PURPOSE

The purpose of this manual is to inform employees of Philips Medical Systems, Inc. (PMSI) of all necessary precautions to be observed when installing, testing, servicing, and observing actual operation of X-ray equipment.

This manual should be read and all procedures set forth strictly adhered to by each and every designated "radiation worker" or employee who works with (and around) X-ray equipment.

THIS IS YOUR PERSONAL COPY. PLEASE USE IT.

RADIATION SAFETY MANUAL

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INTRODUCTION

X-rays are similar in character to radio waves and visible light waves, except for the wave length and frequency. Figure 1 shows this relationship.

Figure 1. The Electromagnetic Spectrum

X-rays act very much like visible light. When a light bulb is turned on in a closed room the entire room will be illuminated because of the direct radiation and diffusion of the light rays. If the light is turned off, the room will become dark; no light remains to radiate or diffuse. X-rays act in the same manner. When an X-ray tube is turned off, it stops emitting radiation, with none remaining to diffuse in the air. Reradiation from irradiated material is an impossibility.

Maintaining distance from an X-ray source is the simplest (and probably the most effective) way to protect yourself from X-radiation. The strength of the X-ray beam attenuates as the inverse square of the distance from the source.

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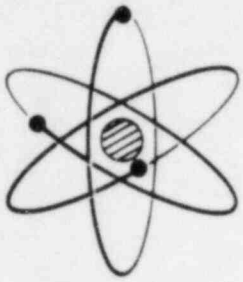

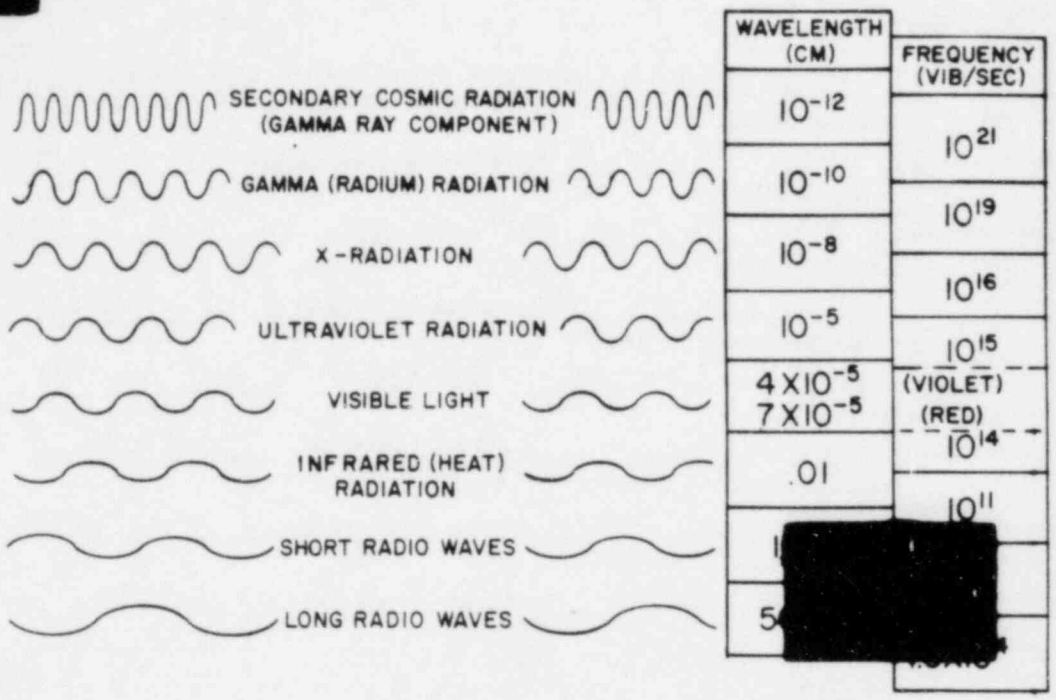

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This is explained mathematically as:

$$I = \frac{1}{d^2}$$

where

I = Radiation intensity

d = Distance

In other words, if we measure at one meter from an X-ray tube and obtain a reading of eight roentgens per minute and then measure at two meters from the same source, we will only read two roentgens per minute.

Another important parameter to keep in mind is time. The total dose a person receives depends upon the dose rate and the amount of time the person is exposed to that dose rate. As an example: A person must remain in a 10R/hour dose rate for one hour to receive a dose of 10R. If the person is in this beam for only one minute then he would only receive a dose of:

$$\frac{10R}{60 \text{ minutes}} = 0.166R \text{ or } 166mR \text{ (milliroentgens)}$$

This is similar to a person sitting in an automobile traveling at 55 miles per hour. The automobile must continue at that speed for a full hour in order to cover a 55 mile distance.

For your own health and safety, please observe all posted precautions, test and operating protocol. Short-cuts which involve safety matters just don't pay off where matters of health and safety are concerned. There are none!

COMPANY AND EMPLOYEE RESPONSIBILITY

As part of PMSI's Radiation Safety Program, the Company provides:

- Personal instruction in radiation safety given by Supervisors
- Relevant manuals, and installation and test instructions for equipment manufactured by the Company
- Radiation safety seminars
- An annual Complete Blood Count (CBC)
- A personal monitoring system (TLD cards and film badges)
- Monitors and survey meters when required
- THIS RADIATION SAFETY MANUAL

EACH OF THESE ITEMS IS COVERED IN DETAIL IN THIS MANUAL.

The general public may not receive more than 500 mR/year whole body exposure from non-medical X-ray exposures. Conversely, a "radiation worker" may receive up to 5,000 mR/year occupational whole body exposure. Refer to Table 1 for detailed maximum exposure. To record this exposure value, radiation workers wear badges. It is assumed that they will be working near operating radiation sources; hence, it is possible for them to exceed the permissible exposure limit for the general public.

TABLE 1. RADIATION PROTECTION GUIDE		
AREA EXPOSED	PERIOD OF EXPOSURE	MAXIMUM DOSE (REMS*)
Radiation Workers		
Whole body, head and trunk, active blood-forming organs, gonads, lens of eye	Lifetime (accumulated dose)	5 x number of years beyond 18
	year	5.0
	13 weeks	1.25
	4 weeks	0.4
Skin of whole body and thyroid	year	30.0
	13 weeks	7.5
Hands and forearms, feet and ankles	year	75.0
	13 weeks	18.75
General Population		
Individual, whole body	year	0.5
*For purposes of X-radiation discussion, 1 rem is considered equivalent to 1 roentgen.		

Those areas where radiation levels may exceed 500 mR/year are designated "Controlled Radiation Areas," and only "radiation workers" are allowed to enter these areas on a regular basis while equipment is operating.

Each and every PMSI employee who installs, services, or tests "live" X-ray equipment is designated a "radiation worker." This designation means:

- "Radiation workers" are assigned individual film badges and/or TLD cards to record lifetime occupational radiation exposure.
- The individual radiation dose received may exceed that of the general public's by a specified amount.
- Each and every individual "radiation worker" is instructed in radiation safety practices.

EVERYTHING YOU'VE ALWAYS WANTED TO KNOW ABOUT RADIATION SAFETY BADGES (BUT WERE AFRAID TO ASK)

HOW THEY OPERATE

A piece of X-ray film is placed between two sets of filters in the holder. When exposed to X-rays and developed, the film shows different degrees of darkness. With this information the radiation badge company can determine the amount and quality of the incident X-ray beam by comparison to calibration curves and standards. The higher the energy the less effect the filters have on preventing blacking of the film. This is an accurate method and universally accepted.

Thermoluminescent dosimeter (TLD) cards contain a small amount of lithium fluoride (LiF) crystals. These crystals absorb the incident X-ray beam and, when heated to a very high temperature (200°-300°C), the crystals glow. The amount of light emitted is an accurate indication of the amount of X-ray energy absorbed.

WHERE AND HOW TO WEAR THEM

Normally, wear the badge in a convenient location, between your waist and neck on the front part of your body. The clip should be located to the rear. If you think another portion of your body is more likely to be exposed, then wear the badge where you think it will record the maximum dose your body is likely to receive. When wearing a protective lead apron, wear your badge under the apron.

BADGE MAINTENANCE AND CONTROL

When not wearing your badge, store it in a cool dry place, such as a tool box, desk drawer, or other convenient location away from heat, sunlight, water, or radiation. Never leave it in your car as the heat from the sun will cause the film to fog and give an erroneous dose reading.

When going on vacation, leave your badge in a safe place; do not take it with you. If transferred to another district office or department take your badge with you. Be sure the Company Radiation Safety Officer is informed of your move.

When transferring to another radiation group, indicate the new group letter and number on you TLD wallet card. This way, the yearly report will be sent to your new group.

Do not contact the radiation badge company directly for any information or requested changes. They have been notified not to act unless authorized by the Company Radiation Safety Officer. This way our records will always be accurate and you can be assured of a single channel for direct action by contacting the Company Radiation Safety Officer directly.

When you terminate employment with PMSI, return your film badge and TLD card promptly. They will be processed and your radiation history brought up to date. This information is available to you at any time.

RADIATION SAFETY PROCEDURES

GENERAL RADIATION SAFETY PROCEDURES

The following General Radiation Safety Procedures must be strictly followed:

- NEVER USE EITHER YOURSELF OR ANOTHER PERSON AS A TEST PHANTOM! VIOLATION OF THIS RULE MEANS IMMEDIATE DISMISSAL.

- Wear your radiation badge while in the vicinity of X-ray equipment on Company business. Do not wear the badge while on personal business or while undergoing a diagnostic X-ray examination.

- Read all relevant manuals and/or specifications before operating, installing, or servicing X-ray generating equipment.

- All permanently installed X-ray equipment must be located in a Controlled Radiation Area.

- Make radiation surveys of X-ray equipment frequently.

- DO NOT DISABLE INTERLOCK(S) UNLESS ABSOLUTELY NECESSARY! IF ABSOLUTELY NECESSARY TO DO SO, PLACE AN APPROPRIATE SIGN AT ANY DISABLED INTERLOCK AND NEVER LEAVE THE EQUIPMENT WITH AN INOPERATIVE INTERLOCK. NEVER REMOVE X-RAY SHIELDS WITHOUT LEAVING AN APPROPRIATE NOTICE EXPLAINING THAT THE EQUIPMENT IS NOT RADIATION SAFE.

- Radiation problems with PMSI equipment as well as radiation accidents must be reported to the Company Radiation Safety Officer immediately.

- Individual employee exposure records are kept in the employee's personnel file and are available upon employee's request, for his/her examination.

- A potential PMSI employee with a previous excessively high radiation record may not be hired by the Company because of the latent health risk.

- Operating X-ray equipment must never be left unattended.

- Report radiation equipment malfunction(s) immediately.

- Because a serious whole body X-ray exposure will affect body chemistry, a mandatory annual blood test is required each June of every "radiation worker," purely as a precautionary measure.

- Female "radiation workers" who are, or who think they are, pregnant must notify their Supervisor, Area Radiation Safety Officer, or Company Nurse immediately. (Pregnant women are NOT to be exposed to radiation while working at PMSI.)

- Persons under 18 years of age are not permitted to enter a radiation area.

PMSI RADIATION SAFETY PROCEDURES

All PMSI personnel who install, service, observe, or test X-ray generating equipment should be given instructions in radiation safety by their Supervisors and by the Area Radiation Safety Officer(s). PMSI personnel who have not received such training should contact their Supervisors and arrange for such an instructional session.

Every PMSI "radiation worker" should make certain that he or she attends at least one of these sessions. Any questions concerning radiation safety will be answered by your Supervisor or your Area Radiation Safety Officer.

RADIATION SAFETY AND BIOLOGICAL EFFECTS TRAINING COURSES

The Company Radiation Safety Officer conducts training courses for PMSI employees to review radiation safety procedures and techniques and biological effects of radiation. These classes are intended to update knowledge and understanding of the Federal, State, and local requirements, safety rules, precautions, and Company policy.

MANUALS AND WRITTEN INSTRUCTIONS

Each piece of X-ray generating equipment comes with an Operating/Installation Service Manual. Each PMSI employee should familiarize himself with the characteristics and functions of the equipment before installing, testing, or servicing it. Manuals are intended for PMSI personnel, as well as owners and operators of the equipment.

NOTE: A WARNING STATEMENT appears on the control panel of each radiation control.

EXAMPLES

WARNING! THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED AND, UNLESS SAFE EXPOSURE FACTORS ARE OBSERVED, MAY BE HAZARDOUS TO BOTH PATIENT AND OPERATORS.

WARNING! THIS X-RAY UNIT MAY BE DANGEROUS TO BOTH PATIENT AND OPERATOR UNLESS SAFE EXPOSURE FACTORS AND OPERATING INSTRUCTIONS ARE OBSERVED.

In addition to the manuals supplied with the equipment, specific instructions or notes may be physically attached to the equipment.

EXAMPLES

CAUTION! THIS EQUIPMENT PRODUCES X-RAYS.

CAUTION! DANGEROUS X-RAYS.

Such instructions should be noted before installing, testing, or servicing the equipment.

RADIATION INCIDENT PROCEDURES

If a suspected radiation incident occurs, take the following actions immediately:

- Contact your local physician and the PMSI Shelton Medical Department, reporting the excessive X-ray exposure. Give all details, i.e., part of body exposed, type, quality and quantity of radiation, intensity, time in beam, etc. The doctor may recommend an immediate physical and blood count. For serious exposure, the doctor may recommend that a radiologist prescribe treatment.

- Immediately contact the Company Radiation Safety Officer at PMSI so any legal requirements may be handled promptly.

- Submit film badge and TLD card for immediate processing to establish the extent of exposure. Results will be forwarded to the Company Radiation Safety Officer within a short period of time.

- If possible, have a qualified radiation physicist determine the extent of actual exposure.

- Submit a written radiation accident report to the Company Radiation Safety officer.

