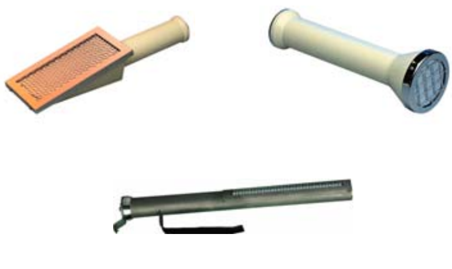
NON-INTELLIGENT & INTELLIGENT
Scintillation Probes

Instruction Manual
August 2006



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NON-INTELLIGENT & INTELLIGENT SCINTILLATION PROBES

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01.08.06

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WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Fisher Scientific products which may assist the detection of substances subject to the RoHS Directive are available at **www.thermo.com/WEEERoHS**.

1. INTRODUCTION

This manual covers the specification and operation of all Thermo scintillation probes designed for measurement of radioactive contamination. The range of intelligent 'I' series scintillation probes is also covered.

The range of probes for contamination monitoring can be sub-divided into four distinct groups with the probe sensitive area as the common denominator. These groups are as follows:

PROBE SENSITIVE AREA	GENERIC PROBE TYPE			
19.6 cm^2	AP4/4	BP4/4	IAP4	IBP4
49 cm^2	AP2/4	AP2R/4	IAP2	IAP2R
	BP5/4	BP7/4	IBP5	IBP7
	DP2/4	DP2R/4	IDP2	IDP2R
80 cm^2	BP13	IBP13		
100 cm^2	AP3/4	AP3R/4	IAP3	IAP3R
	AP5	AP5R	IAP5	IAP5R
	AP5/E		IAP5/E	
	BP6/4	BP6R/4	IBP6	IBP6R
	BP19	BP19R	IBP19	IBP19R
	BP19/E		IBP19/E	
	BP19DD	BP19RD	IBP19DD	IBP19RD
	DP3/4	DP3R/4	IDP3	IDP3R
	DP6	DP6R	IDP6	IDP6R
	DP6DD	DP6RD	IDP6DD	IDP6RD
	DP6/E		IDP6/E	

NOTE: *Above are generic probe types. 'A' and 'B' versions denote connector type, e.g. AP5AD, AP5RA (PET) AP5BD, AP5RB (MHV).* *See description overleaf.*

2. DESCRIPTION

2.1 NON-INTELLIGENT PROBES

The non-intelligent scintillation probes covered in this manual are hand held detectors for monitoring alpha and beta contamination separately or simultaneously.

Each probe comprises a painted aluminium alloy housing with a light-tight aluminised polycarbonate window protected by a metallic grille. For conventional probes, the scintillation phosphor is mounted behind the window. For Endura probes, the window is deposited directly onto the phosphor such that they form an integral unit. A photomultiplier tube and a thick film resistor network are contained in the handle of the housing. The photomultipliers in the 19.6cm^2, 50cm^2 and 100cm^2 rectangular diecast probes are fitted with a shield to protect them from magnetic interference.

Generally A and B versions are available differing only in the type of connector used, i.e. A suffix for PET and B suffix for MHV. However, the BP4/4 differs in this respect as A, B and C versions refer to the spacing between the front grille of the probe and the probe window, greatest for the C version. The A, B and C versions in this case, all have PET connectors fitted. The suffix R means that the probe is fitted with a ruggedised grille.

The DP6AD, DP6BD and IDP6AD are upgraded versions of the DP6A, DP6B and IDP6A respectively. The specification for the upgraded versions is identical to the original.

Probe variants having thinner window material are suffixed DD, e.g. BP19DD and DP6DD or RD if they also include the ruggedised grille.

2.2 INTELLIGENT PROBES (I SERIES)

These probes are simply modified versions of the original Non-Intelligent probe types. The probe description therefore, is as above for non-intelligent probes. These probes can only be used with the Ratemeter type ***SELECTRA***.

Versions with suffix ‘A’ have a fixed cable and standard plug protruding from a cable gland in the end cap of the unit.

Versions with suffix ‘B’ have a fixed plug and require an additional multiwire cable. Suffix ‘A’ versions are not suitable for use where compliance with EC EMC directives is required.

3. SPECIFICATION

Table 3.1a and b provides an overall summary of the specifications for the probes detailed in this manual.

The following details are not covered in Table 3.1a and b.

Radiation Detected:	AP & IAP Probes - Alpha Particles BP & IBP Probes - Beta Particles DP & IDP Probes - Alpha and Beta Particles
Phosphor:	AP & IAP Probes - ZnS(Ag) on Perspex BP & IBP Probes - Anthracene on Perspex for BP4, BP6, BP7 - BC404 for BP5 - BC400 for BP13, BP19 DP & IDP Probes - ZnS(Ag) on BC400
Window Material:	BP13: 14 µm aluminium, 3.8 mg.cm^{-2} BP19DD, BP19RD, DP6DD, DP6RD: 3 layers of polycarbonate, total 0.9 mg.cm^{-2} All others: 2 layers of polycarbonate, total 1.2 mg.cm^{-2} (3.5 µm, aluminised on both sides) Endura /E versions: equivalent to the above
Area:	See Probe Area in Table 3.1 a and b
Operating Voltage:	Between 500 V and 1350 V
Resistance of Dynode Chain:	69.2 MΩ
Connector:	Non 'I' probe BP4A, B & C: PET Non 'I' probes with suffix A: PET Non 'I' probes with suffix B, DD or RD: MHV 'I' probes with suffix A - 7 way FISCHER plug on flying lead 'I' probes with suffix B - 7 way FISCHER plug on probe

