3	4
5	6
7	8
9	10
11	12
Handle	

- (i) Acceptance / Pass criteria – No more than 30% of the total probe area should have a response which is less than 30% of the mean.

h. Beta Rejection

Place the ⁹⁰Sr/Y extended area reference source as listed in 'Required Reference Standards' in the appropriate **position** and record the beta response.

- (i) Acceptance / Pass criteria – Monitor response should be < 1% of the equivalent ²⁴¹Am or ²³⁸Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be < 0.4% for beta radiation.

i. Check Source Response

Place the probe in contact with the Check Source (listed in 'Required Reference Standards') ensuring the side labelled "ALPHA PROBE TEST SOURCE" is facing the detector, allow 30 seconds for the reading to stabilise, record the response on the instrument calibration certificate.

5. Category 2: Annual Test

Complete all Category 1 tests.

- (i) Acceptance / Pass criteria – Reflects those noted for Category 1 tests.

6. Category 3: Test before Operational Use

Complete Category 1 test "Check Source Response" at paragraph 4.i.

- (i) Acceptance / Pass criteria – The check source response should be $\pm 20\%$ of the response recorded at Paragraph 4.i.

Certification (Qualified Person authorisation required)

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 11 Weapon Accident Monitoring Kit Mk 14NRM + XP-100 Mod 1 Probe

Function X-ray Surface Contamination Monitor

Publications A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
B: BR2053 (119) Multi-Function Survey Meter

NSN 6665-99-738-4767

Required Reference Standards

All must be emission rate calibrated except Mk 10 NXS Check Source:

Extended Area:

^{238}Pu Photon Reference Source **Isotrak** code PPRB 4472;

^{241}Am Photon Reference Source **Isotrak** code AMRB4473;

Small area (16mm Active Diameter)

^{241}Am **Isotrak** code AMR 01011, AMR 01021 and AMR 01031.

Check Source

^{232}Th Type Mk 10 NXS, NSN 6665-99-840-3182

Equipment Overview

Description

The XP-100/ADM300A combination provides a gated X-ray contamination monitoring capability for L-X-ray emanation. High voltages for the photomultiplier are generated within the probe, from a control voltage supplied by the ADM300A. Additional alarm and scaler functions are supplied by the ADM300A.

Physical Construction: The probe comprises a CaF_2 crystal coupled to a photomultiplier tube housed within a light tight enclosure. The detector face is protected by a Mylar foil and protective grille assembly.

Energy Range: 8.5 keV - 25.5 keV (X-rays)

Detector Active Area: 9.6 cm²



XP-100 Probe

Controls

1. A comprehensive summary of the ratemeter functions is contained within the Publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: **XP-100** calibration shall only be undertaken when supported by a calibrated ADM300A ratemeter.

Pre-radiation Tests, Electrical and Physical Examination

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

- a. **Battery Test.**
Ensure ratemeter batteries are in good order and provide the necessary voltage for XP operation. Replace as necessary.
- b. **Mechanical Checks.**
Ensure the probe case, grille assembly, Mylar window and input socket are free from damage. Replace as necessary.
- c. **Ancillary Equipment.**
Ensure the interconnection cable maintains pin to pin continuity and is free from damage. Replace as necessary.

Ensure Radioactive Source (if supplied) is free from damage, where sources are damaged or missing, report at once to the local RSO and CBRN IPT.
- d. Check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.
 - a. **Determination of Operating Voltage**
The operating voltage of the XP-100 is preset by the manufacturer and cannot be quantitatively altered without disassembling the probe; therefore no operating voltage plateau can be measured for this instrument.
 - b. **Background Count Rate**
Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.
 - (i) Acceptance / Pass criteria – The background level should be < 0.5 cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$.
 - c. **Light Sensitivity. (With Light Source Only)**
The probe should be exposed to an appropriate light source, any significant change in background should be observed.
 - (i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.
 - d. **Light Sensitivity. (With Radioactive Source)**
Position one of the small area sources (listed in 'Required Reference Standards') on the face of the detector and record the probe's response with and without the presence of the light source.
 - (i) Acceptance / Pass criteria - The response to the source should remain unaffected by the presence of the light source.
 - e. **Response to Photon Contamination**
The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per $\text{Bq}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency (%)	
	Mean Response	Permitted Range	Mean Response	Permitted Range
²³⁸ Pu	1.69	1.18 - 2.20	35.9	25.1 – 46.7
²⁴¹ Am	0.10	0.07 – 0.13	2.2	1.6 – 2.9

- (i) Acceptance / Pass criteria – The instrument response should be within $\pm 30\%$ of the mean efficiencies reported above.

f. Linearity of Response

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.

g. Uniformity of Response

A uniformity check is not required on this probe due to its small active area.

h. Check Source Response

Place the probe in contact with the Check Source (listed in 'Required Reference Standards') ensuring the side labelled "X-RAY PROBE TEST SOURCE" is facing the detector with the detector placed on the circles marked "PLACE XP100 WINDOW IN CIRCLE", allow 30 seconds for the reading to stabilise, record the response on the instrument calibration certificate.

5. Category 2: Annual Test

Complete all Category 1 tests.

- (i) Acceptance / Pass criteria – Reflects those noted for Category 1 tests.

6. Category 3: Test Before Operational Use

Complete Category 1 test "Check Source Response" at paragraph 4.g.

- (i) Acceptance / Pass criteria – The check source response should be $\pm 20\%$ of the response recorded at Paragraph 4.g.

Certification (Qualified Person authorisation required)

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 12 Weapon Accident Monitoring Kit Mk 14NRM + XP-110 Probe

Function Ground Survey X-ray Surface Contamination Monitor

Publications A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
B: BR2053 (119) Multi-Function Survey Meter

NSN 6665-01-440-8997

Required Reference Standards

Spectrometry Standard Reference Source

²⁴¹Am Spectrometry standard reference source, nominal activity 60 kBq. Requires activity calibration.

Check Source

²³²Th Type Mk 10 NXS, NSN 6665-99-840-3182, nominal activity 1 kBq. Does not require calibration.

Equipment Overview

Description and Use: The XP-110 provides a wide area surface contamination monitoring capability with gated channels for 17 & 65 keV.

Physical Construction: The probe is of alloy construction housing the associated electronic circuit boards and photomultiplier / Scintillator assembly. Probe power is supplied by 2 x PP3 batteries located on the top of the probe, next to the associated controls / input sockets.

Detector Type: Scintillator (NaI).

Energy Range: 17 keV / 60 keV (gated).

Detector Active Area: 126 cm².



Controls

1. A comprehensive summary of ratemeter functionality is contained within 'Publications' A and B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection / certificate production.

Notes:

- (i) Do not utilise the ADM300 scalar background subtraction feature, enable gross count for all measurements.
- (ii) The operating voltage of the XP-110 is preset by the manufacturer and cannot be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.
- (iii) A sample calibration proforma has been provided to assist in collection of data and the recording of calculations required carrying out this calibration. Follow each entry sequentially in the proforma, and enter the results of each quantity in the appropriate box.
- (iv) This protocol should only be carried out using a ratemeter calibrated IAW Protocol 22.

Pre-radiation Tests, Electrical and Physical Examination

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. **Battery test.**

Ensure batteries are in good order and provide the necessary voltage for operation.

NOTE: The XP-110 does not derive power from the ADM300, when the batteries are low the probe mounted 'battery' LED will flash.

When the voltage level falls below operational levels the ADM will indicate a reading of zero regardless of contamination.

b. **Mechanical checks.**

Ensure the battery compartment / connections, probe case / handle, cables, connectors and probe window / cover remain fit for purpose.

Replace as necessary.

c. **Connect the unit to a serviceable ADM300, energise the unit and check operation of all controls.**

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

a. **Adjust Peak Align**

(i) Set the probe mounted 'ENERGY SELECT' switch on the detector unit to the 'PEAK ALIGN' position.

(ii) Remove the polythene cover from the probe window and place the instrument such that the face of the detector is in a horizontal orientation facing the work surface. Remove the protective window cover. Place the ²⁴¹Am reference source near to or centrally on the window of the detector.

(iii) In count rate mode, use a trimming tool to adjust peak align potentiometer on the XP-110 to acquire the maximum count rate.

b. **Areal Response Calibration**

(i) Set the probe mounted 'ENERGY SELECT' switch on the detector unit to the 'SUM' position.

(ii) Set the ADM300 scaler to undertake 100 second samples.

(iii) Hold the probe using a retort stand or similar unit placing it such that the detector is in a horizontal orientation facing the work surface, maintaining a source / detector spacing of 30 cm.

(iv) Fix a meter long ruler on the ground such that the 0cm mark lies directly below the centre of the detector window. A jig assembly maybe used to engender repeatability.

(v) Press 'SET' on the ADM300 to start the scaler.

(vi) On completion of the scaler record the result on the Proforma 1A/1B as appropriate.

(vii) Repeat steps v – vi until five background measurements have been taken and calculate / record the mean background count and mean background count rate cps.

(viii) Place the ²⁴¹Am reference source on the ground directly below the centre of the detector (Height 30cm Radial distance 0cm).

- (ix) Set the ADM300 scaler to undertake 300 second samples.
- (x) Press 'SET' on the ADM300 to start the scaler and carry out a 300s measurement of the source and record the gross count on the Proforma 1A/1B.
- (xi) Repeat step (x), placing the source sequentially at increasing radial distances, D, along the ruler, at 10cm intervals, continuing up to a distance of 100cm.
- (xii) For each of the 11 areal measurements, calculate and record the gross count rate cps (by dividing the gross counts by the integration time) and the net count rate cps (by subtracting the mean background count rate from the gross count rate).
- (xiii) Record the multiple of the net count rate by the value of the corresponding scaling factor f.
- (xiv) Calculate and record the total sum (Net cps x f)
- (xv) Calculate and record the areal surface contamination response, S_a , of the instrument according to the following formula;

$$\text{Surface contamination response, } S_a = \frac{\text{Sum (Net count rate (cps) x f)}}{(A / (\pi \times 25) \times 10000)}$$

Where: A is the source activity

- (xvi) The units of S_a are counts per second per unit activity per square meter; i.e. cps / (Bq.m²).
- (xvii) Calculate and record the point source response. P_a , for D=0 by dividing the net count rate cps by the current reference source activity A.

c. Directional Dependency

- (i) Mark a cross on the floor such that all lines are 50cm long and they intersect at right angles, mark points 1 through 4 at the extremities of the cross.
- (ii) Maintaining the same detector positioning used during "Areal Response Calibration"; Place the ²⁴¹Am reference source at each of the 4 points and measure / record the gross count using a 300s integration time.
- (iii) For each of the 4 polar measurements calculate and record the gross count rate cps (by dividing the gross counts by the integration time) and the net count rate cps (by subtracting the mean background count rate from the gross count rate).
- (iv) Calculate and record the mean of the 4 polar counts.
- (v) For each of the 4 polar measurements calculate and record the percentage difference from the mean value.
- (vi) Confirm that none of the polar measurements differ from the mean by more than ± 30%.

d. Check Source Response

- (i) Remove all other radioactive sources well away from detector.
- (ii) Place the Mk 10NXS ²³²Th Check Source centrally, in contact with the detector, such that the source card edge circle perimeter aligns with circumference of the probe with the side marked "X-RAY PROBE TEST SOURCE" facing towards the detector.

- (iii) Carry out five measurements of the detector Check Source gross counts for a 100s integration time.
 - (iv) Calculate and record the net count (by subtracting the mean background count in 100s from the gross count).
 - (v) Calculate and record the mean net count.
5. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / Pass criteria are the same as Category 1 tests.
6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 4.d. using a single measurement.
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 4.d.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

ADM300A WITH XP-110 PROBE CALIBRATION PROFORMA 1A

Calibration Reference:

Calibration Date :	Reference Source S/N :
	Certified Activity :
ADM300A S/N :	Calibration Date :
XP-110 Probe S/N :	Current Activity :

Background Measurement

Gross Counts in 100s	Mean Count in 100s:
	Mean Count Rate :
	Cps

Areal Response Calibration

Radial Distance D [cm]	Gross Count in 300s	Gross Count Rate [cps]	Net Count Rate [cps]	Scaling Factor, f	Net Count Rate x f
0				1	
10				8	
20				16	
30				24	
40				32	
50				40	
60				48	
70				56	
80				64	
90				72	
100				80	
Sum of : Net Count Rate x f					
Areal Surface Contamination Response :		$S_a = \frac{\text{Sum}(\text{Net Count Rate}(\text{cps}) \times f)}{(A / (\pi \times 25) \times 10000)}$			cps / (Bq m ⁻²)
Point Source Response :		$P_a = \frac{\text{Net Count Rate for } D=0}{A}$			cps / Bq

ADM300A WITH XP-110 PROBE CALIBRATION PROFORMA 1A

Calibration Reference:

Polar Response				
Position No.	Gross Count in 300s	Gross Count Rate [cps]	Net Count Rate [cps]	Difference From Mean
1				
2				
3				
4				
Mean Polar Net Count Rate:				

Check Sources Response	
Gross Counts in 100s	Net Count in 100s:
Mean Net Count in 100s :	

Standard Radiological Monitoring Instrument Statutory Test

Protocol 13 Counter Scaler Mk 4NCA (Electrical Calibration Only)

Function Counter Scaler

Publications A: BR2053(20) 4NCA

NSN: 6665-99-541-4983

Equipment Overview

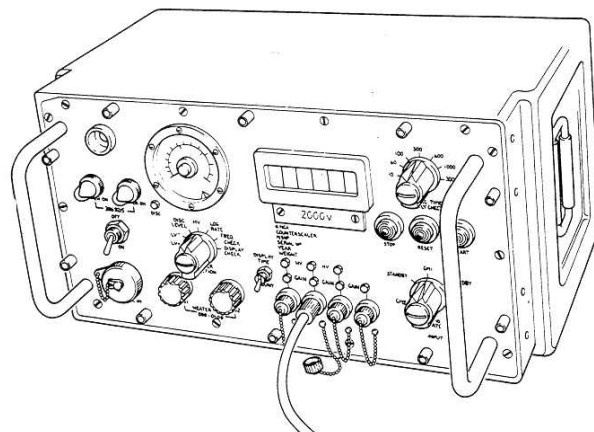
Description and Use: The Mk 4 NCA Counter Scaler equipment is a mains-operated counter scaler for use in nuclear powered submarines, HM Dockyards and Naval shore establishments. The equipment will count pulses received from a variety of radiation detectors, and gives an analogue indication of instantaneous count rate together with digital indication of accumulated count over selected time intervals.

Physical Construction: The equipment is constructed of pressed metal, with Bakelite switches, metal sockets and glass display.

Detector Type: N/A

Doserate Range: N/A

Energy Range: N/A

**Mk 4 NCA Counter Scaler****Controls****1. Front Panel Controls**

Power Socket: Connection for power lead.

Switch 1: ON/OFF switch. - Applies power to the unit.

Switch 2: Count/Time switch. - Changes display from counts to time elapsed.

Switch 3: Meter Function Switch. - Seven positions switch.

- a. LV+ displays the voltage on the 12v dc positive rail.
- b. LV- displays the voltage on the 12v negative rail.
- c. DISC LEVEL displays the level at which the discriminator amplifier has been set.
- d. HV displays the high voltage supply at the detector sockets.
- e. LOG RATE displays the count rate being monitored in counts per second. This is indicated on a log scale calibrated from 0 to 10K.
- f. FREQ CHECK. This position is associated with a check of the equipment logic circuits.
- g. DISPLAY CHECK. This position is associated with a check of the digital display.

Switch 4: Counting Time Selector. - Selects count time in seconds (Seven positions ranging 10 to 3000 seconds).

Switch 5: Input Switch. - Selects which output is powered up i.e.: GM1, GM2 or SKINT.

Switch 6: Stop push switch. - Stops count.

Switch 7: Count reset switch. - Resets count to zero.

Switch 8: Commence Count. - Starts count.

Output Sockets: SCINT, GM1, GM2 and SOLID STATE. For HT lead connection.

GAIN POTS: SCINT, GM1 and GM2. Sealed with tamper seals

HV POTS: SCINT, GM1 and GM2. Adjusts the HV setting.

2. Overall Performance Parameters.

- a. Signal pulse counting for all common radiation detectors including MK 5 NH castles, 1320 Alpha probe, BP 7, BP 4 and BP 10 probes.
- b. Digital display of integrated count and time to an accuracy of $\pm 0.1\%$.
- c. Meter display of detector voltage to an accuracy of $\pm 5\%$ up to 2KV.
- d. Meter display of discriminator voltage to an accuracy of $\pm 5\%$.
- e. Meter display of count-rate up to 10K cps to an accuracy of $\pm 20\%$.

Standard Test Protocol

3. The following tests should be recorded for certificate production and Qualified Person inspection.

Electrical and Physical Examination

4. The following checks must be undertaken before electrical correctness tests.

- a. Visual check of instrument condition.
- b. Check all switches are secure and operate correctly.
- c. Check mechanical zero of meter.

5. Low Voltage Power Supplies:

- a. Plug in low voltage PEC 31NP via extension card Mk 86 NTU.
 - i. Connect 115v to front panel.
- b. Check that HEATER ON light illuminates.
 - i. Wait 5 minutes and check that R200 gets warm.
 - ii. Record Result.
- c. Place power switch to ON and check POWER ON lamp illuminates and HEATER ON lamp is extinguished.
 - i. Record Result.
- d. Set meter function switch to LV+.
 - i. Adjust R135 on PEC31NP to obtain a reading of 1.2 on inner scale of meter.
- e. Connect DVM between TP 1(-ve) and TP 2 (+ve).
 - i. Reading should be $+12v \pm 3\%$.
 - ii. Record results.
- f. Set meter function switch to LV-.
 - i. Adjust R138 on PEC31NP to obtain a reading of 1.2 on inner scale of meter.
- g. Connect DVM between TP 1(-ve) and TP 3 (+ve).
 - i. Reading should be $-12v \pm 3\%$.
 - ii. Record results.
- h. Connect DVM between TP 1(-ve) and TP 4 (+ve).
 - i. Reading should be $-16.5v \pm 10\%$.
 - ii. Record results.
- i. Place power switch to OFF.
 - i. Change the links on the tag board for 240v operation.
 - ii. Remove heater links.
 - iii. Connect 240v AC power supply to instrument and switch ON.
- j. Carry out steps e through to h.
 - i. Results should be as stated below.

Note: For 240v ac units the results for steps "e" and "g" should be within 50mv of those obtained for 115v ac and within 500mv for step "h".

6. High Voltage Power Supply:

- a. Plug in HV PEC via extension card Mk 82 NTU.
 - i. Do not connect HV lead.
 - ii. Set meter function switch to HV.
- b. Connect DVM to S6 (+) and S8 (-) on 4nca test box.
 - i. Connect SKT L on HV PEC to S5 and earth on 4nca test box.
- c. Place power switch to ON and wait 30 seconds.
 - i. DVM reading should be between 100 and 300mv.
 - ii. Record results.
- d. Set input switch to SCINT and turn HV control for SCINT fully clockwise.
 - i. DVM reading should be between 2.1 and 2.4v.
 - ii. Record results.
- e. Turn HV control for SCINT anticlockwise to obtain a DVM reading of 2v +-1%.
 - i. Record results.
- f. Adjust R8 on HV PEC to obtain a reading of 2.0 on the inner scale of the analogue meter.
- g. Place input switch to STANBY.
 - i. Switch power switch to OFF.
 - ii. Remove DVM, Mk 4 NCA test box, HV PEC and extension card.

7. Counting/Timing Circuits and Display:

- a. Plug in Display PEC, Control Timing PEC and the Control Timing PEC via extension card Mk 84 NTU.
 - i. Switch power switch to ON and press reset on front panel.
- b. Check digital display illuminates to read 000000.
 - i. Record Result.
- c. Set TIME/COUNT switch to TIME and check that the two left-hand digits are blank.
 - i. The display should read 0000.
 - ii. Record Result.
- d. Return time/count switch to COUNT and check that the display again reads 000000.
 - i. Record Result.
- e. Set meter function switch to DISPLAY CHECK.
 - i. All digits simultaneously should all cycle through the numerals 0 to 9.
 - ii. Record Result.
- f. Set time/count switch to TIME and check that the two left hand digits are blank whilst the remaining four continue the display check as in 3.e.
 - i. Record Result.
- g. Connect frequency counter between TP 10 (0v) and TP 9 on Control Timing PEC.
 - i. Adjust C38 to obtain a reading of 200 KHz +- 0.1% on frequency counter.
 - ii. Record results.
- h. Remove frequency counter.
- i. Set meter function switch to Frequency Check.
 - i. Press RESET button and check that display resets to 0000.
 - ii. Record Result.
- j. Set time/count switch to COUNTS and check that display reads 000000.
 - i. Switch back to TIME and ensure counting time switch is set to 10.

- k. Press start button and check display starts counting at approximately 1Hz.
 - i. Check that counting stops automatically when display reads 0010.
 - ii. Record Result.
- l. Set count/time switch to COUNTS and check that the display reads 100000.
 - i. Record Result.
- m. Press RESET and check that the display resets to 000000.
 - i. Set count/time switch to TIME and check display reads 0000.
 - ii. Record Result.
- n. Repeat the sequence j - m for each of the counting times 60, 100, 300, 600, 1000 and 3000.
 - i. Check that when counting stops automatically the display reads as follows:
 - ii. Record Results.

Counting Time Switch Position	Display Time	Display Counts
10	10	100000
60	60	600000
100	100	100000
300	300	300000
600	600	600000
1000	1000	100000
3000	3000	300000

- o. Set counting time switch to 10 and press START button.
 - i. When display reads 0004 press STOP button and check that counting stops.
 - ii. Count should be 0005.
 - iii. Record Result.
- p. Set time/count switch to COUNTS and check that display reads 050000.
 - i. Record Result.
- q. Press START button and check that counting continues and stops automatically when the display reads 100000.
 - i. Record Result.
- r. Switch to TIME and check the display reads 0010.
 - i. Record Result.
- s. Switch power switch to OFF.
 - i. Remove extension card.
 - ii. Plug Counter/Scaler and Control/Timing PEC's directly into Mk 4 NCA.
- t. If correct Record result as a DISPLAY PASS on calibration certificate.

8. **Ratemeter and Discriminator Circuits.**

- a. Plug in Ratemeter PEC via extension card Mk 83 NTU.
 - i. Short out PL1 and connect to 0v.
 - ii. Switch S9 on Ratemeter PEC to NORMAL and switch POWER switch (S1) to on.
- b. Connect frequency counter between TP6 (0v) and TP8 and adjust R30 to obtain a reading of 9.7 kHz +-1%
 - i. Record reading.
- c. Remove frequency counter.
 - i. Remove short on PL 1.
- d. Set meter function switch to DISC LEVEL and turn disc control fully anticlockwise.
 - i. Inner scale of analogue meter should read less than 0.1v.
 - ii. Record result.

- e. Turn disc control fully clockwise and inner scale of analogue meter should read greater than 2v.
 - i. Record result.
- f. Turn disc control to obtain a meter reading of 0.5 on the inner scale of the analogue meter.
- g. Set meter function switch to LOG RATE and ensure that input switch is set to STANDBY.
 - i. Set pulse generator to give 3.4 kHz, 3 us pulse width, +10v amplitude and connect to TP6 (0v) and TP5.
 - ii. Wait 60 seconds then adjust R52 on Ratemeter PEC to obtain a reading of 5.0 KHz on the outer scale of analogue meter.
 - iii. Record Result.
- h. Remove pulse generator.
- i. Set counting time switch to 100.
 - i. Set meter function switch (S3) to FREQUENCY CHECK and wait 60 seconds.
 - ii. Adjust R57 on Ratemeter PEC to obtain a reading of 1KHz on the outer scale of analogue meter.
 - iii. Record Results.
- j. Set COUNTING TIME switch (S4) to 10, wait 60 seconds then check analogue meter.
 - i. Reading should be 10 KHz +-20%.
 - ii. Record Results.
- k. Set COUNTING TIME switch (S4) to 1000, wait 60 seconds then check analogue meter.
 - i. Reading should be 100 Hz +-20%.
 - ii. Record Results.
- l. Switch POWER switch (S1) to OFF.
- m. If correct Record result as a FREQUENCY PASS on calibration certificate.

9. Input Amplifiers.

- a. Ensure HV PEC has been removed.
 - i. Turn all gain controls fully clockwise.
 - ii. Set pulse generator to give 1.0 KHz, 200 us pulse width, -120 mV via Mk 4 NCA matching unit to SOLID STATE input socket.
 - iii. Connect oscilloscope between TP 6 (0V) and TP 5 on RATEMETER PEC and set input switch to SOLID STATE.
 - iv. Check pulse amplitude is between +4v and +8v.
 - v. Record Result.
- b. Turn SOLID STATE gain control fully anticlockwise and check pulse amplitude is less than 2v.
 - i. Record Result.
- c. Turn GAIN CONTROL fully clockwise.
 - i. Increase amplitude of pulse generator until pulses displayed on oscilloscope begin to clip.
 - ii. Amplitude should be greater than 7v.
 - iii. Record Results.
- d. Set input switch to STANDBY.
 - i. Transfer pulse generator lead to SCINT input and set input switch to SCINT.
 - ii. Adjust pulse generator amplitude to -5v.
 - iii. Check pulses at TP 5 have rounded (unclipped) peaks with an amplitude between +4v and +8v.
 - iv. Record Results.
- e. Turn SCINT gain control fully anticlockwise and pulse amplitude is less than 2v.
 - i. Record Results.
- f. Turn Gain CONTROL fully clockwise.

- i. Increase amplitude of pulse generator until pulses displayed on oscilloscope begin to clip. Amplitude should be greater than 7v.
 - ii. Record Results.
- g. Set input switch to STANDBY.
 - i. Remove matching unit.
 - ii. Transfer pulse generator lead to GM1 input and set input switch to GM1.
 - iii. Adjust pulse generator amplitude to -150mv.
 - iv. Check pulse amplitude at TP 5 is +5v +-25%.
 - v. Record Results.
- h. Turn GM1 gain control fully anticlockwise and check pulse amplitude is less than 3.5v.
 - i. Record Results.
 - ii. Turn GAIN CONTROL fully clockwise.
 - iii. Increase amplitude of pulse generator until pulses displayed on oscilloscope begin to clip.
 - iv. Amplitude should be greater than 7v.
 - v. Record Results.
- i. Set input switch to STANDBY.
 - i. Transfer pulse generator lead to GM2 input and set input switch to GM2.
 - ii. Adjust pulse generator amplitude to -150mv.
 - iii. Check pulse amplitude at TP 5 is +5v +-25%.
 - iv. Record Results.
- j. Turn GM2 gain control fully anticlockwise and check pulse amplitude is less than 3.5v.
 - i. Record Results.
- k. Turn GAIN CONTROL fully clockwise.
 - i. Increase amplitude of pulse generator until pulses displayed on oscilloscope begin to clip.
 - ii. Amplitude should be greater than 7v.
 - iii. Record Results.
- l. Set input switch to STANDBY.
 - i. Remove pulse generator and oscilloscope.
 - ii. Switch power switch to OFF.
 - iii. Remove RATEMETER PEC extension card and plug RATEMETER PEC directly into the instrument.
 - iv. Plug HV PEC into Mk 4 NCA and connect HV lead.

10. Calibration Checks.

- a. Ensure input switch is set to STANDBY and all HV controls are fully anticlockwise.
 - i. Set meter function switch to HV.
 - ii. Connect DVM to DVM terminals on test box and test box HV terminals to SCINT input socket.
 - iii. Switch power switch to ON.
- b. Set input switch to SCINT.
 - i. DVM reading should be between 100 and 300 mv.
 - ii. Record Result.
- c. Turn SCINT HV control fully clockwise and check DVM reading is between 2.1 and 2.4v.
 - i. Record Result.
- d. Repeat above for GM1 and GM2 input.
 - i. Record Result.
- e. Remove test box. Connect DVM directly to SOLID STATE input socket.
 - i. Reading should be +15v +-10%.
 - ii. Record Result.

- f. Connect BP7 to SCINT socket.
 - i. Set input switch to SCINT and SCINT HV control to read the probe operating HV on the inner scale of the analogue meter.
 - ii. Set TIME/COUNT switch to COUNTS.
 - iii. Set COUNTING TIME switch to 10.
- g. Arrange BP7 on a known source.
 - i. Press START button, take a 10 second count. Repeat 5 times.
 - ii. Record Results.
- h. Check that the mean result is as expected with the probe efficiency and source emission rate.
- i. Set input switch to STANDBY.
 - i. Replace BP7 probe with BP10 probe.
- j. Connect BP10 to GM1 socket.
 - i. Set input switch to GM1 and GM1 HV control to read the probe operating HV on the inner scale of the analogue meter.
 - ii. Set TIME/COUNT switch to COUNTS.
 - iii. Set COUNTING TIME switch to 10.
- k. Arrange BP10 on a known source.
 - i. Press START button, take a 10 second count. Repeat 5 times.
 - ii. Record results.
- l. Check that the mean result is as expected with the probe efficiency and source emission rate.
- m. Set input switch to STANDBY.
- n. Connect BP10 to GM2 socket.
 - i. Set input switch to GM2 and GM2 HV control to read the probe operating HV on the inner scale of the analogue meter.
 - ii. Set TIME/COUNT switch to COUNTS.
 - iii. Set COUNTING TIME switch to 10.
- o. Arrange BP10 on a known source.
 - i. Press START button, take a 10 second count. Repeat 5 times.
 - ii. Record results.
- p. Check that the mean result is as expected with the probe efficiency and source emission rate.
- q. Set input switch to STANDBY.
- r. Remove all test equipment and power supply lead. Ensure mains supply voltage is returned to original setting and ensure the supply voltage is clearly indicated on the instrument front panel.
 - i. Replace side covers and secure instrument in case.
 - ii. Store all accessories in lid of case.
 - iii. Seal instrument with integrity seal and append calibration label.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 14 Counter Scaler Mk 4NCA + Alpha Drawer Type 1320C Probe

Function Alpha Contamination Drawer Assembly Coupled with Mk 4NCA Counter Scaler

Publications A: BR2053(104)
B: BR3014

NSN 6665-99-949-1324

Required Reference Standards

Small area

²⁴¹Am Amersham code AMR 01012, AMR 01022 and AMR 01032

²³⁸Pu Amersham code PPR 01012

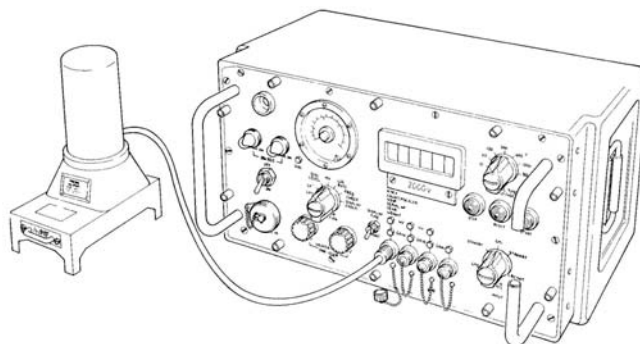
⁹⁰Sr Amersham code SIR 01031

Equipment Overview

Description and Use: The Alpha Draw Assembly comprises an Alpha Probe stripped of its normal scintillation components and a Draw Assembly. The combined units form a light tight scintillation head which when used in conjunction with a Mk 4 NCA may be used to detect a proportion of the alpha particles emitted from a radioactive source or sample.

Detector Type: Scintillation

Probe Active Area: 16 cm²



Mk 4NCA Counter Scaler fitted with Alpha Drawer Assembly

Controls

1. A comprehensive summary of the ratemeter is contained within the Publication, Reference A.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Note: This protocol should only be carried out using a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. MK 4 NCA must be calibrated prior to carrying out this calibration in accordance with [Protocol 13 Counter Scaler Mk 4NCA \(Electrical Calibration Only\)](#).
 - b. **Mechanical checks.**
Check mechanical integrity of the Alpha Draw Assembly, probe, cables, cable connections, and probe window. Replace as necessary.
 - c. **Check operation of all controls**
Note: The Alpha Draw Assembly and MK 4 NCA operational voltage should be determined prior to this test. Precise plateau characteristics will be Alpha Draw Assembly and MK 4 NCA dependent and must be determined for each combination.

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three repeat measurements of the surface contamination response test should be carried out.

a. **Background Count Rate.**

Carry out a 1-minute background count, record the reading.

(i) Acceptance / pass criteria - The background level should be less than 3 cps.

b. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any significant change in background should be observed. Record the probe's response to the ^{241}Am (AMR 01031) with and without the presence of the light source.

(i) Acceptance/Pass criteria - The background count should not be elevated and the response to the alpha source should not be affected by the light source.

c. **Response to Alpha Contamination.**

The procedure below details the calculation and recording of drawer efficiencies.

(i) Place the 16 mm ^{238}Pu Disc source (PPR 01011) in the draw.

(ii) Take five one- minute counts and correct to 1-second record the readings.

(iii) Calculate the mean count (cps).

(iv) Subtract the background from the reading to obtain corrected cps.

Note: the emission rate of the ^{238}Pu Disc source (PPR 01011).

(v) Calculate the efficiency of the detector for this source and record.

(vi) This calculated efficiency is recorded as the counting efficiency for ^{238}Pu .

(vii) Repeat step (i) to (v) using 16 mm ^{241}Am Disc source (AMR 01031).

(viii) This calculated efficiency is recorded as the counting efficiency for ^{241}Am .

Nuclide	2 π Efficiency	
	Mean Response	Permitted Range
^{238}Pu	71	49.7 - 92.3
^{241}Am	74	51.8 - 96.2

(ix) Acceptance/pass criteria - Is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.

d. **Linearity of Response.**

Place the planer disc sources AMR 01011, AMR 01021 and AMR 01031. Carry out five one-minute counts and record the mean count rate.

(i) Acceptance / pass criteria - Are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.

e. **Uniformity of Response.**

Spatial uniformity testing is not required for probes with detector areas $< 40 \text{ cm}^2$.

f. **Beta Rejection.**

Place the ^{90}Sr (SIR 01031) in the alpha draw and record the beta response.

- (i) Acceptance / pass criteria - Is that the monitor response should be < 1% of the equivalent ^{241}Am or ^{238}Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be < 0.4% for beta radiation.

g. **Check Source Response.**

Place the PIRC 8 (^{238}Pu) (Note: This source is held onboard the submarine.) in the draw and do a 1-minute count and correct to cps and the record the response on the calibration certificate.

Expected Response: 16 cps

- (i) Acceptance/Pass criteria - Check source response should be +/- 20% of response shown.

h. **On Completion.**

HV and Gain pots are to be sealed with appropriate seals.

Note: All the above steps are carried out in the calibration lab, on completion of the Mk 4 NCA calibration. When the unit is installed on the submarine the check source response can be recorded.

5. **Category 2: Annual Test.** Complete all Category 1 tests.

- (i) Acceptance / pass criteria - Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test Before Operational Use.** The test before operational use is laid down in Publications Reference A & B.

- (i) Acceptance / pass criteria- Is that laid down in Publications Reference A & B.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

**Protocol 14a Counter Scaler Mk 4NCA + Mk 5NHA Castle
(On-Board Use Calibration)**

Function Beta Contamination Probe installed in Mk 5 NHA Lead Castle used in conjunction with the Mk 4 NCA the Mk 5 NHA Castle is used to measure Beta – Gamma activity.

Publications A: BR2053(104)
B: BR3014

NSN 5 NHA 6665-99-220-5872
G.M tube 5960-99-118-0134

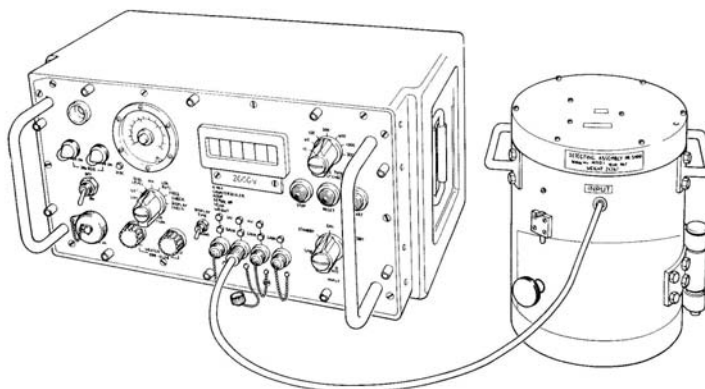
Required Reference Standards

Small area ^{90}Sr Amersham code SIR 01012, SIR 07022 and SIR 07032

MK 1 NCS SET

Description

1. The 5 NHA lead castle is a vertical housing that shields the detector from extraneous radiation fields. The cylindrical wall of the shield consists of lead sandwiched between a steel casing and an aluminium lining. The shield has a removable lid and a flush mounted door. Connection to the Mk 4 NCA is made through the P.E.T. series 100 socket. The detecting element is a halogen quenched end-window GM tube type MX167. It is highly sensitive to beta radiation; its relatively low gamma efficiency is turned to account in the measurement of very low active gaseous samples. The tube has a graphite coated mica window 2 inches in diameter.



Mk 4 NCA Counter Scaler fitted with MX167 GM tube fitted in the Mk 5NHA Lead Castle.

Probe Active Area: X cm²

Controls

2. A comprehensive summary of the ratemeter is contained within the Publication, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Note: This protocol should only be carried out using a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. MK 4 NCA must be calibrated prior to carrying out this calibration in accordance with [Protocol 13 Mk 4 NCA Counter Scaler \(Electrical Calibration\)](#)
 - b. Check mechanical integrity of 5 NHA castle case, cables, and cable connections. Replace as necessary.

Note: The 5 NHA castle and MK 4 NCA operational voltage should be determined prior to this test. Precise plateau characteristics will be 5 NHA and MK 4 NCA dependent and must be determined for each combination.

Radiation Tests

5. **Category 1 Test: Test before First Use** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response, At least three repeat measurements of the surface contamination response test should be carried out.

- a. **Light Sensitivity:** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to ^{241}Am (AMR 01031) with and without the presence of the light source.
 - (i) Acceptance/Pass criteria are that the background count should not be elevated and the response to the alpha source should not be affected by the light source.

- b. **Response to Beta Contamination.** The procedure below details the calculation and recording of the probe efficiencies in relation to shelf positions within the Mk 5NHA Lead Castle when installed on-board HM Submarines.

- (i) Place the Mk1 NXS (2 inch) Source on the shelf in position 1.
- (ii) Take five one- minute counts and record the readings.
- (iii) Calculate the mean count.
- (iv) Subtract the background from the reading to obtain corrected cpm.

Note the apparent dpm for the Mk 1 NXS from test certificate.

- (v) Calculate the efficiency of the detector for this source and record as X efficiency.
- (vi) Repeat this process with the Mk2 NXS (2 inch) source to produce Y efficiency.
- (vii) Calculate the average efficiency of the detector for 2 inch sources as follows:

$$\frac{X + Y}{2} = \% \text{ efficiency}$$

- (viii) This calculated efficiency is recorded as the shelf and counting efficiency for 2-inch planchettes on shelf 1.
- (ix) Place the Mk 4 NXS (1 inch) Source on the shelf in shelf position 1 and repeat step (ii) to (vi) to produce X efficiency.
- (x) Place the Mk 5 NXS (1 inch) Source on the shelf in shelf position 1 and repeat step (ii) to (vi) to produce Y efficiency.
- (xi) Calculate the average efficiency of the detector for 1 inch sources as follows:

$$\frac{X + Y}{2} = \% \text{ efficiency}$$

- (xii) This calculated efficiency is recorded as the shelf and counting efficiency for 1inch planchettes on shelf 1.
- (xiii) This procedure is carried out for all five shelves and recorded.
- (xiv) On completion of calibration the HV and Gain pots are to be sealed with appropriate seals.

Nuclide / Shelf	CPM		2 π Efficiency	
	Mean Response	Permitted Range	Mean Response	Permitted Range
Mk 1 NXS 2 Inch				
Shelf 1	25.90	18.13 – 33.67	25.90	18.13 – 33.67
Shelf 2	12.48	8.74 – 16.22	12.48	8.74 – 16.22
Shelf 3	6.78	4.75 – 8.81	6.78	4.75 – 8.81
Shelf 4	4.08	2.86 – 5.30	4.08	2.86 – 5.30
Shelf 5	2.79	1.95 – 3.63	2.79	1.95 – 3.63
Mk 2 NXS 2 Inch				
Shelf 1	25.96	18.17 – 33.75	25.96	18.8 – 33.75
Shelf 2	12.43	8.70 – 16.16	12.43	8.70 – 16.16
Shelf 3	6.92	4.84 – 9.0	6.92	4.84 – 9.00
Shelf 4	4.42	3.09 – 5.75	4.42	3.09 – 5.75
Shelf 5	2.99	2.09 – 3.89	2.99	2.09 – 3.89
Mk 4 NXS 1 Inch				
Shelf 1	28.64	20.05 – 37.22	28.64	20.05 – 37.23
Shelf 2	15.93	11.15 – 20.71	15.93	11.15 – 20.71
Shelf 3	8.55	5.99 – 11.12	8.55	5.99 – 11.12
Shelf 4	5.22	3.65 – 6.79	5.22	3.65 – 6.79
Shelf 5	3.40	2.38 – 4.42	3.40	2.38 – 4.42
Mk 5 NXS 1 inch.				
Shelf 1	26.23	18.36 – 34.1	26.33	18.36 – 34.10
Shelf 2	14.20	9.94 – 18.46	14.20	9.94 – 18.46
Shelf 3	7.56	5.29 – 9.83	7.56	5.29 – 9.83
Shelf 4	4.56	3.19 – 5.53	4.56	3.19 – 5.93
Shelf 5	2.95	2.07 – 33.84	2.95	2.07 – 3.84

- (xv) Acceptance/pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.
- c. **Check Source Response. (No check source is currently assigned to this unit)**
- d. **Linearity of Response:** Place the planer disc sources SIR 01011, SIR 07021 and SIR 07031. Carry out five one-minute counts and record the mean count rate.
- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- e. **Uniformity of Response:** A uniformity check is not required on this probe due to its small active area.

- f. **Background Count rate:** Carry out a 10-minute background count, record the reading and correct to 1 second.
- (i) Acceptance / pass criteria is TBA cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{241}Am 60 keV.
- g. **On Completion:-** HV and Gain pots are to be sealed with appropriate seals.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** The test before operational use is laid down in Publications Reference A & B.
- (i) Acceptance / pass criteria is that laid down in Publications Reference A & B.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

**Protocol 14b Counter Scaler Mk 4NCA + Mk 5NHA Castle
(Shore Side Use Calibration)**

Function Beta Contamination Probe installed in Mk 5 NHA Lead Castle used in conjunction with the Mk 4 NCA the Mk 5 NHA Castle is used to measure Beta – Gamma activity.

Publications A: BR2053(104)
B: BR3014

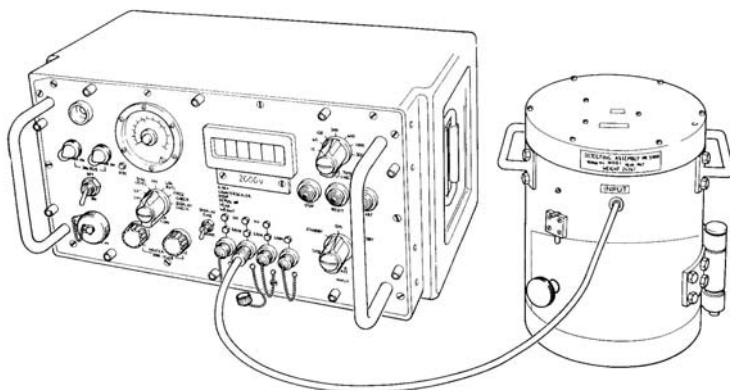
NSN 5 NHA 6665-99-220-5872
G.M tube 5960-99-118-0134

Required Reference Standards

Small area ⁹⁰Sr Amersham code SIR 01012, SIR 07022 and SIR 07032
⁶⁰Co Amersham code CKR 01022

Description

1. The 5 NHA lead castle is a vertical housing that shields the detector from extraneous radiation fields. The cylindrical wall of the shield consists of lead sandwiched between a steel casing and an aluminium lining. The shield has a removable lid and a flush mounted door. Connection to the Mk 4 NCA is made through the P.E.T. series 100 socket. The detecting element is a halogen quenched end-window GM tube type MX167. It is highly sensitive to beta radiation; its relatively low gamma efficiency is turned to account in the measurement of very low active gaseous samples. The tube has a graphite coated mica window 2 inches in diameter.



