APPLICATION TO THE U.S. NUCLEAR REGULATORY COMMISSION FOR RADIATION SAFETY EVALUATION AND REGISTRATION OF DEVICES (REQUEST FOR AMENDMENT TO LICENSE 04-1488501E)

' f '996

HOCHIKI AMERICA CORPORATION
5415 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92649
MANUFACTURER AND DISTRIBUTOR

CONTACT: GYO SHINOZAKI- RSO
LOREN LEIMER- ALT. RSO
TEL (714) 898-0795
FAX (714) 892-2809

IONIZATION TYPE SMOKE DETECTORS

Smoke detector models for submission:
Hochiki Model AIE

This series of detector is manufactured for both Hochiki customers as well as private labelled for specific customers.

RADIOACTIVE SOURCE Am-241 0.98 uCi MODELS

Amersham International
2636 S. Clearbrook Dr.
Arlington Hts., IL 60005
Model: AMMK-2812
USNRC Model: AMM-1001

NRD Inc.
2937 Alt Bl. North
Grand Island, NY 14072
Model: Model A001
USNRC Model: A-001

Radioactive material possessed under conditions of California License 2090-30 (agreement state). Sources will be leak tested at time of manufacture and distribution in compliance with 10 CFR Part 32.29 and as described within this document.

This detector is Principal Use Code **"P"** devices proposed for use under a license exemption per 10 CFR Part 30.20).

Summary Description

The AIE series smoke detector is the industrial ionization type. It is intended to be used for the protection of life and property from fires by the detection of airborne particulates. This detector will normally be mounted on the ceiling or below the floor. A complete system will generally be comprised of a number of detector heads which are connected to and operate from a central control unit. The AIE series detector is designed in such a way that the radioactive material is not readily accessible in its location within the assembly. The outside cover protects the chamber and prevents most objects from reaching the source. During installation there is no need to remove any mechanical or electrical parts which would also preclude anyone from inadvertently coming in contact with the radioactive source.

Description, Intended Use and Operation

The AIE series ionization smoke detector is provided with a radioactive source (Am-241), 0.98 uCi to ionize the air. The detector is designed to detect an abnormal decrease in ionization current due to the combustion products created by a fire. It is installed in a fixed location. The source housing does not move during operation.

The AIE series smoke detector has two sampling chambers, an outer and an inner ionization chamber. Smoke or invisible gasses can freely penetrate the outer chamber, but the inner chamber is virtually closed to prevent easy entry. With both chambers ionized by radioactive source Am-241, a very small amount of current flows in the circuit. The presence of smoke or gases will influence the current flow in the outer chamber and will cause a change in the voltage ratio between chambers. This difference is then amplified inside the detector and transmitted to the fire alarm control unit to which it is connected.

1. Details of Construction and Use

A list of mechanical parts for the AIE series are shown on Enclosure B1. Enclosures B2 through B22 are drawings of those parts and their respective materials. The foil is captured onto the inner electrode with a retaining disc which is staked in place by a hydraulically controlled welding machine. The inner electrode is placed into the insulation plate and the intermediate electrode is then snapped over the inner electrode and into the insulation plate. One leg of the intermediate electrode snaps into the insulation plate and the other leg protrudes through the insulation plate and is soldered onto one lead of the FET. This assembly process assures that the source is protected from damage and makes it otherwise tamper proof. The outer cover protects the unit and prevents objects from approaching the source. The closest approach is approximately 2 cm. During operation the outer cover, outer electrode and the intermediate electrode prevent someone or something from contacting the source.

The detector has been designed so that once the radioactive material has been assembled into the unit at the factory, it is inaccessible without someone removing the printed circuit board from the detector and de-soldering the one leg of the intermediate. After the detector has been assembled by

the factory there would be no need for disassembly, by either the installers or other field service technicians.

The AIE series detector is tested and listed to the ANSI/ UL 268-1988 standard. This standard requires that the detector be subjected to variable ambient temperatures, humidity plunges, corrosive environments and vibration testing. After such testing, the detector shall function normally. During normal use, detector is not expected to be subjected to ambient conditions outside of the listed parameters.