DIMENSIONS

PROBE TYPE		OVERALL LENGTH	MAX. WIDTH	HANDLE DIA.	WEIGHT
AP4/4	IAP4	224 mm	74 mm	37 mm	600 g
BP4/4A	IBP4A				
BP4/4B	IBP4B	232 mm	74 mm	37 mm	600 g
BP4/4C	IBP4C	235 mm	74 mm	37 mm	600 g
AP2/4	IAP2	244 mm	91 mm	37 mm	750 g
AP2R/4	IAP2R				
BP5/4	IBP5				
BP7/4	IBP7				
DP2/4	IDP2				
DP2R/4	IDP2R				
BP13	IBP13	424 mm	89 mm	38 mm	875 g
AP3/4	IAP3	252 mm	123 mm	32 mm	750 g
AP3R/4	IAP3R				
BP6/4	IBP6				
BP6R/4	IBP6R				
DP3/4	IDP3				
DP3R/4	IDP3R				
AP5	IAP5	296 mm	93 mm	40 mm	500 g
DP6	IDP6				
AP5AD	BP19AD	296 mm	93 mm	38 mm	650 g
DP6AD					

All probes are recommended for use with:

Portable Ratemeter type SELECTRA (‘I’ Series Probes ONLY)
Portable Ratemeter type ELECTRA
Portable Ratemeter type DELTA3 and DELTA5
Ratemeter types RM5/1 and RM6
Portable Contamination Monitor type PCM5/1
Contamination Monitor CM9

TABLE 3.1a - PROBE SPECIFICATIONS

PROBE TYPE	PROBE AREA	-------PROBE EFFICIENCIES[1]------- ALPHA ^{241}Am	BETA $^{90}Sr/^{90}Y$	BETA ^{36}Cl	BETA ^{60}Co	BETA ^{14}C	BACKGROUND RESPONSE[2]	GAMMA RESPONSE[3]	GRILLE TRANSMISSION
AP4/4 & IAP4	19.6cm^2	34%	—	—	—	—	<0.1 cps	—	80%
BP4/4A & IBP4A	19.6cm^2	—	46%	44%	36%	24%	<4 cps	25 cps	80%
BP4/4B & IBP4B	19.6cm^2	—	34%	32%	25%	15%	<4 cps	25 cps	80%
BP4/4C & IBP4C	19.6cm^2	—	27%	25%	21%	11%	<4 cps	25 cps	80%
AP2/4 & IAP2	49cm^2	35%	—	—	—	—	<0.1 cps	—	80%
AP2R/4 & IAP2R	49cm^2	25%	—	—	—	—	<0.1 cps	—	65%
BP5/4 & IBP5	49cm^2	—	42%	42%	—	—	<4 cps	25 cps	80%
BP7/4 & IBP7	49cm^2	—	41%	39%	28%	18%	<4 cps	12 cps	65%
DP2/4 & IDP2	49cm^2	35%	34%	29%	9%	—	<4 cps(β), <0.1 cps(α)	25 cps	80%
DP2R/4 & IDP2R	49cm^2	25%	24%	21%	7%	—	<4 cps(β), <0.1 cps(α)	25 cps	65%
BP13 & IBP13	80cm^2	—	16%	15%	10%	—	~ 7 cps	60 cps	80%

1 Efficiency is given as the percentage detection of alpha or beta particles emitting in 2π steradians from a uniformly distributed surface (which has an active area equal to the sensitive area of the probe) with the surface of the probes grille 4 mm away from the source surface. The efficiency for the measurement of activity will be half the efficiency for the measurement of surface emission for sources of zero self absorption and backscatter. The efficiencies quoted are typical type test efficiencies and there will be a spread of efficiencies from probe to probe of the same type. This could be up to ±10%, i.e. a probe with published efficiency to specific nuclide if say 35% could have a mid point plateau efficiency of anything between 31.5% and 38.5%.

2 Response to an ambient background, taken as a dose equivalent field of 0.1 μSv/h (10 μR/h).

3 Response to an ambient dose equivalent field of 1 μSv/h due to ^{137}Cs.

TABLE 3.1b - PROBE SPECIFICATIONS

PROBE TYPE	PROBE AREA	-------PROBE EFFICIENCIES[1]------- ALPHA ^{241}Am	BETA $^{90}Sr/^{90}Y$	BETA ^{36}Cl	BETA ^{60}Co	BETA ^{14}C	BACKGROUND RESPONSE[2]	GAMMA RESPONSE[3]	GRILLE TRANSMISSION
AP3/4 & IAP3	100cm^2	35%	—	—	—	—	<0.1 cps	—	78%
AP3R/4 & IAP3R	100cm^2	25%	—	—	—	—	<0.1 cps	—	63%
BP6/4 & IBP6	100cm^2	—	46%	44%	32%	17%	<10 cps	25 cps	78%
BP6R/4 & IBP6R	100cm^2	—	36%	35%	26%	14%	<10 cps	25 cps	63%
DP3/4 & IDP3	100cm^2	35%	35%	31%	9%	—	<10 cps (β), <0.1 cps(α)	50 cps	78%
DP3R/4 & IDP3R	100cm^2	25%	24%	21%	7%	—	<10 cps (β), <0.1 cps(α)	50 cps	63%
AP5 & IAP5 & /E	100cm^2	35%	—	—	—	—	<0.1 cps	—	80%
AP5R & IAP5R	100cm^2	22%	—	—	—	—	<0.1 cps	—	48%
BP19 & IBP19	100cm^2	—	51%	48%	32%	14%	<10 cps	50 cps	80%
BP19/E & IBP19/E	100 cm^2	—	52%	49%	33%	16%	< 10 cps	50 cps	80%
BP19R & IBP19R	100cm^2	—	40%	35%	21%	9%	<10 cps	50 cps	48%
BP19DD & IBP19DD	100cm^2	—	51%	48%	34%	21%	<10 cps	40 cps	80%
BP19RD & IBP19RD	100cm^2	—	42%	36%	24%	15%	<10 cps	40 cps	48%
DP6 & IDP6	100cm^2	33%	41%	38%	18%	—	<10cps(β), <0.1 cps(α)	50 cps	80%
DP6/E & IDP6/E	100cm^2	33%	38%	35%	—	—	<10cps(β), <0.1 cps(α)	50 cps	80%
DP6R & IDP6R	100cm^2	27%	34%	30%	12%	—	<10cps(β), <0.1 cps(α)	50 cps	48%
DP6DD, IDP6DD	100cm^2	39%	41%	39%	20%	—	<10cps(β), <0.1 cps(α)	40 cps	80%
DP6RD, IDP6RD	100cm^2	28%	36%	31%	13%	—	<10cps(β), <0.1 cps(α)	40 cps	48%