Mk 4 NCA Counter Scaler fitted with MX167 GM tube fitted in the Mk 5NHA Lead Castle.

Probe Active Area: X cm²

Controls

2. A comprehensive summary of the ratemeter is contained within the Publication, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Note: This protocol should only be carried out using a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. MK 4 NCA must be calibrated prior to carrying out this calibration in accordance with [Protocol 13 Mk 4 NCA Counter Scaler \(Electrical Calibration\)](#)

- b. Check mechanical integrity of 5 NHA castle case, cables, and cable connections. Replace as necessary.

Note: The 5 NHA castle and MK 4 NCA operational voltage should be determined prior to this test. Precise plateau characteristics will be 5 NHA and MK 4 NCA dependent and must be determined for each combination.

Radiation Tests

5. **Category 1 Test: Test before First Use** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response, At least three repeat measurements of the surface contamination response test should be carried out.

- a. **Light Sensitivity:** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to ^{241}Am (AMR 01031) with and without the presence of the light source.

- (i) Acceptance/Pass criteria are that the background count should not be elevated and the response to the alpha source should not be affected by the light source.

- b. **Response to Beta Contamination.** The procedure below details the calculation and recording of the probe efficiencies in relation to shelf positions within the Mk 5NHA Lead Castle when installed in Shore Side facilities.

- (i) Place the 16 mm ^{60}Co Disc source (CKR 01021) on the shelf in position 1.

- (ii) Take five one- minute counts and correct to 1-second record the readings.

- (iii) Calculate the mean count (cps).

- (iv) Subtract the background from the reading to obtain corrected cps.

Note the emission rate of the ^{60}Co Disc source (CKR 01021).

- (v) Calculate the efficiency of the detector for this shelf position and record.

- (vi) This calculated efficiency is recorded as the shelf and counting efficiency for ^{60}Co on shelf 1.

- (vii) This procedure is carried out for all five shelves and recorded.

- (viii) On completion of calibration the HV and Gain pots are to be sealed with appropriate seals.

^{60}Co CKR 01021.	CPM		2 π Efficiency %	
	Mean Response	Permitted Range	Mean Response	Permitted Range
Shelf 1	30.60	21.42 – 39.78	30.60	21.42 – 39.78
Shelf 2	13.71	9.6 – 17.82	13.71	9.60 – 17.82
Shelf 3	6.49	4.54 – 8.44	6.49	4.54 – 8.44
Shelf 4	3.62	2.53 – 4.71	3.62	2.53 – 4.71
Shelf 5	1.97	1.38 – 2.56	1.97	1.38 – 2.56

- (ix) Acceptance/pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.

- c. **Check Source Response. (No check source is currently assigned to this unit)**

- d. **Linearity of Response:** Place the planer disc sources SIR 01011, SIR 07021 and SIR 07031. Carry out five one-minute counts and record the mean count rate.
- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- e. **Uniformity of Response:** A uniformity check is not required on this probe due to its small active area.
- f. **Background Count rate:** Carry out a 10-minute background count, record the reading and correct to 1 second.
- (i) Acceptance / pass criteria is TBA cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, H*(10) from ^{241}Am 60 keV.
- g. **On Completion:-** HV and Gain pots are to be sealed with appropriate seals.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** The test before operational use is laid down in Publications Reference A & B.
- (i) Acceptance / pass criteria is that laid down in Publications Reference A & B.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 15 Doserate Meter Type NIS 295B**Function** Gamma / X-ray and Beta Dose Rate Monitor**Publications** AP 112G-1314-0 – Radiation Monitor type NIS 295B**NSN** 6665-99-111-6865**Required Reference Standards**

Gamma Reference Standards

- ^{137}Cs & ^{241}Am

X-radiations

- ISO Narrow Series

All irradiations shall offer traceability to national standards.

Check Source

 ^{235}U Amersham code UAC 1623 NSN 6665-99-193-3906**Equipment Overview****Description and Use**

The NIS 295B is a photon monitor designed to measure gamma and X-radiation. It can also be used for beta radiation detection. The instrument has a single logarithmic scale up to a full-scale deflection of $5000 \mu\text{Sv}\cdot\text{h}^{-1}$.

Physical Construction: Unit construction; a steel case with detector protruding from the front. All controls, meter & handle are on top with battery access through a panel on the bottom.

Detector Type: Zinc loaded plastic scintillator optically matched to a conventional 13-stage photomultiplier.

Doserate Range: $0.5 \mu\text{Sv}/\text{h}$ – $5000 \mu\text{Sv}/\text{h}$ ADE $\text{H} \times 10$.

Energy Range: 45 keV – 2.5 MeV (Gamma & X-ray).

**Controls**

1. The NIS 295B has the following controls:

a. **Function Switch.** The function switch has 5 positions:

- | | | |
|-------|----------|---|
| (i) | OFF | |
| (ii) | BATT | Indicates condition of battery, within battery marker band. |
| (iii) | CHECK 7V | Indicates 7V setting, within narrow band at top of scale. |
| (iv) | SET ZERO | Indicate the electrical zero and can be adjusted using the SET ZERO control |
| (v) | OPERATE | Selects operational mode. |

b. **Response Adjustment.** The SET ZERO control is used to adjust the electrical zero.

c. Two variable resistors which are accessed by removal of the case:

- | | |
|-----|--|
| RV3 | Set EHT control (set for $1 \text{ mSv}\cdot\text{h}^{-1}$) |
| RV5 | Set SCALE control (set for $50 \mu\text{Sv}\cdot\text{h}^{-1}$) |

Note: RV3 and RV5 are dependent upon each other and should be used in conjunction with each other to optimise the reading.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery Test.**
Ensure batteries are in good order and provide the necessary voltage for operation.
Replace as necessary.
 - b. **Check 7 V.** Set the function switch to CHECK 7V and check that the reading is within the 7 V sector.
 - c. **Set Zero.** Set the function switch to SET ZERO and adjust the SET ZERO control for a meter reading of zero.
 - d. **Mechanical checks.**
Check the mechanical integrity of instrument.
Replace defective parts as necessary.

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

- a. **Background Dose Rate.**
Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background doserate on the calibration certificate.

- (i) Acceptance / Pass criteria – Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

- b. **Response to High Dose Rates.**
Expose the UUT to a doserate >10 times scale maxima for at least thirty seconds.

- (ii) Acceptance / Pass criteria - The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high doserate testing at a level >10 times the maximum credible doserate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

- c. **Linearity of Response. (^{137}Cs)**
Expose the UUT to at least one doserate per decade of operation listed in the table below (example min/max ranges have been provided such that errors up to $\pm 30\%$ will NOT pull the unit into a lower/higher decade. Where decades cannot be tested due to facility restrictions, the limit of the calibration should be covered by the statement defining the limit of calibration on the calibration certificate).

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	% of Decade	Example Min/Max ¹³⁷ Cs Doserates
H*(10)	H*(10)	H*(10)
1 - 10 $\mu\text{Sv.h}^{-1}$	<40% of Decade	1.5 – 3.5 $\mu\text{Sv.h}^{-1}$
1 - 10 $\mu\text{Sv.h}^{-1}$	>40% of Decade	6.6 – 7.6 $\mu\text{Sv.h}^{-1}$
10 - 100 $\mu\text{Sv.h}^{-1}$	<40% of Decade	14.3 – 27.5 $\mu\text{Sv.h}^{-1}$
10 - 100 $\mu\text{Sv.h}^{-1}$	>40% of Decade	66 – 76 $\mu\text{Sv.h}^{-1}$
100 - 1000 $\mu\text{Sv.h}^{-1}$	<40% of Decade	150 – 350 $\mu\text{Sv.h}^{-1}$
100 - 1000 $\mu\text{Sv.h}^{-1}$	>40% of Decade	660 – 760 $\mu\text{Sv.h}^{-1}$
1 – 5 mSv.h^{-1}	<40% of Decade	1.5 – 3.5 mSv.h^{-1}

- (i) Acceptance / Pass criteria - is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.

d. **Energy Response Test**

Expose the instrument to a 65 keV ISO narrow series x-ray or Am-241 doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ¹³⁷Cs value.

- (i) Acceptance / Pass criteria – The ¹³⁷Cs: 'Tested energy' response shall indicate a ratio of 1:0.67 ($\pm 30\%$) when exposed to the same ADE rate

Example ¹³⁷Cs Response

H*(10)
25 $\mu\text{Sv.h}^{-1}$

Example 'Tested Energy' Permitted Range

H*(10)
11.7 – 21.8 $\mu\text{Sv.h}^{-1}$

e. **Directional Dependency**

Expose the instrument in the -90° and $+90^\circ$ orientation (as shown below) to the same doserate/energy combination used during the 'Energy Response Test', record the observed reading and calculate a response ratio using the frontal response obtained during the 'Energy Response Test'

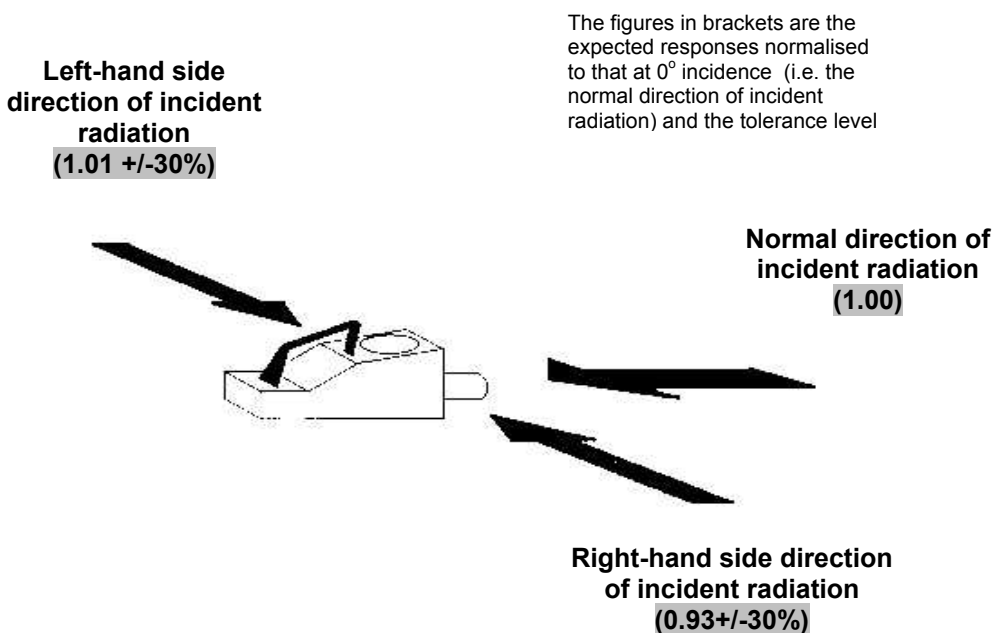


Figure 1: **Expected Directional Dependency**

- (i) Acceptance / Pass criteria - instrument response should be $\pm 30\%$ type test data.
- f. **Check Source Response.** Place the Check Source centrally on the front of the NaI detector, i.e. with the beta absorber removed, and the record the response.
 - (i) Acceptance / Pass criteria - check source response should be $10.2\mu\text{Sv/hr} \pm 20\%$.
- 5. **Category 2: Annual Test.**
Complete all Category 1 tests with the exception of the Directional Dependency Test 4.e.
 - (i) Acceptance / Pass Criteria - reflects those noted for Category 1 tests.
- 6. **Category 3: Test Before Operational Use.**
Complete Category 1 test "Check Source Response" at paragraph 4.f.
 - (i) Acceptance / Pass criteria - check source response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

- 7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 16 Doserate Meter PDR1, IDR1, PDR1Sv and PDR1/R&G**Function** Low Level Gamma Survey Monitor

Publications A: NE Technology Instruction Manual Intrinsically Safe Dose Ratemeter IDR1
 B: NE Technology Instruction Manual Portable Dose Ratemeter PDR1
 C: NE Technology Instruction Manual Portable Dose Ratemeter PDR1/R&G
 D: NE Technology Instruction Manual Portable Dose Ratemeter PDR1Sv

NSN 6665-99-726-3084**Required Reference Standards**

Gamma Reference Standards - ^{137}Cs & ^{241}Am sources shall offer traceability to national standards.

X-radiations - 65 keV ISO Narrow Series X-ray irradiations shall offer traceability to national standards.

Check Source No check source is currently assigned to this unit.

Equipment Overview

Description and Use: The PDR1 provides a general purpose gamma survey capability for determination of low rate emissions.

Physical Construction: The housing is of moulded plastic construction, comprising a logarithmic analogue meter and ratemeter electronics.

Detector Type: Energy compensated GM tube.

Doserate Range: $0.05\mu\text{Sv}\cdot\text{h}^{-1}$ to $100\mu\text{Sv}\cdot\text{h}^{-1}$.

Energy Range: 40 keV – 1.3 MeV.

**Controls**

1. A comprehensive summary of the instrument functions is contained within Publications Reference A, B, C or D.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

- a. **Battery tests.**

Switch the rotary control to the 'BATT CHECK' position and ensure the battery level on the analogue meter falls within the black portion of the display.
 Replace as necessary.

- b. **Mechanical checks.**

Examine the instrument for damage, ensuring the plastic case and handle assembly are free from cracks, the analogue meter and rotary control knob remain fit for use.
 Replace defective parts as necessary.

- c. Energise the unit and ensure the meter remains stable and does not exhibit excessive fluctuation.

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background doserate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a doserate >10 times scale maxima for at least thirty seconds.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high doserate testing at a level >10 times the maximum credible doserate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance / Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Expose the UUT to at least two doserates per decade of operation, representing values greater/less than 40% of the decade under test. Test guidance has been provided in the table below (example Min – Max ranges have been provided such that errors up to 30% will NOT pull the unit into a lower/higher decade).

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	% of Decade	Example Min/Max ^{137}Cs Doserates
$H^*(10)$	$H^*(10)$	$H^*(10)$
1 - 10 $\mu\text{Sv.h}^{-1}$	$<40\%$ of Decade	1.5 – 3.5 $\mu\text{Sv.h}^{-1}$
1 - 10 $\mu\text{Sv.h}^{-1}$	$>40\%$ of Decade	6.6 – 7.6 $\mu\text{Sv.h}^{-1}$
10 – 100 $\mu\text{Sv.h}^{-1}$	$<40\%$ of Decade	15 – 30 $\mu\text{Sv.h}^{-1}$
10 – 100 $\mu\text{Sv.h}^{-1}$	$>40\%$ of Decade	58 – 76 $\mu\text{Sv.h}^{-1}$

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of delivered reference rates.

d. **Energy Response Test (60 keV ²⁴¹Am)**

Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ¹³⁷Cs value.

- (i) Acceptance / Pass criteria – The ¹³⁷Cs: ²⁴¹Am response shall indicate a ratio of 1:0.86 (±30%) when exposed to the same ADE rate, an example is provided below.

Example ¹³⁷Cs Response for PDR1

H*(10)
25 µSv.h⁻¹

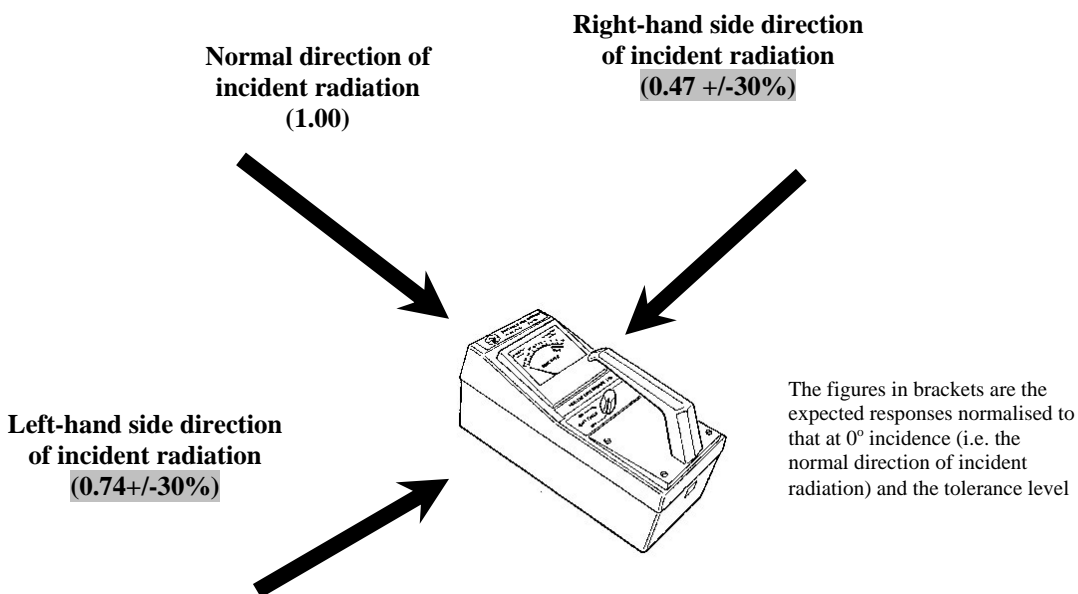
Example ²⁴¹Am Permitted Range

H*(10)
15.05 – 27.95 µSv.h⁻¹

e. **Directional Dependency**

Expose the instrument in the -90° and +90° orientation (as shown below) to the same doserate/energy combination used during the 'Energy Response Test', record the observed reading and calculate a response ratio using the frontal response obtained during the 'Energy Response Test'.

Figure 3. **Expected Directional Dependency**



- (i) Acceptance / Pass criteria – The responses shall reflect the responses detailed in Figure 1.

f. **Check Source Response.**

No check source is currently assigned to this unit.

6. **Category 2: Annual Test.**

Complete all Category 1 tests except Directional Dependency Test 4.e.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

7. **Category 3: Test before Operational Use.**

Complete Category 1 test "Check Source Response" at paragraph 4.f.

- (i) Acceptance / Pass criteria – Response should be ±20% of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

8. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 17 Doserate Meter PDR2, IDR2 and PDR2Sv

Function Low to Medium Level Gamma Survey Monitor

Publications A: NE Technology Instruction Manual Intrinsically Safe Dose Ratemeter IDR2
B: NE Technology Instruction Manual Portable Dose Ratemeter PDR2
C: NE Technology Instruction Manual Portable Dose Ratemeter PDR2Sv

NSN 6665-99-282-5356

Equipment Declared Obsolete under DIN number to be confirmed.

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 18 Doserate Meter PDR3 and PDR3Sv

Function Medium to High Level Gamma Survey Monitor, with integrated dose function.

Publications A: NE Technology Instruction Manual Portable Dose Ratemeter PDR3
B: NE Technology Instruction Manual Portable Dose Ratemeter PDR3Sv

NSN 6665-99-477-4181

Equipment Declared Obsolete under DIN number to be confirmed.

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 19 Doserate Meter PDR4, PDR4Sv

Function Low to medium Level Gamma Survey Monitor with contamination monitor input.

Publications A: NE Technology Instruction Manual Portable Dose Ratemeter PDR4
 B: NE Technology Instruction Manual Portable Dose Ratemeter PDR4Sv

NSN N/A

Equipment Declared Obsolete under DIN number to be confirmed.

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 20 Doserate Meter RO2, RO2W and RO2A**Function** Photon Dose Rate Meter**Publications** A: BR 2053(112) Beta Gamma Doserate meter Type RO-2
B: Eberline RO2, RO2W and RO2A Instruction Manual.**NSN** 6665-01-243-5942**Required Reference Standards**Gamma Reference Standards - ¹³⁷Cs & ²⁴¹Am sources shall offer traceability to national standards.

X-radiations - 65 keV ISO Narrow Series x-ray irradiations shall offer traceability to national standards.

Check Source ⁹⁰Sr/Y Mk 13 NJ check source NSN: 6665-99-733-5728**Equipment Overview****Description and Use:** The RO2 series of instruments provide a general purpose and low energy beta / gamma & X radiation detection capability.**Physical Construction:** The instrument is of two piece aluminium construction, the lower section is largely void and incorporates a sliding beta window assembly, The upper section accommodates the detector, user controls, desiccators, analogue meter and batteries.**Detector Type:** Vented Ion Chamber**Doserate Range: (Over 4 Ranges)****Range 1:** 0 – 50 $\mu\text{Sv.h}^{-1}$ **Range 2:** 0 – 500 $\mu\text{Sv.h}^{-1}$ **Range 3:** 0 – 5 mSv.h^{-1} **Range 4:** 0 – 50 mSv.h^{-1} **Energy Range:** 20 keV - >1.3 MeV**Doserate Meter RO2****Controls**

1. A comprehensive summary of instrument functionality is contained within 'Publications' reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. **Battery tests.**

Ensure the battery compartment is in good order and batteries provide the necessary voltage for operation.

Replace as necessary.

b. **Mechanical checks.**

Ensure the instrument chassis (including machine screws), analogue meter, rotary control knob, detector window and slide are free from damage.

Replace defective parts as necessary.

- c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator / detector spacing of at least 1000mm should be maintained).

Record the instrument background dose rate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a dose rate >10 times scale maxima for at least thirty seconds. Please note all 4 ranges of the instrument must be subjected to this testing to a dose rate > 10 times the scale maximum.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high dose rate testing at a level >10 times the maximum credible dose rate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance / Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery is NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Expose the UUT to at least one dose rate in each range of operation, the selected rate should be between 50% and 75% of scale maxima for each range tested.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within $\pm 30\%$ of delivered reference rates.

Scale of Operation	% of Scale	Example Min/Max ^{137}Cs Doserates
$H^*(10)$	$H^*(10)$	$H^*(10)$
0 - 50 $\mu\text{Sv.h}^{-1}$	50% -75%	25 – 35 $\mu\text{Sv.h}^{-1}$
0 - 500 $\mu\text{Sv.h}^{-1}$	50% -75%	250 – 350 $\mu\text{Sv.h}^{-1}$
0 - 5 mSv.h^{-1}	50% -75%	2.5 – 3.5 mSv.h^{-1}
0 - 50 mSv.h^{-1}	50% -75%	25 – 35 mSv.h^{-1}

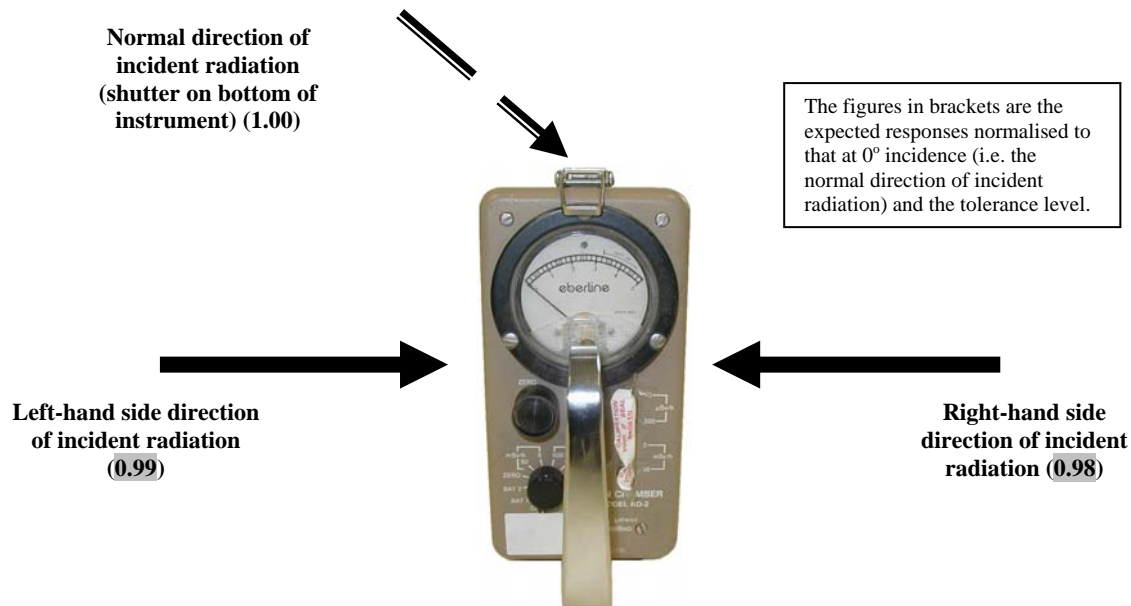
d. **Energy Response Test (60 keV ^{241}Am or 65 keV ISO Narrow Series X-ray)**

Expose the instrument to a dose rate reflecting one of the dose rates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ^{137}Cs value.

- (i) Acceptance / Pass criteria – The ^{137}Cs : ^{241}Am /X-ray response shall indicate a ratio of 1:0.91 ($\pm 30\%$) when exposed to the same ADE rate, an example is provided below.

Example ^{137}Cs Response $H^*(10)$ $25 \mu\text{Sv.h}^{-1}$ Example 'Tested Energy' Permitted
Range $H^*(10)$ $15.93 - 29.58 \mu\text{Sv.h}^{-1}$ e. **Directional Dependency**

Expose the instrument in the -90° and $+90^\circ$ orientation (as shown below) to the same dose rate/energy combination used during the 'Energy Response Test', record the observed reading and calculate a response ratio using the frontal response obtained during the 'Energy Response Test'.

Figure 4. **Expected Directional Dependency**

(i) Acceptance / Pass criteria – The responses shall reflect the responses detailed in Figure 1.

f. **Check Source Response.**

Open the shutter and place the check source centrally against the foil, care should be taken to ensure the foil is NOT damaged. Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. **Category 2: Annual Test.**

Complete all Category 1 tests with the exception of the Directional Dependency Test 4.e.

(i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test before Operational Use.**

Complete Category 1 test "Check Source Response" at paragraph 4.f.

(i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 21 Gamma Alarm Type PNI 1248

Function Submarine Manoeuvring Room On-Board High Level Gamma Alarm

Publications A: Plessey PTM92/00 Technical Manual

NSN 6665-99-538-9196

Description

1. The equipment is housed in a wall-mounted cubicle, with all the indicators and controls on the front panel. (Which is also the hinged door of the cubicle). All the electronic components are mounted on a printed circuit board PCB assembly 611/1/07620. The Gamma Alarm Monitor can be used on 240 volts ac or 115 volts ac; the instrument when dispatched from the manufacturer is wired for 115V AC operation. The instrument is fitted in the Manoeuvring Room of nuclear Submarines to give a high Level alarm if the dose rate reaches a pre-set level of 50uSv/h.



Gamma Alarm Type PNI 1248

Controls:

2. A comprehensive summary of the instrument functions is contained within publications Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, probe case and window. Replace as necessary.
 - b. Check operation of all controls
 - c. **Equipment test.**
 - (i) Operate TEST switch and hold for up to 2 seconds. This energises the Equipment Failed Alarm (EFA) and the High Level Alarm (HLA) indicators and the audible alarm.
 - (ii) Release TEST switch. The audible alarm persists but the EFA and HLA indicators extinguish within 15 seconds. Operate AUDIBLE ALARM MUTE momentarily and the audible alarm is de-energised.
 - (iii) Operate TEST switch. This again energises the EFA and HLA indicators and audible alarm.
 - (iv) Holding the TEST switch in operate position, operate AUDIBLE ALARM MUTE. This de-energises the audible alarm but indicators are illuminated.
 - (v) On releasing the TEST switch, the EFA and HLA indicators are extinguished within 15 seconds and audible alarm remains de-energised.
 - (vi)

Radiation Tests

Note: This instrument is an adjustable set point alarm with no progressive meter indication. Therefore conventional calibration protocols cannot be followed. However, tests to confirm correct equipment operation are to be completed as shown.

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.

a. **High Level Alarm Trip:**

- (i) Place the unit at a distance for an exposure rate of 50 uSv/h at the Geiger-Muller tube.

Result: The HLA should be energised.

- (ii) Operate the Audible Alarm Mute switch. The audible alarm is de-energised but the visual alarm persists. Wait for 2 minutes.

Result: The visual HLA lamp should remain ON.

- (iii) Move the unit, away to from source to a position where the exposure rate is 30 uSv/h. Wait 30 seconds.

Result: The HLA visual indicator should be extinguished.

- (iv) Wait another 2 minutes and note that the HLA indicator remains extinguished.

b. **Geiger-Muller Tube Saturation:**

- (i) Position the unit at the appropriate distance for an exposure of 1Sv/h at the Geiger-Muller tube.

- (ii) Expose the source and check that the HLA is energised immediately.

6. **Category 2: Annual Test.** Complete all Category 1 tests.

- (i) Acceptance / pass criteria are the same as Category 1 tests.

7. **Category 3: Test Before Operational Use.** This equipment is designed for permanent operation, therefore test before use is inappropriate. Complete Functional checks i.a.w. Reference A. and on-board Preventative Maintenance Schedule (PMS).

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 22 Doserate Meter Type ADM-300A(V1A)**Function** Photon Dose Rate Meter**Publications** A: NRC ADM-300 Multi Function Survey Meter Operators Manual
B: BR 2053(119) Multi Function Survey Meter**NSN** 6665-01-418-8038**Required Reference Standards**Gamma Reference Standards - ^{137}Cs & ^{241}Am sources shall offer traceability to national standards.

X-radiations - 65 keV ISO Narrow Series X-ray irradiations shall offer traceability to national standards.

Check Source No check source is currently assigned to a stand alone ADM-300A(V1A).

Equipment Overview**Description and Use:** The ADM-300A(V1A) provides a dose/rate monitoring capability and offers connectivity and ratemeter support to a range of external probes.**Physical Construction:** The ADM-300A(V1A) electronics are housed within a cast alloy housing. A membrane keypad and 2 line LCD display are provided for user interfacing.**Detector Type:** 2 off GM Tubes**Doserate Range:** 0.01 $\mu\text{Sv/h}$ - 100Sv/h (dynamic)0.01 $\mu\text{Sv/h}$ - 50mSv/h (approx.) Low Range
30mSv/h (approx.) - 100Sv/h High Range**Energy Range:** 80 keV - 3 MeV**Controls**

1. A comprehensive summary of the instrument functions is contained within Publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. Battery tests.Ensure batteries are in good order and provide the necessary voltage for operation.
Replace as necessary.**b. Mechanical checks.**Ensure the instrument chassis (including machine screws), beta shutter, internal window; beta shutter hinge, input sockets, membrane keypad and LCD Display are free from damage.
Replace as necessary.**c. Ancillary Equipment.**

Ensure the instrument pouch & strap / gun handle assembly (if supplied) are free from damage.

Replace as necessary.

- d. Energise the unit and check operation of all controls (when switched on, the ADM300A (V1A) self test routine will activate).

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background doserate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a doserate >10 times scale maxima for at least thirty seconds.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high doserate testing at a level >10 times the maximum credible doserate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance / Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Expose the UUT to at least one doserate per decade of operation listed in the table below (example min/max ranges have been provided such that errors up to $\pm 30\%$ will NOT pull the unit into a lower/higher decade). Where decades cannot be tested due to facility restrictions, the limit of the calibration should be covered by the statement defining the limit of calibration on the calibration certificate.

Note: Two readings are required for decade 10 – 100 mSv.h^{-1} as both detectors operate in this decade.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate. At least three repeat measurements of the observed dose rate response should be carried out.

Decade of Operation	Detector Tested	Example Min/Max ^{137}Cs Doserates
H*(10)	H*(10)	H*(10)
1 - 10 $\mu\text{Sv.h}^{-1}$	Low	1.5 – 7.5 $\mu\text{Sv.h}^{-1}$
10 - 100 $\mu\text{Sv.h}^{-1}$	Low	15 – 75 $\mu\text{Sv.h}^{-1}$
100 – 1000 $\mu\text{Sv.h}^{-1}$	Low	150 – 750 $\mu\text{Sv.h}^{-1}$
1 - 10 mSv.h^{-1}	Low	1.5 – 7.5 mSv.h^{-1}
10 – 100 mSv.h^{-1}	Low	15 – 38 mSv.h^{-1}
10 – 100 mSv.h^{-1}	High	72 – 76 mSv.h^{-1}
100 – 1000 mSv.h^{-1}	High	150 – 750 mSv.h^{-1}

1 - 10 Sv.h ⁻¹ *	High	1.5 – 7.5 Sv.h ⁻¹
10 - 100 Sv.h ⁻¹ *	High	15 - 75 Sv.h ⁻¹

(i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to ±30% of delivered reference rates.

Note: Where errors exceed acceptance / pass criteria the response may be corrected by following the steps laid down in Annex 1 of the protocol manual.

d. **Dose Test. (¹³⁷Cs)**

Reset the accumulated dose following instructions documented in publications A & B, expose the instrument to a doserate/time combination enabling dose accumulation to the target levels below. On completion of the tests, record the results on the calibration certificate.

¹³⁷ Cs Dose Target	¹³⁷ Cs Permitted Range
H*(10)	H*(10)
1 mSv*	700 µSv – 1.3 mSv
40 mSv	28 – 52 mSv

*The 1.0mSv dose must be achieved using a doserate of <20mSvh⁻¹.

(i) Acceptance / Pass criteria – Instrument response shall reflect conformity to within ±30% of the target dose value.

e. **Energy Response Test (60 keV ²⁴¹Am or 65 keV ISO Narrow Series X-ray)**

Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ¹³⁷Cs value.

(i) Acceptance / Pass criteria – The ¹³⁷Cs: 'Tested energy' response shall indicate a ratio of 1:3.324 (±30%) when exposed to the same ADE rate, an example is provided below.

Example ¹³⁷Cs Response	Example 'Tested Energy' Permitted Range
H*(10)	H*(10)
25 µSv.h ⁻¹	58.17 – 108.03 µSv.h ⁻¹

f. **Directional Dependency**

Expose the instrument in the -90° and +90° orientation (as shown below) to the same doserate/energy combination used during the 'Energy Response Test', record the observed reading for each position and calculate response ratios using the frontal response obtained during the 'Energy Response Test'.

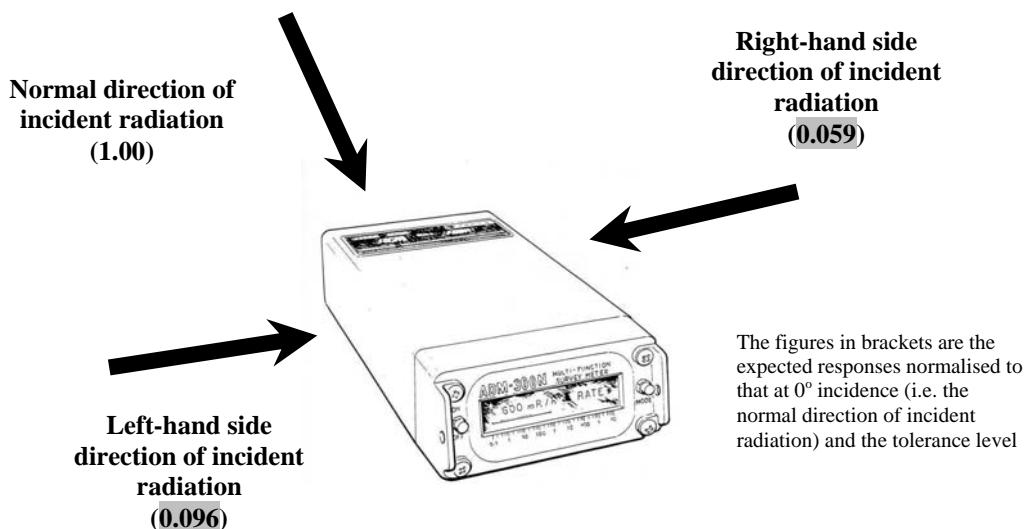


Figure 5. Expected Directional Dependency

(i) Acceptance / Pass criteria – The responses shall reflect the responses detailed in Figure 1 $\pm 30\%$.

g. **Check Source Response.**

No check source is currently assigned to a stand alone ADM-300A(V1A).

5. **Category 2: Annual Test.**

Complete all Category 1 tests except Directional Dependency Test 4.f.

(i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test before Operational Use.**

Complete Category 1 test "Check Source Response" at paragraph 4.g.

(i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 23 Contamination Probe Alpha, Beta, Gamma Type FHZ731

Function Alpha/Beta/Gamma Surface Contamination Monitor Probe

Publications A: AP 112G-1326-0
B: Manufactures Manual

NSN 6665-12-326-4538

Required Reference Standards

Extended area - All sources shall offer traceability to national standards and must be emission rate calibrated

²⁴¹Am Isotrak code AMR 07032 or AMR 06032;

²³⁸Pu Isotrak code PPR 07022 or PPR 06022;

^{NAT}U Isotrak code UAR 07022 or UAR 06032;

⁹⁰Sr/Y Isotrak code SIR 07032 or SIR 06032;

¹⁴C Isotrak code CFR 07032 or CFR 06032;

¹⁴⁷Pm Isotrak code PHR 07022 or PHR 06022;

⁶⁰Co Isotrak code CKR 07032 or CKR 06032;

¹³⁷Cs Isotrak code CDR 07032 or CDR 06032;

³⁶Cl Isotrak code CIR 07032 or UAR 06032.

Small area (16mm Active Diameter) - All sources shall offer traceability to national standards and must be emission rate calibrated.

²⁴¹Am Isotrak code AMR 01011, AMR 01021 and AMR 01031.

⁹⁰Sr/Y Isotrak code SIR 01011, SIR 01021 and SIR 01031.

Check Source - ^{Nat}U Isotrak code UAC 1623 NSN 6665-99-193-3906.

Equipment Overview

Description and Use: The FHZ731 / FH40F2M combination provides a non discriminated general purpose alpha/beta/gamma contamination monitoring capability.

Physical Construction: The probe is of machined aluminium construction incorporating the detector, input connector and associated electronics.

Detector Type: Pancake GM Tube.

Energy Range:

Alpha Energy Range: >5MeV

Beta Energy Range: 156 keV (¹⁴C) – 2.28MeV (⁹⁰Sr/Y)

Gamma Energy Range: Not characterized.

Detector Active Area: 15.5 cm² (LND Data for 7311)



FHZ731 Probe

Controls

1. A comprehensive summary of probe functionality is contained within 'Publications' A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: Calibration shall only be undertaken when supported by a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery tests.**
Probe power is supplied by the parent ratemeter, therefore adequate checks should be undertaken to ensure batteries provide the necessary voltage for operation.
Replace as necessary.
 - b. **Mechanical checks.**
Ensure the probe case, grille assembly, detector window and input socket are free from damage.
Replace defective parts as necessary.
 - c. Energise the unit and check operation of all controls.

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.
 - a. **Determination of Operating Voltage.**
The operating voltage of the equipment is preset and cannot be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.
 - b. **Background Count Rate.**
Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.
 - (i) Acceptance / Pass criteria - The background level should be less than 1.5 cps in a field of < 0.25 $\mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
 - c. **Light Sensitivity. (With Light Source Only)**
The probe should be exposed to an appropriate light source, any significant change in background should be observed.
 - (i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.
 - d. **Light Sensitivity. (With Radioactive Source)**
Position one of the small area alpha sources (listed in 'Required Reference Standards') on the face of the detector and record the probe's response with and without the presence of the light source.
 - (i) Acceptance / Pass criteria - The response to the source should remain unaffected by the presence of the light source.
 - e. **Response To Alpha Contamination.**
The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per $\text{Bq}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	2.18	1.53 – 2.83	22.3	15.61 – 28.99
²³⁸ Pu	1.97	1.38 – 2.56	20.1	14.07 – 26.13
NatU	5.26	3.68 – 6.84	53.7	37.59 – 69.81

- (i) Acceptance / Pass criteria – The instrument response should be within ±30% of the mean responses / efficiencies reported above.

f. Response To Beta Contamination.

The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2π efficiency (%) are given in part 2 of JSP 425.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
¹⁴ C	1.25	0.88 – 1.63	12.7	8.89 – 16.51
¹⁴⁷ Pm*	1.67	1.17 – 2.17	17.0	11.9 – 22.1
⁶⁰ Co	2.31	1.62 – 3.00	23.5	16.45 – 30.55
¹³⁷ Cs*	3.36	2.35 – 4.37	34.4	24.08 – 44.72
³⁶ Cl	3.71	2.60 – 4.82	37.8	26.46 – 49.14
⁹⁰ Sr/Y	4.17	2.92 – 5.42	42.7	29.89 – 55.51

- (i) Acceptance / Pass criteria – The instrument response should be within ±30% of the mean responses / efficiencies reported above.

g. Linearity of Response.

Place each of the small area sources listed in 'Required Reference Standards' centrally with a source to detector face separation of 3mm. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within ± 30% for both alpha and beta source sets.

h. Uniformity of Response.

Due to the small window area a uniformity test is NOT required on this unit.

i. Beta Rejection.

Not applicable for this probe.

j. Check Source Response.

With the source in its screw container, place the thick end of the container centrally in contact with the probe grille. Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

Unscrew the source container, place the black portion of the check source container centrally in contact with the probe grille. Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. Category 2: Annual Test. Complete all Category 1 tests.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 4.j.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificates.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 24 Doserate Meter Type FAG FH40F2M

Function Digital Gamma Survey Monitor

Publications A: AP112G-1326-0 Radiation Monitor Type FH40
B: ESM Instruction Manual FH40F2M RADIACMETER

NSN 6665-12-326-4538

Required Reference Standards

Gamma Reference Standards - ^{137}Cs & ^{241}Am sources shall offer traceability to national standards.

X-radiations - 65 keV ISO Narrow Series X-ray irradiations shall offer traceability to national standards.

Check Source ^{238}U Isotrak code UAC 1623 (NSN 6665-99-193-3906)

Equipment Overview

Description and Use: The FH40F2M provides a dose/rate monitoring capability and offers connectivity and ratemeter support to an external probe.

Physical Construction: The unit is of two piece plastic construction, the upper section houses the membrane keypad, LCD display and sounder assembly. The lower portion accommodates the battery and associated printed circuit boards.

Detector Type: 1 off GM Tube (energy compensated).

Doserate Range: 0.01 $\mu\text{Sv/h}$ to 9.99mSv/h

Energy Range: 45keV – 1.3MeV



Controls

1. A comprehensive summary of instrument functionality is contained within 'Publications' Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery tests.**
Ensure the battery compartment is in good order and batteries provide the necessary voltage for operation.
Replace as necessary.
 - b. **Mechanical checks.**
Ensure the instrument chassis (including machine screws), input socket, membrane keypad and LCD Display are free from damage.
Replace defective parts as necessary.
 - c. **Ancillary Equipment.**
Ensure the instrument carry case / strap are free from damage.
Replace as necessary.
 - d. Energise the unit and check operation of all controls (when switched on, the ratemeter self test routine will activate).

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background doserate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a doserate >10 times scale maxima for at least thirty seconds.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high doserate testing at a level >10 times the maximum credible doserate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance / Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery is NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Expose the UUT to at least one doserate per decade of operation listed in the table below (example min/max ranges have been provided such that errors up to $\pm 30\%$ will NOT pull the unit into a lower/higher decade. Where decades cannot be tested due to facility restrictions, the limit of the calibration should be covered by the statement defining the limit of calibration on the calibration certificate).

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	Example Min/Max ^{137}Cs Doserates
H*(10)	H*(10)
1 – 10 $\mu\text{Sv.h}^{-1}$	1.5 – 7.5 $\mu\text{Sv.h}^{-1}$
10 – 100 $\mu\text{Sv.h}^{-1}$	15 – 75 $\mu\text{Sv.h}^{-1}$
100 – 1000 $\mu\text{Sv.h}^{-1}$	150 – 750 $\mu\text{Sv.h}^{-1}$
1 – 10 mSv.h^{-1}	1.5 – 7.5 mSv.h^{-1}

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within $\pm 30\%$ of delivered reference rates.

d. **Dose Test (^{137}Cs).**

Reset the accumulated dose following instructions documented in publications A & B, expose the instrument to a doserate/time combination enabling dose accumulation to the target levels below. On completion of the tests, record the results on the calibration certificate.

^{137}Cs Dose Target

H*(10)

1 mSv

^{137}Cs Permitted Range

H*(10)

700 μSv – 1.3 mSv

- (i) Acceptance / Pass criteria – Instrument response shall reflect conformity to within $\pm 30\%$ of the target dose value.
- e. **Energy Response Test (60 keV ^{241}Am or 65 keV ISO Narrow Series X-ray)**
Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ^{137}Cs value.
- (i) Acceptance / Pass criteria – The ^{137}Cs : ^{241}Am /X-ray response shall indicate a ratio of 1:1.07 ($\pm 30\%$) when exposed to the same ADE rate, an example is provided below.

