November 14, 2000

iTi QUALITEK, Inc.

267 BOSTON ROAD
N. BILLERICA
MA 01862-2310, USA

TEL 800-550-8930
FAX 978-670-1114

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Email: iti_qualitek@compuserve.com

Mr. Fredrick C. Sturz, Chief, MSIB-A
Materials Safety and Industrial Branch
Division Of Industrial and Medical
Nuclear Safety
Office of nuclear Material safety and Safeguards
Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Sturz:

I thank you for your letter received October 11, 2000 concerning the change of Registration (SSDR) from Ion Track Instruments to ITI Qualitek, Inc. Apart from 1 item A record of the telephone conversation dated May 30, 1995, (no record found) the submission is complete.

I would like to reconfirm two points previously stated:

1. The original registration under Ion Track Instruments was controlled by Ion Track Instruments who are no longer apart of our group. Both Ion Track Instruments and ITI Qualitek are independent companies. The new status of both our companies makes it more difficult to obtain the required paperwork concerning the original application, however I believe the enclosed to be complete and will meet your requirements.

2. A number of the original letters referenced the Leakmeter 120, Model 97, Vixen, Model 85. The Models 97, Vixen and Model 85 are products owned by Ion track Instruments and will not be part of the new registration. The Model 120 Leakmeter is no longer manufactured (last production batch 1994) and all sales were discontinued in 1995. The registration requested is for the Model 200 Leakmeter only.

I trust the enclosed addresses all your concerns and that the registration can be amended from Ion Track Instruments to ITI Qualitek, Inc or the enclosed can be viewed as an application for a new registration and can be dealt with accordingly. If however you do require any additional information, please do note hesitate to contact me. I look forward to receiving your favorable reply.

Sincerely yours,

David Morris
President

ENCLOSURES:

1. Original letters dated: March 21, 1994
   May 12, 1995
   September 27, 1994
   June 20, 1995

2. Original documentation as listed on the letter dated September 27,th 1994 under enclosures.

3. Original documentation as listed in the letter dated may 12, 1995.

4. Additional information concerning a compliance report dated 1996 after the original registration, provided for reference only.

MEGGITT CONTROLS

ION TRACK INSTRUMENTS INC

340 Fordham Road
Wilmington
Massachusetts
01887
USA
telephone
(508) 658-3767
fax
(508) 657-5454

March 21, 1994

Ms. Susan Greene
Medical, Academic and Commercial
Use Safety Branch
Division of Industrial and Medical
Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Dear Ms. Greene:

RE: Request to add New Product to Ion Track Instruments Distribution License (No 20-15525-02E).

Ion Track Instruments requests that a new product, the Model 120-200 Leakmeter be added to its distribution license. This New Leakmeter is a direct decedent of an already existing product the Model 120 Leakmeter, which is currently on ITI's distribution License. The 120-200 Leakmeter uses the same radionulide activities at its predesesor Model and is acceptable in the construction of the ionization chamber from a health physics point of view.

To expedite the issue of a new license to ITI, I am providing you with a package of drawings and information for the Model 120-200 Leakmeter. I have highlighted the relevant area's that detail the ionization chamber and its labelling. An assembly drawing is also included detailing the outline of the product construction and the position of the detector assembly.

The main differences between the 120 and the 120-200 Leakmeter are:

A. Revised product packaging - the detector hand unit assembly is in essence the same for both units, the materials used in the 200 will offer additional strength to the unit.

B. The detector is mounted in both units at the front end of the hand unit assembly.

C. The software 120-200 Leakmeter has been completely revised to make the user interface much simpler.

D. Both ionization chambers are of similar construction with adequate wall thickness for shielding the ionizing radiation.

E. Both ionization detectors are assembled using a tamper proof locking system.

F. Both ionization detector assemblies contain a radioactive label which provides a caution and also denotes the activity of the source.

G. The radioactive source is identical in both units 10 mCi of ^{63} Ni β particles.

H. The detector assemblies used in the 120 & 120-200 Leakmeter are serialized sources from Amersham and or DuPont NEN. A detailed log is kept relating serial numbers of Leakmeters to serial number of the source used.

I. A wipe test of both products is actioned, after assembly and before shipment to our customer. The wipes are sent to a radiochemistry and health and physics facility for analysis.

J. Distribution from ITI is to both North and South America.

I trust the enclosures are sufficient to enable you to add the Leakmeter 120/200 to our current License. I would greatly appreciate if you would expedite the approval as soon as possible, so that we can continue selling the Leakmeter range into our established market base.

Sincerely yours,

William J. McGann
Director of R&D

WG/lam

Enc:

MEGGITT CONTROLS

ITI
QUALITEK

340 Fordham Road
Wilmington
Massachusetts
01887
USA
telephone
(508) 658-3767
fax
(508) 657-5054

May 12, 1995

Mr. Thomas W. Rich - Mechanical Engineer
Sealed Source Safety Section
Source Containment and Device Branch
Division of Industrial and Medical Nuclear Safety
Office of Nuclear Material Safety and Safeguards
United States Regulatory Commission
Washington, DC 20555-0001

Dear Mr. Rich:

In response to your letter dated 3/16/95 concerning our Model 120-200 Leakmeter. I am enclosing the additional information requested for you to complete the safety analysis of the device.

1. Method of attachment of the label is documented on the enclosed drawing A/200001-1 (Wire Attachment). need full set 2 of 2

2. A copy of the prototype tests performed on the Model 120-200 Leakmeter is enclosed-reference Amershaw International QCS828 Issue 1. in 9/27/94 ltr as App C

3. QC Program - attached are the procedures used in the manufacturing and distribution of the device. Refer to documents 99106 and QCP No 130.

4. We are in the process of assembling the materials requested for the Model 120 Leakmeter. They will be forwarded to you in the near future.

I would very much appreciate a speedy response to our request for license for the Model 120-200 Leakmeter as this represents a major part of our business - We urgently need to resolve the issue to ensure our customers receive the latest in SF_6 detection (the Model 120-200 Leakmeter) as soon as possible.

I thank you in anticipation of a speedy response, please do not hesitate to call if require any additional information.

Sincerely yours,

David Morris
President

DM/lam

MODEL 200

99106

SPECIAL PROCESS PROCEDURE

99106

SPECIAL PROCESS PROCEDURE

Title: The Handling and Movement of Radioactive Sources

No: 99106

Prepared by: N.R.P.B.

Date: 5.3.97

Issue No:		
	+2 F/R 2743	25/6/90
	3 CH 1175	27/4/92
	4 CH 1209	3/11/92
	5 CH 1300	25/11/93

Approved by: M. Macadie RPS M. Macadi

Local Rules - Work with Ni-63 Radioactive Foils

Contents

LOCAL RULES FOR WORK WITH Ni-63 RADIOACTIVE FOILS

1. GENERAL

These Rules Are Provided In Compliance With The Ionising Radiations Regulations 1985 (Regulation 11) And The Associated Approved Code Of Practice "The protection of persons against ionising radiations arising from any work activity".

The rules are the general principles and description of the means of complying with the Regulations and should be seen as implementing part of the general safety policy required by Section 2 of the Health and Safety at Work etc Act 1974.

Aims: to ensure that work with ionising radiations is controlled so that -

1. during normal working, radiation doses to all persons as low as reasonably practicable,

2. precaution have been taken to minimise the risk of equipment failure or other occurrence which may result in significant radiation doses to any person, and

3. no doses exceed those specified in the Regulations.

2. RADIATION PROTECTION SUPERVISORS (RPS): Mr Martin Macadie

The RPS may be contacted via internal phone number 2251

2.1 Duties of the RPS

1. To ensure that work is carried out in accordance with the requirements of the Regulations and for taking all reasonable steps to ensure that these rules are obeyed.

2. To ensure that all persons likely to be affected by the local rules are provided with copies, and that they have read and understood them.

3. To ensure that personal wear extremity dosemeters (Thermoluminescent dosemeters (TLDs) during foil manipulations and to return them to the NRPB for evaluation at the end of their wear period.

4. To arrange for the repair/testing of radiation monitors.

5. To ensure that detailed source location/disposal records are kept for all Ni-63 radioactive source and that these records are current.

6. To supervise the work of personnel, undertaking work manipulating/installing Ni-63 in items of equipment manufactured/repaired or serviced by the Company.

7. To liaise with the Radiation Protection Advisor as necessary.

3. RADIATION PROTECTION ADVISER (RPA)

National Radiological Protection Board, Chilton, Didcot, Oxon OX11 0RQ Tel: Abington (0235) 831600

Contact: Robert Hill or Dr Ciaran McDonnell

Out of hours telephone (for emergency use only): (0235) 834590

The out of hours telephone connects with the AEA Technology Harwell Laboratory security control. The caller should state that he requires the assistance of NRPB (Southern Centre) as his RPA and give the name (above) of his usual contact. The NRPB representative returning the call will not necessarily be one of the persons named above.

The RPA advises the Company in the observance of the Regulations and in any other health and safety matters in connection with ionising radiations.

4. DESIGNATED AREAS - GENERAL

Generally areas where radiation dose rates exceed 7.5 uSv h^{-1}, and which persons may enter, require to be designed as controlled areas. Areas where radiation dose rates are between 2.5 and 7.5 uSv h^{-1} require to be designated as supervised areas. Areas where radiation dose rates are below 2.5 uSv h^{-1} require no special designation.

Access to controlled areas is restricted to classified persons, or to those working under a written system of work (WSoW). The system of work must ensure that the person does not receive more than 3/10ths of any relevant dose limit and, further, be designed to restrict so far as reasonably practicable the extent to which any person is exposed to ionising radiations.

Access to supervised areas is not restricted in any way.

5. DESIGNATED AREAS (on the Company's premises)

The internal volume of the Gallenkamph Glove box contained in the radiation room, is designated as a controlled area.

The radiation room is designated as a supervised area.

6. ACCOUNTING OF NEW SOURCES/ITEMS OF EQUIPMENT CONTAINING A RADIOACTIVE SOURCE

This work is only to be preformed in the radiation room by an authorised individual. If it is necessary to remove source packaging (not the external transport packaging) to perform the procedures detailed below then rubber gloves should be worn and handling tongs used.

1. On receipt of containers from Goods In, check that the contents agree with packing note and order.

2. Check serial numbers on glass phial containing the Radioactive foils, corresponds with data sheet (supplied by manufacturer). Enter these serial numbers into Radioactive Source Records Book with date received and test date, all to be in numerical order.

3. The foil serial number and the detector serial number into which it is going to be fitted must be entered into the Source Record Book simultaneously to avoid mistakes.

4. Sources not required for immediate use must be placed in the Safe in the Radioactive Room.

6.1 Source Assembly Identification Procedure

1. Obtain the next batch of serial numbers from the Record Book and etch on the detector body or on the permanently attached label the following:

    1. Radioactive

    2. N-63

    3. 370 MBq

    4. Serial number obtained from the Record Book.

7. FOIL MANIPULATION

All work with Ni-63 radioactive foils must be carried out in accordance with the Work Instructions detailed in Section 8 below.

The person performing the work shall make use of the appropriate bending tools and filling jigs to load the Ni-63 foil into the capsule, this work must only be performed within the Gallenkamph glove box, situated in the radiation room.

8. WORK INSTRUCTIONS

No person(s) other than those authorised shall carry out any loading of source capsules or rectification work on detectors containing a Ni-63 source. The names of authorised workers are T M Brinkley, N Elbourne.

1. At no time shall a Radioactive foil be handled with bare hands.

2. All foil manipulations must be carried out in the Gallenkamph glove box using tweezers - at no point should the foil be nearer than one inch to the hands.

3. No smoking, or eating, or drinking, or snuff taking, or cosmetic application may take place in the supervised area.

4. No food, drink, cigarettes or cosmetics may be taken into the supervised area.

5. Normal green work coats shall not be taken into the supervised area. The special yellow work coats are required to be worn by persons in the work area. The yellow coats must not be worn in any other part of the factory.

6. Any open wounds on the hands must be covered with a waterproof dressing before any radiation work commences.

7. Only disposable handkerchiefs provided shall be used and immediately disposed. Conventional handkerchiefs shall not be used in the supervised area.

8. Working surfaces shall be covered with disposable material supplied.

9. All storage within the Radioactive Safe shall be upon stainless steel trays provided.

10. All loading/bending operations with cells/foils shall take place within the Gallenkamph glove box.

11. If an accident, or any undue exposure has occurred then this must be reported to the RPS immediately.

12. Before leaving the supervised area, for any reason, the yellow work coat must be removed and the hands must be washed using the facilities provided.

13. All authorised workers shall be over the age of 18.

14. All authorised workers must wear extremity (finger) TLDs when manipulating foils or handling source capsules.

15. No expectant mothers shall be used as authorised workers, or perform any work on radioactive cells.

16. All waste sources cells must be properly documented and stored in the metal cabinet provided for that purpose, prior to disposal.

9. DECONTAMINATION CHECK

1. When a detector cell assembly is complete, the cell should be washed as follows:

   Wearing disposable gloves (supplied), and using tweezers, moisten swab in diluted "Decan 90" solution. Clean all external surfaces of the cell body. The swabs should be sealed in a polythene bag and placed in the special low radioactivity waste bin.

2. Now, a background radiation check is performed as follows:

   Turn on the Hughes-Whitlock machine. Check that the instrument is set to 10 second period; ie, x 10 sec depressed, and that the energy switches are set as follows: E1/E3 depressed.

   Take a glass filter circle in the tweezers and moisten with a drop of methanol/water mixture. Allow to dry for a few seconds.

Depress the handle of the Hughes Whitlock machine to release the vacuum, and raise the instrument from the baseplate. Insert the test filter circle into the well in the centre of the baseplate. Now depress fully the handle on the machine, and release. Over the next ten seconds the scintillation counts will be counted and displayed, and the final (10 second) count displayed. This figure should be 200-220 counts. Repeat and check this result. If the figure is too high, then the baseplate or tweezers may be in themselves be slightly contaminated.

Decontaminate these using the above procedure and re-check. When a background count of 200-220 is achieved, discard the test paper.

3. Now, take an actual reading by taking a glass filter circle, moistening with a drop of methanol/water mixture, and wiping the test circle over the external faces of the detector cell. Now repeat the count using the Hughes-Whitlock machine, and repeat the count to test the repeatability of the sample.

   This count should be less than the background count plus 64 thus achieving a less than 20 becquerel contamination level. If the actual reading is too high, perform a repeat wash and then repeat the test until satisfactory.

4. Take one of the glass filter circles supplied for scintillation counting and moisten it with methanol/water mixture. Wipe the external faces of the detector with it, then place it in one of the scintillation counting vials provided for the purpose. Start to fill in form Ai 5001, issue 2 for the detector. Make sure that the detector serial number is correctly filled in. Fill in the "wipe" name date and signature.

5. Mark the vial with the detector identification number using an indelible marker. Write the serial number of the detector in the space provided on the counting service form. Fill in any other appropriate details. Put the detector in a plastic bag with the partially completed forms, and place in the safe. Put the vial in the container with the other vials awaiting counting and place this in the safe as well.

6. When a suitable number of vials (usually at least five) have accumulated they should be despatched to an approved counting service, together with the associated counting service forms. A list of the approved counting services is given in appendix 4.

7. If, when the counting reports are returned, it states that the activity detected on a wipe exceeds the threshold, then the detector capsule to which the wipe relates must be re-washed and another wipe taken and assessed as detailed above. The RPS should be informed if this occurs.

8. Complete form Ai 5001 issue 2 for all detectors with counting results below the threshold. Attach a copy of the results sheet, with the relevant results indicated, to the form. Place the form and attachments in the bag with the appropriate detector and replace in the safe.

9. When the detector is required for use, make out the counterfoil book with the detector type, batch number, and serial numbers of the detectors required. Obtain the signature of the person receiving the detectors, passing a copy to production control. Double check that form Ai 5001 is FULLY COMPLETED for each detector released and each form is with the correct detector.

10. Modifications to the above procedure for in-situ wiping of Ai manufacture electron capture detectors fitted to gas chromatographs.

a. The service engineer should carry out the wiping described in section 4 on the detector while it is fitted into the GC. The detector should be at room temperature when this is done. All the external surfaces of the detector body which are accessible should be wiped.

b. The wipe, in the scintillation vial, should be returned to Ai together with the partially completed Ai 5001. The vial and counting form will be marked as described in section 5, using the detector number given on the 5001 form. The process will then proceed as described, until in section 8 the completed form and copy of the results are despatched to the customer.

c. If the wipe results indicate that the contamination level exceeds the threshold specified, then the RPS should be informed immediately. The RPS should contact the RPA and act on the advice received.

10. HAZARD ASSESSMENT

There are two types of incident which are considered, these are:

1. The dropping of an open tray containing unprotected electro- deposited radioactive Ni-63 foils.

2. Failure of the heater control mechanism in a detecting instrument incorporating a Ni-63 source.

3. Radioactive source or the radiation room, is involved in a fire.

11. CONTINGENCY PLAN

Accident 1

Adherence to the procedures detailed in the local rules should limit the occurrence of such an incident to within the confines of the radiation room as this is the only area where unprotected sources should be manipulated.

1. In the event of such occurrence, the individual(s) concerned should take care not to stand on any sources, thereby preventing further damage.

2. They should pick up the Ni-63 sources and replace then in the tray using tongs and wearing thick rubber gloves to prevent contamination of the hands. The tray should then be placed on a stable work surface.

3. The area where the sources fell should be wiped with wet disposable rags soaked in decon solution, the rags should then be placed in a polythene bag which should be sealed ready for disposal as radioactive waste.

4. The outer surfaces of the tray should also be wiped with rags soaked in decon solution if it is suspected that it may be contaminated ie, by falling on Ni-63 sources.

5. If it is suspected that an operatives shoes have been contaminated then they should be wiped with rags soaked in decon solution and the rags disposed of accordingly.

Before leaving the room, the tray of sources should be replaced in the safe. If the individual suspects that their overalls have been contaminated, they should remove them, fold them inside out, and place them in a plastic bag. Arrangements should be made to wash the overalls. The person should then wash his/her hands using the facilities in the radiation room.

The Radiation Protection Supervisor should be informed of the occurrence and of the actions taken to remedy the situation. The circumstances leading up to the incident should be investigated with a view of improving the procedures to minimise the risk of such an incident re-occurring.

Accident 2

The risk to personnel from such an incident would be from airbourne contamination. For this to occur the temperature of the radioactive source would need to be raised sufficiently to release electro-deposited radioactive Ni-63 from the source surface.

The person discovering such a fault should switch off the instrument and vacate the area. The Radiation Protection Supervisor should be informed immediately, who will then contact the Radiation Protection Advisor for further advice.

Accident 3

In the event of a radioactive source being involved in a fire, then the area should be evacuated, the fire service should be called and informed of the potential hazard. The RPS should be informed immediately. He should immediately contact the RPA and act on any advice received.

Appendix 1 Related Documents

1. Radioactive Substance Act 1960
2. Health and Safety at Work Act 1974
3. Ai Fire and Safety Regulations
4. Radioactive Source Records Book
5. Radioactive Waste Disposal Book
6. Radioactive Source Wipe Test Book
7. Ai Form 5001
8. Ai Radioactive Decontamination Record Book
9. Transport QA plan

Appendix 2 Equipment required for work with Ni-63 radioactive foil sources

1. Manipulator Glove Box
2. Hughes Whitlock Radioactive Test Meter (calibrated)
3. Associate Bending and Forming Jigs and tweezers (for use within glove boxes only)
4. Tweezers for use on scintillation tests only
5. Glass filter circles, one inch diameter
6. Diluted "Decon 90" solution
7. Methanol/water mixture

Appendix 3 Disposal of Radioactive Waste

Count up all the waste sources or bodies and enter the detector serial number(s) in the Waste Source Book.

NB. Our present licence imposes activity limits on waste and volume as follows:

Tritium; maximum 2 Tera Becquerels (1000 sources each 1.8 MBq)
Nickel; maximum 60 Giga Becquerels (162 sources each 370 MBq)

Volume of waste 1 litre maximum.

1. Fill in Form RSA4 (use example) send to:

NDS
Secretary of State for the Environment
Becket House
Lambeth Place Road
London SE1 7ER

Copy to:

UKAEA Building 462
AERE
Didcot, Oxfordshire

2. Fill in Form SPS50 (use example)

3. When approved a form RSA5 will be received from UKAEA.

Follow the instructions on the form

Seal waste in tin, with outer box marked with:

1. Address for waste
2. Disposal Certificate Number (from RSA5)
3. "Radioactive Waste" in large letters.

The package can only be delivered by Radiac (Radioactive Securicor)

Telephone: WEST DRAYTON 08954 48555

They will arrange to pick up delivery.

The Form SPS50 is send the packages.

Appendix 4 Approved Scintillation Counting Services

The scintillation counting service used must provide a reliable and traceable means of counting Ni-63 contamination. The following have provided documentary evidence of meeting the requirement:-

University Safety Services
University of East Anglia
Norwich
Norfolk

contact: Robin Thomas, Director of Safety Services

Appendix 5 Local Rules Concerning Accounting Records for Radioactive Sources in Detection held By Ai Cambridge for use by the Company other than in the Manufacture of Instruments

Contents

1. This appendix describes the records which must be kept for detectors which Ai holds other than those used in production. This includes ALL detectors used by sales, marketing, service, and development.

2. Records of Source location

EACH SOURCE will have TWO record books associated with it.

2.1 The Master Source Movement Record Book will be kept at Ai Cambridge at all times. It will contain the following information at the front of the book:

1. Instrument type and serial number.
2. Source serial number, activity and radioanuclide.
3. Date of receipt of source.
4. Date of disposal.
5. Name and address of disposal route.

A record must be made in this book for each movement of the source. This record must contain the following information:

6. Name and address to which the source is being transported.
7. Name of person removing the source, and date of removal.
8. Name of persons returning the source, and date of return.

An entry must be made in this book whenever the source travels from one location (postal address) to another. If the source is in storage at Ai Cambridge then this book should be signed and dated monthly to indicate that the location of the source has been checked. If the source is in use at Ai Cambridge then the book should be signed and dated weekly.

2.2 The Mobile Source Movement Record Book travels with the source when it is off site. It will contain the following information at the front of the book:

1. Instrument type and serial number.
2. Source serial number, activity and radionuclide.
3. Date of receipt of source.
4. Date of disposal.
5. Name and address of disposal route.

Within the book the following information must be added for each movement of the source:

6. Name and address to which the source is being transported.
7. Name of person making the entry and the date of that entry.

An entry must be made in this book whenever the source travels from one location (postal address) to another. While the source is not at Ai Cambridge the book should be signed and dated EVERY WORKING DAY, to indicate that the location of the source has been checked.

2.3 These books are legal documents and must be treated accordingly. They must be made available for inspection on request. When the corresponding source is disposed of, they should be passed to the Radiation Protection Supervisor (Martin Macadie) who must retain them for at least two years after the disposal.

3. Transport of Sources.

Sources should be transported in accordance with the Source Transport Local Rules.

RADIOACTIVE SOURCE - CERTIFICATE OF TEST FOR LEAKAGE

Source identification number:

Reason for test :

Nuclide: Ni-63

Date of wipe :

Physical form of source: Electrodeposited foil

Wipe performed by:

Activity:

Signature:

DETAILS OF TEST

Method used: The source is wiped with a glass fibre disc moistened with a methanol/water mixture. The disc is counted with a liquid scintillation counter and the activity is compared with that of a standardised reference solution of Ni-63 of known activity. This procedure follows method 5.3.1 of International Standard ISO 9978:1992 (Radiation Protection - Sealed Radioactive Sources - Leakage Test Methods).

Counter used:

Activity of standard reference solution: 231 ± 8 Bq

Counting period: 60 s

Background count:

Reference count:

Sample count (1): Repeat (2):

Estimated activity of sample: Bq

Notes: (i) The limit of detection is less than 1 Bq. Samples for which the estimated activity is less than this amount are recorded as " < 1 Bq" .

(ii) The approval criteria of ISO 9978:1992(para 5.3.3) are used. These state that if the activity detected does not exceed 200 Bq the source is considered to be leaktight.

STATEMENT OF TEST RESULT

This is to certify that the radioactive source described above has been tested for leakage in accordance with the requirements of section 18(3) of the Ionising Radiations Regulations 1985 and that the source is leak-free.

Name: Position:

Signed: Date:

MODEL 200

MANUFACTURING AND DISTRIBUTION

QCP 130

CERTIFICATE OF RADIOACTIVE SOURCE INTEGRITY

Amersham Laboratories
White Lion Road Amersham
Buckinghamshire England HP7 9LL

telex 83141 ACTIVA G
fax (0494) 543588

QCP 130

CERTIFICATE OF RADIOACTIVE SOURCE INTEGRITY

Title : EC dectector assembly, Ai Cambridge Ltd.

Assembly code : None

Assembly drawing : A/200003 (Ai Cambridge Ltd)

Nuclide : Nickel - 63 (Ni-63)

Radiotoxicity group : B2

Maximum activity : 500 MBq (13.5 mCi)

CLASSIFICATION : BS/ISO/ANSI 77 C32313

RECOMMENDED WORKING LIFE : Not assessable

Test sources : Two active samples, serial numbers 002519 and 002522, each containing a 370 MBq Nickel-63 foil, type NBCK 7074, assembled as per Ai Cambridge drawing A/200003 issue A. QA reference: 95/073 and 95/074.

Tests carried out in accordance with:

BS.5288:1976 ISO.2919:1980(E) ANSI N542:1977

Leak test method	Temperature	Pressure	Impact	Vibration	Puncture	Units
	3	2	3	1	3	
Wipe (QCP 130)	Pass 2.68 0.25	Pass 0.25 0.20	Pass 1.44 0.31		Pass 0.82 0.25	nanocuries

Quality Assurance Manager

5.5.95
Date

RS 353 Issue 1

Q. A. AUTHENTICATED

Amersham

AMERSHAM INTERNATIONAL PLC

INDUSTRIAL PRODUCTS

QUALITY CONTROL PROCEDURE (QCP)

Title: Wipe test of sources produced in the Industrial Products

Prepared by: Mr D J Aston Date: September 1990

Approved by: B J Senior Date: 18 September 1990.

QA Manager

Scope

This document details four wip test protocols.

1. Wipe test for NBC... CAM type sources.
2. Wipe test for other Ni-63 sources.
3. Wipe test (A) which is used on all of the nuclides.
4. Wipe test of alpha foils.
5. Sentencing.

Appendix 1 - Checking wipes using end window geiger conuter.

Wipe test (A) is based on a discussion in Quality Control Technical Memo 7 (QCTM/7) and conforms to BS.5288 Section D.21.

AB

X Ai Foils of this type

Protocol 1. Wipe Test for NBC... CAM type sources

1.1 Prepare tissue swabs, dimensions 1" x 0.5".

1.2 Grip one swab at and end using a pair of forceps (5").

1.3 Dispense 25 microlitres of methanol onto the swab.

1.4 Draw the moistened swab over the exterior surfaces of 5 NBCQ8681 sources.

1.5 Place the swab into a liquid scintillation vial.

1.6 Clearly label the vial with the source batch identity.

1.7 Submit the vial for QC analysis.

Notes

1. The wipe test pass limit has been set at 250 nanocuries for a batch of 5 NBCQ8681 sources.

2. The NBCQ8681 is considered to be an unsealed source and must be wipe tested only in accordance with this procedure otherwise the source may be damaged.

Protocol 2. Wipe test procedure for other Ni-63 ECD foil sources

2.1 Prepare tissue swabs, dimensions 1" x 0.5".

2.2 Grip one swab at and end using a pair of forceps (5").

2.3 Dispense 25 microlitres of methanol onto the swab.

2.4 Draw the moistened swab over the active surfaces of a source.

2.5 Place the swab into a liquid scintillation vial.

2.6 Clearly label the vial with the source batch identity.

2.7 Submit the vial for QC analysis.

Notes

1. The wipe test pass limit has been set at 5 nanocuries per source.

2. The ECD foil is considered to be an unsealed source and must be wipe tested only in accordance with this procedure otherwise the source may be damaged.

Protocol 3. Wipe test A

1.1 Choose either a cotton wool swab or half foam.

1.2 Moisten the swab or foam with either water, meths or ethanol.

1.3 Squeeze the swab or foam to remove any excess moisture.

1.4 Using a clean pair of forceps wipe all over the faces of the sources using a firm even pressure.

1.5 Place the swab or foam in a liquid scintillation vial and submit to QC for analysis or for production on the Harwell site only proceed with 1.6.

1.6 Foams only can be checked using the method specified in Appendix 1.

Note

All identification numbers should be small and near to the neck of the vial.

Protocol 4. Wipe test for alpha foils

a) Foil strip (1 to 100 cm pieces).

1. Choose cotton wool swab.

2. Moisten with meths and squeeze to remove excess liquid.

3. Using clean pair of forceps wipe over face of alpha foil strip avoiding cut emds. Take care not to damage foil face.

4. Place swab in liquid scintillation vial and submit to QC for analysis.

b) Foil strips <1 cm and discs

1. Sources laid in petri dish in batches up to 500.

2. Choose lint free tissues or cotton wool swab.

3. Moisten with meths and squeeze to remove excess liquid.

4. Using clean pair of forceps wipe over all the sources in the petri dish taking care not to damage source faces.

5. Check no sources attached to cotton wool.

6. Place tissue or swab in liquid scintillation vial - check each vial with x-ray probe before submitting to QC for analysis.

c) Foil strips and discs loaded into holders

1. Sources laid out in batches of 50 - 100.

2. Choose lint free tissues.

3. Moisten with meths and squeeze to remove excess liquid.

4. Using clean pair of forceps wipe over all the sources in the petri dish taking care not to damage source faces.

5. Check no sources attached to cotton wool.

6. Place tissue or swab in liquid scintillation vial - check each vial with x-ray probe before submitting to QC for analysis.