1 Efficiency is given as the percentage detection of alpha or beta particles emitting in 2π steradians from a uniformly distributed surface (which has an active area equal to the sensitive area of the probe) with the surface of the probes grille 4 mm away from the source surface. The efficiency for the measurement of activity will be half the efficiency for the measurement of surface emission for sources of zero self absorption and backscatter. The efficiencies quoted are typical type test efficiencies and there will be a spread of efficiencies from probe to probe of the same type. This could be up to ±10%, i.e. a probe with published efficiency to specific nuclide if say 35% could have a mid point plateau efficiency of anything between 31.5% and 38.5%.

2 Response to an ambient background, taken as a dose equivalent field of 0.1 μSv/h (10 μR/h).

3 Response to an ambient dose equivalent field of 1 μSv/h due to ^{137}Cs.

4. OPERATION

To facilitate calibration and periodic checking the following Radioactive Reference Source Types are recommended.

AP4	RRS11A (^{241}Am)
BP4	RRS12A (^{14}C) RRS14A (^{36}Cl)
AP2	RRS21A (^{241}Am)
BP5	RRS24A (^{36}Cl) RRS25A ($^{90}Sr/^{90}Y$)
BP7	RRS22A (^{14}C) RRS24A (^{36}Cl)
DP2	RRS21A (^{241}Am) RRS24A (^{36}Cl) RRS25A ($^{90}Sr/^{90}Y$)
BP13	RRS63A (^{60}Co) RRS64A (^{36}Cl)
AP3	RRS31A (^{241}Am)
AP5	RRS51A (^{241}Am)
BP6	RRS32A (^{14}C) RRS34A (^{36}Cl)
DP3	RRS31A (^{241}Am) RRS34A (^{36}Cl) RRS35A ($^{90}Sr/^{90}Y$)
DP6	RRS51A (^{241}Am) RRS53A (^{60}Co) RRS54A (^{36}Cl) RRS55A ($^{90}Sr/^{90}Y$)
BP19	RRS52A (^{14}C) RRS53A (^{60}Co) RRS54A (^{36}Cl) RRS55A ($^{90}Sr/^{90}Y$)

4.1 SETTING THE OPTIMUM HIGH VOLTAGE

This procedure **must** be performed whenever repair involves replacing the probe photomultiplier (PM) tube. It should also be performed periodically as a routine calibration.

The relevant probe must be connected to the measuring instrument by means of a suitable coaxial cable, i.e. cable assemblies:

CA 3152C	2 m 'straight' coaxial cable PET to PET
CA 3190A *	0.3 m extendible 'curly' coaxial cable MHV to MHV
CA 3191A *	0.3 m extendible 'curly' coaxial cable MHV to PET
CA 3201A *	0.3 m extendible 'curly' coaxial cable PET to PET

* EC EMC compliance not guaranteed for these cables.

Generally, the equipment associated with this probe, RM5/1, RM6, CM9 and PCM5/1 have a single connector and fixed discriminator levels. In the case of the ***SELECTRA***, ***ELECTRA***, DELTA 3 and DELTA5, the unit has a variable upper level discriminator (ULD) but the lower level discriminator (LLD) is fixed; the ULD should be set to 1.5 V.

If other ratemeters are used which have accessible discriminator control, discriminator levels should be set to the following:

LLD: equivalent to an input pulse height of 100 mV or a charge sensitivity of 17 pC for β particles

ULD: equivalent to an input pulse height of 1.5 V or a charge sensitivity of 250 pC for α particles

4.1.1 AP, IAP, BP and IBP Probes

This section details the set up procedure required for the alpha only or beta only probes listed below:

Alpha Probes:	AP2, AP3, AP5
Beta Probes:	BP4, BP5, BP6, BP7, BP13, BP19

With the lid and shutter of the relevant Radioactive Reference Source (RRS as defined above) open, place the probe in position with the probe window directly above the source surface.

Switch the measuring instrument ON. Increase the high voltage slowly until counts are first observed in the relevant channel. Plot a count rate against high voltage curve not exceeding 1350 V. From this curve, determine the voltage range at which the rate of change of countrate with change in voltage is a minimum, i.e. a 'plateau' region. The centre of this plateau region is the optimum operating voltage of the probe.

NOTE: *This operating voltage is specific to the discriminator setting of the measuring instrument and the cable being used.*

It is generally more advantageous to operate at little below the centre of the plateau especially where there is likely to be a high background due to gamma or neutron radiation. This is particularly true of alpha probes. In the case of alpha probes if it is necessary, due to economic reasons, to operate a probe at a fixed efficiency an efficiency should be chosen such that all probes of the same type will operate at the lower end of the plateau, i.e. for say the AP5 operate at an efficiency of 30% rather than 32%. This will avoid the possibility of higher than expected sensitivity to gamma and neutrons. It is however recommended that wherever possible probes are operated on their plateau otherwise there will be a higher susceptibility to drift due to temperature electronic instability etc.

The operating voltage should be recorded along with the ratemeter type and serial number, the discriminator setting, the cable type and the probe type number and serial number to avoid unnecessary repetition of the setting up procedure.

The background countrate at the operating voltage determined above should be within the limits specified in Table 3.1 a & b.

4.1.2 DP and IDP Probes

This section details the set up procedure required for Dual Probes used for the simultaneous measurement of alpha and beta particles listed below:

Dual Probes: DP2, DP3, DP6.