Example ^{137}Cs Response

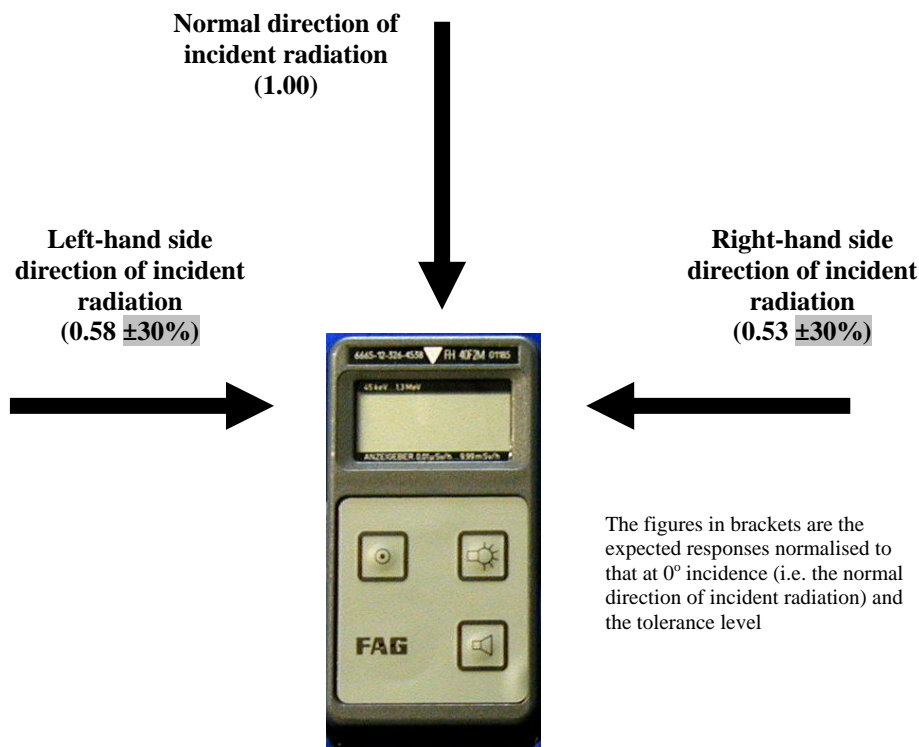
H*(10)
25 $\mu\text{Sv}\cdot\text{h}^{-1}$

Example ^{241}Am /X-ray Permitted Range

H*(10)
18.73 – 34.78 $\mu\text{Sv}\cdot\text{h}^{-1}$

f. **Directional Dependency**

Expose the instrument in the -90° and $+90^\circ$ orientation (as shown below) to the same doserate/energy combination used during the 'Energy Response Test', record the observed reading and calculate a response ratio using the frontal response obtained during the 'Energy Response Test'.

Figure 6. **Expected Directional Dependency**

- (i) Acceptance / Pass criteria – The responses shall reflect the responses detailed in Figure 1.
- g. **Check Source Response.**
Unscrew the UAC 1623 check source from its protective enclosure, place the source such that the black circular portion is centrally positioned and in direct contact with the front of the instrument (the inverted triangle provides a reference point for this measurement). Allow approximately 30 seconds for the instrument to stabilize and record the reading.
- (i) Acceptance / Pass criteria – The check source response should be 2.48 $\mu\text{Sv/h} \pm 30\%$.

5. **Category 2: Annual Test.**

Complete all Category 1 tests except Directional Dependency Test 4.f.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test before Operational Use.**

Complete Category 1 test “Check Source Response” at paragraph 4.g.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 25 Hot Spot Monitor Type Mk 8NRM

Function **Semi Flexible Arm High Range Gamma Hot Spot monitor**

Publications A:

NSN 6665-9999-736-4918

Equipment Declared Obsolete under DIN 07-025

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 26 SIRS Low Level Detector Head Mk 28NH

Function Low Level Gamma Detection Head

Publications A: BRF 2053(17)
B: BRF 2053(18)

NSN 6665-99-733-5339

Required Reference Standards

All measurement equipment used must be traceable to national standards.

Equipment required for setting up the Mk 28NH detector head can be found in publications Reference A & B.

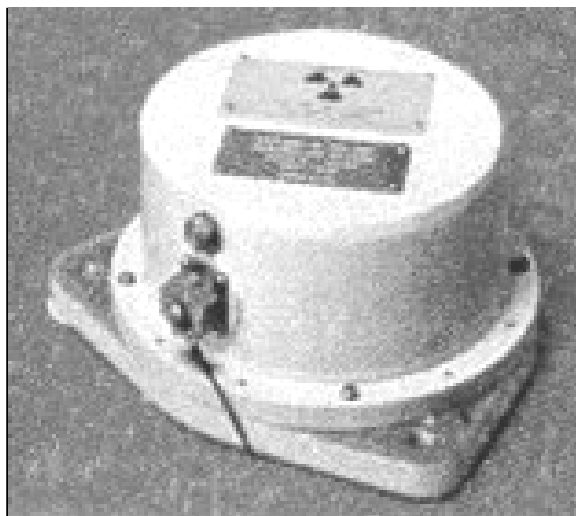
Description and Use: The Mk 28NH Detector head is part of the Mk 22NRS and Mk 23NRS Ships Installed RADIAC Systems and the Transportable Reactor Accident Monitoring System (TRAMS). Protocols for the calibration of the complete systems are given in [Protocol 50 Ships Installed RADIAC System \(SIRS\) Mk 22 NRS](#), [Protocol 50a Ships Installed RADIAC System \(SIRS\) Mk 23 NRS](#) and [Protocol 53 Transportable Reactor Accident Monitoring System \(TRAMS\)](#). The Mk 28NH provides low level dose-rate information. When fitted as part of a SIRS system the Mk 28NH is used for the (WARNING) channels. The Detector head assembly contains a Geiger Muller detector and Keep-Alive radioactive source (^{90}Sr 1.11kBq) to enable fail safe indication on assembly failure at the control console.

Physical Construction: The detection heads are of waterproof construction formed from an aluminium base plate and 'top hat' assembly, within which the associated electronics and GM tube assembly are mounted. Connection to the unit is made via a 3-pin plug fitted on the side of the housing assembly.

Detector Type: Tube type ZP1320

Doserate Range: 0 to 9.99 mGy.h⁻¹.

Energy Range: 80 keV - 3 MeV



Mk 28 NH Low Level Detector Head

Controls

1. A comprehensive summary of the instrument functions is contained within publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated detector head and Display console combinations. Where separate testing of detector heads and control consoles is required appropriate subsidiary test should be completed, to confirm suitability of replacement detector head or control console. These tests may be derived from those detailed in this protocol.

Note: This protocol should only be carried out using a calibrated control console.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

- a. **Mechanical checks.** Check mechanical integrity of detector head case, cables, and cable connections. Replace as necessary.
- b. Check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.

- a. **Background Dose Rate.**

(Not applicable as this instrument does not measure down to background)

- b. **Response to High Dose Rates.**

Expose the instrument to a dose rate in excess of that which it could reasonably encounter in practice, for at least thirty seconds.

- (i) Acceptance / Pass criteria - The instrument should maintain the reading through out the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown. .

Note: Where possible, instruments should be overload tested at 10 times the maximum scale indication. It is recognised that for a number of test houses this is impracticable. In these instances instruments should be tested at 5 or 10 times the maximum credible dose rate to which the instrument could be exposed. These instruments shall be labelled "Limited Cal" and the calibration certificate shall clearly state the limits of the overload and range testing

- c. **Linearity of Response. (¹³⁷Cs and / or ⁶⁰Co)**

Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the observed dose rate response should be carried out.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Applied Dose Rate	⁶⁰ Co Permitted Range	¹³⁷ Cs Permitted Range
50 µGy.h ⁻¹	42.7 - 79.3 µGy.h ⁻¹	35 - 65 µGy.h ⁻¹
500 µGy.h ⁻¹	427 - 793 µGy.h ⁻¹	350 - 650 µGy.h ⁻¹
5 mGy.h ⁻¹	4.3 - 7.9 mGy.h ⁻¹	3.5 - 6.5 mGy.h ⁻¹
7.5 mGy.h ⁻¹	6.4 - 11.9 mGy.h ⁻¹	5.25 - 9.75 mGy.h ⁻¹

- (i) Acceptance / Pass criteria - Is instrument response within ± 30% i.e. within the permitted ranges shown above.

- d. **Dose Test**

A dose test is NOT required on this unit.

- e. **Energy Response Test. (¹³⁷Cs and / or ⁶⁰Co)**

Expose the instrument to either a ¹³⁷Cs or a ⁶⁰Co radiation field at a dose rate of 0.1 mGy.h⁻¹. Select the alternative nuclide for this test to the one used for the Linearity of Response Test 5.c. i.e. if ¹³⁷Cs was used in 5.c. use ⁶⁰Co.

Note: Due to the construction of this equipment it is not practical to perform this test at the Best Practice recommended energy of 60 keV. This test is to be used as a confirmation of the set-up and calibration of the equipment against the alternative nuclides used for calibration.

Dose Rate	^{60}Co Permitted Range	^{137}Cs Permitted Range
0.1 mGy.h ⁻¹	0.09 - 1.6 mGy.h ⁻¹	0.07 - 1.3 mGy.h ⁻¹

- (i) Acceptance / Pass criteria - Is within $\pm 30\%$ i.e. within the permitted range shown above.

f. **Directional Dependency at 60 keV (^{241}Am or 65 keV ISO X-ray Quality).**

Expose the instrument to ^{241}Am or 65 keV ISO X-ray Quality radiation field at a dose rate of 0.1 mGy.h⁻¹ the expected polar responses are shown in Figure 1.

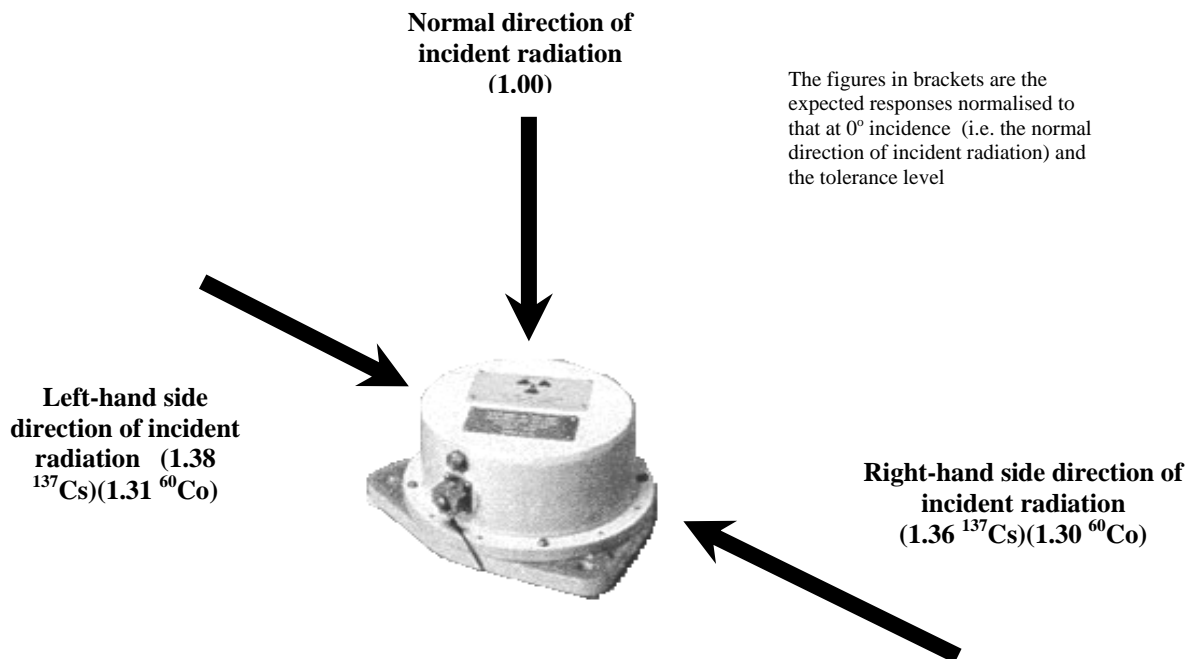


Figure 1. **Expected Directional Dependency**

- (i) Acceptance / Pass criteria response should be within $\pm 30\%$ of type test data.
2. **Category 2: Annual Test.** Complete all Category 1 tests except Directional Dependency Test 4.f.
- (i) Acceptance / Pass criteria are the same as Category 1 tests.
3. **Category 3: Test Before Operational Use.** Complete Functional checks i.a.w. Publications Reference A & B and on-board Preventative Maintenance Schedule (PMS).

Certification (Qualified Person authorisation required)

4. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 27 SIRS High Level Detector Head Mk 29NH

Function High Level Gamma Detection Head

Publications A: BRF 2053 (17)
B: BRF 2053 (18)

NSN 6665-99-733-1142

Required Reference Standards

All measurement equipment used must be traceable to national standards.

Equipment required for setting up the Mk 29NH detector head can be found in publications Reference A & B.

Equipment Overview

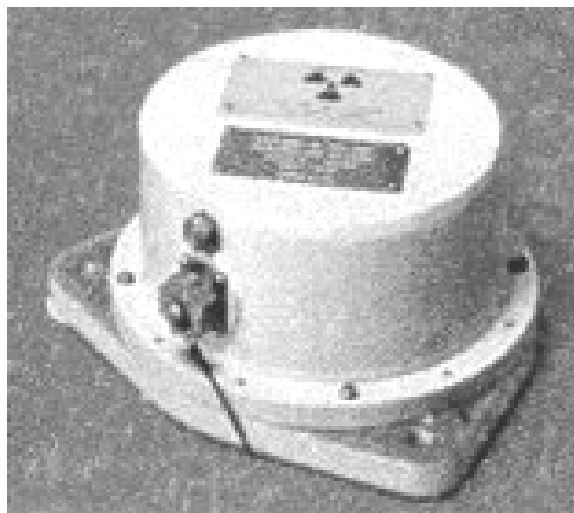
Description and Use: The Mk 29NH Detector head is part of the Mk 22NRS and Mk 23NRS Ships Installed RADIAC Systems and the Transportable Reactor Accident Monitoring System (TRAMS). Protocols for the calibration of the complete systems are given in [Protocol 50 Ships Installed RADIAC System \(SIRS\) Mk 22 NRS](#), [Protocol 50a Ships Installed RADIAC System \(SIRS\) Mk 23 NRS](#) and [Protocol 53 Transportable Reactor Accident Monitoring System \(TRAMS\)](#). The Mk 29NH provides high level dose-rate information. When fitted as part of a SIRS system the Mk 29NH is used for the (CONTROL) channels. The Detector head assembly contains a Geiger Muller detector and Keep-Alive radioactive source (^{90}Sr 2.6 MBq) to enable fail safe indication on assembly failure at the control console.

Physical Construction: The detection heads are of waterproof construction formed from an aluminium base plate and 'top hat' assembly, within which the associated electronics and GM tube assembly are mounted. Connection to the unit is made via a 3-pin plug fitted on the side of the housing assembly.

Detector Type: Tube type 3G10

Doserate Range: 0 to 9.99 Gy.h⁻¹.

Energy Range: 80 keV - 3 MeV



Mk 29 NH High Level Detector Head

Controls

2. A comprehensive summary of the instrument functions is contained within publications Reference A & B.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated detector head and display console combinations. Where separate testing of detector heads and control consoles is required appropriate subsidiary test should be completed, to confirm suitability of replacement detector head or control console. These tests may be derived from those detailed in this protocol.

Note: This protocol should only be carried out using a calibrated control console.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical checks.**
Check mechanical integrity of detector head case, cables, and cable connections. Replace as necessary.
 - b. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.
 - a. **Background Dose Rate.**
(Not applicable as this instrument does not measure down to background)
 - b. **Response to High Dose Rates.**
Expose the instrument to a dose rate in excess of that which it could reasonably encounter in practice, for at least thirty seconds.
 - (i) Acceptance / Pass criteria - The instrument should maintain the reading through out the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.

Note: Where possible, instruments should be overload tested at 10 times the maximum scale indication. It is recognised that for a number of test houses this is impracticable. In these instances instruments should be tested at 5 or 10 times the maximum credible dose rate to which the instrument could be exposed. These instruments shall be labelled "Limited Cal" and the calibration certificate shall clearly state the limits of the overload and range testing

- c. **Linearity of Response. (¹³⁷Cs and / or ⁶⁰Co)**
Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the observed dose rate response should be carried out.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Applied Dose Rate	⁶⁰ Co Permitted Range	¹³⁷ Cs Permitted Range
5 cGy.h ⁻¹	3.8 – 7.0 cGy.h ⁻¹	3.5 - 6.5 cGy.h ⁻¹
10 cGy.h ⁻¹	7.6 – 14.0 cGy.h ⁻¹	7 - 13 cGy.h ⁻¹
50 cGy.h ⁻¹	37.8 – 70.2 cGy.h ⁻¹	35 - 65 cGy.h ⁻¹
100 cGy.h ⁻¹	75.6 – 140.4 cGy.h ⁻¹	70 - 130 cGy.h ⁻¹
200 cGy.h ⁻¹	151.2 – 280.8 cGy.h ⁻¹	140 - 260 cGy.h ⁻¹

- (i) Acceptance / Pass criteria - Is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.
- d. **Dose Test**
A dose test is NOT required on this unit.
- e. **Energy Response Test. (¹³⁷Cs and / or ⁶⁰Co)**
Expose the instrument to either a ¹³⁷Cs or a ⁶⁰Co radiation field at a dose rate of 5 cGy.h⁻¹. Select the alternative nuclide for this test to the one used for the Linearity of Response Test 5.d. i.e. if ¹³⁷Cs was used in 5.d. use ⁶⁰Co.

Note: Due to the construction of this equipment it is not practical to perform this test at the Best Practice recommended energy of 60 keV. This test is to be used as a confirmation of the set-up and calibration of the equipment against the alternative nuclides used for calibration.

Dose Rate	⁶⁰ Co Permitted Range	¹³⁷ Cs Permitted Range
5 cGy.h ⁻¹	3.8 – 7.0 cGy.h ⁻¹	3.5 - 6.5 cGy.h ⁻¹

- (i) Acceptance / Pass criteria - Is within $\pm 30\%$ i.e. within the permitted range shown above.

f. **Directional Dependency at 60 keV (²⁴¹Am or 65 keV ISO X-ray Quality).**

Expose the instrument to ²⁴¹Am or 65 keV ISO X-ray Quality radiation field at a dose rate of 10 cGy.h⁻¹ the expected polar responses are shown in Figure 1.

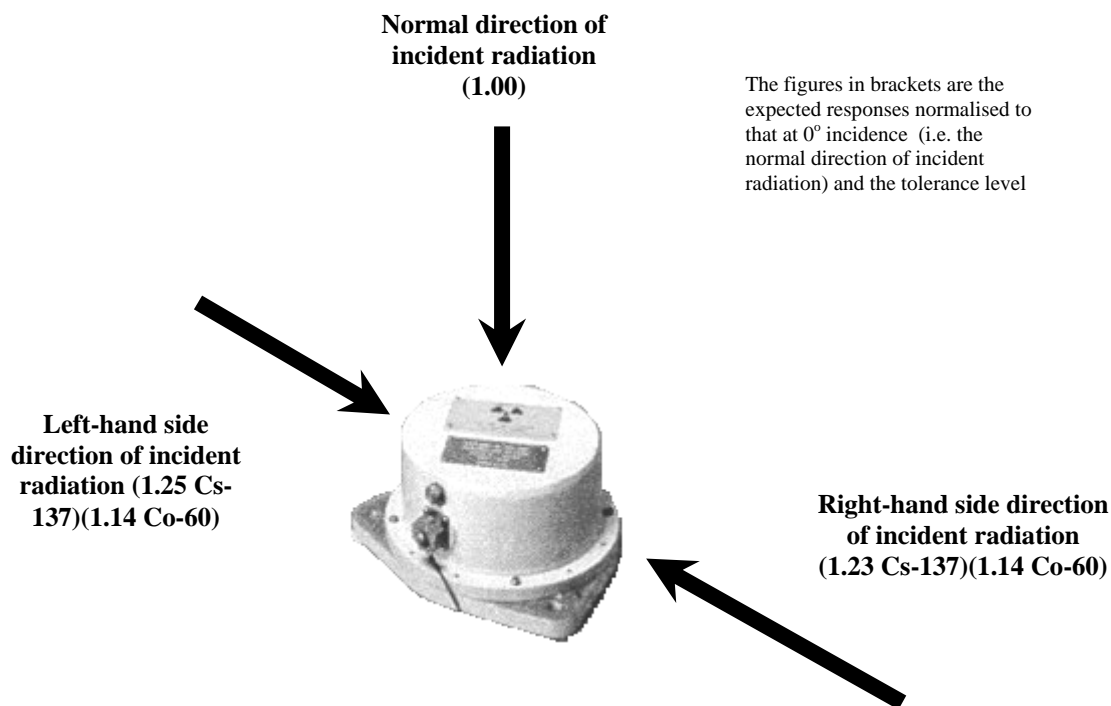


Figure 1. **Expected Directional Dependency**

- (i) Acceptance / Pass criteria - Response should be within $\pm 30\%$ of type test data.

g. **Check Source Response.**

No check source is currently assigned to this unit.

6. **Category 2: Annual Test.**

Complete all Category 1 tests except Directional Dependency Test 5.f.

- (i) Acceptance / pass criteria - Are the same as Category 1 tests.

7. **Category 3: Test before Operational Use.**

Complete Functional checks i.a.w. Publications Reference A & B and on-board Preventative Maintenance Schedule (PMS).

Certification (Qualified Person authorisation required)

8. Certify test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 28 Contamination Monitor Low Energy X-ray Monitor Type IS610A

Function Weapon Accident Contamination Monitor

Publications A: AP112G-1324-0 X-Ray Monitor Type NIS610A

NSN 6665-99-083-1929

Required Reference Standards/Equipment

All must be activity calibrated

Spectrometry Standard Reference Source

²⁴¹Am Spectrometry standard reference source, nominal activity 60 kBq. Requires activity calibration.

²⁴¹Am Spectrometry standard reference source, nominal activity 6 kBq. Requires activity calibration.

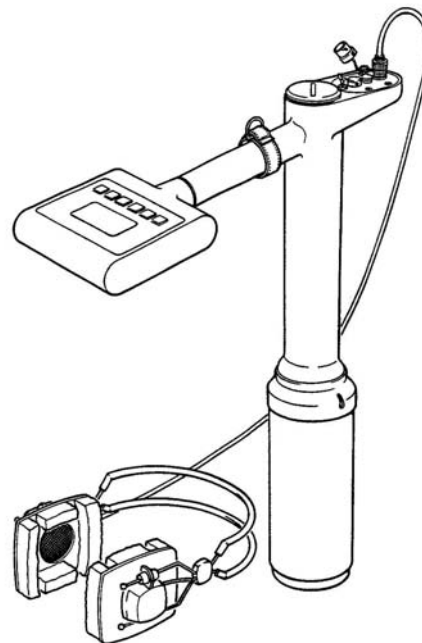
Other additional Equipment required can be found in AP112G-1321-1

Description

1. The IS610 is a portable large area X-ray ground contamination monitor. It comprises of a large area NaI detector 75mm in diameter by 1mm thick, coupled to a high gain photo multiplier tube. The detected radiation falls into 3 channels. Channel 1 covers the energy range 10 – 24 KeV and is centered on the ²³⁹Pu and ²⁴¹Am X-rays. Channel 2 covers the energy range 47 – 72 KeV and is centered on the gamma from ²⁴¹Am. Channel 3 covers the energy range 10 – 72 KeV and can be used as a seek and find channel. The display is an LCD type, which can display two channels at any time.

Controls

2. A comprehensive summary of the dose rate meter functions is contained within the Publication Reference A.



IS610A

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical checks.** Check mechanical integrity of Instrument Case and body, Display head, headphones and BNC socket, detector face and window. Replace as necessary.
 - b. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - c. Check operation of all controls and switches.

5. **Category 1 Test: Test before First Use.** The IS610A is an instrument which requires electronic alignment of its reference peak before first use, also the pass/fail criteria are held within software, which calculates all of the results automatically. It is with this in mind that all tests before first use are carried out IAW the procedures laid down in the AP listed at the beginning of this protocol.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** The test before operational use is laid down in the AP listed at the beginning of this protocol.
 - (i) Acceptance / pass criteria is that laid down in the Air Publication.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 29 Mini Instruments Type 6-80**Function** Gamma Environmental Monitor**Publications** A: Environmental Radiation Meter Type 6-80 Manufacturers Handbook**NSN** N/A**Required Reference Standards**

Gamma Reference Standards	-	¹³⁷ Cs & ²⁴¹ Am sources shall offer traceability to national standards.
---------------------------	---	---

X-radiations	-	65 keV ISO Narrow Series X-ray irradiations shall offer traceability to national standards.
--------------	---	---

Check Source ¹³⁷Cs Point source **Isotrak** code CDR1122 mounted in plastic sleeve.

Equipment Overview

Description and Use: The Mini 6-80 provides a doserate monitoring capability for determination of environmental gamma radiation levels.

Physical Construction: Ratemeter – The ratemeter is of two piece plastic construction, the upper section houses the analogue / digital displays, input connector, controls and provides a seat for the internal electronics. The lower portion contains the batteries but is largely void.

Probe – The probe comprises a tufnol body with a Pet-100 series HV connector mounted at the lower end.

Detector Type: 1 off GM Tube
 MC70 (uncompensated)
 MC71 (compensated)

Doserate Range: 0 – 75µGy/h or 0 – 75µSv/h

Energy Range: Energy response of 55keV – 1.2MeV.



Mini 6-80 connected to MC probe

Note: The unit supports a digital scaler assembly enabling determination of rates over protracted monitoring periods, correction of the digitally scaled count relies on a ratio of 16 counts s⁻¹/µGy/h

Controls

1. A comprehensive summary of instrument functionality is contained within 'Publications' Reference A.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

- a. **Battery tests.**

Ensure the battery compartment is in good order and batteries provide the necessary voltage for operation.

Replace as necessary.

- b. **Mechanical checks.**

Ensure the instrument chassis (including machine screws), input socket, rotary knob, depression switches, LCD and analogue displays are free from damage.

Replace defective parts as necessary.

- c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

- a. **Background Dose Rate. (Analogue Meter)**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background dose rate on the calibration certificate.

Integrated Background. (Digital Meter)

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained). Set the instrument for a 30 second count and start the integration.

Record the instrument background dose rate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

- b. **Response to High Dose Rates.**

Expose the UUT to a dose rate >10 times scale maxima for at least thirty seconds.

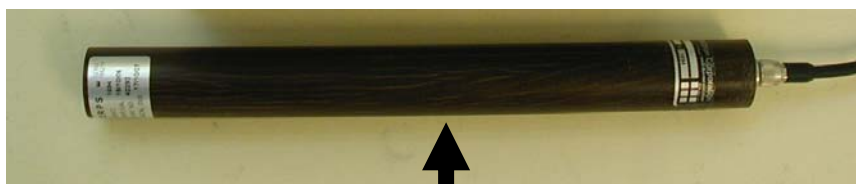
Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high dose rate testing at a level >10 times the maximum credible dose rate which could be encountered during operational use. Units tested in this manner shall carry a 'Limited Cal' tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance / Pass criteria – The instrument Analogue meter should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

- c. **Linearity of Response (^{137}Cs).**

Expose the UUT to at least two dose rates per decade of operation, representing values greater/less than 40% of the decade under test. Test guidance has been provided in the table below (example Min – Max ranges have been provided such that errors up to 30% will NOT pull the unit into a lower/higher decade).

Note: The angle of incidence of exposures for this instrument should be at 90° to the front of the environmental probe as indicated below.



Incident Radiation

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	% of Decade	Example Min/Max ¹³⁷ Cs Doserates
$\mu\text{Sv/h}$ or $\mu\text{Gy/h}$	μSv or $\mu\text{Gy/h}$	$\mu\text{Sv/h}$ or $\mu\text{Gy/h}$
1 - 10	<40% of Decade	1.5 – 3.5
1 - 10	>40% of Decade	6.6 – 7.6
10 - 75	<40% of Decade	14.3 – 27.5
10 - 75	>40% of Decade	52 – 57.6

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within $\pm 30\%$ of delivered reference rates.
- d. **Energy Response Test. (60 keV ²⁴¹Am or 65 keV ISO Narrow Series x-ray)**
Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ¹³⁷Cs value.
- (i) Acceptance / Pass criteria – The ¹³⁷Cs: ²⁴¹Am/X-ray response shall indicate a ratio of 1:0.647 (μSv) or 1:1 (μGy) $\pm 30\%$ when exposed to the same ADE rate, an example is provided below.

Example ¹³⁷Cs Response for the MC71 probe

$\mu\text{Sv/h}$ or $\mu\text{Gy/h}$

10 $\mu\text{Sv.h}^{-1}$

10 $\mu\text{Gy.h}^{-1}$

Example ²⁴¹Am/X-ray Permitted Range

$\mu\text{Sv/h}$ or $\mu\text{Gy/h}$

4.54 – 8.42 $\mu\text{Sv.h}^{-1}$

7.00 – 13.0 $\mu\text{Gy.h}^{-1}$

- e. **Directional Dependency.**
Due to the omni-directional nature of the probe this test is not required.
- f. **Check Source Response.**
Place the ¹³⁷Cs Check Source sleeve over the probe wait for 30 seconds to allow reading to stabilize, record the response after the 30 seconds has elapsed. The result should be recorded on the instrument calibration certificate.
5. **Category 2: Annual Test.**
Complete all Category 1 tests.
- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.
6. **Category 3: Test before Operational Use.**
Complete Category 1 test "Check Source Response" at paragraph 4.f.
- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 30 Mini Instruments Type 7-10G

Function Installed Gamma Monitor

Publications A: MINALARM Type 7-10 Alarm Monitor Manufacturers Handbook.

NSN N/A

Required Reference Standards

Gamma Reference Standards - ^{137}Cs & ^{241}Am sources shall offer traceability to national standards.

X-radiations - 65 keV ISO Narrow Series x-ray irradiations shall offer traceability to national standards.

Check Source ^{137}Cs Point source **Isotrak** code CDR1122 mounted in plastic.

Equipment Overview

Description and Use: The 7-10G is a common range alarming gamma monitoring capability used in semi-installed applications.

Physical Construction: Ratemeter – The ratemeter is of two piece construction, the rear section, formed from sheet aluminium houses the mains input, conditioning circuitry, alarm beacon and carry handle. The steel front panel accommodates the user controls, meter and probe input / alarm output connectors.

Probe – The probe comprises a tufnol body with a Pet-100 series HV connector mounted at the lower end.

Detector Type: 1 off GM Tube
MC70 (uncompensated)
MC71 (compensated)

Doserate Range: 0 – 75 $\mu\text{Gy/h}$ or 0 – 75 $\mu\text{Sv/h}$

Energy Range: Energy response of 55keV – 1.2MeV.



Mini 7-10 Alarm + MC Probe

Controls

1. A comprehensive summary of instrument functionality is contained within 'Publications' Reference A.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. Electrical checks.

The unit is a mains powered device, therefore prior to undertaking any works an electrical safety / Portable Appliance Test (PAT) must be carried out by a Suitably Qualified Experienced Person (SQEP).

(i) Acceptance / Pass criteria – The unit shall conform to the testing criteria.

b. Mechanical checks.

Ensure the instrument chassis (including machine screws), input sockets, depression switches, indicating beacon and analogue display are free from damage. Replace defective parts as necessary.

- c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background dose rate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a dose rate >10 times scale maxima for at least thirty seconds.

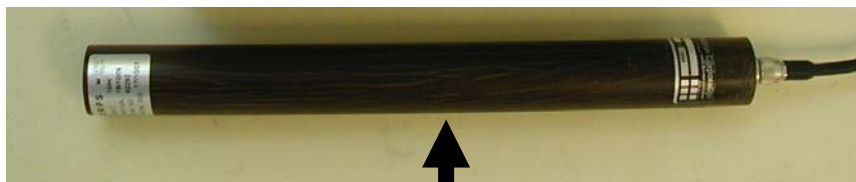
Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high dose rate testing at a level >10 times the maximum credible dose rate which could be encountered during operational use. Units tested in this manner shall carry a 'Limited Cal' tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance / Pass criteria - The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Expose the UUT to at least two dose rates per decade of operation, representing values greater/less than 40% of the decade under test. Test guidance has been provided in the table below (example Min – Max ranges have been provided such that errors up to 30% will NOT pull the unit into a lower/higher decade).

Note: The angle of incidence of exposures for this instrument should be at 90° to the front of the environmental probe as indicated below.



Incident Radiation

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	% of Decade	Example Min/Max ¹³⁷ Cs Doserates
H*(10)	H*(10)	H*(10)
1 - 10 $\mu\text{Sv.h}^{-1}$	<40% of Decade	1.5 – 3.5 $\mu\text{Sv.h}^{-1}$
1 - 10 $\mu\text{Sv.h}^{-1}$	>40% of Decade	6.6 – 7.6 $\mu\text{Sv.h}^{-1}$
10 - 75 $\mu\text{Sv.h}^{-1}$	<40% of Decade	14.3 – 27.5 $\mu\text{Sv.h}^{-1}$
10 - 75 $\mu\text{Sv.h}^{-1}$	>40% of Decade	52 – 57.6 $\mu\text{Sv.h}^{-1}$

- (i) Acceptance / Pass criteria – Instrument response shall reflect conformity to within $\pm 30\%$ of the delivered reference rates.

d. **Energy Response Test (60 keV ²⁴¹Am or 65 keV ISO Narrow Series X-ray)**

Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ¹³⁷Cs value.

- (i) Acceptance / Pass criteria – The ¹³⁷Cs: ²⁴¹Am/X-ray response shall indicate a ratio of 1:0.647 ($\pm 30\%$) when exposed to the same ADE rate, an example is provided below.

Example ¹³⁷Cs Response

H*(10)
10 $\mu\text{Sv.h}^{-1}$

Example ²⁴¹Am/X-ray Permitted Range

H*(10)
4.54 – 8.42 $\mu\text{Sv.h}^{-1}$

e. **Directional Dependency**

Due to the omni-directional nature of the probe this test is not required.

f. **Check Source Response.**

Place the ¹³⁷Cs Check Source sleeve over the probe wait for 30 seconds to allow reading to stabilize, record the response after the 30 seconds has elapsed. The result should be recorded on the instrument calibration certificate.

5. **Category 2: Annual Test.**

Complete all Category 1 tests.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test before Operational Use.**

Complete Category 1 test "Check Source Response" at paragraph 4.f.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 31 Mini Monitor Series 900 + 42b Probe**Function** Photon Surface Contamination Monitor**Publications** A: AP112G-1325-0 Mini Monitor 900 Series
B: Instrument Operating handbook Series 900 Scintillation Mini Monitor with types 41, 42A/B & 44A/B probes.**NSN** 6665-99-570-5736**Required Reference Standards**

Extended area - All sources shall be suitably filtered to remove alpha/beta emissions and must be emission rate calibrated, offering traceability to national standards.

⁵⁵ Fe	Photon Reference Source Isotrak code IERB 4536;
²³⁸ Pu	Photon Reference Source Isotrak code PPRB 4472;
¹²⁹ I	Photon Reference Source Isotrak code ISRB 4474;
²⁴¹ Am	Photon Reference Source Isotrak code AMRB 4473;
⁵⁷ Co	Photon Reference Source Isotrak code CTRB 3504;
¹³⁷ Cs	Photon Reference Source Isotrak code CDRB 4475;
⁶⁰ Co	Photon Reference Source Isotrak code CKRB 4476.

Small area (16mm Active Diameter) - All sources shall offer traceability to national standards and must be emission rate calibrated.

⁹⁰Sr/Y **Isotrak** code SIR 01011, SIR 01021 and SIR 01031.Check Source ^{Nat}U **Isotrak** code UAC 1623 NSN 6665-99-193-3906.**Equipment Overview****Description and Use:** The Mini Monitor 900/42b' probe combination provides a general purpose Photon contamination / leakage monitoring capability.**Physical Construction: Ratemeter –** The ratemeter is of two piece construction, the rear section, formed from sheet aluminium houses the battery cradle, charging circuitry and sounder. The steel front panel accommodates the user controls and analogue meter. **Probe –** The probe comprises a spun Aluminium body housing the detector, photo multiplier tube, dynode resistors and a Pet-100 series HV connector mounted at the upper end.**Detector Type:** Beryllium windowed NaI crystal.**Photon Energy Range:** 5.9 keV (Fe-55) to 1.25 MeV (Co-60) significant reduction at >200 keV.**Detector Active Area:** 4.1 cm².

Mini Monitor 900 + 42B probe

Controls

1. A comprehensive summary of instrument functionality is contained within 'Publications' reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery tests.**
Ensure the battery compartment is in good order and batteries provide the necessary voltage for operation.
Replace as necessary.
 - b. **Mechanical checks.**
Ensure the instrument chassis (including machine screws), analogue meter, rotary control knob, cable, probe case, detector window and probe connectors are free from damage.
Replace defective parts as necessary.
 - c. **Energise the unit and** check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.
 - a. **Determination of Operating Voltage.**
The operating voltage of the equipment is preset and cannot be quantitatively altered without disassembling the instrument. Therefore no operating voltage plateau can be measured for this instrument.

Note: The operating voltage should only be altered if the unit response to ^{55}Fe is low, this operation requires the front panel to be removed and internal potentiometers adjusted, set up details are provided in within 'Publications' reference A & B.
 - b. **Background Count Rate.**
Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.
 - (i) Acceptance / Pass criteria - The background level should be less than 8 cps in a field of $< 0.25 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
 - c. **Light Sensitivity. (With Light Source Only)**
The probe should be exposed to an appropriate light source, any significant change in background should be observed.
 - (i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.
 - d. **Light Sensitivity. (With Radioactive Source)**
Due to the small area of the probe it is likely that positioning a radioactive source beneath the detector during the test will obscure light entering the probe therefore this test is NOT applicable to the unit.
 - e. **Response To Photon Contamination.**
The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per $\text{cm}^{-1}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425.

Nuclide	cps.em ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
⁵⁵ Fe	0.44	0.31 – 0.57	10.66	7.46 – 13.86
²³⁸ Pu	1.75	1.23 – 2.28	42.60	29.82 – 55.38
¹²⁹ I	1.34	0.94 – 1.74	32.75	22.92 – 42.57
²⁴¹ Am	1.70	1.19 – 2.21	41.47	29.03 – 53.91
⁵⁷ Co	0.80	0.56 – 1.04	19.62	13.74 – 25.51
¹³⁷ Cs	0.22	0.15 – 0.29	5.30	3.71 – 6.89
⁶⁰ Co	0.20	0.14 – 0.26	4.98	3.48 – 6.47

- (i) Acceptance / Pass criteria – The instrument response should be within ±30% of the mean efficiencies reported above.

f. Linearity of Response.

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within ± 30%.

g. Uniformity of Response.

Due to the small window area a uniformity test is NOT required on this unit.

h. Check Source Response.

With the source in its screw container, place the thick end of the container centrally in contact with the end of the probe. Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. Category 2: Annual Test. Complete all Category 1 tests noting the asterisk marked sources in the 'Response to Alpha Contamination' tests.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. Category 3: Test Before Operational Use. Complete Category 1 test "Check Source Response" at paragraph 4.h.

- (i) Acceptance / Pass criteria – Response should be ±20% of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 32 Mini Monitor Series 900 + 44b Probe**Function** Photon Surface Contamination Monitor**Publications** A: AP112G-1325-0 Mini Monitor 900 Series
B: Instrument Operating handbook Series 900 Scintillation Mini Monitor with types 41, 42A/B & 44A/B probes.**NSN** 6665-99-801-3983**Required Reference Standards**

Extended area - All sources shall be suitably filtered to remove alpha/beta emissions and must be emission rate calibrated, offering traceability to national standards.

⁵⁵ Fe	Photon Reference Source Isotrak code IERB 4536;
²³⁸ Pu	Photon Reference Source Isotrak code PPRB 4472;
¹²⁹ I	Photon Reference Source Isotrak code ISRB 4474;
²⁴¹ Am	Photon Reference Source Isotrak code AMRB 4473;
⁵⁷ Co	Photon Reference Source Isotrak code CTRB 3504;
¹³⁷ Cs	Photon Reference Source Isotrak code CDRB 4475;
⁶⁰ Co	Photon Reference Source Isotrak code CKRB 4476.

Small area (16mm Active Diameter) - All sources shall offer traceability to national standards and must be emission rate calibrated.

⁹⁰Sr/Y **Isotrak** code SIR 01011, SIR 01021 and SIR 01031.Check Source ^{Nat}U **Isotrak** code UAC 1623 NSN 6665-99-193-3906.**Equipment Overview****Description and Use:** The Mini Monitor 900/44b' probe combination provides a general purpose Photon contamination / leakage monitoring capability.**Physical Construction: Ratemeter –** The ratemeter is of two piece construction, the rear section, formed from sheet aluminium houses the battery cradle, charging circuitry and sounder. The steel front panel accommodates the user controls and analogue meter. **Probe –** The probe comprises a spun Aluminium body housing the detector, photo multiplier tube, dynode resistors and a Pet-100 series HV connector mounted at the upper end.**Detector Type:** Beryllium windowed NaI crystal.**Photon Energy Range:** 5.9 keV (Fe-55) to 1.25 MeV (Co-60) significant reduction at >200 keV.**Detector Active Area:** 8.0 cm².**Mini Monitor 900 + 44b Probe****Controls**

1. A comprehensive summary of instrument functionality is contained within 'Publications' reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery tests.**
Ensure the battery compartment is in good order and batteries provide the necessary voltage for operation.
Replace defective parts as necessary.
 - b. **Mechanical checks.**
Ensure the instrument chassis (including machine screws), analogue meter, rotary control knob, cable, probe case, detector window and probe connectors are free from damage.
Replace defective parts as necessary.
 - c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.
 - a. **Determination of Operating Voltage.**
The operating voltage of the equipment is preset and cannot be quantitatively altered without disassembling the instrument. Therefore no operating voltage plateau can be measured for this instrument.

Note: The operating voltage should only be altered if the unit response to ^{55}Fe is low, this operation requires the front panel to be removed and internal potentiometers adjusted, set up details are provided in within 'Publications' reference A & B.
 - b. **Background Count Rate.**
Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.
 - (i) Acceptance / Pass criteria - The background level should be less than 15 cps in a field of $< 0.25 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
 - c. **Light Sensitivity. (With Light Source Only)**
The probe should be exposed to an appropriate light source, any significant change in background should be observed.
 - d. **Light Sensitivity. (With Radioactive Source)**
Due to the small area of the probe it is likely that positioning a radioactive source beneath the detector during the test will obscure light entering the probe therefore this test is NOT applicable to the unit.
 - (i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.
 - e. **Response To Photon Contamination.**
The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per $\text{em}^{-1}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425.

Nuclide	cps.em ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
⁵⁵ Fe	2.31	1.62 – 3.00	28.91	20.24 – 37.59
²³⁸ Pu	7.09	4.96 – 9.22	88.57	62.0 – 115.14
¹²⁹ I	7.14	5.00 – 9.28	89.20	62.44 – 115.96
²⁴¹ Am	8.58	6.01 – 11.15	107.28	75.09 – 139.46
⁵⁷ Co	6.46	4.52 – 8.40	80.71	56.5 – 104.92
¹³⁷ Cs	1.57	1.01 – 2.04	19.68	13.78 – 25.59
⁶⁰ Co	1.07	0.75 – 1.39	13.35	9.35 – 17.36

(i) Acceptance / Pass criteria – The instrument response should be within ±30% of the mean efficiencies reported above.

f. **Linearity of Response.**

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

(i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within ± 30%.

g. **Uniformity of Response.**

Due to the small window area a uniformity test is NOT required on this unit.

h. **Check Source Response.**

With the source in its screw container, place the thick end of the container centrally in contact with the end of the probe. Allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. **Category 2: Annual Test.** Complete all Category 1 tests.

(i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 4.h.