Protocol 5. Sentencing

5.1 Sentence the results against the cinteria defined in this document or as defined in the relevant MP, SPS or catalogue.

5.2 In the event of a failed result consult the relevant MP.

Appendix 1

Checking wipes using end window geiger counter

1. Test validity

The test is valid only if:-

1.1 The daily calibration check as per section 3 has been carried out.

1.2 The source being wiped is Co-60, Ir-192, Cs-137, Cf-252 or Tm-170.

1.3 The end window geiger in Building 10.23 or Building 443.26 is used.

1.4 Foam swabs is used.

2. Procedure

2.1 Count the background for 1 minute. The background must be less than 100 counts. If not then inform technical services sction before proceeding.

2.2 Count the foam for 1 minute.

2.3 Subtract the background from the count rate.

< 475 counts is a pass on the Building 10.23 counter.

< 750 counts is a pass on the Building 443.26 counter.

3. Daily calibration check

3.1 Count the U-238 source (serial No. 681 for Building 10.23 and serial No. 145 for Building 443.26 counter) for 10 minutes.

3.2 Count the background for 10 minutes.

3.3 Count the background count from the source count and check that the resultant value is between,

10,400 and 11,100 counts for Building 10.23 counter,

and 6,500 and 7,000 counts for Building 443.26 counter.

3.4 If the result is not within the mark the counter 'NOT TO BE USED OUT OF CALIBRATION' and refer to the technical services section.

MEGGITT CONTROLS

ION TRACK INSTRUMENTS

340 Fordham Road
Wilmington
Massachusetts
01887
USA
telephone
(508) 658-3767
fax
(508) 657-5954

TO: Mr. Tom Rich - NRC

FR: Mr. David Morris - Ion Track Instruments, Inc.

DATE: June 13, 1995

Further to our telephone conversation of yesterday, I have pleasure in forwarding the information requested.

A. The Heater Control Circuit Statement

B. The point of Sales Package Label under Exhibit B.

Please let me know if you require any additional information. I thank you for your assistance and attention to our application.

Sincerely yours,

David Morris
President

MEGGITT
CONTROLS

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TRACK
INSTRUMENTS
INC

340 Fordham Road
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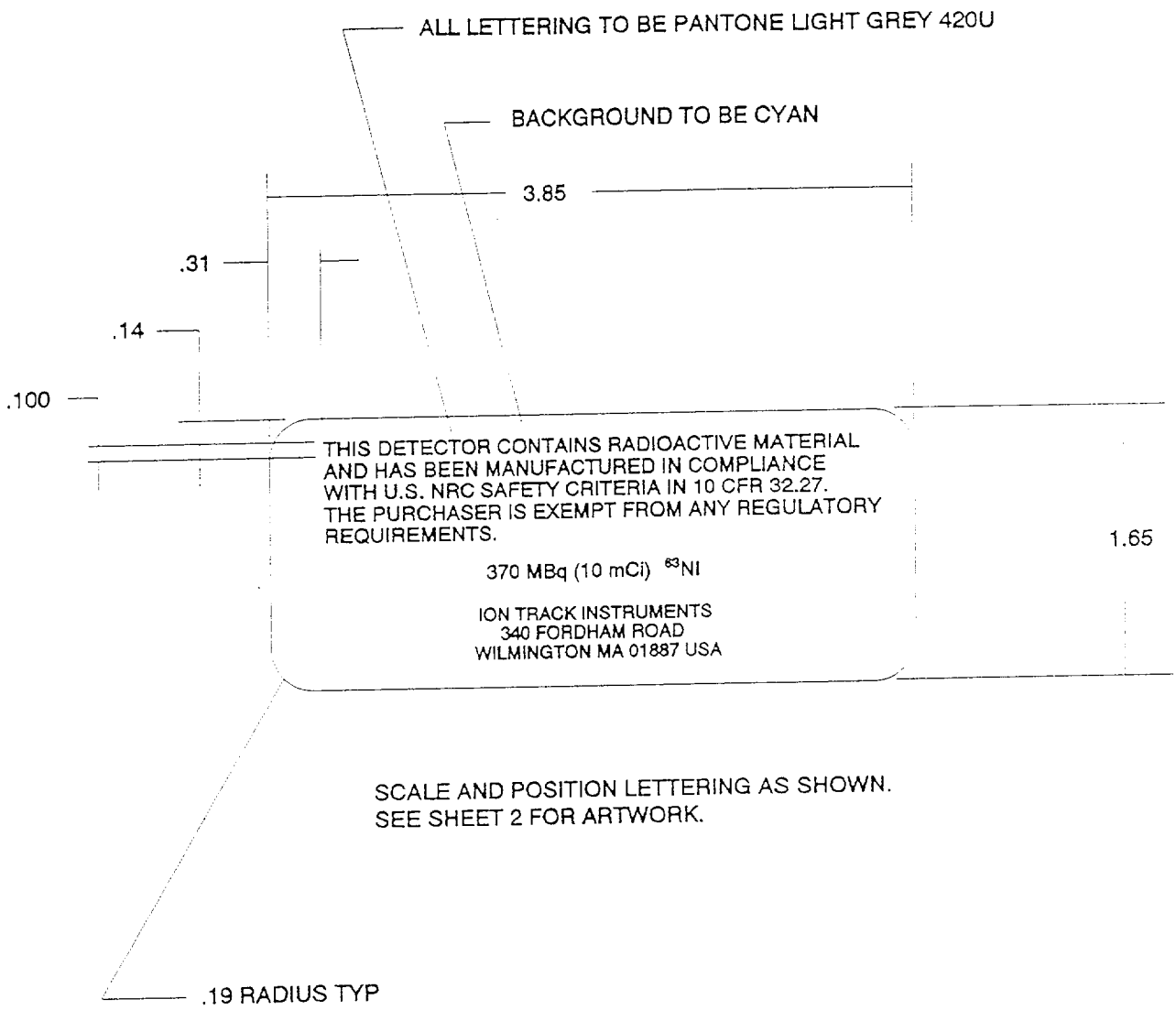
LEAKMETER 200 LICENSE APPLICATION NRC

HEATER CONTROL CIRCUIT

The heater circuit is controlled by P.R.T. (Platinum Resistance Thermometer) The operating temperature is 50°C. In the unlikely event that the controlling device (P.R.T.) either opens or short circuits the microprocessor will shut off power to the heater. In the event of heater breakdown (short) the system will power down. The maximum temperature the heater will achieve if not controlled (i.e. Thermal runaway) is between 140 -180°C.



CHG LTR	ECO NO	DRW	APD	REVISIONS	DATE

TOLERANCES UNLESS OTHERWISE NOTED
.XX ± .01
.XXX ± .005
ANGLES EXCEPT 90° 0° 30'

MATERIAL:
.005 THK VELVET
POLYCARBONATE
3M 468 ADHESIVE
FINISH:

DRW JDN | CHK
PROJ ENG J. NAPOLI | SUPV
REL NO | REL DATE

ASSY NO.	ASSY NAME	QTY
		1

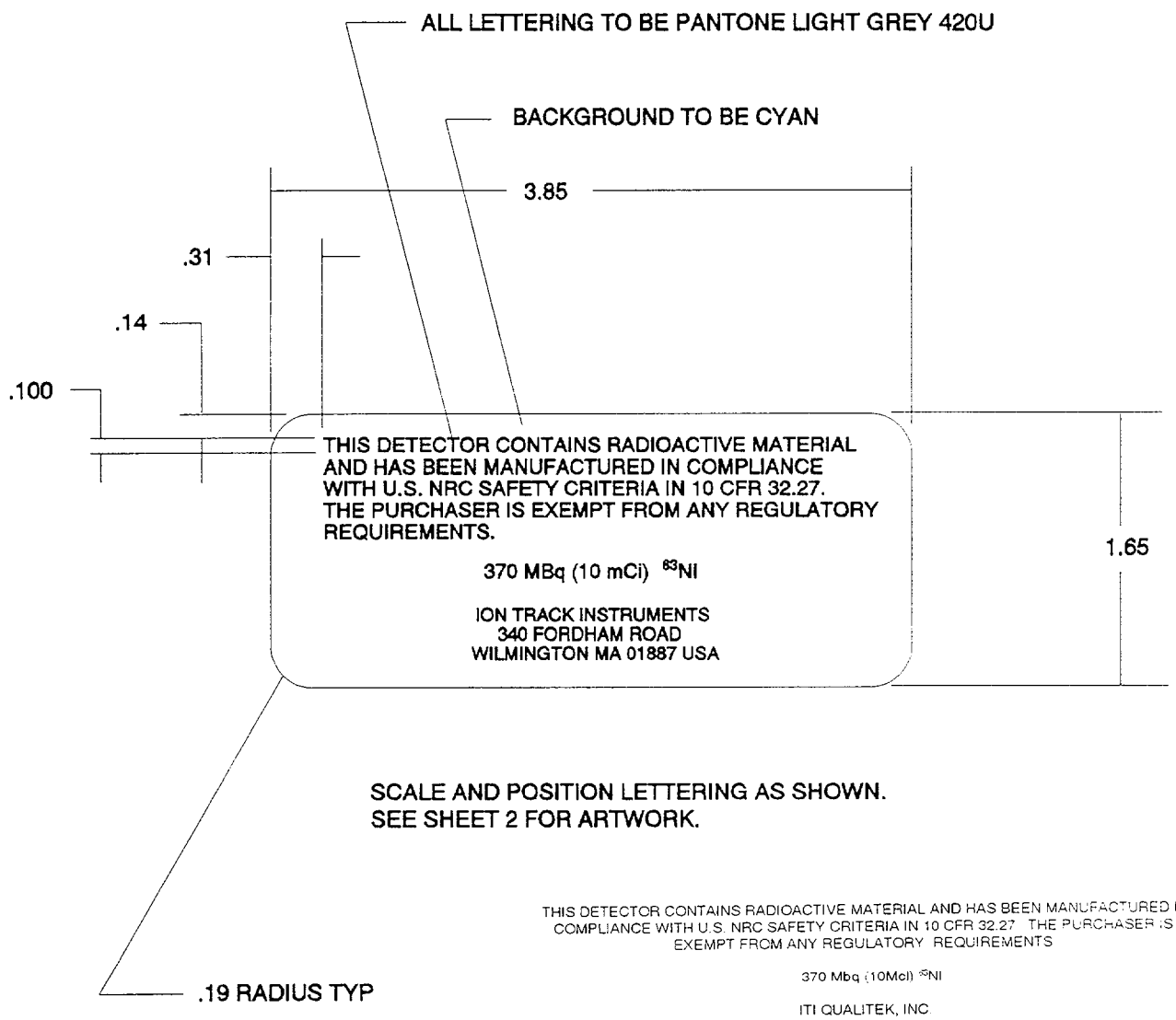
ION TRACK INSTRUMENTS
340 Fordham Road Wilmington, MA 01887

LABEL, RADIOACTIVE CAUTION, CASE, LEAKMETER 200

A DRAWING NO. ITI20025 SHT 1 OF 2 REV A

CONTRACT NO.

SCALE A



THIS DETECTOR CONTAINS RADIOACTIVE MATERIAL AND HAS BEEN MANUFACTURED IN COMPLIANCE WITH U.S. NRC SAFETY CRITERIA IN 10 CFR 32.27 THE PURCHASER IS EXEMPT FROM ANY REGULATORY REQUIREMENTS

370 Mbq (10Mci) ^{63}Ni

ITI QUALITEK, INC
267 BOSTON ROAD
N. BILLERICA, MA 01862 USA

NEW LABEL

CHG LTR	ECO NO	DRW	APD	REVISIONS	DATE

TOLERANCES UNLESS OTHERWISE NOTED
.XX ± .01
.XXX ± .005
ANGLES EXCEPT 90° 0° 30'

MATERIAL:
.005 THK VELVET POLYCARBONATE
3M 468 ADHESIVE
FINISH:

DRW	CHK
JDN	
PROJ ENG	SUPV
J. NAPOLI	
REL NO	REL DATE

ASSY NO.	ASSY NAME	QTY
		1

ION TRACK INSTRUMENTS
340 Fordham Road Wilmington, MA 01887

LABEL, RADIOACTIVE CAUTION, CASE, LEAKMETER 200

A	DRAWING NO. ITI20025	SHT 1 OF 2	REV
	CONTRACT NO.		SCALE A

June 20, 1995

United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Michele L. Burgess, Mechanical Engineer
Sealed Source Safety Section
Source Containment and Devices Branch
Division of Industrial and Medical Nuclear Safety
Office of Nuclear Material Safety and Safeguards

This letter is provided in response to your letter to Ion Track Instruments Inc. dated June 14, 1995. In your letter, you have requested additional information as well as updated information regarding the application for ITI's ITEMISER product. The following information should satisfy your query.

First, Ion Track Instruments, Inc. manufactures and distributes product based on mechanical and electrical documentation which is under strict engineering control.

Second, with regard to your observation of the tamperproof screws have been removed from the top plate of the ITMS head assembly, they are not required to prevent access to the source holder. Once the source is fit inside the holder and positioned inside the detector assembly it is sealed in by the nozzle mid-section assembly and is captured by the inside wall of the tamperproof box enclosure. removal of the top plate of the box exposes only the rear section of the sealed detector and the insulation surrounding it. **It is not possible to gain access to the source holder and therefore the source itself with ordinary tools or procedures from the top**. In addition, it is therefore not possible to gain access from the open rear of the box since the detector assembly is captured by the front of the box. **The only access to the detector assembly itself and therefore the source holder inside is through the removal of the tamperproff screws which hold the detector enclosure (box) together.**

Third, the exact placement of all labels is shown in drawing numbers MS001006, M0001104 and M0001111. There does seem to be some confusion with regard to labels. First, there are only three labels pertaining to the radionuclide source inside the detector. Two of these are positioned on the outside of the instrument and are position on the **rear panel** and on the **underside** of the instrument which may be exposed during servicing. These two drawings are M0001104 and M0001111 respectively. The third and final (Trefoil) label is not metal and is

mounted to the tamperproof box inside the instrument. The mechanical drawings and the specifications for the artwork are already in your possession. If you have an "old" metal label please disregard it since it has not been part of the instrument design package for more than one year. A sample of the "original metal trefoil label was probably sent with the original application submission nearly eighteen months ago and was before the release of production documentation was in effect.

Fourth, and finally, coming back full circle to the tamperproof design, we have at your request removed the tamperproof screws from the outside of the instrument package and this is indicated in drawing number MS001004 which is provided.

I hope that this clears up all of the remaining issues with regard to Ion Track Instruments lisence application. If you have any questions **please dont call me**!

Sincerely,

William J. McGann, Ph.D.
Vice President of R&D

MEGGITT CONTROLS

ION
TRACK
INSTRUMENTS
INC

340 Fordham Road
Wilmington
Massachusetts
01887
U.S.A.
telephone
[illegible]
fax
[illegible]

September 27, 1994

U.S. Nuclear Regulatory Commission
Mr. Doug Brodus
Mail Stop T 8F5
11545 Rockville, Pike
Rockville, MD 20852

Dear Mr. Brodus:

In response to comments regarding the deficiencies in our application to add the Model 200 to our exempt distribution license.

First, pursuant to Section 32.26 (b2) the model number (manufacturer's number) of the ^{63}Ni foil sources are as follows. DuPont NER-0004 (370 MBq). This is a standard ionization source supplied by DuPont. (See Appendix D for Mfg. Specifications and registry of radio active sealed source).

Second, with regard to changes of physical/chemical form under operational conditions over the useful lifetime of the instrument, we can confidently report none. This is supported by the facts that we operate the ionization sources well within the manufacturer's specifications (see above) and that we have supplied of 5000 detectors of similar type around the world without an incident. Some of these systems have been in continuous (24 hr/day) operation for more than 10- years.

Third, pertaining to the solubility of the by product material in water and in bodily fluids, the following information is provided. DuPont performed a study several years ago when applying to register ^{63}Ni foils with the NRC. This study showed that the Ni foils are extremely pure and stable (negligible solubility) in water and bodily fluids. Over prolonged use of the foils, a thin nickel oxide layer forms over the surface. This NiO_2 layer is also insoluble in water and in bodily fluids. It was concluded in this report that even if the by-product material was ingested directly (an extremely unlikely if not virtually impossible event in our application) that the material would pass through the body with no biological half-life.

Fourth, pertaining to 32.26 (b5), the details of the construction and design of the product as related to containment, shielding and safety under normal and severe conditions of use, handling, storage and disposal, we are providing details regarding the materials of construction of the insulation cover and mounting insulator which houses and supports the ionization chamber. First it should be stated that these materials are in no way necessary for shielding. Furthermore, as stated in Section

32.26 (b12) regarding prototype testing of the Model 200 where the ionization chamber has been drop tested on its own and thermally cycled independently, these support materials are not required for safety in terms of leakage of by-product material under severe conditions. However, they because of their presence do provide an added measure of safety and definitely restrict the access of the ionization chamber. We have provided the details of the material used in the construction of Appendix A.

Fifth, pursuant to Section 32.26 (b6), the maximum external radiation levels at 5cm and 25cm from the external surface of the a product cannot be measured above the normal levels of background radiation. Effectively the emissions are "Zero".

Sixth, Pursuant to Section 32.26 (b7), regarding the degree of access of human beings to the product during normal use. Access to the ionization chamber in the Model 200 is first and foremost guarded by a tamperproof design. The dosimetry implications to humans in the actual handling of the ionization chamber is negligible. The only humans with cause to ever handle the ionization chamber will be production personnel and in-house service engineers. Users of the Model 200 will at no time access to the external housing of the ionization chamber and therefore dosimetry implications are also negligible.

Seventh, the maximum total quantity of by-product material expected to be shipped on an annual basis is 50 Model 200 units which represents 5000 millicurie of by-product material.

Eighth, pursuant to 32.26 (b9), the expected useful life of the product will be five years. The useful lifetime is in no way determined by the physical or chemical composition of the product itself as evidenced by the fact that some of our previous Models are still in use around the world after fifteen years.

Ninth, pursuant to Section 32.36 (b10), regarding labelling the point of sale package for the Model 200, we submit a detailed drawing of the point of sale label which will be affixed to each shipping case (See Appendix B).

Pursuant to Section 32.26 (b11), regarding procedures for prototype testing. We are now having test performed by Amersham International to establish a classification to ISO2919, and international standard for sealed radio active sources. This was apparently modelled on USA standard USAI N 5.10.

The classification being sought is C32211, the suggested level for chromatographic detectors. The initial "C" is determined by the toxicity of the radioactive material. The standard of test implied by the numbers are given in table 1 attached (copied from the identical British Standard). The two sheets give details of the experimental methods used.

These results take about 8 weeks to get back to Ai and I have placed a priority on them. However, they are not included in this package and will be forwarded as Appendix C as soon as we receive them. However suffice to say we do not expect any wipe to show greater than to 50 picoCuries of activity.

Pursuant to Section 32.26 (b13) - part a: regarding external radiation doses we respond as follows: Given the physical and chemical stability of the source, the typical operating conditions of the product, the accessibility of the ionization chamber and the tamperproof design of the ionization chamber itself, the estimated cumulative external radiation doses to any individual associated with building . distributing or servicing the product on an annual basis will far less than 5 millrem to any part of the body. The cumulative dose will fall into the low microrem range and will in fact be far less cumulative dose on the general population due to natural background radiation.

Part b: Regarding the likelihood of a significant reduction in the effectiveness of the containment or shielding from wear and normal use/abuse. The probability of exposure of any individual to the by-product material contained in the Model 200 over time due to reduction of effectiveness or integrity of the product is extremely low. The ionization source is both physically and chemically very stable. The ionization chamber is constructed from stainless steel and is of more than sufficient material thickness to be comprised by greatest amount of abuse. It is also a tamperproof design. Warnings, indicating the presence of a radioactive material are etched into the assembly.

In addition to the design features, we also rely on our historical record of distributing products of a similar nature containing the same by-product material for over fifteen years without a single incident. Over this period of time, more than 5000 such systems have been distributed and many of these systems operate continuously every day. One particularly relevant example is that we have distributed over 500 systems having a similar source assembly to virtually every nuclear power plant in the USA. These systems have an excellent record for reliability and our companies record for service and maintenance of our products in the field is second to none.

Part c: Regarding disposal of a single exempt unit or in storage of many such units, there is no risk of failure of confinement of the source or the shielding. Again, due to the extreme physical and chemical stability of the source and the construction of the ionization chamber the dose to any part of the body will not even begin to approach 1 millirem (See Appendix E - DuPont data sheets for ^{63}Ni).

Finally, Pursuant to Section 32.26 (b15) we have enclosed a copy of the quality control procedures for handling ^{63}Ni sources in our manufacturing facility. Additionally, once the product units have been manufactured, the final units are wipe tested over all outside sufaces for any residual contamination before they are distributed or put into inventory. (Appendix F contains the source handling procedures).

Sincerely yours,

Anthony Hawes
Ai Cambridge Ltd, (UK)
Development Manager

William McGann
Ion Track Instruments, Inc. (USA)
Director of R&D

Enclosures:

1. Table 1. Classification of Sealed Source
2. 200 Leakmeter Mechanical Testing
3. Appendix A - Materials used in Construction
4. Drawings - 200041 - A200001-1 - A00003 - 200008 - 200010 - 200011- 200017 200018 - 200027 - 200035 - 200039 - 200040 - 200062 - 200067 - 200091 - 200092 200097 - 91780 - 99024
5. Appendix B - Drawing 99065 - A200200
6. Appendix C - Results of Prototype Testing
7. Appendix D - Manufacturing Specifications and Registry of Radioactive Seal
8. Appendix E - DuPont Data Sheet
9. Appendix F - Source Handling

MODEL 200

1

CLASSIFICATION OF A SEALED SOURCE

Table 1. Classification of sealed source performance standards

Test	Class						
	1	2	3	4	5	6	X
Temperature	No test	–40 °C (20 min) +80 °C (1 h)	–40 °C (20 min) +180 °C (1 h)	–40 °C (20 min) +400 °C (1 h) and thermal shock 400 °C to 20 °C	–40 °C (20 min) +600 °C (1 h) and thermal shock 600 °C to 20 °C	–40 °C (20 min) +800 °C (1 h) and thermal shock 800 °C to 20 °C	Special test
External pressure	No test	25 kPa absolute to atmospheric pressure	25 kPa absolute to 2 MPa absolute	25 kPa absolute to 7 MPa absolute	25 kPa absolute to 70 MPa absolute	25 kPa absolute to 170 MPa absolute	Special test
Impact	No test	50 g from 1 m	200 g from 1 m	2 kg from 1 m	5 kg from 1 m	20 kg from 1 m	Special test
Vibration	No test	30 min 25 Hz to 500 Hz at 5 g_n peak amplitude	30 min 25 Hz to 50 Hz at 5 g_n peak amplitude and 50 Hz to 90 Hz at 0.635 mm amplitude peak to peak and 90 Hz to 500 Hz at 10 g_n	90 min 25 Hz to 80 Hz at 1.5 mm amplitude peak to peak and 80 Hz to 2000 Hz at 20 g_n	—	—	Special test
Puncture	No test	1 g from 1 m	10 g from 1 m	50 g from 1 m	300 g from 1 m	1 kg from 1 m	Special test

in which the activity does exceed this value has to be considered individually. If the activity does not exceed the values shown in appendix B, appendix C may be used without further consideration of either radiotoxicity or solubility.

10.4 Quality control. A quality control programme is essential and shall be operated in both the design and the manufacture of sealed sources that are to be classified.

11. Procedure to establish classification and performance requirements

11.1 Establish radiotoxicity group from appendix A.

11.2 Determine amount of activity allowable from appendix B.

11.3 If the desired quantity does not exceed the allowable quantity of appendix B, make an evaluation of fire, explosion, and corrosion hazards. If no significant hazard exists, the sealed source's classification may be taken directly from appendix C. If a significant hazard exists, evaluate the factors listed in **10.2** with particular attention to the temperature and impact requirements.

11.4 If the desired quantity exceeds the allowable quantity of appendix B, make an evaluation of fire, explosion and corrosion hazards and a separate evaluation of the use and design of the sealed source.

11.5 After the required classification of the sealed source for the particular application or use has been established, obtain the performance standards directly from table 1.

11.6 Alternatively, determine the sealed source class from table 1 and select some suitable application from appendix C.

Since table 1 is arranged in order of increasing severity from class 1 through to class 6, sealed sources of an established classification may be used in any application having less severe specific performance requirements (classification numbers).

12. Testing procedures for table 1

12.1 General. The testing procedures given in this clause present acceptable procedures for determining performance classification numbers. All the criteria set are the minimum requirements. Procedures that can be demonstrated to be at least equivalent are also acceptable. All tests except the temperature tests shall be carried out at ambient temperature.

12.2 Temperature test*

12.2.1 *Equipment.* The heating or cooling equipment shall have a test zone volume of at least five times the volume of the test specimen. If a gas- or oil-fired furnace is used for the temperature test, an oxidizing atmosphere shall be maintained throughout the test.

12.2.2 *Procedure.* All tests shall be performed in air except that in the low temperature test an atmosphere of carbon dioxide is a permitted alternative; this alternative permits the use of 'dry ice' when a temperature lower than that required will be achieved.

All test sources shall be held at the maximum test temperature for a period of at least 1 h, and at the minimum test temperature for at least 20 min.

Sources to be subjected to temperatures below ambient shall be cooled to the test temperature in less than 45 min.

Sources to be subjected to temperatures above ambient shall be heated to the test temperature at least as rapidly as indicated by the following temperature-time table:

Temperature	Time
° C	min
ambient	0
80	5
180	10
400	25
600	40
800	70

For classes 4, 5 and 6 test sources shall also be subjected to a thermal shock test. Either a second test source or the source used in the temperature test may be used. If the latter is used, it shall be evaluated for passage of the temperature test before it is subjected to the thermal shock test.

For the thermal shock test, the source shall be heated to the maximum test temperature (required for that particular class) and held at that temperature for at least 15 min. The test source shall be transferred in 15 s or less to water at a maximum temperature of 20 °C. The water shall be flowing at a rate of at least ten times the source volume per minute, or, if the water is stationary, it shall have a volume of at least twenty times the source volume.

12.2.3 *Evaluation.* Test sources shall be examined visually and subjected to an appropriate leak test selected from appendix D.

12.3 External pressure test

12.3.1 *Equipment.* The pressure gauge shall have been recently calibrated and should have a pressure range at least 10 % greater than the test pressure. The vacuum gauge shall read to a pressure at least as low as 20 kPa absolute. Different test chambers may be used for the low and high pressure tests.

12.3.2 *Procedure.* Place the test source in the chamber and expose it to the test pressure for two periods of 5 min each. Return the pressure to atmospheric between each period. Conduct the low pressure test in air. Conduct the high pressure test in class 6 by a hydraulic method using water as the medium in contact with the source. Preferably conduct the high pressure test in classes 3, 4 and 5 by the same procedure; for fear of blocking small leaks, in no case having hydraulic oil as the medium in contact with the source†.

12.3.3 *Evaluation.* Test sources shall be examined visually and subjected to an appropriate leak test selected from appendix D.

*Part of this test for class 6 is similar in principle to the heating test given in IAEA Safety Series No. 6, 'Regulations for the safe transport of radioactive materials', 1973, paragraph 735.

†The source may be in water in a flexible bag sealed from the hydraulic oil in the test chamber.

12.4 Impact test*

12.4.1 *Equipment.* This comprises

(a) a steel hammer, the upper part of which is equipped with means of attachment and the lower part of which has a flat striking surface, 25 mm in diameter, with edge rounded to a radius of 3 mm. The centre of gravity of the hammer lies on the axis of the circle that defines the striking surface; this axis itself passes through the point of attachment. The mass of the hammer depends on the test class;

(b) a steel anvil, the mass of which is at least ten times that of the hammer. It is rigidly mounted so that it does not deflect during impact. It has a flat surface, large enough to take the whole of the source.

12.4.2 *Procedure.* Choose the mass of the hammer according to the class as specified in table 1. Adjust the drop height to 1 m measured between the top of the source positioned on the anvil and the base of the hammer in the release position. Position the source so that it offers its most vulnerable area to the hammer. Drop the hammer onto the source.

12.4.3 *Evaluation.* Test sources shall be examined visually and subjected to an appropriate leak test selected from appendix D.

12.5 Vibration test

12.5.1 *Equipment.* A vibrating machine capable of performing the tests specified is required.

12.5.2 *Procedure.* Fix the source securely to the platform of the vibrating machine so that at all times the source will be rigidly in contact with the platform.

For classes 2 and 3 subject the source to three complete test cycles for each condition specified. Conduct the test by sweeping through all the frequencies in the range at a uniform rate from the minimum frequency to the maximum frequency and return to the minimum frequency in 10 min or longer. Test each axis† of the source. In addition continue the test for 30 min at each resonance frequency found.

For class 4 subject the source to three complete test cycles for each condition specified. Conduct the test by sweeping through all the frequencies in the range at a uniform rate from the minimum frequency to the maximum frequency and return to the minimum frequency in 30 min or longer. Test each axis† of the source. In addition continue the test for 30 min at each resonance frequency found.

12.5.3 *Evaluation.* Test sources shall be examined visually and subjected to an appropriate leak test selected from appendix D.

12.6 Puncture test

12.6.1 *Equipment.* This comprises

(a) a hammer, the upper part of which is equipped with means of attachment and the lower part of which has a pin rigidly fixed to the hammer.

The characteristics of this pin are as follows:

(1) hardness from 50 Rockwell C to 60 Rockwell C;

(2) free height 6 mm;

(3) diameter 3 mm;

(4) lower surface hemispherical.