Total Expected Annual Distribution

It is estimated that a total of up to 300,000 detectors may be distributed in the United States by Hochiki annually. Each detector contains a maximum of 0.98 uCi, making the maximum distribution of Am-241 in the United States 300 millicuries. The useful life of the detector is assumed to be 10 years. This is the same useful life value commonly used in other similar fire protection devices already in service in the field.

1. Labeling and Marking

Each detector is manufactured with a permanent type, self adhesive backed label which is affixed to the bottom of the detector. The label contains the model name, type of detector, serial number, amount and type of radioactive material used, distribution license number, installation instruction drawing number, where to send for service, where unit was produced and other pertinent information regarding its use. The labels are expected to last the useful life of the detector. The AIE series detectors are placed in a five piece shipping carton. Each carton is printed with the name of the radionuclide and the quantity of activity: Americium 241, 0.98 uCi.

3. Prototype Testing and Evaluation

Tests were performed on the source after it was mounted onto the inner electrode. The tests were done by the Japan Radioisotope Association. The certification of approval under the classification C 32222 of IS-Z4821 of the above mentioned part is included in Enclosure B25. Hochiki Corporation in Japan performed vibration tests on 6 completed detectors. The test consisted on 1000 cycles per minute at an amplitude of 4 mm for 60 minutes. The test results showed no leakage of the source. The results also showed there was no damage to the integrity of the operation of the detector. (See Enclosure B26). Hochiki Corporation also performed shock and impact tests with acceptable results. (See Enclosure B27).

An impact test was also performed by Hochiki America Corporation. The results showed that the there was no leakage from the detector source. The AIE series detector was dropped from a height of 6 1/2 feet. A total of 25 drops were performed , and there were some signs of physical damage. Further investigation revealed that the inner electrode that holds the RI material was not damaged and appeared to be unaffected. The outer and inner electrodes remained very solid within the insulation plate and showed no other signs of physical damage. Even though there were signs of external physical damage the internal components remained unaffected so as to protect the radioactive source and keeping it isolated from direct contact with the outside. (See Enclosure B28).

SOLUBILITY OF WATER AND BODY FLUIDS

The following tests were performed by Amersham International Corporation Radiochemical Center in England to determine solubility of the foils in water and body fluids.

Test 1 - Sample foils containing 100 uCi Am-241 in an area of 1 square cm were immersed in distilled water at 98 degrees Fahrenheit for four (4) hours. In all tests, less than 0.003 uCi Am-241 were transferred to the water.

Test 2 - Sample foils containing 1 uCi in an area of 9 square mm were immersed in distilled water for three (3) weeks. In all tests, less than .001 uCi Am-241 were transferred to the water.

Test 3 - Sample foils containing 1 uCi in an area of 9 square mm were immersed in distilled water for twelve (12) weeks. Wipe out tests and immersion tests carried out on the foils indicated less than .001 Am-241 were removed from the sample.

Test 4 - Sample foils containing 1 uCi in an area of 9 square mm were immersed in a 0.1n HCl solution for four (4) hours at 98 degrees Fahrenheit. In all tests, less than .004 uCi Am-241 were removed from the sample. HCl was chosen for this test to more closely simulate body fluids.

The following were performed by New York State University at Buffalo to determine solubility of the foils in water and body fluids for NRD Inc.

Test 1 - Sample foils containing 2 uCi Am-241 in an area of 20mm^2 were immersed in city water at 98 degrees Fahrenheit for four (4) hours. In all tests, less than 0.0001 uCi Am-241 was transferred to the water.

Test 2 - Sample foils containing 2 uCi in an area of 20mm^2 were immersed in city water for twelve (12) days. In all tests, less than .001 uCi were transferred to the water.

Test 3 - Sample foils containing 2 uCi in an area of 20mm^2 were immersed in a solution simulating digestive juices with a ph of 1.96 for seven and one half (71/2) hours - Total activity released was less than .005 uCi.

Based on Test Report May 1976 David Dooley etal.