(i) Acceptance / Pass criteria – Response should be ±20% of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 33 Mini Monitor Series 900 + 'E' Probe**Function** Alpha/Beta Surface Contamination Monitor**Publications** A: Mini Monitor Series 900, Models E, EL, S, SL & X operators Manual**NSN** N/A**Required Reference Standards**

All must be emission rate calibrated: -

Extended area

²⁴¹Am Type WRS 7/E Amersham code AMR 07032 or Type WRS 6/E AMR 06032;²³⁸Pu Type WRS 7/E Amersham code PPR 07032 or Type WRS 6/E PPR 06032;^{Nat}U Type WRS 7/E Amersham code UAR 07032 or Type WRS 6/E UAR 06032;¹⁴C Type WRS 7/E Amersham code CFR 07032 or Type WRS 6/E CFR 06032;³⁶Cl Type WRS 7/E Amersham code CIR 07032 or Type WRS 6/E CIR 06032;¹⁴⁷Pm Type WRS 7/E Amersham code PHR 07032 or Type WRS 6/E PHR 06032;⁹⁰Sr/Y Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032;⁶⁰Co Type WRS 7/E Amersham code CKR 07032 or Type WRS 6/E CKR 06032;¹³⁷Cs Type WRS 7/E Amersham code CDR 07032 or Type WRS 6/E CDR 06032.

Small area (16mm Active Diameter)

⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.²⁴¹Am Type WRS 1/E Amersham code AMR 01011, AMR 01021 and AMR 01031.**Description**

1. The Mini Monitor Series 900 is a common rate meter, when used with the 'E' probe is scaled from 0-2 kCPS. The unit has a control knob on the front panel allowing the following operations, OFF, BAT, ON and ON WITH MUTED AUDIO. The battery check is displayed on the green and white band of the meter. The unit has an alarm function which is set using the SET ALARM potentiometer on the front of the unit (a source is required for this procedure). The 'E' is an Alpha/Beta probe comprising of a thin end window GM tube with a stainless steel grille for protection from damage.

**Mini Monitor Series 900 + 'E' Probe****Probe Active Area:** 2 cm²**Controls**

2. A comprehensive summary of the ratemeter functions is contained within the Publication, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
- Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, probe case and window. Replace as necessary.
 - Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.
- Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
 - Response To Alpha/Beta Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	0.99	0.69 – 1.29	31.33	21.93 – 40.73
²³⁸ Pu	0.87	0.61 – 1.13	27.77	19.44 – 36.10
^{NAT} U	1.67	1.17 – 2.17	53.80	37.66 – 69.94
¹⁴ C	0.37	0.26 – 0.48	11.75	8.22 – 15.27
³⁶ Cl	1.33	0.93 – 1.73	42.58	29.81 – 55.35
¹⁴⁷ Pm	0.93	0.65 – 1.20	23.88	16.71 – 31.04
⁹⁰ Sr/Y	1.32	0.92 – 1.71	42	29.40 – 54.59
⁶⁰ Co	1.12	0.79 – 1.46	35.59	24.91 – 46.26
¹³⁷ Cs	1.28	0.90 – 1.67	40.82	28.57 - 53.06

- Acceptance / pass criteria is instrument response within ± 30% i.e. within the expected levels shown above.

- c. **Check Source Response.** (no check source has been assigned to this unit).
 - d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn 3mm below the detector. Record the net response (cps) for each planar disc source.
 - (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
 - e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
 - f. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria is a background level of approx. < 2 cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
 - (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 34 Mini Monitor Series 900 + 'EL' Probe**Function** Alpha/Beta Surface Contamination Monitor**Publications** A: Mini Monitor Series 900, Models E, EL, S, SL & X operators Manual**NSN** N/A**Required Reference Standards**

All must be emission rate calibrated: -

Extended area

²⁴¹Am Type WRS 7/E Amersham code AMR 07032 or Type WRS 6/E AMR 06032;²³⁸Pu Type WRS 7/E Amersham code PPR 07032 or Type WRS 6/E PPR 06032;^{Nat}U Type WRS 7/E Amersham code UAR 07032 or Type WRS 6/E UAR 06032;¹⁴C Type WRS 7/E Amersham code CFR 07032 or Type WRS 6/E CFR 06032;³⁶Cl Type WRS 7/E Amersham code CIR 07032 or Type WRS 6/E CIR 06032;¹⁴⁷Pm Type WRS 7/E Amersham code PHR 07032 or Type WRS 6/E PHR 06032;⁹⁰Sr/Y Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032;⁶⁰Co Type WRS 7/E Amersham code CKR 07032 or Type WRS 6/E CKR 06032;¹³⁷Cs Type WRS 7/E Amersham code CDR 07032 or Type WRS 6/E CDR 06032.

Small area (16mm Active Diameter)

²⁴¹Am Type WRS 1/E Amersham code AMR 01011, AMR 01021 and AMR 01031.**Description**

1. The Mini Monitor Series 900 is a common rate meter, when used with the EL probe is scaled from 0-600 cps. The unit has a control knob on the front panel allowing the following operations, OFF, BAT, ON and ON WITH MUTED AUDIO. The battery check is displayed on the green and white band of the meter. The unit has an alarm function which is set using the SET ALARM potentiometer on the front of the unit (a source is required for this procedure). The 'EL' is an Alpha/Beta probe comprising of a thin end window organically quenched GM tube with a stainless steel grille for protection from damage.

**Mini Monitor Series 900 + 'EL' Probe****Probe Active Area:** X cm²**Controls**

2. A comprehensive summary of the ratemeter functions is contained within Publication, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
- Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, probe case and window. Replace as necessary.
 - Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.
- Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
 - Response To Alpha/Beta Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	3.13	2.19 – 4.06	32.07	22.45 – 41.69
²³⁸ Pu	2.94	2.06 – 3.82	30.32	21.22 – 39.41
^{NAT} U	4.76	3.33 – 6.19	49.14	34.39 – 63.88
¹⁴ C	1.09	0.76 – 1.41	11.23	7.86 – 14.60
³⁶ Cl	3.70	2.59 – 4.81	39.01	27.30 – 50.71
¹⁴⁷ Pm*	1.89	1.32 – 2.45	19.27	13.49 – 25.06
⁹⁰ Sr/Y	3.85	2.69 – 5.00	40.51	28.35 – 52.66
⁶⁰ Co	2.94	2.06 – 3.82	30.86	21.60 – 40.12
¹³⁷ Cs*	3.57	2.50 – 4.64	37.10	25.97 – 48.23

- Acceptance / pass criteria is instrument response within ± 30% i.e. within the expected levels shown above.

- c. **Check Source Response.** (no check source has been assigned to this unit).
 - d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn 3mm below the detector. Record the net response (cps) for each planar disc source.
 - (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
 - e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
 - f. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria is a background level of approx. $<2\text{cps}$ in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
 - (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 35 Mini Monitor Series 900 + 'X' Probe (Contamination Response)

Function Alpha/Beta Surface Contamination Monitor

Publications A: Mini Monitor Series 900, Models E, EL, S, SL & X operators Manual

NSN N/A

Required Reference Standards

All must be emission rate calibrated:-

Extended area

⁵⁵Fe Photon Reference Source Amersham code IERB 4536;

²³⁸Pu Photon Reference Source Amersham code PPRB 4472;

¹²⁹I Photon Reference Source Amersham code ISRB 4474;

²⁴¹Am Photon Reference Source Amersham code AMRB4473;

⁵⁷Co Photon Reference Source Amersham code CTRB3504;

¹³⁷Cs Photon Reference Source Amersham code CDRB4475;

⁶⁰Co Photon Reference Source Amersham code CKRB4476;

Small area (16mm Active Diameter)

⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031

Description

1. The Mini Monitor Series 900 is a common rate meter, when used with the X-ray probe gives the ability to search for X-ray leakage and high energy Beta emitters. The unit is scaled 0.5 – 2000 CPS and has a control knob on the front panel allowing the following operations, OFF, BAT, ON and ON WITH MUTED AUDIO. The 'X' is an X-Ray/Beta probe comprising of a thin end window GM tube with a diameter of 17mm. The probe response is approximately 2 cps per $\mu\text{Gy/h}$ in air for ¹³⁷Cs and 15 cps per $\mu\text{Gy/h}$ in air for ²⁴¹Am.



Mini Monitor Series 900 + 'X' Probe

Probe Active Area: X cm²

Controls

2. A comprehensive summary of the ratemeter functions is contained within Publication, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, probe case and window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.
 - a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
 - b. **Response To Photon Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)		2 π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
⁵⁵ Fe	TBA	± 30%	TBA	± 30%
²³⁸ Pu	TBA	± 30%	TBA	± 30%
¹²⁹ I	TBA	± 30%	TBA	± 30%
²⁴¹ Am	TBA	± 30%	TBA	± 30%
⁵⁷ Co	TBA	± 30%	TBA	± 30%
¹³⁷ Cs*	TBA	± 30%	TBA	± 30%
⁶⁰ Co	TBA	± 30%	TBA	± 30%

- (i) Acceptance / pass criteria is instrument response within ± 30% i.e. within the expected levels shown above.
- c. **Check Source Response. (no check source has been assigned to this unit).**
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn 3mm below the detector. Record the net response (cps) for each planar disc source.
 - (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within ± 30%.

- e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
 - f. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria is a background level of approx. <3cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 35a Mini Monitor Series 900 + 'X' Probe (Doserate Response)

Function Alpha/Beta Surface Contamination Monitor

Publications A: Mini Monitor Series 900, Models E, EL, S, SL & X operators Manual

NSN N/A

Required Reference Standards

Check Source ^{Nat}U Amersham code UAC 1623 NSN 6665-99-193-3906

Description

1. The Mini Monitor Series 900 is a common rate meter, when used with the X probe gives the ability to search for X-ray leakage and high energy Beta emitters. The unit is scaled 0.5 – 2000 CPS and has a control knob on the front panel allowing the following operations, OFF, BAT, ON and ON WITH MUTED AUDIO. The 'X' is an X-Ray/Beta probe comprising of a thin end window GM tube with a diameter of 17mm. The probe response is approximately 2 cps per $\mu\text{Gy/h}$ in air for ^{137}Cs and 15 cps per $\mu\text{Gy/h}$ in air for ^{241}Am .



Mini Monitor Series 900 + 'X' Probe

Probe Active Area: X cm²

Controls

2. A comprehensive summary of the ratemeter functions is contained within Publication, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, probe case and window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.

- a. **Background Dose Rate.** Remove the instrument from sources and record the instrument background dose rate.
- (i) Acceptance / Pass criteria - instrument response should reflect $\pm 10\%$ of the known dose rate for the area
- b. **Response to High Air Kerma Rates.** Expose the instrument to a dose rate in excess 1 mGy.h^{-1} for at least thirty seconds.
- (i) Acceptance / Pass criteria the instrument should maintain the overload reading throughout the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.
- c. **Check Source Response. (No check source has been assigned to this unit)**
- d. **Linearity of Response. (^{137}Cs)** Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the observed dose rate response should be carried out.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Air Kerma Rate	^{137}Cs Permitted Range
Air Kerma	C.P.S.
10 $\mu\text{Gy.h}^{-1}$	14 – 26
25 $\mu\text{Gy.h}^{-1}$	35 – 65
100 $\mu\text{Gy.h}^{-1}$	140 – 260
500 $\mu\text{Gy.h}^{-1}$	700 – 1300

- (i) Acceptance / pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.
- e. **Energy Response Test at 60 keV (60 keV ^{241}Am).** Expose the instrument to a 60 keV ^{241}Am radiation field at a dose rate of $25\mu\text{Gy.h}^{-1}$.

Air Kerma Rate	^{241}Am Permitted Range
Air Kerma	C.P.S.
25 $\mu\text{Sv.h}^{-1}$	263 – 488

- (i) Acceptance / Pass criteria is within $\pm 30\%$ i.e. within the permitted range shown above.
- f. **Directional Dependency at 60 keV (^{241}Am or 65 keV ISO X-ray Quality).** Expose the instrument to ^{241}Am or 65 keV ISO X-ray Quality radiation field at a dose rate of $25\mu\text{Sv.h}^{-1}$ the expected polar responses are shown in Figure 1.

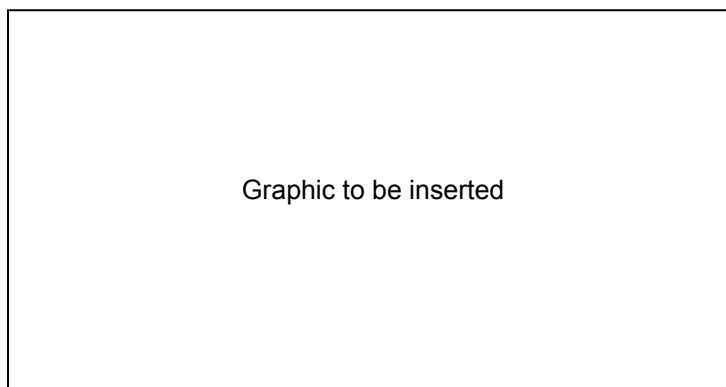


Figure 1: **Expected Directional Dependency**

- (i) Acceptance / Pass criteria check source response should be $\pm 30\%$ type test data.
- 6. **Category 2: Annual Test.** Complete all Category 1 tests with the exception of the Directional Dependency Test 5.f.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
- 7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
 - (i) Acceptance / pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

- 8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 36 Neutron Doserate Meter Type Mk 7NRM**Function** Neutron Dose Rate Meter

Publications

A: BR 2053(13)
 B: Manufactures Technical Manual and User Guide
 C: Good Practice Guide No.14 – The Examination, Testing and Calibration of Portable Radiation Protection Instruments, March 1999
 D: Joint Services Publication 425 – Examination and Testing of Ionising Radiation Protection Instruments, **Edition 3**
 E: Mk7 NRM Neutron Monitor Check Source Assembly Protocol, June 1997
 F: Response Characteristics of Neutron Survey Instruments – NRPB Report No R333 (Revised February 2002)
 G: IEC61005 – Radiation Protection Instruments – Neutron Ambient Dose Equivalent (Rate) Meters, **June 2004**
 H: ICRP 74 - Conversion coefficients for use in radiological protection against external radiation

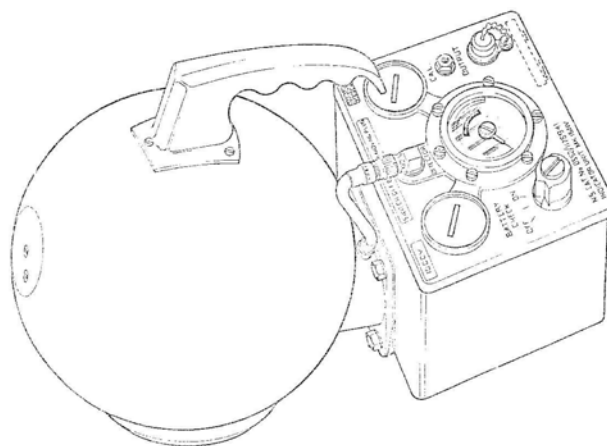
NSN 6665-99-721-2702**Required Reference Standards****Calibration Source Reference Standards**

Reference D recommends the following selected standards for the calibration of Neutron Dose Rate Meters.

$^{241}\text{Am}/^9\text{Be}$
 ^{252}Cf
 $^2\text{H}_2\text{O}$ Moderated ^{252}Cf
 Deuterium-Tritium Accelerator

Check Source Reference Standard $^{241}\text{Am}/^9\text{Be}$ Check Source – NSN 2090-99-930-7770**Description**

1. The ratemeter indicates on a quasilogarithmic scale neutron dose equivalent rate in the range of 0 to 10,000 $\mu\text{Sv}\cdot\text{h}^{-1}$ over a range of neutron energies from thermal to 14 MeV. The neutron detector consists of a 208.3mm (8.2") diameter polyethylene sphere, an intermediate perforated cadmium layer and a 33 mm diameter Helium-3 filled spherical proportional counter mounted in the centre. The proportional counter detects the thermal neutrons that have been moderated by the polyethylene sphere.

**Neutron Monitor Mk 7 NRM****Controls**

2. A comprehensive summary of the ratemeter functions is contained within the Publications, Reference A & B.

Standard Test Protocol

3. This protocol has been produced in accordance with the guidelines detailed within References C, D, E & G. All tests should be recorded for Qualified Person inspection and certificate production. This protocol should only be used in conjunction with calibrated reference standards.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests unless stated otherwise.
 - a. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace batteries as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, polyethylene sphere and meter. Replace as necessary.
 - c. **Functionality.** Check operation of all controls
 - d. **Electrical Set-up.** For Category 1 Tests only; Check electrical settings in accordance with References A & B.

Radiation Tests

Note: References C & D provide guidance on the tests that must be conducted under each category. Additionally, Reference H provides the conversion factors that should be used for the calculation of fluence to Ambient Dose Equivalent (ADE) $H^*(10)$ response. The fluence response characteristics for calibration sources should also be applied in order to obtain an overall instrument response. Refer to Reference F, Page 17 Table 4 for further details.

Note: - For $^{241}\text{Am}/^9\text{Be}$ and ^{252}Cf sources correction factors should be applied to the true doserate to reflect the instrument response. Reference response for Leak Detector $0.24 \text{ cps}/\mu\text{Svh}^{-1}$.

The tests that are required for each category are detailed below: -

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.
 - a. **Background Dose Rate.** Remove the instrument from the influence of any radiological sources and record the instrument background doserate.
 - (i) Acceptance / Pass criteria meter indication of less than $1\mu\text{Svh}^{-1}$ or instrument response should reflect $\pm 10\%$ of the known dose rate for the area.
 - b. **Response to High Dose Rates.** Expose the instrument to a dose rate in excess of that which it could reasonably encounter in practice, for at least thirty seconds.
 - (i) Acceptance / Pass criteria the instrument should maintain the reading through out the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.

Note: Where possible, instruments should be overload tested at 10 times the maximum scale indication. It is recognised that for a number of test houses this is impracticable. In these instances instruments should be tested at 5 or 10 times the maximum credible dose rate to which the instrument could be exposed. These instruments shall be labelled "Limited Cal" and the calibration certificate shall clearly state the limits of the overload and range testing.

- c. **Gamma Rejection** – Expose the instrument to a suitable gamma source i.e. ^{137}Cs or ^{60}Co , at $10\text{mSvh}^{-1} H^*(10)$. See Reference C & D for further details of gamma rejection.

- (i) Acceptance/Pass criteria meter indication of less than $5\mu\text{Sv h}^{-1}$.

d. **Sensitivity.**

Expose the instrument to the doserate stated in Table 1 for the time period detailed. Conduct a second measurement with the reference source suitably stored for the same period. Determine the sensitivity of the instrument utilising the appropriate correction factors taking account for any geometrical effects that make influence the response of the instrument.

Table 1 – Sensitivity

Nominal Doserate $H^*(10)$ $^{241}\text{Am}/^9\text{Be}$	Count Period (secs)
$500\mu\text{Sv h}^{-1}$	100s
Background	100s

- (i) Acceptance/Pass criteria the instrument background corrected sensitivity shall be within $\pm 30\%$ of the nominal reference response.

- e. **Linearity of Response.** Expose the instrument to the range of doserates indicated in Table 2 and record the observed background corrected measurements. Reference G, Paragraph 6.1.2.2 states that instruments with a logarithmic scale should be checked at one value within each decade of that scale. This is readily achieved by the doserates detailed within Table 2. However, additional doserates may be included at the discretion of the Qualified Person. Reference C, Section 4.2 recommends that at low dose rates sufficient measurements should be taken to establish a mean indication with a suitable accuracy. (i.e. $\pm 10\%$ standard deviation of the mean).

Note: As a minimum, 1 reading from each decade within the type test data range shown should be tested.

Table 2 – Linearity of Response doserates

Nominal Doserate $H^*(10)$ $^{241}\text{Am}/^9\text{Be}$	Relative Response Tolerance
$7.5\mu\text{Sv h}^{-1}$	$\pm 30\%$
$50\mu\text{Sv h}^{-1}$	$\pm 30\%$
$500\mu\text{Sv h}^{-1}$	$\pm 30\%$
$2000\mu\text{Sv h}^{-1}$	$\pm 30\%$

- (i) Acceptance/Pass criteria – the instrument background corrected response shall be within $\pm 30\%$ of the relative response at each doserate measured.

- f. **Energy Dependency.** The response of the instrument will be dependent on the energy spectrum in which it is to be exposed. Expose the instrument to the doserate indicated in Table 3 and record the observed measurement. Reference C – Appendix A2.5 discusses Neutron Energy Dependence.

Table 3 – Energy Dependence doserate

Nominal Doserate $H^*(10)$ ^{252}Cf	Relative Response Tolerance
$50\mu\text{Sv h}^{-1}$	$\pm 30\%$

- (i) Acceptance/Pass criteria – the instrument response shall be within $\pm 30\%$ of the relative response.
- g. **Directional Dependency** – Expose the instrument to the doserate indicated in Table 4. Take a measurement at 0° and record the instrument response. Rotate the instrument through 90° clockwise and record its response. Return the instrument to its original position. Repeat the measurement at 90° in anti-clockwise direction and record its response. The instrument response must be normalised to unity for normal radiation incidence, with the instrument in a horizontal orientation.

Table 4 – Directional Dependency doserate

Nominal Doserate H*(10) ²⁴¹ Am/ ⁹ Be	Tolerance wrt normalised response at 0°
$180\mu\text{Svh}^{-1}$	$\pm 30\%$

- (i) Acceptance/Pass criteria – the instrument response should be within $\pm 30\%$ of the normalised response. Reference C, Section 4.4 for further details.
- h. **Check Source Response** – Remove the plug from polyethylene sphere. Place the ²⁴¹Am/⁹Be check source into the sphere and record the instrument response.
- (i) Acceptance/Pass criteria – check source response should provide a reading of $55\mu\text{Svh}^{-1} \pm 30\%$. See Reference E for further details.
6. **Category 2: Annual Test.** Complete all Category 1 tests with the exception of the Directional Dependency Test 5.g.
- (i) Acceptance / Pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test “Check Source Response” at paragraph 5.h.
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.g.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 test protocols.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 37 Dosimeter Electronic Personal (PED) Type SAIC PD-12i / PD-2i (Submarine Reactor Compartment Emergency Response)

Function Electronic Personal Dosimeter

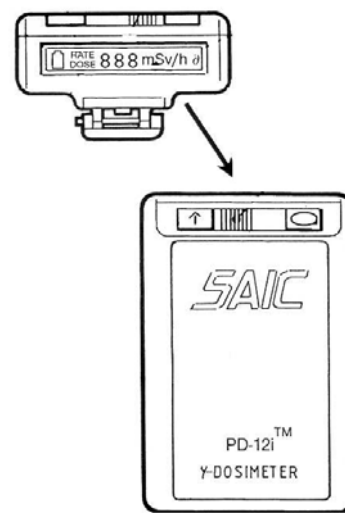
Publications A: SAW Operation and Maintenance Manual REV

NSN PD12i - 6665-01-445-0695
PD2i - 6665-XX-XXX-XXXX

Required Reference Standards

Description

1. This personal radiation monitor operates as a pager sized stand-alone Electronic Personal Dosimeter unit. The visual readout is based on a backlit LCD. The user can define the display on the dosimeter which steps through Total Dose, Dose Rate and Stay-time. Excess exposure above pre-set Dose and Doserate alarms are indicated by a chirp tone, additionally icons flash on the LCD unit. Dose management / history facilities are accessed through a separate SAIC PDR-1 Dosimeter Reader using a standard RS232C interface with SAIC PDRC3 Version 2.04 (release date March 1996) software running on a PC.



- a. Radiation detection is based on a miniature energy compensated Geiger-Muller tube. Exposure to a radiation field above the predefined EEPROM default is indicated by;
- | | | |
|------------|---|------------------------|
| Dose alarm | - | Repeated double bleep. |
| Doserate | - | Repeated single bleep. |

- b. In the Submarine Reactor Accident Emergency Response Protection scenario. The measurement quantity of interest is Absorbed Dose, cGy (not to be confused with air KERMA, also with units Gy).

Controls

2. The PD-12i / PD-2i dosimeters have the following controls:
- Run button** Turns unit on / off and illuminates display.
 - Mode button** Selects display function.

Operation of PDRCS Dosimeter Software.

- See instruction manual Dosimeter Software package 20.L800 REV 061996 for full and complete details.
- Operation of PDR-1 Dosimeter Reader.**
 - Turn on the dosimeter using the RUN button. Place the dosimeter on the PDR-1 dosimeter reader unit with dosimeter clip facing upwards. To Dose reset the PD-12i/2i, depress DOSE RESET membrane pad on the PDR-1 (the status light will change to red momentarily to indicate action). In PDRC3 software "Main Menu Options" Press R for reset of Dosimeter. Dosimeter unit will bleep twice confirming a reset to dose zero.
 - In main menu options menu select option A "EDIT". Software will enter Menu "PD12i/2i EEPROM EDITING UTILITY" The Dosimeter will then be read by the EEPROM utility program.

- c. On the left-hand side of the computer display, select Pre-set Total Dose or Dose Rate as required for the functional role required. Use the tab key to navigate around the menu. Change Dose rate and Dose alarms accordingly. Press keyboard escape key and then press enter key to write changes to the dosimeter. The Dosimeter will chirp to indicate that a change of EEPROM default has occurred.
- d. Toggle through the Dosimeter LCD display using the MODE button to ensure that the required defaults have been successfully set.

5. Setting of PD-12i/2i EEPROM Dose Management Functions test points.

- (i) The PD-12i/2i internal settings and calibration test points vary depending on the operational use of the instrument as shown below. It will be necessary to alter the various settings as required during the calibration process.

Standard Test Protocol

6. All tests should be recorded for Qualified Person inspection and certificate production.

Note: The instrument should be orientated such that the LCD display faces upwards and the green/white SAIC label (dependant on model) is facing the source of radiation. The reference center for the Geiger is marked as a cross on the sidewall and the left edge of the label at the rear of instrument for the Geiger centerline.

Pre-radiation Tests, Electrical and Physical Examination.

7. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of dosimeter case. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

8. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.
 - a. For Submarine Reactor Compartment Emergency Response Purposes, source terms must be realized in terms of Absorbed Dose.
 - b. Configure the internal settings of the PD-12i/2i as follows:-
 - (i) Dose alarm D-Alm set point 70 cGy Absorbed Dose (equivalent to 639 mGy air KERMA)
 - (ii) Dose alarm D-Alm set point 140 cGy Absorbed Dose (equivalent to 1277 mGy air KERMA)

Note: For derivation of calibration source terms utilize;

$$^{137}\text{Cs}: 1.096 \text{ cGy Absorbed Dose} = 1.000 \text{ cGy Air KERMA}$$

- c. **Dose Test.** - Expose the instrument to the following ^{137}Cs integrated dose.

Absorbed Dose cGy	^{137}Cs Expected Response
70 cGy	614 - 920 mSv
140 cGy	1227 - 1841 mSv

- d. **Directional Dependency at 60 keV (^{241}Am or 65 keV ISO X-ray Quality).** Reset the accumulated dose and expose the left hand side (+90°) instrument to a 60 keV ^{241}Am or 65 keV ISO X-ray Quality radiation field to a dose rate and time combination which will allow the dose to accumulate to 50 μSv . This test should be repeated for the right hand side (-90°) of the instrument.

Note: If using a PMMA slab to achieve Personal Dose Equivalent quantity, keep the PMMA slab immobile and rotate the instrument in front of the slab.

Dose Applied/Orientation of Instrument	$^{241}\text{Am}/65\text{ keV X-rays}$ Permitted Range on PMMA Phantom	$^{241}\text{Am}/65\text{ keV X-rays}$ Permitted Range Free in Air
50 μSv - Left-hand Side	TBA	TBA
50 μSv - Right-hand Side	TBA	TBA

- (i) Acceptance / pass criteria response should be within $\pm 30\%$ of type test data.

9. **Category 2: Annual Test.** Complete all Category 1 tests except Directional Dependency Test 8d.

- (i) Acceptance / pass criteria are the same as Category 1 tests.

10. **Category 3: Test Before Operational Use.** Not Required.

Certification (Qualified Person authorisation required)

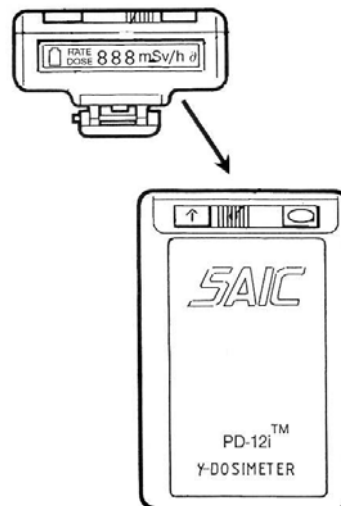
11. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

**Protocol 37a Dosimeter Electronic Personal (PED) Type SAIC PD-12i / PD-2i
(Non Destructive Testing & Health Physics Use)****Function** Electronic Personal Dosimeter**Publications** A: SAW Operation and Maintenance Manual REV**NSN** PD12i - 6665-01-445-0695
PD2i - 6665-XX-XXX-XXXX**Required Reference Standards****Description**

1. This personal radiation monitor operates as a pager sized stand-alone Electronic Personal Dosimeter unit. The visual readout is based on a backlit LCD. The user can define the display on the dosimeter which steps through Total Dose, Dose Rate and Stay-time. Excess exposure above pre-set Dose and Doserate alarms are indicated by a chirp tone, additionally icons flash on the LCD unit. Dose management / history facilities are accessed through a separate SAIC PDR-1 Dosimeter Reader using a standard RS232C interface with SAIC PDR3 Version 2.04 (release date March 1996) software running on a PC.



- a. Radiation detection is based on a miniature energy compensated Geiger-Muller tube. Exposure to a radiation field above the predefined EEPROM default is indicated by;

Dose alarm	-	Repeated double bleep.
Doserate	-	Repeated single bleep.

PD12i

- b. In the Non-Destructive Testing and Health Physics Protection scenario, the measurement quantity of interest is Personal Dose Equivalent, $\mu\text{Sv H}_p$ (10).

Controls

2. The PD-12i/2i dosimeter has the following controls:
- Run button** Turns unit on / off and illuminates display.
 - Mode button** Selects display function.

Operation of PDRCS Dosimeter Software.

- See instruction manual Dosimeter Software package 20.L800 REV 061996 for full and complete details.
- Operation of PDR-1 Dosimeter Reader.**
 - Turn on the dosimeter using the RUN button. Place the dosimeter on the PDR-1 dosimeter reader unit with dosimeter clip facing upwards. To Dose reset the PD-12i/2i, depress DOSE RESET membrane pad on the PDR-1 (the status light will change to red momentarily to indicate action). In PDR3 software "Main Menu Options" Press R for reset of Dosimeter. Dosimeter unit will bleep twice confirming a reset to dose zero.

- b. In main menu options menu select option A "EDIT". Software will enter Menu "PD12i/2i EEPROM EDITING UTILITY" The Dosimeter will then be read by the EEPROM utility program.
- c. On the left-hand side of the computer display, select Pre-set Total Dose or Dose Rate as required for the functional role required. Use the tab key to navigate around the menu. Change Dose rate and Dose alarms accordingly. Press keyboard escape key and then press enter key to write changes to the dosimeter. The Dosimeter will chirp to indicate that a change of EEPROM default has occurred.
- d. Toggle through the Dosimeter LCD display using the MODE button to ensure that the required defaults have been successfully set.

5. Setting of PD-12i/2i EEPROM Dose Management Functions test points.

- a. The PD-12i/2i internal settings and calibration test points vary depending on the operational use of the instrument as shown below. It will be necessary to alter the various settings as required during the calibration process.

Standard Test Protocol

6. All tests should be recorded for Qualified Person inspection and certificate production.

Note: The instrument should be orientated such that the LCD display faces upwards and the green/white SAIC label (dependant on model) is facing the source of radiation. The reference center for the Geiger is marked as a cross on the sidewall and the left edge of the label at the rear of instrument for the Geiger centerline.

Pre-radiation Tests, Electrical and Physical Examination.

7. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of dosimeter case. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

8. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.

Note: For Non-destructive Testing and Health Physics Protection Purposes, all source terms must be realised in terms of Personal Dose Equivalent $H_p(10)$. The methods for realizing this dosimetric quantity are detailed in JSP 425.

- a. Configure the internal settings of the PD-12i / PD-2i as follows:-
 - (i) Dose Alarm D-Alm as operationally required, typically $1000 \mu\text{Sv}$, $H_p(10)$.
 - (ii) Dose Rate alarm D-Alm as operationally required, suggest $12 \text{ mSv}\cdot\text{h}^{-1}$, $H_p(10)$.
 - (iii) Set CHIRP Increment to $10 \mu\text{Sv}$, $H_p(10)$.
 - (iv) Enable alarms.
 - (v) Enable Rate Mode Change.
 - (vi) Disable Stay Mode.

Note: For derivation of calibration source terms for 'free in air' irradiation's utilize;

^{137}Cs : $1.154 \text{ mSv Personal Dose Equivalent } H_p(10) = 1.000 \text{ mGy Air KERMA}$

These factors are derived assuming a backscatter correction factor of 4 %. If the calibration is carried out using an appropriate phantom, then these correction factors are not required.

- b. **Doserate Alarm Test.** - The instrument should be exposed to ^{137}Cs doserate of $12 \text{ mSv}\cdot\text{h}^{-1}$ for a minimum of 30 seconds.
- (i) Acceptance / Pass criteria, the instrument should alarm (continuous intermittent beep) at the alarm level set prior to the calibration, if the unit does not alarm when this doserate is applied the unit must be failed.
- c. **Accumulated Dose Test. (^{137}Cs)** Expose the instrument to a dose rate and time combination, which will allow the dose to accumulate to the values given in the table below. When each exposure has finished record the dose measurement.

Accumulated Dose	^{137}Cs Permitted Range
Hp(10)	Hp(10)
50 μSv	40 – 60 μSv
500 μSv	400 – 600 μSv
5000 μSv	4000 – 6000 μSv

- (i) Acceptance / Pass criteria is instrument response within $\pm 20\%$ i.e. within the permitted ranges shown above.
- d. **Dose Alarm Test. (^{137}Cs)** Expose the instrument to a dose rate and time combination, which will allow the dose to accumulate to 1.1 mSv.
- (i) Acceptance / Pass criteria, the instrument should alarm (repeated double beep) at the alarm level set prior to the calibration, if the unit does not alarm when this dose is applied the unit must be failed.
- e. **Energy Response Test (^{241}Am or 65 keV ISO X-ray Quality).** Expose the instrument to a ^{241}Am or 65 keV ISO X-ray Quality radiation field at dose rate and time combination, which will allow the dose to accumulate 50 μSv .

Accumulated Dose	^{241}Am Permitted Range	65 keV ISO X-ray Quality
Hp(10)	Hp(10)	Hp(10)
50 μSv	19.6 – 36.4 μSv	TBA

- (i) Acceptance / Pass criteria is within the permitted ranges shown above.
- f. **Directional Dependency at 60 keV (^{241}Am or 65 keV ISO X-ray Quality).** Reset the accumulated dose and expose the left hand side ($+90^\circ$) instrument to a 60 keV ^{241}Am or 65 keV ISO X-ray Quality radiation field to a dose rate and time combination which will allow the dose to accumulate to 50 μSv . This test should be repeated for the right hand side (-90°) of the instrument.

Note: If using a PMMA slab to achieve Personal Dose Equivalent quantity, keep the PMMA slab immobile and rotate the instrument in front of the slab.

Dose Applied/Orientation of Instrument	$^{241}\text{Am}/65 \text{ keV X-rays}$ Permitted Range on PMMA Phantom	$^{241}\text{Am}/65 \text{ keV X-rays}$ Permitted Range Free in Air
50 μSv - Left-hand Side	TBA	TBA
50 μSv - Right-hand Side	TBA	TBA

- (i) Acceptance / pass criteria response should be within $\pm 30\%$ of type test data.

9. **Category 2: Annual Test.** Complete all Category 1 tests except Directional Dependency Test 8f.

(i) Acceptance / pass criteria are the same as Category 1 tests.

10. **Category 3: Test Before Operational Use.** Not Required.

Certification (Qualified Person authorisation required)

11. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 38 Harwell Pocket Dosimeter Type 975002

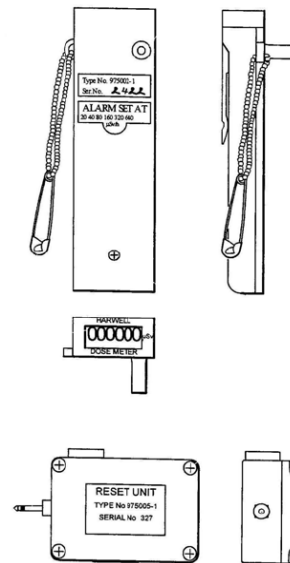
Function Electronic Personal Dosimeter

Publications A: Pocket Dosimeter Type 975002

NSN 6Z-99-015-5023

Description

1. This dosimeter is a pocket sized gamma dose integrator and doserate alarm covering the energy ranges 40keV – 3 MeV. The unit has no ON/OFF switch as such but the EHT supply can be disabled by insertion of a jack plug on the front of the case, thus increasing battery life. The dosimeter incorporates a six-digit display and a piezo ceramic sounder provides 'pips' proportional to the doserate being applied. There is no provision on the dosimeter for user rest and this has to be carried out using a dedicated reset unit (97505-1 or 975004-1). The unit is housed in a lightweight, strong polycarbonate case incorporating a pocket clip with provision for a retaining lanyard.



Harwell Pocket Dosimeter Type 975002
+ Reset Unit

Controls

1. A comprehensive summary of the ratemeter functions is contained within Publication, Reference A.

The 975002 dosimeter has the following controls:

- a. **Alarm Setting** These are found inside the unit and the pin must be inserted into the plug which refers to the alarm level, the available levels are 20, 40, 80, 160, 320 and 640 $\mu\text{Sv/hr}$.
- b. **Jack plug** When the jack plug is inserted the EHT is taken off line and the unit ceases to record dose. When removed the unit is fully operational.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Note: The instrument can be calibrated free in air or mounted on a PMMA phantom to simulate the backscatter of a body (as if the dosimeter were actually being worn). The instrument in both cases should be mounted such that the clip is facing the incident radiation and the instrument is stood vertically.

Pre-radiation Tests, Electrical and Physical Examination.

4. These tests must be undertaken prior to both category 1 and 2 tests.
 - a. **Battery test.** Check battery indication (using 975004-1 reset unit if available), if a battery indication unit is not available replace the battery as a matter of routine. Check condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of dosimeter case, jack plug and display window. Replace as necessary.

Radiation Tests

5. **Category 1 Test: Test Before use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.

- a. **Dose Test. (¹³⁷Cs)** Reset the accumulated dose on the unit, expose the instrument to a dose rate and time combination which will allow the dose to accumulate to the values given in the table below. When each exposure has finished record the dose measurement.

Dose Applied	Permitted Range on PMMA	Permitted Range
	Phantom	Free in Air
10 µSv	7 – 13 µSv	Tba
100 µSv	70 – 130 µSv	Tba
1000 µSv	700 - 1300 µSv	Tba

- (i) Acceptance / Pass criteria is instrument response is within the permitted ranges shown above.
- b. **Doserate Alarm Test.** The instrument should be exposed to ¹³⁷Cs doserate of that which has been set as the doserate alarm within the instrument for a minimum of 30 seconds.
- (i) Acceptance / Pass criteria, the instrument should alarm at the alarm level set, if the unit does not alarm when this doserate is applied the unit must be failed.
- c. **Energy Response Test at 60 keV (²⁴¹Am or 65 keV ISO X-ray Quality).** Reset the accumulated dose and expose the instrument to a 60 keV ²⁴¹Am or 65 keV ISO X-ray Quality radiation field to a dose rate and time combination which will allow the dose to accumulate to 100µSv.

Dose Applied	Permitted Range on PMMA	Permitted Range
	Phantom	Free in Air
100 µSv	77 – 144 µSv	Tba

- (i) Acceptance / Pass criteria is instrument response is within the permitted ranges shown above.
- d. **Directional Dependency at 60 keV (²⁴¹Am or 65 keV ISO X-ray Quality).** Reset the accumulated dose and expose the left hand side (+90°) instrument to a 60 keV ²⁴¹Am or 65 keV ISO X-ray Quality radiation field to a dose rate and time combination which will allow the dose to accumulate to 100µSv. This test should be repeated for the right hand side (-90°) of the instrument.

Note: If using a PMMA slab to achieve Personal Dose Equivalent quantity, keep the PMMA slab immobile and rotate the instrument in front of the slab.

Dose Applied/Orientation of Instrument	²⁴¹ Am/65 keV X-Rays	²⁴¹ Am/65 keV X-Rays Permitted
	Permitted Range on PMMA Phantom	Range Free in Air
100 µSv - Left-hand Side	Tba	Tba
100 µSv - Right-hand Side	Tba	Tba

6. **Category 2: Annual Test.** Complete all category 1 tests.

(i) Acceptance / pass criteria are the same as Category 1 tests.

7. **Category 3: Test Before Operational Use.** Not required.

8. **Certification (Qualified Person authorisation required)**

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 39 Counting System Portable Harwell Type 0734 / 0744

Function Alpha Drawer and Scaler System

Publications A: AP 112G-1319-0 – Harwell Portable counting System Type 0734/0744

NSN 6665-99-659-5815

Equipment Declared Obsolete under DIN number to be confirmed.

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 40 Potable Water Monitor Type Mk 25NRM

Function Beta/Gamma Drinking Water Contamination monitor

Publications A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
 B: BR 2053(119) Multi-Function Survey Meter
 C: BR 2053(118) Monitor, Water Contamination Mk25NRM

NSN 6665-01-440-8993

Required Reference Standards

All must be emission rate calibrated except Mk 14NJ Check Source:

Small area (16mm Active Diameter)

⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source ³⁶Cl Mk 14NJ Check Source

Description

1. The Mk25NRM is used for monitoring the level of radioactivity in potable water. It is used primarily for use onboard Royal Navy surface vessels. Beta and gamma activity levels in water of up to 10kBq/ml can be measured. The kit consists of an ADM300A(V3A) ratemeter and a lead castle containing an M2NA GM tube. The unit is designed so that the activity of Drinking water can be measured in Bq/ml. The kit also contains a Mk 14NJ check source for pre use checks when in service.



Mk 25NRM Potable Water Monitor

Controls

2. A comprehensive summary of the ratemeter functions is contained within the Publications Reference, A, B & C.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Note: This protocol should only be carried out using a calibrated ratemeter IAW protocol 22.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of Ratemeter, lead castle, cables, and cable connections and GM tube. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The operating voltage of the MK 25NRM is preset by the manufacturer and can not be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
 - b. **Background Count Rate.** Remove any sources from the close proximity of the castle, set the ADM timer to take a 10-minute background and record the monitor background reading.
 - (i) Acceptance / pass criteria is $< 4.0 \text{ Bq/ml}$ in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV. If the reading is higher than this consult publication, reference C for decontamination instructions.
 - c. **Check Source Response.** Remove the rubber cap from the top of the detector housing and place the ^{36}Cl Mk 14NJ Check Source centrally over the GM tube allowing the end flange to rest on the glass rim of the GM tube housing. Set the ADM timer to take a 10-minute integrated count and record the monitor reading on the calibration certificate.
 - (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ type test data response.
 - d. **Linearity of Response.** With the rubber cap removed Place the small area sources listed in Required Reference Standards centrally in turn on the glass rim of the GM tube housing with the active area facing the GM tube. Set the ADM timer for a 1-minute count and record the net response (cps) for each planar disc source.
 - (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
 - e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 41 Dosimeter Quartz Fibre (QFD)

Function Personal Dosimeter.

Publications A: BRF 2053(108)

NSN 6665-99-721-4780 - 0-5000 μ Sv
6665-99-721-4781 - 0-50 mSv
6665-99-721-4872 - 0-500 mSv
6665-99-778-8896 - 0-2000 μ Sv
6665-99-776-8050 - 0-200 cGy
6665-99-763-2053 - Charger - Reset Unit

Equipment Declared Obsolete under

DCI RN 179-00 - 6665-99-776-8050 - 0-200 cGy
DCI GEN 122/02 - 6665-99-778-8896 - 0-2000 μ Sv

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 42 Radon Monitor Thomson & Nielson Type Radon WL Meter

Function Radon Monitor

Publications A: Radon WL Meter Manufacturers Handbook

NSN 6665-21-907-4098

Required Equipment

All measurement equipment used must be traceable to national standards

Equipment required for setting up the WL meter can be found in the manufacturers handbook.