The centre line of the pin is in alignment with the centre of gravity and with the point of attachment of the hammer. The mass of the hammer and pin depends on the test class;

(b) a hardened steel anvil, rigidly mounted and with a mass at least ten times that of the hammer. The contact surface between the source and the anvil is large enough to prevent deformation of this surface when puncture takes place. If necessary, a cradle of suitable form may be interposed between the source and the anvil.

12.6.2 *Procedure.* Choose the mass of the hammer and pin according to the class as required in table 1. Adjust the drop height to 1 m measured between the top of the source positioned on the anvil and the point of the pin in the release position. Position the source so that it offers its most vulnerable area to the pin. Drop the hammer onto the source.

If the source has more than one vulnerable area, carry out the test on each of them.

If the dimensions and mass of the source concerned do not permit unguided fall, lead the striker to the puncture point in a smooth vertical tube.

12.6.3 *Evaluation.* The test sources shall be examined visually and subjected to an appropriate leak test selected from appendix D.

*It has been estimated that the class 3 impact test has an effect on the source similar to that produced by the percussion test given in IAEA Safety Series No. 6, 'Regulations for the safe transport of radioactive materials', 1973, paragraph 733.

†A maximum of three axes shall be used. A spherical source has one axis taken at random. A source with an oval or disc type cross section has two axes, one of revolution and one taken at random in a plane perpendicular to the axis of revolution. Other sources have three axes, taken parallel to the significant overall dimensions.

(a) The applicant satisfies the general requirements specified in § 30.33 of this chapter: *Provided, however,* That the requirements of § 30.33(a) (2) and (3) do not apply to an application for a license to transfer byproduct material in gas and aerosol detectors manufactured, processed or produced pursuant to a license issued by an Agreement State.

(b) The applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control procedures, labeling or marking, and conditions of handling, storage, use, and disposal of the gas and aerosol detector to demonstrate that the product will meet the safety criteria set forth in § 32.27. The information should include:

(1) A description of the product and its intended use or uses;

(2) The type and quantity of byproduct material in each unit;

(3) Chemical and physical form of the byproduct material in the product and changes in chemical and physical form that may occur during the useful life of the product;

(4) Solubility in water and body fluids of the forms of the byproduct material identified in paragraphs (b) (3) and (12) of this section;

(5) Details of construction and design of the product as related to containment and shielding of the byproduct material and other safety features under normal and severe conditions of handling, storage, use, and disposal of the product;

(6) Maximum external radiation levels at 5 and 25 centimeters from any external surface of the product, averaged over an area not to exceed 10 square centimeters, and the method of measurement;

(7) Degree of access of human beings to the product during normal handling and use;

(8) Total quantity of byproduct material expected to be distributed in the product annually;

(9) The expected useful life of the product;

(10) The proposed methods of labeling or marking the detector and its point—of—sale package to satisfy the requirements of § 32.29(b);

(11) Procedures for prototype testing of the product to demonstrate the effectiveness of the containment, shielding, and other safety features under both normal and severe conditions of handling, storage, use, and disposal of the product;

(12) Results of the prototype testing of the product, including any change in the form of the byproduct material contained in the product, the extent to which the byproduct material may be released to the environment, any increase in external radiation levels, and any other changes in safety features;

(13) The estimated external radiation doses and dose commitments relevant to the safety criteria in § 32.27 and the basis for such estimates;

(14) A determination that the probabilities with respect to the doses referred to in § 32.27(c) meet the criteria of that paragraph;

(15) Quality control procedures to be followed in the fabrication of production lots of the product and the quality control standards the product will be required to meet; and

(16) Any additional information, including experimental studies and tests, required by the Commission.

§ 32.27 Same: safety criteria.

An applicant for a license under § 32.26 shall demonstrate that the product is designed and will be manufactured so that:

(a) In normal use and disposal of a single exempt unit, and in normal handling and storage of the quantities of exempt units likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, it is unlikely that the external radiation dose in any one year, or the dose commitment resulting from the intake of radioactive material in any one year, to a suitable sample of the group of individuals expected to be most highly exposed to radiation or radioactive material from the product will exceed the dose to the appropriate organ as specified in Column I of the table in § 32.28.

(b) It is unlikely that there will be a significant reduction in the effectiveness of the containment, shielding, or other safety features of the product from wear and abuse likely to occur in normal handling and use of the product during its useful life.

(c) In use and disposal of a single exempt unit and in handling and storage of the quantities of exempt units likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, the probability is low that the containment, shielding, or other safety features of the product would fail under such circumstances that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column II of the table in § 32.28, and the probability is negligible that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column III of the table in § 32.28.[1]

§ 32.28 Same: table of organ doses.

Part of body	Column I (rem)	Column II (rem)	Column III (rem)
Whole body; head and trunk; active blood-forming organs, gonads, or lens of eye	0.005	0.5	15
Hands and forearms, feet and ankles, localized areas of skin averaged over areas no larger than 1 square centimeter	0.075	7.5	200
Other organs	0.015	1.5	50

§ 32.29 Conditions of licenses issued under § 32.26: quality control, labeling, and reports of transfer.

Each person licensed under § 32.26 shall:

(a) Carry out adequate control procedures in the manufacture of the product to assure that each production lot meets the quality control standards approved by the Commission;

(b) Label or mark each detector and its point-of-sale package so that:

(1) Each detector has a durable, legible, readily visible label or marking on the external surface of the detector containing:

(i) The following statement: "CONTAINS RADIOACTIVE MATERIAL";

(ii) The name of the radionuclide and quantity of activity; and

(iii) An identification of the person licensed under § 32.26 to transfer the detector for use pursuant to § 30.20 of this chapter or equivalent regulations of an Agreement State.

(2) The labeling or marking specified in paragraph (b)(1) of this section is located where its will be readily visible when the detector is removed from its mounting.

[1] It is the intent of this paragraph that as the magnitude of the potential dose increases above that permitted under normal conditions, the probability that any individual will receive such a dose must decrease. The probabilities have been expressed in general terms to emphasize the approximate nature of the estimates which are to be made. The following values may be used as guides in estimating compliance with the criteria:

Low—not more than one such failure per year for each 10,000 exempt units distributed.

Negligible—not more than one such failure per year for each one million exempt units distributed.

to which the byproduct material may be released to the environment, any increase in external radiation levels, and any other changes in safety features.

(xiii) The estimated external radiation doses and dose commitments relevant to the safety criteria in § 32.23 and the basis for such estimates.

(xiv) A determination that the probabilities with respect to the doses referred to in § 32.23(d) meet the criteria of that paragraph.

(xv) Quality control procedures to be followed in the fabrication of production lots of the product and the quality control standards the product will be required to meet.

(xvi) Any additional information, including experimental studies and tests, required by the Commission.

(b) Notwithstanding the provisions of paragraph (a) of this section, the Commission may deny an application for a specific license under this section if the end uses of the product cannot be reasonably foreseen.

34 FR 9025

§ 32.23 Same: safety criteria.

An applicant for a license under § 32.22 shall demonstrate that the product is designed and will be manufactured so that:

(a) In normal use and disposal of a single exempt unit, it is unlikely that the external radiation dose in any one year, or the dose commitment resulting from the intake of radioactive material in any one year, to a suitable sample of the group of individuals expected to be most highly exposed to radiation or radioactive material from the product will exceed the dose to the appropriate organ as specified in Column I of the table in § 32.24 of this part.

(b) In normal handling and storage of the quantities of exempt units likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, it is unlikely that the external radiation dose in any one year, or the dose commitment resulting from the intake of radioactive material in any one year, to a suitable sample of the group of individuals expected to be most highly exposed to radiation or radioactive material from the product will exceed the dose to the appropriate organ as specified in Column II of the table in § 32.24.

(c) It is unlikely that there will be a significant reduction in the effectiveness of the containment, shielding, or other safety features of the product from wear and abuse likely to occur in normal handling and use of the product during its useful life.

34 FR 9025

(d)[1] In use and disposal of a single exempt unit, or in handling and storage of the quantities of exempt units likely to accumulate in one location during marketing, distribution, installation, and servicing of the product, the probability is low that the containment, shielding, or other safety features of the product would fail under such circumstances that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column III of the table in § 32.24, and the probability is negligible that a person would receive an external radiation dose or dose commitment in excess of the dose to the appropriate organ as specified in Column IV of the table in § 32.24.

34 FR 9329

§ 32.24 Same: table of organ doses.

Part of body	Column I (rem)	Column II (rem)	Column III (rem)	Column IV (rem)
Whole body; head and trunk; active blood-forming organs; gonads; or lens of eye	0.001	0.01	0.5	15
Hands and forearms; feet and ankles; localized areas of skin averaged over areas no larger than 1 square centimeter	0.015	0.15	7.5	200
Other organs	0.003	0.03	1.5	50

43 FR 6915

§ 32.25 Conditions of licenses issued under § 32.22: quality control, labeling, and reports of transfer.

Each person licensed under § 32.22 shall:

(a) Carry out adequate control procedures in the manufacture of the product to assure that each production lot meets the quality control standards approved by the Commission;

(b) Label or mark each unit so that the manufacturer, processor, producer, or initial transferor of the product and the byproduct material in the product can be identified; and

[1] It is the intent of this paragraph that as the magnitude of the potential dose increases above that permitted under normal conditions, the probability that any individual will receive such a dose must decrease. The probabilities have been expressed in general terms to emphasize the approximate nature of the estimates which are to be made. The following values may be used as guides in estimating compliance with the criteria:

Low—not more than one such failure per year for each 10,000 exempt units distributed.

Negligible—not more than one such failure per year for each 1 million exempt units distributed.

48 FR 12331

(c) Maintain records and file reports with the Director of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, with copies to the appropriate NRC Regional Office listed in Appendix D of Part 20 of this chapter.

(1) The report must include the following information on products transferred to other persons for use under § 30.19 of this chapter or equivalent regulations of an Agreement State—

(i) A description or identification of the type of each product;

(ii) For each radionuclide in each type of product, the total quantity of the radionuclide; and

(iii) The number of units of each type of product transferred during the reporting period.

(2) The licensee shall file the report within 30 days following—

(i) Five years after filing the preceding report; or

(ii) Filing an application for renewal of the license under § 30.37; or

(iii) Notifying the Commission under § 30.34(f) of the licensee's decision to permanently discontinue activities authorized under the license issued under § 32.22.

(3) The report must cover the period between the filing of the preceding report and the occurrences specified in paragraphs (c)(2)(i), (ii), or (iii) of this section. If no transfers of byproduct material have been made under 32.22 during the reporting period, the report must so indicate.

(4) The licensee shall maintain the record of a transfer for a period of one year after the event is included in a report to the Commission.

43 FR 6915

§ 32.26 Gas and aerosol detectors containing byproduct material: requirements for license to manufacture, process, produce, or initially transfer.

An application for a specific license to manufacture, process, or produce gas and aerosol detectors containing byproduct material and designed to protect life or property from fires and airborne hazards, or to initially transfer such products for use pursuant to § 30.20 of this chapter or equivalent regulations of an Agreement State, will be approved if:

MODEL 200

2

MODEL 200 MECHANCIAL TESTING

27/10/93
G. Brooks

200 Leakmeter Mechanical Testing

1. Object

The purpose of these tests is to provide some confidence in the robustness and reliability of the 200 hand gun in an industrial enviroment and subjected to some mistreatment. The tests are not intended to be exhaustive nor test the Leakmeter as a whole. The complete unit may be subjected to more extensive testing at a later date by an outside test house which these initial tests should indicate the hand unit has a higher chance of passing.

2. BS 2011 Enviromental Testing

The tests will be based upon BS 2011 Part 2.1 Ed Free Fall. This procedure is intended to reproduce the effects of repetitive shocks likely to be received in service by remote control units that are normally attached to cables during use. Procedure 2 - Free Fall - Repeated will be used.

3. Desciption Of The Test

The test consists of subjecting the specimen to a prescibed number of falls from a specified height onto a hard surface. The effect of the test is checked in relation to the changes, if any, in the mechanical and electrical parameters of the specimen.

4. Test Conditions

4.1 Test Surface - The test surface will be a smooth steel plate.

4.2 Height of fall - The height shall be measured from the part of the specimen nearest to the test surface prior to release.

4.3 Method of release - The releasing method shall allow free fall from the point of suspension with minimum disturbance at the moment of release.

5. Severities

The specimen will be drop from a number of increasing heights. These will be :
25mm, 100mm, 500mm, 1000mm.

6. Initial Measurements

The specimen shall be visually examined and mechanically and electrically checked prior to the test falls commencing. The tests carried out shall be:

i) Visually inspect the unit internally and externally noting any faults.

ii) Perform a functional test and note the units response to 2 known leaks.

iii) Test and inspect the hand unit L.E.D displays and keypad.

iv) Measure and note the

a) Argon flow
b) Sample flow
c) Total pump flow
d) Block temperature
e) Background frequency

7. Test Falls

The unit shall be dropped 6 times from each height once onto each of its 6 main faces.

8. Subsequent Measurements

After each fall the unit will be visually inspected externally and any faults noted. After each group of 6 falls the following measurements will be carried out:

i) Perform a functional test and note the units response to 2 known leaks.

ii) Test and inspect the hand unit L.E.D displays and keypad.

iii) Measure and note the

a) Argon flow
b) Sample flow
c) Total pump flow
d) Block temperature
e) Background frequency

iv) Visually inspect the unit internally and externally noting any faults.

200 Leakmeter mechanical tests and results

1 Hand unit drop tests

1.1 Test method and conditions
The test method and conditions are detailed by Graham Brooks in a separate document.
Additional information relevant to the test procedures etc. are as follows :

Tests were conducted on prototype instrument PR4 with 2200 hours of accumulated running.The build was as per standard production except that the connector terminating the umbilical cable to the ECD amp board was 32 way Harwin type.
Duration of the test was 2 hours approx
Visual examination and flow checks after each stage of the test were conducted with the unit still powered.

1.2 Test results
These are shown on the following page

1.3 Conclusions and recommendations
The instrument sustained little damage or performance degredation following the 25,100 and 500mm drops.
Although the 1 metre drops proved more damaging,it does not appear to present a safety hazard in that the detector body remains intact;details of the damage sustained are as follows:
- a small piece of the moulding where the two halves butt together broke off
- paint was chipped from off the moulding at 3 corners exposing the base material
- the probe snapped at the point where it enters the nozzle
- the pump sustained damage such that sample flow was reduced and became erratic
- as a result of the flow changes the instrument measurement performance was degraded to an unacceptable level.

After replacing the pump, the flows were restored to normal and the instrument continued to perform to an acceptable standard.An examination of the failed pump did not reveal any obvious reason for it having failed;the pump body,rotor and vanes all looked normal.
As a result of the above tests we can have some confidence that the hand gun can withstand some abuse during use without degrading it's performance and without becoming a safety hazard.The probe appears to be a weak component but is an easily replaceable item. However,the 1 metre drops did result in performance degredation but this was restored to normal after replacing the pump.
The test results highlight the need for a protective cover to cope with severe environments.
It is proposed that the tests are repeated when the protective cover becomes available.If the pump still sustains damage with the protective cover fitted then further measures will need to be considered.

Hand unit drop test results

	Initial performance	after 6 drops from 25mms	after 6 drops from 100mms	after 6 drops from 500mms	after 6 drops from 1000mms
external visual		probe tip flattened	probe tip flattened	end of probe tip snapped off	probe snapped off at nozzle moulding damaged
internal visual		no change	no change	no change	no change
response 1x10-5ml/s SF6	8.0x10-6	7.8x10-6	8.5x10-6	8.2x10-6	1.6x10-5
response 1x10-4ml/s SF6	9.7x10-5	9.0x10-5	1.0x10-4	8.6x10-5	overrange >1x10-4
leds/display	ok	ok	ok	ok	ok
hand gun switches	ok	ok	ok	ok	ok
argon flow	45ml/s	45ml/s	45ml/s	45ml/s	45ml/s
sample flow	95ml/s	105ml/s	105ml/s	110ml/s	70ml/s
pump flow	620ml/s	650ml/s	650ml/s	650ml/s	500ml/s
det temp	49.9 C	49.9 C	49.9 C	49.9 C	49.9 C
f b/gnd	5.2KHz	5.4KHz	5.6KHz	5.7KHz	5.9KHz

Notes

1.Flows were measured using Honeywell AWM3100 (argon and sample flow) and AWM3300 (total pump flow) flow sensors with 10.00 volts excitation

2.The leak rate measurements were made on standard SF6 leaks at 1x10-4 and 1x10-5 ml/sec from Test Dept ;an initial calibration to 1.0x10-4 ml/sec SF6 was done at the start of the test

3.Replacement probe fitted after 1 metre drops

2 Console unit drop tests

2.1 Test method and conditions
The test method and conditions are detailed by Graham Brooks in a separate document
Additional information relevant to the test procedures etc. are as follows :
Tests were conducted on prototype instrument PR5 with approx 2700 hours of accumulated running.The build was as per standard production except that some foam was stuck to the base moulding at the points where the electronics enclosure touches the base;this was done to simulate as closely as possible the situation with the revised moulding where there is a gap at this point.
Duration of the test was 2 hours approx
Visual examination and flow checks after each set of drops were conducted with the unit still powered.
The hand gun sustained some damage following the drops from 500mms;it was thought prudent to conduct the 1 metre drops on the console with the hand gun removed from it's cradle.

2.2 Test results
These are shown on the following page

2.3 Conclusions and recommendations
The instrument sustained little damage or performance degredation following the 25 mm drops.
After the 100mm drops, gaps were beginning to appear at the 2 front corners of the case to the extent that the case lid could not be closed down on to the base.
The hand gun broke out of it's cradle position after each of the 500mm drops resulting in the probe snapping off and the nozzle being dislodged off it's threads.Further damage to the front of the case occured with one of the corner mouldings being broken and the sealing gasket lifting ;no internal parts were damaged.After the drops the broken probe was replaced and the nozzle refitted in order to continue with the test.
The 1 metre drops were conducted with the hand gun removed from the it's cradle because it was felt that this simulated the real-life situation where the console was pulled off a bench on to the floor by pulling on the cable.More extesive damage occurred to the case;the two corner pieces at the front of the case broke away,the case had become distorted with 2 of the rivets holding the moulding in to the case being pulled and 1 rivet being snapped.Both case locks shattered and 1 broke away from the case and the case sealing gasket fell away from it's seat.Internally,the rear Velcro strap retaining the gas bottle in position had pulled out;the base moulding was cracked at one of the regulator plate fixing points and one of the fixing holes in the regulator plate itself had been broken out.The regulator had created a bulge in the case base,this being hard up against the inner surface.
In spite of the degree of damage to the case,the instrument still appeared to be fully functional and did not present any safety hazard as a result of the tests;all controls and indicators were fully functional,detector flows,temperature and background frequency were normal and performance had not been degraded.
As a result of the above tests we can have some confidence that the console can withstand some abuse during use without degrading instrument performance and becoming a safety hazard; the case appears to be strong enough to absorb much of the damage and would be an easy item to replace.

Console drop test results

	Initial performance	after 4 drops from 25mms	after 4 drops from 100mms	after 4 drops from 500mms	after 4 drops from 1000mms
console external visual		no change	gaps appear at 2 corners of case	gaps in case increase, corner moulding broken	case corner pieces break,rivets fail,locks shatter,case bent
console internal visual		no change	no change	no change	gas bottle retaining strap fails,base moulding and regulator plate damaged
hand gun visual		no change	paint chipped one corner	gun dislodged from case,probe snapped off,nozzle dislodged	removed from console
response 1x10-5ml/s SF6	10.0x10-6	9.8x10-6	1.0x10-5	9.3x10-6	9.6x10-6
response 1x10-6ml/s SF6	1.3x10-6	1.0x10-6	1.3x10-6	9.9x10-7	1.2x10-6
leds/display	ok	ok	ok	ok	ok
switches	ok	ok	ok	ok	ok
argon flow	45ml/s	45ml/s	45ml/s	45ml/s	45ml/s
sample flow	115ml/s	110ml/s	105ml/s	105ml/s	105ml/s
pump flow	600ml/s	600ml/s	600ml/s	600ml/s	600ml/s
det temp	49.9 C	49.7 C	49.7 C	49.9 C	49.9 C
f b/gnd	2.9KHz	2.75KHz	2.9KHz	2.8KHz	2.9KHz

Notes

1.Flows were measured using Honeywell AWM3100 (argon and sample flow) and AWM3300 (total pump flow) flow sensors with 10.00 volts excitation.

2.The leak rate measurements were made on standard SF6 leaks at 1x10-5 and 1x10-6 ml/sec from Test Dept ;an initial calibration to 1.0x10-5 ml/sec SF6 was done at the start of the test

3.Replacement probe fitted after the 500mm drops

3 Cable pull tests

This test was conducted to check that the console could be pulled along a floor by the hand gun without degrading the instrument performance.

3.1 Test method and conditions
This test was conducted on PR5 after the console drop tests.The test consisted of making an initial set of performance measurementsThe console is then placed on the floor and pulled by the hand gun for approx 100 metres along the floor;various obstacles in the path are struck by the case as the pull proceeds.Unfortunately,no means of measuring the pull force was available so this could not be measured.After the pull,the performance measurements are repeated.
3.2 Test results
No degradation of functionality and performance results from the pull test.There was no apparent damage to the cable at the cable retainers at either end. using the hand gun to test method and conditions are detailed in a separate document.
3.3 Conclusions
The cable and cable restraining components are adequate for their intended function.

4 Case topple tests

These tests cannot be conducted until the foam infill becomes available.

T Baines
Dated 03-November-1993

200 LEAKMETER

Access to Ionisation Chamber Detector Tool 200041

The drawing attached 200041 shows the special tool required to gain access to the Ni63 source (8/044) contained in the E.C. Detector Housing 200008. Only 1 has been made and it is not supplied to customers. It is used only by qualified personnel in the assembly of the E.C. Detector 200003 at A.i. Cambridge Ltd.

APPENDIX A

Materials used in the Construction

200003 E.C. Detector Assembly
Used on 200001

Part No.	Description	Unit	Quantity
120173	RESISTANCE THERMOMETER ASSY	EACH	1
2/671	O RING 2.9 ID X 1.78 BS006	EACH	1
200008	VACUUM BRAZING ASSY	EACH	1
200018	ELECTRODE PIN ASSY	EACH	1
200027	DETECTOR HOUSING	EACH	1
200039	ELECTODE CLAMP CONNECTOR	EACH	1
200040	INSULATOR	EACH	1
200067	SMB MODIFIED BODY	EACH	1
200097	SINTER ASSY	EACH	1
200105	DETECTOR HEATER	EACH	1
5/179	0.1" HOUSING 3WAY	EACH	1
5/344	CRIMP TERMINAL 2.5MM MOLEX	EACH	1
6/035	TYWRAP MAX DIA 44MM	EACH	1
7/3414	POLARISING KEY 0.1" MOLEX	EACH	1
7/652	SILOCOSET 152 RTV SEALANT	EACH	AS REQD
8/044	RADIOACTIVE SOURCE NI63	EACH	1

200001 Hand Gun Assembly

Part No.	Description	Unit	Quantity
120034	ARGON RESTRICTOR ASSY	EACH	1
120159	CLEANED CLIPPARD PIPE (7/628)	METERS	AS REQD
120201	RESTRICTOR BLOCK	EACH	1
2/078	O RING 4.4 ID X 1.78 BS008	EACH	1
200003	E.C. DETECTOR ASSY	EACH	1
200010	L.H. MOULDING	EACH	1
200011	R.H. MOULDING	EACH	1
200016	SWITCH PANEL (HAND UNIT)	EACH	1
200019	HAND UNIT LABEL SET	EACH	1
200029	RUBBER BEZEL	EACH	1
200036	SECURING RING	EACH	1
200032	LED MOUNTING PLATE	EACH	1
200033	NOSE CONE	EACH	1
200034	CABLE CLAMP	EACH	1
200092	SINTER PROBE	EACH	1

200096	SINTER BRACKET			
200101	HAND UNIT PCB	EACH		1
200103	UMBILICAL CABLE ASSY	EACH		1
3/920	WIRE 7/0.2 BLACK	METERS	AS REQD	
3/922	WIRE 7/0.2 RED	METERS	AS REQD	
5/129	TUBE SILICONE RUBBER 4.7 OD 2.5 ID	METERS	AS REQD	
5/179	0.1" HOUSING 3WAY	EACH		2
5/344	CRIMP TERMINAL 2.5MM MOLEX	EACH		2
7/1046	O RING 37.8 ID X 1.78 BS029	EACH		2
7/1228	BARB	EACH		4
7/1238	PRESS ON HOSE CLAMP (5000-4)	EACH		5
7/3476	PUMP	EACH		1
7/3414	POLARISING KEY 0.1" MOLEX	EACH		1
91780	ECD LABEL	EACH		1
99024	RADIOACTIVE LABEL 1 X 370 MBq	EACH		1

200 Leakmeter Hand gun

Critical Component Material List

To be read in conjunction with assembly drawings A/ 200003, A/200001/1 & A/200001/2

Part Number	Description	Material
200008,	E.C Detector Brazing	Stainless Steel 303S21 BS970 (Body & Gas pipes, 3 off)
8/044	Radioactive Source	Ni 63 Foil Dupont NER-0004 (370 MBq)
200018,	Electrode Pin Assy	Stainless Steel 303S21 BS970 (Body) & 48% Nickel Iron Wire (Pin) Glass Bead Seal
200040,	Insulator	Polytetrafluorethylene (PTFE)
200039,	Electrode Clamp Connector	Stainless Steel 303S21 BS970
200067,	SMB Modified Body	SMB Coaxial Connector Brass body & centre pin PTFE Insulation
200027,	Dectector Housing	Nylon 6.6
200097,	Sinter Assy	Stainless Steel 303S21 BS970 (Sinter Body) AISI 316 Wire Mesh (Sinters)
200010,	Gun LH Moulding	ME 600 Rigid Polyurethane
200011,	Gun RH Moulding	ME 600 Rigid Polyurethane

MEGGITT CONTROLS

ION TRACK INSTRUMENTS

340 Fordham Road
Wilmington
Massachusetts
01887
USA
telephone
(508) 658-3767
fax
(508) 657-5954

TO: Mr. Tom Rich - NRC

FR: Mr. David Morris - Ion Track Instruments, Inc.

DATE: June 13, 1995

Further to our telephone conversation of yesterday, I have pleasure in forwarding the information requested.

A. The Heater Control Circuit Statement

B. The point of Sales Package Label under Exhibit B.

Please let me know if you require any additional information. I thank you for your assistance and attention to our application.

Sincerely yours,

David Morris
President

MEGGITT CONTROLS

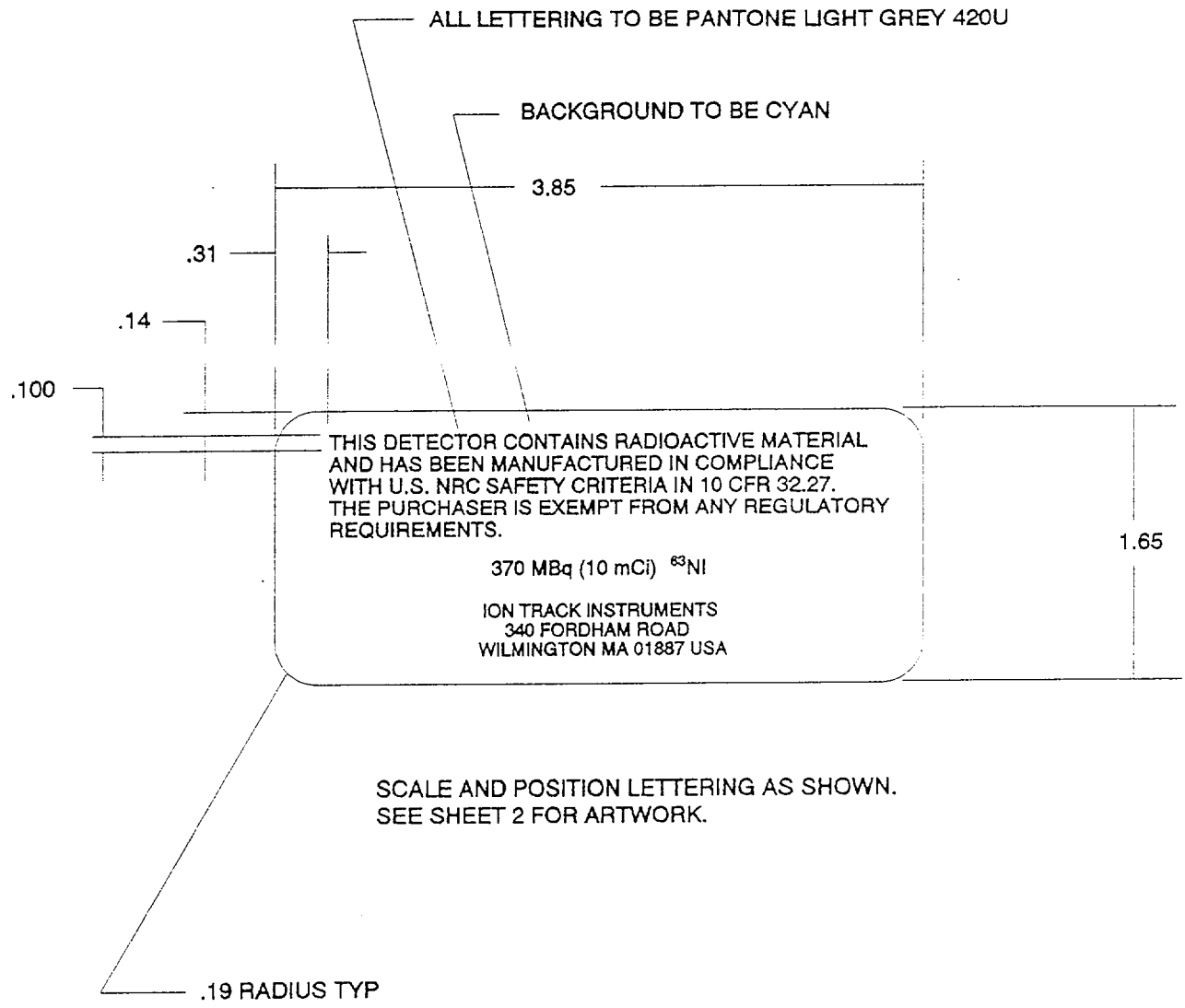
ION
TRACK
INSTRUMENTS
INC

340 Fordham Road
Wilmington
Massachusetts
01887
USA
telephone
(508) 658-3767
fax
(508) 657-5954

LEAKMETER 200 LICENSE APPLICATION NRC

HEATER CONTROL CIRCUIT

The heater circuit is controlled by P.R.T. (Platinum Resistance Thermometer) The operating temperature is 50°C. In the unlikely event that the controlling device (P.R.T.) either opens or short circuits the microprocessor will shut off power to the heater. In the event of heater breakdown (short) the system will power down. The maximum temperature the heater will achieve if not controlled (i.e. Thermal runaway) is between 140 -180°C.