- Do not enter Radiation Areas until cleared by the PMSI Radiation Safety Officer or the PMSI Medical Department.

RADIATION MONITORING INSTRUMENTS

PERSONAL MONITORING SYSTEMS

Each employee classified as a "radiation worker" may be assigned a film badge, TLD card, or both to record his occupational exposure. These must be worn at all times in a Controlled Radiation Area or near an operating X-ray source while working for PMSI. Additionally, film badges and TLD cards must be carried when on Company business, when in the vicinity of X-ray equipment at other than normal work locations.

The Area Radiation Safety Officer will determine which monitoring system (or systems) will be used for people in his/her group.

Film Badge

The film badge helps to protect personnel from excessive exposure by providing a readout and record of any exposure the individual may have received, so that prompt medical attention, if required, can be administered. Each month the film is replaced and the exposed one sent for processing. An exposure report is submitted to the Company Radiation Safety Officer and each Area Radiation Safety Officer approximately two weeks after processing. Any exposure above background is noted, but if the exposure appears abnormal, a request for explanation is forwarded to the individual person and his Area Radiation Safety Officer. Each excessive exposure must be explained and, in certain instances, a report is forwarded to the State Control Agency as well as the Federal Government.

TLD Cards

Thermoluminescent dosimeter (TLD) cards store the incident radiation in a luminescent phosphor, usually lithium fluoride (LiF). These TLD de-tection cards are wallet size and are extremely useful as a back-up to the film badge, or for those who do not normally work in a radiation area but who may occasionally enter one for short periods. TLD cards are issued annually.

RADIATION ALARMS

Both film badges and TLD cards are passive radiation detectors that record exposures but do not give immediate warning of radiation. Active radiation detectors are used for this purpose.

Pocket Radiation Alarms

One type of active detector is the pocket radiation alarm which can be turned on when needed. Pocket radiation alarms should be frequently tested by placing them in a radiation chamber and listening for an audible signal. Pocket radiation alarms contain very small detectors that do not respond to X-rays or energy of less than approximately 50 keV.

Permanent Wall Monitors

In the manufacturing facility, permanent wall monitors may be installed at selected operating equipment sites. These permanent wall monitors are superior to portable instruments because: (1) they are always switched on and perform a continuous monitoring function; (2) no batteries are required; and (3) they can not be "lost," abused, or misused as are portable alarms.

SURVEY METERS

Radiation survey meters are used both for monitoring and checking X-ray equipment for the protection of the operator, and for determining whether the X-ray equipment conforms to the Federal and State Radiation Requirements. Official Radiation Certification can only be performed by or under the guidance of a Certified Health Physicist or a Certified Radiological Physicist. However, Quality Control personnel are permitted to perform radiation surveys, as specified in manufacturing procedures, in order to establish legal compliance of PMSI products. Each employee is expected to survey the X-ray equipment he or she is working on at frequent intervals to ensure a safe environment for all employees in the area.

Active detectors of ionizing radiation include Geiger tubes, scintillation detectors, ionization chambers, solid state detectors, and proportional detectors. When these detectors are integrated into electronic indicating units they form an active radiation sensing instrument, i.e., they indicate that X-rays are, or are not, present.

Each survey meter has specific characteristics that must be matched with the source of X-rays for which it is rated. These include energy response, sensitive detector volume, and type of radiation flux reading (counts/min or mR/hr). The two most commonly used active detectors are the Geiger detector and the ionization chamber.

Geiger Detector Survey Meters

Geiger detector survey meters measure counts per minute which are then converted into milliroentgens per hour. The meters on some Geiger detector survey instruments show both counts/min and mR/hr. The counts/min scale indicates the actual detector response. The mR/hr scale has been determined by calibrating the counts/min scale with a radioactive isotope source. Therefore, unless the meter has been calibrated using the particular X-ray source measured, the mR/hr scale will not indicate true exposure values.

Advantages of Geiger detector survey meters are:

- Rapid response for go/no-go type surveys. The output can be either visual (meter and lights) or audible (speaker or buzzer)
- Sensitivity over large X-ray ranges, although they may not give a linear response
- Very small detector volumes for measuring highly collimated beams
- Low cost
- Small, strong, yet highly reliable

Most pocket radiation alarms are of the Geiger detector type and produce an audible tone for each discharge of the Geiger tube, the frequency of which is proportional to the radiation dose rate. Because the Geiger tube is very small, it is useful only for protection against large area radiation fields, not highly collimated beams. Additionally, Geiger tubes are usually made with steel walls so that no response is given to X-rays of energy less than approximately 50 keV.

Ionization Chamber Survey Meters

Ionization chamber survey meters indicate true milliroentgens per hour over the energy range for which they are designed. These meters usually have a slow response time which makes then unsuitable for rapid surveys or short exposures. In addition, they are quite fragile and require frequent calibration. However, they do:

- Indicate true exposure rates in mR/hr
- Give accurate readings over large X-ray ranges (e.g., the Victoreen 440 gives readings within 15% over the range 6.5 keV to 1.2 MeV)

Integrating Survey Meters

Survey meters that indicate only rates are not suitable for measuring the X-ray exposure from pulsed sources or from short exposures because the response time of the meter is very long compared to the X-ray pulse length. Therefore, an integrating survey meter is required that will accumulate the exposure from a specific number of pulses enabling the exposure (in roentgen units) per pulse to be determined. A dose rate can be calculated by multiplying the roentgen units per pulse times the number of pulses per unit time (second, minute, hour).

Film badges and TLD cards are integrating devices that show total exposure no matter the exposure rate. Even though each pulsed exposure may be small, the total exposure accumulates rapidly because of the rapid pulse rate.

Selecting a Survey Meter

When using a survey meter for measurement or test, remember:

- Select a meter designed for the X-ray energy range emitted by the equipment. In addition, if the primary X-ray beam is scattered, it will result in a lower energy X-ray. Thus, the meter must be able to detect energies of at least half that of the primary beam.

- Geiger detector survey meters only give count rates, not milliroentgen/hour rates.

- Use a Geiger detector to locate a radiation leak and an ionization chamber to measure it (correcting for beam size, if possible).

- The larger the sensitive detector volume, the greater the error when measuring a highly collimated beam as only part of the detector volume is being activated.

- Only end-window Geiger tubes respond to very low energy X-rays. Side window Geiger tubes are seldom responsive to less than 50 keV X-rays.

RADIATION SAFETY BADGE POLICY AND PROCEDURE

GENERAL COMPANY POLICY

To maintain a safe environment for PMSI employees and visitors.

PURPOSE

To establish a monitoring system for reporting and measuring any occurrence of radiation exposure to individuals involved in, or observing, PMSI operations.

SCOPE

This policy and procedure shall be applicable to all PMSI employees and visitors who must be in a radiation area on company business.

POLICY AND PROCEDURE RESPONSIBILITIES

Implementation

Those designated as Area Radiation Safety Officers (ARSO) will implement and maintain this procedure.

Compliance

The Company Radiation Safety Officer (CRSO) will ensure strict compliance with this Policy and Procedure.

RADIATION SAFETY OFFICERS

Company Radiation Safety Officer

Responsible for setting PMSI Radiation Safety Policies and administering Company Radiation Safety Program.

Assistant Company Radiation Safety Officer

Will function as Company Radiation Safety Officer when necessary.

Area Radiation Safety Officers

Individuals have been designated responsible for each group and it is their function to administer the Radiation Badge Program for their respective group. Refer to the attached list for the current officers.

BADGE FUNCTIONS

Badge issuance and monitoring procedures are based upon badge function. Badge functions are determined according to the classification of individual and the length of assignment in the radiation area as shown in Table 2.

BADGE ISSUANCE

All radiation safety badges are issued on the basis of the functions shown in Table 2. No permanent badge will be issued to a PMSI employee until the medical examination and Complete Blood Count (CBC) are approved by the PMSI Medical Department.

Temporary Badges

All temporary badges (Visitors, Short Term, and Interim) are issued by the Company Radiation Safety Officer. Application is made on the "Temporary Radiation Badge Record" PMSI Form 105 (Exhibit A), available from the CRSO. All such forms must be signed by the individual receiving the badge and the Area Radiation Safety Officer responsible for the individual, except for visitors. The visitor's escort will sign and assume responsibility for the visitor's safety.

Visitors and Other Non-PMSI Employees must provide home address and/or company affiliation and address in the box provided at the bottom of the form so that any report of radiation which he/she receives can be forwarded.

Short Term Badges are issued to individuals who are assigned to a radiation area for a period of less than two months.

TABLE 2. BADGE FUNCTIONS				
CLASSIFICATION OF INDIVIDUAL AND DURATION IN RADIATION AREA	TEMPORARY BADGES			PERMANENT BADGES
	VISITOR	SHORT	INTERIM*	
PMSI EMPLOYEES New Hire - permanent assignment			X	X
Transfer - permanent assignment			X	X
Temporary Assignment - Less than 2 months		X		
More than 2 months			X	
OTHERS ON ASSIGNMENT TO PMSI (Employees of N.V. Philips, contract personnel, job shop personnel, consultants) Less than 2 months		X		
More than 2 months			X	X
VISITORS	X			

*Interim badges are issued only to those who have received clearance for a permanent badge.

Interim Badges are issued only to those individuals who have fulfilled the requirements for a permanent badge but have not yet received it.

Permanent Badges are issued to individuals who must frequent a radiation area for more than two months. A radiation history and complete blood count are required before the badge will be approved for PMSI employees by the CRSO.

A Radiation History must be provided by every applicant on the Radiation History card shown in Exhibit B. The form must be signed by the individual and the Company Radiation Safety Officer. The Area Radiation Safety Officer certifies that a briefing has been held with the employee, and selects the type of monitoring for the individual.

A Complete Blood Count (CBC) must be performed and the results approved by the PMSI Medical Department.

MONITORING SYSTEM

When to Wear Badges

Individuals who are assigned badges must wear them at all times while working on Company business. Badges should not be taken from company facilities except when an individual must travel directly between his/her home and a temporary work site or to a PMSI customer location.

Positioning of Badge

Radiation safety badges must be worn on the front of the body facing forward (preferably in the high chest area, such as clipped to the tie). The badge may be positioned at the waist.

Collection and Submission of Badges and Inserts

Visitors Badges are returned at the end of the visit to the CRSO. It is the responsibility of the individual who signs for the visitor to return the badge to the CRSO at the end of the visit.

Short Term Badge film is collected by the CRSO on a schedule established with the radiation badge service company.

Permanent Badge film inserts will be replaced by the Area Radiation Safety Officer, who will submit the film directly to the radiation badge service company. The schedule for exchanging inserts and submitting film is established by the CRSO.

Radiation Reports

Reports are received from the radiation badge service company. Each report lists any radiation recorded by the badge for that period. The cumulative total exposure is also shown for those individuals who have permanent badges. Each Area Radiation Safety Officer receives a copy of the report for his/her area. The CRSO receives a report for all areas, which he reviews and forwards to the Company Medical Department for record retention.

If Exposure is Recorded by Badge the following steps are taken. If exposure is:

300 mR or more in any single badge period: A report must be prepared and signed by the individual and submitted to the CRSO. The report must describe the exposure incident and steps to be taken to avoid recurrence.

5R or more in any single badge period: A report must be submitted as above. In addition, the individual must have a blood test immediately. The results are submitted to the Medical Department for review. If follow-up action is required, the individual and the Area Radiation Safety Officer are notified by the CRSO.

3R cumulative in any calendar quarter or 5R cumulative in any calendar year: Such cases of exposure are reviewed by the CRSO and Medical Department to determine action to be taken.

GENERAL REGULATIONS

Visitors

The visitor's escort must point out any hazardous area which the visitor may be entering and will ensure that all Company radiation safety rules and precautions are observed. The escort must also inform the appropriate Area Radiation Safety Officer that a visitor will be present. Any special instructions must be followed.

Non-Medical Exposure of Employees

No employee may use himself/herself or another individual as a radiation test phantom for testing equipment. Violation of this regulation is cause for dismissal.

Individuals Under 18 Years of Age

Persons under 18 years of age must receive special approval from the CRSO and the Medical Department to be allowed in any radiation area. This is to ensure conformance to radiation regulations.

Record Requests

Any employee may see his/her radiation monitoring record. Any employee is entitled to an annual written report if requested.

Contacts with Radiation Badge Service Company

All contact with the radiation badge service company is to be made through the Company Radiation Safety Officer.

RADIOACTIVE MATERIAL POLICY AND PROCEDURE

PURPOSE

PMSI requires a strict policy and operating procedure for storage, handling, and using radioactive materials in order to safeguard the health of employees and to prevent accidents.

GENERAL CONTROLS

Organization

The Radiation Safety Program is administered by the Radiation Safety Officer (RSO) listed for each class of material. There is a Radiation Safety Committee (RSC) composed of:

(a) A Certified Health Physicist (CHP) or Certified Radiological Physicist (CRP) (Chairman)

(b) Medical Director

(c) Director of Engineering

(d) PMSI Legal Counsel

(e) Company Radiation Safety Officer

Safety Procedures

All employees working with radiation or in a radiation area will be monitored to record their occupational exposure.

All employees monitored will have formal training in radiation safety and biological effects. No employee is permitted to use himself or another person as a test phantom. Doing so is cause for immediate dismissal from PMSI.

A Radiation Safety Manual will be given to each radiation worker.

When radioactive material is not in use, it will be stored in a safe manner to prevent unauthorized use.

ORDERING AND RECEIVING PROCEDURE

Ordering Procedure

Any person requiring radioactive material for use at PMSI facilities must obtain the written approval of the Company Radiation Safety Officer or the PMSI Certified Radiological Physicist. No purchase order will be processed without one of these approvals. This is to ensure compliance with PMSI/NRC licenses and that adequate storage and handling capabilities are available.