Description

1. The Radon WL meter is a hand held instrument and is designed to accurately measure radon levels inside buildings. For longer sampling periods the meter can be connected to a data logger and stand-alone operation is achievable. The detector is a solid state semiconductor housed in the rear of the unit, in operation air is drawn by an internal pump, over a filter paper. Any contamination picked up on the filter paper will be counted and the result will be displayed on the six-digit LCD display.



Radon WL Meter

Controls

2. A comprehensive summary of the instrument functions is contained within Publication Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical checks.** Check mechanical integrity of Case, power cable, internal pump, filter holder and LCD display. Replace as necessary.
 - b. **Battery test.** Check battery compartment and battery condition terminations. Replace as necessary.
 - c. Check operation of all controls and switches.
5. **Category 1 Test: Test before First Use.** The RADON WL METER 3 is an instrument which requires calibration procedures over and above that of the ability of the majority of calibration facilities, it is with this in mind that all tests before first use are carried out IAW the procedures laid down in publication, reference A.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.

7. **Category 3: Test Before Operational Use.** The test before operational use is laid down in publication, Reference A.
 - (i) Acceptance / pass criteria is that laid down in publication, Reference A.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 43 Contamination Probe Beta Type 1275C Probe

Function Beta / Gamma Contamination Monitor

Publications A: AP112G-1316-0 - Ratemeter Set Type RM10

NSN 6665-99-911-0260

Required Reference Standards

All must be emission rate calibrated except UAC1623:

Extended area $^{90}\text{Sr/Y}$ Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032;

^{36}Cl Type WRS 7/E Amersham code CIR 07032 or Type WRS 6/E CIR 06032;

^{137}Cs Type WRS 7/E Amersham code CDR 07032 or Type WRS 6/E CDR 06032;

Small area (16mm Active Diameter)

$^{90}\text{Sr/Y}$ Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source $^{\text{Nat}}\text{U}$ Amersham code UAC 1623 NSN 6665-99-193-3906

MOD Jigs Rig SK 1407

Description

1. The 1275C beta / gamma probe and a ratemeter combination is a general purpose beta / gamma contamination monitor. The probe is fitted with a geiger-muller tube containing argon / ethyl formate gas at low pressure, this tube is fragile and care must be taken not to damage it. The probe is fitted with a shutter allowing β assessment to be carried out and has an opening of 22.1 cm^2 . The beta / gamma probe is normally used in a training role.



1275C Probe

Probe Active Area: $X \text{ cm}^2$

Controls

2. A comprehensive summary of the ratemeter functions is contained within the Publication, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and radiacmeter connections. Where separate testing of probe and radiacmeter is required for logistics reasons, appropriate subsidiary test should be completed, to confirm suitability of replacement probe or radiacmeter. These tests may be derived from those detailed in this protocol.

Note: This protocol should only be carried out using a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of probe, cables, cable connections and GM tube. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The 1275C probe and ratemeter operational voltage should be determined prior to this test, following the procedure given in publication TBA. Precise plateau characteristics will be probe and ratemeter dependent and must be determined for each combination. All measurements are undertaken unless otherwise stated with the shutter open

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
- b. **Response To Beta Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2 π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
³⁶ Cl	1.79	1.25 – 2.32	16.5	11.5 – 21.4
⁹⁰ Sr/Y	2.33	1.63 – 3.02	21.5	15 – 27.9
¹³⁷ Cs*	1.14	0.80 – 1.48	10.7	7.5 – 13.9

- (i) Acceptance / pass criteria is instrument response within \pm 30% i.e. within the permitted ranges shown above.
- c. **Check Source Response.** Place the ^{Nat}U UAC 1623 Check Source centrally 3mm below the detector with the shutter closed and the record the response on the calibration certificate. Open the shutter and record the response on the calibration certificate.
 - (i) Acceptance / Pass criteria check source response should be \pm 20% type test data response.
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn 3mm below the detector. Record the net response (cps) for each planar disc source.

- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
 - e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
 - f. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria is 1 cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
- (i) Acceptance / pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 44 Contamination Probe Alpha Type 1320C

Function Alpha Surface Contamination Monitor

Publications A: AP112G-1316-0 – Ratemeter Set Type RM10

NSN 6665-99-949-1324

Required Reference Standards

All must be emission rate calibrated except UAC1623:

Extended area ^{241}Am Type WRS 7/E Amersham code AMR 07032 or Type WRS 6/E AMR 06032;

$^{90}\text{Sr/Y}$ Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032;

^{238}Pu Type WRS 7/E Amersham code PPR 07032 or Type WRS 6/E PPR 06032;

$^{\text{Nat}}\text{U}$ Type WRS 7/E Amersham code UAR 07032 or Type WRS 6/E UAR 06032.

Small area (16mm Active Diameter)

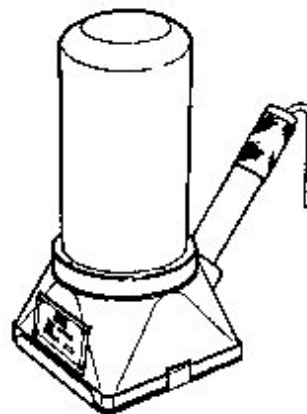
^{241}Am Type WRS 1/E Amersham code AMR 01011, AMR 01021 and AMR 01031.

Check Source $^{\text{Nat}}\text{U}$ Amersham code UAC 1623 NSN 6665-99-193-3906

MOD Jigs
Rig SK 1407
Base plate jig
Linearity Jig

Description

1. The 1320C alpha probe and a ratemeter combination is a general purpose alpha surface contamination monitor. The probe comprises an enamel painted aluminium housing with a light tight Melinex and aluminium foil window protected by a chrome plated grille. The scintillation phosphor is a layer of silver activated zinc sulphide on a thin sheet of Perspex, giving a nominal window area of 75.7 cm^2 . A photomultiplier tube and thick film resistor network are contained in the housing. The ratemeter provides high voltage, counting threshold and scaler functions. The 1320C grille provides better protection for the window of the probe.



1320C Probe

Probe Active Area: 75.7 cm^2

Controls

2. A comprehensive summary of the ratemeter is contained within the Publication, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Note: This protocol should only be carried out using a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of the probe, cables, cable connections, and probe window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The 1320C alpha probe and ratemeter operational voltage should be determined prior to this test, following the procedure given in publication TBA. Precise plateau characteristics will be probe and ratemeter dependent and must be determined for each combination.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
- b. **Response To Alpha Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	11.11	7.78 – 14.44	29.5	20.6 – 38.3
²³⁸ Pu	11.11	7.78 – 14.44	29.3	20.5 – 38.1
^{NAT} U	4.35	3.04 – 5.65	12	8.4 – 15.7

- (i) Acceptance / pass criteria is instrument response within ± 30% i.e. within the permitted ranges shown above.
- c. **Check Source Response.** Place the ^{Nat}U UAC 1623 Check Source in contact with the detector grille and the record the response on the calibration certificate.
 - (i) Acceptance / Pass criteria check source response should be ± 20% type test data response.
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn with a source to detector separation of 3mm. Record the net response (cps) for each planar disc source.
 - (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within ± 30%.

- e. **Uniformity of Response.** Each 10 cm² area of the detector window must be tested by placing one of the small area sources listed in Required Reference Standards (preferably the item with the highest activity) in turn in nine measurement positions to ensure uniformity and record the instrument response for each position.
 - (i) Acceptance / pass criteria is that no more than 30% of the total probe area should have a response which is less than 30% of the mean.
- f. **Beta Rejection.** Place the ⁹⁰Sr/Y extended area reference source as listed in Required Reference Standards in the appropriate contamination response jig and record the beta.
 - (i) Acceptance / pass criteria is that the monitor response should be < 1% of the equivalent ²⁴¹Am or ²³⁸Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be < 0.4% for beta radiation.
- g. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria is 0.5 cps in a field of < 0.15 μSv.h⁻¹, H*(10) from ²⁴¹Am 60 keV.
6. **Category 2: Annual Test.** Complete all Category 1 tests with the exception of the Uniformity of Response Test 5.e.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
 - (i) Acceptance / pass criteria check source response should be ± 20% of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 45 Contamination Probe Alpha Type AP2/4 or AP2R/4

Function Alpha surface Contamination Monitor

Publications A: NE Technology Instruction Manual Alpha Probe AP2/4
B: NE Technology Instruction Manual Alpha Probe AP2R/4

NSN N/A

Required Reference Standards

All must be emission rate calibrated except UAC1623:

Extended area ²⁴¹Am Type WRS 7/E Amersham code AMR 07032 or Type WRS 6/E AMR 06032;
²³⁸Pu Type WRS 7/E Amersham code PPR 07032 or Type WRS 6/E PPR 06032;
^{NAT}U Type WRS 7/E Amersham code UAR 07032 or Type WRS 6/E UAR 06032;
⁹⁰Sr/Y Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032.

Small area (16mm Active Diameter)

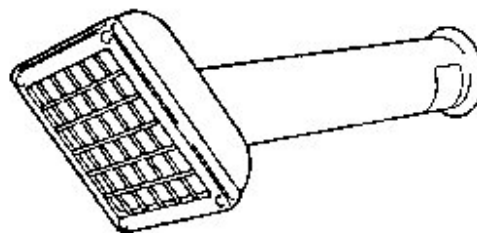
⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source ²⁴¹Am Mk 7 NXS check source NSN: 6665-99-736-2887

MOD Jigs	WRS 7/E Base Plate	Drawing Ref. AS710067
	WRS 6/E Base Plate	Drawing Ref. AS710066
	AP2/4 Support Plate	Drawing Ref. AS710071
	AP2/4 Uniformity & Linearity Insert	Drawing Ref. AS710074

Description

1. The AP2/4 or 'ruggedised' AP2R/4 alpha probes and a ratemeter combination is a general purpose alpha surface contamination monitor. The probes comprises an enamel painted aluminium housing with a light tight aluminised polycarbonate window protected by a chrome plated grille, giving a nominal window size of 49 cm². The scintillation phosphor is a layer of silver activated zinc sulphide on a thin sheet of Perspex. A photomultiplier tube and thick film resistor network are contained in the handle of the housing. The ratemeter provides high voltage, counting threshold and scaler functions. The AP2/4 and AP2R/4 differ only in the type of grille used. The AP2R/4 grille provides better protection for the window of the probe.



AP2R/4 Probe

Probe Active Area: 49 cm²

Controls

2. A comprehensive summary of the ratemeter is contained within the Publications, Reference A & B.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of probe, cables, cable connections, and probe window. Replace as necessary
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The AP2 series alpha probe and ratemeter operational voltage should be determined prior to this test, following the procedure given in publication A & B. Precise plateau characteristics will be probe and ratemeter dependent and must be determined for each combination.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
- b. **Response To Alpha Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)				2π Efficiency %			
	AP2/4		AP2R/4		AP2/4		AP2R/4	
	Mean Response	Permitted Range	Mean Response	Permitted Range	Mean Efficiency	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	10	7 – 13	TBA	±30%	39.54	27.68 – 51.40	TBA	±30%
²³⁸ Pu	10	7 – 13	TBA	±30%	39.35	27.54 – 51.15	TBA	±30%
^{NAT} U	5.26	6.84 – 3.68	TBA	±30%	22.17	15.52 – 28.82	TBA	±30%

- (i) Acceptance / pass criteria is instrument response within ± 30% i.e. within the permitted ranges shown above.
- c. **Check Source Response.** Place the ^{Nat}U UAC 1623 Check Source in contact with the detector grille and the record the response on the calibration certificate
 - (i) Acceptance / Pass criteria check source response should be ± 20% type test data response.
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn with a source to detector separation of 3mm. Record the net response (cps) for each planar disc source.

- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- e. **Uniformity of Response.** Each 10 cm^2 area of the detector window must be tested by placing one of the small area sources listed in Required Reference Standards (preferably the item with the highest activity) in turn in five measurement positions and recording the instrument response.
 - (i) Acceptance / pass criteria is that no more than 30% of the total probe area should have a detection efficiency which is less than 30% of the mean.
- f. **Beta Rejection.** Place the $^{90}\text{Sr/Y}$ extended area reference source as listed in Required Reference Standards in the appropriate contamination response jig and record the beta.
 - (i) Acceptance / pass criteria is that the monitor response should be $< 1\%$ of the equivalent ^{241}Am or ^{238}Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be $< 0.4\%$ for beta radiation.
- g. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria is 0.5 cps in a field of $< 0.15 \mu\text{Sv.h}^{-1}$, $\text{H}^*(10)$ from ^{241}Am 60 keV.
- 6. **Category 2: Annual Test.** Complete all Category 1 tests with the exception of the Uniformity of Response Test 5.e.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
- 7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
 - (i) Acceptance / pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

- 8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 46 Contamination Probe Alpha Type AP3/4 or AP3R/4

Function Alpha surface Contamination Monitor

Publications A: NE Technology Instruction Manual Alpha Probe AP3/4
B: NE Technology Instruction Manual Alpha Probe AP3R/4

NSN N/A

Required Reference Standards

All must be emission rate calibrated except UAC1623:

Extended area ^{241}Am Type WRS 7/E Amersham code AMR 07032 or Type WRS 6/E AMR 06032;
 ^{238}Pu Type WRS 7/E Amersham code PPR 07032 or Type WRS 6/E PPR 06032;
 $^{\text{NAT}}\text{U}$ Type WRS 7/E Amersham code UAR 07032 or Type WRS 6/E UAR 06032;
 $^{90}\text{Sr/Y}$ Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032.

Small area (16mm Active Diameter)

$^{90}\text{Sr/Y}$ Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source ^{241}Am Mk 7 NXS check source NSN: 6665-99-736-2887

MOD Jigs	WRS 7/E Base Plate	Drawing Ref. AS710067
	WRS 6/E Base Plate	Drawing Ref. AS710066
	AP3/4 Support Plate	Drawing Ref. AS710073
	AP3/4 Uniformity & Linearity Insert	Drawing Ref. AS710068

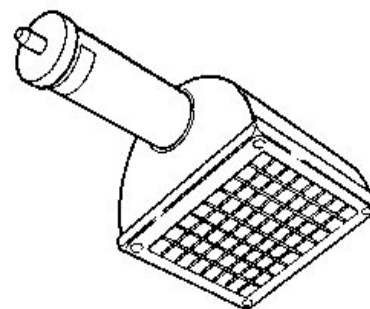
Equipment Overview

Description and Use: The AP3/4 or 'ruggedised' AP3R/4 alpha probes and a ratemeter combination is a general purpose alpha surface contamination monitor. The scintillation phosphor is a layer of silver activated zinc sulphide on a thin sheet of Perspex. A photomultiplier tube and thick film resistor network are contained in the handle of the housing. The ratemeter provides high voltage, counting threshold and scaler functions. The AP3/4 and AP3R/4 differ only in the type of grille used. The AP3R/4 grille provides better protection for the window of the probe.

Physical Construction: The probes comprises an enamel painted aluminium housing with a light tight aluminised polycarbonate window protected by a chrome plated grille, giving a nominal window size of 100 cm².

Detector Type: Photomultiplier EMI type 9600H

Detector Active Area: 100 cm²



AP3R/4 Probe

Controls

1. A comprehensive summary of the ratemeter is contained within the Publications, Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter connections. Where separate testing of probe and ratemeter is required, appropriate subsidiary test should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Note: This protocol should only be carried out using a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.**
Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical Zero.**
Zero meter mechanical movement using meter adjustment screw. if necessary.
 - c. **Mechanical checks.**
Check mechanical integrity of probe, cables, cable connections, and probe window. Replace as necessary.
 - d. Check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The AP3 series alpha probe and ratemeter operational voltage should be determined prior to this test, following the procedure given in publications reference A & B. Precise plateau characteristics will be probe and ratemeter dependent and must be determined for each combination.

- a. **Background Count Rate.**
Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria - 0.1 cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{241}Am 60 keV.
- b. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources in Required Reference Standards with and without the presence of the light source.
 - (i) Acceptance / pass criteria - The background count should not be elevated and the response to the source should not be affected by the presence of the light.
- c. **Response to Alpha Contamination.**
The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per $\text{Bq}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)				2π Efficiency %			
	AP3/4		AP3R/4		AP3/4		AP3R/4	
	Mean Response	Permitted Range	Mean Response	Permitted Range	Mean Efficiency	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	17.7	12.4 – 23.0	12.5	8.8 – 16.3	35	24.5 – 45.5	25	17.5 – 32.5
²³⁸ Pu	17	11.9 – 22.1	12.5	8.8 – 16.3	34	23.8 – 44.2	25	17.5 – 32.5
^{NAT} U	8	5.6 – 10.4	5.9	4.3 – 7.7	16	11.2 – 20.8	12	8.4 – 15.6

- (i) Acceptance / pass criteria - Instrument response within $\pm 30\%$ i.e. the expected levels shown above.
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn with a source to detector separation of 3mm. Record the net response (cps) for each planar disc source.
- (i) Acceptance / pass criteria - The ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- e. **Uniformity of Response.** Each 10 cm² area of the active detector window must be tested by placing one of the small area sources listed in Required Reference Standards (preferably the item with the highest activity) in turn in five measurement positions and recording the instrument response.
- (i) Acceptance / pass criteria - No more than 30% of the total probe area should have a detection efficiency which is less than 30% of the mean.
- f. **Beta Rejection.** Place the ⁹⁰Sr/Y extended area reference source as listed in Required Reference Standards in the appropriate contamination response jigs and record the beta response.
- (i) Acceptance / pass criteria - The monitor response should be $< 1\%$ of the equivalent ²⁴¹Am or ²³⁸Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be $< 0.4\%$ for beta radiation.
- g. **Check Source Response.** Place the ²⁴¹Am Mk 7NXS Check Source centrally in contact with the detector grille and the record the response on the calibration certificate
- (i) Acceptance / Pass criteria - Check source response should be $\pm 20\%$ type test data response.
5. **Category 2: Annual Test.** Complete all Category 1 tests with the exception of the Uniformity of Response Test 5.e.
- (i) Acceptance / pass criteria - The same as Category 1 tests.
6. **Category 3: Test before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
- (i) Acceptance / pass criteria - Check source response should be $\pm 20\%$ of the response recorded at Para 5.c.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 47 Contamination Probe Beta Type BP10

Function Beta Contamination Monitoring Probe

Publications A: BR 2053 (111).

NSN 6665-99-640-0349

Equipment Declared Obsolete under DCI RN 125/03

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 48 Contamination Probe Beta Type BP4, BP4/4A, BP4/4B or BP4/4C**Function** Beta surface Contamination Monitor

Publications A: NE Technology Instruction Manual Beta Probe BP4
 B: NE Technology Instruction Manual Beta Probe BP4/4A
 C: NE Technology Instruction Manual Beta Probe BP4/4B
 D: NE Technology Instruction Manual Beta Probe BP4/4C

NSN 6665-99-765-7402**Required Reference Standards**

All must be emission rate calibrated except UAC1623:

Extended area ^{14}C Type WRS 7/E Amersham code CFR 07032 or Type WRS 6/E CFR 06032;
 ^{36}Cl Type WRS 7/E Amersham code CIR 07032 or Type WRS 6/E CIR 06032;
 ^{147}Pm Type WRS 7/E Amersham code PHR 07032 or Type WRS 6/E PHR 06032;
 $^{90}\text{Sr/Y}$ Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032;
 ^{60}Co Type WRS 7/E Amersham code CKR 07032 or Type WRS 6/E CKR 06032;
 ^{137}Cs Type WRS 7/E Amersham code CDR 07032 or Type WRS 6/E CDR 06032.

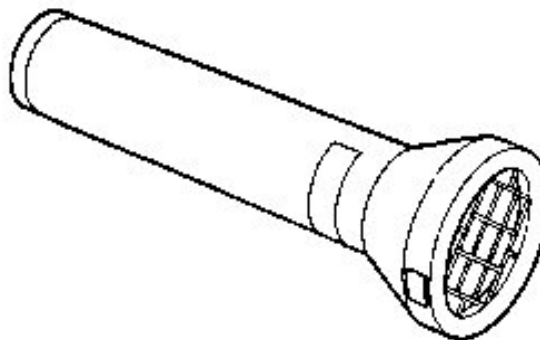
Small area (16mm Active Diameter)

 $^{90}\text{Sr/Y}$ Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.Check Source ^{238}U Amersham code UAC 1623 NSN 6665-99-193-3906

MOD Jigs	WRS 7/E Base Plate	Drawing Ref. AS710067
	WRS 6/E Base Plate	Drawing Ref. AS710066
	BP4 Support Plate	Drawing Ref. AS710069
	BP4 Uniformity & Linearity Insert	Drawing Ref. AS710074

Description

- The BP4 series beta probes and a ratemeter combination is a general purpose beta surface contamination monitor. The BP4 series probes are comprised of an enamel painted aluminium housing with a light tight aluminised polycarbonate window protected by a chrome plated grille, giving a nominal window size of 19.6 cm^2 . The scintillation phosphor is a layer of anthracene on a Perspex light guide. A photomultiplier tube and thick film resistor network are contained in the handle of the housing. The ratemeter provides high voltage, counting threshold and scaler functions. The BP4, A, B and C versions differ in the spacing between the protective grille and light tight window; these are 3, 6 and 9 mm respectively. This allows ruggedisation to be balanced against sensitivity for specific applications.

**BP4 Probe****Probe Active Area:** 19.6 cm^2

Controls

2. A comprehensive summary of the ratemeter functions is contained within the Publications, Reference A, B, C & D.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary test should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of probe, cables, cable connections and probe window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The BP4 series beta probe and ratemeter operational voltage should be determined prior to this test, following the procedure given in publication A - D. Precise plateau characteristics will be probe and ratemeter dependent and must be determined for each combination.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
- b. **Response To Beta Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)				2π Efficiency %			
	Mean Response				Mean Efficiency			
	BP4	BP4/4A	BP4/4B	BP4/4C	BP4	BP4/4A	BP4/4B	BP4/4C
¹⁴ C	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
³⁶ Cl	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
¹⁴⁷ Pm*	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
⁹⁰ Sr/Y	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
⁶⁰ Co	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
¹³⁷ Cs*	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA

- (i) Acceptance / pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.
- c. **Check Source Response.** Place the ^{NAT}U UAC 1623 Check Source centrally on the probe grid and the record the response on the calibration certificate
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ type test data response.
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn 3mm below the detector. Record the net response (cps) for each planar disc.
- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
- f. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
- (i) Acceptance / pass criteria is < 6 cps in a field of $< 0.15 \mu\text{Sv.h}^{-1}$, H*(10) from ¹³⁷Cs 662 keV.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
- (i) Acceptance / pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 49 Contamination Probe Beta Type BP7, BP7/4**Function** Low Energy Beta surface Contamination Monitor**Publications** A: NE Technology Instruction Manual Beta Probe BP7
B: NE Technology Instruction Manual Beta Probe BP7/4**NSN** N/A**Required Reference Standards**All must be emission rate calibrated except ^{Nat}U Amersham code UAC 1623 Check Source:

Extended area

¹⁴C Type WRS 7/E Amersham code CFR 07032 or Type WRS 6/E CFR 06032;³⁶Cl Type WRS 7/E Amersham code CIR 07032 or Type WRS 6/E CIR 06032;¹⁴⁷Pm Type WRS 7/E Amersham code PHR 07032 or Type WRS 6/E PHR 06032;⁹⁰Sr/Y Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032;⁶⁰Co Type WRS 7/E Amersham code CKR 07032 or Type WRS 6/E CKR 06032;¹³⁷Cs Type WRS 7/E Amersham code CDR 07032 or Type WRS 6/E CDR 06032.

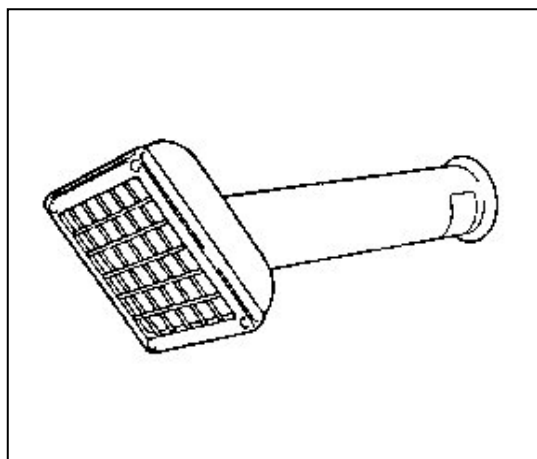
Small area (16mm Active Diameter)

⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source

^{Nat}U Amersham code UAC 1623 NSN 6665-99-193-3906**Description**

1. The BP7 series beta probes and a ratemeter combination is a low energy beta surface contamination monitor. The BP7 series probes are comprised of an enamel painted aluminium housing with a light tight aluminised polycarbonate window protected by a chrome plated grille, giving a nominal window size of 49 cm². The scintillation phosphor is a layer of anthracene on a Perspex light guide. A photomultiplier tube and thick film resistor network are contained in the handle of the housing. The ratemeter provides high voltage, counting threshold and scaler functions.

**Probe Active Area:** 49 cm²**Controls**

2. A comprehensive summary of the ratemeter functions is contained within the Publications, Reference A & B.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of probe , cables, cable connections and probe window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The BP4 series of beta probe and ratemeter operational voltage should be determined prior to this test, following the procedure given in publications A - D. Precise plateau characteristics will be probe and ratemeter dependent and must be determined for each combination.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
- b. **Response To Beta Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)		2 π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
¹⁴ C	2.54	1.78 – 3.30	11.4	8 – 14.8
³⁶ Cl	8.39	5.87 – 10.91	33.6	23.5 – 43.7
¹⁴⁷ Pm*	TBA	TBA	18.9	13.2 – 24.6
⁹⁰ Sr/Y	9.74	6.82 – 12.66	34.5	24.2 – 44.9
⁶⁰ Co	6.64	6.49 – 8.63	27.6	19.3 – 35.9
¹³⁷ Cs*	8.46	5.92 – 11	32.8	23 – 42.7

- (i) Acceptance / pass criteria is instrument response within \pm 30% i.e. within the permitted ranges shown above.
- c. **Check Source Response.** Place the ^{Nat}U UAC 1623 centrally on the probe grid and the record the response on the calibration certificate.
 - (i) Acceptance / Pass criteria check source response should be \pm 20% type test data response.
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn 3mm below the detector. Record the net response (cps) for each planar disc source.

- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- e. **Uniformity of Response.** Each 10 cm^2 area of the detector window must be tested by placing one of the small area sources listed in Required Reference Standards (preferably the item with the highest activity) in turn in five measurement positions and recording the instrument response.
 - (i) Acceptance / pass criteria is that no more than 30% of the total probe area should have a response which is less than 30% of the mean.
- f. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria is $< 6 \text{ cps}$ in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
- 6. **Category 2: Annual Test.** Complete all Category 1 tests with the exception of the Uniformity of Response Test 5.e.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
- 7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
 - (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

- 8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 50 Ships Installed RADIAC System (SIRS) Mk 22NRS

Function Complete on-Board Installed Gamma Detection System

Publications A: BRF 2053(17)

NSN N/A

Required Reference Standards

All measurement equipment used must be traceable to national standards.

Equipment required for setting up the Mk 22NRS SIRS can be found in publications Reference A

Equipment Overview

Description: The Mk 22NRS Ship Installed RADIAC System is designed for use within surface ships. Ships which have survived the initial blast of a nuclear explosion will be subject to danger from radioactive fallout. The Ship Installed RADIAC System (SIRS) provides the command with a full appreciation of the radiological hazard to their ship and its personnel. The Mk 22NRS measures the atmospheric gamma radiation dosage and the radioactivity both in the atmosphere and sea. The system comprises of 5 high level and 2 low level detectors positioned at specific locations within the ship.

Detector Type: See Protocols 26 & 27

Doserate Range: 0 to 9.99 mGy.h⁻¹ and 0 to 9.99 Gy.h⁻¹

Energy Range: See Protocols 26 & 27



Mk 22NRS Ships Installed RADIAC System

Controls

1. A comprehensive summary of the instrument functions is contained within Publication Reference A.

Standard Test Protocol

2. The complete Mk 22NRS equipment is unable to be radiological calibrated as a complete system at this time due to the high doserate sources required and the location of the detector heads when installed on a platform.
3. Therefore the Category 1 "Before First Use" test is a visual inspection of the installation and a functional test of the control and display circuitry.
4. **Category 1 Test: Test before Use.** This procedure must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the system is made.

Note: The Category 1 Test should only be carried out under the supervision and/or Authority of the Equipment Project Management office for the equipment (CBRN IPT, MoD Abbey Wood). This testing is normally completed during the Harbour Acceptance Trials (HAT) after installation of the system to a new platform.

- a. The test procedure for complete system test has been reproduced from BRF2053(17) in [ANNEX A](#) to this protocol.

- b. In addition to complete system testing all detector heads to be incorporated into the system must be calibrated i.a.w. [Protocol 26 Mk 28NH Low Level Detector Head](#) and [Protocol 27 Mk 29NH High Level Detector Head](#).
5. **Category 2: Annual Test.** Complete Calibration of Mk 28 NH and Mk 29 NH Detector heads i.a.w. [Protocol 26 Mk 28NH Low Level Detector Head](#) and [Protocol 27 Mk 29NH High Level Detector Head](#)
6. **Category 3: Test Before Operational Use.** Complete Functional checks i.a.w. Publication Reference A. and on-board Preventative Maintenance Schedule (PMS).

Certification (Qualified Person Authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

ANNEX A to Protocol 50**Mk 22NRS Complete System Setting to Work (procedure reproduced from BRF2053(17))**

1. Most circuits used in this system depend upon stabilised power supplies for their accuracy. These supplies are preset and are not adjustable in situ. Switches on the Mk 20NV should be in the positions as follows. (Switches are behind hinged panel on front of indicating unit Mk 20NV).

- a. Detector Test set to OFF
- b. Equipment Tests set to OFF
- c. Audio Alarm set to ON

2. The 24V power supply should be connected first. The ON/OFF switches on the Indicating Unit Mk 20NV and Simulator Mk 5NG (or Mk 7NG) should be illuminated in the OFF sections if not the switch(es) should be pressed once.

3. Indications on Indicating Unit Mk 20NV and Audio and Visual Alarm Unit VCS 355 should be as follows:

- a. All digital readouts should be on and reading 000 (or some small reading due to effect from the priming source in the detectors).
- b. All Fail lamps should be out.
- c. All Alarm lamps should be out.

Note: Any other VCS Alarm unit in use should indicate '**No Alarm**'

4. Set Audio Alarm switch on Indicating Unit Mk 20NV to OFF. Operate Lamp Test switch:

- a. All lamps (Alarm and Fail) on Indicating Unit Mk 20NV should be on (Audio and Visual Alarm Unit VCS 355 Alarm lamps will be out).
- b. All Dose rate displays should read '888'.
- c. Release the Lamp Test switch and when the lamps and displays revert to normal, switch the Audio Alarm switch to ON.

5. The following test will produce an alarm state locally and at all interfacing consoles. Set System Test switch to ON.

- a. Alarm lamps on Indicating Unit 20NV and Audio and Visual Alarm Unit VCS 355 should be illuminated.
- b. Warning Channel displays should read 655 + original reading (± 001).
- c. Control Channel displays should read 468 (± 001).
- d. Total dose indicators should count (approximately once every 8/9 seconds).
- e. Audio alarms should sound.

6. Carry out the following checks:

- a. Check that the Mute Alarm switch on the Audio and Visual Alarm Unit VCS 355 operates (if audio alarm fitted in that position).
- b. Check that the external Mute switches operate.
- c. Where other VCS units are in use, check that they operate satisfactorily (ie lamp flashes and audio alarm sounds and operation of switches inhibits flashing and mutes audio alarm).
- d. Check that the Dim control on the Audio and Visual Alarm Unit VCS 355 operates.

7. Return the System Test switch to its **OFF** position and check that all alarm lamps go out and the digital displays return to 000 (exceptionally the low level channels may read a few micrograys).
8. Ensure that where other VCS units are in use that they are in the 'accept' position.
9. Where the Simulator Mk 5NG is fitted proceed as follows:
 - a. Press the ON/OFF switch on the Simulator and check that the ON section of the switch is illuminated. Check that the cassette indicators are also illuminated. Press the ON/OFF switch again and check that the OFF section of the switch is illuminated. Reset the switch to ON.
 - b. Ensure that the Pre-wetting switch on the Simulator is set to OFF.
 - c. Insert cassette Mk 53NTU (6665-99-531-0607) into the Simulator cassette recorder.
 - d. Press the Search/Start pushswitch on the Simulator. When the Ready lamp illuminates, press the Search/Start push switch again.
10. Where the Simulator Mk 7NG is fitted, proceed as follows:
 - a. Press the ON/OFF switch on the simulator and check that the ON section of the switch is illuminated. Press the ON/OFF switch again and check that the OFF section of the switch is illuminated. Reset the switch to ON.
 - b. Ensure that the Pre-wetting switch on the Simulator is set to OFF.
 - c. Set the Program select switch on the Simulator to position 7.
 - d. Press the Search/Start pushswitch on the Simulator. When the Ready lamp illuminates, press the Search/Start pushswitch again. Check that the Program Running lamp is illuminated.
11. Check that all Alarm lamps are illuminated and that all Fail lamps, except U/D, are extinguished.
12. Ensure that the Detector Test switch on the Indicating Unit Mk 20NV is OFF and check that during the operation of the program the dose rate displays indicated in Table 11 are obtained.

Time Approx Mins	U/D Channel	Water Channel	Air Channel	B/D (Channel Select Switch)			
				1	2	3	4
1/2	000	999	999	000	000	000	000
1	010	999	999	002	005	001	001
1 1/2	050	999	999	012	025	006	006
2	100	999	999	025	050	012	012
2 1/2	150	999	999	037	075	018	018
3	200	999	999	050	100	025	025
3 1/2	250	999	999	062	125	031	031
4	500	999	999	125	250	062	062
4 1/2	999 Flashing	999	999	999	999	999	999

Table 11 - Test Program Sequence

13. At the end of the program the total dose reading should be:
 - a. U/D 0104
 - b. B/D1 0026
 - c. B/D2 0052
 - d. B/D3&4 0013

14. During test time switch Channel Selector switch between positions 1 & 4 so that all channels are tested within the 5 minute program. Alternatively, run the program twice and check U/D and B/D3 & 4 and B/D1 & 2 on separate runs.

15. Where the Simulator Mk 5NG is fitted, rewind the cassette Mk 53NTU, eject the tape and set the ON/OFF switch to OFF.

16. Where the Simulator Mk 7NG is fitted, set the ON/OFF switch to OFF.

Reset Audio Alarm Switch on Mk 20NV to ON

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 50a Ships Installed RADIAC System Lightweight (LWSIRS) Mk 23NRS

Function Complete on-Board Lightweight Installed Gamma Detection System

Publications A: BRF 2053(18)

NSN No NSN is issued for this complete assembly.

Required Reference Standards

All measurement equipment used must be traceable to national standards.

Equipment required for setting up the Mk 23NRS SIRS can be found in publications Reference A.

Equipment Overview:

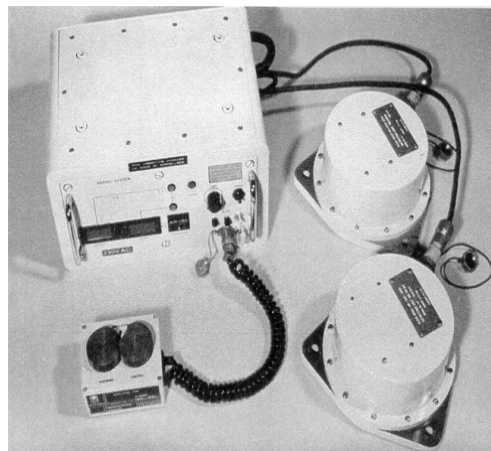
Description and Use: The Mk 23NRS Ship Installed RADIAC System is smaller and lighter than the Mk 22NRS System. The Ship Installed RADIAC System (SIRS) provides the command with a full appreciation of the radiological hazard to their ship and its personnel following a nuclear blast. The system is intended for use within submarines, minesweepers and patrol boats. The Mk 23NRS comprises two detector heads, one Low level and one High level, and one indicating unit.

Physical Construction: See protocols 26 & 27

Detector Type: See protocols 26 & 27

Doserate Range: 0 to 9.99 mGy.h⁻¹ and 0 to 9.99 Gy.h⁻¹

Energy Range: See protocols 26 & 27



Mk 23NRS Ships Installed RADIAC System

Controls

1. A comprehensive summary of the instrument functions is contained within Publication Reference A.

Standard Test Protocol

2. The complete Mk 23NRS equipment is unable to be radiologically calibrated as a complete system at this time due to the high doserate sources required and the location of the detector heads when installed on a platform.
3. Therefore the Category 1 "Before First Use" test is a visual inspection of the installation and a functional test of the control and display circuitry.
4. **Category 1 Test: Test before Use.**
This procedure must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the system is made.

Note: The Category 1 Test should only be undertaken under the supervision and/or Authority of the Equipment Project Management office for the equipment (MESH CBRN RAD1, MESH IPT, MOD Abbey Wood). This testing is normally completed during the Harbour Acceptance Trials (HAT) after installation of the system to a new platform.

- a. The test procedure for complete system test has been reproduced from BRF2053(18) in [ANNEX A](#) to this protocol.
- b. In addition to complete system testing all detector heads to be incorporated into the system must be calibrated i.a.w. [Protocol 26 Mk 28NH Low Level Detector Head](#) and [Protocol 27 Mk 29NH High Level Detector Head](#).

5. **Category 2: Annual Test.**

Complete Calibration of Mk 28 NH and Mk 29 NH Detector heads i.a.w. [Protocol 26 Mk 28NH Low Level Detector Head](#) and [Protocol 27 Mk 29NH High Level Detector Head](#)

6. **Category 3: Test before Operational Use.**

Complete Functional checks i.a.w. Publication Reference A. and on-board Preventative Maintenance Schedule (PMS).

Certification (Qualified Person Authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

ANNEX A to Protocol 50a**Mk 23NRS Complete System Setting to Work (procedure reproduced from BRF2053(18))**1. Check Documentation

- (a) Installation Inspection Certificate
- (b) BR2053(18)
- (c) Calibration Certificate
- (d) Source Register

2. Ensure RAD HAZ is clear for Bridge roof

3. Arrange "pipe" warning re alarms

4. Check voltage setting for 115v - the settings for 115v are:

- X or (1) of supply to pin 8 with link to pin 4 } (ie. both 125v pins,
- Y or (2) of supply to pin 2 with link to pin 6 } & both 10v pins are linked)
- Link PL2/19 and PL2/21
- Check FS1 and FS2 for correct rating (2A)

5. Maintenance Heaters Supply

- (a) If the Mk 21NV is mounted in a consul which has anti condensation heating, then the Mk 21NV does not require its own anti condensation heating, therefore the heater lamp is extinguished and the Mk 21NV "Power On" switch is permanently live - proceed to step 6.
- (b) If the Indicating Unit Mk 21NV is separately mounted, then its power will be supplied through a change over switch which has two functions:
 - MAINTENANCE HEATERS SUPPLY - supplies power to anti condensation heaters only
 - POWER SUPPLY - provides power to the Mk 21NV "Power On" switch.

Ensure that the change-over switch on the external ac power supply is set to "MAINTENANCE HEATERS SUPPLY". With both the Mk 21NV Power Supply and Equip Test switches off, the heater lamp on the indicating unit should be on.

- (c) Set external change over switch to POWER SUPPLY, heater lamp is extinguished.

6. Switch on Mk 21NV, the following should occur:

- (a) Fail and Alarm lamps may come on but will be extinguished almost immediately.
- (b) Digital readouts should be on and reading 000 (or some small reading due to the priming source in the detector)

7. Lamp Test

Press and hold the Lamp Test push-button and check that:

- (a) Fail and Alarm lamps illuminate.
- (b) Warning and Control dose rate displays should read 888.
- (c) Check that the warning lights are illuminated on VCS unit on the bridge.
- (d) Rotate lamp dim potentiometer and ensure that lamp brilliance can be controlled

Equipment Test

Set the Equip Test switch to ON (down position) and check that:

- (a) The Alarm lamp illuminates.
- (b) The audible alarm operates (switch off if required).
- (c) The Warning dose rate display shows $655 \mu\text{Gy/h} \pm 001$.
- (d) The Control dose rate display shows $468 \mu\text{Gy/h} \pm 001$.
- (e) The Total Dose register increments every 8 seconds approximately.

Set the Equip Test switch to OFF and check that:

- (f) The Alarm lamp extinguishes
- (g) The audible alarm ceases
- (h) The dose rate displays return to normal, ie 000 (+ 1, - 0)
- (i) Reset the Total Dose register to 0000 by means of the reset switch below the register.

9. Channel test

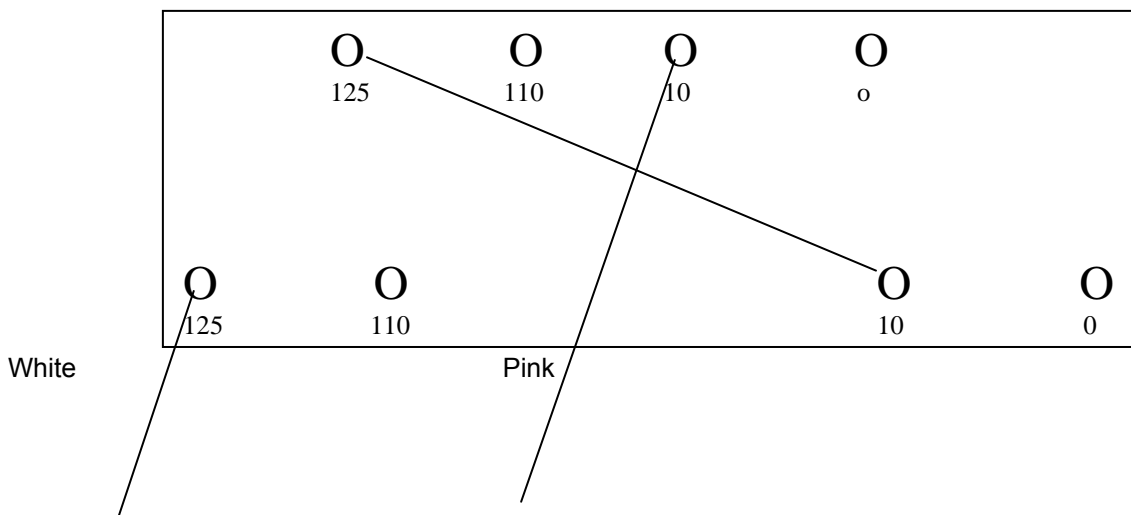
- (a) Disconnect connector from Mk 28NH and observe that the top (Warning) Fail light illuminates and the digital display extinguishes.
- (b) Reconnect the Mk 28NH connector and check that the Fail Light extinguishes and the digital display returns to '000'.
- (c) Disconnect connector from Mk 29NH and observe that the bottom (Control) Fail light illuminates and the digital display extinguishes.
- (d) Reconnect the Mk 29NH connector and check that the Fail Light extinguishes and the digital display returns to '000'.
- (e) Switch off the Mk 21NV.

10. 6NG Simulator

With both controls fully anti-clockwise, plug in the Mk 6NG Simulator and switch on Mk 21NV.

- (a) Rotate Warning potentiometer slowly clockwise, the Warning channel reading will increase. At 010 mrad reading, the Alarm light and the audible alarm will operate
- (b) When Warning potentiometer has been rotated fully clockwise, the Warning display should indicate '999'.
- (c) The Control potentiometer should now be rotated clockwise until a reading of 999 is obtained at the fully clockwise position. At this point the control display should flash.
- (d) Rotate the Control and Warning potentiometers fully anticlockwise, and check that the displays return to zero.
- (e) Switch off Mk 21NV and remove Mk 6NG simulator and reset Total Dose register
- (f) If change over switch is fitted, then switch the change over switch on the external a.c. power supply to "MAINTENANCE HEATERS SUPPLY".