CHG LTR	ECO NO	DRW	APD	REVISIONS	DATE

TOLERANCES UNLESS OTHERWISE NOTED
.XX ± .01
.XXX ± .005
ANGLES EXCEPT 90° 0° 30'

MATERIAL:
.005 THK VELVET POLYCARBONATE
3M 468 ADHESIVE
FINISH:

DRW	CHK
JDN	
PROJ ENG	SUPV
J. NAPOLI	
REL NO	REL DATE

ASSY NO.	ASSY NAME	QTY
		1

ION TRACK INSTRUMENTS
340 Fordham Road Wilmington, MA 01887

LABEL, RADIOACTIVE CAUTION, CASE, LEAKMETER 200

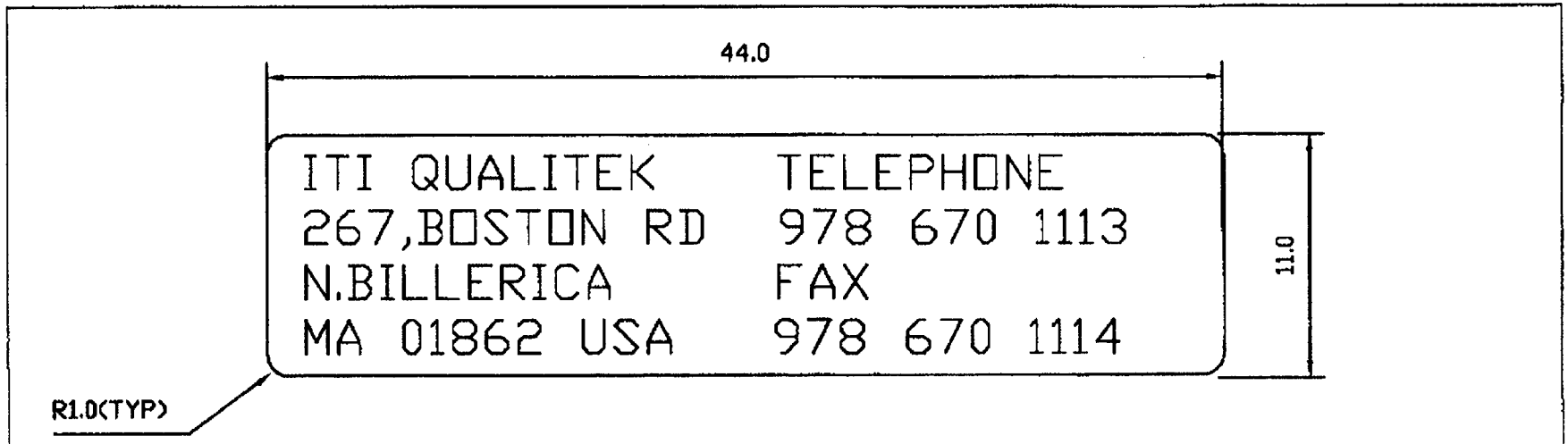
A	DRAWING NO. ITI20025	SHT 1 OF 2	REV
	CONTRACT NO.		SCALE A

200 LEAKMETER

External Labeling

APPENDIX B

The address label 99065 is attached to all instruments supplied in the U.S.A. as displayed on the drawing 200200 and shown in the view "Detail of rear labeling"



FINISH.
SCREEN ON REAR FACE BLACK BACKGROUND. TEXT 1.5 HIGH
MATERIAL.
0.010"THICK VELVET POLYCARB.(0.25THK)
468 ADHESIVE ON REAR FACE.

ISSUE	3	4										
CH.No.	REDRAWN	TELEPHONE & FAX No PREFIX 0223										
DATE	22.11.96	21.06.99										

CONFORMS TO BS308	DIMS. IN mm	DO NOT SCALE PRINT	REMOVE ALL BURRS & SHARP EDGES	TOLERANCES UNLESS OTHERWISE STATED WHOLE NUMBERS ±0.4 1 DECIMAL PLACE= ±0.2 2 DECIMAL PLACES= ±0.1 SCREW THREADS MED. FIT ANGLES ±30'
CHKD. –	SCALE 4:1	MATL. SEE DRG		
DRN. DB	DATE 22.11.96	FINISH SEE DRG		TITLE ITI ADDRESS LABEL

AiCambridge Ltd
LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4EF.
TEL: (0223) 834420 FAX: (0223) 835060

DRG.No. 99065

A4

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

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A/200200, REV. 6:

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WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

A/200200, REV. 6

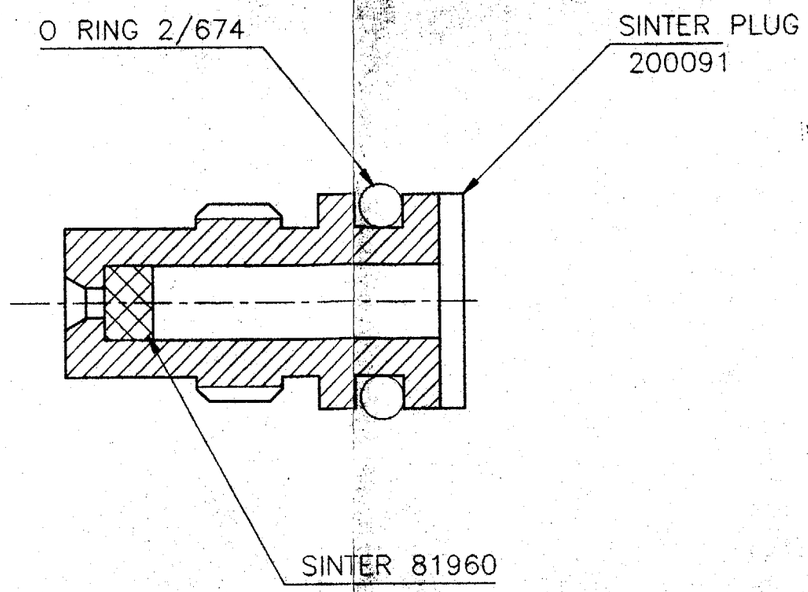
NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: 200091, REV. 2: SINTER PLUG

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER: 200091, REV. 2

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

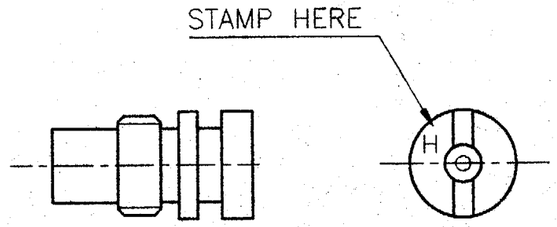


NOTES

1. THE SINTERS ARE TO BE SET TO THE FLOW RATE SHOWN BELOW USING JIG NO. AJ 2816 AT 10 PSI. GAS TO BE AIR.

FLOW	STAMPED	APPLICATION
5.5–6.0 mL/MIN	H	MEASURING LEAK RATE

2. FIT O RING 2/674 AS SHOWN



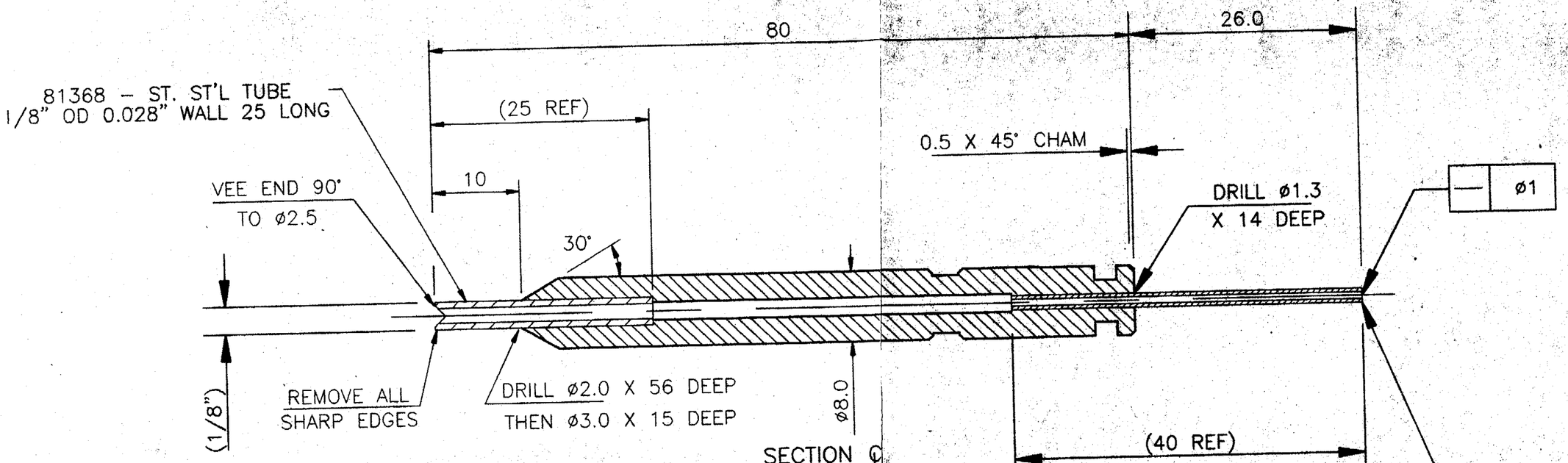
ISSUE	A	1	2								
CH.No.	–	–	1425								
DATE	8/9/94	8/9/94	18/4/96								

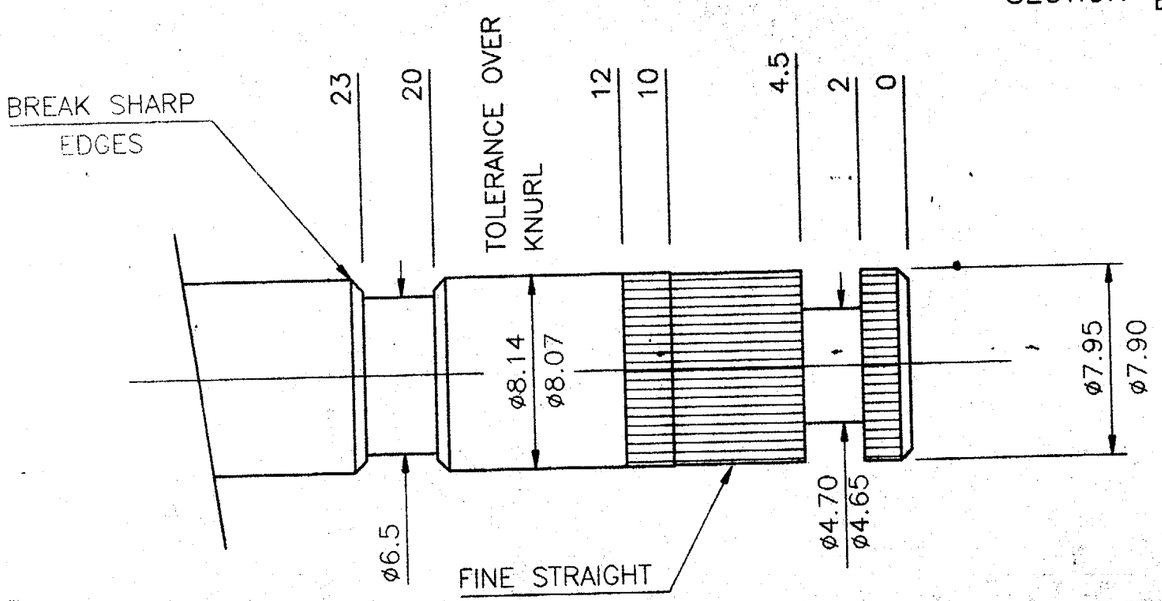
CONFORMS TO BS308	DIMS. IN mm	DO NOT SCALE PRINT	REMOVE ALL BURRS & SHARP EDGES	TOLERANCES UNLESS OTHERWISE STATED WHOLE NUMBERS ±0.4 1 DECIMAL PLACE= ±0.2 2 DECIMAL PLACES= ±0.1 SCREW THREADS MED. FIT ANGLES ±30'
CHKD. DB	SCALE 4:1 & 2:1	MATL. –		
DRN. G.J.B	DATE 8/9/94	FINISH –		TITLE SINTER ASSY H

AlCambridge Ltd
LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4EF.
TEL: (0223) 834420 FAX: (0223) 835050

DRG.No. 200097

A3





ENLARGED VIEW · 4:1

NOTES:

1. PRESS STEEL TUBES INTO HOUSING TO DISTANCE SHOWN.
2. ENSURE BURRS ARE CLEANED FROM BORE AFTER INSERTING TUBES.
3. 81087 TUBE TO BE STRAIGHT AS SHOWN ABOVE

ISSUE	A	1	2									WAS 200092
CH.No.	–	–	1369									
DATE	18/8/94	28/8/94	6/1/95									

CONFORMS TO BS308 | DIMS. IN mm | DO NOT SCALE PRINT | REMOVE ALL BURRS & SHARP EDGES

TOLERANCES UNLESS OTHERWISE STATED
WHOLE NUMBERS ±0.4
1 DECIMAL PLACE= ±0.2
2 DECIMAL PLACES= ±0.1
SCREW THREADS MED. FIT
ANGLES ±30'

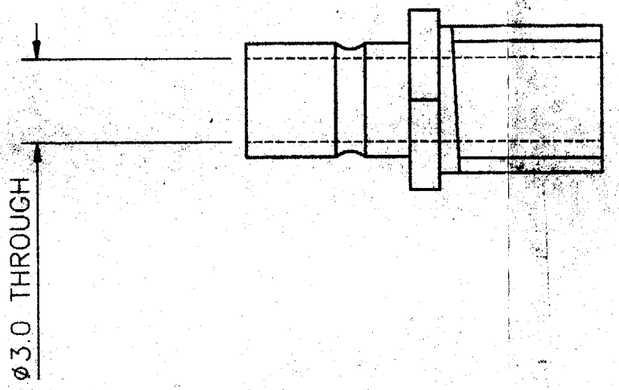
CHKD. –/PC | SCALE 2:1 & 4:1 | MATL. BLACK NYLON 6 / ST. ST'L

DRN. GJB | DATE 18/8/94 | FINISH CLEAN

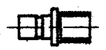
TITLE SINTER PROBE

AlCambridge Ltd
LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4EF.
TEL: (0223) 834420 FAX. (0223) 835050

DRG.No. 200092 | A3



NOTES:
1. REMOVE CENTRE PIN & INSULATOR
2.DRILL ø3.0 HOLE THROUGH



ACTUAL SIZE

MATERIAL:SMB COAX. CONNECTOR GE 65218(Al CAMBRIDGE No.7/1615)

ISSUE	A		1	2								
CH.No.	–		–	1376								
DATE	27/8/93		8/7/94	23/2/95								

CONFORMS TO BS308 | DIMS. IN mm | DO NOT SCALE PRINT | REMOVE ALL BURRS & SHARP EDGES

TOLERANCES UNLESS OTHERWISE STATED
WHOLE NUMBERS ±0.4
1 DECIMAL PLACE= ±0.2
2 DECIMAL PLACES= ±0.1
SCREW THREADS MED. FIT
ANGLES ±30'

CHKD. | SCALE 5 : 1 | MATL SEE NOTE

DRN R.RAND | DATE 28/8/93 | FINISH CLEAN

TITLE: SMB MODIFIED BODY

AlCambridge Ltd
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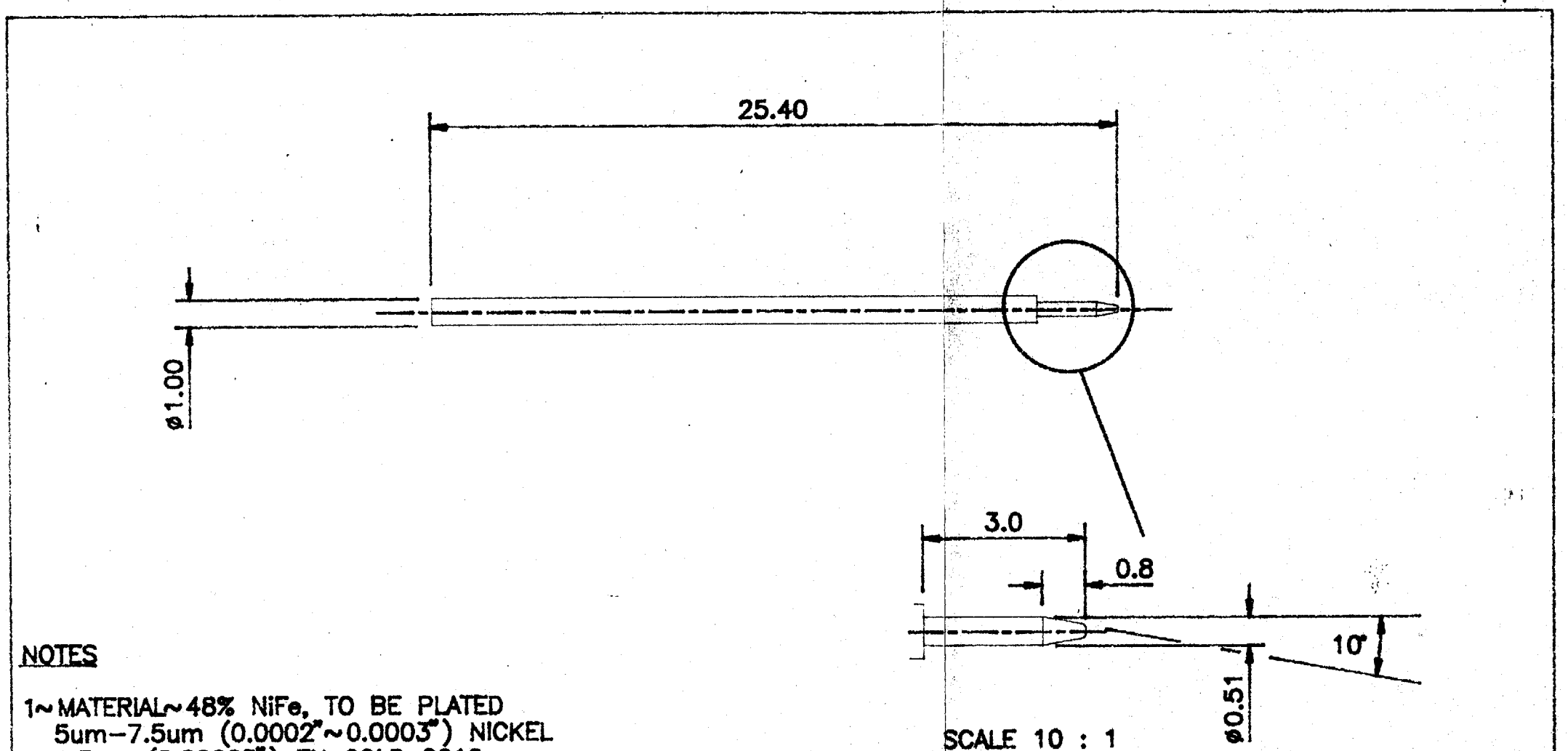
TEL. (0223) 834420 FAX: (0223) 835050

DRG.No. 200067



SCALE 10 : 1

NOTES

1~MATERIAL~48% NiFe, TO BE PLATED
5um–7.5um (0.0002"~0.0003") NICKEL
1.3um (0.00005") EN GOLD 2010.

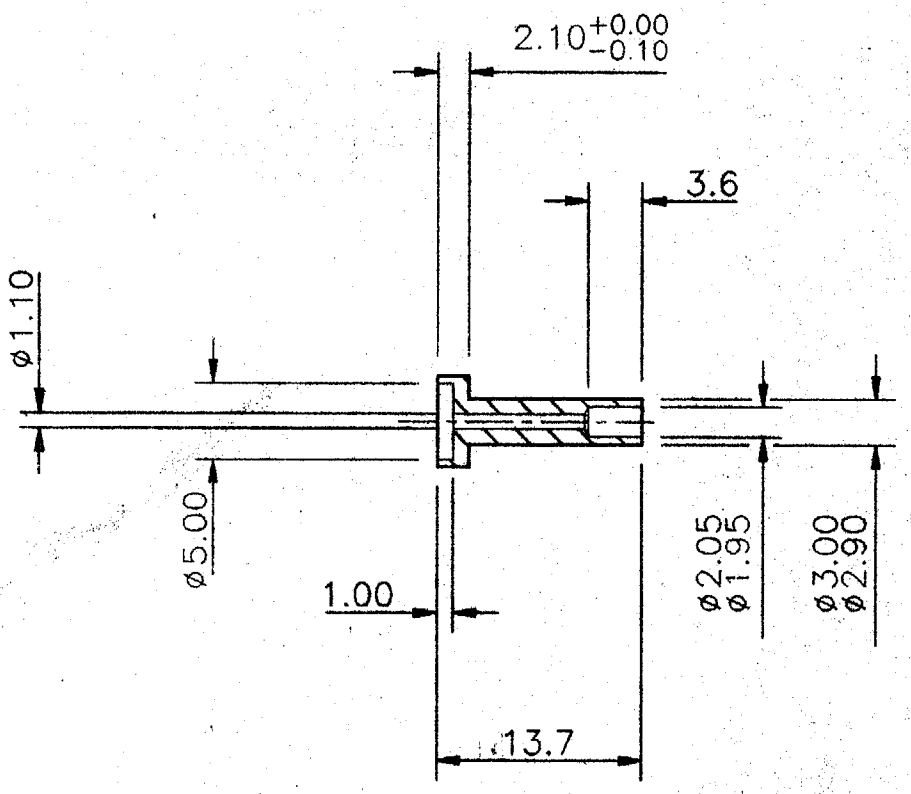
ISSUE	A	1										
CH.No.	–	–										
DATE	28\04\93	6/7/94										

CONFORMS TO BS308	DIMS. IN mm	DO NOT SCALE PRINT	REMOVE ALL BURRS & SHARP EDGES
CHKD. M Bristow	SCALE 5 : 1	MTRL. SEE NOTES	TOLERANCES UNLESS OTHERWISE STATED: WHOLE NUMBERS ±0.4; 1 DECIMAL PLACE ±0.2; 2 DECIMAL PLACES ±0.1; SCREW THREADS MED. FIT; ANGLES ±30'
DRN. Reinclair	DATE 20\4\93	FINISH CLEAN AND DE-BURR	TITLE ELECTRODE PIN

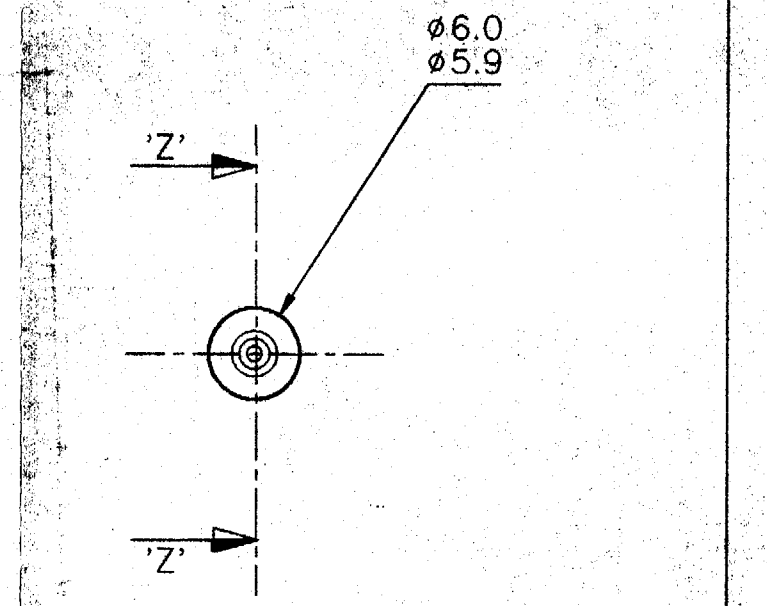
AlCambridge Ltd — LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4EF. TEL: (01223) 834430 FAX: (01223) 835050

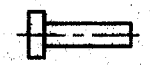
DRWG. No. 200062

A4



SECTION 'Z'~'Z'





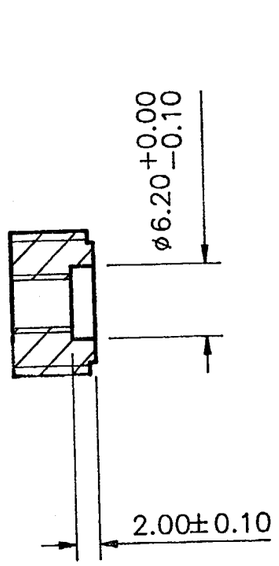
ACTUAL SIZE

ISSUE	A	B	1	2									
CH.No.	-	-	-	1376									
DATE	8/12/92	24\8\93	8/7/94	23/2/95									

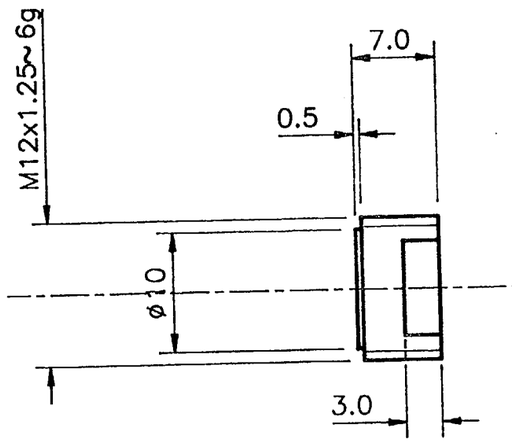
CONFORMS TO BS308	DIMS. IN mm	DO NOT SCALE PRINT	REMOVE ALL BURRS & SHARP EDGES
CHKD.	SCALE 2 : 1	MATL. P.T.F.E.	TOLERANCES UNLESS OTHERWISE STATED WHOLE NUMBERS ±0.4 1 DECIMAL PLACE= ±0.2 2 DECIMAL PLACES= ±0.1 SCREW THREADS MED. FIT ANGLES ±30'
DRN. R.RAND	DATE 24\8\93	FINISH CLEAN & DE-BURR	TITLE INSULATOR

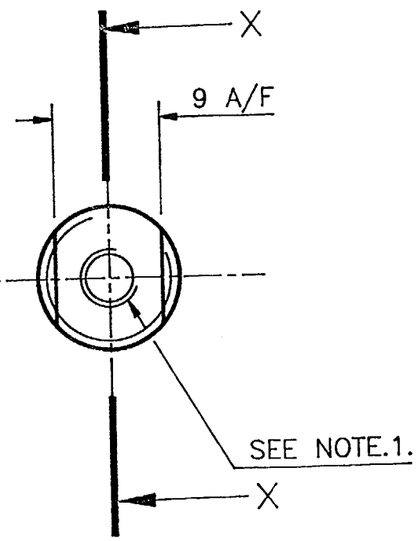
AlCambridge Ltd — LONDON ROAD, PAMPISFORD, CAMBRIDGE — TEL: (0223) 834420 — FAX: (0223) [illegible]

CUST. REF. — M — DRG.No. 200040



SECTION X–X





NOTES

1~1off HOLE~DRILL THEN TAP 10–32 UNF THREAD FORM THRO'.