Receiving Procedure

Upon receipt of any radioactive material, the Receiving Department will immediately notify either the RSO or CRP. The shipment will be immediately checked and moved to a safe area under the control of the RSO or CRP. Proper precautions and procedures will be followed, depending upon the class of material.

Storage of Radioactive Material

Radioactive material will always be stored in a safe container and under sufficient control to prevent unauthorized use or a radiation hazard.

Identification of Material and Areas

All radioactive material will be identified by type of material and its activity. This marking shall be on all containers, including the smallest container holding the source so that it cannot lose its identify.

Each area where radioactive material is stored or used shall have signs prominently posted that describe the area, i.e., "Radiation Area," "Radioactive Material Area," or "High Radiation Area." The signs selected shall depend upon the maximum strength and/or dose a person can receive from the material.

Storage of Radioactive Material

Radioactive material will always be stored in a safe container and under sufficient control to prevent unauthorized use or a radiation hazard.

Special Procedures and Control

PMSI uses three (3) classes of radioactive material. Each has its own particular cautions, uses, and methods of handling. The classes are:

Class I

Material	Co 60
Total Amount	44,000 curies
No single source	to exceed 11,000 curies
NRC License	06.10081.02 as amended
RSO	See separate list for current name.

Class II

Material	Cs 137 Ba 133
Total Amount	100 millicuries 100 microcuries
Material	Americium 241 sealed source
Total Amount	Not to exceed 10 millicuries per source
NRC License	06.10081.03 as amended
RSO	See separate list for current name.
Individual Users	See separate list for current names

Class III

Material Type and Amount	As specified in 10 CFR, Part 30 Section 30.70
NRC License	None required
Individual Users	Persons authorized by the RSO

Class I Material

Class I material is used for cobalt therapy installations and, as such, will never be brought into the Shelton facility. It will be handled at the customer's premises under the control of the persons listed. Refer to NRC License No. 06.10081.02 for procedures, methods, and safety precautions when handling this material.

Class II Material

The Cs 137 source is used as a calibration standard by the Calibration Laboratory to check monitoring instruments. Its calibration is traceable to N.B.S. The Ba 133 source will be used for certain testing requirements by authorized personnel. The only persons authorized to use these sources are listed. Details concerning procedures, methods, and safety precautions are given in NRC License No.06.10081.03 and procedures in this manual. The sources will be stored in an area labeled "Radiation Area," "Radioactive Material." When in use, the signs must be changed to "High Radiation Area."

Class III Material

Class III material is stored in the Manufacturing Department Tool Room in a locked container. Its use is limited to those persons who have on file with the CRSO an approved "Application to Use Radioactive Materials" form (Exhibit C).

Disposal of Radioactive Material

Class I material will be returned to source of purchase for proper disposal. Refer to NRC License No. 06.10081.02 for complete details.

Class II material will be returned to source of purchase for proper disposal if it is no longer required.

Class III material will either be returned to source of purchase or sent to a commercial authorized radioactive material disposal company.

Leak Testing Procedure

A leak testing and wipe test will be performed on all sealed sources when received and at semi-annual intervals thereafter. The procedure to be followed for leak testing is set forth in NRC License No. 06.10081.03.

PROCEDURE FOR THE USE OF Cs 137 RADIOISOTOPE SOURCE FOR CHECKING AND CALIBRATING X-RADIATION MEASURING EQUIPMENT

SCOPE

This procedure describes the procedure, method, and safety requirements to be used while using the Cs 137 radioisotope calibration source.

PURPOSE

This procedure is in compliance with NRC regulations to provide a safe environment during use.

APPLICABILITY

This procedure applies to all personnel authorized to use the Cs 137 radioisotope source.

EFFECTIVITY

This procedure is effective immediately upon receipt.

AUTHORITY

Authority to operate and use the Cs 137 radioisotope source is granted by our NRC license and only the personnel designated may operate and use the Cs 137 radioisotope source:

See separate list for current names.

SAFETY EQUIPMENT REQUIRED

- Lead Apron
- Lead Gloves
- Radiation Monitor

POSTING OF RADIATION WARNING SIGNS

A "High Radiation Area" sign will be hung outside of the Calibration Laboratory door during the use of the Cs 137 source.

CLEARING AREA OF UNNECESSARY OR UNAUTHORIZED PERSONNEL

Before the source is used, only people required will be allowed in the Calibration Laboratory. The Calibration Laboratory door will be locked. A survey will be made of the Calibration Laboratory and the survey meter will be left 'on' in the area where personnel will stand when the Cs 137 source is operational.

PROCEDURE FOR USE

Setup

The source container will be placed as shown in Figure 2.

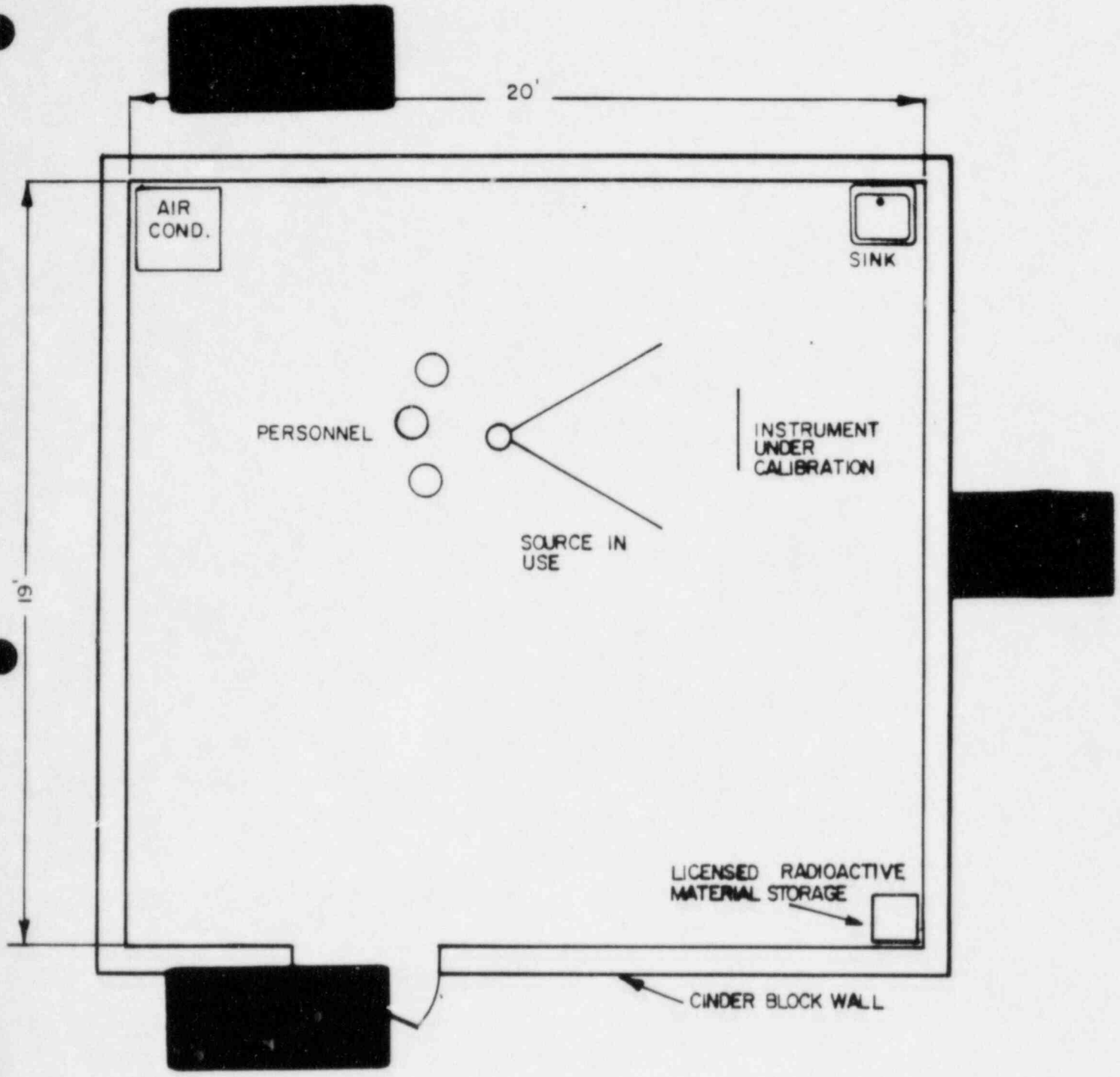

20'
19'
AIR COND.
SINK
PERSONNEL
INSTRUMENT UNDER CALIBRATION
SOURCE IN USE
LICENSED RADIOACTIVE MATERIAL STORAGE
CINDER BLOCK WALL

Figure 2. Calibration Laboratory

Survey Prior to Operation

Set the distance from source to detector head to the distance required by the calibration procedure for the device being calibrated. When all personnel are to the rear of source, energize the source by turning the timer knob on the source past 5 minutes and then bring it back to approximately 30 seconds. Now pull rod in center of source up. Wait until reading stabilizes and record.

Wait until timer times out and rod drops back into source. DO NOT set the next distance until this occurs.

Repeat until all distances are checked.

Secure source with lock; survey source to make sure that it is safe. Return source to storage area, and remove "High Radiation Area" sign from Calibration Laboratory door. Calibration Laboratory may now resume normal operation.

PROCEDURE FOR USING SEALED RADIOACTIVE MATERIALS

SCOPE

This procedure describes the method and safety requirements for using sealed radioactive sources in the Engineering Lead Room or in the Calibration Laboratory.

PURPOSE

This procedure is in compliance with Nuclear Regulatory Commission (NRC) regulations to provide a safe work environment.

APPLICABILITY

This procedure applies to all personnel authorized to use radioactive materials.

EFFECTIVITY

This procedure is effective immediately upon receipt.

AUTHORITY

Authority to use licensed sources is granted by NRC and is specified on PMSI's license. The following persons only may use this material:

See separate list for
current names.

SAFETY EQUIPMENT REQUIRED

- Lead Apron
- Lead Gloves
- Radiation Monitor
- Portable Lead Shields (as required)

POSTING OF RADIATION WARNING SIGNS

A "High Radiation Area" sign will be hung outside the Engineering Lead Room door or the Calibration Laboratory door, whenever a radioactive source is to be used inside. PMSI's Lead Room design is shown in Figure 3.

CLEARING ROOM OF UNNECESSARY PERSONNEL

The person(s) authorized to use the radioactive source has the responsibility to ensure that only persons required for the performance of the test are present in the room before unlocking the source container. If the person responsible for the source is required to leave the room for any reason with the source not locked in its safe container, he must clear the Lead Room, lock the door, and retain the door key.

NOTES:

1. CEILING 10 FT. HIGH
2. (4) FOUR WALLS AND CEILING COVERED WITH 1/8" LEAD
3. METAL DOORS LINED WITH 1/8" LEAD
4. FLOOR 8" CONCRETE ON GROUND

Figure 3. Engineering Lead Room

PROCEDURE FOR USE

The radioactive material to be used will be checked in its locked container, using a radiation monitor or survey instrument, before being taken from storage in the Calibration Laboratory.

The radioactive material will be carried, by an authorized person, in a locked container from the Calibration Laboratory to the Engineering Lead Room, if the source is to be used there. The locked container will be rechecked with a radiation monitor or survey instrument immediately after being placed in the Engineering Lead Room and before unlocking the container.

Because of the nature of the tests which will be run, a detailed testing procedure cannot be given. However, these general rules should be followed when using the source:

(a) Keep the source inside its locked storage container except when in active use.

(b) Always wear protective clothing (lead apron and gloves) when handling the source.

(c) Ensure that no unnecessary persons are present when using the source.

(d) Ensure that all persons present are properly monitored by film badges and/or TLD cards.

(e) Ensure that there is always a radiation monitoring instrument in the area.

(f) The person authorized to use the source is responsible for observing all safety rules.

(g) Whenever handling a sealed source, visually check for any possible crack in the container. If suspicious, notify the Company Radiation Safety Officer and perform a wipe test.

TEMPORARY RADIATION BADGE RECORD Badge #_____

Name: (Print)_____ Signature:_____

Badge Issued for:

☐ Visitor

☐ Short Term Assignment of Less than Two Months
(PMSI Employees, N.V. Philips Employees, Contract Personnel & Consultants)

☐ Interim Period (Until permanent badge is received)

Reason for Issuance: _____

Area Assigned or Visited: _____

Individual Responsible for Radiation Safety

Name: _____ Signature: _____

Date Issued _____ Date Returned _____

Badge Analysis Results _____

For Non PMSI Employees (for Radiation Reporting Purposes)

Home Address	Company

EXHIBIT A

18340

RADIATION HISTORY

Name _____ Social Security No. _____

Department Name or
District Office _____ Date of Birth _____

Past History of Occupational Radiation Exposure: (Dates and Amount of Exposure)(Obtain From Previous Employer(s))

I certify that the above information is correct to the best of my knowledge.

Radiation Safety Briefing _____ Date

Request TLD Card ☐ Film Badge ☐

_____ Employee Signature _____ Date

_____
Area Radiation Safety Officer

Approved By

_____
Company Radiation Safety Officer

Blood Count Approved _____ Date Card/Badge Ordered _____ No. _____ Gp. _____

RADIATION HISTORY

Record all exposures.

Date	Amount	Date	Amount

Exhibit B

APPLICATION TO USE RADIOACTIVE MATERIAL

NAME _____

DEPARTMENT _____

JOB TITLE _____

TYPE OF TRAINING

PAST EXPERIENCE WITH RADIATION

TYPE	AMOUNT	WHERE	CONDITIONS OF USE	TIME

Signed _____ Date _____

Approvals _____ _____ _____

Department Mgr. Area RSO Company RSO

Exhibit C

We request the following changes to our present license, as amended:

1. Delete Eric C. Lavers as an authorized user.

2. Add Charles Worrilow as an authorized user. His resume is included in our response to items 16 and 17.

3. Add new source for survey meter calibration, Americium 241. This is described in Tab 13.

Americium 241

Sealed Source

Not to exceed 10 millicuries per source

Mfg: Amersham International plc.
White Lion Road, Amersham
Buckinghamshire, England HP79LL

Container - See attached sheets for description of sealed source container from Amersham and its specifications.