240 Setting



Standard Radiological Monitoring Instrument Statutory Test

Protocol 51 Contamination Monitor Alpha Solid State Type 995000

Function Alpha Contamination Monitor

Publications A: AP-112G-1322

NSN 6665-99-138-0231

Required Reference Standards

All must be emission rate calibrated except the check source:

Extended area ^{241}Am Type WRS 7/E Amersham code AMR 07032 or Type WRS 6/E AMR 06032;

^{238}Pu Type WRS 7/E Amersham code PPR 07032 or Type WRS 6/E PPR 06032;

$^{\text{Nat}}\text{U}$ Type WRS 7/E Amersham code UAR 07032 or Type WRS 6/E UAR 06032;

$^{90}\text{Sr/Y}$ Type WRS 7/E Amersham code SIR 07032 or Type WRS 6/E SIR 06032.

Small area (16mm Active Diameter)

$^{90}\text{Sr/Y}$ Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source $^{\text{Nat}}\text{U}$ Amersham code UAC 1623 NSN 6665-99-193-3906

MOD Jigs Rig SK 1407

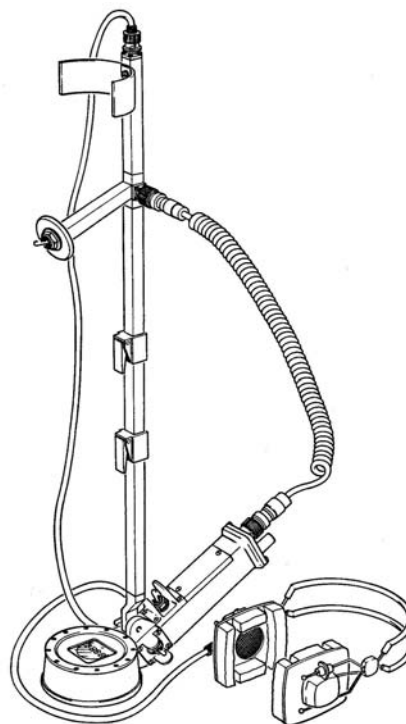
Description

1. The 995000 is a battery operated portable instrument used to detect alpha contamination on personnel, equipment and a variety of terrain. It can be hand held or used with an extension handle, which also allows remote use of the headphone lead and controls. The detector is a 100 mm diameter solid state silicon detector of overall area 78.5 cm² with a liquid crystal output display of 0 to 9999 counts per second.

Probe Active Area: 78.5 cm²

Controls

1. The monitor has two switches for use by the user:
 - a. **Operate Switch.** This is an ON/OFF switch. When the monitor is on the headphone socket is active so that headphone operation is always possible.
 - b. **Display Hold Switch.** When the monitor is switched to the analogue pseudo-logarithmic display it indicates the count rate being measured. When an exact figure for the count rate is required operation of the switch enables the average count rate over 2 seconds to be displayed.



Solid State Alpha Monitor

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of instrument case, cables, Headphones, extension arm, plugs, socket connections and probe window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The operating voltage of the SSAM is preset by the manufacturer and can not be quantitatively altered without disassembling the instrument. Therefore no operating voltage plateau can be measured for this instrument.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
- b. **Response To Alpha Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined all nuclides listed. Details are given below for type responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
²⁴¹ Am	14.93	10.45 – 19.40	38.68	27.08 – 50.28
²³⁸ Pu	14.71	10.29 – 19.12	38.13	26.69 – 49.57
^{NAT} U	5.59	3.91 – 7.26	14.38	10.07 – 18.69

- (i) Acceptance / pass criteria is instrument response within ± 30% i.e. within the permitted ranges shown above.
- c. **Check Source Response.** Place the ^{Nat}U UAC 1623 Check Source in contact with the detector grille and the record the response on the calibration certificate
 - (i) Acceptance / Pass criteria check source response should be ± 20% type test data response.
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn with a source to detector separation of 3mm. Record the net response (cps) for each planar disc source.
 - (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within ± 30%.

- e. **Uniformity of Response.** Each 10 cm² area of the detector window must be tested by placing one of the small area sources listed in Required Reference Standards (preferably the item with the highest activity) in turn in Nine measurement positions and recording the instrument response.
 - (i) Acceptance / pass criteria is that no more than 30% of the total probe area should have a detection efficiency which is less than 30% of the mean.
- f. **Beta Rejection.** Place the ⁹⁰Sr/Y extended area reference source as listed in Required Reference Standards in the appropriate contamination response jigs record the beta response
 - (i) Acceptance / pass criteria is that the monitor response should be < 1% of the equivalent ²⁴¹Am or ²³⁸Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be < 0.4% for beta radiation.
- g. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
 - (i) Acceptance / pass criteria is 0.5 cps in a field of < 0.15 μSv.h⁻¹, H*(10) from ²⁴¹Am 60 keV.
5. **Category 2: Annual Test.** Complete all Category 1 tests with the exception of the Uniformity of Response Test 5.e.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
 - (i) Acceptance / pass criteria check source response should be ± 20% of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 52 Submarine Escape Monitor Type ADM300N

Function Submarine Escape Monitor

Publications A: NRC ADM-300 Multi Function Survey Meter Operators Manual
B: BR 2053(119) Multi Function Survey Meter

NSN 6665-99-083-2988

Required Reference Standards

Gamma Reference Standards - Am-241 & Cs-137 Sources shall offer traceability to national standards.

Check Source No Check Source is currently assigned to the unit.

Equipment Overview

Description and Use: The ADM300N provides a pressure resilient photon / gamma doserate / dose monitoring capability.

Physical Construction: The ADM300N comprises a regular box section cast alloy housing containing a suite of PECs, an LCD display and 2 control switches are located in a cast alloy end panel.

Detector Type: 2 x GM Tubes

Doserate Range: 0.01 μ Sv/h – 100Sv/h

Energy Range: 80keV – 3MeV (manufacturers data)



Controls

1. A comprehensive summary of instrument functionality is contained within 'Publications' A & B.

Standard Test Protocol

2. Tests should be recorded for Qualified Person inspection / certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. Battery tests.

Remove the battery compartment cover, inspect the battery box ensuring the terminals are fit for purpose and the internals are free from corrosion.

Ensure batteries are in good order and provide the necessary voltage for operation.

Replace as necessary.

b. Mechanical checks.

Inspect the instrument, ensuring the case, input sockets, push buttons and LCD display are free from damage.

Replace defective parts as necessary.

c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response. Irradiations (excluding directional dependency) should be undertaken such that the instrument is placed vertically (display

uppermost) and the incident radiation enters the unit through the black decal.

a. Background Dose Rate.

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background doserate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. Response to High Dose Rates.

Expose the UUT to a doserate >10 times scale maxima for at least thirty seconds.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high doserate testing at a level >10 times the maximum credible doserate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance / Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery is NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. Linearity of Response. (^{137}Cs)

Expose the UUT to at least one doserate per decade of operation listed in the table below (example min/max ranges have been provided such that errors up to $\pm 30\%$ will NOT pull the unit into a lower/higher decade. Where decades cannot be tested due to facility restrictions, the limit of the calibration should be covered by the statement defining the limit of calibration on the calibration certificate.

Note: Two readings are required for decade 10 – 100 mSv.h^{-1} as both detectors operate in this decade.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	Detector Tested	Example Min/Max ^{137}Cs Doserates
$\text{H}^*(10)$	$\text{H}^*(10)$	$\text{H}^*(10)$
1 - 10 $\mu\text{Sv.h}^{-1}$	Low	1.5 – 7.5 $\mu\text{Sv.h}^{-1}$
10 -100 $\mu\text{Sv.h}^{-1}$	Low	15 – 75 $\mu\text{Sv.h}^{-1}$
100 – 1000 $\mu\text{Sv.h}^{-1}$	Low	150 – 750 $\mu\text{Sv.h}^{-1}$
1 - 10 mSv.h^{-1}	Low	1.5 – 7.5 mSv.h^{-1}
10 – 100 mSv.h^{-1}	Low	15 – 38 mSv.h^{-1}
10 – 100 mSv.h^{-1}	High	72 – 76 mSv.h^{-1}
100 – 1000 mSv.h^{-1}	High	150 – 750 mSv.h^{-1}
1 - 10 Sv.h^{-1} *	High	1.5 – 7.5 Sv.h^{-1}
10 - 100 Sv.h^{-1} *	High	15 - 75 Sv.h^{-1}

*Facilities incapable of generating doserates in these decades shall include the limit of the testing within the "Limited Cal" statement on the calibration certificate.

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of delivered reference rates.

Note: Non conforming responses may be corrected through application of the procedure documented in protocol manual [Annex 1](#), following adjustment, a full calibration is required.

d. **Dose Test. (¹³⁷Cs)**

Reset the accumulated dose following instructions documented in 'publications' A & B, expose the instrument to a doserate/time combination enabling dose accumulation to the target levels below. On completion of the tests, record the results on the calibration certificate.

¹³⁷ Cs Dose Target	¹³⁷ Cs Permitted Range
H*(10)	H*(10)
1 mSv	700 µSv – 1.3 mSv
40 mSv	28 – 52 mSv

(i) Acceptance / Pass criteria – Instrument response shall reflect conformity to within ±30% of the target dose value.

e. **Energy Response Test. (²⁴¹Am)**

Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ¹³⁷Cs value.

(i) Acceptance / Pass criteria – The ¹³⁷Cs: 'Tested energy' response shall indicate a ratio of 1:0.24 (±30%) when exposed to the same ADE rate, an example is provided below.

Example ¹³⁷ Cs Response	Example ²⁴¹ Am Permitted Range
H*(10)	H*(10)
25 µSv.h ⁻¹	4.2 – 7.8 µSv.h ⁻¹

f. **Directional Dependency**

Expose the instrument in the -90° and +90° orientation (as shown below) to the same doserate/energy combination used during the 'Energy Response Test', record the observed reading and calculate a response ratio using the frontal response obtained during the 'Energy Response Test'.

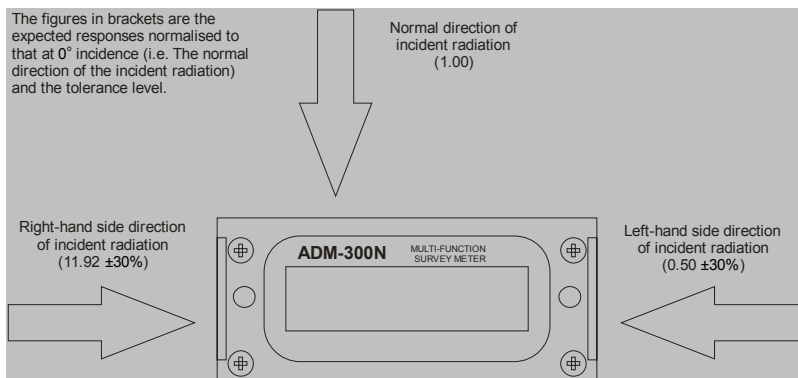


Figure 7. **Expected Directional Dependency**

(i) Acceptance / Pass criteria – The responses shall reflect the response ratios detailed in Figure 1.

g. **Check Source Response.**

No check source is currently assigned to the unit.

5. **Category 2: Annual Test.**

Complete all Category 1 tests except Directional Dependency Test 4.f.

(i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. Category 3: Test before Operational Use.

Complete Category 1 test "Check Source Response" at paragraph 4.g.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

- 7. Certicate all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 53 Transportable Reactor Accident Monitoring System (TRAMS)

Function Transportable gamma area monitor

Publications A: BR / AP
B: Plessey Controls Ltd Handbook

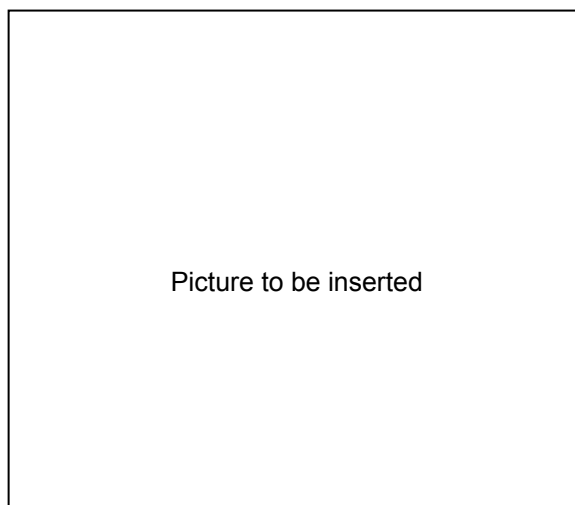
NSN Mk 11 NHA Detector Assembly 6665-99-373-0322
Mk 12 NVA Display Assembly 6665-99-781-1307

Required Reference Standards

None.

Description

1. The T.R.A.M.S consists of two separate assemblies, the detector assembly and the display assembly. They are designed to be transported by road or air for emergency deployment. The Detector assembly contains three detectors (two low-level, one high-level). This assemble may be powered from 115VAC or 240VAC and is battery backed for 24 hours in the event of a mains failure. The pulses from the detectors are transferred via a modem to a British telecom line to the display assemble. This assembly, which displays the level of radiation on an alphanumeric display, may be powered from 115VAC or 240VAC or 12VDC (when connected via a power lead to the detector assembly 12v Aux. output).



Controls

2. A comprehensive summary of the dose rate meter functions is contained within the Publications, Reference A & B.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated detector display assembly combinations. Where separate testing of detector display assemblies is required appropriate subsidiary test should be completed, to confirm suitability of replacement detector display assembly. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. Check Detector Assembly for moisture.
 - b. Check and dry desiccators (Detector Assembly 2 in No., Indicator Assembly 1 in No.).
 - c. Earth Indicating and Detector Assemblies via earth bonding studs provided.
 - d. Detector Assembly: Ensure battery fuse is in the operational position, battery isolator switch is in the 'ON' position, voltage select switch is in the correct position, 'Equipment Operational' and 'Equipment Fault' indicators are lit.
 - e. Connect mains lead to detector assembly and switch on. Ensure 'Equipment Fault' indicator goes out.
 - f. Connect transmission line to TX+ and TX- terminals.
 - g. Indicating Assembly: Set voltage select switch to required position, connect mains lead and switch on, displays should show 'TEST' and then go blank. Fault alarm should sound and 'Transmission Error' indicator should illuminate. Operate 'alarm mute' switch to silence fault

- alarm. Connect transmission line to RX+ and RX- terminals. Transmission Error indicator should go out and the three radiation displays should show a value (probably zero).
- h. Set date / time on the Display Assembly as follows : Remove the rear switch cover plate, operate and release the 'SET DATE' switch, operate and release the appropriate switch as follows: leap year enter 1 non leap year enter 0. Month Tens enter 0 or 1, Month Units enter 0 - 9, Day Tens enter 0 - 3, Day Units 0 - 9, Hours Tens 0 - 2, Hours Units 0 - 9, Minutes Tens 0 - 5, Minutes Units 0 - 9. Operate 'SET DATE' switch again to enter this time and date. Monitor date / time print out during radiation tests.
 - i. Press 'Lamp Test' switch on Display Assembly, all segments of all digits on all detector displays should be illuminated, as should all LED's.
 - j. Press the 'Fault Alarm Test' switch on the Display Assembly, a continuous tone should sound.
 - k. Press the 'High Radiation Alarm Test' switch on the Display Assembly, a sweeping tone should sound.
 - l. Press 'Printer Feed' switch on the Display Assembly, printer paper should continuously feed whilst switch is held.

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.
 - a. **Background Dose Rate.** Remove the instrument from sources and record the instrument background dose rate.
 - (i) Acceptance / Pass criteria - instrument response should reflect $\pm 10\%$ of the known dose rate for the area
 - b. **Response to High Dose Rates.** Expose the instrument to a dose rate in excess of that which it could reasonably encounter in practice, for at least thirty seconds.
 - (i) Acceptance / Pass criteria the instrument should maintain the reading through out the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.

Note: Where possible, instruments should be overload tested at 10 times the maximum scale indication. It is recognised that for a number of test houses this is impracticable. In these instances instruments should be tested at 5 or 10 times the maximum credible dose rate to which the instrument could be exposed. These instruments shall be labelled "Limited Cal" and the calibration certificate shall clearly state the limits of the overload and range testing.

- c. **Check Source Response. (No Check Source is currently assigned to this unit.)**
- d. **Linearity of Response. (^{60}Co)** Expose the instrument to a range of dose rates and record the observed measurements.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Dose Rate for Detector L1 & L2	^{60}Co Expected Response	Dose Rate for Detector L3	^{60}Co Expected Response
H*(10)	H*(10)	H*(10)	H*(10)
10 $\mu\text{Gy.h}^{-1}$	7 – 13 $\mu\text{Gy.h}^{-1}$	10 mGy.h^{-1}	7 – 13 mGy.h^{-1}
100 $\mu\text{Gy.h}^{-1}$	70 – 130 $\mu\text{Gy.h}^{-1}$	100 mGy.h^{-1}	70 – 130 mGy.h^{-1}
1 mGy.h^{-1}	0.7 – 1.3 $\mu\text{Gy.h}^{-1}$	500 mGy.h^{-1}	350 – 650 mGy.h^{-1}
		1500 mGy.h^{-1}	1050 – 1950 mGy.h^{-1}

- (i) Acceptance / Pass criteria is instrument response within $\pm 30\%$ i.e. the expected levels shown above.

- e. **Energy Response Test.** Expose the instrument to either a ^{137}Cs or a ^{60}Co radiation field at a dose rate of $100 \mu\text{Gy.h}^{-1}$. Select the alternative nuclide for this test to the one used for the Linearity of Response Test 5.d. i.e. if ^{137}Cs was used in 5.d. use ^{60}Co .

Note: Due to the construction of this equipment it is not practical to perform this test at the Best Practice recommended energy of 60 keV. This test is to be used as a confirmation of the set-up and calibration of the equipment against the alternative nuclides used for calibration.

Dose Rate	^{60}Co Permitted Range	^{137}Cs Permitted Range
H*(10)	H*(10)	H*(10)
$100 \mu\text{Gy.h}^{-1}$	TBA	$70 - 130 \mu\text{Gy.h}^{-1}$

- (i) Acceptance / Pass criteria is $\pm 30\%$ of incident dose rate.
- f. **Directional Dependency at 60 keV (^{241}Am or 65 keV ISO X-ray Quality).** The Directional Dependency is not required for this equipment as it is only operated in a fixed direction and position relative to the incident source.
- (i) Acceptance / Pass criteria N/A.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** No radiological Before Operational Use test are applicable to this equipment
- (i) Acceptance / pass criteria N/A.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 54 Tritium Monitor Type Mk 4NRM

Function Tritium in Air Monitor

Publications A:

NSN 6665-99-199-8508

Equipment Declared Obsolete under DCI RN 62/03

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 55 Tritium Monitor Type TAM-73

Function Tritium in Air Monitor

Publications A: Tritium in Air Monitor Type TAM-73 Operators Manual

NSN 6665-99-317-1071

Required Equipment

All measurement equipment used must be traceable to national standards

Equipment required for setting up the Tritium-in-air monitor can be found in the manufacturers handbook.

Equipment Overview

Description and Use: The Tritium-in-air monitor consists of a portable air monitor, with analogue display and accessories designed to detect gaseous radioactive contamination in ambient air. The instrument is capable of continuous air sampling and is calibrated to read directly the level of Tritium from 0 to $10^4 \mu\text{Ci}/\text{m}^3$ over four ranges

Controls

1. A comprehensive summary of the instrument functions is contained within Publication Reference A.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.



Tritium-in-air Monitor Type TAM-73

Pre-Radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Mechanical checks.**
Check mechanical integrity of Case, power cable, internal pump, filter holder and LCD display. Replace as necessary.
 - b. **Battery test.**
Check battery compartment and battery condition terminations. Replace as necessary.
 - c. Check operation of all controls and switches.
4. **Category 1 Test: Test before First Use.** The TAM-73 instrument requires calibration procedures over and above that of the ability of the majority of calibration facilities, it is with this in mind that all tests before first use are carried out IAW the procedures laid down in publication, reference A.
5. **Category 2: Annual Test.** Complete all Category 1 tests.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
6. **Category 3: Test before Operational Use.** The test before operational use is laid down in publication, Reference A.
 - (i) Acceptance / pass criteria is that laid down in publication, Reference A.

Certification (Qualified Person authorisation required)

7. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 56 Weapon Accident Monitoring Kit Mk 3NRM + 1320C Alpha Probe

Function Alpha Contamination Monitoring Probe for Weapon Accident Monitoring

Publications A:

NSN 6665-99-949-1324

Use [Protocol 44 - Ratemeter with 1320C Probe](#)

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 57 **Weapon Accident Monitoring Kit Mk 3 NRM + Mk 15NH X-ray Probe**

Function **X-ray Contamination Monitor for Weapon Accident Monitoring**

Publications A: BRF 2053(1)

NSN 6665-99-462-3970

Required Reference Standards

All must be emission rate calibrated except ^{239}Pu Plaque and Mk 20NJ.

Extended area ^{239}Pu Mk 2NCS (300mm x 300mm Plaque) 200KBq.

Small area ^{241}Am Type WRS/E Amersham code AMR 01011, AMR 01021, AMR 01031.

Check source ^{239}Pu 3.7kBq. Mk 20NJ NSN 736-4922.

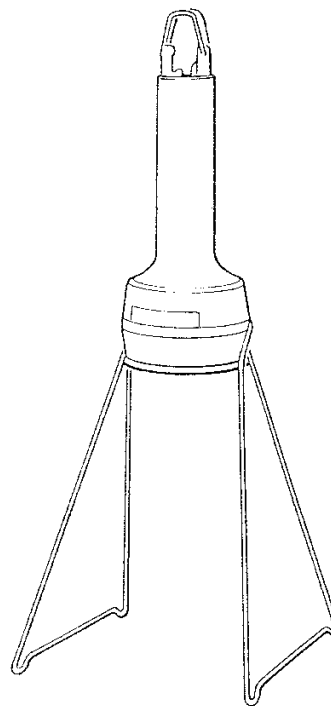
Jig Dedicated Mk 3NRM jig.

Description

1. The Mk 15NH X-ray contamination probe and indicating Unit Mk 9NV is used to locate high concentrations of Contamination. The probe comprises an enamel painted cast aluminium case. The case contains a photo-multiplier tube plus phosphor detector and its associated dynode resistor chain, in a sub-assembly. The sodium iodide crystal is 76mm diameter and 1mm thick. The Mk 9NV provides the probe high voltage, counting threshold and scaler functions. The ratemeter threshold and operating voltage are set during calibration.

Controls

2. A comprehensive summary to the Mk 9NV functions can be found in BRF 2053(1). With the Mk 15NH connected to the Mk 9NV, the channel switch to position 1 and the rate switch to the EHT position, the meter should indicate the voltage printed on the Mk 15NH probe. If this is correct switch meter switch to one of the ranges ie. X1000, x100, x10 or x1 for normal operation. If the voltage is incorrect adjust voltage (while meter switch is in the EHT position) to read correctly by adjusting the potential divider No1 located on the top of the Mk 9NV.



Mk 15NH X-Ray Probe

Standard Test Protocol

3. All tests should be recorded for the Qualified Persons inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations.

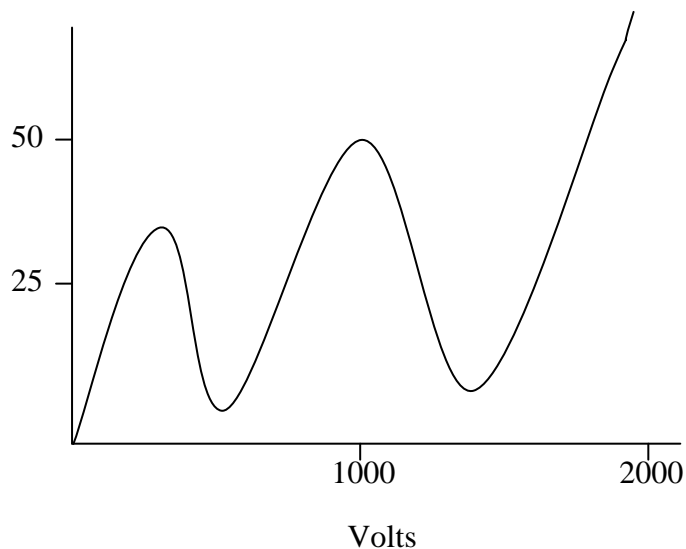
Note: This protocol should only be carried out using a calibrated ratemeter.

Pre- radiation Tests, Electrical and Physical Examination

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, probe case and window. Replace as necessary.
 - c. Check operation of all controls.

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.
- a. Place the Mk 15NH detector, connected to the 9NV ratemeter, and the ^{239}Pu area plaque on the dedicated jig. Plot a graph of EHT voltage against counts per second (cps). A typical plot can be seen below. The EHT that aligns with the second peak should be the operating voltage.



- b. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Record the probe's response ^{241}Am 16mm Planar Disc source with and without the present of the light source.
- (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the alpha source should not be affected by the present of the light.
- c. **Response To ^{239}Pu Contamination.** The response detailed below is for the specified ^{239}Pu area source with a source to detector separation of 153mm.

Nuclide	Mean Response	Permitted Range
^{239}Pu	50cps	45 - 55 cps

- (i) Acceptance / pass criteria is the instrument response within $\pm 30\%$ i.e. within the permitted range shown above.
- d. **Check Source Response.** Place the check source centrally on the probe face and record the response.
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ type test data response.
- e. **Linearity of response.** Place the 16mm (active) diameter planar disc centrally on the detector face in contact geometry. In turn record the net response (cps) for each planar disc source.
- (i) Acceptance / Pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within 30%.

- f. **Background Count Rate.** Remove the probe from the sources and record the background count rate.
 - (i) Acceptance / Pass criteria is < 2 cps in a field of $< 0.15\mu\text{Sv}^{-1}$
6. **Category 2: Annual Test.** Complete all Category 1 tests.
 - (i) Acceptance / Pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test Check Source Response at paragraph 5.b.
 - (i) Acceptance / Pass criteria are the same as Category 1 test.

Certification (Qualified Person authorisation required)

8. Certify test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as directed by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 58 Doserate Meter Type RO10

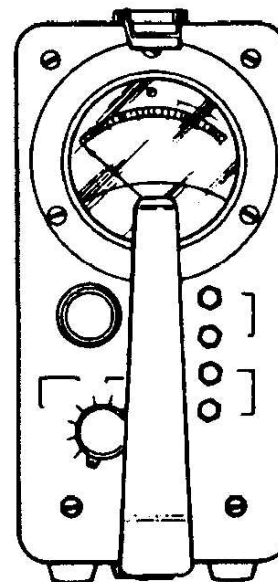
Function Low Level Gamma Survey Meter

Publications A: Technical Manual for Ion Chamber Model RO-2/10/2A/2W/2WS

NSN This equipment is not codified as a MOD Stores Item.

Description

1. The RO10 is a portable air vented ion chamber based instrument for the detection of X and gamma radiation, it also has the capability, for beta / gamma discrimination via a phenolic beta shield ($400\text{mg}/\text{cm}^2$). Dose rate is indicated on a single scale analogue meter, with maximum doserate capability of $10\text{ mSv}\cdot\text{h}^{-1}$. The unit is constructed from a rugged case with side dimples indicating the centre of the chamber, there are four selectable ranges on the instrument, these are $0 - 10\mu\text{Sv}\cdot\text{h}^{-1}$, $0 - 100\mu\text{Sv}\cdot\text{h}^{-1}$, $0 - 1\text{mSv}\cdot\text{h}^{-1}$ and $0 - 10\text{ mSv}\cdot\text{h}^{-1}$. The ion chamber is of "cuboid" appearance; the walls are constructed from phenolic resin employing an aluminiumised Mylar sheet ($7\text{mg}/\text{cm}^2$) for the beta entry window. The ion chamber volume is 400cm^3 , the beta window area is 55cm^2 , and a dessicator module is incorporated within the case to ensure the chamber is free of moisture. The unit has a useful $\text{H}^*(10)$ energy response between 20 keV and $>1.3\text{ MeV}$.



RO10

Controls

2. A comprehensive summary of the dose rate meter functions is contained within the operating manual, Publications Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication (See note) and condition of battery terminations. Replace as necessary.

Note: The unit contains four PP3 batteries, only two of these (BATT 1 & 2) can be tested by means of the battery test position on the rotary switch. Depressing the push switch when unit is in the off position tests BATT 3 & 4.

- b. **Mechanical checks.** Check mechanical integrity of ratemeter case (including snap clips and rubber feet), Meter, handle, beta shield and window. Replace as necessary.
- c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.
 - a. **Background Dose Rate.** Remove the instrument from sources and record the instrument background dose rate.
 - (i) Acceptance / Pass criteria - instrument response should reflect $\pm 10\%$ of the known dose rate for the area

- b. **Response to High Dose Rates.** Expose the instrument to a dose rate in excess 100 mSv.h^{-1} for at least thirty seconds.
- (i) Acceptance / Pass criteria the instrument should maintain the overload reading throughout the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.
- c. **Check Source Response. No check source is currently assigned to this instrument.**
- d. **Linearity of Response. (^{137}Cs)** Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the observed dose rate response should be carried out.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Applied Dose Rate $H^*(10)$	Range Switch Setting	Permitted Range
$2.5 \text{ } \mu\text{Sv.h}^{-1}$	10 $\mu\text{Sv/h}$	1.75 – 3.25 $\mu\text{Sv/h}$
$7.5 \text{ } \mu\text{Sv.h}^{-1}$	10 $\mu\text{Sv/h}$	5.25 – 9.75 $\mu\text{Sv/h}$
$25 \text{ } \mu\text{Sv.h}^{-1}$	100 $\mu\text{Sv/h}$	17.5 – 32.5 $\mu\text{Sv/h}$
$75 \text{ } \mu\text{Sv.h}^{-1}$	100 $\mu\text{Sv/h}$	52.5 – 97.5 $\mu\text{Sv/h}$
0.25 mSv.h^{-1}	1 mSv/h	0.175 – 0.325 mSv/h
0.75 mSv.h^{-1}	1 mSv/h	0.525 – 0.975 mSv/h
2.5 mSv.h^{-1}	10 mSv/h	1.75 – 3.25 mSv/h
7.5 mSv.h^{-1}	10 mSv/h	5.25 – 9.75 mSv/h

- (i) Acceptance / Pass criteria is instrument response is $\pm 30\%$ of the given dose rate i.e. within the permitted ranges shown above.
- e. **Energy Response Test at 60 keV (60 keV ^{241}Am).** Expose the instrument to a 60 keV ^{241}Am radiation field at a dose rate of $25 \text{ } \mu\text{Sv.h}^{-1}$ / or $75 \text{ } \mu\text{Sv.h}^{-1}$.

Applied Dose Rate $H^*(10)$	Range Switch Setting	Permitted Range
$25 \text{ } \mu\text{Sv.h}^{-1}$	100 $\mu\text{Sv/h}$	15.31 – 28.43 $\mu\text{Sv/h}$
$75 \text{ } \mu\text{Sv.h}^{-1}$	100 $\mu\text{Sv/h}$	TBA

- (i) Acceptance / Pass criteria is $\pm 30\%$ of incident dose rate, i.e. the permitted range shown above.
- f. **Directional Dependency at 60 keV (^{241}Am or 65 keV ISO X-ray Quality).** Expose the instrument to ^{241}Am or 65 keV ISO X-ray Quality radiation field at a dose rate of $25 \text{ } \mu\text{Sv.h}^{-1}$ / or $75 \text{ } \mu\text{Sv.h}^{-1}$ the expected polar responses are shown in Figure 1.

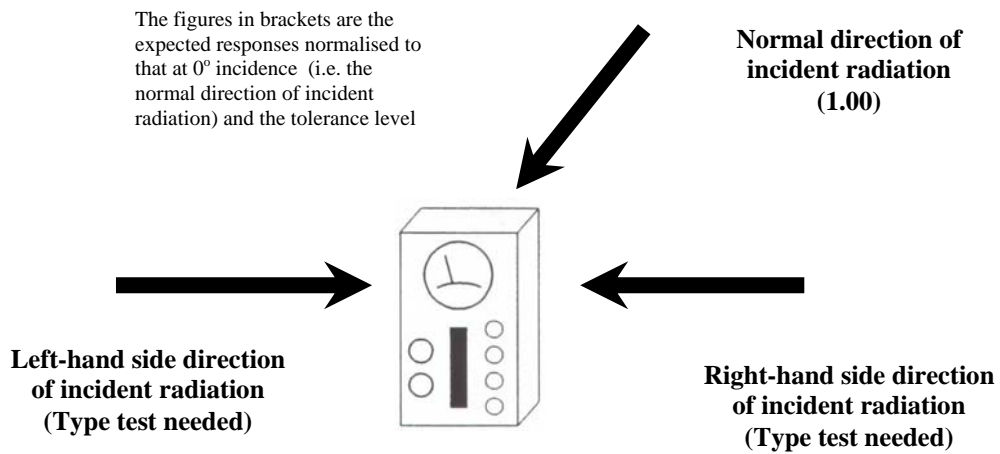


Figure 1: **Expected Directional Dependence**

- (i) Acceptance / Pass criteria response should be within $\pm 30\%$ of type test data.
6. **Category 2: Annual Test.** Complete all Category 1 tests except Directional Dependency Test 5.f.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test before Operational Use.** Complete Category 1 test Check Source Response at paragraph 5.c.
- (i) Acceptance / pass criteria are the same as Category 1 test.
8. **Certification (Qualified Person authorisation required)**

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 59 710C Lead Castle + BP4 Probe

Function Low Background Beta Contamination Monitor

Publications A: NE Technology Instruction Manual Beta Probe BP4
 B: NE Technology Instruction Manual 710 (refers to pre-mod item)
 C: Ratemeter Manual (Dependant on instrument used)

NSN 6665-99-765-7402

Required Reference Standards

All must be emission rate calibrated:

Extended area

- ¹⁴C Amersham code CFR 05022;
- ³⁶Cl Amersham code CIR 05022;
- ⁹⁰Sr/Y Amersham code SIR 05022;
- ⁶⁰Co Amersham code CKR 05022;
- ¹³⁷Cs Amersham code CDR 05022.

Small area (16mm Active Diameter)

- ⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

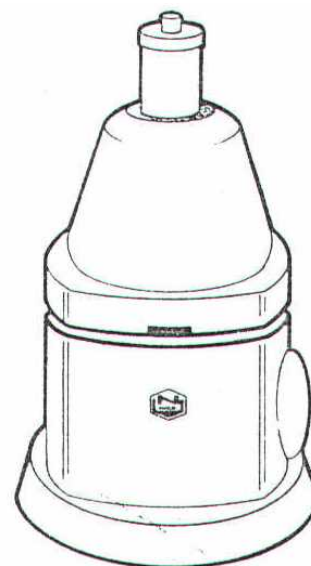
Description

- The 710C lead castle is a historic unit, which has been modified to accept a BP4 series beta probe by means of a hole being bored through the lid and restraining collets fitted. When connected to a compatible ratemeter the unit can be used as a low background, beta contamination monitor. The 710C lead castle weighs 52.27kg (approx.) and stands 280mm high (not including beta probe), the unit has four shelf positions. Shelf 1 sits 14.3mm below the detector, shelf 2 sits 27.0mm below the detector, shelf 3 sits 39.7mm below the detector and shelf 4 sits 52.4mm below the detector. The BP4 probe has a nominal window size of 19.6 cm² and uses an anthracene scintillation phosphor mounted on a Perspex light guide. The unit connects to the ratemeter via a PET100 connector.

Probe Active Area: 19.6 cm²

Controls

- A comprehensive summary of the unit and ratemeter functions is contained within the Publications, Reference A, B & C.



BP4 Fitted in 710C Castle

Standard Test Protocol

- All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of unit and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Note: Owing to the nature of the unit and the shelf spacing it is necessary to calibrate the unit as a complete fixture and not just the BP4 as a single item removed from the castle.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of probe, castle and ratemeter case, ensuring there is no physical damage, particular attention should be given to the door hinge assembly. Check all cables, and cable connections and probe window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each probe before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three observations of the surface contamination response should be made.

Note: The BP4 series of beta probe and ratemeter operational voltage should be determined prior to this test, following the procedure given in publication A. Precise plateau characteristics will be probe and ratemeter dependent and must be determined for each combination.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed, this is awkward but can be achieved by opening the castle door and exposing a bright light to the probe. Record the probe's response to one of the small area sources listed in Required Reference Standards, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the source should not be affected by the presence of the light.
- b. **Response To Beta Contamination.** The responses detailed below are for the specified reference standards, with a source to detector separation determined by the shelf spacing. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)				2 π Efficiency %			
	Mean Response							
	Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 1	Shelf 2	Shelf 3	Shelf 4
¹⁴ C	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
³⁶ Cl	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
⁹⁰ Sr/Y	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
⁶⁰ Co	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
¹³⁷ Cs*	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA

- (i) Acceptance / pass criteria is instrument response within \pm 30% i.e. within the permitted ranges shown above.
- c. **Check Source Response. (No check source is currently assigned to this unit.)**
- d. **Linearity of Response.** Place the small area sources listed in Required Reference Standards centrally in turn on each shelf position. Record the net response (cps) for each planar disc source.

- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$ for each of the shelf positions.
 - e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
 - f. **Background Count Rate.** Remove any sources from the castle and record the monitor background count rate.
 - (i) Acceptance / pass criteria is < 5 cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.
6. **Category 2: Annual Test.** Complete all Category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 5.c.
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 5.c.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 60 Doserate Meter RADIAC Type PDRM82C**Function** High Level Doserate Meter**Publications** A:**NSN** 6665-99-225-4087**Description**

1. The PDRM82C is a rugged, hand held, water-resistant doserate instrument scaled in cGy/hr in air, on a digital auto ranging scale. The detector is contained within a black cylindrical housing at the end of a flying lead connected via a threaded connector at the base of the instrument. The unit requires 3 C-Cells and the function of the unit is controlled by rotation of the battery compartment lid.

**PDRM82C****Controls**

2. The instrument is controlled via the battery compartment lid.

- | | |
|-------------------|--|
| Position 1 | BATT ACCESS, Allows removal of compartment lid on lanyard. |
| Position 2 | OFF, with batteries inserted turning the lid clockwise whilst applying slight pressure allows unit to sit in "OFF" position. |
| Position 3 | ON, with the unit in this position it will run through a short self-test. |

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both category 1 and 2 tests.
 - a. Check unit for visible damage.
 - b. Check battery cover and lanyard for damage including internal copper terminals.
 - c. Check display.
 - d. Check probe housing and cable for damage.
 - e. Inspect the battery box cover seal for damage.
 - f. Functional Check. Switch the unit on and a self-test routine will activate. The unit will power all segments of the LCD display followed by the word "tES.t". On successful completion of the self-test the unit will display 0.0 with a flashing decimal point.

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification, which may have altered the response of the detector is made.

Note: The probe should be positioned to receive the radiation beam from the side.

- a. **Background Dose Rate.** Owing to the nature of the instrument range, the reading for background is zero.

- (i) If a reading greater than zero is observed, the problem should be looked into.
- b. **Response to High Dose Rates.** Expose the instrument to a dose rate in excess of that which it could reasonably encounter in the work place for at least 30 seconds.
- (i) Acceptance / Pass criteria the instrument should maintain the reading through out the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.

Note: Where possible, instruments should be overload tested at 10 times the maximum scale indication. It is recognised that for a number of test houses/Instruments this is impracticable. In these instances instruments should be tested at 5 or 10 times the maximum credible dose rate to which the instrument could be exposed. These instruments shall be labelled "limited calibration" and the calibration certificate shall clearly state the limits of the overload and range testing.

- c. **Check Source Response.** No check source is currently assigned to the PDRM82C.
- d. **Linearity of Response. (¹³⁷Cs)** Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the observed dose rate response should be carried out.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Dose Rate cGy/h	¹³⁷ Cs Permitted Range
50 cGy.h ⁻¹	35 – 6.5 cGy.h ⁻¹
25 cGy.h ⁻¹	17.5 – 32.5 cGy.h ⁻¹
10 cGy.h ⁻¹	7 – 13 cGy.h ⁻¹
5 cGy.h ⁻¹	3.5 – 6.5 cGy.h ⁻¹
1 cGy.h ⁻¹	0.7 – 1.3 cGy.h ⁻¹

- (ii) Acceptance / Pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.
- e. **Energy Response Test at 60 keV (60 keV ²⁴¹Am).** Due to the nature of the high doserate levels required for this instrument it is impractical to undertake an energy response test.
- f. **Directional Dependency at 60 keV (²⁴¹Am or 65 keV ISO X-ray Quality.)** Due to the nature of the high doserate levels required for this instrument, it is impractical to undertake a directional dependency test.
6. **Category 2: Annual Test.** Complete all category 1 tests.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** On power up the instrument will run though a short self test.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 61 Doserate Meter RADIAC Type PDRM82D**Function** High Level Doserate meter**Publications** A:**Description**

1. The PDRM82D is a rugged, hand held, water-resistant doserate instrument scaled in cGy/hr in air, on a digital auto ranging scale. The ratemeter unit is housed in a shock proof housing. The detector is contained within a green cylindrical housing at the end of a coiled lead which is hardwired at the base of the instrument. An audio sounder is supplied via an additional coiled cable and provides audible indication of the Doserate. The unit requires 3 C-Cells for operation, all unit functionality is controlled by rotation of the battery compartment lid.

**PDRM82D****Controls**

2. The instrument is controlled via the battery compartment lid.

- | | |
|-------------------|--|
| Position 1 | BATT ACCESS, Allows removal of compartment lid on lanyard. |
| Position 2 | OFF, with batteries inserted turning the lid clockwise whilst applying slight pressure allows unit to sit in "OFF" position. |
| Position 3 | ON, with the unit in this position it will run through a short self-test. |

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

4. These tests must be undertaken prior to both category 1 and 2 tests.
 - a. Check unit for visible damage.
 - b. Check battery cover and lanyard for damage including internal copper terminals.
 - c. Check display.
 - d. Check probe housing and cable for damage.
 - e. Check Audio unit and cable for damage.
 - f. Inspect the battery box cover seal for damage.
 - g. Functional Check. Switch the unit on and a self-test routine will activate. The unit will power all segments of the LCD display followed by the word "tES.t". On successful completion of the self-test the unit will display 0.0 with a flashing decimal point.

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification, which may have altered the response of the detector is made.

Note: The probe should be positioned to receive the radiation beam from the side, within the striped region.

- a. **Background Dose Rate.** Owing to the nature of the instrument range, the reading for background is zero.
 - (i) If a reading greater than zero is observed, the problem should be looked into.

- b. **Response to High Dose Rates.** Expose the instrument to a dose rate in excess of that which it could reasonably encounter in the work place for at least 30 seconds.
- (i) Acceptance / Pass criteria the instrument should maintain the reading through out the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.

Note: Where possible, instruments should be overload tested at 10 times the maximum scale indication. It is recognised that for a number of test houses/Instruments this is impracticable. In these instances instruments should be tested at 5 or 10 times the maximum credible dose rate to which the instrument could be exposed. These instruments shall be labelled "limited calibration" and the calibration certificate shall clearly state the limits of the overload and range testing.

- c. **Check Source Response.** No check source is currently assigned to the PDRM82D.
- d. **Linearity of Response. (¹³⁷Cs)** Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the observed dose rate response should be carried out.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Dose Rate cGy/h	¹³⁷ Cs Permitted Range
5000 $\mu\text{Gy.h}^{-1}$	3500 – 6500 $\mu\text{Gy.h}^{-1}$
500 $\mu\text{Gy.h}^{-1}$	350 – 650 $\mu\text{Gy.h}^{-1}$
100 $\mu\text{Gy.h}^{-1}$	70 – 130 $\mu\text{Gy.h}^{-1}$
25 $\mu\text{Gy.h}^{-1}$	17.5 – 32.5 $\mu\text{Gy.h}^{-1}$
10 $\mu\text{Gy.h}^{-1}$	7 – 13 $\mu\text{Gy.h}^{-1}$
5 $\mu\text{Gy.h}^{-1}$	3.5 – 6.5 $\mu\text{Gy.h}^{-1}$

- (iii) Acceptance / Pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.

- e. **Energy Response Test at 60 keV (60 keV ²⁴¹Am).** Expose the instrument to a 60 keV ²⁴¹Am radiation field at an air kerma rate of $25\mu\text{Gy.h}^{-1}$ or $100\mu\text{Sv.h}^{-1}$.