ISSUE	A	B	C	1
CH.No.	-	-	-	-
DATE	7\12\92	20/04/93	24/08/93	8-7-94

CONFORMS TO BS308 | DIMS. IN mm | DO NOT SCALE PRINT | REMOVE ALL BURRS & SHARP EDGES

CHKD. G.J.G | SCALE 2 : 1 | MATL. STAINLESS STEEL 303 S21

DRN. R.RAND | DATE 7\12\92 | FINISH CLEAN & DE–BURR

TOLERANCES UNLESS OTHERWISE STATED
WHOLE NUMBERS ±0.4
1 DECIMAL PLACE= ±0.2
2 DECIMAL PLACES= ±0.1
SCREW THREADS MED. FIT
ANGLES ±30°

TITLE: ELECTRODE CLAMP CONNECTOR

AICambridge Ltd
LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4EF.
TEL: (0223) 834420 FAX: (0223) 835050

M

DRG.No. 200039

A4

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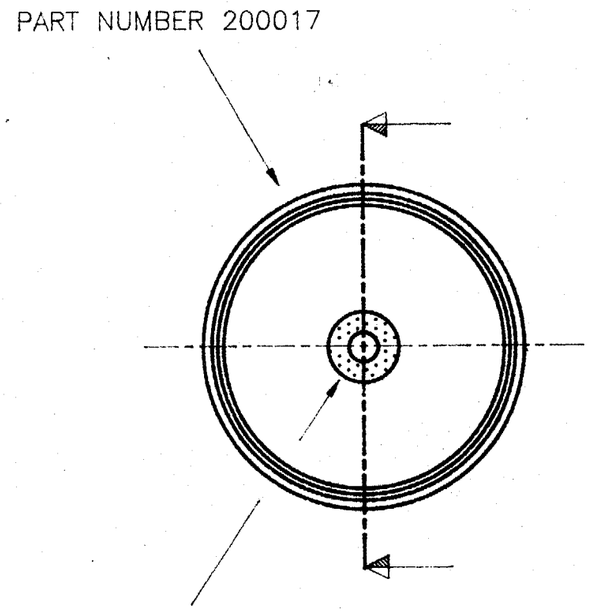
200035, REV. 2:

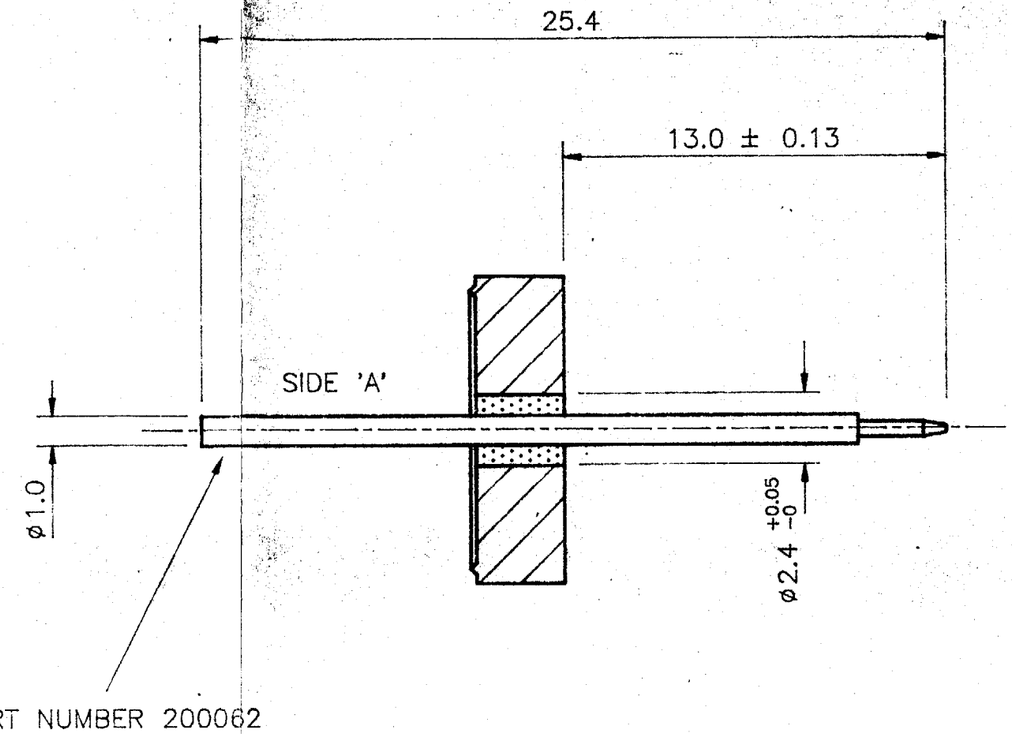
E.C. DETECTOR

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

200035, REV. 2

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.





NOTES:

1. GLASS TO BE FLUSH TO SUB-FLUSH BOTH SIDES.
2. FINISH
   FERRULE – CLEAN
   PIN – TO BE PLATED AS PER DRAWING 200062
   [5uM – 7.5uM (0.0002" – 0.0003") NICKEL
   1.3uM (0.00005") EN GOLD 2010]
3. NO WIRE MARKS PERMISSABLE ON SIDE 'A'

TESTS:

1. INSULATION RESISTANCE – 1000M OHMS @ 500 VDC
2. ELECTRICAL – FLASH 1KV DC MAX
3. BAKE TEST – @ 200°C FOR 2 HRS AFTER GOLD PLATE.

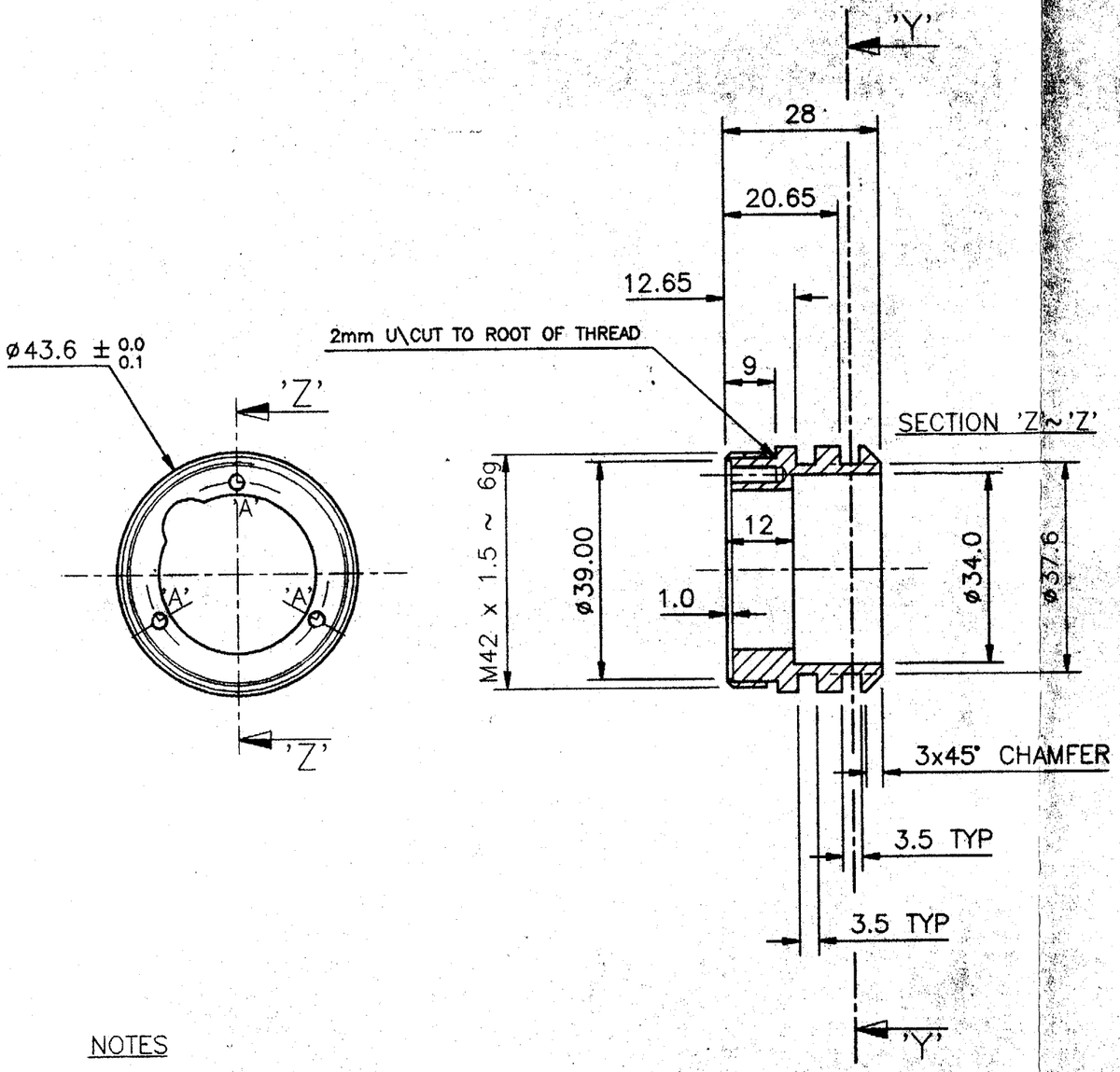
ISSUE	A	B	C	1								SK200051
CH.No.	–	–	–	–								
DATE	10\9\92	20\04\93	26/10/93	13/7/94								

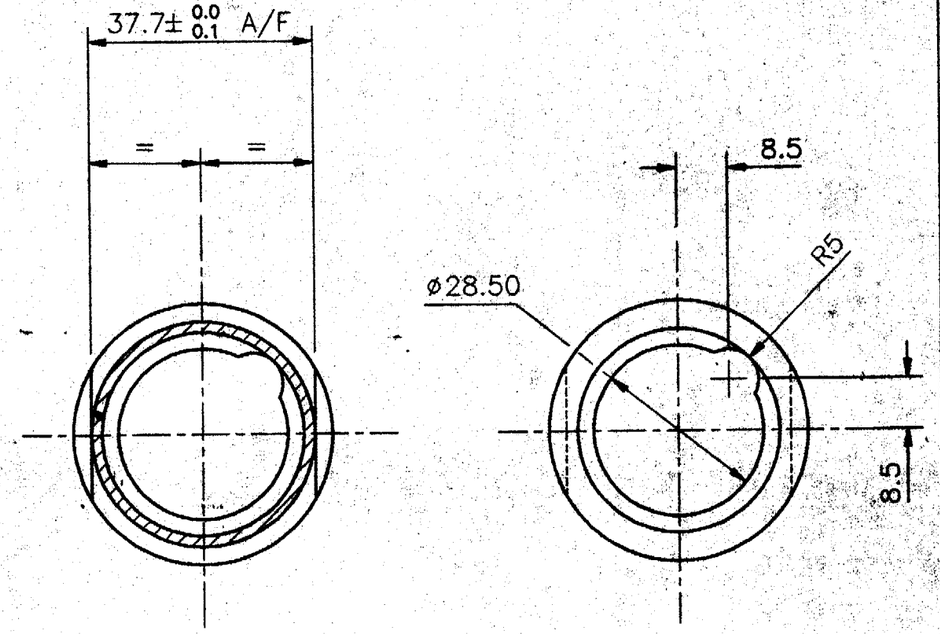
CONFORMS TO BS308	DIMS. IN mm	DO NOT SCALE PRINT	REMOVE ALL BURRS & SHARP EDGES	TOLERANCES UNLESS OTHERWISE STATED WHOLE NUMBERS ±0.4 1 DECIMAL PLACE= ±0.2 2 DECIMAL PLACES= ±0.1 SCREW THREADS MED. FIT ANGLES ±30'
CHKD.	SCALE 5 : 1	MATL. SEE DRG.		
DRN. R.S.	DATE 30\7\92	FINISH SEE NOTES.		TITLE ELECTRODE PIN ASSEMBLY.

AICambridge Ltd
LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4EF.
TEL: (0223) 834420 FAX: (0223) 835050

DRG.No. 200018

A3





NOTES

'A'~HOLES~3off DRILL ø2.5 x 11 DEEP,
THEN TAP M3 x 0.5 ~ 6H x 9 FULL THREAD,
EQUALLY SPACED ON 33 PCD.

USE RING GAUGE 0935
M42 X 1.5 AVAILABLE FROM AI CAMBRIDGE

ISSUE	A	B	C	D	1	2					SK200943
CH.No.	-	-	-	-	-	1398					
DATE	30\9\93	5\7\93	17\9\93	4/23/94	8/7/94	18/8/95					

CONFORMS TO BS308

DIMS. IN mm. DO NOT SCALE PRINT. REMOVE ALL BURRS & SHARP EDGES

TOLERANCES UNLESS OTHERWISE STATED
WHOLE NUMBERS ±0.4
1 DECIMAL PLACE= ±0.2
2 DECIMAL PLACES= ±0.1
SCREW THREADS MED. FIT
ANGLES ±30'

DRN. SCALE 1:1

MATL. NYLON 66 (BLACK)

DES. DATE 7\92

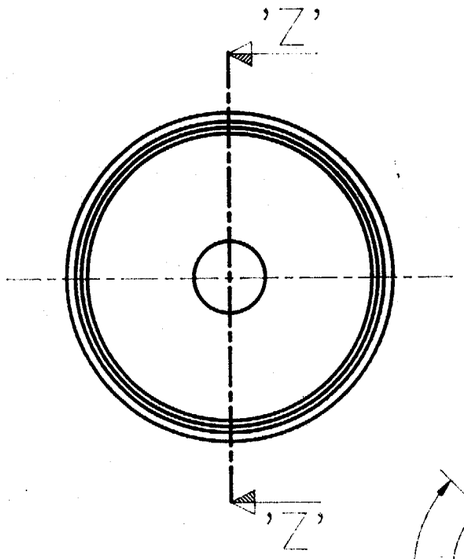
FINISH CLEAN & DE-BURR

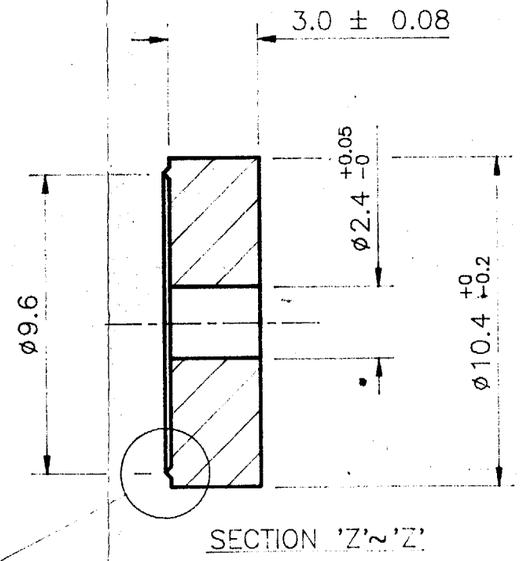
TITLE DETECTOR HOUSING

DRG.No. 200027

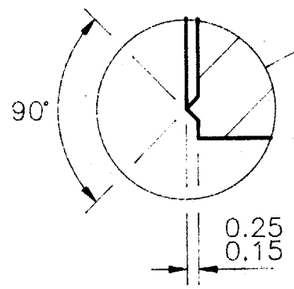
AICambridge Ltd LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4ET.
TEL: (0223) 834428 FAX: (0223) 835950

A3





SECTION 'Z'~'Z'



ISSUE	A	1			SK200064
CH.No.	–	–			
DATE	10\9\92	9/2/94			

CONFORMS TO BS308	DIMS. IN mm | DO NOT SCALE PRINT	REMOVE ALL BURRS & SHARP EDGES	TOLERANCES UNLESS OTHERWISE STATED WHOLE NUMBERS ±0.4 1 DECIMAL PLACE= ±0.2 2 DECIMAL PLACES= ±0.1 SCREW THREADS MED. FIT ANGLES ±30'
CHKD.	SCALE 5 : 1	MATL. STAINLESS STEEL 303 S21. BS 970	
DRN. R.S.	DATE 30/7/92	FINISH CLEAN	TITLE FERRULE

AlCambridge Ltd
LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4EF.
TEL: (0223) 834420 FAX: (0223) 835050

DRG.No. 200017

A4

NOTES

1~ CARE MUST BE TAKEN TO PROTECT THE INTERNAL BORES AND THREADS.

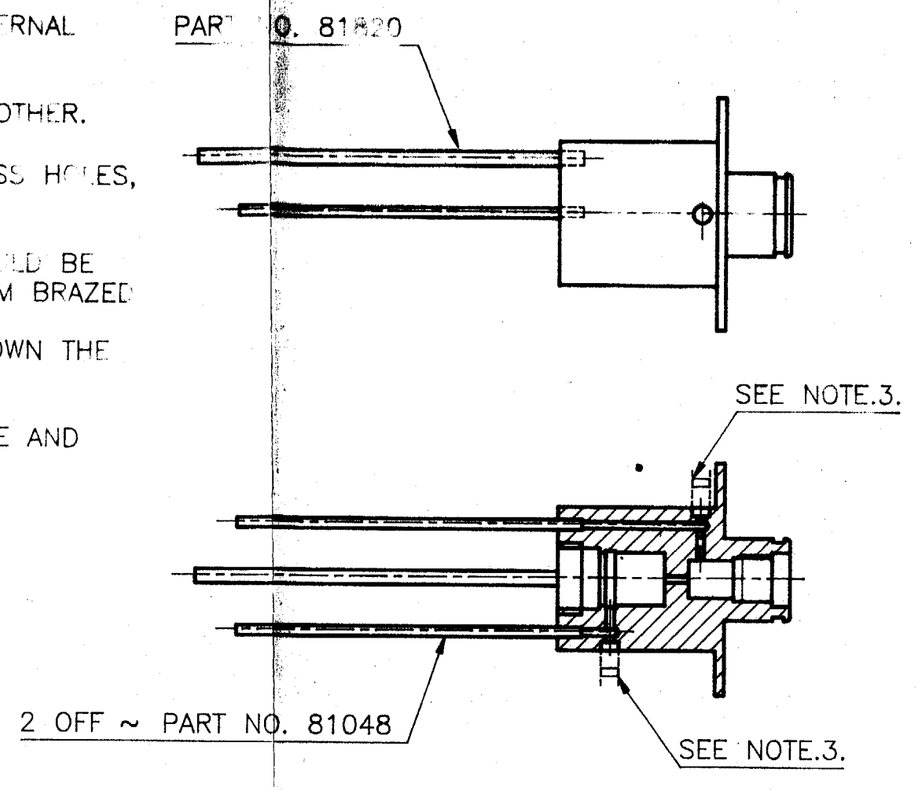
2~ THE PIPES SHOULD BE PARALLEL TO EACH OTHER.

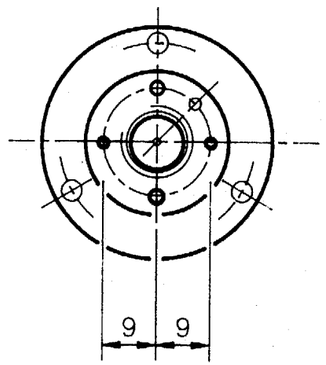
3~ 2off~ BLANKING BILLETS TO BLANK OFF CROSS HOLES, PART NUMBER 200061.

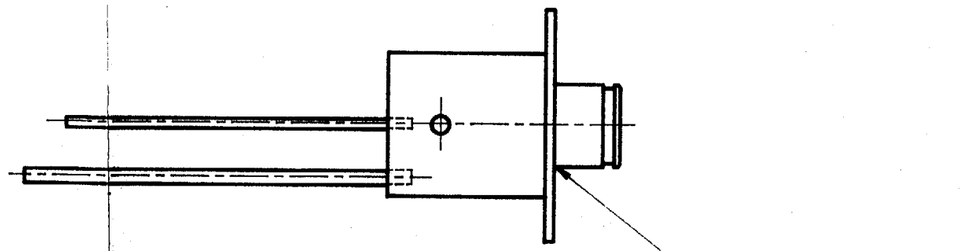
4~ THE PIPES AND THE BLANKING BILLETS SHOULD BE FITTED INTO THEIR HOLES, AND THEN VACUUM BRAZED.

5~ NO BRAZE SHOULD BE ALLOWED TO RUN DOWN THE HOLES CAUSING THEM TO BLOCK.

6~ ALL COMPONENTS MUST BE CLEANED BEFORE AND AFTER BRAZING.







ISSUE	'A'	B	1									
CH.No.	-	-										
DATE	17\11\92	14/3/94	8-7-94									

CONFORMS TO BS308	DIMS. IN mm	DO NOT SCALE PRINT	REMOVE ALL BURRS & SHARP EDGES	TOLERANCES UNLESS OTHERWISE STATED WHOLE NUMBERS ±0.4 1 DECIMAL PLACE= ±0.2 2 DECIMAL PLACES= ±0.1 SCREW THREADS MED. FIT ANGLES ±30'
CHKD.	SCALE 1 : 1	MATL. STAINLESS STEEL		
DRN. R SINCLAIR	DATE 17\11\92	FINISH CLEAN & DE-BURR		TITLE VACUUM BRAZING ASSEMBLY DETAIL

AlCambridge Ltd
LONDON ROAD, PAMPISFORD, CAMBRIDGE, CB2 4EF.
TEL: (0223) 834420 FAX: (0223) 835050

M DRG.No. 200008

A3

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

200011, REV. 4:

R.H. MOULDING

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

200011, REV. 4

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

200010, REV. 3:

L.H. MOULDING

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

200010, REV. 3

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

A/200003, REV. 2:
E.C.DETECTOR

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

A/200003, REV. 2

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

200041, REV. 2:
DETECTOR TOOL

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

200041, REV. 2

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

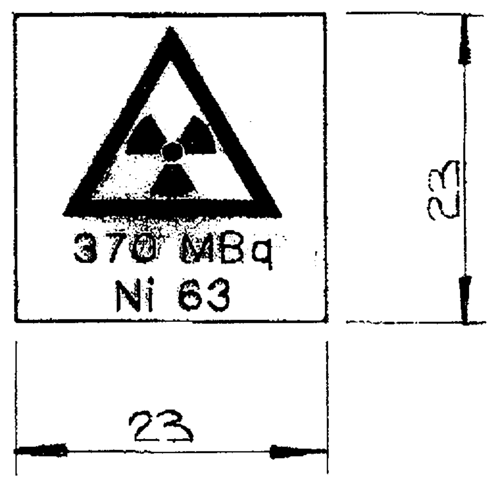
THAT CAN BE VIEWED AT THE RECORD TITLED:

A/200001, REV. 8:
HAND UNIT ASSY (SHT.1 OF 2)

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

A/200001, REV. 8

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.



Note

BLACK FIGURES & SIGN ON CANARY YELLOW (309) BACKGROUND.

SELF ADHESIVE REAR

MATERIAL :- 0.2 MM CLEAR PLASTIC SHEET.

IF IN DOUBT ASK

REMOVE ALL BURRS & SHARP EDGES

TOOL Nº

DO NOT SCALE PRINT | 3rd ANGLE PROJECTION | CONFORMS TO BS 308 | ALL DIMS IN MM | # SPECIAL INSPECTION

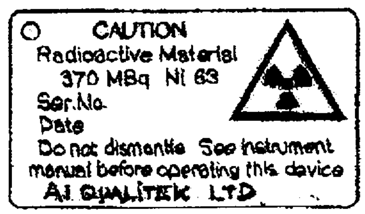
ISSUE 1
CH Nº /
DATE 30 9 85

FINISH: SEE NOTE
SCALE: 2:1
DRN: KRH
DATE: 30-9-85
MAT^L^: SEE NOTE
TITLE: RADIO-ACTIVE LABEL

UNLESS OTHERWISE STATED:- DIMENSIONAL TOLERANCES M/C ± 0.2 SHT ± 0.4 HOLES ⌀ ± 0.1 ANGLES ± 30'
SCREW THREADS:– 'MEDIUM FIT'.

DRG Nº 99024

Analytical Instruments Ltd
LONDON ROAD PAMPISFORD CAMBS TEL 0223 834420



LEGEND TO BE BLACK (001) ON
YELLOW (043) BACKGROUND.

IF IN DOUBT ASK

REMOVE ALL BURRS & SHARP EDGES

TOOL Nº			
DO NOT SCALE PRINT	3rd ANGLE PROJECTION	CONFORMS TO BS 308	ALL DIMS IN MM
# SPECIAL INSPECTION %			

ISSUE	3	4
CH Nº	529	0085
DATE	10.12.85	[illegible]

FINISH EPOXY INKS AS STATED ABOVE

SCALE 1:1

DRN G.I.H.E.

DATE 10.12.85

MAT^L BLANK 91179

TITLE ECD LABEL

UNLESS OTHERWISE STATED:- DIMENSIONAL TOLERANCES
M/C ± 0.2 SHT ± 0.4 HOLES ø ± 0.1 ANGLES ± 30'
SCREW THREADS:— 'MEDIUM FIT'.

DRG Nº 91780

LONDON ROAD PAMPISFORD CAMBS TEL 0223 834420

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

A/200001-1, REV. 2:
HAND UNIT ASSY (SHT.1 OF 2)

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

A/200001-1, REV. 2

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

A/200001-2, REV. 2:
HAND UNIT ASSY (SHT.2 OF 2)

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

A/200001-2, REV. 2

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

MODEL 200

APPENDIX C

RESULTS OF PROTOTYPE TESTING

Amersham International plc
Amersham Laboratories
White Lion Road Amersham
Buckinghamshire England HP7 9LL

telephone (0494) 544000
cables Activity Amersham telex
telex 83141 ACTIVA G
fax (0494) 543588

QCS 828 Issue 1

CERTIFICATE OF RADIOACTIVE SOURCE INTEGRITY

Title : EC dectector assembly, Ai Cambridge Ltd.

Assembly code : None

Assembly drawing : A/200003 (Ai Cambridge Ltd)

Nuclide : Nickel - 63 (Ni-63)

Radiotoxicity group : B2

Maximum activity : 500 MBq (13.5 mCi)

CLASSIFICATION : BS/ISO/ANSI 77 C32313

RECOMMENDED WORKING LIFE : Not assessable

Test sources : Two active samples, serial numbers 002519 and 002522, each containing a 370 MBq Nickel-63 foil, type NBCK 7074, assembled as per Ai Cambridge drawing A/200003 issue A. QA reference: 95/073 and 95/074.

Tests carried out in accordance with:

BS.5288:1976 ISO.2919:1980(E) ANSI N542:1977

Leak test method	Temperature	Pressure	Impact	Vibration	Puncture	Units
	3	2	3	1	3	
Wipe (QCP 130)	Pass 2.68 0.25	Pass 0.25 0.20	Pass 1.44 0.31		Pass 0.82 0.25	nanocuries

.....
Quality Assurance Manager

5.5.95
.....
Date

RS 353 Issue 1

Q. A. AUTHENTICATED

Amersham

D

APPENDIX D

Manufacturing specifications and registry of radioactive sealed source.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

JUL 12 1993

Post-It™ brand fax transmittal memo 7671	# of pages ▸ 8
To Bill McGann	From R. Brown
Co. ITI	Co. Dupont Merck
Dept.	Phone # 508 671 8000
Fax # 508 657 5954	Fax #

Francis E. Roy Jr.
Du Pont Merck Pharmaceutical Co.
Radiopharmaceutical Division
331 Treble Cove Road
N. Billerica, MA 01862

Dear Mr. Roy:

Based on the information submitted in your letter dated May 4, 1993, with enclosures thereto, we have made the changes to the enclosed registration certificate NR-476-S-131-S as you have requested .

We have broadened the principle use code of these models to code (S), Foil Source. We understand that the models, NER-004 and NER-004P, designate that the Nickel-63 is either a source or is electroplated onto components. This activity can occur under principle use code (S). We have included examples of uses of the sources under the "Conditions of Normal Use" section of the registration for clarity.

Please be advised that you must manufacture and distribute the product in accordance with the statements and representations contained in your application, with enclosures thereto, and the information set out in your registration certificate. As a general rule, you must request and obtain an amendment to the certificate before you make changes or modifications to the information submitted to obtain the certificate.

Please read over the registration certificate in its entirety and notify us immediately of any errors or omissions.

You are obligated to notify us promptly in writing should you decide to no longer manufacture or offer service support for the product.

If you have any questions, please contact me at (301) 504-3336 or Mr. Steven Baggett at (301) 504-2542.

Sincerely,

Michael Russ, Co-op Engineer
Sealed Source Safety Section
Source Containment and
Devices Branch
Division of Industrial and
Medical Nuclear Safety, NMSS

Enclosure: As stated

cc: SKimberley, LFDCB (w/encl.)

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO.: NR-476-S-131-S DATE: June 25, 1993

SEALED SOURCE TYPE: Beta Ionization Source

MODEL: NER-004, NER-004P

MANUFACTURER/DISTRIBUTOR:

Radiopharmaceutical Division
The Du Pont Merck Pharmaceutical Company
331 Treble Cove Road
North Billerica, MA 01862

ISOTOPE:	MAXIMUM ACTIVITY:
Nickel-63	50 millicuries (1.85 GBq)

LEAK TEST FREQUENCY: 6 months

PRINCIPLE USE: (S) Foil Source

CUSTOM SOURCE: _____ YES ___X___ NO

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

SEALED SOURCE TYPE: Beta Ionization Source

DESCRIPTION:

The sources consist of radioactive Ni-63 electroless plated or electroplated onto components fabricated from the approved materials in the following table:

Model	Approved Base Materials
NER-004	gold, platinum, nickel, copper, or monel (copper-nickel alloy)
NER-004P	gold, platinum, nickel, copper, monel, stainless steel

The NER-004 indicates a foil configuration of Du Pont design and manufacture. The NER-004P allows plating onto components of other manufacturer's design and manufacture. All sources must meet the following constraints:

maximum activity: 50 mCi (1.85 GBq)
minimum specific activity: 5 mCi/mg (0.185 GBq/mg)
radiopurity of Ni-63: > 99.9%.

LABELING:

The Model NER-004 foils are serialized by scribing or laser engraving on the non-radioactive side.

The Model NER-004P sources are permanently marked on a non-radioactive surface of the component with the radiation symbol, serial number and model number (i.e. "NER-004P"). If space permits, the sources will also be labeled with the isotope, activity and the words "Caution, Radioactive Material."

DIAGRAM:

Attachment 1 shows diagrams of dose rate locations.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

SEALED SOURCE TYPE: Beta Ionization Source

CONDITIONS OF NORMAL USE:

The Models NER-004 and the NER-004P are beta ionization sources and are routinely used in gas chromatograhpy systems, gas detection equipment, and aerosol neutralization applications. The sources shall not be subjected to temperatures which exceed 752°F (400°C).

PROTOTYPE TESTING:

The manufacturer tested prototype Models NER-004 and NER-004P sealed sources to the ANSI N542-1977 77C32211 requirements. In addition, the prototypes were subjected to 752°F (400°C) in air for 2 hours. Wipes of the inactive side of the sources after the tests revealed no removable contamination above 0.005 microcurie (185 Bq).