The sealed sources are housed in a special Philips container so that they can be used safely for calibration purposes. Drawings and description of this special container are described in Tab 14.

Americium-241

Disc sources, stainless steel window, 0·2–0·25mm thick

Americium-241 incorporated in a ceramic enamel sealed in a welded stainless steel capsule.

Sources codes AMC.61–66 are designed for backscatter applications; the active area is recessed into a tungsten alloy backing.

activity mCi	capsule (see pages 72, 73)	code	availability
0·1	X.10	AMC.61	D1
1	X.10	AMC.62	D1
3	X.10	AMC.63	D1
10	X.10	AMC.64	D1
30	X.11	AMC.65	D1
100	X.11*	AMC.66	D1
100	X.91	AMC.16	D1
300	X.92	AMC.17	D1
500	X.97	AMC.18	D1
1000	X.93	AMC.19	D1
3000	X.94	AMC.30	D3
5000	X.95	AMC.50	D3

(*active dia. for AMC.66 is 8mm).

Disc sources, beryllium window, 1mm thick

Americium-241 as oxide incorporated in a rolled aluminium foil, sealed in a monel capsule with beryllium window; the active area is recessed into a tungsten alloy backing.
These sources are designed for applications where the Np L X-rays are also required.

0·1	X.130	AMC.1301	D3
1	X.130	AMC.1302	D3
3	X.130	AMC.1303	D3
10	X.130	AMC.1304	D3
30	X.131	AMC.1315	D3
100	X.131	AMC.1316	D3
100	X.134	AMC.1346	D3

Line sources, incorporating swaged wire

Americium-241 as oxide incorporated in a swaged aluminium wire, sealed in a welded stainless steel capsule.
Sources can be supplied in lengths up to 2m, with activities up to ~50mCi/cm, in the type X.107 capsule; selected examples only are listed.

10	X.104/1	AMC.44	D1
30	X.104/2	AMC.45	D1
100	X.104/3	AMC.46	D1
300	X.104/4	AMC.47	D1
500	X.104/5	AMC.48	D1
1200	X.107/3	AMC.1071	D5
2500	X.107/4	AMC.1073	D5
5000	X.107/2	AMC.1076	D5

Line sources, incorporating ceramic beads

Americium-241 incorporated in ceramic beads, sealed in a stainless steel capsule, type X.103.

10	X.103	AMC.34	D1
100	X.103	AMC.36	D1

Point sources

Americium-241 incorporated in a ceramic bead, sealed in a stainless steel capsule (type X.100–102) or in a stainless steel capsule with conical aluminium window (type X.106).

2	X.100	AMC.21	D1
14	X.101	AMC.24	D1
45	X.102	AMC.25	D1
14	X.106	AMC.1064	D1

Annular sources, stainless steel window

Americium-241 incorporated in a ceramic enamel, sealed in a welded stainless steel annular capsule.

10	X.85	AMC.8504	D2
100	X.85	AMC.8506	D2
1000	X.85	AMC.8509	D2

Annular sources, beryllium window

Americium-241 incorporated in rolled aluminium foil, sealed in an annular capsule with beryllium window and stainless steel holder.

These sources are designed for applications where the Np L X-rays are also required.

10	X.87	AMC.8705	D3
100	X.87	AMC.8706	D3
1000	X.87	AMC.8708	D3

Testing
Wipe test A
Bubble test D
Immersion test L

Special testing: see pages 72, 73.

Neutron emission

All ^{241}Am sources emit ~10^4 n/sec per Ci due to (α, n) reactions with the low atomic number elements (e.g. Si, Al, O) in the active material.

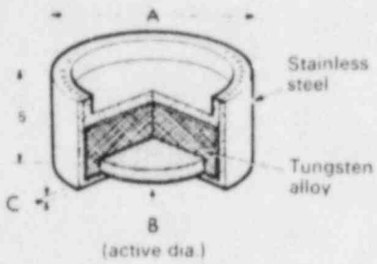
The use of Be windows does not increase this emission significantly.

Specifications:
Only typical sources are listed.
Enquiries invited for sources to other specifications.

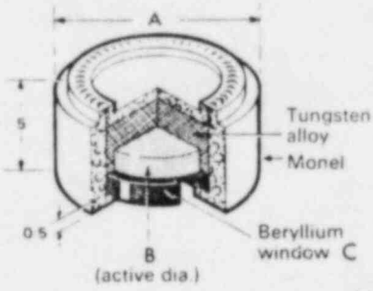
Testing:
Leakage and Contamination tests, see page 7.
A Test Report is supplied with each source or batch of sources.

Capsules for low energy gamma and X-ray sources

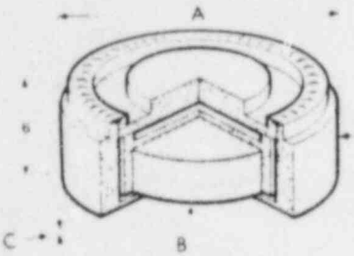
Disc sources



X.10,11

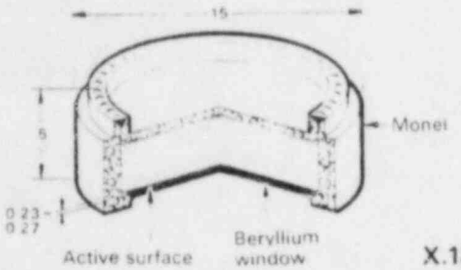


X.130,131,134



X.91-95,97

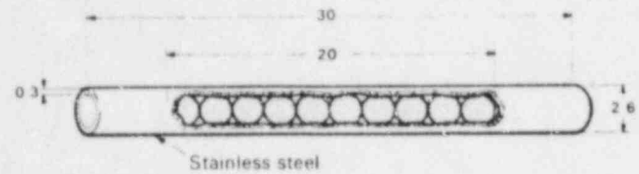
capsule type	overall dia. 'A' mm	active dia. 'B' mm	window thickness 'C' mm	Special testing IAEA Special form	ANSI Classification	ISO Impact test
X.10	8	4·2	0·2–0·25	SFC.3	C54544	
X.11	10·8	7·2	0·2–0·25	SFC.4	C54544	
X.91	10·8	7·6	0·2–0·25	SFC.38	C54444	
X.92	15	12	0·2–0·25	SFC.39	C44444	
X.93	30	25	0·2–0·25	SFC.40	C33434	
X.94	36	31	0·25–0·3	SFC.107		
X.95	45	40	0·25–0·3	SFC.121		
X.97	22	18	0·2–0·25	SFC.41	C44144	Class 4
X.130	8	4·2	0·95–1·05			
X.131	10·8	7·2	0·95–1·05	SFC.110	C44344	
X.134	15	10·6	0·95–1·05			



X.133

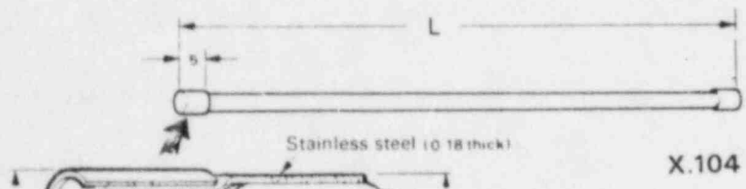
Special testing:
ANSI Classification, C43444

Line sources

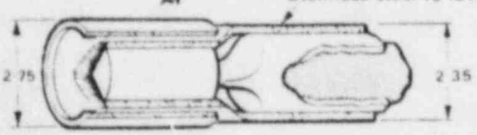


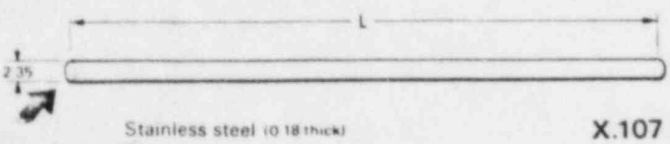
X.103

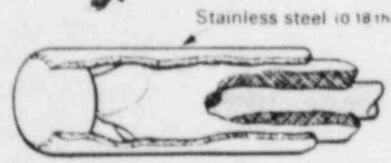
Special testing:
IAEA Special form, SFC.42
ANSI Classification, C44344



X.104







X.107

capsule type	length 'L' mm	Special testing IAEA Special form
X.104/1	30	SFC.109
2	70	SFC.109
3	26	SFC.109
4	69	SFC.109
5	90	SFC.109
X.107/1	2000	SFC.123
2	1000	SFC.124
3	600	SFC.125
4	500	SFC.126

Figure 43

Dimensions in mm

ISO Classification

The International Organization for Standardization (ISO) has proposed a system of classification of sealed radioactive sources based on safety requirements for typical uses (see ISO 2919).

This system provides a manufacturer of sealed radioactive sources with a set of tests to evaluate the safety of his products under working conditions. It also assists a user of such sealed sources to select types which suit the application he has in mind, especially where protection against the release of radioactive material is concerned.

The tests to which prototype sources are subjected are listed in Table 1.
Each test can be applied in several degrees of severity. Test results are expressed as a five figure code to indicate the severity of the tests.
These figures are preceded by the letter C or E to show whether the source activity is less than or greater than certain limits. These limits depend upon the toxicity, solubility and reactivity of the active component of the source.
C indicates that the activity level of the source does not exceed the prescribed limit and
E that the limit is exceeded.

Table 1. Classification of sealed source performance standards

Test	Class 1	2	3	4	5	6
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
External pressure	No test	25kPa absolute to atmospheric pressure	25kPa absolute to 2 MPa absolute	25kPa absolute to 7MPa absolute	25kPa absolute to 70MPa absolute	25kPa absolute to 170MPa absolute
Impact	No test	50g from 1m	200g from 1m	2kg from 1m	5kg from 1m	20kg from 1m
Vibrations	No test	30min 25Hz to 500Hz at 5gn peak amplitude	30min 25Hz to 50Hz at 5gn peak amplitude and 50Hz to 90Hz at 0·635mm amplitude peak to peak and 90Hz to 500Hz at 10gn	90min 25Hz to 80Hz at 1·5mm amplitude peak to peak and 80Hz to 2000Hz at 20gn		
Puncture	No test	1g from 1m	10g from 1m	50g from 1m	300g from 1m	1kg from 1m

Notes to Table 1

1. Details of the testing procedures are given in ISO 2919 and BS 5288. A further class X can be used where a special test procedure has been adopted.
2. **External pressure**
   100kPa = 1 atmosphere (approx.)
3. **Impact test**
   The source, positioned on a steel anvil, is struck by a steel hammer of the required weight; the hammer has a flat striking surface, 25mm diam. with the edges rounded.
4. **Puncture test**
   The source, positioned on a hardened steel anvil, is struck by a hardened pin, 6mm long, 3mm diam. with hemispherical end, fixed to a hammer of the required weight.

Quality control

Testing for leakage and contamination

Stringent tests for leakage are an essential feature of radioactive sources production. The methods adopted depend on the design and intended application of the source, and also on statutory requirements. Where necessary, tests can be specially modified to meet particular requirements.

The standard methods used for testing radiation sources are listed below.

Wipe test A
The source is wiped with a swab or tissue, moistened with ethanol or water; the activity removed is measured. Limit: 0·005μCi (0·18kBq).
(This test conforms to BS.5288/App. D.2·1).

Wipe test B
The source is wiped with a swab or tissue, moistened with ethanol or water; the activity removed is measured. Limit: 0·05μCi (1·8kBq).

Bubble test D
The source is immersed in a suitable liquid (ethanediol) and the pressure in the vessel reduced to 100mm of mercury. No bubbles must be observed.
(This test conforms to BS.5288/App. D.3·1, except that for some sources, the 100mm³ free volume requirement is not met).

Immersion test F
The source is immersed in water at 50°C for 8 hours and the activity in the water measured.
Limit: 0·05μCi (1·8kBq).

Immersion test L
The source is immersed in water at 50°C for 4 hours and the activity in the water measured.
Limit: 0·005μCi (0·18kBq).
(This test conforms to BS.5288/App. D.2·3).

Immersion test M
The source is immersed in water which is raised to 100°C and held at that temperature for 10 min. The water is then removed, the source cooled and rinsed using fresh water. These operations are repeated twice, boiling in the water from the preceding rinsing operation. If the activity detected in all the liquid collected is less than 0·005μCi (0·18kBq) the source is considered to be leak-free.
(This test conforms to BS.5288/App. D.2·4).

Helium mass spectrograph test H
Limit: leak rate of 10^{-8} standard cm^3/sec.
(This test used conforms to either BS.5288/App. D.3·4 or D.3·5, but our limit is much more stringent).

Emanation test K
(scintillation counting test for radon)
The appliance is immersed in a solution of a phosphor in an organic liquid under vacuum; the leakage of radon is measured by liquid scintillation counting (DWIGHT, O. J. Radiochemical Centre Report R.176.).
The limit corresponds to about 5×10^{-11} Ci per 24 hours (2Bq per 24 hours).
(This test conforms to BS.5288/App. D.2·6, but our limit is 200 times more stringent).

Performance requirements for typical uses

Typical applications in which sealed radioactive sources may be used with minimum performance requirements are also given in ISO 2919 (see Table 2 below). These requirements take into account normal usage and reasonable accidental risks, but do not include exposure to the risk of fire, explosion or corrosion.