4. Quality Control

Incoming inspections are performed when containers of radioactive material are received. The outside of the shipping container is smear tested and the results recorded. The inside of the inner container is smear tested and the results recorded. If any contamination is detected, the foils are isolated and returned to the manufacturer for disposal. If there is no contamination detected the foils are placed in the safe and the information recorded. Before the foils are dispersed to the

assembly area the inside of the container is smear tested and the results recorded and initialed. If any contamination is detected the foils are isolated and returned to the manufacturer of the foils for disposal. These tests are conducted by using a cotton tip swab wetted with alcohol. Wipes are inserted into the chamber of the Eberline SRM-100 and counted. The results are recorded on the appropriate forms. The background of the Eberline model SRM-100 will be determined by counting with the chamber empty and the results recorded in the appropriate space on the applicable form. Any wipe showing greater than 10 cpm above background will be recounted to verify results. If results continue to show more than 10 cpm above background, item(s) will be cleaned until no activity is detectable.

There are two survey meters that can be used to make these tests. Each will be calibrated by the manufacturer against known radioactive materials including americium annually. The tests are incorporated into Hochiki's equipment calibration program.

A minimum of 1% of the daily production of ionization chambers, randomly selected, will be wiped. The results will be recorded. Any contamination detected will result in an investigation until the cause is found. Contaminated units will be properly disposed of according to applicable regulatory procedures.

FINISHED GOODS PRIOR TO SHIPMENT

All (100%) of the daily quantity of units ready for final packaging will be wiped, counted, recorded and initialed. The following are the procedures routinely performed:

1. Indicate on the form provided the lot number, date, serial numbers and the sample size of the lot checked.

2. Background of the Eberline SRM--100 currently being used will be determined by counting with the chamber empty and the results recorded on the appropriate form.

3. A cotton tip swab, wetted with alcohol, will be used to wipe the detectors. The area wiped will not exceed 100 cm per wipe.

4. Wipes will be taken through the slots in the outer enclosure until the swab touches the bug screen.

5. A maximum total of 100 detectors are to be wiped before the swab is placed in the meter and the findings recorded and initialed.

6. Any wipes showing a reading greater than 10 cpm above background will be recounted to verify results. If the wipe shows more than 10 cpm above background, the detectors will be re-wiped and the data recorded. If the detectors show the presence of contamination, they will be checked and cleaned until no activity is detectable, or the contaminated detector(s) will be disposed of by a NRC approved procedure.

Radiation Profiles

BY-PRODUCT MATERIAL

The radioactiveisotope used in the AIE series detectors is Americium - 241, manufactured by Amersham International Corporation and NRD Inc. The activity is 0.98 uCi, the physical size is 3.6 X 3.6 mm. The Amersham part number is AMMK-2812 the NRC listed model number is AMM-1001. The NRD model number is A001 and the NRC listed model number is A001.

Each detector contains a single foil. Each detector is defined by a unique serial number. The source is mounted onto the inner electrode and crimped into place.

BY-PRODUCT, CHEMICAL & PHYSICAL FORM

The radionuclide, in the form of Americium oxide (AmO^2), is uniformly distributed and sintered in a matrix of pure fine gold at temperatures in excess of 800 degrees C. It is contained between a backing of pure silver and a front covering of gold-palladium alloy (94% gold, 6% palladium) by hot forging. **The metal layers, continuously welded, are extended by means of a power rolling mill to give required foil strips which contain 8 uCi per cm^2 and from which elements of foil are cut into sections containing 0.98 uCi each.** Encapsulating in this manner insures that there will be no physical or chemical changes in the radioactive material over the life of the detector.

RADI . . N FROM SMOKE DETECTOR HEADS

Radiation dose from the detector head was measured in Tokyo, Japan by Hochiki Corporation on 2 AIE series detectors. A hologram G-M tube attached to TGS 111 Survey Meter was used in measurements. Four positions on the detector were measured, top, bottom, left and right sides. These measurements were taken at the surface of the detector, and at 5 cm and 25 cm to the center of the tube. The tube was calibrated against a Co 60 source. The dose rates are an average of the measurements from the two AIE detectors. (See Enclosure B29).