EXTERNAL RADIATION LEVELS:

The manufacturer reports maximum external radiation levels as follows:

Model		Dose Rate (deep/shallow) mrem/hr/mCi	mSv/hr/GBq
NER-004	on contact with active side	0.15/12.3	0.04/3.32
	inactive side	1.1 /1.1	0.30/0.30
NER-004P	at mouth of cavity *	0.11/6.7	0.03/1.81

See Attachment 1 for diagrams of dose rate locations.

* The electroplating is typically within a cavity of the component and this is the typical radiation dose when installed in the cavity.

QUALITY ASSURANCE AND CONTROL:

Du Pont Merck had previously described a quality assurance program which has been deemed acceptable for licensing purposes. The program consists of the following basic components:

SEALED SOURCE TYPE: Beta Ionization Source

QUALITY ASSURANCE AND CONTROL (Cont.):

- Design control
- Procurement control
- Process quality control including content activity measurement, leak tests, physical dimensions and visual inspection
- Final acceptance and records

A copy of the program is on file with the Source Containment and Devices Branch.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- The maximum activity concentration shall be 15 millicuries (0.555 GBq) per square centimeter.
- The source, when used in the United States, shall be distributed only to those persons specifically licensed by the NRC or an Agreement State. Distribution outside the United States should be to persons authorized by a regulatory authority, as appropriate.
- The source shall not be subjected to pressures or impact which exceed the ANSI N542-1977 classification of 77C32211.
- The sources shall not be subjected to temperatures which exceed 758°F (400°C).
- The model NER-004P shall only be used in devices which are registered with the NRC or an Agreement State.
- The source shall be leak tested at intervals not to exceed 6 months using techniques capable of detecting 0.005 microcurie (185 Bq) of removable contamination. Removable contamination from the inactive side shall not exceed 0.005 microcurie and the active side shall not exceed 0.5 microcurie (18.5 kBq).

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO.: NR-476-S-131-S DATE: June 25, 1993

SEALED SOURCE TYPE: Beta Ionization Source

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE (Cont'd):

- Handling, Storage, Use, Transfer, and Disposal: To be determined by the licensing authority.
- This registration sheet and the information contained with the references shall not be changed without the written consent of the NRC.

SAFETY ANALYSIS SUMMARY:

Based on our review of the information and test data cited below, we continue to conclude that the Du Pont Merck Models NER-004 and NER-004P sealed sources are acceptable for licensing purposes.

Furthermore, we continue to conclude that the sources would be expected to maintain their containment integrity for normal conditions of use which might occur during the uses specified in this registration sheet.

REFERENCES:

The following supporting documents are hereby incorporated by reference and are made part of this registry document.

- Du Pont Merck letters dated December 9, 1991, May 15, 1992, June 11, 1992, and July 31, 1992, and May 4, 1993, with enclosures thereto.
- NEN Products letter dated October 1, 1984, with enclosures thereto.

ISSUING AGENCY:

U.S. Nuclear Regulatory Commission

Date June 25, 1993 Reviewer: Steven Baggett

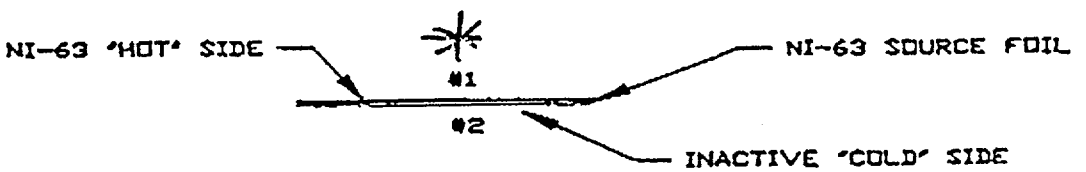
Date June 25, 1993 Concurrence: John Lubinski

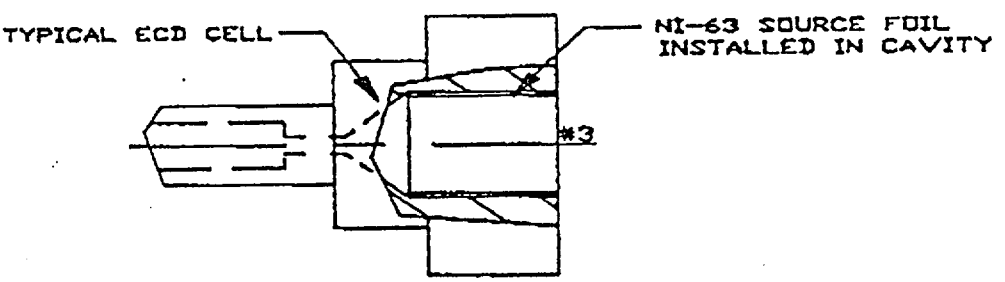
REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(AMENDED IN ITS ENTIRETY)

NO.: NR-476-S-131-S DATE: June 25, 1993 ATTACHMENT 1

SEALED SOURCE TYPE: Beta Ionization Source

NER-004 DOSE RATE REPORT





LOCATION NO.	DOSE RATE mREM/HR/MCI DEEP / SHALLOW
#1	0.15 / 12.3
#2	1.1 / 1.1
#3	0.11 / 6.7

NOTES

1. THE 'LANDAUER' DOSE REPORT IS THE DOSIMETRY DATA FOR THE DURATION OF THE SURVEY (6 HOURS) USING A 15 MCI NI-63 SOURCE FOIL.

2. TLD BADGES ARE 'LANDAUER' TYPE K.

APPENDIX E

Dupont data sheet for ^{63}Ni

^{63}Ni
100y
β 0.066
nσγ
E 0.066

NICKEL-63 Handling Precautions

Du Pont has developed the following suggestions for handling nickel-63 after years of experience working with this low energy beta emitter.

PHYSICAL DATA

Maximum Beta Energy:	0.066 MeV	(100%)[1]
Maximum Range of Beta in Air:	about 5 cm (2 inches)[2]	

OCCUPATIONAL LIMITS

Maximum Permissible Air Concentration (based on a 40-hour working week) = 6×10^{-8} μCi/mL[3] (2.2 kBq/m^3)
Quarterly Inhalation Intake Limit = 38 μCi (1.4 MBq)

DOSIMETRY

Millicurie quantities of ^{63}Ni do not represent a significant external exposure hazard since the low energy betas emitted cannot penetrate the horny outer skin layer. The critical organ for ^{63}Ni is the bone.[4] The elimination rate of ^{63}Ni depends on the chemical form. A few percent of most compounds taken into the body are eliminated via the urine,[5] 667 days being a reasonably conservative half-life.[4]

PRECAUTIONS

1. Designate area for handling ^{63}Ni and clearly label all containers.
2. Prohibit smoking, eating and drinking in room where ^{63}Ni is handled.
3. Use transfer pipets, spill trays and absorbent coverings to confine contamination.
4. Handle ^{63}Ni compounds which are potentially volatile or in powder form in ventilated enclosures.
5. Sample exhausted effluent by continuously drawing a known quantity through a membrane filter.
6. Wear disposable lab coat, gloves and wrist guards for secondary protection.
7. Select gloves appropriate for chemicals handled.
8. Regularly monitor and promptly decontaminate gloves and surfaces to maintain contamination control.
9. Use open window Geiger Muller detector or liquid scintillation counter to detect ^{63}Ni.
10. Submit periodic urine samples for bioassay to determine uptake by personnel.
11. Isolate, label and dispose waste according to approved guidelines.
12. Establish surface contamination, air concentration and bioassay action levels below maximum permissible limits and investigate any causes that threaten these levels to be exceeded.
13. On completing an operation, secure all ^{63}Ni, remove and dispose protective clothing and coverings, monitor and decontaminate self and surfaces, wash hands and monitor them again.

Many ^{63}Ni compounds cannot be detected with sufficient sensitivity by liquid scintillation counting of small volume urine samples. If insoluble compounds are handled, 24-hour urine samples should be periodically collected and radiochemically analyzed to ensure that contamination controls are adequate.

REFERENCES

[1] Kocher, David C., Radioactive Decay Data Tables. (Springfield: National Technical Information Service) 1981, DOE/TIC-11026.

[2] Kaplan, Irving, Nuclear Physics. New York: Addison-Wesley, 1964.

[3] 10 CRF 20 – Standards for Protection Against Radiation.

[4] Recommendations of the International Commission on Radiological Protection. ICRP Publication 2, Pergamon Press, London, 1959.

[5] Report of the Task Group on Reference Man, ICRP Publication 23, Pergamon Press, London, 1975.

APPENDIX F

Source Handling procedures

2. Check serial numbers on glass phial containing the Radioactive foils, corresponds with data sheet (supplied by manufacturer). Enter these serial numbers into Radioactive Source Records Book with date received and test date, all to be in numerical order.

3. The foil serial number and the detector serial number into which it is going to be fitted must be entered into the Source Record Book simultaneously to avoid mistakes.

4. Sources not required for immediate use must be placed in the Safe in the Radioactive Room.

6.1 Source Assembly Identification Procedure

1. Obtain the next batch of serial numbers from the Record Book and etch on the detector body or on the permanently attached label the following:

    1. Radioactive

    2. N-63

    3. 370 MBq

    4. Serial number obtained from the Record Book.

7. FOIL MANIPULATION

All work with Ni-63 radioactive foils must be carried out in accordance with the Work Instructions detailed in Section 8 below.

The person performing the work shall make use of the appropriate bending tools and filling jigs to load the Ni-63 foil into the capsule, this work must only be performed within the Gallenkamph glove box, situated in the radiation room.

8. WORK INSTRUCTIONS

No person(s) other than those authorised shall carry out any loading of source capsules or rectification work on detectors containing a Ni-63 source. The names of authorised workers are T M Brinkley, N Elbourne.

1. At no time shall a Radioactive foil be handled with bare hands.

2. All foil manipulations must be carried out in the Gallenkamph glove box using tweezers - at no point should the foil be nearer than one inch to the hands.

3. No smoking, or eating, or drinking, or snuff taking, or cosmetic application may take place in the supervised area.

4. No food, drink, cigarettes or cosmetics may be taken into the supervised area.

5. Normal green work coats shall not be taken into the supervised area. The special yellow work coats are required to be worn by persons in the work area. The yellow coats must not be worn in any other part of the factory.

6. Any open wounds on the hands must be covered with a waterproof dressing before any radiation work commences.

7. Only disposable handkerchiefs provided shall be used and immediately disposed. Conventional handkerchiefs shall not be used in the supervised area.

8. Working surfaces shall be covered with disposable material supplied.

9. All storage within the Radioactive Safe shall be upon stainless steel trays provided.

10. All loading/bending operations with cells/foils shall take place within the Gallenkamph glove box.

11. If an accident, or any undue exposure has occurred then this must be reported to the RPS immediately.

12. Before leaving the supervised area, for any reason, the yellow work coat must be removed and the hands must be washed using the facilities provided.

13. All authorised workers shall be over the age of 18.

14. All authorised workers must wear extremity (finger) TLDs when manipulating foils or handling source capsules.

15. No expectant mothers shall be used as authorised workers, or perform any work on radioactive cells.

16. All waste sources cells must be properly documented and stored in the metal cabinet provided for that purpose, prior to disposal.

9. DECONTAMINATION CHECK

1. When a detector cell assembly is complete, the cell should be washed as follows:

   Wearing disposable gloves (supplied), and using tweezers, moisten swab in diluted "Decan 90" solution. Clean all external surfaces of the cell body. The swabs should be sealed in a polythene bag and placed in the special low radioactivity waste bin.

2. Now, a background radiation check is performed as follows:

   Turn on the Hughes-Whitlock machine. Check that the instrument is set to 10 second period; ie, x 10 sec depressed, and that the energy switches are set as follows: E1/E3 depressed.

   Take a glass filter circle in the tweezers and moisten with a drop of methanol/water mixture. Allow to dry for a few seconds.

Depress the handle of the Hughes Whitlock machine to release the vacuum, and raise the instrument from the baseplate. Insert the test filter circle into the well in the centre of the baseplate. Now depress fully the handle on the machine, and release. Over the next ten seconds the scintillation counts will be counted and displayed, and the final (10 second) count displayed. This figure should be 200-220 counts. Repeat and check this result. If the figure is too high, then the baseplate or tweezers may be in themselves be slightly contaminated.

Decontaminate these using the above procedure and re-check. When a background count of 200-220 is achieved, discard the test paper.

3. Now, take an actual reading by taking a glass filter circle, moistening with a drop of methanol/water mixture, and wiping the test circle over the external faces of the detector cell. Now repeat the count using the Hughes-Whitlock machine, and repeat the count to test the repeatability of the sample.

   This count should be less than the background count plus 64 thus achieving a less than 20 becquerel contamination level. If the actual reading is too high, perform a repeat wash and then repeat the test until satisfactory.

4. Take one of the glass filter circles supplied for scintillation counting and moisten it with methanol/water mixture. Wipe the external faces of the detector with it, then place it in one of the scintillation counting vials provided for the purpose. Start to fill in form Ai 5001, issue 2 for the detector. Make sure that the detector serial number is correctly filled in. Fill in the "wipe" name date and signature.

5. Mark the vial with the detector identification number using an indelible marker. Write the serial number of the detector in the space provided on the counting service form. Fill in any other appropriate details. Put the detector in a plastic bag with the partially completed forms, and place in the safe. Put the vial in the container with the other vials awaiting counting and place this in the safe as well.

6. When a suitable number of vials (usually at least five) have accumulated they should be despatched to an approved counting service, together with the associated counting service forms. A list of the approved counting services is given in appendix 4.

7. If, when the counting reports are returned, it states that the activity detected on a wipe exceeds the threshold, then the detector capsule to which the wipe relates must be re-washed and another wipe taken and assessed as detailed above. The RPS should be informed if this occurs.

8. Complete form Ai 5001 issue 2 for all detectors with counting results below the threshold. Attach a copy of the results sheet, with the relevant results indicated, to the form. Place the form and attachments in the bag with the appropriate detector and replace in the safe.

9. When the detector is required for use, make out the counterfoil book with the detector type, batch number, and serial numbers of the detectors required. Obtain the signature of the person receiving the detectors, passing a copy to production control. Double check that form Ai 5001 is FULLY COMPLETED for each detector released and each form is with the correct detector.

RADIOACTIVE SOURCE - CERTIFICATE OF TEST FOR LEAKAGE

Source identification number:

Reason for test :

Nuclide: Ni-63

Date of wipe :

Physical form of source: Electrodeposited foil

Wipe performed by:

Activity:

Signature:

DETAILS OF TEST

Method used: The source is wiped with a glass fibre disc moistened with a methanol/water mixture. The disc is counted with a liquid scintillation counter and the activity is compared with that of a standardised reference solution of Ni-63 of known activity. This procedure follows method 5.3.1 of International Standard ISO 9978:1992 (Radiation Protection - Sealed Radioactive Sources - Leakage Test Methods).

Counter used:

Activity of standard reference solution: 231 ± 8 Bq

Counting period: 60 s

Background count:

Reference count:

Sample count (1): Repeat (2):

Estimated activity of sample: Bq

Notes: (i) The limit of detection is less than 1 Bq. Samples for which the estimated activity is less than this amount are recorded as " < 1 Bq" .

(ii) The approval criteria of ISO 9978:1992(para 5.3.3) are used. These state that if the activity detected does not exceed 200 Bq the source is considered to be leaktight.

STATEMENT OF TEST RESULT

This is to certify that the radioactive source described above has been tested for leakage in accordance with the requirements of section 18(3) of the Ionising Radiations Regulations 1985 and that the source is leak-free.

Name: Position:

Signed: Date:

UNIVERSITY OF EAST ANGLIA SAFETY SERVICE, NORWICH, NR4 7TJ

Restricted Commercial

AEA/RMCS/24955001/R4
ISSUE 1

Report to Ai Cambridge Ltd

Report on Compliance of Ai Cambridge Leakmeter 200 with Requirements for Laboratory Equipment

D McCrindle

March 1996

AEA Technology
Machinery Certification Service

DOCUMENT TYPE:- REPORT	CLASSIFICATION:- RESTRICTED COMMERCIAL
PROJECT:- AI CAMBRIDGE	DOCUMENT REFERENCE:- AEA /RMCS/24955001/R4
TITLE:- Report on Compliance of Ai Cambridge Leakmeter 200 with Requirements for Laboratory Equipment	FILE NO:- AEA /RMCS/24955001
	COPY NO:- N/A
	PAGE 1 OF 5 PLUS APPENDICES

SUMMARY:-

Ai Cambridge produce a range of laboratory equipment, including the Leakmeter 200 leak detector. This report demonstrates that the Leakmeter 200 leak detector meets the required safety standards for laboratory equipment.

DISTRIBUTION:-

Mr A Hawes - 2 copies
File

ISSUE		NAME	SIGNATURE	DATE	REMARKS
1	AUTHOR	D McCrindle		11/3/96	
	CHECKED	A M Stock		12/3/96	
	APPROVED	D T Parr		12/3/96	

Report on Compliance of Ai Cambridge Leakmeter 200 with Requirements for Laboratory Equipment.

Contents

1. Introduction

Ai Cambridge produce a range of laboratory equipment. One item is the Leakmeter 200 leak detector. In order to demonstrate that the Leakmeter 200 leak detector meets the required safety standards this file has been drawn up.

2. Brief Description of Equipment

The Leakmeter 200 is a system consisting of a hand held leak detecting probe unit connected to a stand alone case which contains the argon supply bottle, batteries etc. For certain applications the probe unit may be rigidly fixed in place. It functions by detecting trace gases which may have leaked from a nominally sealed component. The trace gas used is normally SF6. The detector nozzle is placed near the item to be leak tested. Small concentrations of SF6 leaking from the item will diffuse into the Leakmeter 200 argon carrier gas and be detected by the detector head. The detector head contains a small radioactive source. The Leakmeter 200 may be used with a wide range of test programmes. More details of the equipment and its operation are given in the user's manual (Appendix 5).

3. Compliance Requirements

The Leakmeter 200 is a robust stand alone piece of equipment. A brief review of the item indicated that the principle hazards were those associated with the use of electricity. Hence it is considered that the equipment should satisfy the relevant parts of BSEN 61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use) and BSEN 50081-1/BSEN 50082-1 (Standards for electromagnetic compatibility).

In order to demonstrate compliance with the above standards a series of tests were carried out on samples of the Leakmeter 200.

4. Compliance with BSEN 61010-1

In order to demonstrate compliance with BSEN 61010-1, a series of tests were carried out.

The first set of tests were carried out by Rowland Laboratories Ltd and covered clauses 5, 6, 8 (except 8.3), 9, 10 and 14. The results of these tests are given in Appendix 1. A number of minor non-compliances were found during the tests, mainly associated with labelling. These have been corrected by modification. A record of the modifications is given in Appendix 4.

The second set of tests were carried out by AEA Technology and covered clause 8.3 of the standard. A report of these tests is given in Appendix 2. The equipment was found to comply.

Clauses 1-4 of the standard cover the scope, references, definitions and test conditions. No tests are required in these clauses.

Clause 7 concerns the stability and handling of the equipment. The Leakmeter 200 is a stable device, and can be handled easily. In such circumstances stability tests are not required by the standard.

Clause 11, which deals with testing of equipment used to contain liquids, measure liquids or process liquids, was deemed to be irrelevant.

Clause 12 concerns protection against ultraviolet, ionising, microwave and laser radiation, and against sonic and ultrasonic pressure, where the radiation or pressure is generated in the equipment. The only source of radiation or pressure in the Leakmeter 200 is the detector head radioactive source. This is a small beta source which is well shielded, unless tampered with. Leakage tests are carried out on each unit after production and the customer is informed in the User Manual of the requirement for periodic leak testing. These leakage tests are more rigorous than the BSEN 61010-1 clause 12 test, which only requires a single sample to be tested.

Clause 13 deals with toxic gases and explosives used in or generated by the item. The Leakmeter 200 may be used in association with a wide range of trace gases, some of which may be toxic or explosive at certain concentrations. The standard does not require any tests to be carried out but requires reference to be made to tables of occupational threshold doses. This requirement will be met by the customers own COSSH assessments.

Clause 15 deals with the use of interlocks as protective devices. No interlocks are used on the Leakmeter 200 and so no testing is required.

It is believed that a combination of the test results, the record of modifications made following the tests and the above discussion demonstrates compliance of the Leakmeter 200 with BSEN 61010-1.

5. EMC compliance

In order to demonstrate compliance with BSEN 50081-1/BSEN 50082-1 a series of tests were carried out by AEA Technology. As a result of these tests a number of minor modifications were made. These modifications are recorded in Appendix 4. The equipment was then retested. The results of the retests are shown in Appendix 3

It is believed that the test results demonstrate compliance of the Leakmeter 200 with BSEN 50081-1/BSEN 50082-1.

6. Other hazards

No significant hazards, other than those covered in 4 and 5 above have been identified as associated with the Leakmeter 200. In particular it does not give rise to mechanical, noise, vibration or non-electrical fire hazards.

7. Summary

The Leakmeter 200 leak detector, manufactured by Ai Cambridge limited, has been shown to be an item of equipment which can be operated safely and which complies with the relevant safety standards.

Appendix 1 Report of assessment against BSEN 61010-1 (5, 6, 8 (except 8.3), 9, 10 and 14)

Rowland Laboratories Ltd.

Laboratory Test Report

No:- 18410

Client AEA Technology
Risley
Warrington
Cheshire
WA3 6AT

Client Contact Mr D. McCrindle

Telephone No. 01925 252000

Item(s) Under Test * 1x Leakmeter 200

Insulation Class I

Insulation Materials Not Declared

Temperature Method Used Thermocouple

Tests Carried Out At 23 °C

Tested To The relevant clauses of BSEN 61010 1: 1993

Date Sample Received 04.08.95

Date Test Started 22.08.95

Supervising Officer

Steve Hunt

Testing Officer

Date Report Prepared 29.08.95

"OPINIONS AND INTERPRETATIONS EXPRESSED HEREIN ARE OUTSIDE THE SCOPE OF NAMAS ACCREDITATION."

NAMAS TESTING NO 0225 (M)

EC Notified Body

ROWLAND LABORATORIES Ltd.

Report No. _____ :	18410
Date sample received _____ :	4th August 1995
Client _____ :	AEA Technology
Client contact _____ :	Mr. D McCrindle
Item under Test _____ :	Leakmeter 200

A system comprising :
(i) A switched-mode power supply having a single output which is connected to ...
(ii) A console, fitted in a suitcase. The console supplies a charge voltage for ...
(iii) A lead-acid battery which is also housed in the suitcase. This provides power for ...
(iv) A hand-held gas detector which needs for its operation ...
(v) A supply of argon gas which is also mounted in the suitcase.

Tested to _____ :	BSEN 61010 - 1 : 1993
Date of Test _____ :	29th August 1995
Test conducted by _____ :	Steve Hunt
Insulation Class _____ :	Of power supply - I Of rest of system - III
Ambient Temperature _____ :	23°
Temperature Method used _____ :	Thermocouple only
Insulation Materials _____ :	Not declared

Test carried out to

Clause 5 : Marking and documentation

Clause 6 : Protection against electric shock

Clause 8 : Mechanical resistance to shock,vibration and impact
Note - Vibration testing not undertaken, as agreed.

Clause 9 : Equipment temperature limits and protection against the spread of fire

Clause 10 : Resistance to heat

Clause 14 : Components

ONLY THE WORK DETAILED IN THIS REPORT HAS BEEN UNDERTAKEN

Test-work has been limited to electrical and fire assessment of the power supply only since the maximum output of the switched-mode supply was measured as approximately 3.25A (1.5A, under short-circuit conditions) and the battery supply is fused at 2.5A. (open-circuit voltage of smpsu is 15.4V DC and battery is rated 12V DC). (See Annex F of IEC1010).

The available energy of the lead-acid battery is a possible source of other hazards (ie explosion). It is therefore recommended that, to avoid any hazards caused by a direct short-circuit of the battery, an appropriately rated fuse be installed in one of the battery supply leads, as close as possible to the battery terminal.

Note - the battery compartment is inside the suitcase and is covered by a removable cover (2 wing nuts). It is further covered by the internal moulding which covers the gas cannister and houses the display/control console.
The battery terminals/connectors are considered to be adequately housed/shielded to eliminate the liklihood of accidental short-circuiting and therefore it is considered that the fuse protection is in compliance when mounted in the console but would be more efficient if placed directly in a supply lead.

Note - All control/logic circuitry is housed in a metal enclosure. All voltages below SELV. Available current below that required for a limited power source (Annex F).

5 Marking and documentation

5.1 Marking

5.1.1 General

Rack mounted equipment	:	Not applicable.
Letter and symbols for quantities and units in accordance with IEC 27	:	Complies.
Graphic symbols are in accordance with Table	:	Complies.

5.1.2 Identification

- Manufacturer's name or registered Trade Mark	:	Ai Cambridge Ltd
- Model Number or name	:	See below

Considered to comply since the power supply is marked -
"12V Lead-Acid Battery Charger for use only with a 200 Leakmeter Battery"

5.1.3 Mains supply

a) Nature of supply

- a.c. RATED frequency or range of frequencies	:	50/60Hz
- d.c. (with symbol 1 of Table 1)	:	Not applicable.
For information purposes it may also be useful to mark a.c. equipment "~"	:	marked " ~ "
- equipment suitable for both a.c. and d.c	:	Not applicable.
- Three-phase equipment	:	Not applicable.

b) The RATED value(s) of the supply voltage(s) or the RATED range of the supply voltages	:	90-264V
c) The maximum rated power in Watts or Volt-Amperes or the maximum RATED input current	:	40VA (40.3VA measured)
d) Equipment which the OPERATOR can set for different voltages indicates the voltage for which the equipment is set	:	Not applicable.
For PORTABLE EQUIPMENT the indication is visible from the exterior	:	Complies.
If the OPERATOR can alter the voltage setting without the use of a TOOL, changing the setting also changes the indication	:	Not applicable.

e) Accessory mains socket-outlets marked with the voltage if it is different from the mains supply voltage : Not applicable.

Outlets for use with only specified equipment marked to identify the equipment for which it is intended : Complies.

5.1.4 Fuses

Fuseholder marking included type and rating : See below

The internal fuse holder is marked T1.6H - Complies.

The "1.0 A T", included with the mains input rating presumably refers to the user replacable fuses but should be placed nearer to the fuses or otherwise labelled to avoid any confusion.

Fuses not replaceable by the OPERATOR : Rating and type to be included in service manual.

5.1.5 Measuring circuit TERMINALS

Unless a clear indication is provided on a measurement instrument that is not intended to be connected to voltages to earth above 50V a.c or 120 V d.c,the measuring input circuit TERMINALS for use by an OPERATOR and used for voltage or current measurement are marked with the maximum RATED voltage : Not applicable.

5.1.6 TERMINALS and operating devices

TERMINALS,connectors,controls and indicators identified by words or symbols : Complies.

The following TERMINALS and operating devices shall be marked as follows

a) FUNCTIONAL EARTH TERMINALS : Not applicable.

b) PROTECTIVE CONDUCTOR TERMINALS : Fails to comply - See below

The protective conductor terminal (earth) is required to be marked with symbol 6 of table 1.

c) TERMINALS connected to ACCESSIBLE conductive parts marked with symbol 7 of Table 1 : Not applicable.

d) TERMINALS supplied from inside the equipment and which are HAZARDOUS LIVE, marked with the voltage,current,charge or energy value or range, or with symbol 14 of Table 1 : Not applicable.

e) ACCESSIBLE FUNCTIONAL EARTH TERMINALS connected to ACCESSIBLE conductive parts marked with an indication that this is the case,unless self evident : Not applicable.

f) The on/off position of power supply switch and/or circuit breaker is clearly marked : Not applicable.

5.1.7 Equipment protected by DOUBLE or REINFORCED INSULATION

Equipment protected by DOUBLE INSULATION or REINFORCED INSULATION marked with symbol 11 of Table 1 unless it provided with a PROTECTIVE CONDUCTOR TERMINAL : Not applicable.

Equipment only partially protected by DOUBLE or REINFORCED INSULATION not to carry symbol 11 of Table 1 : Complies.

5.1.8 Battery charging : Complies.

5.2 Warning markings

Markings shall be visible when the equipment is ready in normal use : Complies.

5.3 Durability of markings : Complies.

5.4 Documentation

5.4.1 General

Equipment accompanied by documentation for safety purposes includes

- Technical specification : Fails - see below.

The technical parameters of the power supply are required to be included in the user hand-book.

- Instructions for use : Complies.

- Address where technical assistance may be obtained : Complies.

- Information specified in 5.4.2 to 5.4.5 : Complies.

5.4.2 Equipment ratings

Documentation shall include the following

- Supply voltage or voltage range	:	Fails - not included in hand-book
Frequency or frequency range	:	-- ditto --
Power or current RATING	:	-- ditto --
- A description of all input/output connections	:	-- ditto --
- Rating of the insulation of external circuits, appropriate for SINGLE FAULT CONDITIONS, when such circuits are inaccessible	:	Not applicable.
- A statement of the range of suitable environmental conditions	:	Fails - see below

The Environmental conditions information does not include :
(i) The installation category (II)
(ii) The operating and storage temperature range.

5.4.3 Equipment installation

Documentation includes installation and specific commissioning instructions

- Assembly,location and mounting requirements	:	Complies.
- Instructions for protective earthing	:	Complies.
- Connections to the supply	:	Not applicable.
- Ventilation requirements	:	Complies.
- Requirements for special services	:	Complies.
For PERMANENTLY CONNECTED EQUIPMENT, additional information includes	:	Not applicable.
- Supply wiring requirements	:	Not applicable.
- Requirements for external switch, circuit-breaker or external overcurrent protection devices and a recommendation that the switch or circuit-breaker be near the equipment	:	Not applicable.

5.4.4 Equipment operation

Instructions for use includes

- Identification of operating controls and their use in all operating modes : See below

The illustrations in the user manual of the symbols used on the control panel are too small to be clearly definable. They should correspond with those on the equipment and be easily indentifiable.