There are two methods by which the optimum α and β separation can be achieved; both of which are described below.

Alpha Counts in the Beta Channel:

Use the relevant ^{241}Am Radioactive Reference Source (RRS*1A as defined above) and with the lid and shutter open, place the probe in position with the probe window directly above the source surface.

Switch the measuring instrument ON. Increase the high voltage slowly until counts are first observed in the *beta* channel. Plot a count rate against high voltage curve up to a maximum of 1350 V. The count rate should increase, then decrease, then increase again with increasing high voltage (HV) applied. Adjust the HV to the centre of the dip of the curve.

Beta Counts in the Alpha Channel:

Alternatively, place the probe in the relevant ^{90}Sr/^{90}Y Radioactive Reference Source (RRS*5A as defined above). Observing the count rate in the alpha channel, increase the High Voltage slowly until counts are first observed. Set the *maximum* HV such that less than 1 count per second is observed in the alpha channel.

NOTE: *The point at which the beta-in-alpha take-off occurs will depend upon the beta energy. ^{90}Sr/^{90}Y is taken as a worst case, being a high energy beta. Take-off for lower energy betas such as from ^{36}Cl or ^{60}Co would occur at a slightly higher HV setting.*

The operating voltage should be recorded along with the ratemeter type and serial number, the discriminator setting, the cable type and the probe type number and serial number to avoid unnecessary repetition of the setting up procedure.

NOTE: *This operating voltage is specific to the discriminator setting of the measuring instrument and the cable being used.*

The background countrate at the operating voltage determined above should be within the limits specified in Table 3.1 a & b.

4.2 CALIBRATION

When the source countrate is measured at the optimum HV setting, as determined in 5.1 above, the probe efficiency for the measurement of surface emission is given by:

$$2\pi \text{ Efficiency} = \frac{\text{Detected Source Countrate - Background Countrate}}{\text{Source Emission Rate}\left(s^{-1}\right)} \text{ x } 100\%$$

The efficiency for the measurement of activity will be half the efficiency for measurement of surface emission for sources of zero self absorption and zero backscatter.

4.3 GENERAL USE

Since alpha particles have a range in air of typically only 4 cm and this is effectively reduced by the window of the probe, the probe should be placed as near to the surface to be measured as possible and no further away than 2 cm. It should be noted that the window of the probe is extremely fragile and direct contact with any surfaces must be avoided.

Beta particles have a relatively large range in air compared with alphas but, to maintain efficiency, the probe should also be placed as near to the surface to be measured as possible.

When using the probe to detect low levels of alpha or beta contamination over large areas, the probe should be moved slowly over these areas. Each area should be "seen" by the probe for at least a second.

EXAMPLE

Probe: DP6 (or IDP6)

The expected countrate for 0.37 $Bq.cm^{-2}$ (10^{-5} $\mu Ci.cm^{-2}$) of alpha contamination will be:

$$0.37 \text{ x Probe Area}\left(cm^{-2}\right) \text{ x } \frac{\left(\text{Probe Efficiency for Surface Emission}\right)}{2}$$

= 18.5 x Probe Efficiency

i.e. typically 6.1 s^{-1} for ^{241}Am.

The expected countrate for 3.7 $Bq.cm^{-2}$ (10^{-4} $\mu Ci.cm^{-2}$) of beta contamination will be:

$$3.7 \text{ x Probe Area} \left(cm^{-2}\right) \text{ x } \frac{\left(\text{Probe Efficiency for Surface Emission}\right)}{2}$$

= 185 x Probe Efficiency

i.e. typically 76.1 s^{-1} for $^{90}Sr/^{90}Y$.

5. TECHNICAL DESCRIPTION

Radiation particles are emitted from the source in all directions. A proportion of these particles pass through the thin window of the probe and strike the scintillator screen causing pulses of light to be emitted. When the light falls on the semi-transparent cathode of the photomultiplier the cathode emits electrons by the photo-electric effect which is attracted to the positive voltage on the first dynode. Each electron which strikes the surface of the dynode causes several more electrons to be emitted from that surface by secondary emission. These are then attracted by the higher positive voltage on the second dynode. This process of electron multiplication is repeated by typically ten dynodes until the last electrode in the photomultiplier (the anode) receives approximately 10^6 times more electrons than were originally emitted from the cathode.

Thus, a measurable charge pulse is produced on the anode when each radiation particle strikes the scintillator. The charge pulse height is related to the energy which the scintillator received from the radiation particles. A thick film resistor network is used to derive the correct voltage for each electrode in the photomultiplier. Capacitors on the thick film de-couple the last two dynodes. The high voltage determines the gain of the photomultiplier.

6. LIGHT LEAKS

If high countrates are obtained when the probe is exposed to ambient light levels then the window seal has been damaged.

Some instruments do not indicate any countrate when a light leak occurs on the probe; alpha or beta contamination cannot be detected under this condition: the meter constantly reads low. This is caused by pulse pile up from excessive countrates (from light pulses). The majority of Thermo Fisher Scientific equipment has been designed so that a high level indication is given should light leaks occur.

Where a light leak is diagnosed the window should be replaced as described in the Maintenance Section.

7. MAINTENANCE

The most common fault condition is damage to the window. Failure due to very small holes and blemishes can temporarily be cured by application of a spot of black cellulose paint. This paint should not pass through the window as it could ruin the phosphor. It should also be remembered that areas covered with paint will be insensitive (and the probe calibration will be invalidated) so the above should be regarded as a temporary cure only.

The window assembly is accessed by first removing the protective grille, which is retained by screws. The window plate is then unscrewed from the housing to allow replacement.

It is strongly recommended that window assemblies be replaced by units supplied by Thermo Fisher Scientific. Thin enough aluminised materials normally available are not sufficiently opaque for scintillation counter use.

It is unlikely that any other maintenance will be required but should the photomultiplier be broken or a fault in the dynode chain be suspected, access to these is obtained by removing the four screws in the end cap at the handle end of the probe and withdrawing the assembly from the handle.