At 5 cm 3.9 uR/hr
At 25cm 1.78 uR/hr

CALCULATED DOSE RATES

A theoretical dose rate may be calculated, based on a gamma emission of 60 KeV (35%) and a specific gamma ray constant of 0.036 R/h at 1 meter from 1 Ci (Radiological Health Book, HEW, 1970.)

The calculated dose rate at 5 cm from a 1.0 uCi source, for comparison

$$\frac{(0.036)(0.35)(1.0 \times 10^{-6})(100^2)}{(5.0)^2} = 4.8 \text{ uR/hr}$$

Similarly, the dose rate, 25 cm from a 1.0 microcurie source is calculated to be:

$$\frac{4.8(5.0)^2}{(25)^2} = 0.19 \text{ uR/hr}$$

ORNL Report TM-2864 reports an exposure rate of 0.01 mR/h 14 cm from a 13.5 uCi foil. This would translate into a dose rate of 5.0 uR/hr at 5.0 cm from a 1.0 uCi source.

RADIATION DOSE AND DOSE COMMITMENTS

To determine the external exposure dose rate it was assumed that the dose rate 5 cm from a 1.0 uCi of Am-241 is 5.7 uR/hr. From this dose rate, other distances were calculated. Such as, the dose rate 25 cm from the detector:

$$\frac{(5.7)(5.0)^2}{(25)^2} = .22 \text{ uR/hr}$$

The following were also calculated:

At 2cm from the source 36 uR/hr.

At 5cm from the source 5.7 uR/hr

At 25cm from the source 0.22 uR/hr

At 1m from the source 0.014 uR/hr

At 2m from the source 0.004 uR/hr

At 3m from the source 0.002 uR/hr

A number of potential exposure conditions are summarized below using the values calculated previously. It was assumed in the evaluations that the detectors were mounted on the ceiling as in a normal field installation.

Example 1

A person who works in a facility pro'ected by one or more detectors and lives in a residence with 1 detector in the bedroom and 1 or more in the hallway. The estimated dose is:

8 hrs/day work at 1m 0.014 X 8 X 5 X 50 = 28.0 urems/y

8 hrs/day work at 2m 0.004 X 8 X 365 = 11.7 urems/y

8 hrs/day transient at 1m 0.014 X 4 X 365 = 20.4 urems/y

Total annual dose = 60 microrems or 0.060 mrems per year. If this same person were to be involved in cleaning or relocating 5 detectors and if this operation was performed 6 times a year and it took 1 hour per operation, the estimated dose would be: Body at 25 cm, 30 hours X 0.22 = 6.6 urems/y or 0.007 mrems/y. Hands at surface, 30 hrs. X 21 = 630 urems/y or 0.63 mrems/y.

The total annual dose estimate for this person would be:

Body, 0.060 + 0.007 = 0.067 mrems/y

Hands 0.060 + 0.63 = 0.69 mrems/y

Example 2

A person who is working at a station 1 m from a lot of 100 detectors that are stacked in such a way that they would be in a cube approximately 60 cm on a side. The calculated dose rate at 1 m from this lot is 0.24 urads/hr. The estimated dose is: 0.24 X 40 X 50 = 480 urems/y or 0.48 mrems/. The same person might also handle an individual detector 1 hour per day and this additional dose would be:

Body at 25 cm 0.22 X 5 X 50 = 55 urems/y or 0.06 mrems/y

Hands at 5 cm 5.7 X 5 X 50 = 1,425 urems/y or 1.425 mrems/y

Assuming the same person was also exposed as the person in example 1, this dose would be: Body, 0.48 + 0.06 + 0.07 = 0.61 mrems/y. Hands, 0.48 + 1.425 + 0.69 = 2.6 mrems/y.