- Instructions for interconnecting accessories other equipment,including indication of suitability of accessories,detachable parts and any specific materials : Complies.

- Details of limits for intermittent operation : Not applicable.

- An explanation of symbols used on the unit : Fails to comply - see below.

The product should be clearly marked with symbol 14 of table 1 to bring the user's attention to the hand-book where the symbol should be repeated against each safety instruction given.

- Instructions for replacement or consumables : Complies but see below.

The user handbook should, where necessary, give information where replacement argon gas, batteries or other replacable parts can be obtained.

- Cleaning instructions (please see 11.2) : Complies.

5.4.5 Equipment maintenance

Instructions for preventative maintenance and inspection necessary for safety given in sufficient detail : Not applicable.

For equipment using batteries,the specific battery type are stated : Fails to comply - see below.

The handbook should advise the battery type or the suppliers part number for the battery.

Manufacturer specifies parts which are required to be examined or supplied only by the manufacturer or his agent : Not applicable.

The RATING and characteristics of fuses used stated : Fails - see below.

The type and rating of all fuses used should be included in the service documentation.

6 Protection against electric shock

6.1 General

Protection against electric shock maintained in NORMAL CONDITION (see 6.4) and SINGLE FAULT CONDITION (see 6.5) : Complies.

ACCESSIBLE parts not HAZARDOUS LIVE (see 6.3) : Complies.

6.1.1 Exceptions

The following HAZARDOUS LIVE parts are permitted to be ACCESSIBLE to the OPERATOR during NORMAL USE

- parts of lamps,lamp sockets after lamp removal : Not applicable.
- parts which are accessible only with the use of a tool and which are marked in accordance with 5.2 : Not applicable.
- Measuring and operating terminals which for operational reasons are unavoidably live : Not applicable.

6.2 Determination of ACCESSIBLE parts

6.2.1 General examination : Complies.

Direct earth leakage current was measured as 0.43mA. When measured according to appendix A1 earth leakage current was 0.256V/500Ω = 0.512mA, but voltage below limit.

6.2.2 Openings above parts at HAZARDOUS LIVE : Complies - see below.
Openings in side panels only (nominally 3mm deep)

6.2.3 Openings for pre-set controls : Not applicable.

6.3 Permissible limits for ACCESSIBLE parts

ACCESSIBLE voltage shall be measured : Measured : < 10 Volts

Current : Not applicable.

Capacitance : Not applicable.

6.3.1 Values in NORMAL CONDITION

6.3.1.1 Voltage : Complies.

6.3.1.2 Current : Not applicable.

6.3.1.3 Capacitance : Not applicable.

6.3.2 Values in SINGLE FAULT CONDITION

6.3.2.1 Voltage : Measured : < 10 V

Limit : 50V

6.3.2.2 Current : Not applicable.

6.3.2.3 Capacitance : Not applicable.

6.4 Protection in NORMAL CONDITION

ACCESSIBLE parts prevented from becoming HAZARDOUS LIVE by

- BASIC INSULATION : Complies.

- ENCLOSURES or BARRIERS : Not applicable.

- PROTECTIVE IMPEDANCE : Not applicable.

6.5 Protection in SINGLE FAULT CONDITION : Complies.

6.5.1 Protective earthing : Complies.

6.5.1.1 PROTECTIVE BONDING

PROTECTIVE BONDING construction : Complies.

6.5.1.2 Bonding impedance of plug-connected equipment :
Measured : 0.015Ω

6.5.1.3 Bonding impedance of PERMANENTLY CONNECTED EQUIPMENT

Bonding of PERMANENTLY CONNECTED EQUIPMENT is of low impedance : Not applicable.

6.5.1.4 Indirect bonding for measuring and test equipment

a) The voltage between ACCESSIBLE conductive part and the PROTECTIVE CONDUCTOR TERMINAL : Not applicable.

b) Voltage sensitive tripping devices : Not applicable.

6.5.2 DOUBLE INSULATION and REINFORCED INSULATION

Cr/Cl distances should meet the requirements of ANNEX D : Compliance is checked by the tests of 6.7, 6.8 and 6.9.2

6.5.3 PROTECTIVE IMPEDANCE : Not applicable.

6.5.4 Built-in equipment : Not applicable.

6.6 External circuits

6.6.1 Separation of internal circuits

Internal circuits not at hazardous live and intended for connection to external circuitry are protected from becoming live under single fault conditions : Complies.

6.6.2 TERMINALS for external circuits : Complies.

6.6.3 Circuits with TERMINALS which are HAZARDOUS LIVE: Not applicable.

6.7 CLEARANCES AND CREEPAGE DISTANCES : Complies.

Creepage distance/clearances measured :
(1) Between primary and secondary on pcb approx 8mm (reinforced).
(2) Between primary and earth approx. 4.4mm (basic).
(3) Within transformer - see construction (Clause 14) (Complies.)

6.8 Dielectric strength tests : Complies.

Withstood 1.5kV between live parts and earth (basic) and 3kV between live parts and secondary circuitry (reinforced).

6.8.1 Reference test earth : Complies.

6.8.2 Humidity pre-conditioning : Complies.

6.8.3 Conduct of tests : Complies.

6.8.4 Voltage tests : Complies.

6.9 Constructional requirements for protection against electric shock

6.9.1 General : Complies.

6.9.2 ENCLOSURES of equipment with DOUBLE INSULATION or REINFORCED INSULATION

ENCLOSURE surrounds all metal parts : Not applicable.

Protection for ENCLOSURES or parts of ENCLOSURES made of metal : Not applicable.

6.9.3 Equipment using PROTECTIVE BONDING

6.9.3(a) Operator removable parts	:	Not applicable.
6.9.3(b) Movable conductive connections	:	Not applicable.
6.9.3(c) Metal braid of cables	:	Not applicable.
6.9.3(d) Mains passing through the equipment	:	Not applicable.

Note: The battery output lead from the mains charger has a yellow green conductor. Green yellow coloured insulation should be used only for mains earthing.

6.9.3(e) Colour of protective earthing conductors	:	Complies.
6.9.3(f) Protective bonding terminal	:	Complies.

6.10 Connection to mains supply

6.10.1 Mains supply cords	:	Complies.
6.10.2 Fitting of non-detachable mains supply cords	:	Not applicable.
6.10.3 Plugs and connectors	:	Complies.
6.10.3(a) Compliance with relevant specification	:	Complies.
6.10.3(b) Sockets at other than mains voltages	:	Complies.
6.10.3(c) Charge on plug pins	:	Complies - decayed virtually to zero in 5 seconds.
6.10.3(d) Mains socket outlets	:	Not applicable.

Note - IEC inlet socket has integral fuse holder

6.11 TERMINALS

6.11.1 ACCESSIBLE

a) The 8mm strand test	:	Not applicable.
b) Screw terminals should not work loose	:	Not applicable.

6.11.2 PROTECTIVE CONDUCTOR TERMINAL

a) Earth contact integral part of socket	:	Complies.
b) Earth adjacent to mains terminals	:	Not applicable.
c) Protective conductor terminal	:	Not applicable.
d) Protective conductor terminal	:	Complies.
e) Soldered connections should be secured independently from the soldering	:	Complies.
Screw connections secured against loosening	:	Not applicable.
f) Contact surfaces should be bare metal and corrosion free	:	Complies.
g) Construction of plug-in type protective conductor terminals	:	Complies.
6.11.3 FUNCTIONAL EARTH TERMINALS	:	Not applicable.

6.12 Disconnection from supply source

6.12.1 General	:	Complies.
6.12.1.1 Exceptions	:	Not applicable.
Description of the disconnecting device	:	Inlet socket

6.12.2 Requirements according to type of equipment

6.12.2.1 PERMANENTLY CONNECTED EQUIPMENT

PERMANENTLY CONNECTED EQUIPMENT and multi-phase equipment	:	Not applicable.

6.12.2.2 Single phase cord-connected equipment

Requirements for a single-phase cord connected equipment	:	Complies.

6.12.2.3 Hazards arising from function

Emergency switch	:	Not applicable.
6.12.3 Disconnecting devices	:	Complies.
6.12.3.1 Switches and circuit-breakers	:	Not applicable.
6.12.3.2 Appliance couplers and plugs	:	Complies.

8 Mechanical resistance to shock,vibration and impact

8.1 Rigidity Test

Force : 30N

Result : Complies.

NOTE : For equipment with non-metallic ENCLOSURES, this test is carried out at an ambient of 40°C : Not applicable.

8.2 Impact Hammer Test

Force used with Impact Test Hammer : 0.5J
Result : Complies.

Force used with Impact Test Hammer : 0.2J (windows of indicating and recording instruments)
Result : Not applicable.

8.3 Vibration Test : Not undertaken

8.4 Drop Test

8.4.1 Equipment other than HAND-HELD EQUIPMENT : Complies.

8.4.2 HAND-HELD EQUIPMENT : Not applicable.

9 Equipment temperature limits and protection against the spread of fire

9.1 General

9.2 Temperature Tests

Equipment was tested under reference test conditions and in the position of NORMAL USE
Temperatures were measured when a steady state has been attained

NOTE : Results extrapolated for an ambient of 40°C (Tests conducted in an ambient of 28°C

Area	Temperature rise - °C	Limit
Gun/probe assembly		
Enclosure	neglible	70°C
Nozzle area of gun	75-28+40 = 87°	80°C

Console

Enclosure	neglible	80°C

Power supply unit

Enclosure (metal)	42-28+40 = 56°	70°C
Transformer	65-28+40 = 77°	105°C
Hottest elec. capacitor	76-28+40 = 88°	--
Resistor R3	108-28+40 = 120°	--
PCB under R2	88°C	95°C

The mains transformer temperature was measured by thermocouple.

IMPORTANT - Note - Insulation of mains connected cables can touch resistors R2 and must be routed and tied away from all hot parts which could damage the insulation (R2 had a body temperature of 211°C).

9.2.1 Heating equipment : Not applicable.

9.2.2 Equipment intended for installation in a cabinet or a wall

Built-in equipment : Not applicable.

9.3 Guards : Not applicable.

9.4 Field wiring TERMINAL boxes : Not applicable.

9.5 Overtemperature protection devices : Not applicable.

9.6 Overcurrent protection : Complies.

9.6.1 PERMANENTLY CONNECTED EQUIPMENT : Not applicable.

9.6.2 Other equipment : Complies.

10 Resistance to heat

10.1 Integrity of CLEARANCES and CREEPAGE DISTANCES

CLEARANCES and CREEPAGE DISTANCES shall meet the requirements of 6.7 and ANNEX D when the equipment is operated at an ambient temperature of 40°C : Complies.

10.2 Resistance to heat of non metallic ENCLOSURES : Not applicable.

10.3 Resistance to heat of insulating materials

VICAT softening Test (ISO 306 method A) : Not applicable.

14 Components

14.1 General

Where safety is involved,components comply with applicable safety requirements specified in relevant IEC Standards : Complies.

14.2 Motors : Not applicable.

14.3 Overtemperature protection devices : Not applicable.

14.4 Fuse holders : Not applicable.

14.5 Mains voltage selecting devices : Not applicable.

14.6 HIGH INTEGRITY components : See below

A circuit diagram was not provided for the power supply / battery charger.
All components which limit the maximum available output current or which control the battery charge are considered to be HIGH INTEGRITY components and must be appropriately rated or selected.

14.7 Mains transformers : Complies.

14.7.1 Short-circuit tests : Complies.

1. When output of psu s/c'd - no heating or other hazards.

2. When tx output winding s/c'd - input 230V 0.66A, (rising to 0.76A).
No heating of tx. Arcing noted after approx 2 mins, in vicinity of R8/D2 causing transistor T1 to fail s/c, R13 to fail o/c and input fuse (T1.6H) to rupture.
No heating or other hazards caused.

3. Output of second sample s/c'd - input dropped from approx 0.05A (offload) to approx 0.03A with s/c applied.
After 4 hours input at 0.028A, transformer at 39°C in ambient of 23°C. No hazards.

4. Loaded output with approx 6.5Ω (This gave both the maximum input of 168mA and the maximum output of approx 3.25A). During a four hour test the temperature of the transformer, measured by thermocouple, reached a maximum of 91° in an ambient of 25° = rise of 76°. When extrapolated for an ambient temperature of 40° this gives a maximum temperature of 116°.
Note - This is acceptable only if the insulation of the enamelling of the primary winding is better than Class A.

5. s/c output of opto-isolator. No hazards occurred.

6. s/c input of opto-isolator. PSU did not start up. Input 0.02A - no hazards.

7. No further fault testing considered necessary.

14.7.2 Overload tests : Not applicable.

TX marked - DARREN ELECTRONICS LTD / DEL 455B / SER. NO 903105

Transformer construction :

1 Single layer of tape over whole
2 3+ layers of tape
3. Sec to 5mm+ of primary cheek (approx 2mm clearance leadouts to next insulation)
4. 1 Layer tape
5. Copper foil screen (earth) to top & bottom cheeks
6. 3+ layers of tape
7. Pri - 5mm+ to sec cheek, insulated to 4mm+ of pri cheek.
8. 1 Layer tape
9. Pri winding to 3-mm to either cheek.

Internal Creepage Distances :

1. Between primary and secondary 2mm(from 3 above) + 3mm (from 9 above) + thickness of windings and insulation = 7mm.
2. Between secondary and earthed screen - approx 3mm
3. Between primary and earthed screen - >5mm.

Appendix 2 (8.3) Report of assessment against BSEN 61010-1

AEA
Plant Support Services Group
Structural Performance Department
Structural Features Test Facility

CERTIFICATE OF ENVIRONMENTAL TESTING (VIBRATION)

Certificate No. SPD/JF/797/VC/3

Customer	AEA Technology
Address	Risley
	Warrington
	Cheshire WA3 6AT
Contact	Mr. D. McCrindle
Tel. No.	x4554
Fax. No.	x4632
E. Mail	

Component Tested

Manufacturer	MEGGITT CONTROLS
Equipment Type	Battery Charger for Leakmeter 200
Serial No.	898105 (Internal on transformer)
Date Received	4 Mar 1996
SPD Specimen Code	SPD/JF/797/SP/3

Tested to

Standard Used	BS EN 61010
Paragraphs	8.3
Date Tested	6 March 1996
Quality Assurance	ISO 9001 :Pt 1
Quality Plan	SPD/JF/797/QP/3

Test Engineer Name	G. T. Melvin	Signed	G. T. Melvin
Supervisor Name	Dr. J.C. Duthie	Signed	J.C. Duthie

TESTS ON QUALITEC 200 BATTERY CHARGER

BEFORE VIBRATION TEST

1/ INSULATION RESISTANCE WAS CHECKED USING PAT TESTER A READING OF INFINITY WAS ACHIEVED.

2/ A VOLTAGE TEST WAS CARRIED USING MEGGER FT6/12 MK2 BREAKDOWN TESTER(FLASH TESTER) PROCEDURE AS FOLLOWS
VOLTAGE RANGE SELECTED 4KV
PHASE/TRIP/ DIRECT WHERE ALSO SELECTED
TRIP LEVEL CONTROL 1mA TRIP LEVEL
VOLTAGE OUTPUT CONTROL FULLY ANTI CLOCKWISE(MINIMUM)
EARTH TERMINAL OF FLASH TESTER WAS CONNECTED TO METAL BODY OF QUALITEC
LIVE & NEUTRAL MAINS INPUT CONNECTIONS WHERE STRAPPED TOGETHER & THE LIVE PROBE OF FLASH TESTER CONNECTED TO THESE CONNECTIONS
THE TEST BUTTON WAS THEN PRESSED & THE OUTPUT CONTROL WAS TURNED SLOWLY TO 1.9KVD.C (OVER A PERIOD OF 10 SECONDS) THE TEST VOLTAGE WAS THEN MAINTAINED FOR 1MIN BEFORE RELEASING TEST BUTTON TO SWITCH OF TEST.

RESULTS AS FOLLOWS
FLASH TEST WAS DONE AND A SMALL CURRENT OF 5 uA WAS DETECTED

3/ AFTER FLASH TEST WAS FINISHED A EARTH BOND TEST USING PAT TESTER WAS DONE AT 25AMPS A READING OF 50mΩ WAS ACHIEVED.

4/ AN INSPECTION WAS DONE AND NO APPARENT DAMAGE WAS FOUND AND NO HAZARDOUS PARTS BECAME ACCESSIBLE.

EQUIPE MENT USED.
MEGGER FT/16/12 MK2 BREAK DOWN TESTER SER NUMBER M938650
MEGGER PAT 32 SER NUMBER 940740 1005
BOTH TEST INSTRUMENTS WHERE NAMAS CALIBRATED.
THE 1.9KVTEST VOLTAGE AS IN SECTION 2 WAS DERIVED FROM EN61010 APPENDIX D.4 BASIC INSULATION OR SUPPLEMENTARY INSULATION.PULLUTION DEGREE 2 INTALLATION CATEGORY (OVERVOLTAGE CATEGORY)II. WORKING VOLTAGES UPTO 300VOLTS.

TESTS CARRIED OUT BY SIG S/Jones

TESTS ON QUALITEC 200 BATTERY CHARGER

AFTER VIBRATION TEST

1/ INSULATION RESISTANCE WAS CHECKED USING PAT TESTER A READING OF INFINITY WAS ACHIEVED.

2/ A VOLTAGE TEST WAS CARRIED USING MEGGER FT6/12 MK2 BREAKDOWN TESTER(FLASH TESTER) PROCEDURE AS FOLLOWS
VOLTAGE RANGE SELECTED 4KV
PHASE/TRIP/ DIRECT WHERE ALSO SELECTED
TRIP LEVEL CONTROL 1mA TRIP LEVEL
VOLTAGE OUTPUT CONTROL FULLY ANTI CLOCKWISE(MINIMUM)
EARTH TERMINAL OF FLASH TESTER WAS CONNECTED TO METAL BODY OF QUALITEC
LIVE & NEUTRAL MAINS INPUT CONNECTIONS WHERE STRAPPED TOGETHER & THE LIVE PROBE OF FLASH TESTER CONNECTED TO THESE CONNECTIONS
THE TEST BUTTON WAS THEN PRESSED & THE OUTPUT CONTROL WAS TURNED SLOWLY TO 1.9KVD.C (OVER A PERIOD OF 10 SECONDS) THE TEST VOLTAGE WAS THEN MAINTAINED FOR 1MIN BEFORE RELEASING TEST BUTTON TO SWITCH OF TEST.

RESULTS AS FOLLOWS
FLASH TEST WAS DONE AND A SMALL CURRENT OF6 uA WAS DETECTED

3/ AFTER FLASH TEST WAS FINISHED A EARTH BOND TEST USING PAT TESTER WAS DONE AT 25AMPS A READING OF 59mΩ WAS ACHIEVED.

4/ AN INSPECTION WAS DONE AND NO APPARENT DAMAGE WAS FOUND AND NO HAZARDOUS PARTS BECAME ACCESSIBLE.

EQUIPE MENT USED.
MEGGER FT/16/12 MK2 BREAK DOWN TESTER SER NUMBER M938650
MEGGER PAT 32 SER NUMBER 940740 1005
BOTH TEST INSTRUMENTS WHERE NAMAS CALIBRATED.
THE 1.9KVTEST VOLTAGE AS IN SECTION 2 WAS DERIVED FROM EN61010 APPENDIX D.4 BASIC INSULATION OR SUPPLEMENTARY INSULATION.PULLUTION DEGREE 2 INTALLATION CATEGORY (OVERVOLTAGE CATEGORY)II. WORKING VOLTAGES UPTO 300VOLTS.

TESTS CARRIED OUT BY SIG

Appendix 3 EMC test report.

RESTRICTED COMMERCIAL

Electromagnetic Compatibility Test Report on AI Cambridge Leakmaster 200

E A Walters

The work reported in this document was commissioned by

Machinery Certification Services
Risley Laboratory,
Cheshire

January 1996

WINFRITH SAFETY SYSTEMS • WINFRITH TECHNOLOGY CENTRE
DORCHESTER • DORSET • DT2 8DH

RESTRICTED COMMERCIAL

DOCUMENT TITLE	**Electromagnetic Compatibility Test Report** **on** **AI Cambridge Leakmaster 200**

REFERENCE	WSSD/0957/10.002
ISSUE	02

	NAME	POSITION	SIGNATURE	DATE
AUTHOR	E A Walters	EMC ENGINEER	E A Walters	14/2/96
APPROVED	D Bardsley	SECTION MANAGER	D J Bardsley	14/2/96

Winfrith Safety Systems
AEA Technology
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Dorchester
Dorset
DT2 8DH

Contents

1.0 Introduction

This report describes the EMC test programme and results on the AI Cambridge equipment Leakmaster 200.

The AI Cambridge equipment was tested in the Winfrith Safety Systems laboratories at Winfrith Technology Centre between 29 September - 17 October 1995.

2.0 Objective

The objective of the work was to carry out an investigation of the EMC performance of the AI Cambridge Equipment against the requirements of usage within a Light Industrial Environment.

Radiated and mains conducted emissions tests were based on the British version of the European Standard BS EN 50081-1:1992 for the light industrial environment.

Electromagnetic field immunity tests were based on the European Standard EN 50082-1:1992 for the light industrial environment, though industry standard specifications were used for the radiated immunity tests.

3.0 EUT Description and Operation

The Equipment Under Test (EUT) consisted of the unit defined below:

i) Leakmaster 200 - is a high sensitivity leak detector used in a variety of industrial and scientific applications. It comprises a hand unit, control console, rechargeable battery and Argon gas cylinder, contained within a case. Facilities are built in to allow the instrument to be operated using external power supplies.
The instrument is microprocessor based, and is capable of interfacing with a printer to output data via the RS232 connector.

The mode of operation tested was measurement of trace SF6 giving results in ml/sec. The instrument was enabled and ready to run, all ancillary units and the star printer were connected.

Only the single mode of operation stated above was investigated.

3.1 Failure Criteria

No user defined failure modes have been given, the following criteria have been applied.

1. Significant variation in normal steady state reading. A four times ambient reading being classed as a fail.

2. An unitententionl change in display units or range.

3. A noticeable change in the audio signal.

4. An unitentional change in display functionality.

These parameters were monitored and discrepancies noted. These measurements were taken in accordance with specified failure performance criteria. Analysis of these results was used to evaluate the instruments immunity performance.

3.2 Performance Criteria

The basic performance criteria used in evaluating the EUT were:

Criteria A — The EUT shall continue to operate as intended. No degradation of performance or loss of function is allowed below the test level specified.

Criteria B — The EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below the test level specified. But during the test, degradation of performance is allowed, but this should not involve any change in the actual operating state or loss of any stored data.

Criteria C — Temporary loss of function is allowed, provided the function is self recoverable or can be restored by the operation of the controls.

4.0 Personnel

Tests were carried out by Mr Edward Walters and Mr Guy Moore, AEA Technology EMC Engineers.

5.0 Test Equipment

Item	Serial number
Biconical Antenna R&S HK116	839472/011
Log Periodic Antenna R&S HL223	840578/001
LISN R&S ESH3-Z5	840092/011
Test Reciever (9kHz-30MHz) ESHS10	840499/014
Test Reciever (20 - 1000 MHz) ESVS10	840698/005
Isotropic Field Monitor FM1000	10976
RF Generator Marconi 2022D	119138/048
Biconical Antenna EMCO 3109	9109-2580
Log Spiral Antenna EMCO 3101	9003-3412
Power Meter Rhode & Schwarz 392.4017.02	879 995/047
Power Amplifier AR150L	11082
Power Amplifier AR25W1000M7	11263
ESD Simulator Schaffner NSG 430	1019
Main Frame Schaffner NSG 200E	2856 8514
Interference Generator Schaffner NSG 225	405 8528
Coupling Clamp CDN 125	397 9343

6.0 Test Programme and Standards

All tests were carried out in the Winfrith Safety Systems laboratories at AEA Technology, Winfrith Technology Centre.

The environment defined by Ai Cambridge indicates the product will be expected to meet the conditions laid out within the Light Industrial Generics EN50081-1 and EN50082-1. These standards detail test levels and test methods for EMC phenomena in the following areas.

1. Electrostatic discharge (ESD)
   Test Specification: IEC 801-2(1984)

   This test was completed on the parts of the kit to which the operator can have access to (i.e areas in which the is a likelyhood of a discharge) during normal operation or if agreed with the manufacturer during maintenance operation. The level required being 8 kV air discharge, as stated within IEC 801-2(1984). To ensure repeatibility, this test was completed within a temperature and humidity controlled atmosphere. The EUT was elevated above a ground plane, the discharge gun was applied in a predetermined manner.

2. Electrical Fast Transients (EFT)
Test Specification: IEC801-4(1988)

This test was applied to power, control, signal and input and output lines. The test level severity was dependent on the use and function of the lines. The method of application was in accordance with IEC 801-4 (1988), all tests were completed via the capactive clamp. The EUT was elevated above a ground plane and the capacitive clamp coupled the positive and negative pulses onto the respective lines.

3. Conducted Emissions
Test Specification: EN55022

This test was applied to all EUTs via an AC power supply or through a DC supply. The EUT was elevated over a ground plane, and the interference was monitored via a power supply connection (DC or AC).

4. Radiated Emissions
Test Specification: EN55022 Class B

These tests were applied to all EUT's in operation, all ancillary remote units and printers were connected. The configuration and radial position of the EUT and associated cabling were arranged to maximise the emissions.

The radiated emission tests were completed at a three metres distance, the EUT was positioned at 0.8 metre height, the antennas were statically positioned at one metre height. The test site was free from reflecting objects over the ellipse of test.

5. Radiated Immunity
Test Specification CEGB DN5 (IEC801-3)

These tests were completed to an industry modified IEC 801-3, the frequency band of interest has been increased to 1 GHz.

The severity level of the requirements of the light industrial environment is 3 V/m. The radiated immunity tests were completed at a one metre distance, the EUT was positioned at 0.8 metre height, the antennas were statically positioned at one metre height. The test site was free from reflecting objects over the ellipse of test. The field strength at the EUT was monitored via an isotropic field monitor.

6. Drops and Surges
It is assummed that these requirements have already been covered within AI Cambridge design or type testing schedule, i.e the regulatory requirements for connection to public mains supply.

7. Table of Tests

7.1 Leakmaster 200

Test No.	Test Type	Test Standard	Frequency range	Test criteria	Severity	Aerial Polarity	Comments
01	Radiated Immunity	CEGB DN5 1988	20 MHz to 200 MHz	Class A	3V/m	H	EUT active Results given in table A1
02	"	"	"	"	-	V	EUT active Results given in table A1
03	"	"	200 MHz to 1 GHz	"	-	Conical	EUT active Results given in table A1
04	ESD	IEC 801-2 (1988)	-	Class B	8 kV air discharge	-	EUT active Results given in table A2
05	EFT	IEC 801-4 (1984)	-	Class B	0.5 kV	DC power supply	EUT active Results given in table A3
06	"	"	-	"	0.5 kV	RS232	EUT active Results given in table A3
07	Conducted Emissions	EN55022 Class B	150 kHz to 30 MHz	Class A	-	Neutral	EUT active Prescan - peak search
08	"	"	"	"	-		EUT active Final - Quasi peak measurements
09	"	"	"	"	-	Neutral	EUT active - artificial hand applied Prescan - peak search
10	"	"	"	"	-		EUT active - artificial hand applied Final - Quasi peak Measurements

RESTRICTED COMMERCIAL

Test No.	Test Type	Test Standard	Frequency range	Test criteria	Severity	Aerial Polarity	Comments
11	Radiated Emissions	EN55022 Class B	30 MHz to 230 MHz	Class A	-	H	EUT active prescan - peak search
12	"	"	"	"	-	H	EUT active Final - Quasi peak results
13	"	"	"		-	V	EUT active prescan - peak search
14	"	"	"	"	-	V	EUT active Final - Quasi peak result
15	"	"	230 MHz to 1 GHz	"	-	H	EUT active prescan - peak search
16	"	"	"	"	-	H	EUT active Final - Quasi peak results
17	"	"	"	"	-	V	EUT active prescan - peak search
18	"	"	"	"	-	V	EUT active Final- Quasi peak results

8.0 Summary of Test Results

Full and detailed test results are given in appendix A at the back of this report. A brief summary of the instruments performance against the relevant EMC phenomena is given below.

Radiated Immunity

The EUT was stable at ambient. On application of the field, no deviations were noted.
On the basis of the defined failure criteria the EUT passed the radiated test.

ESD

The EUT was stable at ambient. On application of the discharges, no deviations were noted.

On the basis of the defined failure criteria the EUT passed the ESD test.

Electrical Fast Transients (EFT)

The EUT was stable at ambient. On application of the transients, no deviations were noted.

On the basis of the defined failure criteria the EUT passed the EFT test.

Conducted Emissions

The EUT showed conducted emissions below the limit levels. Therefore the EUT successfully passed the mains conducted emission test.

Radiated Emissions

The EUT showed emissions below the limit levels. Therefore the EUT successfully passed the radiated emission test.

9.0 Conclusions

The EUT successfully passed all the tests stated within section 6, these test results can now be used as supporting evidence within a technical file.

9.1 RADIATED EMISSIONS

The EUT radiated emissions levels were below the limits, though these tests were carried out with high ambient fields present. These ambient peaks were isolated and identified as not being due to the EUT under test using techniques detailed within the basic standards. Therefore the EUT passed the radiated emission test.

9.2 MAINS CONDUCTED EMISSIONS

The EUT mains conducted emissions levels were below the limits. Therefore the EUT passed the conducted emission test.

9.3 RADIATED IMMUNITY

The EUT operated normally in radiated fields of 3 volts per metre.

This result constitutes a pass to performance criteria A.