NOTE (1): *Access to the PM tube and dynode chain assembly for the AP5, IAP5, DP6A&B and IDP6A can be obtained by removing the grille, window assembly and phosphor and withdrawing the complete assembly through the probe housing, after releasing the four screws in the probe end cap at the probe handle.*

NOTE (2): *If the PM tube is removed from the AP4/4, BP4/4 IAP4 or IBP4 probes, smear a small amount of silicone oil (See Section 8.1) upon the end of the PM tube prior to refitting the tube to the phosphor/light guide.*

Replacement parts may be obtained from the Service Department by quoting the part numbers given in section 8 (see below for address details).

NOTE (3): *The photomultiplier should never be exposed to light with high voltage applied. After any maintenance wait 24 hours before use and reset the high voltage as described in section 4.1.*

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8. COMPONENTS

8.1 19.6 cm^2 PROBES

AP4/4, IAP4, BP4/4A,B&C, IBP4A,B&C

Body Assembly:		C33509/A
Front Cap (Grille)	AP4/4 & IAP4:	B33364/A
	BP4/4A & IBP4A:	B33364/A
	BP4/4B & IBP4B:	B34610/A
	BP4/4C & IBP4C:	B33364/A
Window Assembly:		B33518/A
Phosphor:	AP4/4 & IAP4:	B35887
	BP4/4 & IBP4:	B33512
Seal (below Spacing Ring):		A33513
Seal (above Window Assembly):		A33515
Spacing Ring:		A33544
Sleeve (BP4/4B&C and IBP4B&C only):		B33511
Protective Cover:		B33516
Photomultiplier Tube:		B33852
Magnetic Shield		A91679
Dynode Chain Assy	AP4/4 & BP4/4:	B33543/A
	IAP4A & IBP4A,B&C	5483A (incl. cable)
O Ring:		204261JC
Screw M2 x 5 RC PAN CH (3 off):		300102FA
Screw M2 x 6 RC PAN CH (4 off):		300104FA
Silicon Oil (Midland Silicone MS200/12500CS):		205432DE
Connector (included in Dynode Chain Assembly)	AP4/4 & BP4/4 only:	425709KF

8.2 49cm² PROBES

AP2/4, IAP2, AP2R/4, IAP2R
BP5/4, IBP5, BP7/4, IBP7
DP2/4, IDP2, DP2R/4, IDP2R

Body Assembly:		C33306/A
Grille Assembly:	AP2/4 & IAP2:	B33328/A
	AP2R/4 & IAP2R:	B33340/A
	BP5/4 & IBP5:	B33328/A
	BP7/4 & IBP7:	B33328/A
	DP2/4 & IDP2:	B33328/A
	DP2R/4 & IDP2R:	B33340/A
Window Assembly:		B33321/A
Phosphor:	AP2/4 & IAP2:	B33464
	AP2R/4 & IAP2R:	B33464
	BP5/4 & IBP5:	B33468
	BP7/4 & IBP7:	B33472
	DP2/4 & IDP2:	B33319
	DP2R/4 & IDP2R:	B33319
Gasket:		B33317
Protective Cover:		B33342/A
Photomultiplier Tube:		B33852
Magnetic Shield		A91679
Dynode Chain Assy	Non Intelligent Probes:	B33448/A
	I Probes suffix A only:	5480A (incl. cable)
Screw M2 x 8 RC CSK ZN (12 off):		300705FA
Screw M2 x 8 RC CSK CH (4 off):		300706FA
Connector (Non Intelligent Probes only): (included in Dynode Chain Assembly)		425709KF

8.3 80 cm² PROBES

BP13 & IBP13

Body Assembly:		C38398/A
Grille Assembly:		B38408/A
Window Foil Assembly:		C38415/A
Phosphor Assembly:		B38388/A
O ring:		204258JC
Photomultiplier Tube:		B33852
Dynode Chain Assy:	BP13	B33543/A
	IBP13A:	5483A (incl. cable)
Screw M2 x 8 RC CSK ZN (12 off):		300705FA
Screw M2 x 8 RC CSK CH (4 off):		300706FA
Connector (included in Dynode Chain Assembly)	BP13 only:	425709KF

8.4 100 cm^2 SQUARE PROBES

AP3/4, IAP3, AP3R/4, IAP3R
BP6/4, IBP6, BP6R4, IBP6R
DP3/4, IDP3, DP3R/4, IDP3R

Body Assembly:		D33923/A
Grille Assembly:	AP3/4 & IAP3:	C33922/A
	AP3R/4 & IAP3R:	C34888/A
	BP6/4 & IBP6:	C33922/A
	BP6R/4 & IBP6R:	C34888/A
	DP3/4 & IDP3:	C33922/A
	DP3R/4 & IDP3R:	C34888/A
Window Assembly:		B34897/A
Phosphor:	AP3/4 & IAP3:	B33920
	AP3R/4 & IAP3R:	B33920
	BP6/4 & IBP6:	B35249
	BP6R/4 & IBP6R:B33249	B33249
	DP3/4 & IDP3:	B34898
	DP3R/4 & IDP3R:	B34898
Gasket:		A33909
Protective Cover:		C33915
Photomultiplier Tube:		B35246
Dynode Chain Assy:	Non Intelligent Probes:	B33903/A
	I Probes suffix A only:	5481A (incl. cable)
Screw M2.5 x 6 RC CSK CH (2 off):		300754FA
Connector (Non Intelligent Probes only): (included in Dynode Chain Assembly)		425709KF