Air Kerma Rate Gy (air)	²⁴¹ Am Permitted Range Gy (air)
$25\mu\text{Gy.h}^{-1}$	$24.2 - 36.3 \mu\text{Gy.h}^{-1}$
$100\mu\text{Gy.h}^{-1}$	$\pm 30\%$

- f. **Directional Dependency at 60 keV (²⁴¹Am or 65 keV ISO X-ray Quality).** Expose the instrument to ²⁴¹Am or 65 keV ISO X-ray Quality radiation field at an air kerma rate of $25\mu\text{Gy.h}^{-1}$ / or $100 \mu\text{Sv.h}^{-1}$ the expected polar responses are shown in Figure 1.

6. **Category 2: Annual Test.** Complete all category 1 tests.

- (i) Acceptance / pass criteria are the same as Category 1 tests.

7. **Category 3: Test Before Operational Use.** On power up the instrument will run through a short self test.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

Protocol 62 Doserate Meter RADIAC Type PDRM82M

Function High Level Doserate Meter

Publications A: 611/2/09646/001 ISSUE 2 (NSN 6665-99-225-4082) USER LEAFLET

NSN 6665-99-225-3926

Equipment Declared Obsolete, DIN to be promugated

Protocol Deleted

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 63 Doserate Meter Type Bicron Micro Sievert LE

Function Gamma / X-ray doserate Monitor

Publications A: Bicron Micro Sievert manufacturers handbook

NSN This equipment is not codified as a MOD Stores Item.

Description

1. The Bicron Micro Sievert LE Radiation Monitor is a portable, battery operated instrument used for the measurement of dose equivalent rate produced by gamma and X-radiation. The detector is a NaI(Tl) scintillator, which is located in a spun aluminium housing and is extended from the front face of the instrument. The energy response of the LE option is 17keV – 1.3MeV, the instrument range is 0-2000 μ Sv/h scaled over five ranges.



Bicron Micro Sievert LE

Controls

2. A comprehensive summary of the ratemeter functions is contained within the Publication Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

4. The following tests must be undertaken prior to both Category 1 and 2 tests.
 - a. **Battery Test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Check HV.** Set the function switch to “HV” and check that the reading is within the “HV ok” sector.
 - c. **Mechanical checks.** Check operation of all controls.

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.
 - a. **Background Dose Rate.** With the instrument set to the lowest doserate range remove the instrument from sources and record the instrument background dose rate.
 - (i) Acceptance / Pass criteria - instrument response should reflect $\pm 10\%$ of the known dose rate for the area
 - b. **Response to High Dose Rates.** Expose the instrument to a dose rate in excess of 20 $\text{mSv}\cdot\text{h}^{-1}$, for at least thirty seconds.
 - (i) Acceptance / Pass criteria the instrument should maintain the overload reading throughout the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.

- c. **Check Source Response – (No check source is currently assigned to this unit.)**
- d. **Linearity of Response. (¹³⁷Cs)** Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the observed dose rate response should be carried out.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Note: Owing to the detection ranges on this instrument it may not be able to test all ranges on the instrument without the aid of a low background / doserate facility. Where full testing is not achievable, instruments shall be labelled "Limited Cal" and the calibration certificate shall clearly state the limits of the tests carried out.

Applied Dose Rate H*(10)	Range Switch Setting	Permitted Range
0.05 $\mu\text{Sv.h}^{-1}$	X0.1	0.035 – 0.065 $\mu\text{Sv/h}$
0.15 $\mu\text{Sv.h}^{-1}$	X0.1	0.105 - 0.195 $\mu\text{Sv/h}$
0.5 $\mu\text{Sv.h}^{-1}$	X1	0.35 – 0.65 $\mu\text{Sv/h}$
1.5 $\mu\text{Sv.h}^{-1}$	X1	1.05 – 1.95 $\mu\text{Sv/h}$
2.5 $\mu\text{Sv.h}^{-1}$	X10	1.75 – 3.25 $\mu\text{Sv/h}$
7.5 $\mu\text{Sv.h}^{-1}$	X10	5.25 – 9.75 $\mu\text{Sv/h}$
15 $\mu\text{Sv.h}^{-1}$	X10	10.5 – 19.5 $\mu\text{Sv/h}$
25 $\mu\text{Sv.h}^{-1}$	X100	52.5 – 97.5 $\mu\text{Sv/h}$
50 $\mu\text{Sv.h}^{-1}$	X100	35 – 65 $\mu\text{Sv/h}$
150 $\mu\text{Sv.h}^{-1}$	X100	105 – 195 $\mu\text{Sv/h}$
500 $\mu\text{Sv.h}^{-1}$	X1000	350 – 650 $\mu\text{Sv/h}$
1500 $\mu\text{Sv.h}^{-1}$	X1000	1050 – 1950 $\mu\text{Sv/h}$

- (i) Acceptance / pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.

- e. **Energy Response Test at 60 keV (60 keV ²⁴¹Am).** Expose the instrument to a 60 keV ²⁴¹Am radiation field at a dose rate of 25 $\mu\text{Sv.h}^{-1}$ or 100 $\mu\text{Sv.h}^{-1}$.

Dose Rate H*(10)	²⁴¹ Am Permitted Range H*(10)
25 $\mu\text{Sv.h}^{-1}$	18.47 – 34.29 $\mu\text{Sv.h}^{-1}$
100 $\mu\text{Sv.h}^{-1}$	$\pm 30\%$

- (i) Acceptance / Pass criteria is instrument response within the permitted range shown above.

- f. **Directional Dependency at 60 keV (²⁴¹Am or 65 keV ISO X-ray Quality).** Expose the instrument to ²⁴¹Am or 65 keV ISO X-ray Quality radiation field at a dose rate of 25 $\mu\text{Sv.h}^{-1}$ / or 100 $\mu\text{Sv.h}^{-1}$ the expected polar responses are shown in Figure 1.

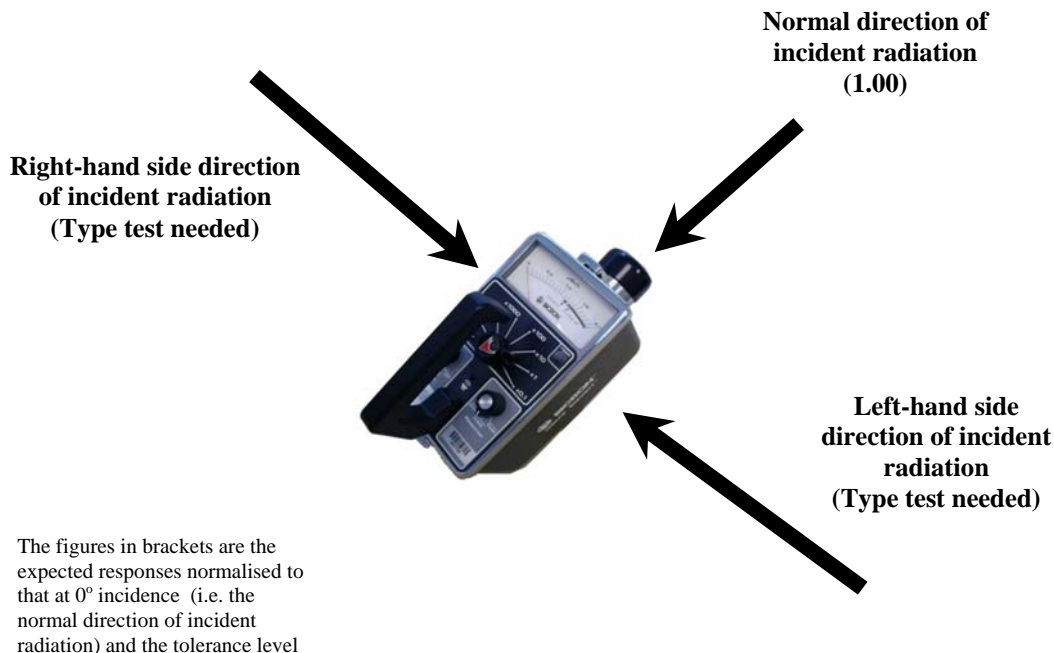


Figure 1: **Expected Directional Dependency**

- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ type test data response.
6. **Category 2: Annual Test.** Complete all Category 1 tests except Directional Dependency Test 5.f.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test Check Source Response at paragraph 5.c.
- (i) Acceptance / pass criteria are $\pm 30\%$ of the value recorded in the Category 1 test.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 64 Contamination Probe Beta Type BSP100A**Function** Beta Surface Contamination Monitor**Publications** A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
B: BR2053(119) Multi-Function Survey Meter**NSN** 6665-99-759-4587**Required Reference Standards**

Extended area - All sources shall offer traceability to national standards and must be emission rate calibrated

¹⁴C **Isotrak** code CFR 07032 or CFR 06032;¹⁴⁷Pm **Isotrak** code PHR 07022 or PHR 06022;⁶⁰Co **Isotrak** code CKR 07032 or CKR 06032;¹³⁷Cs **Isotrak** code CDR 07032 or CDR 06032;³⁶Cl **Isotrak** code UAR 07032 or UAR 06032;⁹⁰Sr/Y **Isotrak** code SIR 07032 or SIR 06032.

Small area (16mm Active Diameter) - All sources shall offer traceability to national standards and must be emission rate calibrated

⁹⁰Sr/Y **Isotrak** code SIR 01011, SIR 01021 and SIR 01031.Check Source ^{Nat}U **Isotrak** code UAC 1623 (NSN 6665-99-193-3906)**Equipment Overview****Description and Use:** The BSP100A / ADM300 combination provides a general purpose, wide area beta surface contamination monitoring capability.**Physical Construction:** The BSP-100A is constructed from a welded sheet metal housing incorporating a top mounted tubular handle assembly and a rear mounted input connector.**Detector Type:** Plastic Scintillator**Beta Energy Range:** 156 keV (¹⁴C) – 2.28MeV (⁹⁰Sr/Y)**Detector Active Area:** 128 cm²**Controls**

1. A comprehensive summary of probe functionality is contained within 'Publications' A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Note: Calibration shall only be undertaken when supported by a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. Mechanical checks.

Ensure the probe case (particularly the rear portion of the handle mount), grille assembly, Mylar window, handle grip and input socket are free from damage.
Replace defective parts as necessary.

b. Ancillary Equipment.

Ensure the interconnection cable maintains pin to pin continuity and is free from damage.
Replace as necessary.

Ensure radioactive check source (if supplied) is free from damage, where sources are damaged or missing report at once to the local RSO and CBRN IPT.

c. Energise the unit and check operation of all controls (using ADM 300A (V1A)).

Radiation Tests

4. Category 1 Test: Test before First Use. These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response.

a. Determination of Operating Voltage.

The operating voltage of the equipment is preset cannot be quantitatively altered without disassembling the probe. Therefore no operating voltage plateau can be measured for this instrument.

b. Background Count Rate.

Remove the probe from the sources and record the instrument background dose rate on the calibration certificate.

(i) Acceptance / Pass criteria - The background level should be less than 2 Counts Per Second in a field of $< 0.25 \mu\text{Sv}\cdot\text{h}^{-1}$, $\text{H}^*(10)$ from ^{137}Cs 662 keV.

c. Light Sensitivity. (With Light Source Only)

The probe should be exposed to an appropriate light source, any significant change in background should be observed.

(i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.

d. Light Sensitivity. (With Radioactive Source)

Position one of the small area beta sources (listed in 'Required Reference Standards') on the face of the detector and record the probe's response with and without the presence of the light source.

(i) Acceptance / Pass criteria - The response to the source should remain unaffected by the presence of the light source.

e. Response To Beta Contamination.

The responses detailed below are for the specified extended area reference standards, with a source to detector face separation of 3mm. For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate. Details of the derivation of contamination responses (cps per $\text{Bq}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425.

Nuclide	$\text{cps}\cdot\text{Bq}^{-1}\cdot\text{cm}^2$ (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
^{14}C	5.3	3.7 – 7.0	8.6	6.0 – 11.2

¹⁴⁷ Pm	8.9	6.3 – 11.6	14.0	9.8 – 18.2
⁶⁰ Co	16.9	11.9 – 22.0	26.3	18.4 – 34.2
¹³⁷ Cs	22.3	15.6 – 30.0	34.8	24.4 – 45.2
³⁶ Cl	24.9	17.4 – 32.4	39.0	27.3 – 50.7
⁹⁰ Sr/Y	24.9	17.4 – 32.4	38.8	27.2 – 50.4

- (i) Acceptance / Pass criteria – The instrument response should be within $\pm 30\%$ of the mean responses reported above.

NOTE: On completion of beta contamination response testing the operator should affix an anti tamper seal over the HV potentiometer access screw located on the right hand side of the probe body.

f. **Linearity of Response.**

Place each of the small area sources listed in 'Required Reference Standards' centrally in turn 3mm below the detector. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.

g. **Uniformity of Response.**

Each 10 cm² area of the detector window must be tested by placing one of the small area sources listed in 'Required Reference Standards' (preferably the item with the highest activity) in turn in the 12 positions indicated in the figure below, for each position, record the instrument response.

1	2
3	4
5	6
7	8
9	10
11	12
Handle	

- (i) Acceptance / Pass criteria – No more than 30% of the total probe area should have a response which is less than 30% of the mean.

h. **Check Source Response.**

Place the check source centrally on the probe grid, allow 30 seconds for the reading to stabilize and record the response on the instrument calibration certificate.

5. **Category 2: Annual Test.**

Complete all Category 1 tests except Uniformity of Response Test 4.g.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 4.h.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certificate all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 65 710C Lead Castle with Type 47490 Probe

Function Low Background Beta Contamination Monitor

Publications A: NRC ADM-300 Multi-Function Survey Meter Operators Manual
B: BR2053 (119) Multi-Function Survey Meter

NSN 6665-99-665-9012

Required Reference Standards

All must be emission rate calibrated:

Extended area - All sources shall offer traceability to national standards and must be emission rate calibrated

⁶⁰Co Isotrak code CKR 05022

¹³⁷Cs Isotrak code CDR 05022

³⁶Cl Isotrak code UAR 05022

⁹⁰Sr/Y Isotrak code SIR 05022

¹⁴C Isotrak code CFR 05022

Small area (16mm Active Diameter) - All sources shall offer traceability to national standards and must be emission rate calibrated.

⁹⁰Sr/Y Isotrak code SIR 01011, SIR 01021 and SIR 01031.

Equipment Overview

Description and Use: The 710C castle provides a low background beta contamination monitoring capability (when supported by an ADM300 ratemeter) for use in elevated gamma fields.

Physical Construction: The 710C castle is constructed from a 3 piece lead enclosure (weighing 52.27kg) with an internal detector and sample chamber offering 4 shelf positions. Connection to the unit is made via a top mounted entry gland.

Detector Type: Pancake GM Tube.

Beta Energy Range: >156 keV

Detector Active Area: 15.5 cm²



Controls

1. A comprehensive summary of ratemeter functionality is contained within 'Publications' A and B

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection/certificate production.

Note: Calibration shall only be undertaken when supported by a calibrated ratemeter.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. **Battery tests – (ADM300).**

Ensure batteries are in good order and provide the necessary voltage for operation.
Replace as necessary.

b. **Mechanical checks.**

Ensure the castle is suitably anchored and the door/hinge and cable assemblies are fit for use.

Release the door and examine the shelf insert / detector window, ensure all items remain fit for purpose.

c. Energise the unit and check operation of all controls.

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to initial introduction to service, the test regime must also be employed where major repairs/modifications may have altered detector response. All readings should be taken over a period of 100 seconds. At least three measurements of surface contamination response should be made to obtain a mean value.

a. **Background Count Rate.**

Remove all sources from the castle and close the door, initiate a 100 second count and record the instrument response on completion of the count. Obtain a mean response from the assembly and record the instrument background dose rate on the calibration certificate.

- (i) Acceptance / Pass criteria - The background level should be less than 3 c.p.s. in a field of $< 0.25 \mu\text{Sv.h}^{-1}$, $H^*(10)$ from ^{137}Cs 662 keV.

b. **Light Sensitivity. (With Light Source Only)**

Open the castle door and expose the GM tube to an appropriate light source, any significant change in background should be observed.

- (i) Acceptance / Pass criteria - The background level should remain unaffected by the presence of the light source.

c. **Response To Beta Contamination.**

The responses detailed below are for the specified extended area reference standards, with a source to detector separation determined by the shelf spacing. Details of the derivation of contamination responses (cps per Bq.cm^2) and equivalent 2π efficiency (%) are documented in JSP 425.

For each source record at least three observations of response to obtain a mean figure, mean figures should be background corrected and recorded on the calibration certificate.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)				2 π Efficiency %			
	Mean Response				Mean Efficiency			
	Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 1	Shelf 2	Shelf 3	Shelf 4
¹⁴ C	0.90	0.39	0.17	0.08	11.8	4.9	2.5	1.3
³⁶ Cl	2.66	1.47	0.93	0.64	34.4	19.1	12.3	8.3
⁹⁰ Sr/Y	2.65	1.49	0.93	0.65	34.5	19.2	12.1	8.5
⁶⁰ Co	1.75	0.90	0.52	0.32	22.4	11.8	6.7	3.8
¹³⁷ Cs*	2.58	1.40	0.86	0.58	33.8	18.3	11.0	7.6

- (i) Acceptance / Pass criteria – The instrument response should be within $\pm 30\%$ of the mean efficiencies reported above.

d. **Linearity of Response.**

Place the small area sources listed in Required Reference Standards centrally in turn on each shelf position. Record the net response (cps) for each source and calculate the ratio of indicated response to source emission rate.

- (i) Acceptance / Pass criteria – The ratio of indicated response to source emission rate should be determined for each of the three sources on each shelf. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$ for each of the shelf positions.

e. **Uniformity of Response.**

Due to the small window area a uniformity test is NOT required on this unit.

f. **Check Source Response.**

(No check source is currently assigned to this unit.)

5. **Category 2: Annual Test***. Complete all Category 1 tests noting the asterisk marked sources in the 'Response To Beta Contamination' tests.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 4.f.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 66 RADIAC Detection Meter (RDM) Type SOR/T

Function x

Publications A: ???

NSN 6665-99-665-9012

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 67 RADIAC Survey Meter (RSM) Type SVG2

Function xx

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 67a ABG Contamination and Dose Rate Probe for use with the SVG2

Function xx

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 68 RADIAC Identification Equipment (RIE) Type GR-135

Function xx

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 69 3 Channel Scaler Mk5NCA

Function 3 Channel Scaler for use in HM Submarines Health Physics Laboratory

Publications A: Manufacturers handbook
B: BR 2053(119) NRC ADM-300 Multi-Function Survey Meter
C: NRC ADM-300 Multi-Function Survey Meter Operators Manual

NSN TBA

Equipment Required

Variable A/C Power Source
Serviceable MD-35 Alpha Drawer Assembly
Serviceable ADM300A(V1A)

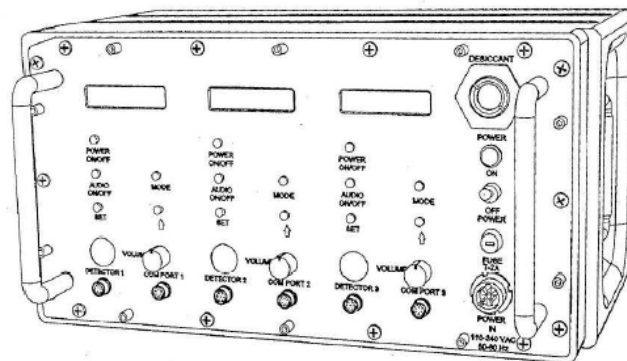
Required Reference Standards

Extended area - ²⁴¹Am Amersham code, AMR 05021, AMR 05022 (VZ-1370)

*Must be emission rate calibrated

Description

1. The Mk 5 NCA is an upgrade from the 4NCA scaler offering a 3 channel operation of ADM300 SMART probes, the unit shares control functions and operational functionality with the ADM300A(V1A) stand alone unit currently in service with the MOD. In standard fit the unit is designed primarily to operate two beta castle units and one MD-35 based alpha drawer unit fitted in Her Majesties Submarines health physics laboratory. The unit can be operated from both 110V and 240V AC supplies and is auto switched to accommodate both voltages.



Controls

2. A comprehensive summary of the ratemeter functions is contained within the Publication Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-Radiation Test. Electrical and Physical Examination

4. The following tests must be undertaken prior to operational issue.
 - a. **Mechanical Integrity.**
Check equipment condition, ensuring push buttons, Rotary controls, displays, speaker outputs, connecting sockets, power leads, screw fixings and captive threads are all free from physical damage and remain fit for purpose.
 - b. **Desiccator Check.**
Ensure the dessicator unit is intact and securely attached to the unit by the large flat retaining nut.

Where desiccator units have become damaged, loose or foreign objects can be heard "rattling" inside the 5NCA the front panel and desiccator unit should be removed and checked for completeness, being refitted using the recommended spares.

c. Power Supply Test.

Connect the 5NCA unit to a variac or similar variable A/C supply using the power lead supplied.

110 Volt Check

Set the variable A/C supply to 110V.

Switch on the 5NCA using the rubber booted "POWER" toggle switch.

Ensure the "POWER" lamp illuminates.

If scalers have not automatically energised, energise each scaler unit via depression of the "POWER ON/OFF" push switches, ensuring each unit powers up.

Upon completion of the test de-energise the 5NCA using the rubber booted "POWER" toggle switch.

240 Volt Check

Increase the voltage of the variable A/C supply to 240 V.

Switch on the 5NCA using the rubber booted "POWER" toggle switch.

Ensure the "POWER" lamp illuminates.

If scalers have not automatically energised, energise each scaler units via depression of the "POWER ON/OFF" push switches, ensuring each unit powers up.

Upon completion of the test de-energise each of the scalers using the "POWER ON/OFF" push switches.

d. Operational checks.

Scaler 1

Energising

Connect a serviceable MD-35 Alpha drawer to the "DETECTOR 1" input socket.

Energise the specific scaler using the "POWER ON/OFF" push switch.

Ensure the scaler powers up noting the following sequence

"Please wait"

"ALPHA probe"

".000 cps Alpha"

Ensure the display has no visible drop outs when in operation.

Keypad operation.

Power supply testing will have proven "POWER ON/OFF" push switch functionality.

Set the scaler to undertake a 100 second count using the method dictated in Publication Reference B.

Through completion of this, operation functionality of the "MODE", "SET" and "↑" keys will be verified.

Background Check

Undertake a 100 second count, recording the result on completion of the counting period.

Radiation Tests

5. Category 1 tests.

Insert the ²⁴¹Am reference standard into the drawer assembly and undertake a 100 second count.

Record the result on completion of the counting period and ensure the result conforms with type test data recorded below.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency*	Permitted Range
²⁴¹ Am	4.76	3.70 - 6.67	52.3	36.6 - 68

*During testing a probe area of 18.1cm² and a plaque area of 19.6cm² have been assumed.

Audio Test

Rotate the rotary "VOLUME" control to it's fully clockwise position.

With the source inserted in the drawer ensure the unit provides audible clicks, if no audio is heard depress the "AUDIO ON/OFF" push switch.
 Ensure the audio is toggle on and off upon depression of the switch.
 When the clicks are audible rotate the the rotary "VOLUME" control to it's fully anti-clockwise position ensuring that the audio changes linearly with control operation.

Alarm Test

Set the alarm threshold to a level below that observed with the source in the drawer unit, ensure the ratemeter alarm sounds when undertaking an instantaneous count.
 Reset the alarm threshold to a level greater than that observed with the source in the drawer unit, ensure the ratemeter alarm does not sound when undertaking an instantaneous count.

Completion of Testing

De energise the scaler using the "POWER ON/OFF" push switch.
 Disconnect the MD-35 from the "DETECTOR 1" input.

Repeat the operational checks for the remaining scalers.

On completion of all testing ensure all cables are stowed correctly and the case is securely fastened.

5. Independent check.

Connect a serviceable ADM300A(V1A) to the MD-35 Alpha drawer unit.
 Insert the ²⁴¹Am reference standard into the drawer assembly and undertake a 100 second count.
 Record the result on completion of the counting period and ensure the result conforms with type test data.
 Check to ensure each of the scalers within the 5NCA conform to within $\pm 20\%$ of the result obtained from the ADM300A(V1A).

Where equipment does not conform to any one of the above tests it should be failed and returned for repair through the recognised repair route.

6. Category 2: Annual Test. Complete all category 1 tests.

- (i) Acceptance / Pass criteria are the same as Category 1 tests.

7. Category 3: Test Before Operational Use. Complete Check Source Response test in line with local operating procedures noted in BR3014.

- (i) Acceptance / Pass criteria are +/-30% of the recommended value.

Certification (Qualified Person authorisation required)

- 8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Protocol 70 Mk 5 NHA Lead Castle (POST-MOD)**Function** Low background Beta Contamination Monitor**Publications** A: BR3014 The counting of Radioactive Samples in Nuclear Powered Submarines**NSN** TBA**Required Reference Standards**

All must be emission rate calibrated:

Extended area

¹⁴C Amersham code CFR 05021; or Amersham code CFR 05022⁶⁰Co Amersham code CKR 05021; or Amersham code CKR 05022⁹⁰Sr Amersham code SIR 05021; or Amersham code SIR 05022

Linearity Sources

Either source set listed below can be used to determine linearity

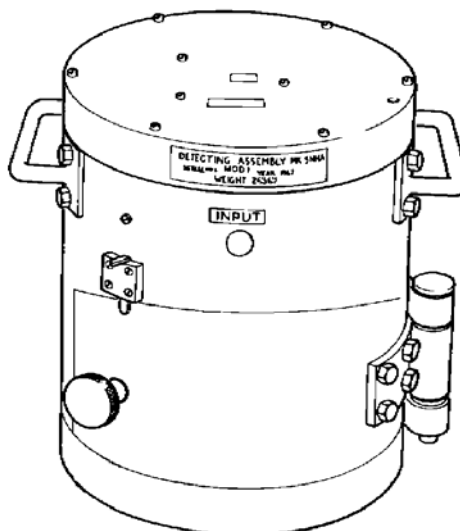
Small area (16mm Active Diameter)

⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Large Area (50mm Active Diameter)

⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 05011, SIR 05021 and SIR 05031.**Description**

1. The Mk5NHA lead castle has been upgraded such that it can be operated with the Mk5NCA 3 channel scaler system common range ADM300 hand held instrumentation. The unit provides a low background beta capability through application of a thin end window halogen quenched GM tube, coupled via extension pins to a protocol module enabling "SMART" operation. The castle unit has been modified such that connection to the Beta detector is made via a 7-Pin interconnection cable thus negating the need for soldering. Inside the castle assembly there are five shelf positions allowing counting of differing activity or out sized sources of beta radiation. Caution should be taken if the castle has to be moved owing to the extreme weight of the assembly.

**Probe Active Area:** 15.5cm²**Controls**

2. A comprehensive summary of the unit and ratemeter functions is contained within the Publications, Reference A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for verification of shelf efficiencies and sensitivity data for castle assemblies.

4. All calibration should be undertaken with the detectors mounted inside a castle assembly.

Pre-radiation Tests, Electrical and Physical Examination.

5. These tests must be undertaken prior to both category 1 and 2 tests.
- a. **Mechanical checks.** Check castle integrity ensuring there is no physical damage, particular attention should be afforded to the door hinge and lock assembly. Check all cables/cable connections, extenders pins, sockets, GM and housing, protocol module and housing. - Replace damaged components as necessary.

Radiation Tests

6. **Category 1 Test: Test before First Use.** These tests must be undertaken on each GM Tube module prior to initial introduction to service. They must also be carried out after any repair that may have altered probe response.
- a. **Light Sensitivity.** A light leakage test is not required on GM Tube instruments.
- b. **Response To Beta Contamination.** Using the source positioning jig place the 50mm Active Diameter sources in turn at each of the shelf positions, undertake at least three 30 second counts for each shelf/source combination. Record each reading such that a mean figure for each shelf/source combination can be calculated, background correcting the figure to indicate a value in cps.

Calculate the response in cps per Bq.cm² and equivalent 2 π efficiency.

Acceptance / pass criteria - Instrument response should be within $\pm 30\%$ of the mean values provided below.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)					2 π Efficiency %				
	Mean Response					Mean Efficiency				
	Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5	Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5
¹⁴ C	1.33	0.47	0.17	0.07	0.03	17.16%	6.05%	2.25%	0.84%	0.35%
⁶⁰ Co	2.49	1.05	0.51	0.29	0.16	32.08%	13.51%	6.60%	3.70%	2.12%
⁹⁰ Sr	3.51	1.58	0.86	0.53	0.36	45.54%	20.42%	11.09%	6.84%	4.65%

- c. **Check Source Response. (See Category 3: Test Before Operational Use.)**
- d. **Linearity of Response.** – A linearity check has to be carried out for each of the five shelf positions using a series of small or large area linearity sources.

Place each linearity source (from the chosen set) in turn centrally in the source positioning jig. Record the net response over 30 seconds for each disc source, the figure should be corrected to indicate a value in cps.

- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.

This procedure should be repeated for each shelf position.

- e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
- f. **Background Count Rate.** Remove any sources from the castle, carry out a 30 second integrated count and record the monitor integrated background count. Correct the figure to indicate a value in cps.

Acceptance / pass criteria is < 5 cps in a field of < 0.15 μ Sv.h⁻¹, H*(10) from ¹³⁷Cs 662 keV.

7. **Category 2: Annual Test.** Complete all category 1 tests with the exception of the Uniformity of Response Test 5.e.

Acceptance / pass criteria are the same as Category 1 tests.

8. **Category 3: Test Before Operational Use.** The unit should be checked for conformity prior to use following the approved procedure documented in BR3014.

Remove any sources from the castle, carry out a 30 second integrated count and record the monitor integrated background count. Correct the figure to indicate a value in cps.

Position the 50mm Active Diameter ⁹⁰Sr source (from the 3 source set) in the source positioning jig in the shelf 1 position, undertake a 30 second count and record the reading on completion. Correct the figure to indicate a value in cps.

Background correct the resultant reading and calculate the response in cps per Bq.cm² and equivalent 2 π efficiency.

Ensure the calculated figures are within ± 20% of the response reported for shelf 1 on the current calibration certificate.

Certification (Qualified Person authorisation required)

9. Certify test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 71 Victoreen 4000M

Function Medical and Dental Quality Assurance

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 72 Victoreen 4000+

Function Medical and Dental Quality Assurance

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 73 Keithley KvP Dividers

Function Medical and Dental Quality Assurance

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 74 Unfors Mult-O-Meter

Function Medical and Dental Quality Assurance

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Protocol 75 Thermo Electron Mini Rad 1000 RA

Function Low Level Gamma Survey Monitor

Publications A: Thermo Electron Corporation Instruction Manual, 1000 Series: Covering 1000RA, 1000RMA and 1000RLA Radiation Monitors

NSN TBA

Description

1. The Mini 1000RA is a portable, low-level, gamma survey monitor, using an internal, energy compensated, Geiger-Muller detector. The useful energy range for ambient dose equivalent $H^*(10)$ measurement, is 50keV to 1.25 MeV ($\pm 20\%$ relative to ^{137}Cs). Dose rate is indicated on a logarithmically scaled meter, covering the range $0.1 \mu\text{Sv}\cdot\text{h}^{-1}$ to $1000 \mu\text{Sv}\cdot\text{h}^{-1}$.



Controls

2. A comprehensive summary of the dose rate meter functions is contained within the operating manual, References A.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

4. These tests must be undertaken prior to both category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication, condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Inspect the analogue meter and face for signs of fading and damage to both glass and bezel. Ensure the handle and rotary control knob are free from damage and are securely attached to the unit. Replace defective parts as necessary.
 - c. **Alarm Set Point.** Select the "set alm" position using the rotary control knob, using a flat head screw driver adjust the "adj alarm" potentiometer until the meter displays $10\mu\text{Sv}/\text{h}$.

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument prior to introduction to service for the first time and also if any major repair or modification which may have altered the response of the detector is made. All radiological testing should be undertaken with the unit in the "on" position i.e. On with Audio.
 - a. **Background Dose Rate.** Remove the instrument from sources and record the instrument background dose rate.
 - (i) Acceptance / Pass criteria is $\pm 10\%$ of known low dose rate area dose rate.
 - b. **Response to High Dose Rates.** Expose the instrument to a dose rate in excess $10 \text{ mSv}\cdot\text{h}^{-1}$ for at least thirty seconds.
 - (i) Acceptance / Pass criteria - The instrument should maintain full scale deflection throughout the test, accompanied by an audible alarm.
 - c. **Check Source Response. (no check source is currently assigned to this unit)**

- d. **Linearity of Response. (¹³⁷Cs)** Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the instrument response should be recorded.

Note: As a minimum, 1 reading of each decade within the type test data range shown should be tested.

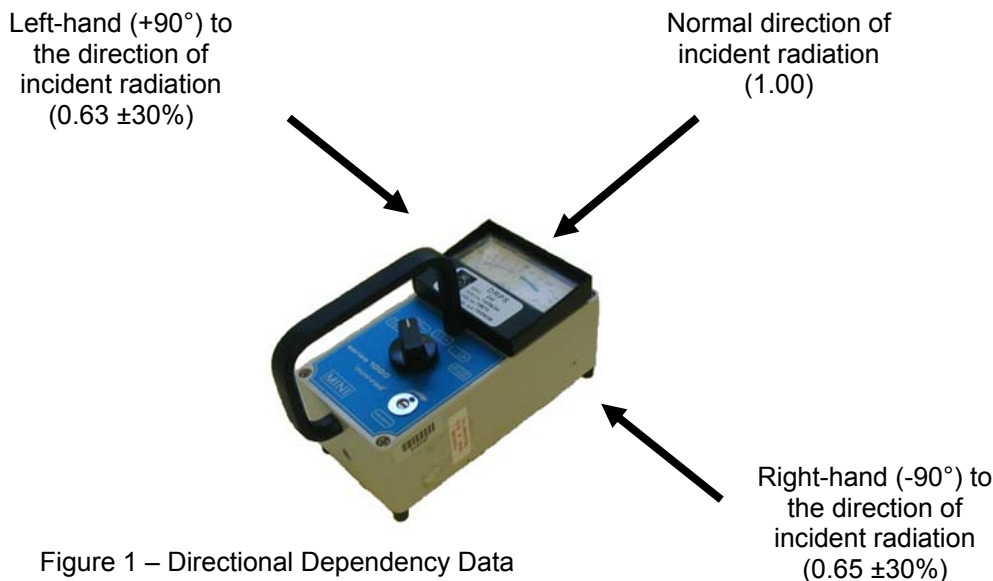
Dose Rate H*(10)	¹³⁷ Cs Permitted Range H*(10)
500 μSv.h ⁻¹	350 – 650 μSv.h ⁻¹ (see note)
100 μSv.h ⁻¹	70 – 130 μSv.h ⁻¹ (see note)
25 μSv.h ⁻¹	17.5 – 32.5 μSv.h ⁻¹ (see note)
7.5 μSv.h ⁻¹	5.25 – 9.75 μSv.h ⁻¹
2.5 μSv.h ⁻¹	1.75 – 3.25 μSv.h ⁻¹

Note: The unit should alarm during the 25, 100 and 500μSv/h exposures.

- (i) Acceptance / Pass criteria – The instrument response must be within ± 30% of the reference doserate. The unit should also issue an audible alarm on the relevant exposures.
- e. **Energy Response Test at 60 keV (60 keV ²⁴¹Am).** Expose the instrument to a 60 keV ²⁴¹Am radiation field at a dose rate of H*(10) 25 μSv.h⁻¹ or 100 μSv.h⁻¹.

Dose Rate H*(10)	²⁴¹ Am Permitted Range H*(10)
25 μSv.h ⁻¹	17.5 – 32.5 μSv.h ⁻¹
100 μSv.h ⁻¹	± 30%

- (i) Acceptance / Pass criteria – The instrument response must be within the permitted ranges shown above.
- f. **Directional Dependency at 60 keV (²⁴¹Am or 65 keV ISO X-ray Quality).** Expose the instrument to ²⁴¹Am or 65 keV ISO X-ray Quality radiation field at a dose rate of 25μSv.h⁻¹ / or 100 μSv.h⁻¹ the expected polar responses are shown in Figure 1.



6. **Category 2: Annual Test.** Complete all category 1 tests with the exception of the Directional Dependency Test reported at para 5.f.
 - (i) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test Check Source Response at paragraph 5.c.
 - (i) Acceptance / pass criteria – The instrument response should be $\pm 30\%$ of the values recorded for the Category 1 test.

Certification (Qualified Person authorisation required)

8. Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 76 Doserate Meter Type FH11

Function Digital Gamma Survey Meter

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 77 Ship Installed Radiac System (S2) Detector Head Assembly

Function **Installed Gamma Detection**

Publications A: BR - TBA
 B: ANV-S2 Naval Radiation Monitoring Systems – A Guide to Using

NSN XXXX-XX-XXX-XXXX

Required Reference Standards

Gamma Reference Standards - This protocol requires Am-241 and Cs-137, all Sources shall offer Air Kerma rate traceability to national standards.

Check Source - No Check Source has currently been assigned to this equipment

Equipment Overview

Description and Use: The S2 detector head is designed for use as part of an installed system and provides a wide detection range covering background to RADIAC levels.

Physical Construction: The detector unit consists of an aluminium cast dome structure connected to a back panel assembly, the back panel portion provides a PCB mount for the detectors and associated electronics. Connection to the unit is via a single connector.

Detector Type: GM Tube (Low Range) PIN Photo-diode (High Range)

Doserate Range: 10nGy.h⁻¹ to 100Gy.h⁻¹

Energy Range: 60keV to 1MeV ±20% - 1MeV to 3MeV ±35%



SIRS 2

Controls

1. A comprehensive summary of the instrument functions is contained within Publications Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

a. **Mechanical checks.**

Check the mechanical integrity of the detector head ensuring that all screws are fitted on the rear panel, the dome assembly is free from cracks and major corrosion and the plug assembly is intact and fit for use.

Replace defective parts as necessary.

- b. Energise the unit and ensure the unit is operation prior to committing the unit for calibration.

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

Detector Positioning: All Testing shall be undertaken with the unit positioned in the vertical plane (with the input plug assembly in the 12 o' clock position, incident radiation should enter the unit through the centre of the detector dome.

a. **Background Dose Rate.**

Position the unit under test (UUT) in a low background environment (where measurement of background is undertaken in the exposure room, a collimator/detector spacing of at least 1000mm should be maintained).

Record the instrument background dose rate on the calibration certificate.

- (i) Acceptance / Pass criteria - Instrument response should reflect $\pm 10\%$ of the known dose rate for the area.

b. **Response to High Dose Rates.**

Expose the UUT to a dose rate >10 times scale maxima for at least thirty seconds.

Note: Test houses incapable of generating rates at or greater than scale maxima should undertake high dose rate testing at a level >10 times the maximum credible dose rate which could be encountered during operational use. Units tested in this manner shall carry a "Limited Cal" tally, supported by a statement on the calibration certificate defining the limits of the testing.

- (i) Acceptance / Pass criteria – The instrument should maintain an overload state throughout testing, where FSD is reported there should be no evidence of fallback. Where overload delivery NOT achievable by the facility, the instrument shall report a response conforming to within $\pm 30\%$ of the delivered reference rate.

c. **Linearity of Response. (^{137}Cs)**

Expose the UUT to at least one Air Kerma rate per decade of operation listed in the table below (example min/max ranges have been provided such that errors up to $\pm 30\%$ will NOT pull the unit into a lower/higher decade. Where decades cannot be tested due to facility restrictions, the limit of the calibration should be covered by the statement defining the limit of calibration on the calibration certificate.

Obtain a mean reported figure from the instrument for each delivered rate, mean figures should be background corrected and recorded on the calibration certificate.

Decade of Operation	Detector Used	Example Min/Max ^{137}Cs Rates
Air Kerma Rate		Air Kerma Rate
10 – 100 $\mu\text{Gy.h}^{-1}$	Low	15 – 75 $\mu\text{Gy.h}^{-1}$
100 – 1000 $\mu\text{Gy.h}^{-1}$	Low	150 – 750 $\mu\text{Gy.h}^{-1}$
1 – 10 mGy.h^{-1}	Low	1.5 – 7.5 mGy.h^{-1}
10 – 100 mGy.h^{-1}	High ($>15 \text{mGy.h}^{-1}$)	15 – 75 mGy.h^{-1}
100 – 1000 mGy.h^{-1}	High	150 – 750 mGy.h^{-1}
1 – 10 Gy.h^{-1}	High	1.5 – 7.5 Gy.h^{-1}
10 – 100 Gy.h^{-1}	High	15 – 75 Gy.h^{-1}

NOTE: Due to the long processing time required for sub $50\mu\text{Gy/h}$ levels a suitable level should be chosen for the 10 - 100 $\mu\text{Gy/h}$ decade.

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within $\pm 30\%$ of delivered reference rates.

d. **Dose Test (Not Req'd)**

Dose data is calculated by the display unit and NOT the detector.

e. **Energy Response Test (Using Am-241)**

Expose the instrument to a doserate reflecting one of the doserates used during the 'Linearity of Response' testing. Record the observed reading and calculate a response ratio using the normalised ^{137}Cs value.

- (i) Acceptance / Pass criteria – The ^{137}Cs 'Tested energy' response shall indicate a ratio of 1:1 ($\pm 30\%$) when exposed to the same ADE rate, an example is provided below.

Example ^{137}Cs Response

H*(10)

25 $\mu\text{Gy}\cdot\text{h}^{-1}$

Example 'Tested Energy' Permitted Range

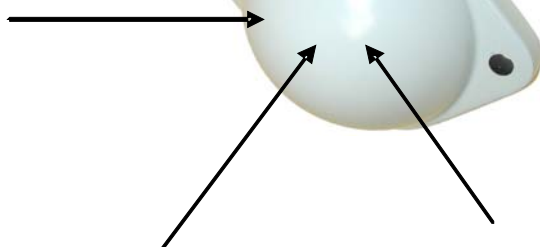
H*(10)

17.5 – 32.5 $\mu\text{Gy}\cdot\text{h}^{-1}$

f. **Directional Dependency**

Expose the instrument in the -75° and $+75^\circ$ orientation (as shown below) to the same doserate/energy combination used during the 'Energy Response Test', record the observed reading and calculate a response ratio using the frontal response obtained during the 'Energy Response Test'.

**Right-hand side
($+75^\circ$) direction
of incident
radiation
(0.9 $\pm 30\%$)**



**Normal direction
of incident
radiation
(1.00)**

The figures in brackets are the expected responses normalised to that at 0° incidence (i.e. the normal direction of incident radiation) and the tolerance level

**Right-hand side
(-75°) direction
of incident
radiation
(0.9 $\pm 30\%$)**

Figure 8. **Expected Directional Dependency**

- (i) Acceptance / Pass criteria – The responses shall reflect the responses detailed in Figure 1.

g. **Check Source Response.**

No check source is currently assigned to the unit.

5. **Category 2: Annual Test.**

Complete all Category 1 tests except Directional Dependency Test 4.f.

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

6. **Category 3: Test before Operational Use.**

Complete Category 1 test "Check Source Response" at paragraph 4.g.

- (i) Acceptance / Pass criteria – Response should be $\pm 20\%$ of the response recorded on the extant calibration certificate.

Certification (Qualified Person authorisation required)

7. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Standard Radiological Monitoring Instrument Statutory Test

**Protocol 78 NATO Submarine Rescue Service Intervention Remote
Operated Vehicle Radiation Detection Equipment (NSRS IROV
RDE)**

Function High Energy Gamma Detector

Publications A: ???

NSN XXXX-XX-XXX-XXXX

Protocol not yet developed.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 79 ABSP-100A

Function	ADM300SI compatible Dual Probe
Publications	A: Manufacturers Operating Manual ABSP-100A
NSN	6665-01-538-5300

Required Reference Standards

All must be emission rate calibrated except UAC1623:

Extended area

- ⁹⁰Sr/Y Type WRS 7/E Amersham code SIR 07031 or Type WRS 6/E SIR 06031;
- ³⁶Cl Type WRS 7/E Amersham code CIR 07031 or Type WRS 6/E CIR 06031;
- ⁶⁰Co Type WRS 7/E Amersham code CKR 07031 or Type WRS 6/E CKR 07031;
- ²⁴¹Am Type WRS 7/E Amersham code AMR 07031 or Type WRS 6/E AMR 06031;
- ¹³⁷Cs Type WRS 7/E Amersham code CDR 07031 or Type WRS 6/E CDR 06031;
- ²³⁸Pu Type WRS 7/E Amersham code PPR 07031 or Type WRS 6/E PPR 06031;
- ^{NAT}U Type WRS 7/E Amersham code UAR 07031 or Type WRS 6/E UAR 06031.