Example 3

A person working in a warehouse who is stationed 3 m from a lot of 1000 detectors. It is calculated that the dose rate 3m from such an array would be 3.1 urads/h. The estimated dose is: 3.1 X 50 X 40 = 620 urems/y or 0.62 mrems/y. Assuming the 1,000 were in 10 cartons of 100 detectors each, the same person might handle each of the 10 cartons an additional 4 times a year, 1 hour per handling. It is calculated that the dose rate from a carton containing 100 detectors is 3.1 urads/h at the surface and 1.1 urads/h at 25 cm. The estimated handling dose would be: Body at 25 cm, 1.1 X 10 X 4 = 44 urems/y or 0.044 mrems/y. Hands at surface, 3.1 X 10 X 4 = 124 mrems/y or 0.124 mrems/y. Assuming the same person were also exposed as in example 1, the estimated dose would be: Body, 0.067 + 0.044 + 0.62 = 0.73 mrems/y. Hands, 0.69 + 0.124 + 0.044 = 0.86 mrems/y.

Example 4

A person who installs detectors 40 hours per week might have his hands at the surface of a detector 1/4 of the time, and at 5 cm 3/4 of the time. The body average would be 25 cm from a detector. The estimated dose would be: Body, 0.22 X 40 X 50 = 440 urems/y. Hands, 25%, 21 X 40 X 50 X 1/4 = 10500 urems/y. Hands, 75%, 5.7 X 40 X 50 X 3/4 = 8550 urems/y. Total estimate dose to hands = 19050 urems/y or 19.1 mrems/y. Assuming the same person were also exposed as in

Example 1, his estimated dose would be: Body, 0.44 + 0.067 = 0.51 mrems/y. Hands, 19.1 + 0.69 = 19.8 mrems/y.

Example 5

A person working 40 hours per week, repairing, cleaning detectors with his hands at 2 cm from the source 1/2 of his time and ~5 cm from the detectors the other 1/2 of his time, the body averages 25 cm from the detector. His estimated dose would be: Body, 0.22 X 50 X 40 = 440 urems/y or 0.44 mrems/y. Hands 50% of the time 2 cm, 36X 50 X 40 X 1/2 = 36000 urems/y. Hands 50 % of the time 5 cm, 5.7 X 50 X 40 X 1/2 = 5700 urems/y. Total estimated dose to hands = 41700 urems/y or 41.7 mrems/y.

Assuming the same person was also exposed as in example 1, the estimated dose would be: Body 0.44 + 0.067 = 0.51 mrems/y. Hands, 41.7 + 0.69 = 42.4 mrems/y.

Example 6

A person who transports 10 cartons containing 100 detectors each, totaling 1000 detectors across country traveling 4000 miles. The trip took 80 hours traveling at 50 mph. The estimated dose would be: 0.31 X 80 = 24.8 urems/y or .025 mrems/y. The same person making the trip 10 more times during the year would have an estimated dose of 0.25 mrems/y. If the same person were exposed as in example 1 in addition to the 10 trips made yearly, the estimated dose would be: 1 - trip, 0.025 + 0.01 = 0.035 mrems. 10 - trips, 0.25 + 0.01 = 0.26 mrems.

EXTERNAL EXPOSURE, SUMMARY

All of the examples used are very conservative in scope, such as distances, proximity to the source, and exposure times. Examples given do not take into consideration the shielding effect provided by packaging or other materials. All the preceding estimates are + less than the limits in 10 CFR 32.28, Column I (5 mrems/y body and 50 mrems/y hands), so it is very unlikely that these limits will be exceeded.

DOSE COMMITMENT

In the following section on Dose Commitment, several unusual examples, such as fires, are considered. While the Dose Commitments may be higher in these cases, the external exposure to such personnel as described will be negligible because of the short exposure times.