8.5 100cm² RECTANGULAR NON DIECAST PROBES

AP5, IAP5, DP6A&B, IDP6A

Body Assembly:		E37365/A
Grille:	Open	B39752
	Rugged	B90279
Window Assembly:		B37416/A
Phosphor	AP5 & IAP5:	B38073
	DP6 & IDP6:	B38349
Gasket:		B37396
Protective Cover:		C39259
Photomultiplier (PM) Tube:		B35246
End Cap Gasket:	AP5A & DP6A	A37398
	DP6B	A38355
Dynode Chain Assy:	AP5A & DP6A	B38208/A
	DP6B:	B38208/B
	I Probes suffix A only:	5482A (incl. cable)
Screw M2.5 x 5 RC PAN CH (6 off):		
Screw M2.5 x 6 RC CSK CH (10 off):		
Connector	AP5A & DP6A:	
	DP6B:	

(included in Dynode Chain Assembly)

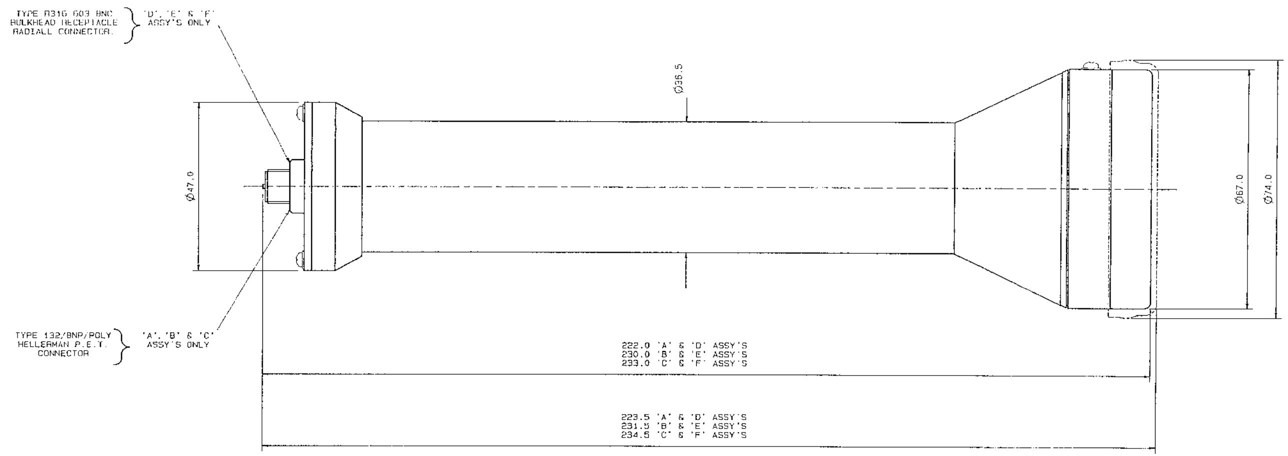
8.6 100cm^2 RECTANGULAR DIECAST PROBES

(I)AP5AD(E), (I)AP5BD(E), (I)AP5RA, (I)AP5RB, (I)BP19AD(E), (I)BP19BD(E), (I)BP19DD, (I)BP19R, (I)BP19RD (I)DP6AD(E), (I)DP6BD(E), (I)DP6DD, (I)DP6R, (I)DP6RD

Body Casting:		E39291
Grille:	Open	B39752
	Rugged	B90279
Window Assembly:	Suffix DD/RD probes	B90202/A
	Suffix /E:	——
	Other probes:	B37416/A
Window Plate:	Suffix /E:	B37395
Phosphor	AP5AD&BD & IAP5AD:	B90252
	AP5/E:	A90999
	BP19:	B90204
	BP19/E:	A91286
	BP19/E support:	A91287
	DP6AD&BD & IDP6BD:	B90239
	DP6/E	A91000
	DP6DD & IDP6DD	B90200
Gasket:	Suffix /E	B91096
	Other probes:	B37396
Protective Cover:		C39259
Photomultiplier Tube:		B35246
Magnetic Shield		A91679
Dynode Chain Assy:	AP5AD, DP6AD	B33448/A
	AP5BD, DP6BD	B39607/B
	I Probes suffix A	5480A (incl. cable)
	I Probes suffix B or D	5542A (no cable)
Screw M2.5 x 5 RC PAN CH (2 off):		300753FA
Screw M2.5 x 6 RC PAN CH (4 off):		300104FA
Screw M2.5 x 6 RC CSK CH (10 off):		300754FA
Connector	AP5AD & DP6AD:	425709KF
	AP5BD & DP6BD:	426073KF

(included in Dynode Chain Assembly)

THIRD ANGLE PROJECTION



APPROX. WEIGHT 600gm

ISO THREADS CLASS 6g/6H

ISSUE	DATE	DOI/MOD.
1	06.09.79	/
2	01.12.80	DOI5688
3	15.07.81	17255
4	07.05.98	21666

MATL. /
SPEC. /
FINISH. REMOVE ALL BURRS. /
SURFACE TEXTURE √ UNLESS STATED
TOLERANCES UNLESS STATED: 1 DEC.PL. ± 0.4; 2 DEC.PL. ± 0.15
DIMENSIONS IN mm
SCALE 2:1
DRN OTE
CHKD.
APPD.