Table 2. Sealed source performance requirements for typical uses

Sealed source use		Sealed source test and class: Temperature	Pressure	Impact	Vibration	Puncture
Industrial radiography	Unprotected source	4	3	5	1	5
	Source in device	4	3	3	1	3
Gamma gauges (medium and high energy)	Unprotected source	4	3	3	1	3
	Source in device	4	3	2	1	2
Beta gauges and sources for low energy gamma gauges or X-ray fluorescence analysis (excluding gas filled sources)		3	3	2	2	2
Oil well logging		5	6	5	2	2
Portable moisture and density gauges (including hand held or dolly transported)		4	3	3	3	3
General neutron source application (excluding reactor start-up)		4	3	3	2	3
Calibration sources: activity greater than 30μCi (1·11MBq)		2	2	2	1	2
Gamma irradiation sources	Unprotected source	4	3	4	2	4
	Source in device	4	3	3	2	3
Ion generators (source-device combination may be tested)	Chromatography	3	2	2	1	1
	Static eliminators	2	2	2	2	2
	Smoke detectors	3	2	2	2	2
Medical	Radiography	3	2	3	1	2
	Gamma teletherapy	5	3	5	2	4
	Beta teletherapy	5	3	3	2	2
	Interstitial and intracavitary appliances*	5	3	2	1	1
	Surface applicators	4	3	3	1	2

*Sources of this nature may be subject to severe deformation in use. Manufacturers and users may wish to formulate additional or special test procedures.

If the sealed source has a 'C' classification.
Table 2 can be used directly to assess the suitability of the source for the proposed application provided that there is no significant fire, explosion or corrosion hazard.

If such a hazard does exist, the user and the manufacturer have to consider the following factors to determine whether additional testing is required:
1. consequences of loss of activity.
2. quantity of active material contained in the source.
3. radiotoxicity.
4. chemical and physical form of the material and the geometrical shape.
5. environment in which it is to be used.
6. protection afforded to the source or source-device combination.

If the sealed source has an 'E' classification.
Table 2 cannot be used directly.

To determine whether any additional testing is necessary an evaluation of the fire, explosion and corrosion hazards must first be made and a separate evaluation of the use and design of the source.

Some of our source designs exceed the recommendations of Table 2 and may therefore be acceptable for the applications listed despite the 'E' classification.

Acknowledgement: Tables from BS 5288: 1976 are reproduced by permission of BSI, 2 Park Street, London W1A 2BS from whom complete copies can be obtained.

Laboratory applications

The ISO classification system does not refer explicitly to sources designed for research laboratory usage because of the wide variety of applications and environments in which such sources might be used.

Special applications

No test programme can cover all possible combinations of environments to which a source may be exposed.

Users should therefore consult our technical staff before using sources in potentially adverse environments.

IAEA Special Form

'Special Form' is a test specification for sealed sources given in the IAEA transport regulations.
(IAEA Safety Series No. 6, 1967/1973 revised edition†).

It is used in determining the maximum acceptable activities for various types of transport containers.

The required tests are:
impact test
percussion test
bending test (only for long, slender sources)
heat test
After each test the source must be subjected to immersion testing.

The certificate (SFC) numbers given are those issued by the Dept. of the Environment, the competent authority in the UK for administering the IAEA regulations.

†1973 regulations not yet universally adopted.

Source working life

The 'recommended working life' is our recommendation of the period within which the source should be replaced. The period given has been assessed on the basis of such factors as: toxicity of nuclide, total initial activity, source construction (eg capsule design, source insert type, etc), half-life of nuclide, typical application environments, operational experience, test performance data, etc.

Adverse environments could affect the appearance and integrity of a source. It is the user's responsibility to regularly inspect and test the source in order to assess at what point during the 'recommended working life' the source should be replaced.

The special Philips calibration source container is described in the attached drawings. Please note the following:

1. Referring to assembly drawing 4522 161 52761, the source access is closed by strip 4522 161 52641 (item 2). When this strip is opened, the outcoming radiation is less than 0.25mR/hour.

2. A radioactive warning sticker, part number 4522 161 52721 (item 18) will be affixed to the outside surface of the container as shown.

3. Radiation at the surface of the container is much less than 0.5mR/hr with two (2) 10 milliCurie sealed sources installed.

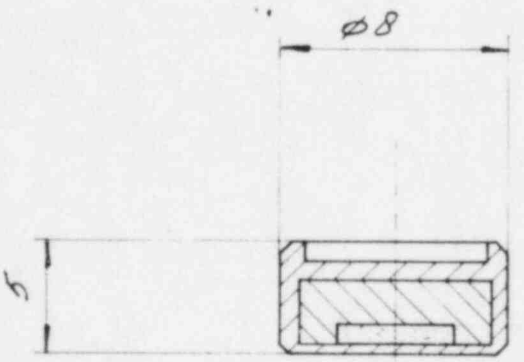
CODENUMMER: 4522 161 52761 IJKBRON ROFO-METER STUKLIJSTDATUM: 830606

* GROEPSNUMMER	: 1200	* VORIGE VERSIE	: 0 000000 *
* STADIUM	: 2 (830601)	* VERSIE GEWIJZIGD	: 0 *
* GEARCHIVEERD	: 0	* TAALNUMMER	: 27 *
* PB KODE	:	* SERVICE KODE	: *
* WB NUMMER	: 91100004	* NAAM KONSTRUKTEUR	: RIETVELD P.CH. *
* BEHEERDER	: JA	*	*

1	1.000 ST	4522 161 52701	*	BRONHOUDER		20	36100	00000
2	1.000 ST	4522 161 52641	*	SLUITSTRIP		20	36100	00000
3	2.000 ST	4522 161 52521	*	OPSLUITSCHROEF		20	30140	00000
4	2.000 ST	4522 161 52561	*	DRUKVEER		20	33310	00000
5	2.000 ST	4522 161 52501	*	CAPSULE X-RAY SOURCE		20	35700	00000
6	4.000 ST	2522 187 62044	*	VERZ SCHR STZN M2,5X6	B1013	10	30021	00000
7	2.000 ST	4522 161 52601	*	AFDEKPLAAT		20	36300	00000
8	1.000 ST	4522 161 52621	*	AFSCHERMDEKSEL		20	30140	00000
9	3.000 ST	2522 004 08027	*	CIL SCHR ST ZN M3X12	UNB054	10	30011	00000
10	3.000 ST	2522 728 04003	*	GEW.VEERR.ST ZN 3,1		10	30311	00000
11	1.000 ST	2522 600 12147	*	RING-B050 IKRT 6,4 X12,5 S1,6		10	30301	00000
12	1.000 ST	2522 411 01013	*	LAGE KART MOER MS NI M6	B028	10	30037	00000
13	1.000 ST	4522 161 52661	*	KARTELSCHROEF		20	30010	00000
14	1.000 ST	2522 043 39046	*	STELSCHR RND STZN M4X4	B061	10	30074	00000
15	1.000 ST	4522 161 52681	*	TORSIEVEER		20	33010	00000
16	1.000 ST	4522 161 52581	*	PEN		20	30260	00000
17	2.000 ST	4522 161 52541	*	BUS		20	30100	00000
18	1.000 ST	4522 161 52721	*	RADIATION STICKER		20	32214	00000

901	1 A2	1100	MECH. TEKENING	830606	4522 161 52761
970	1 A4	2680	LIJMVOORSCHR.	810306	4522 800 00500

PHILIPS



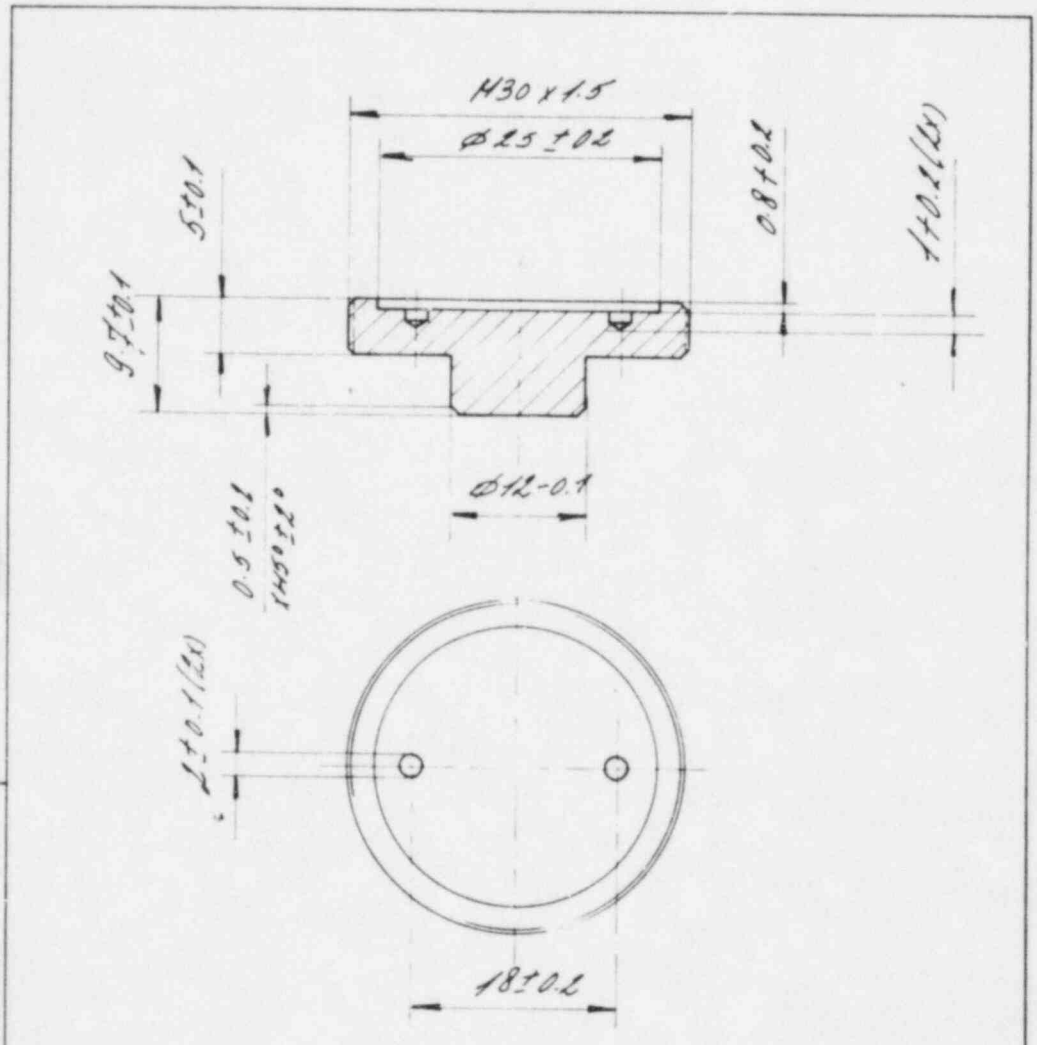
Type nr: AMC.64 ([illegible] millicurie) [illegible]
Leverancier: Amersham Int. [illegible]
Amersham U.K.

TOLERANCES UNLESS OTHERWISE STATED / TOLERANTIES TENZIJ ANDERS VERMELD	DIMENSION / MAAT	ANGLE / HOEK
GENERAL ROUGHNESS / ALGEMENE RUWHEID	UNIT / EENH: mm	MATERIAL / MATERIAAL
SCALE / SCHAAL: 5:1	PROJ / EUROP	TREATMENT / BEHANDELING
CLASS NO: 35700	Capsule X-Ray source	4522 161 5250
NAME / NAAM: RIETVELD		1100 — 1
CHECK / CONTR	DAT: 83-06-06	Property of / Eigendom van N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN NEDERLAND

ASSEMBLY NO. / SAMENSTELLINGSNR — QUANT / AANTAL: 2
PATTERN NO./MODELNR
ORDER NO./ORDERNR — QUANT / AANTAL
1 83-06-06

2822 100 02245 GAF UF 2003

PHILIPS

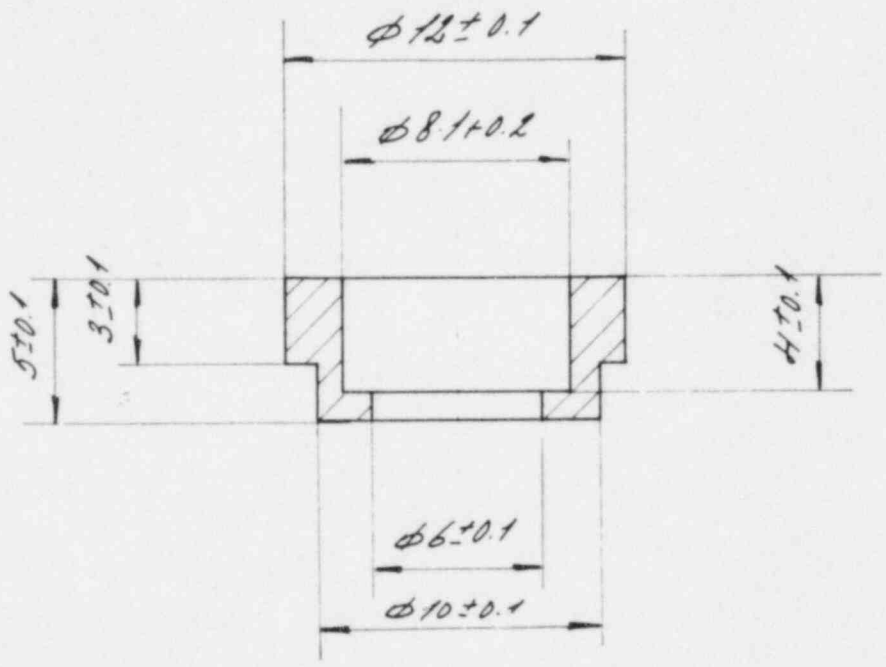


UNIV.D 28 — R_a in micrometres (µm)	TOLERANCES UNLESS OTHERWISE STATED / TOLERANTIES TENZIJ ANDERS VERMELD — DIMENSION MAAT: ANGLE HOEK	UNIV.D 803	2
GENERAL ROUGHNESS ALGEMENE RUWHEID: 32	UNIT EENH: mm	MATERIAL MATERIAAL: LOOD BRONS M.C.B. 15% Pb - 77% Cu - 8% Sn.	ASSEMBLY NO. SAMENSTELLINGSNR / QUANT. AANTAL
SCALE SCHAAL: 2:1	PROJ EUROP	TREATMENT BEHANDELING	PATTERN NO./MODELNR
CLASS NO: 30140	Opsluitschroef	4522 161 5252	ORDER NO./ORDERNR / QUANT. AANTAL
NAME NAAM: RIETVELD	DATE DATUM: 83-03-06	Property of Eigendom van N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN NEDERLAND	83-06-06 / H00 — 1 / H0

2822 100 02245

GAF UF 2003

PHILIPS



0 1 2 3 4 5 6 7 8 9 10

UN-O 26 — R_a in micrometres (µm)

TOLERANCES UNLESS OTHERWISE STATED
TOLERANTIES TENZIJ ANDERS VERMELD
DIMENSION MAAT | ANGLE HOEK

UN-O 803

ASSEMBLY NO. SAMENSTELLINGSNR | QUANT. AANTAL: 1

GENERAL ROUGHNESS ALGEMENE RUWHEID: 3.2 | UNIT EENH.: mm

MATERIAL MATERIAAL: LOODBRONS H.C.B. 15% Pb - 77% Cu - 8% Sn.