Calculations of the annual intake of AM-241 to produce a 50 year dose commitment of 0.005 rems, based on the report of ICRP Committee II on Permissible Dose for Internal Radiation follow:

$$R = \frac{EF\ (RBE)\ n\ (q)\ (3.7 \times 10^{4} \times 3600 \times 24 \times 365 \times 1.6 \times 10^{-6})}{100\ m}$$

Where EF (RBE) n = effective absorbed energy per dis, MeV
q = uCi of Am-241 deposited in organ of reference
m = mass of organ of reference, grams
3.7×10^{4} = dis/sec per uCi
3600 X 24 X 365 = sec/year
1.6×10^{-6} = ergs per MeV
100 = ergs/grams per rad
and R is in units of rems/year

$$R = \frac{EF\ (RBE)\ n\ q}{m} = (1.867 \times 10^{4})$$

If bone is the organ of reference, EF (RBE) n = 280, and m = 7×10^{3}, and $R = \frac{280\ q}{7000}$

$= (1.867 \times 10^{4}) = 747$ q rems/year

The integrated dose over 50 years is:

$$D = \frac{R}{\lambda}\ (1 - e^{\lambda t})$$

Where R = rems/year
λ = the elimination constant = $0.693/T$ years^{-1}
T = the effective half-life, years
t = the time of consideration, years = 50 and D is in rems

For Bone, T is 5.1×10^{4} days or 140 years, and

$$D = \frac{(747\ q)\ (140)}{0.693}\ (1 - e^{-0.2475}) = 3.30 \times 10^{4}\ q \text{ rems}$$

For the limiting dose of 0.005 rems,

$$q = \frac{0.005}{3.3 \times 10^{4}} = 1.5 \times 10^{7}\ uCi$$

The fraction of Am-241 inhaled which reaches the bone, Fa is 0.063, so the amount of AM-241 inhaled per year to produce a 50 year dose of 0.005 rems, Qa is:

$$\frac{1.5 \times 10^{7}}{0.063} = 2.4 \times 10^{4}\ uCi$$

Similarly, the fraction reaching the bone through ingestion, f is 2.5×10 and Qw is
$\frac{1.5 \times 10^{-7}}{2.5 \times 10^{-5}} = 6.1 \times 10^{-3}$ by ingestion

Another set of calculations using "Whole Body" as the organ of reference was made. EF (RBE)n = 57, m = 7×10^4 grams.

T = 1.8×10^4 days or 49.3 years, fa = 0.25, f = 10^{-4}

This resulted in annual intake of Am-241 to produce a dose of 0.0005 rems in 50 years as follows:

Qa = 3.7×10^{-5} uCi by inhalation
Qw = 9.1×10^{-2} uCi by ingestion

Comparing these values with similar ones for bone, it is obvious that bone is the more critical organ. Similar c[illegible]lations for other organs (limiting dose is 0.015 rems) also showed that bone is the most critical organ. Therefore, all of the estimated dose commitments that follow are based on bone as the critical organ. There is no evidence that Am-241 becomes airborne and respirable from sources previously described. Placing an upper limit on zero is difficult but will be done in order to estimate an upper limit on dose commitment. ORNL Report TM-2684 summarizes a number of tests performed on 12 smoke detectors which had been in service at least 5 years. The detectors contained a total of 78 foils (some Ra-226, some Am-241) and contained 20 to 130 uCi per detector. Foil construction was similar to what has been previously described. Some pertinent results of these tests were:

1. Only one of the smear tests on the external surface of the 12 detectors showed detectable alpha activity, and this was 20 d/m.

2. The average removable contamination on the Am-241 foils, as measured by smear tests, was 694 d/m.

3. Following a "12-week Environmental Test" at 110 degrees F and 80% relative humidity, on 20 foils (12 Ra-226, 8 Am-241), half of which were intentionally damaged. There was no detectable contamination on the interior surfaces of the test chamber, as measured by a smear test.

4. During 1 hour "Fire Tests" (925 degrees C for 1 hour), the average loss from Am-241 foils was 31% and the loss which was deposited on filters or became airborne, was 0.002%. The ORNL Report indicates that there was no detectable contamination on the interior surfaces of the test chamber after the "12-Week Environmental Test." From the report, levels down to 6 d/m could be detected, so it would be reasonable to assume that at least 20 d/m would have been detected on a smear test of the chamber. Also, from the report, it is noted that a total of 0.12 uCi were available to become airborne, as measured by smear tests on the foils at the beginning of the test. This amount is approximately 25 times the permissible contamination (0.005 uCi) on the foils used in production of the detectors and as measured by smear tests. If it is assumed that the sample in the ORNL Tests represented at least 4% of the chamber area, and 20 d/m could be detected, the maximum that could be released from a foil in a year would be:

$$\frac{20 \times 52}{12} = 87 \text{ d/m or } 3.9 \times 10^{-5} \text{ uCi}$$

If this detector were in a room of 4 X 5 X 3 meters, and there was one air change per hour, the concentration average over a year would be:

$$\frac{3.9 \times 10^{-5}}{4 \times 5 \times 3 \times 10^{6} \times 24 \times 365} = 7.4 \times 10^{-17} \text{ uCi/cc}$$

The above represents a maximum concentration of a room in a residence. Similarly, if a work place had a volume of 8 X 10 X 6 cubic meters, the concentration average over a year would be:

9.3×10^{-18} uCi/cc

If a person were exposed as in Example 1 for 12 of the 16 hours per day at home and breathe 1×10^{7} cc in this 16 hour period, his annual intake of Am-241 would be:

$(7.4 \times 10^{-17})(1 \times 10^{7}) \times 12/16 \times 365 = 2.0 \times 10^{-17}$ uCi/y

Also, as in Example 1, if the same person were exposed at work to 9.3×10^{-18} uCi/cc in this 8 hours per day and breathed 1×10^{7} cc in this 8 hours his annual intake of Am-241 would be:

$(9.3 \times 10^{-18})(1 \times 10^{7}) \times 5 \times 50 = 2.3 \times 10^{-8}$ uCi/y

The total intakes would be 2.2×10^{-7} uCi/y. As calculated previously, inhalation of 2.4×10^{-6} uCi/y would result in a 50 year dose commitment of 0.005 rems. The dose commitment from an intake of 2.2×10^{7} uCi/y would therefore be:

$$\frac{2.2 \times 10^{-7}}{2.4 \times 10^{-6}} (0.005) = 0.00046 \text{ rems}$$

The above is intended to be an upper limit on zero, since there is no evidence to show that Am-241 becomes airborne under normal conditions. It can also be said that in Examples 2- 6 previously described, that there is a negligible release of Am-241 to be respirable, even though quantities of 100 or 1000 detectors are involved.

Estimated Dose Commitments under abnormal conditions are calculated in the following examples:

Example 7

If a fire should occur in a 4 X 5 X 3 meter room, and 0.31% of the 1.0 uCi Am-241 source should become airborne, the average concentration might be:

$$\frac{0.0031 \times 1.0}{4 \times 5 \times 3 \times 10^{6}} = 5.2 \times 10^{-11} \text{ uCi/cc}$$

If a person were to remain in this room for 5 minutes, he might inhale:

$$5.2 \times 10^{-11} \times 2 \times 10^{7} \times \frac{5}{60 \times 24} = 3.6 \times 10^{-6} \text{ uCi}$$

If as previously calculated, inhalation of 2.4×10^{-6} uCi/y would result in a 50 year dose commitment of 0.005 rems, inhalation of 3.6×10^{-6} uCi would result in a 50 year dose commitment of approximately 0.0075 rems.

Example 8

If a fire occurred in an area having a volume of 8 X 10 X 6 cubic meters and containing 10 detectors, and 0.31% of the 100 uCi became airborne, the average concentration might be:

$$\frac{0.0032 \times 100}{8 \times 10 \times 6 \times 10^{6}} = 6.7 \times 10^{-10} \text{ uCi/c}$$

However, it would take some period of time for the airborne contamination to become evenly distributed in a room of this size. The heat from such a fire would preclude any person from being in close proximity of the fire. There would be at least a dilution factor of 10 to where a person might be during the first few minutes of the fire. Assuming a person might take 5 minutes to evacuate, he might inhale:

$$6.7 \times 10^{-11} \times 2 \times 10^{7} \times \frac{5}{60 \times 24} = 4.7 \times 10^{-6} \text{ uCi}$$