9.4 ELECTROSTATIC DISCHARGE

The EUT showed no deviations during the electrostatic discharge test.

This result constitutes a pass to performance criteria A.

9.5 FAST TRANSIENTS

The EUT showed no deviations during the Fast transient test.

This result constitutes a pass to performance criteria A.

Appendix A: Test results

Index

RESTRICTED COMMERCIAL

JOB NAME:	Testing of AI equipment
TEST TYPE:	Radiated Immunity
Test File No:	WSSD/0957/102/DN5
EUT:	Leakmaster 200
Manuf:	AI Cambridge
Op Cond:	EUT functional
Operator:	Edward Walters
Test Spec:	CEGB DN5 [IEC801-3(1984)]
Test Method:	Biconical antenna 20 - 200 MHz Log Conical 200 - 1000 MHz
Severity level:	3 V/m (light Industrial)
Test Criteria:	A

Comments:

No unacceptable disturbance was noted on any antenna.

The EUT passed the radiated immunity test.

JOB NAME:	Testing of AI equipment
TEST TYPE:	ESD
Test File No:	WSSD/0957/102/ESD
EUT:	Leakmaster 200
Manuf:	AI Cambridge
Op Cond:	EUT functional
Operator:	Edward Walters
Test Spec:	IEC 801-2(1984) [BSEN50082-1]
Test Method:	Air discharge
Severity level:	8 KV (light Industrial)
Test Criteria:	B

Comments:

No unacceptable disturbance was noted.

The EUT passed the ESD test.

JOB NAME:	Testing of AI equipment
TEST TYPE:	EFT
Test File No:	WSSD/0957/102/EFT
EUT:	Leakmaster 200
Manuf:	AI Cambridge
Op Cond:	EUT functional
Operator:	Edward Walters
Test Spec:	IEC 801-4(1988) [BSEN50082-1]
Test Method:	Capacitive Clamp
Severity level:	Signal Ports 0.5 kV DC power ports 0.5 kV AC power ports 1 kV
Test Criteria:	B

Comments:

DC power port:

No unacceptable readings noted.

RS232 port:

No unacceptable readings noted.

The EUT passed the EFT test.

Testing of Ai cambridge leakmeter 200

Conducted Emissions

EUT: leakmeter 200
Manuf: Ai cambridge ltd
Op Cond: Unit Energised
Operator: Edward Walters
Test Spec: BS6527 Class B (EN50081-1)
Comment: modification no 2

File: ai200cem2.dat : AI leakmeter 200 (mod 2) - conducted emissions

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	5kHz	10kHz	PK+AV	20msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	11	9kHz	30MHz	ESH3-Z5

Final Measurement: X QP / + AV
Meas Time: 20sec
Subranges: 8
Acc Margin: 35 dB

Final Measurement Results:

Frequency MHz	QP Level dBµV	QP Limit dBµV	QP Delta dB	Phase -	PE -
0.17	55.49	64.96	9.47	L1	gnd
0.36	39.38	58.73	19.35	N	gnd
0.57	28.16	56.00	27.84	N	gnd
1.135	18.38	56.00	37.62	N	gnd
15.43	49.73	60.00	10.27	N	gnd
17.96	44.49	60.00	15.51	L1	gnd

Frequency MHz	AV Level dBµV	AV Limit dBµV	AV Delta dB	Phase -	PE -
0.18	44.54	54.49	9.95	L1	gnd
0.36	29.41	48.73	19.32	N	gnd
1.055	10.34	46.00	35.66	N	gnd
1.235	4.46	46.00	41.54	N	gnd
15.43	44.06	50.00	5.94	L1	gnd
18.105	37.25	50.00	12.75	N	gnd

* limit exceeded

Indicated Phase/PE shows Configuration of max. Emission

Testing of Ai cambridge leakmeter 200

Conducted Emissions

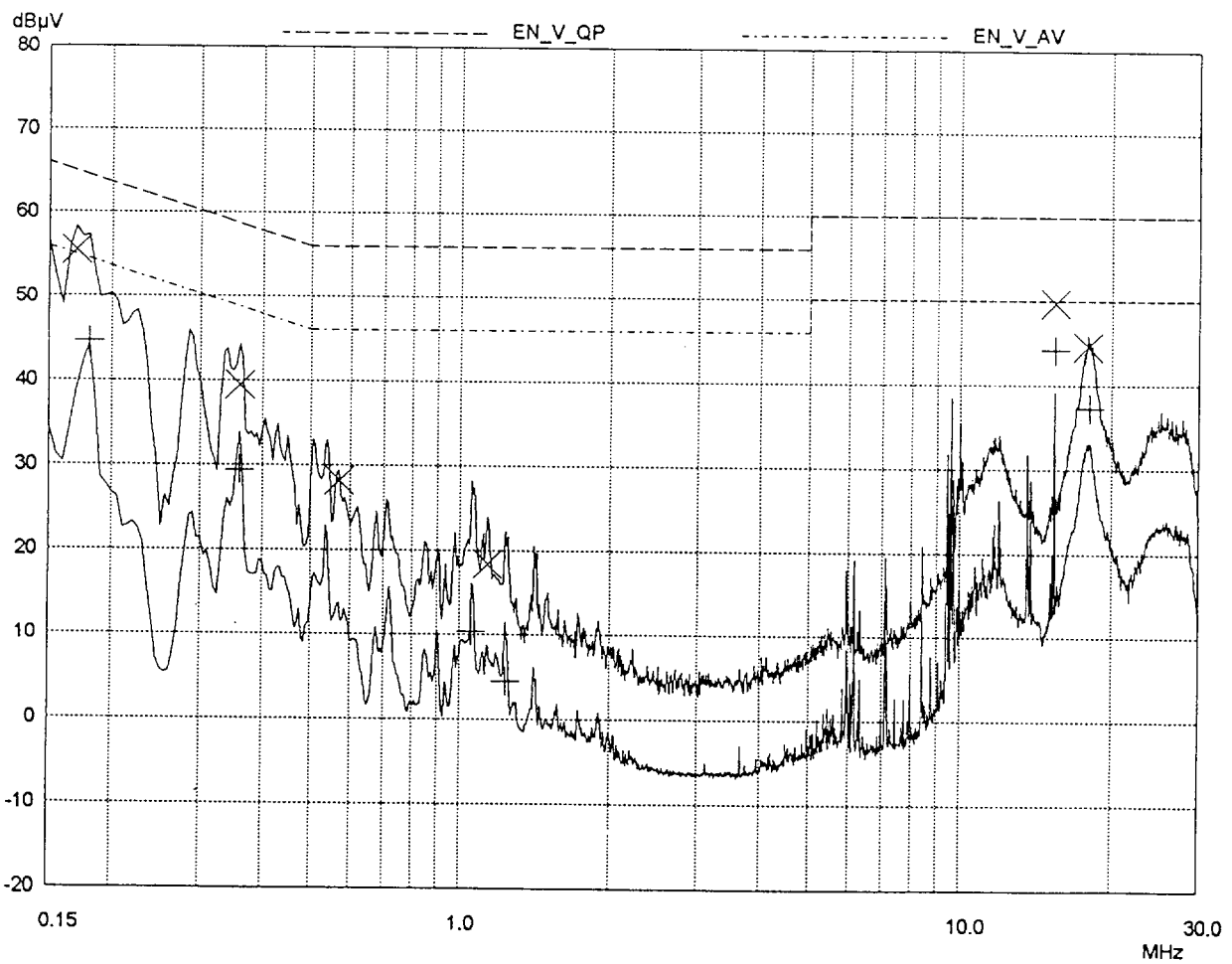
EUT:	leakmeter 200
Manuf:	Ai cambridge ltd
Op Cond:	Unit Energised
Operator:	Edward Walters
Test Spec:	BS6527 Class B (EN50081-1)
Comment:	modification no 2
File:	ai200cem2.dat : AI leakmeter 200 (mod 2) - conducted emissions

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	5kHz	10kHz	PK+AV	20msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	11	9kHz	30MHz	ESH3-Z5

Final Measurement:		
	X QP / + AV	
	Meas Time:	20sec
	Subranges:	8
	Acc Margin:	35 dB



Testing of Ai Cambridge Equipment

Radiated Emissions

EUT: Leakmeter 200
Manuf: Ai Cambridge
Op Cond: EUT ENERGISED, ancillary cables attached
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

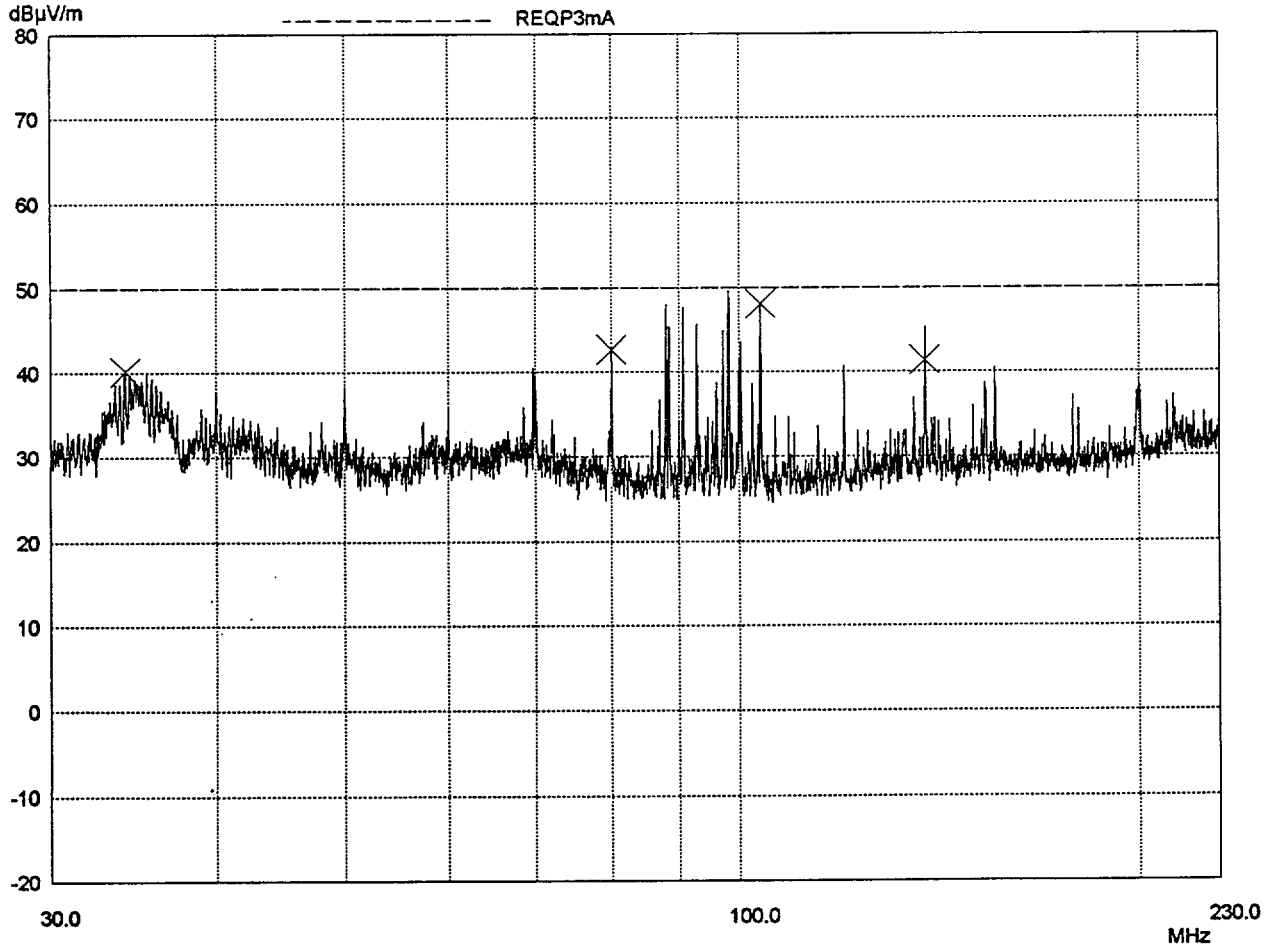
File: ai200ch.dat : Leakmeter 200 modified (2) biconical horizontal

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	230MHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	21	30MHz	300MHz	HK116

Prescan Measurement: X PK
Meas Time: see scan settings
Subranges: 8
Acc Margin: 10 dB



Testing of Ai Cambridge Equipment

Radiated Emissions

EUT: Leakmeter 200
Manuf: Ai Cambridge
Op Cond: EUT ENERGISED, ancillary cables attached
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

File: ai200ch.dat : Leakmeter 200 modified (2) biconical horizontal

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	230MHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	21	30MHz	300MHz	HK116

Prescan Measurement: X PK
Meas Time: see scan settings
Subranges: 8
Acc Margin: 10 dB

Peak Search Results:

Frequency MHz	PK Level dBµV/m	PK Limit dBµV/m	PK Delta dB	Ref. Offset dB
34.15	40.11	50.00	9.89	0.20
80.0	42.60	50.00	7.40	-0.24
103.8	48.12	50.00	1.88	-0.32
138.0	41.33	50.00	8.67	-1.35

* limit exceeded

Testing of Ai Cambridge Equipment

Radiated Emissions

EUT: Leakmeter 200
Manuf: Ai Cambridge
Op Cond: EUT ENERGISED, ancillary cables attached
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

File: ai200bcv.dat : Leakmeter 200 mod 2 bi-conical vertical

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	230MHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	21	30MHz	300MHz	HK116

Prescan Measurement: X PK
Meas Time: see scan settings
Subranges: 8
Acc Margin: 10 dB

Peak Search Results:

Frequency MHz	PK Level dBµV/m	PK Limit dBµV/m	PK Delta dB	Ref. Offset dB
30.0	40.35	50.00	9.65	0.67
69.8	40.33	50.00	9.67	-3.77
92.9	47.50	50.00	2.50	-1.53
120.0	44.32	50.00	5.68	-1.27
153.25	43.90	50.00	6.10	-3.79

* limit exceeded

Testing of Ai Cambridge Equipment
Radiated Emissions

EUT:	Leakmeter 200
Manuf:	Ai Cambridge
Op Cond:	EUT ENERGISED, ancillary cables attached
Operator:	Edward Walters
Test Spec:	EN55022 class B - 3m test
Comment:	

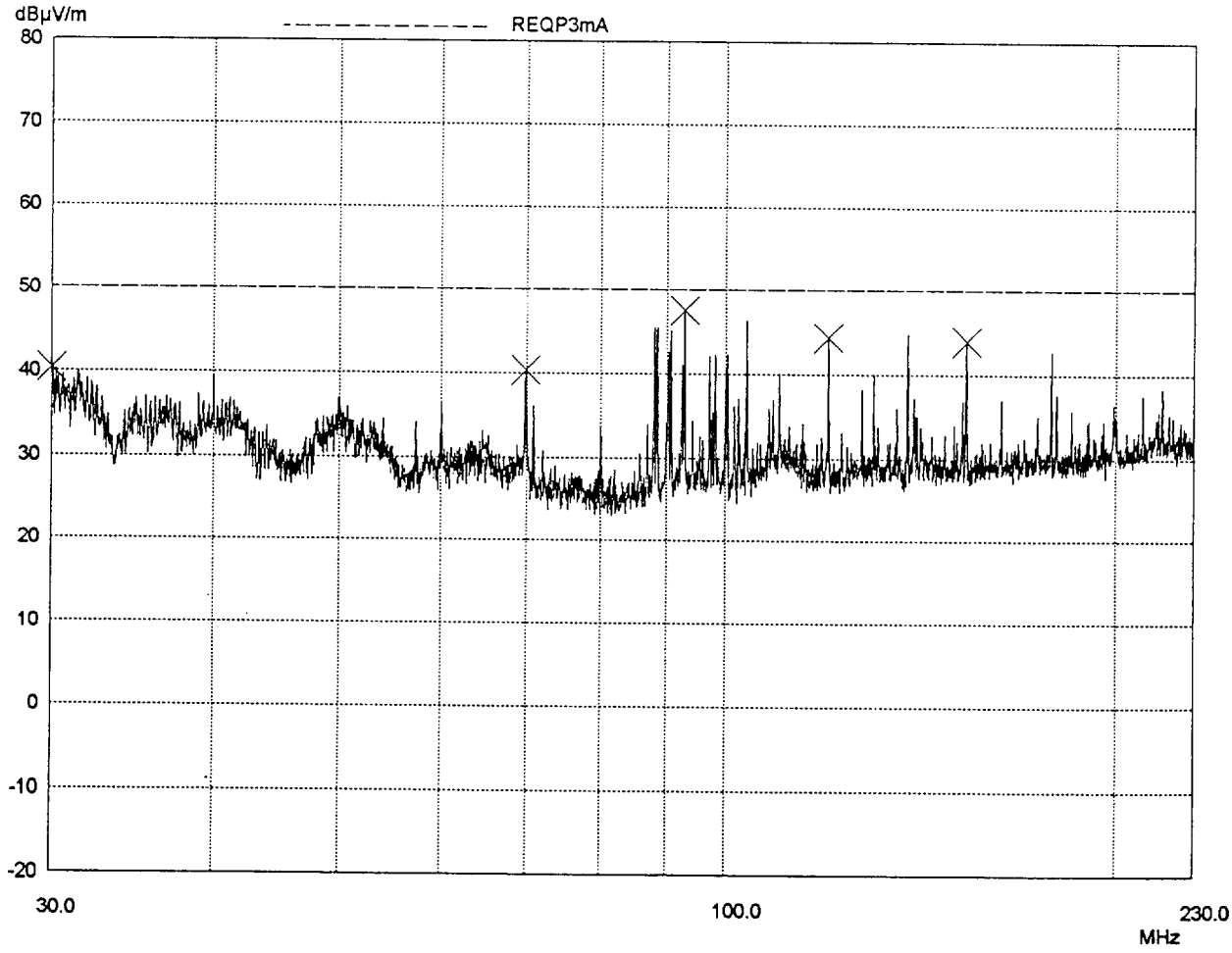
File: ai200bcv.dat : Leakmeter 200 mod 2 bi-conical vertical

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	230MHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	21	30MHz	300MHz	HK116

Prescan Measurement: X PK
Meas Time: see scan settings
Subranges: 8
Acc Margin: 10 dB



Testing of AI equipment

Radiated Emissions

EUT: Leakmaster 200
Manuf: AI cambridge
Op Cond: EUT functional - in RUN mode
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

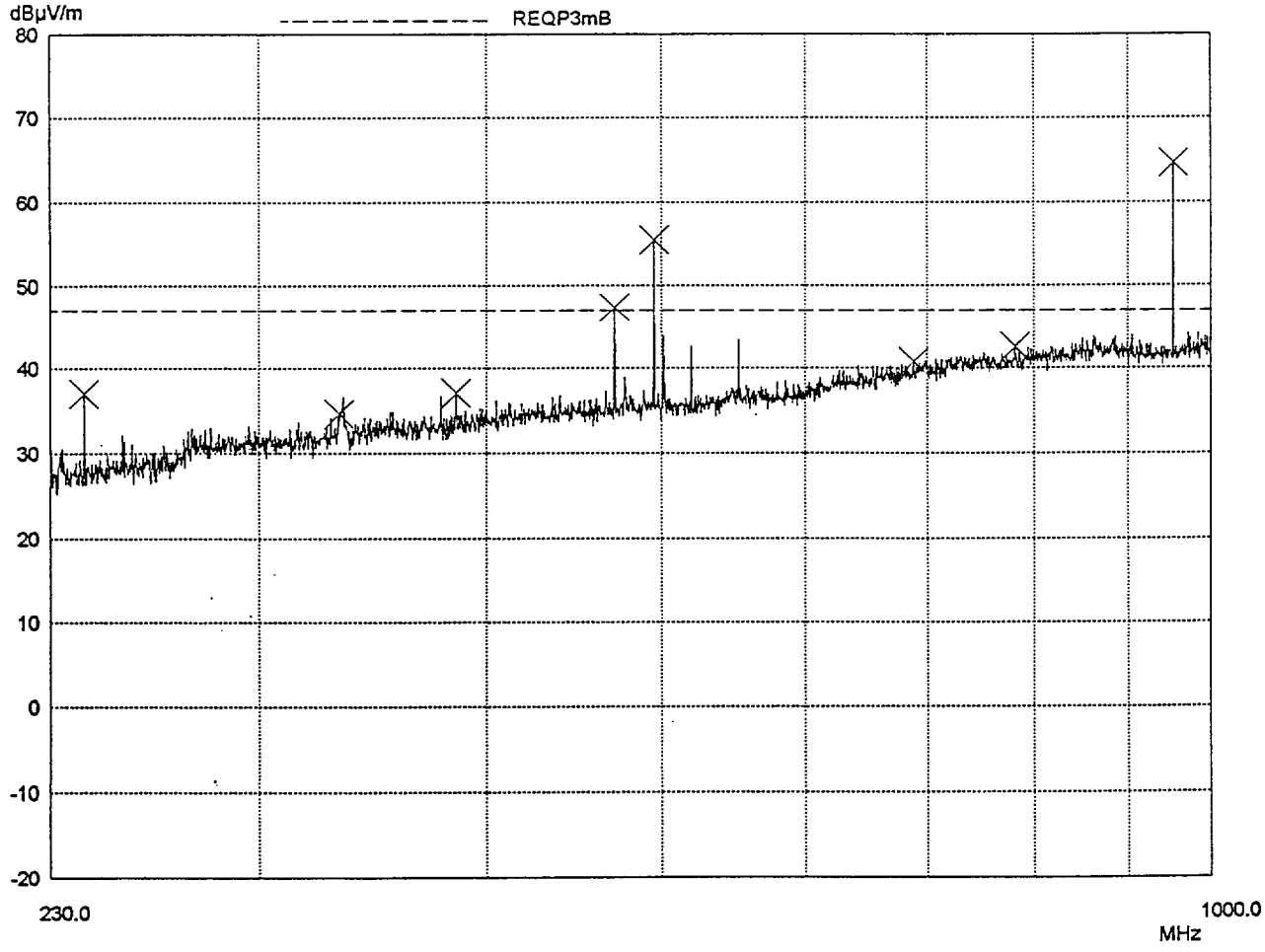
File: aihp200p.dat : prescan results leakmaster 200 log peroidic 230- 1 GHz hor pol

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
230MHz	1GHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	200MHz	1GHz	HL223

Prescan Measurement: X PK
Meas Time: see scan settings
Subranges: 8
Acc Margin: 15 dB



Testing of AI equipment

Radiated Emissions

EUT: Leakmaster 200
Manuf: AI cambridge
Op Cond: EUT functional - in RUN mode
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

File: aihp200p.dat : prescan results leakmaster 200 log peroidic 230- 1 GHz hor pol

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
230MHz	1GHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	200MHz	1GHz	HL223

Prescan Measurement: X PK
Meas Time: see scan settings
Subranges: 8
Acc Margin: 15 dB

Peak Search Results:

Frequency MHz	PK Level dBµV/m	PK Limit dBµV/m	PK Delta dB
240.0	36.98	47.00	10.02
331.75	34.61	47.00	12.39
385.0	37.04	47.00	9.96
471.25	47.32*	47.00	-0.32
495.2	55.49*	47.00	-8.49
687.9	40.72	47.00	6.28
781.1	42.52	47.00	4.48
954.2	64.64*	47.00	-17.64

* limit exceeded

Testing of AI equipment

Radiated Emissions

EUT: Leakmaster 200
Manuf: AI cambridge
Op Cond: EUT functional - in RUN mode
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

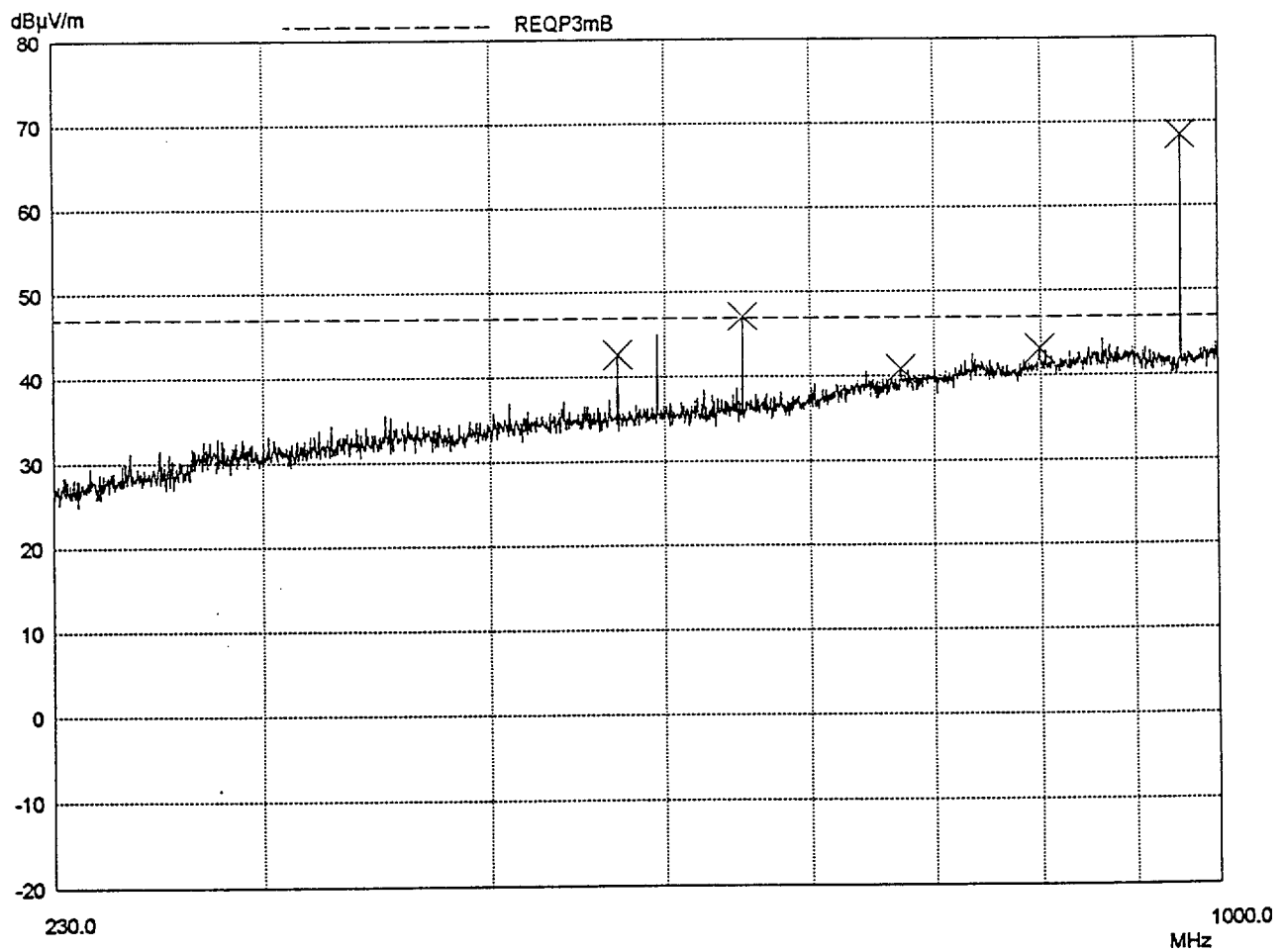
File: aivp200p.dat : prescan results leakmaster 200 log peroidic 230- 1 GHz vert pol

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
230MHz	1GHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	200MHz	1GHz	HL223

Prescan Measurement: X PK
Meas Time: see scan settings
Subranges: 8
Acc Margin: 10 dB



Testing of AI equipment

Radiated Emissions

EUT: Leakmaster 200
Manuf: AI cambridge
Op Cond: EUT functional - in RUN mode
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

File: aihp200f.dat : final results leakmaster 200 log peroidic 230- 1 GHz hor pol

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
230MHz	1GHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	200MHz	1GHz	HL223

Final Measurement: X QP
Meas Time: 20sec
Subranges: 8
Acc Margin: 15 dB

Final Measurement Results:

Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
471.25	52.16*	47.00	-5.16
495.2	56.08*	47.00	-9.08
781.1	36.63	47.00	10.37
954.2	65.60*	47.00	-18.60

* limit exceeded

Testing of AI equipment

Radiated Emissions

EUT: Leakmaster 200
Manuf: AI cambridge
Op Cond: EUT functional - in RUN mode
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

File: aivp200f.dat : final results leakmaster 200 log peroidic 230- 1 GHz vert pol

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
230MHz	1GHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	200MHz	1GHz	HL223

Final Measurement: X QP
Meas Time: 20sec
Subranges: 8
Acc Margin: 10 dB

Final Measurement Results:

Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
471.25	43.10	47.00	3.90
495.2	44.89	47.00	2.11
551.3	46.43	47.00	0.57
954.15	69.64*	47.00	-22.64

* limit exceeded

Testing of AI equipment

Radiated Emissions

EUT: Leakmaster 200
Manuf: AI cambridge
Op Cond: EUT functional - in RUN mode
Operator: Edward Walters
Test Spec: EN55022 class B - 3m test
Comment:

File: aivp200p.dat : prescan results leakmaster 200 log peroidic 230- 1 GHz vert pol

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
230MHz	1GHz	50kHz	120kHz	PK	1msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	200MHz	1GHz	HL223

Prescan Measurement: X PK
Meas Time: see scan settings
Subranges: 8
Acc Margin: 10 dB

Peak Search Results:

Frequency MHz	PK Level dBµV/m	PK Limit dBµV/m	PK Delta dB
471.25	42.58	47.00	4.42
551.3	47.08*	47.00	-0.08
671.25	40.82	47.00	6.18
798.85	43.08	47.00	3.92
954.15	68.45*	47.00	-21.45

* limit exceeded

Appendix 4 Record of modifications

Appendix 5 User manual