Small area

- ⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.
- ²⁴¹Am Type WRS 1/E Amersham code AMR 01011, AMR 01021 and AMR 01031.

Description

- The ABSP-100A is an ADM300SI compatible SMART dual probe used for the measurement of Alpha/Beta contamination. The active area of the probe is considered to be 128cm². Due to the nature of the probe construction it does not offer usable detection capabilities for Carbon-14 or Promethium-147.

Probe Active Area: 128 cm²

**Controls**

- A comprehensive summary of the ratemeter functions is contained within the ratemeter operating manual, Publications Reference A.

Standard Test Protocol

- All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for calibration of the ABSP-100A using a calibrated ADM300SI IAW protocol 82. The probe should not be tested using standard ADM300(A)V1A, V3A or N variants.

Pre-radiation Tests, Electrical and Physical Examination.

5. These tests must be undertaken prior to both category 1 and 2 tests.
- Mechanical checks.** Ensure probe case, window, grille and input connector are free from damage. Replace as necessary.
 - Ancillary Equipment. Ensure the ADM300SI is calibrated and the cable being used remains fit for purpose.

Radiation Tests

6. **Category 1 Test: Test before First Use.** The following tests must be undertaken on each instrument before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three repeat measurements of surface contamination response should be recorded.
- Light Sensitivity. – Alpha Channel –** Expose the probe to one of the small area alpha sources listed in para 1, noting the countrate. Maintaining the source position expose the probe to an intense light source and record the response.
 - Acceptance / pass criteria – The response to the source should remain unaffected by the presence of light.
 - Light Sensitivity. – Beta Channel –** The background countrate should be noted prior to exposure to the light source. Illuminate the light source and note the background reading.
 - Acceptance / pass criteria – The response to the source should remain unaffected by the presence of light.
 - Response To Surface Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per Bq.cm²) and equivalent 2 π efficiency (%) are given in part 2 of JSP 425. All testing should be undertaken using the specific detection channel reporting using the Counts Per Second (CPS) display. At least three repeat measurements of surface contamination response should be taken to obtain a mean value.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	cps.Bq ⁻¹ .cm ² (P=2)		2π Efficiency %	
	Mean Response	Permitted Range	Mean Response	Permitted Range
²⁴¹ Am	20.34	14.24 – 26.44	32	22.4 - 41.6
²³⁸ Pu	20.14	14.1 – 26.18	31	21.7 – 40.3
NatU	11.70	8.19 – 15.21	18	12.6 – 23.4
⁶⁰ Co	6.10	4.27 – 7.93	10	7 - 13
¹³⁷ Cs*	14.93	10.45 – 19.41	23	16.1 – 29.9
⁹⁰ Sr/Y	19.90	13.93 – 25.87	31	21.7 – 40.3
³⁶ Cl	19.29	13.50 – 25.08	30	21 - 39

- Acceptance / pass criteria – Instrument response is within ± 30% of the mean response i.e. within the permitted ranges shown above.

- Check Source Response. – No check source is currently assigned to this unit.**
- Linearity of Response. – Alpha Channel –** Using a 3mm Source/Detector separation, place each of the small area Alpha sources in turn central to the detector face. Record the net response (cps) for each planar disc source.

- (i) Acceptance / pass criteria – The ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- f. **Linearity of Response. – Beta Channel** – Using a 3mm Source/Detector separation, place each of the small area Beta sources in turn central to the detector face. Record the net response (cps) for each planar disc source.
- (ii) Acceptance / pass criteria – The ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- g. **Uniformity of Response.** Each 10 cm² area of the detector window must be tested by placing one of the small area sources listed in para 1 (preferably the item with the highest activity) in turn in the twelve measurement positions indicated in the table below and recording the instrument response.

1	2
3	4
5	6
7	8
9	10
11	12
Handle	

- h. **Beta Rejection – Alpha Channel – Position the ⁹⁰Sr/Y extended area reference source** 3mm below the detector face and record the beta response.
- (i) Acceptance / pass criteria – The monitor response should be < 1% of the equivalent ²⁴¹Am or ²³⁸Pu response, i.e. if the probe efficiency is 40% for alpha radiation it should be < 0.4% for beta radiation measured in the alpha channel.
- i. **Background Count Rate.** – Remove the probe from the sources and record the monitor background count rate in both alpha and Beta Channels.
- (i) Acceptance / pass criteria is < 1 cps in a field of < 0.15 $\mu\text{Sv}\cdot\text{h}^{-1}$, H*(10) from ¹³⁷Cs 662 keV and 0.5 cps in a field of < 0.15 $\mu\text{Sv}\cdot\text{h}^{-1}$, H*(10) from ²⁴¹Am 60 keV.
7. **Category 2: Annual Test.** Complete all category 1 tests with the exception of the Uniformity of Response Test (Recorded at para 6.g.)
- (i) Acceptance / pass criteria are the same as Category 1 tests.
8. **Category 3: Test Before Operational Use.** Complete Category 1 test Check Source Response at paragraph 6.d.
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 6.d.
9. **Certification (Qualified Person authorisation required)**

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 80 Mini Monitor Series 900 Ratemeter with 42a Probe**Function** Photon Surface Contamination Monitor**Publications** A: AP112G-1325-0 Mini Monitor 900 Series
B: Instrument Operating handbook Series 900 Scintillation Mini Monitor with types 41, 42A/B & 44A/B probes.**NSN** TBA**Required Reference Standards**

All must be emission rate calibrated except UAC 1623 Check Source:

Extended Area:

⁵⁵Fe Photon Reference Source Amersham code IERB 4536;²³⁸Pu Photon Reference Source Amersham code PPRB 4472;¹²⁹I Photon Reference Source Amersham code ISRB 4474;²⁴¹Am Photon Reference Source Amersham code AMRB4473;⁵⁷Co Photon Reference Source Amersham code CTRB3504;¹³⁷Cs Photon Reference Source Amersham code CDRB4475;⁶⁰Co Photon Reference Source Amersham code CKRB4476;

Small area (16mm Active Diameter)

⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source

^{Nat}U Amersham code UAC 1623 NSN 6665-99-193-3906**Description**

1. The Series 900 is a common rate meter, when used with the 42a probe is scaled from 0-5 kcps. The unit has a control knob on the front panel allowing the following operations, OFF, BAT, ON and ON WITH MUTED AUDIO. The battery check is displayed on the green and white band of the meter. The unit has an alarm function which is set using the SET ALARM potentiometer on the front of the unit (a source is required for this procedure). The 42a, Photon contamination probe contains an Aluminium windowed sodium iodide crystal 1mm thick, 23mm diameter coupled to a high gain photo multiplier. The housing is of spun Aluminium construction containing shielding to give greater directionality whilst in use.

**Probe Active Area:** X cm²**Controls**

2. A comprehensive summary of the ratemeter functions is contained within the Publications, Reference A & B.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. These tests must be undertaken prior to both category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, probe case and window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each unit before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three repeat measurements of surface contamination response should be recorded.

Note: The operating voltage of the Series 900 and 42a is preset by the manufacturer and should only be altered if the unit response to ^{55}Fe is low, this operation requires the front panel to be removed and internal potentiometers adjusted.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Check the probe response to one of the small area sources listed in para 1, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the sources should not be affected by the presence of the light.
- b. **Response To Photon Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per $\text{Bq}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	Cps. $\text{Bq}^{-1}\cdot\text{cm}^2$ (P=2)		2 π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
^{55}Fe	TBA	TBA	TBA	TBA
^{238}Pu	TBA	TBA	TBA	TBA
^{129}I	TBA	TBA	TBA	TBA
^{241}Am	TBA	TBA	TBA	TBA
^{57}Co	TBA	TBA	TBA	TBA
$^{137}\text{Cs}^*$	TBA	TBA	TBA	TBA
^{60}Co	TBA	TBA	TBA	TBA

- (i) Acceptance / pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.

- c. **Check Source Response.** When the source is in its container it visibly has a thick end and a thin end. Place the probe in contact with the thin end of the Check Source (^{Nat}U Amersham code UAC 1623 NSN 6665-99-193-3906) centrally in contact with the end of the 42a probe and record the result on the calibration certificate.
- d. **Linearity of Response.** Place the small area sources listed in para 1 centrally in turn 3mm below the detector. Record the net response (cps) for each planar disc source.
- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- e. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
- f. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
- (i) Acceptance / pass criteria is a background level of approx. 2-8 cps in a field of $< 0.15 \mu\text{Sv.h}^{-1}$, H*(10) from ¹³⁷Cs 662 keV.
7. **Category 2: Annual Test.** Complete all category 1 tests with the exception of the Uniformity of Response Test 6.e.
- (i) Acceptance / pass criteria are the same as Category 1 tests.
8. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 6.c.
- (i) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 6.c.
9. **Certification (Qualified Person authorisation required)**

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 81 Mini Monitor Series 900 Ratemeter with 44a Probe

Function	Photon Surface Contamination Monitor
Publications	A: AP112G-1325-0 Mini Monitor 900 Series B: Instrument Operating handbook Series 900 Scintillation Mini Monitor with types 41, 42A/B & 44A/B probes.
NSN	TBA

Required Reference Standards

All must be emission rate calibrated except UAC 1623 Check Source:

Extended Area:

- ⁵⁵Fe Photon Reference Source Amersham code IERB 4536;
- ²³⁸Pu Photon Reference Source Amersham code PPRB 4472;
- ¹²⁹I Photon Reference Source Amersham code ISRB 4474;
- ²⁴¹Am Photon Reference Source Amersham code AMRB4473;
- ⁵⁷Co Photon Reference Source Amersham code CTRB3504;
- ¹³⁷Cs Photon Reference Source Amersham code CDRB4475;
- ⁶⁰Co Photon Reference Source Amersham code CKRB4476;

Small area (16mm Active Diameter)

- ⁹⁰Sr/Y Type WRS 1/E Amersham code SIR 01011, SIR 01021 and SIR 01031.

Check Source

- ^{Nat}U Amersham code UAC 1623 NSN 6665-99-193-3906

Description

- The Series 900 is a common rate meter, when used with the 44a probe is scaled from 0-5 kcps. The unit has a control knob on the front panel allowing the following operations, OFF, BAT, ON and ON WITH MUTED AUDIO. The battery check is displayed on the green and white band of the meter. The unit has an alarm function which is set using the SET ALARM potentiometer on the front of the unit (a source is required for this procedure). The 44a is a Photon contamination probe suitable for photon energies 4keV to approx 1.3MeV containing an Aluminium windowed sodium iodide crystal 2.5mm thick, 38mm diameter coupled to a high gain photomultiplier. The probe housing is of spun aluminium construction.



Probe Active Area: X cm²

Controls

- A comprehensive summary of the ratemeter functions is contained within the Publications, Reference A & B.

Standard Test Protocol

3. All tests should be recorded for Qualified Person inspection and certificate production. This protocol is specifically designed for dedicated probe and ratemeter combinations. Where separate testing of probe and ratemeter is required appropriate subsidiary tests should be completed, to confirm suitability of replacement probe or ratemeter. These tests may be derived from those detailed in this protocol.

Pre-radiation Tests, Electrical and Physical Examination.

4. These tests must be undertaken prior to both category 1 and 2 tests.
 - a. **Battery test.** Check meter battery indication and condition of battery compartment and terminations. Replace as necessary.
 - b. **Mechanical checks.** Check mechanical integrity of ratemeter case, cables, and cable connections, probe case and window. Replace as necessary.
 - c. Check operation of all controls

Radiation Tests

5. **Category 1 Test: Test before First Use.** These tests must be undertaken on each unit before introduction into service for the first time. They must also be carried out after any repair that may have altered probe response. At least three repeat measurements of surface contamination response should be recorded.

Note: The operating voltage of the Series 900 and 44a is preset by the manufacturer and should only be altered if the unit response to ^{55}Fe is low, this operation requires the front panel to be removed and internal potentiometers adjusted.

- a. **Light Sensitivity.** The probe should be exposed to an appropriate light source, any change in background should be observed. Check the probe response to one of the small area sources listed in para 1, with and without the presence of the light source.
 - (i) Acceptance / pass criteria is that the background count should not be elevated and the response to the sources should not be affected by the presence of the light.
- a. **Response To Photon Contamination.** The responses detailed below are for the specified reference standards, with a source to detector grille separation of 3 mm. Details of the derivation of contamination responses (cps per $\text{Bq}\cdot\text{cm}^2$) and equivalent 2π efficiency (%) are given in part 2 of JSP 425. Responses must be determined for all nuclides listed. Details are given below for type test responses.

Note: Nuclide's identified by a * are desirable for category two tests only.

Nuclide	Cps.Bq ⁻¹ .cm ² (P=2)		2 π Efficiency %	
	Mean Response	Permitted Range	Mean Efficiency	Permitted Range
^{55}Fe	TBA	TBA	TBA	TBA
^{238}Pu	TBA	TBA	TBA	TBA
^{129}I	TBA	TBA	TBA	TBA
^{241}Am	TBA	TBA	TBA	TBA
^{57}Co	TBA	TBA	TBA	TBA
$^{137}\text{Cs}^*$	TBA	TBA	TBA	TBA
^{60}Co	TBA	TBA	TBA	TBA

(i) Acceptance / pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.

- b. **Check Source Response.** When the source is in its container it visibly has a thick end and a thin end. Place the probe in contact with the thin end of the Check Source (^{Nat}U Amersham code UAC 1623 NSN 6665-99-193-3906) centrally in contact with the end of the 44a probe and record the result on the calibration certificate.
- c. **Linearity of Response.** Place the small area sources listed in para 1 centrally in turn 3mm below the detector. Record the net response (cps) for each planar disc source.
- (i) Acceptance / pass criteria are that the ratio of indicated response to source emission rate should be determined for each of the three sources. Each individual ratio should agree with the mean of all three ratios to within $\pm 30\%$.
- d. **Uniformity of Response.** A uniformity check is not required on this probe due to its small active area.
- e. **Background Count Rate.** Remove the probe from the sources and record the monitor background count rate.
- (i) Acceptance / pass criteria is a background level of approx. 6-15 cps in a field of $< 0.15 \mu\text{Sv}\cdot\text{h}^{-1}$, H*(10) from ¹³⁷Cs 662 keV.
6. **Category 2: Annual Test.** Complete all category 1 tests with the exception of the Uniformity of Response Test 6.e.
- (ii) Acceptance / pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test "Check Source Response" at paragraph 6.c.
- (ii) Acceptance / Pass criteria check source response should be $\pm 20\%$ of the response recorded at Para. 6.c.

8. **Certification (Qualified Person authorisation required)**

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 82 ADM300SI Multipurpose Meter**Function** Multi Function Survey Meter**Publications** A: NRC ADM-300 Multi Function Survey Meter Operators Manual
 B: BR 2053(119) Multi Function Survey Meter**NSN** 6665-21-913-3793**Description**

The ADM 300SI Multi-Function Meter is a portable, compact, microprocessor based instrument. As a stand alone unit it can be used for X, Gamma and Beta Doserate measurement. Its capabilities can be extended by the connection of additional probes (this protocol covers the calibration of a stand alone unit). The main difference between the ADM300SI and other variants is it's ability to offer Alpha/Beta differentiation whilst externally connected dual probes.

**Controls**

1. A comprehensive summary of the ratemeter functions is contained within the Publications, Reference A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. These tests must be undertaken prior to both category 1 and 2 tests.
 - a. Check membrane switches for cracks.
 - b. Check beta window cover for damage, holes, dirt and moisture.
 - c. Check the display window is not broken.
 - d. Inspect the battery box cover seal for damage.
 - e. Inspect the battery contacts for damage and corrosion.
 - f. Inspect probe and comms port to ensure that they are undamaged and the contacts are free of foreign matter.
 - g. Functional Check. Energise the ADM300SI and a self test routine will activate.

Radiation Tests

4. **Category 1 Test: Test before First Use** These tests must be undertaken on each instrument before introduction into service for the first time and also if any major repair or modification which may have altered the response of the detector is made.

Note: The unit should be positioned to receive the radiation beam from the beta window end centred between the 'L' and 'H' markings on the housing and the 'X' mark on the side of the ADM 300SI.

- a. **Background Dose Rate.** Remove the instrument from sources and record the instrument background dose rate.
 - (i) Acceptance / Pass criteria is $\pm 10\%$ of known low dose rate area dose rate.
- b. **Response to High Dose Rates.** Expose the instrument to a dose rate in excess of that which it could reasonably encounter in the work place for at least 30 seconds.

- (i) Acceptance / Pass criteria the instrument should maintain the reading through out the test. If the instrument reaches full-scale deflection no evidence of fold over is to be shown.

Note: Where possible, instruments should be overload tested at 10 times the maximum scale indication. It is recognised that for a number of test houses this is impracticable. In these instances instruments should be tested at 5 or 10 times the maximum credible dose rate to which the instrument could be exposed. These instruments shall be labelled "limited calibration" and the calibration certificate shall clearly state the limits of the overload and range testing.

- e. **Check Source Response. (no check source is currently assigned to the ADM300SI).**
- f. **Linearity of Response. (¹³⁷Cs)** Expose the instrument to a range of dose rates and record the observed measurements. At least three repeat measurements of the observed dose rate response should be carried out.

Note: As a minimum, 1 reading for each decade within the type test data range shown should be tested.

Dose Rate H*(10)	¹³⁷ Cs Permitted Range H*(10)
2.5 µSv.h ⁻¹	1.75 – 3.25 µSv.h ⁻¹
7.5 µSv.h ⁻¹	5.25 – 9.75 µSv.h ⁻¹
25 µSv.h ⁻¹	17.5 – 32.5 µSv.h ⁻¹
100 µSv.h ⁻¹	70 – 130 µSv.h ⁻¹
1.0 mSv.h ⁻¹	700 µSv.h ⁻¹ – 1.3 mSv.h ⁻¹
10 mSv.h ⁻¹	7 – 13 mSv.h ⁻¹
80 mSv.h ⁻¹	56 – 104 mSv.h ⁻¹
150 mSv.h ⁻¹	105 – 190 mSv.h ⁻¹
400 mSv.h ⁻¹	280 – 520 mSv.h ⁻¹

- (iv) Acceptance / Pass criteria is instrument response within ± 30% i.e. within the permitted ranges shown above.

Note: The ADM300SI should not be normalised to ⁶⁰Co, however there maybe circumstances where the reported readings are outside accepted tolerances. In these circumstances the unit can be corrected by following the steps laid down in [Annex 1](#) of the protocol manual.

- e. **Dose Test. (¹³⁷Cs)** Reset the accumulated dose on the unit, expose the instrument to a dose rate and time combination which will allow the dose to accumulate to the values given in the table below. When each exposure has finished record the dose measurement.

Accumulated Dose H*(10)	¹³⁷ Cs Permitted Range H*(10)
1 mSv	700 µSv – 1.3 mSv
40 mSv	28 – 52 mSv

- (i) Acceptance / Pass criteria is instrument response within ± 30% i.e. within the permitted ranges shown above.

- f. **Energy Response Test at 60 keV (60 keV ^{241}Am).** Expose the instrument to a 60 keV ^{241}Am radiation field at a dose rate of $25 \mu\text{Sv}\cdot\text{h}^{-1}$ or $100 \mu\text{Sv}\cdot\text{h}^{-1}$.

Dose Rate	^{241}Am Permitted Range
H*(10)	H*(10)
$25 \mu\text{Sv}\cdot\text{h}^{-1}$	TBA
$100 \mu\text{Sv}\cdot\text{h}^{-1}$	$\pm 30\%$

- (i) Acceptance / Pass criteria is instrument response within $\pm 30\%$ i.e. within the permitted ranges shown above.
- g. **Directional Dependency at 60 keV (^{241}Am or 65 keV ISO X-ray Quality.)** Expose the instrument to ^{241}Am or 65 keV ISO X-ray Quality radiation field at a dose rate of $25 \mu\text{Sv}\cdot\text{h}^{-1}$ / or $100 \mu\text{Sv}\cdot\text{h}^{-1}$ the expected polar responses are shown in Figure 1.

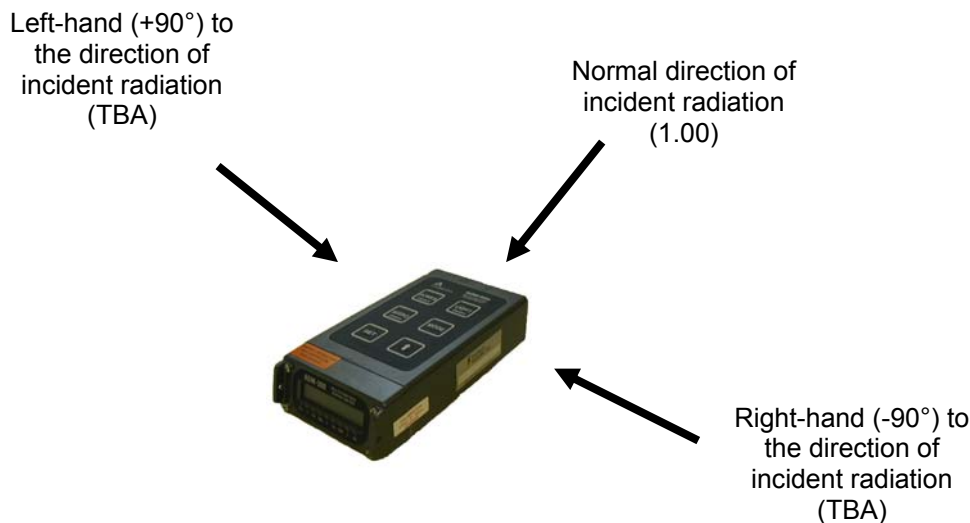


Figure 1. **Expected Directional Dependency**

6. **Category 2: Annual Test.** Complete all category 1 tests except Directional Dependency Test 5.g.
- (i) Acceptance / Pass criteria are the same as Category 1 tests.
7. **Category 3: Test Before Operational Use.** Complete Category 1 test Check Source Response at paragraph 5.c.
- (i) Acceptance / Pass criteria are $\pm 20\%$ of the value recorded in the Category 1 test.
8. **Certification (Qualified Person authorisation required)**

Certificate test results as appropriate. Failed instruments must be re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 83 L60iF Air Sampler**Function** Intelligent Air Sampler**Publications** A: TBA – No MIL documentation is currently available
B: Munro L60iF Instruction Manual**NSN** 6665-99-134-9075 – NR2050Y (115V 50Hz)
6665-99-391-2306 – NR2050G (115V 60Hz)
6665-99-551-6099 – NR2050B (240V 50Hz)**Required Support Equipment**

All calibration standards must be traceable to national standards

Flow meter (scaled in L/Min)

Flow restriction device

Nozzle Adaptor Cone + pipeworks

Whatman Filters Type GF/A 1820-060 NSN: 6640-99-448-5863

Equipment Overview**Description and Use:** The L60iF is a high accuracy air sampler designed for medium/high volume applications.**Physical Construction:** The unit consists of a motor driven sliding vane pump housed in a pressed steel case, a collection nozzle, digital display and membrane keypad are located on the front end plate.**Filter Type:** 60mm Whatman GF/A (Standard), capable of operation with Maypack and snorkel attachments.**Power Supply:** 115VAC / 240VAC 50/60Hz**Flow Rate:** 60 l/min (approx. dust load dependant)**Controls**

1. A comprehensive summary of sampler functionality is contained within 'Publications' reference A. & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

- a. **Mechanical Checks.**

Uncoil the mains cable and inspect insulation and mains connector for damage.

Examine the power switch and nozzle assemblies ensuring they are fit for service.

Check the external condition of the unit ensuring the handle, ON/OFF switch, display / keypad and filter mount assemblies remain intact and fit for purpose.

Remediate corrosion and replace missing/unserviceable items as necessary.

- b. Energise the unit and ensure the motor spins freely. Friction related noise should be investigated.

c. Electrical Checks.

Undertake a Portable Appliance Test (PAT) on the unit ensuring it fully meets the requirements of a Class 1 device.

Any non conformances should be considered a failure and should not be calibrated due to safety issues.

Flow Tests

4. Category 1 Test: Test before First Use. These tests must be undertaken on each unit prior to introduction into service, the test regime must also be employed where major repairs/modifications may have altered flow response.

a. Max Flow Test.

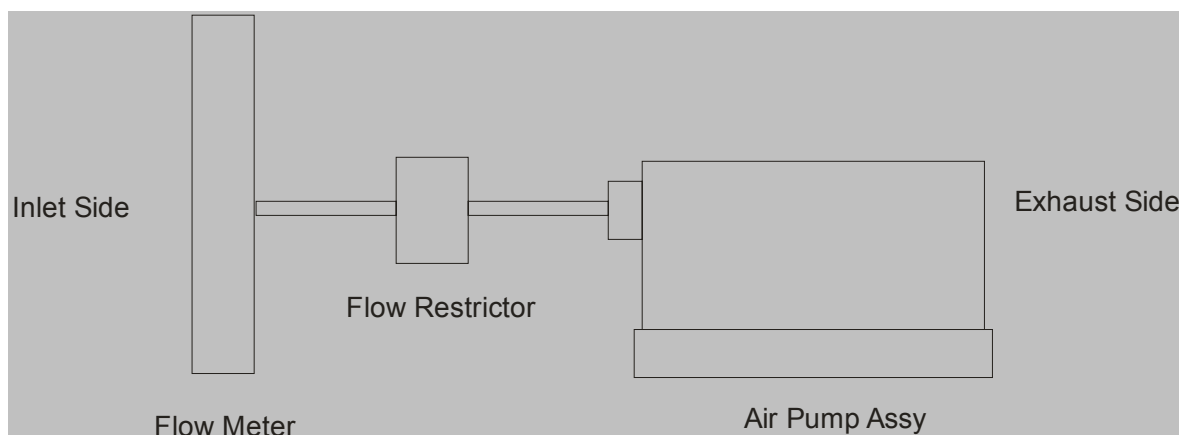
Connect the Flow meter in line with the natural draw of the air sampler assembly (reflected in the diagram below), energise the unit allowing the motor/flow meter and temperature time to stabilise (approx. 20 mins).

Regulate the flow using a suitable flow restriction device such that no resistance exists in the intake tract, thus providing maximum draw through the sampler.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

(i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

**b. Restricted Flow Test – 45 l/min.**

Regulate the flow using a suitable flow restriction device to provide an indicated flow rate of 45 lpm on the sampler mounted flow meter.

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.

(i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

c. Flow Rate with Filter Fitted.

Fit a suitable filter paper to the unit (as listed in Required Support Equipment).

Connect the unit as per paragraph 4a.

Regulate the flow using a suitable flow restriction device such that no resistance exists in the intake tract, thus providing maximum draw through the sampler.

Energise the unit allowing the motor/flow meter and temperature time to stabilise (approx. 20 mins).

Record the reading provided by the sampler mounted flow meter on the calibration/test certificate.

Record the reading provided by the reference flow meter on the calibration/test certificate.
After taking the readings switch the unit off and disconnect all pipe works.

(i) Acceptance / Pass criteria – The reading provided by the instrument flow meter must conform to within $\pm 10\%$ of the figure reported by the reference flow meter.

NOTE: Where responses are outside of the specified Acceptance / Pass criteria the unit should be fully calibrated using the formal 'Calibration set up' specified in 'Publications' reference B.

5. Category 2: Annual Test.
Complete Category 1 tests

(i) Acceptance / Pass criteria - Reflects those noted for Category 1 tests.

6. Category 3: Test before Operational Use.

Fit a suitable filter paper to the unit (as listed in Required Support Equipment), energise the unit allowing the motor/flow meter temperature time to stabilise (approx. 20 mins). Once the unit has stabilised record the reading on the instrument flow meter.

(i) Acceptance / Pass criteria – The reading should be within $\pm 10\%$ of that noted at paragraph 4c.

7. Certification (Qualified Person authorisation required)

Certificate all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Intentionally Blank

Standard Radiological Monitoring Instrument Statutory Test

Protocol 84 RAE 2000 – DoseRAE(P)**Function** Personal Electronic Dosimeter**Publications** A: DEP (Number TBA)
B: Manufactures Manual**NSN** 6665-01-548-5037**Required Reference Standards**

Gamma Reference Standards - All Sources shall offer traceability to national standards.

Cs-137 and Am-241*

X-radiations - All irradiations shall offer traceability to national standards.

ISO Narrow Series X – Radiation – 65 keV *

*Am-241 or 65 keV X-Radiation maybe used for energy response testing.

Equipment Overview**Description and Use:** The RAE2000 offers a control dosimeter capability for real time dose assessment and provides the user with dose and dose rate alarm functions. This device is not intended to provide data for legal dose records.**Physical Construction:** The unit is constructed from high impact plastic and comprises a top mounted backlit LCD display.**Detector Type:** Miniature GM Tube**Dose Range:** 0 μ Sv – 9.99 Sv**Energy Range:** 55 keV – 6Mev**Controls**

1. A comprehensive summary of dosimeter functionality is contained within 'Publications' A & B.

Standard Test Protocol

2. All tests should be recorded for Qualified Person inspection and certificate production.

Pre-radiation Tests, Electrical and Physical Examination.

3. The following tests must be undertaken prior to both Category 1 and 2 tests.

- a. **Battery tests.**

Ensure batteries are in good order and provide the necessary voltage for operation, where a steady / flashing battery icon indicator is observed in the display the batteries should be replaced.

Replace as necessary.

- b. **Mechanical checks.**

Check the mechanical integrity of instrument ensuring the case is free from cracks, the mounting clip and push buttons are fit for purpose and the LCD display is easily readable and does not show signs of segment 'bleed'.

Replace defective parts as necessary.

- c. Energise the unit and check operation of all controls

Radiation Tests

4. **Category 1 Test: Test before First Use.** These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have altered detector response.

a. **Drift Test**

Reset the unit following instructions provided in 'Publications' A & B and leave the unit under test (UUT) in a known low background environment for a period of 12 hours.

Record the instrument response after 12 hours.

- (i) Acceptance / Pass criteria - Instrument response should reflect $< 4\mu\text{Sv}$.

b. **Dose Linearity (^{137}Cs) – Doses should be delivered to Hp10 qualities.**

Reset the accumulated dose and configure the unit to provide a dose indication, using a PMMA phantom assembly orientate the dosimeter at the facility point of reference such that it represents operational geometry.

Using the doserates specified in the table below and a suitable exposure time, irradiate the dosimeters to the target doses.

On completion of each exposure record the observed reading on the calibration certificate.

	Reference Doserate	Target Dose
Low Dose	$< 100\mu\text{Sv/h}$	$> 10\mu\text{Sv} / < 100\mu\text{Sv}$
High Dose	$> 10\text{mSv/h}$	$> 500\mu\text{Sv}$

- (i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within $\pm 30\%$ of delivered reference doses.

c. **Energy Response Test - (^{241}Am or 65 keV ISO Narrow Series X-ray Quality)**

Reset the accumulated dose and expose the UUT to a doserate / time combination used during the 'Dose Linearity' testing. Record the observed reading and calculate a response ratio to the ^{137}Cs value.

- (i) Acceptance / Pass criteria – The ^{137}Cs : 'Tested energy' response shall indicate a ratio of 1:1.30 ($\pm 30\%$) when exposed to the same dose achieved using the same rate / time utilised during linearity testing, an example is provided below.

Example ^{137}Cs Response

Hp(10)

25 μSv

Example 'Tested Energy' Permitted Range

Hp(10)

22.75 – 42.25 μSv

d. **Directional Dependency - (^{241}Am or 65 keV ISO Narrow Series X-ray Quality)**

Reset the accumulated dose and expose the UUT in the -45° and $+45^\circ$ orientation (as shown below) to the doserate / time combination used during the 'Energy Response Testing', record the observed reading and calculate a response ratio for each angle using the frontal response as the unity value.

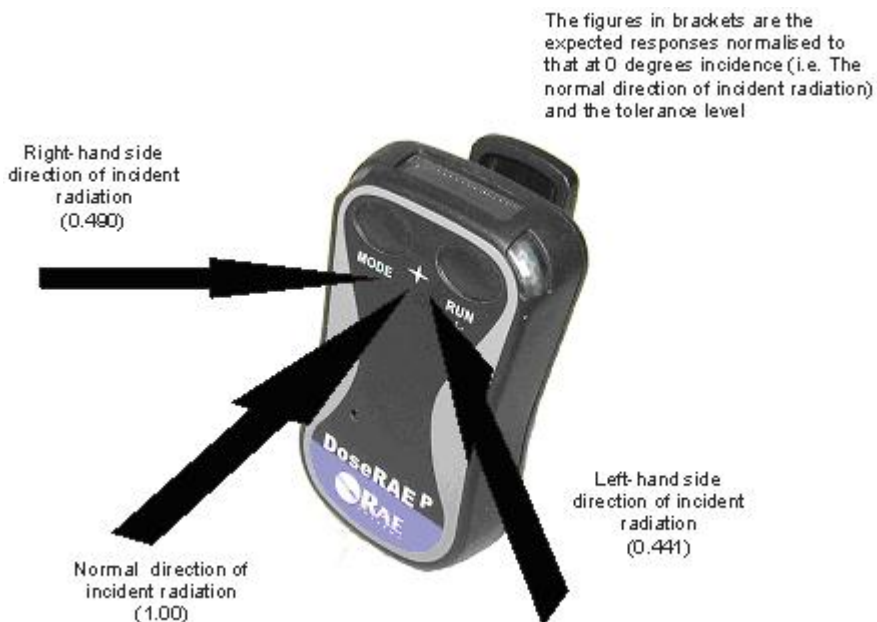


Figure 9. **Expected Directional Dependency**

- (i) Acceptance / Pass criteria – The responses shall reflect the responses detailed in Figure 1.

5. Category 2: Annual Test.

Complete all Category 1 tests except Directional Dependency Test 4.d

- (i) Acceptance / Pass criteria – Criteria reflects those noted for Category 1 tests.

Certification (Qualified Person authorisation required)

6. Certify all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 or Category 2 test protocols as dictated by the nature of the repair.

Labelling

7. The DoseRAE(P) is designed to connect via capacitive transfer to a SAIC PDR-1 reader, therefore it is imperative that the frontal portion of the dosimeter is not obstructed by a calibration label. All labels should be attached to the unit using a plastic 'dog tag' assembly using a plastic lanyard or cable tie.

Intentionally Blank

Annex 1 Correcting Response of under-reading ADM300's

1. The ADCOM software instruction set provides two methods of automatic calibration:
 - a. Remote computer calibration
 - b. Stand-alone self-calibration – The standalone method provides automatic low – and high range calibration by pressing the appropriate ADM 300A(V1A) keypad buttons.

2. **Correction using ADCOM software**
 - a. Place the ADM 300A(V1A) in a known radiation field and the PC terminal in a safe location. Establish serial communications with the computer.
 - b. On the ADM 300A(V1A), press the **POWER** key for at least two seconds until the **PLEASE WAIT** indication is shown. If no messages appear within ten seconds, check that charged batteries are fitted correctly and press the power key again. The message **PLEASE WAIT** is shown during the self-test routine. On completion of the self-test routine, the **µSv/h Rate** legend is shown.
 - c. On the PC, select Item 4 **TEST ADM-300** from the main menu.
 - d. Select Item 1 **TEST G-M TUBE SCALE FACTOR CALIBRATION**
 - e. Select Item 1 **TEST LOW RANGE CALIBRATION**. The computer will respond with the message: **ENTER SOURCE DOSE RATE**.
 - f. Enter the value of the calibration field in units of Sv. The computer will respond with the message: **IS SOURCE DOSE RATE CORRECT?**
 - g. Expose the ADM 300A(V1A) to the actual calibrating radiation field.
 - h. Enter **YES** to the computer prompt.
 - i. The computer initiates the calibration procedure. Data is collected and the calibration scale factor is dynamically calculated. At the end of approximately one-minute, the computer will have acquired sufficient data for an accurate determination of the calibration scale factor. The computer will indicate this by a beep tone.
 - j. At the beep tone, enter **QUIT** to terminate the collection calibration cycle.
 - k. A new message will appear: **TO INSTALL SCALE FACTOR ENTER YES**. Enter **YES**. At the end of 10 seconds, the computer will install the new calibration scale factor into the non-volatile memory of the ADM 300A(V1A), finalising the low range calibration.
 - l. Repeat the above procedure for the high range calibration by selecting **TEST HIGH RANGE CALIBRATION**.
 - m. To use newly developed scale factors, the ADM 300A(V1A) must be turned off and restarted. Switch off the ADM 300A(V1A) by pressing the **POWER** key for at least two seconds, or until the display goes blank. Switch on the ADM 300A(V1A). The new values will be loaded during the boot-up process.

3. **Stand-alone Calibration/Correction Procedure**
 - a. Enter the stand-alone calibration mode with the ADM 300A(V1A) switched off. Press the **MODE** and **SET** keys simultaneously and then switch on the ADM 300A(V1A). The display responds with the message: **CALIBRATE ADM300**. Push **MODE** key.
 - b. Press the **MODE** key. The display responds with the message: 'Using **LOW** range' 'SET>Freeze range' or 'INC>Change range'.
 - c. Pressing the ↑ key allows the operator to select the desired range to calibrate. LOW range will be the first displayed. Press **SET** key to enter the selected range into the ADM 300A(V1A). The display responds with the message: '0.05 mSv/h Source' 'Enter **LOW** source Use **SET** or **INC**'.
 - d. Select the desired calibration source dose rate in the same manner as for entering a new alarm set point.
 - e. After entering the desired calibration dose rate, the ADM 300A(V1A) responds with **To start Calibration push MODE button**'.

- f. Place the ADM 300A(V1A) in front of a shielded gamma source at the exact distance that will produce the actual source field that was entered above.
- g. Press the **MODE** key. The display will indicate a delay start countdown of 60 seconds. The delay allows the user 60 seconds to verify the calibrating geometry, enter a safe location, and expose the ADM 300A(V1A) to the actual calibrating radiation field.
- h. At the end of 60 seconds, the ADM 300A(V1A) beeps indicating that the calibration cycle is about to begin. This tone gives the user confidence that he has exposed the instrument in advance of the calibration cycle. The ADM 300A(V1A) must be exposed to the radiation field prior to the beep and beginning of the calibration cycle to prevent erroneous field information from entering the calibration calculations.
- i. Upon beginning the calibration cycle, the ADM 300A(V1A) collects data and dynamically calculates the calibration scale factor. At the end of approximately 2 minutes, the ADM 300A(V1A) will have acquired sufficient data for an accurate determination of the scale factor.
- j. When the beep tone is produced, remove the radiation field source. The top line of the display indicates the average dose rate over the two-minute period and the flashing message **DONE**. The bottom line indicates the old and the new scale factors (**OLD NEW**) and the message **To Enter Scale Push MODE & SET**.
- k. Press the **MODE** and **SET** keys simultaneously. The new calibration factors are entered into the non-volatile memory. The message '**LOW Range Saved**' '**Scale entered Turn off power**' is displayed.
- l. Switch the ADM 300A(V1A) off and then on again.
- m. Repeat the above procedure for the high range calibration by selecting **Using HIGH range**.
- n. Switch off the ADM 300A(V1A) by pressing the power key for two seconds, or until the display goes blank. The new scale factors will be available when the ADM 300A(V1A) is again switched on.

Annex 2 ADM300N – Pressure Testing

Required Reference Standards

Gamma Reference Standards ¹³⁷Cs - Source shall offer traceability to national standards.

Required Test Equipment

Pressure chamber assembly – Capable of delivering pressures up to 6 bar.

NOTE: The facility must be capable of directly observing the instrument display and/or obtaining a response via the instrument serial data link.

1. Category 1 Test: Test before First Use. These tests must be undertaken on each instrument before introduction into service, the test regime must also be employed where repairs/modifications may have compromised the integrity of the detectors / housing assembly.

a. Response to Ionising Radiations in Elevated Pressure Environments.

Position the UUT in the pressure chamber assembly and expose the unit to at least one dose rate per detector, increasing chamber pressure to the levels prescribed in the table below.

NOTE: The responses obtained are relative measurements, therefore specific instrument orientation is NOT critical but all responses should be obtained using identical orientation.

Obtain a mean reported figure from the instrument for each delivered rate / pressure level, figures should be recorded on the pressure test certificate.

Example Doserate H*(10)	Detector Tested	Applied Pressure
500 $\mu\text{Sv.h}^{-1}$	Low	Ambient
		3 bar
		6 bar
150 mSv.h^{-1}	High	Ambient
		3 bar
		6 bar

(i) Acceptance / Pass criteria – Instrument responses shall reflect conformity to within to $\pm 30\%$ of the response obtained at ambient levels.

Certification (Qualified Person authorisation required)

2. Certificate all test results, failed instruments must be certified with a relevant failure certificate and re-tested after repair using Category 1 test protocols.

Intentionally Blank

SOURCE DOSERATE 90 μ S

ADM300 DOSERATE (AVERAGED) 90 μ S (90%)

MODIFY ADM300 SCALE FACTOR DIGITS 77 → 99

n. Repeat the above procedure for the high range calibration by selecting **TEST HIGH RANGE CALIBRATION**.

n.b. for Hi range GM tube testing the value should be greater than 50mSv/h

o. To use newly developed scale factors, the ADM 300A(V1A) must be turned off and restarted. Switch off the ADM 300A(V1A) by pressing the **POWER** key for at least two seconds, or until the display goes blank. Switch on the ADM 300A(V1A). The new values will be loaded during the boot-up process.

3. Stand-alone Calibration/Correction Procedure

a. Enter the stand-alone calibration mode with the ADM 300A(V1A) switched off. Press the **MODE** and **SET** keys simultaneously and then switch on the ADM 300A(V1A). The display responds with the message: **CALIBRATE ADM300**. Push **MODE** key.

b. Press the **MODE** key. The display responds with the message: **'Using LOW range' 'SET>Freeze range' or 'INC>Change range'**.

c. Pressing the \uparrow key allows the operator to select the desired range to calibrate. LOW range will be the first displayed. Press **SET** key to enter the selected range into the ADM 300A(V1A). The display responds with the message: **'0.05 mSv/h Source' 'Enter LOW source Use SET or INC'**.

d. Select the desired calibration source dose rate in the same manner as for entering a new alarm set point.

e. After entering the desired calibration dose rate, the ADM 300A(V1A) responds with **To start Calibration push MODE button'**.

f. Place the ADM 300A(V1A) in front of a shielded gamma source at the exact distance that will produce the actual source field that was entered above.

g. Press the **MODE** key. The display will indicate a delay start countdown of 60 seconds. The delay allows the user 60 seconds to verify the calibrating geometry, enter a safe location, and expose the ADM 300A(V1A) to the actual calibrating radiation field.

h. At the end of 60 seconds, the ADM 300A(V1A) beeps indicating that the calibration cycle is about to begin. This tone gives the user confidence that he has exposed the instrument in advance of the calibration cycle. The ADM 300A(V1A) must be exposed to the radiation field prior to the beep and beginning of the calibration cycle to prevent erroneous field information from entering the calibration calculations.

i. Upon beginning the calibration cycle, the ADM 300A(V1A) collects data and dynamically calculates the calibration scale factor. At the end of approximately 2 minutes, the ADM 300A(V1A) will have acquired sufficient data for an accurate determination of the scale factor.

j. When the beep tone is produced, remove the radiation field source. The top line of the display indicates the average dose rate over the two-minute period and the flashing message **DONE**. The bottom line indicates the old and the new scale factors (**OLD NEW**) and the message **To Enter Scale Push MODE & SET**.

k. Press the **MODE** and **SET** keys simultaneously. The new calibration factors are entered into the non-volatile memory. The message **'LOW Range Saved' 'Scale entered Turn off power'** is displayed.

l. Switch the ADM 300A(V1A) off and then on again.

m. Repeat the above procedure for the high range calibration by selecting **Using HIGH range**.

n. Switch off the ADM 300A(V1A) by pressing the power key for two seconds, or until the display goes blank. The new scale factors will be available when the ADM 300A(V1A) is again switched on.