PATTERN NO./MODELNR

SCALE SCHAAL: 5:1 | PROJ. EUROP.

TREATMENT BEHANDELING

ORDER NO./ORDERNR | QUANT. AANTAL

CLASS NO.: 30100

Bus

4522 161 5254

1 83-06-06

1100 — 1

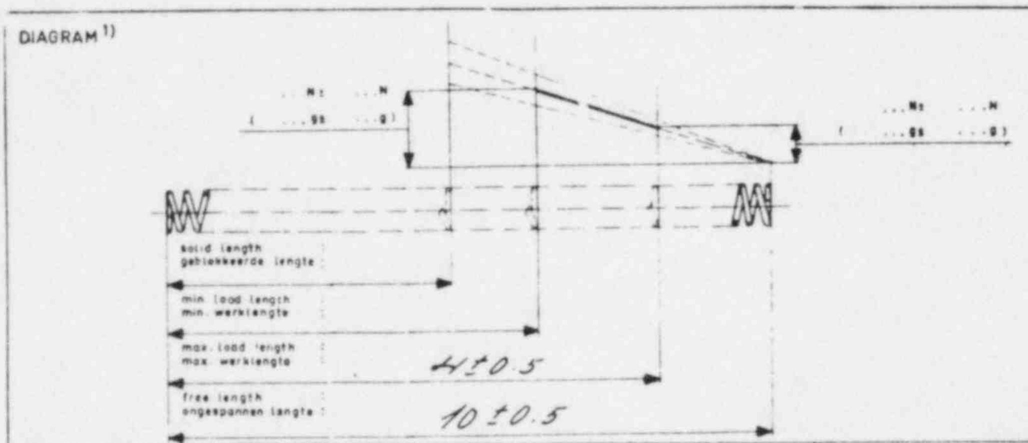
DRAWN TEKEN: RIETVELD | CHECKED CONTR. | DATE DAT: 83-06-06

Property of Eigendom van N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN - NEDERLAND

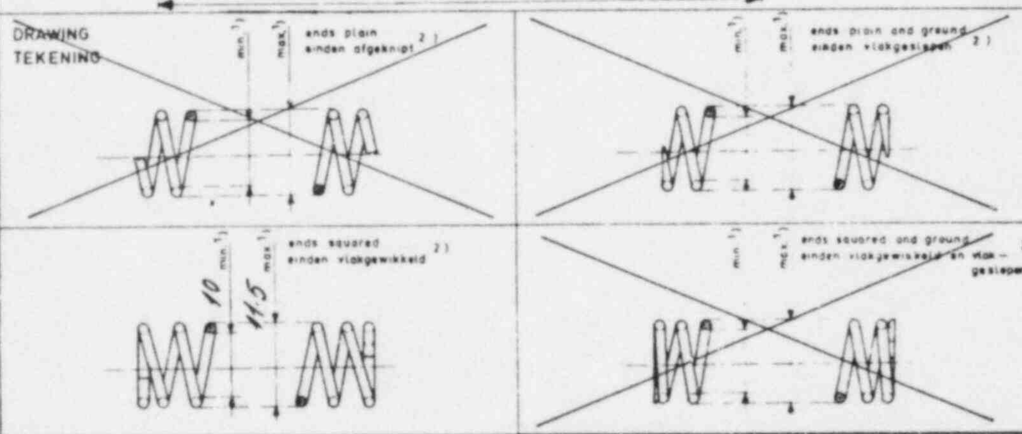
2822 100 02245

GAF UF 2003

DIAGRAM 1)



DRAWING
TEKENING



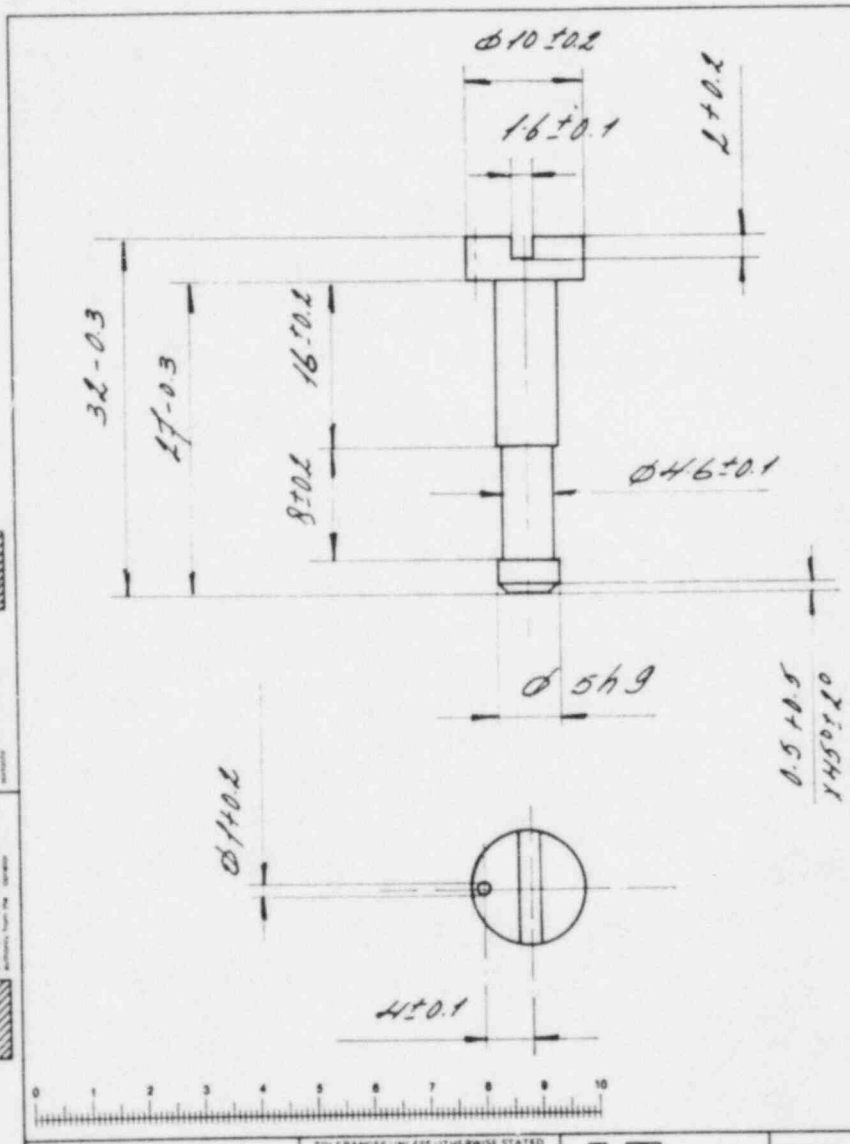
FURTHER DATA / OVERIGE GEGEVENS 1)	THEORETICAL DATA FOR INFORMATION ONLY ACCORDING TO NLN-D117 / THEORETISCHE GEGEVENS TER INFORMATIE VOLGENS NLN-D117
direction of helix / wikkelrichting: arbitrary / willekeurig - ~~righthand lefthand~~ / ~~rechts links~~ 2)	material / materiaal: X12CrNi 17-7 550 HV UN-N 940
heat treatment / warmtebehandeling: none / geen - ~~tempered not tempered hardened~~ / ~~ontlaten niet ontlaten gehard~~ 2)	wire size / draaddikte: 0.5 mm
surface treatment / oppervlaktebehandeling:	number of active coils / aantal werkzame windingen: 4
material / materiaal:	total number of coils / totaal aantal windingen:
	pitch / spoed: 2.5
life duration requirement / levensduureis:	mean diameter of spring / gemiddelde veermiddellijn:
	increase of tension per mm of compression / krachttoename per mm indrukking:
packing / verpakking: springs must be packaged so that they do not get entangled / veren zodanig verpakt dat ze niet in elkaar haken	coil ratio / wikkelverhouding:
1) stated if necessary/ingevuld voorzover noodzakelijk/ 2) deleted if not applicable/het niet gewenste doorgestreept/	

PROJ. EUROP	UNIT / EENHEID mm	ASSY Nr / SAM Nr		QUANT. 2	COMM Nr	QUANT

33310	COMPRESSION SPRING DRUKVEER	4522 161 5256	1 83-05-06
NAME / NAAM: RIETVELD	SUPERS. / VERY.		
N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN NEDERLAND	CHECK / CONTR	DAT 83-05-06	FORM A4

37 199 84

PHILIPS



UNIDO 28 — R_a in micrometres (µm)

TOLERANCES UNLESS OTHERWISE STATED
TOLERANTIES TENZIJ ANDERS VERMELD
DIMENSION MAAT | ANGLE HOEK

UNIDO 003

ASSEMBLY NO. SAMENSTELLINGSNR.	QUANT. AANTAL
PATTERN NO./MODELNR.	
ORDER NO./ORDERNR.	QUANT. AANTAL

GENERAL ROUGHNESS ALGEMENE RUWHEID: 32

UNIT EENH: mm

MATERIAL MATERIAAL: X14 CrS17 260 HV UV-V219

SCALE SCHAAL: 2:1

PROJ EUROP

TREATMENT BEHANDELING:

CLASS NO.: 30200

Pen

4522 161 5258

1 83-06-06

1100 — 1

DRAWN TEKEND: RIETVELD | DATE DAT: 83-06-06

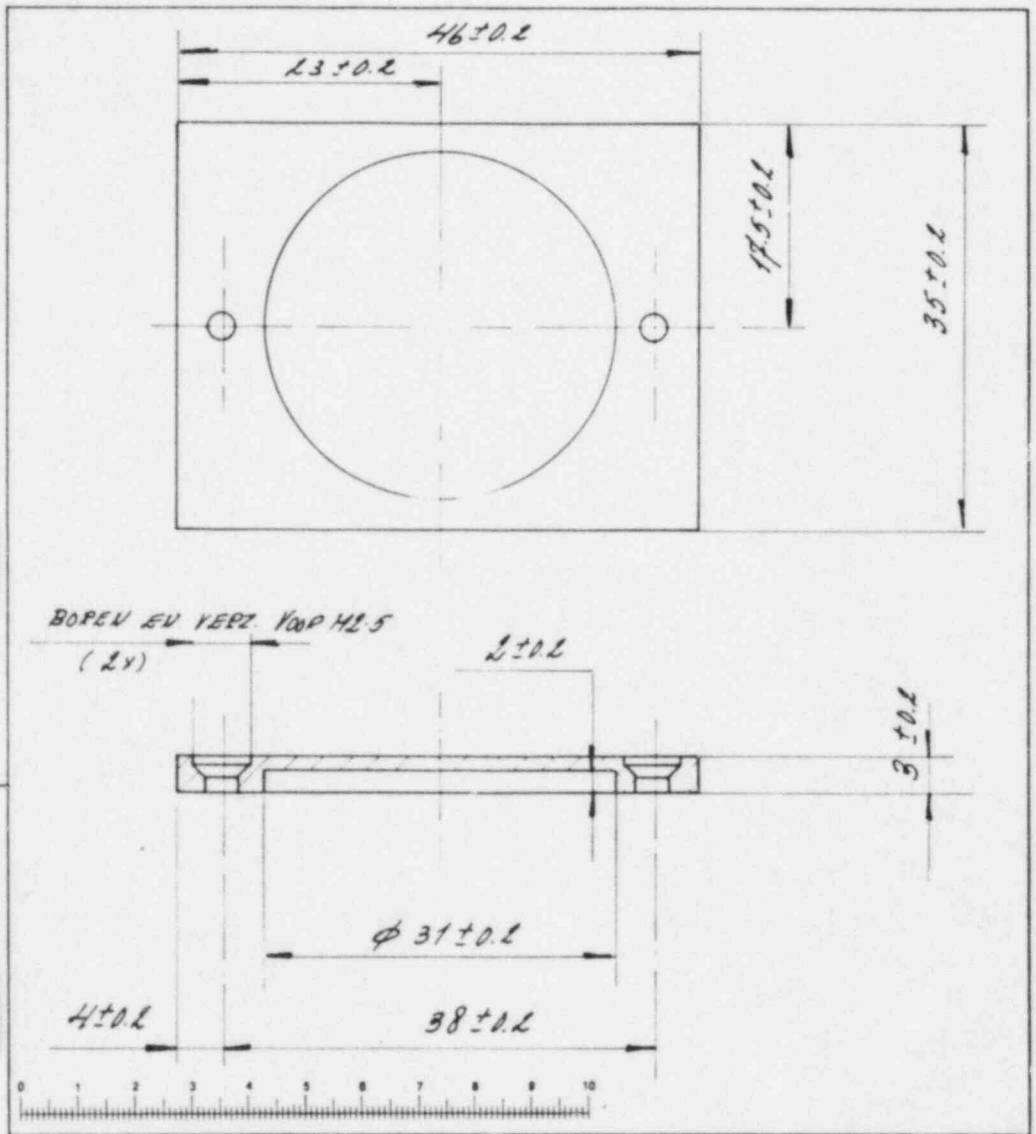
CHECKED CONTR.