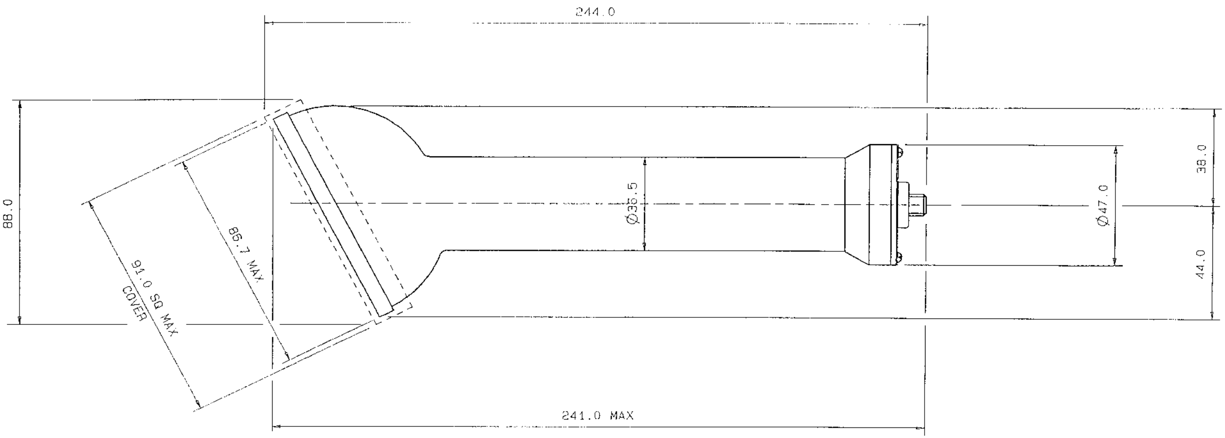
MANUFACTURE TO DIMENSIONS SHOWN. FINISHING ALLOWANCE ALREADY DEDUCTED

Thermo
Bath Road, Beenham, Reading, Berkshire RG7 5PR ENGLAND

TITLE OUTLINE DRAWING
BETA PROBE BP4/4D/4E & /4F.

DRG. No. D 33546

DRG. No. D 33546



APPROXIMATE WEIGHT = 750gm

THIRD ANGLE PROJECTION

C33474

ISO THREADS CLASS 6g/6H

MATL. / /		TOLERANCES UNLESS STATED 1 DEC.PL. ± 0.4 2 DEC.PL. ± 0.15	DRN. E.A.MORRISON CHKD. APPD.
SPEC. / /			
FINISH. REMOVE ALL BURRS. /	SURFACE TEXTURE √ UNLESS STATED	DIMENSIONS IN MM SCALE 1 : 1	

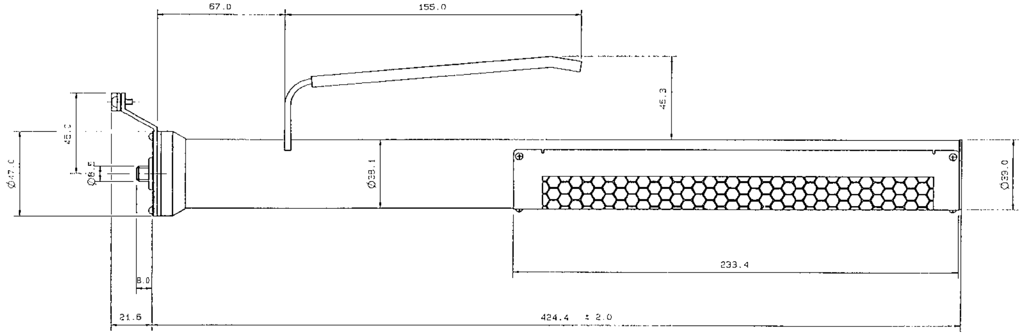
ISSUE	DATE	DOI/MOD.
1	15.06.79	DOI 5657
2	26.01.87	18884
3	14.09.88	19405
4	17.11.94	DOI 6952

Thermo
Bath Road, Beenham, Reading, Berkshire RG7 5PR ENGLAND

TITLE OUTLINE DRAWING (STANDARD) (VERSION)
49 SQ CM SCINTILLATION PROBE

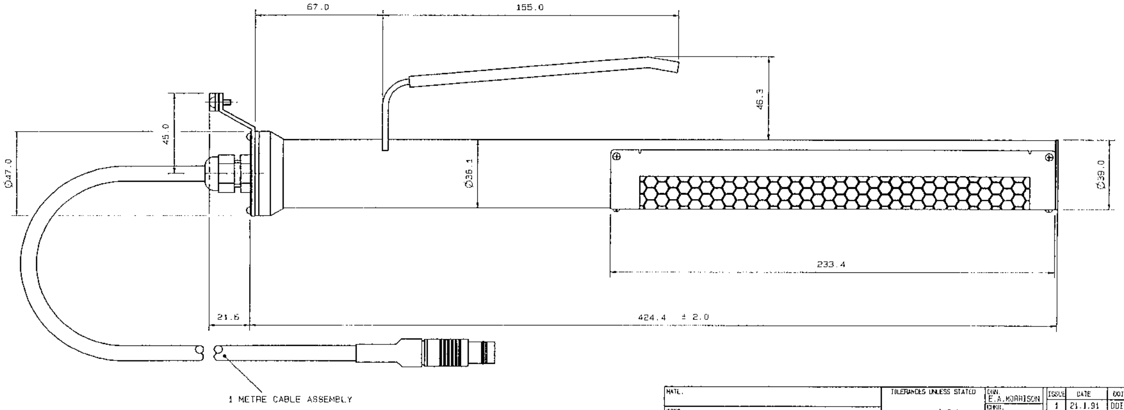
DRG.No. C33474

THIRD ANGLE PROJECTION



STANDARD PROBE

APPROX WEIGHT :- 875 GRAMMES



INTELLIGENT PROBE

APPROX WEIGHT :- 975 GRAMMES

ISO THREADS CLASS 6g/6H

MATL.		TOLERANCES UNLESS STATED 1 DEC.PL. ± 0.4 2 DEC.PL. ± 0.15	DRN. E.A.MORRISON	
SPEC.			CHKD.	
FINISH. REMOVE ALL BURRS.	SURFACE TEXTURE √ UNLESS STATED	DIMENSIONS IN MM	APPD.	
		SCALE 1 : 1	TITLE OUTLINE DRAWING 80 SQ.CM. SCINTILLATION PROBES	DRG.No. D 38400
MANUFACTURE TO DIMENSIONS SHOWN. FINISHING ALLOWANCE ALREADY DEDUCTED				