Property of Eigendom van N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN - NEDERLAND

2822 100 02245

GAF UF 2003

PHILIPS



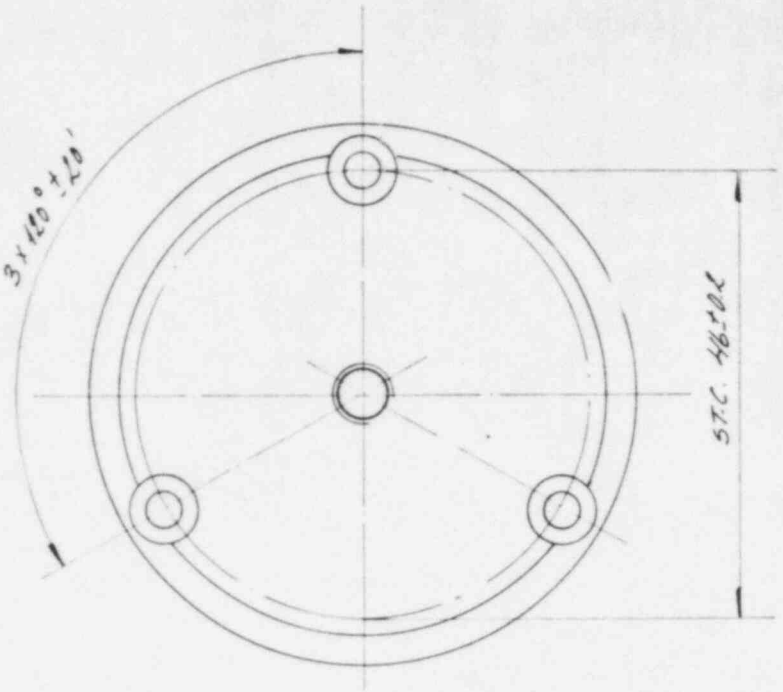
UN 0.28 R_a in micrometres (µm)	TOLERANCES UNLESS UTHERWISE STATED / TOLERANTIES TENZIJ ANDERS VERMELD; DIMENSION MAAT; ANGLE HOEK	UN 0.802	ASSEMBLY NO. SAMENSTELLINGSNR; QUANT. AANTAL: 1
GENERAL ROUGHNESS ALGEMENE RUWHEID: 32	UNIT EENH.: mm	MATERIAL MATERIAAL: Al Si 100 HV UN-T 633	PATTERN NO./MODELNR
SCALE SCHAAL: 2:1	PROJ. EUROP	TREATMENT BEHANDELING: Alox zwart N.O. NLN-D469	ORDER NO./ORDERNR; QUANT. AANTAL
CLASS NO.: 36300	Afdekplaat	4522 161 5260	1 83-06-06
NAME NAAM: RIETVELD; DATE DATUM: 83-06-06	1100 — 1		

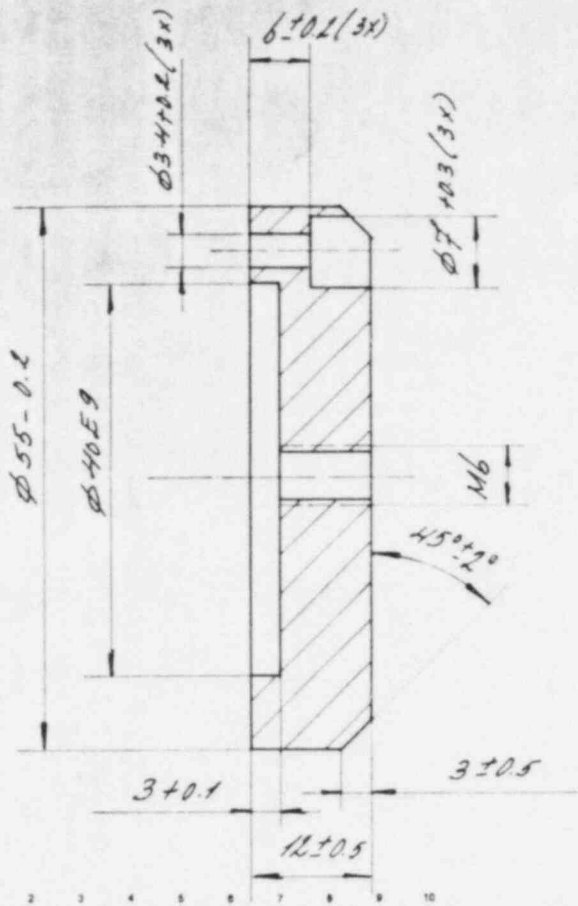
Property of Eigendom van N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN - HOLLAND

2822 100 02245

GAF UF 2003

PHILIPS

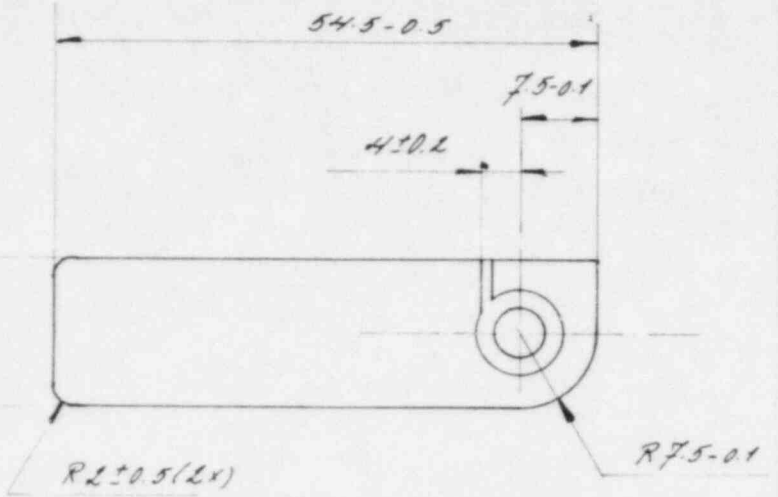


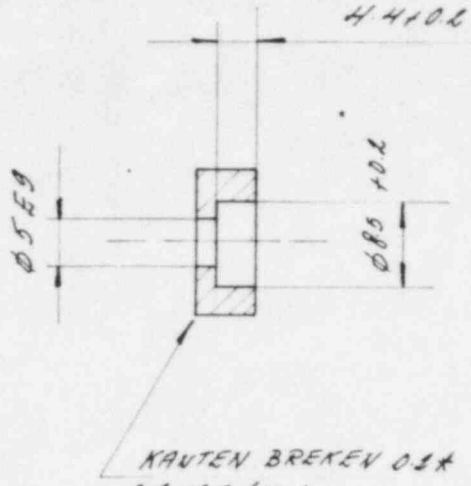


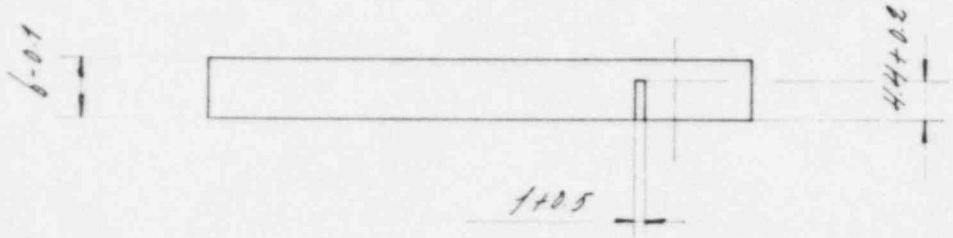
4522 161 53760	1	
ASSEMBLY NO. SAMENSTELLINGSNR	QUANT. AANTAL	
PATTERN NO. MODEL NR		
ORDER NO. ORDERNR	QUANT. AANTAL	
GENERAL ROUGHNESS ALGEMENE RUWHEID 3.2	UNIT/EENH. —	MATERIAL MATERIAAL: LOODBRONS M.C.B. 15% Pb - 77% Cu - 8% Sn.
SCALE SCHAAL 2:1	PROJ. EUROP	TREATMENT BEHANDELING
CLASS NO. 30140		Afschermdeksel
4522 161 5262	1 83-06-06	
1100 — 1	A3	
DRAWN TEKEND RIETVELD	DAT 83-06-06	Property of N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN NEDERLAND

GAF UP 2003

PHILIPS







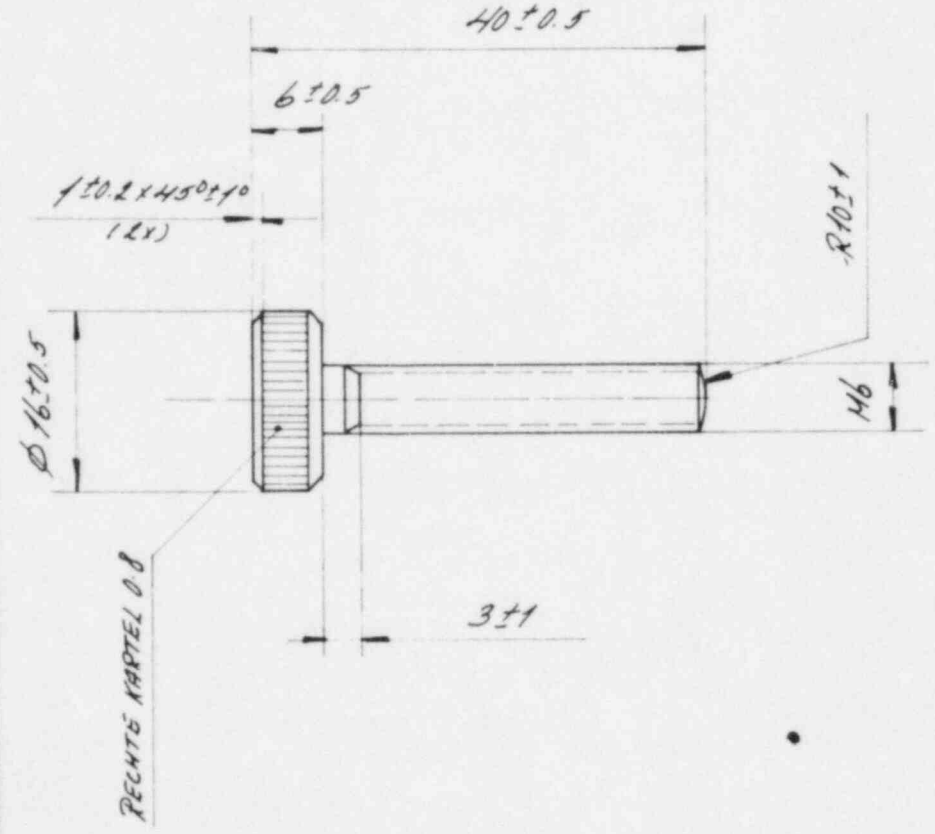
GENERAL ROUGHNESS ALGEMENE RUWHEID	32	
UNIT EENH	—	
MATERIAL MATERIAAL	LOODBRONS U.C.B. 15% Pb - 77% Cu - 8% Sn	
SCALE SCHAAL	2:1	
PROJ EUROP		
TREATMENT BEHANDELING		
CLASS NO	36100	
DRAWN TEKEND	RIETVELD	
DATE DAT	83-06-06	
4522 161 33760 1		
ASSEMBLY NO SAMENSTELLINGNR		QUANT AANTAL
PATTERN NO MODELNR		
ORDER NO ORDERNR		QUANT AANTAL
Sluitstrip	4522 161 5264	1 83-06-06
1100 — 1		A3

Property of N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN NEDERLAND

7822 100 02244

GAF UF 2003

PHILIPS



0 1 2 3 4 5 6 7 8 9 10

UN-O 28 — TOLERANCES UNLESS OTHERWISE STATED / TOLERANTIES TENZIJ ANDERS VERMELD — DIMENSION/MAAT — ANGLE/HOEK — UN-O 803

ASSEMBLY NO./SAMENSTELLINGSNR — QUANT./AANTAL

GENERAL ROUGHNESS/ALGEMENE RUWHEID: 32 — UNIT/EENH: mm — MATERIAL/MATERIAAL: LOOD BRONS H.C.B. 15% Pb - 77% Cu - 8% Sn

PATTERN NO./MODELNR

SCALE/SCHAAL: 2:1 — PROJ. EUROP — TREATMENT/BEHANDELING

ORDER NO./ORDERNR — QUANT./AANTAL

CLASS NO.: 30070

Kartelschroef

4522 161 5266

1 83-06-06

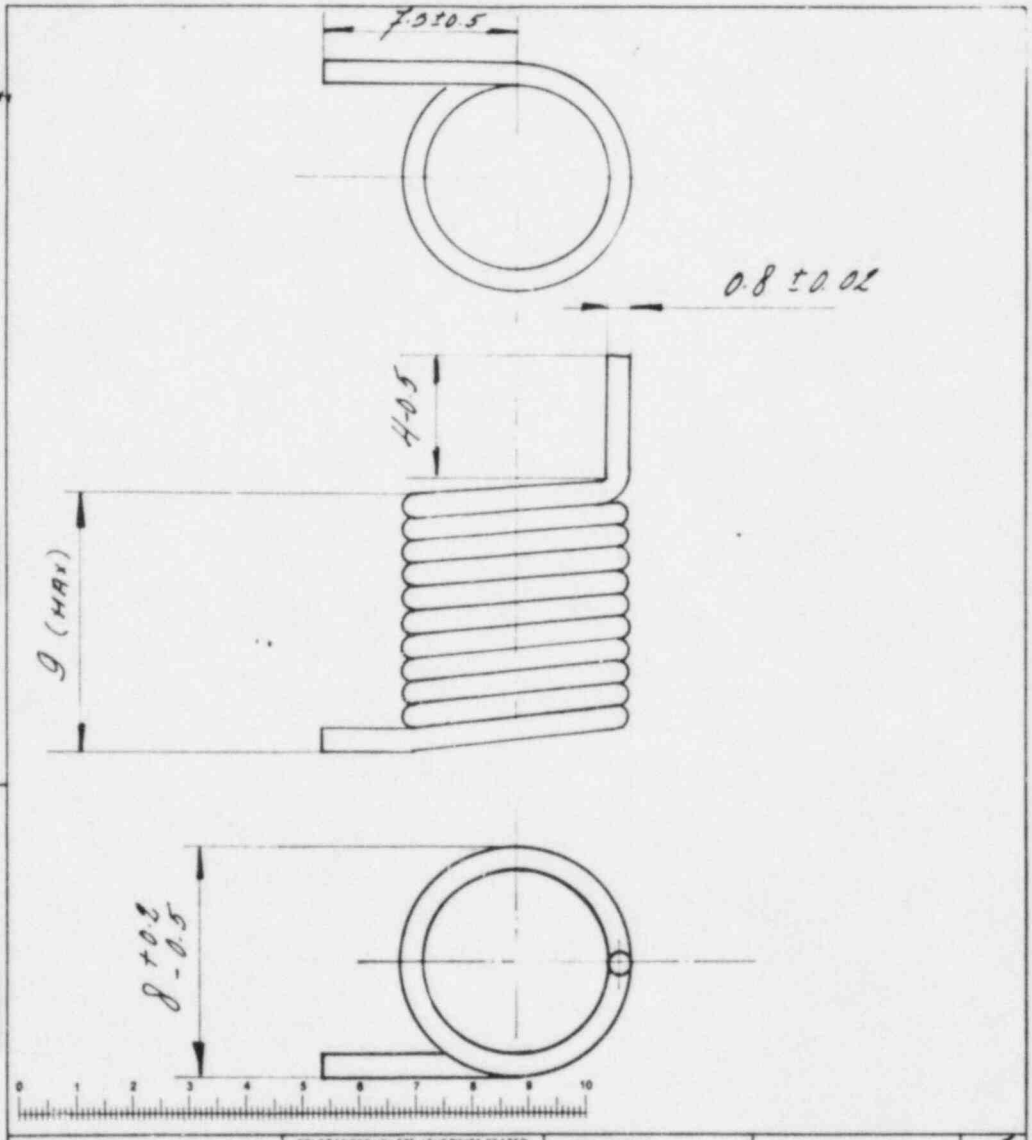
1100 — 1 — A4

ISSUE NAME: REIVELD — CHECK/CONTR. — DATE/DATUM: 83-06-06

3822 100 02245

GAF UF 2003

PHILIPS



UN-D 28 — R_a in micrometers (µm)

TOLERANCES UNLESS OTHERWISE STATED
TOLERANTIES TENZIJ ANDERS VERMELD

DIMENSION MAAT | ANGLE HOEK

UN-D 803

ASSEMBLY NO. SAMENSTELLINGSNR	QUANT. AANTAL
PATTERN NO./MODELNR	
ORDER NO./ORDERNR	QUANT. AANTAL

GENERAL ROUGNESS ALGEMENE RUWHEID

UNIT EENH. mm

MATERIAL MATERIAAL: VERENST DR HARD VLV-V137

SCALE SCHAAL 5:1

PROJ. EUROP

TREATMENT BEHANDELING: INGEVET

CLASS NO. 33070

Torsieveer

4522 161 5268

1 83-06-06

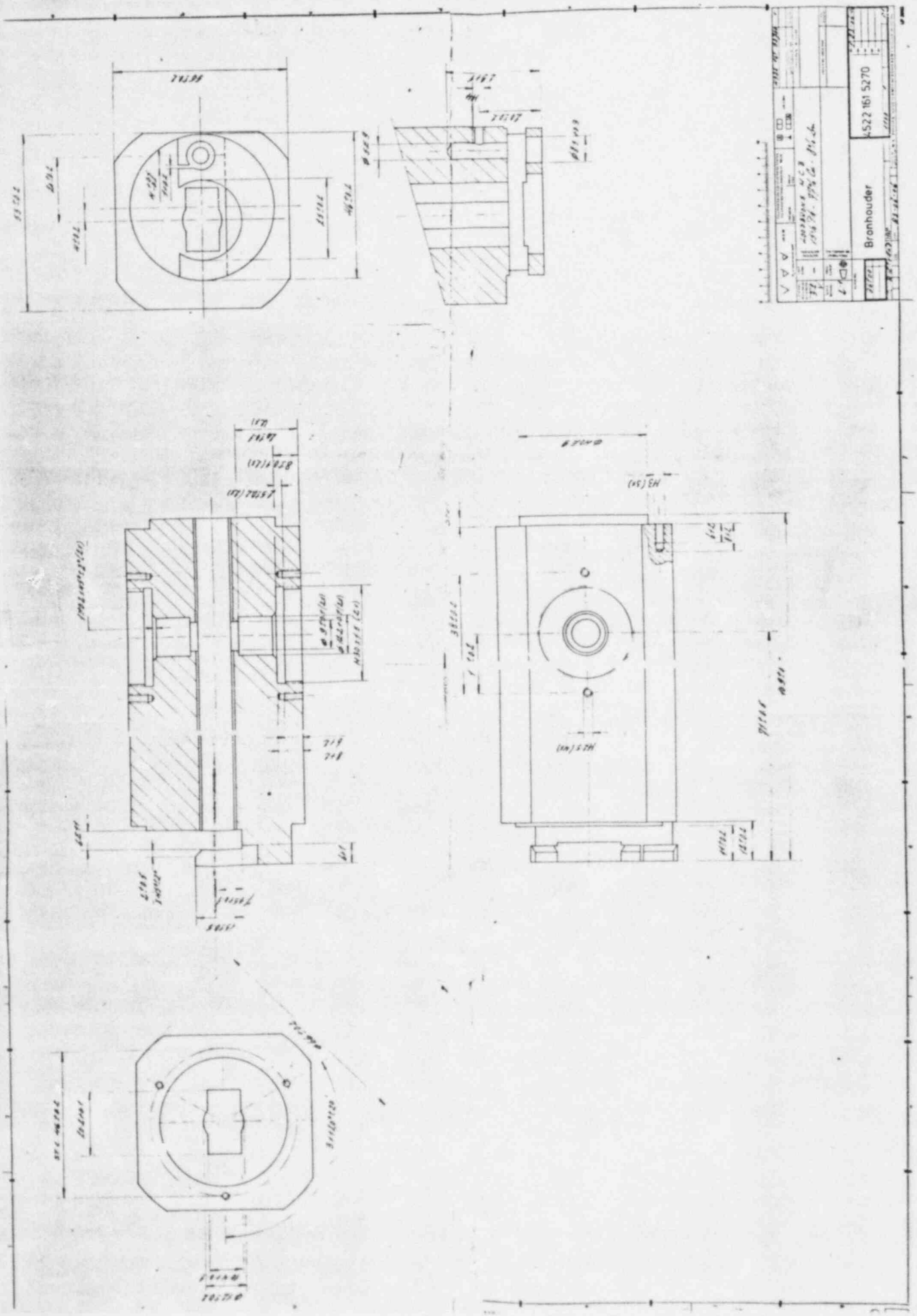
1100 — 1

DRAWN TEKEN	RIETVELD	DATE DATUM	83-06-06
CHECK TOETS			

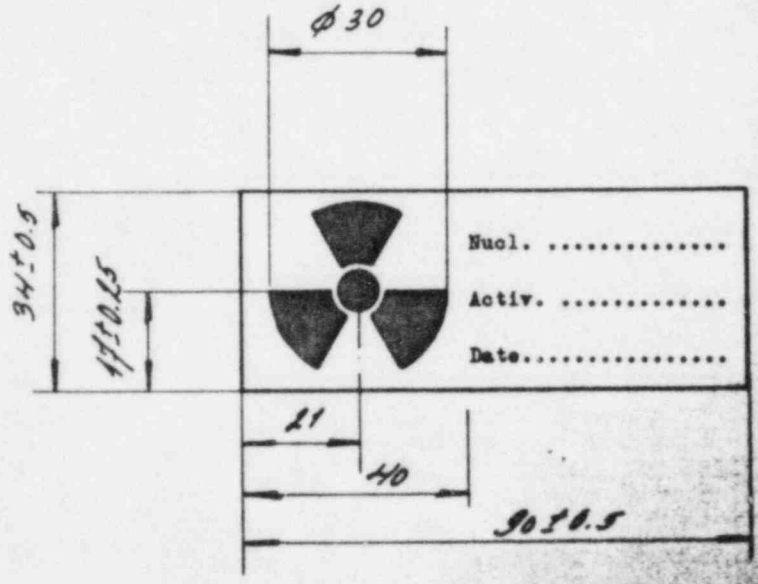
Property of Eigendom van N.V. PHILIPS GLOEILAMPENFABRIEKEN EINDHOVEN - NEDERLAND

2822 100 02245

GAF UF 2003


4822 161 5270
Bronhouder

PHILIPS



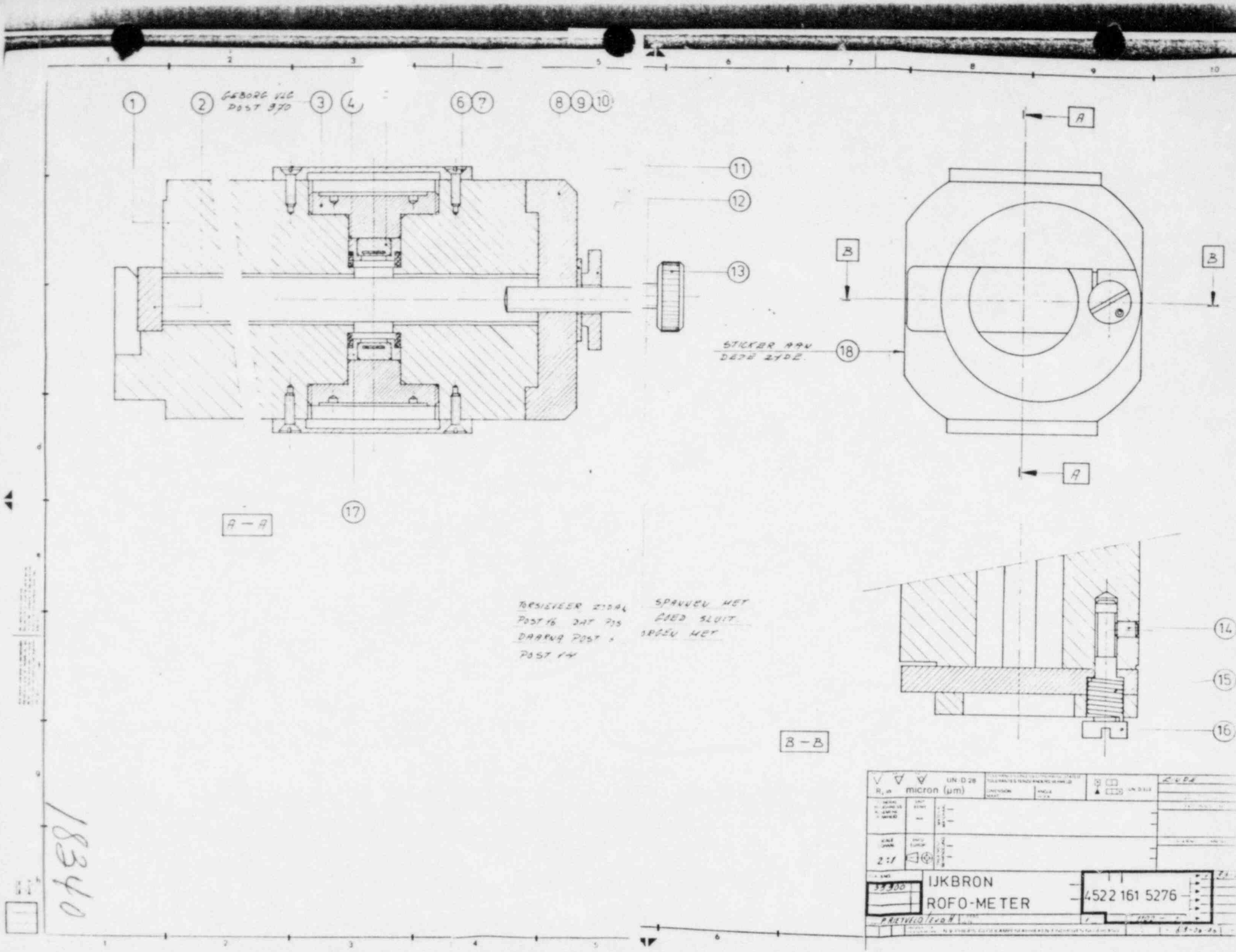
Symbool en tekst volgens XW 32220. Kleur zwart 00007/15

Kleur ondergrond geel 40010/15

Scotch cal Nr: 3484

Radiation sticker

4522 161 5272



GEBORG VLG POST 370
1
2
3
4
6
7
8
9
10
11
12
13
17
A — A
A
B
STICKER AAN DEZE ZIJDE
18
14
15
16
B — B
SPANNEN MET
GOED SLUIT
POST 16
DAARNA POST
micron (µm)
UN-D 28
2:1
33300
IJKBRON
ROFO-METER
4522 161 5276
18340