ISSUE	DATE	DOI/MOD.
1	21.1.91	DOI 6550
2	15.11.94	DOI 6960

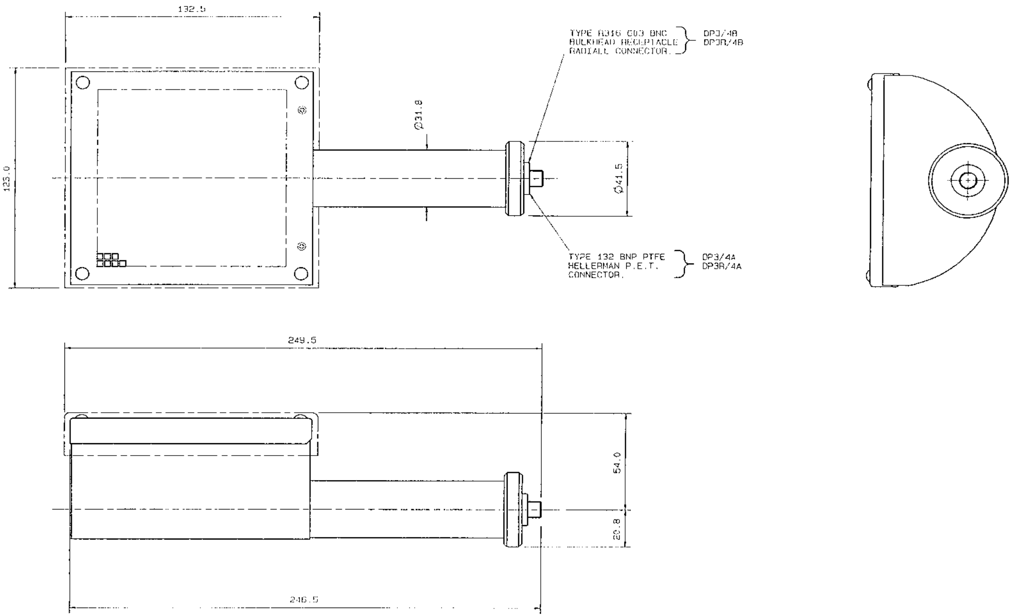
Thermo

Bath Road, Beenham, Reading, Berkshire RG7 5PR ENGLAND

DRG.No. D 38400

DRG. No. D 34902

THIRD ANGLE PROJECTION



APPROX. WEIGHT 750gm

ISO THREADS CLASS 6g/6H

MATL. /
SPEC. /
FINISH. REMOVE ALL BURRS. /
SURFACE TEXTURE √ UNLESS STATED
TOLERANCES UNLESS STATED: 1 DEC.PL. ± 0.4; 2 DEC.PL. ± 0.15
DIMENSIONS IN mm
SCALE 1:1
DRN DTE
CHKD.
APPD.

ISSUE	DATE	DOI/MOD.
1	23.10.81	0015792
2	24.07.82	17524
3	23.09.88	19413
4	20.03.99	19510
5	29.04.90	21663

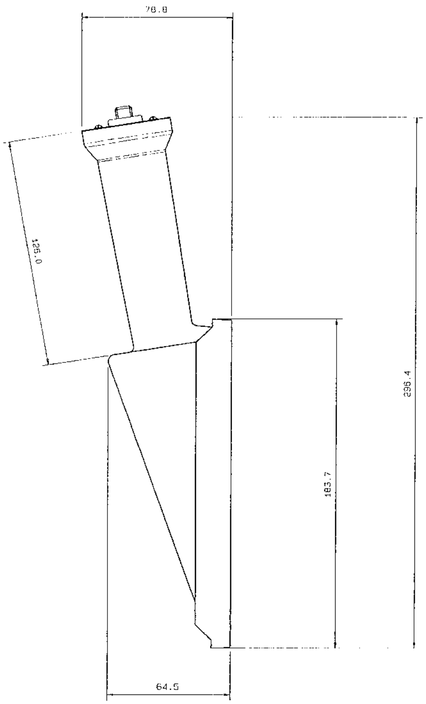
Thermo
Bath Road, Beenham, Reading, Berkshire RG7 5PR ENGLAND

TITLE OUTLINE DRAWING
DUAL PROBE DP3/4 & DP3R/4

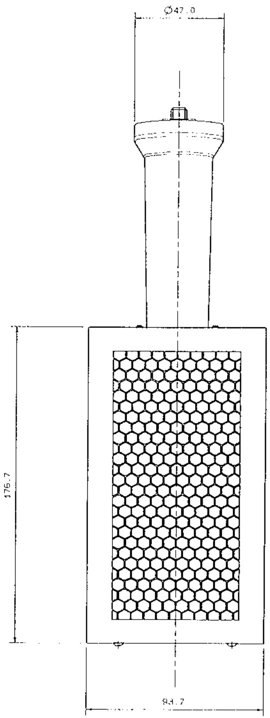
DRG. No. D 34902

MANUFACTURE TO DIMENSIONS SHOWN, FINISHING ALLOWANCE ALREADY DEDUCTED

THIRD ANGLE PROJECTION



PROBE WITH COVER



PROBE WITHOUT COVER

MAXIMUM APPROX. WEIGHT 650gm.

ISO THREADS CLASS 6g/6H

MATL.	TOLERANCES UNLESS STATED 1 DEC.PL. ± 0.4 2 DEC.PL. ± 0.15	DRN. E.A.MORRISON	
SPEC.		CHKD.	
FINISH. REMOVE ALL BURRS. SURFACE TEXTURE ✓ UNLESS STATED	DIMENSIONS IN MM	APPD.	
	SCALE 1 : 1	TITLE OUTLINE DRAWING 100SQ.CM.SCINTILLATION PROBE DIECAST VERSION	DRG.No. D 39615

ISSUE	DATE	DOI/MOD.
1	23.03.94	DOI 6007
2	02.08.94	20795
3	21.09.95	21163

Thermo
Bath Road, Beenham, Reading, Berkshire RG7 5PR ENGLAND

MANUFACTURE TO DIMENSIONS SHOWN, FINISHING ALLOWANCE ALREADY DEDUCTED

DRG. No. D 39615