This corresponds to a 50 year dose commitment of:

$$\frac{4.7 \times 10^{-6}}{2.4 \times 10^{-6}} (0.005) = 0.010 \text{ rems}$$

If a person fighting the fire would enter the room after the airborne contamination had been distributed throughout the volume, and the person was not wearing a respirator and he remained 1/2 an hour, he might inhale:

$$\frac{6.7 \times 10^{-10} \times 2 \times 10^{7}}{2 \times 24} = 2.8 \times 10^{-4} \text{ uCi}$$

Note: Water or other fire-fighting materials would tend to reduce the airborne contamination. This corresponds to a 50 year dose commitment of:

$$\frac{2.8 \times 10^{-4}}{2.4 \times 10^{-6}} (0.005) = 0.58 \text{ rems}$$

Example 9

If a fire should occur in an area having a volume of 30 X 50 X 6 cubic meters and there were 1000 detectors present and 0.31% of the 1000 uCi became airborne, the average concentration would be:

$$\frac{0.0031 \text{ X } 1000}{30 \text{ X } 50 \text{ X } 6 \text{ X } 10^{6}} = 3.4 \text{ X } 10^{-10} \text{ uCi/cc}$$

Again assuming there would be a dilution factor of at 10 where a person might be during the first few minutes of the fire, and delayed his exit for 5 minutes, the person might inhale:

$$3.4 \text{ X } 10^{-11} \text{ X } 2 \text{ X } 10^{7} \text{ X } \frac{5}{60 \text{ X } 24} = 2.4 \text{ X } 10^{-6} \text{ uCi}$$

This corresponds to a 50 year dose commitment of:

$$\frac{2.4 \text{ X } 10^{-6}}{2.4 \text{ X } 10^{-6}} (0.005) = 0.005 \text{ rems}$$

If a fire fighter entered the area after the airborne contamination had distributed throughout the volume, and was not wearing respiratory protection, and he remained for 1/2 hour, he might inhale:

$$\frac{3.4 \text{ X } 10^{-10} \text{ X } 2 \text{ X } 10^{7}}{2 \text{ X } 24} = 1.4 \text{ X } 10^{-4} \text{ uCi}$$

This corresponds to a 50 year dose commitment of:

$$\frac{1.4 \text{ X } 10^{-4}}{2.4 \text{ X } 10^{-6}} (0.005) = 0.29 \text{ rems}$$

Example 10

A person who would be cleaning up after the fire described in Example 9 might be exposed to 0.0031 X 1000 = 3.1 uCi of contamination which might have become airborne. Dunster Health Physics (Vol. 8, No. 4, Aug. "62") indicates a re-suspension factor when rummaging through dusty building rubble in an enclosed and unventilated space would be:

$$2 \text{ X } 10^{-6} \text{ m}^{-1}$$

Assuming the 3.1 uCi were in an area of 6 X 6 square meters, the concentration in the room would be:

$$\frac{3.1 \text{ X } 2 \text{ X } 10^{-6}}{6 \text{ X } 6} = 1.7 \text{ X } 10^{-7} \text{ uCi/m}^{3} \text{ or } 1.7 \text{ X } 10^{-13} \text{ uCi/cc}$$

If a person were to work 8 hours under these conditions, he might inhale:

$$1.7 \text{ X } 10^{-13} \text{ X } 2 \text{ X } 10^{7} \text{ X } \frac{8}{24} = 1.1 \text{ X } 10^{-6} \text{ uCi}$$

This corresponds to a 50 year dose commitment of:

$\frac{1.1 \times 10^{-6}}{2.4 \times 10^{-6}}$ (0.005) = 0.0023 rems

Example 11

In the unlikely event that a person should swallow a foil and the total activity (1.0 uCi) were ingested as previously calculated, and the quantity ingested in a year is 6.1×10^{-3} uCi to produce a 50 year dose commitment of 0.005 rems, the dose commitment would be

$\frac{1.0}{6.1 \times 10^{-3}}$ (0.005) = 0.82 rems

An actual case history (Health Physics, Vol. 33 No. 5, Dec. 1977) indicate the scenario in above assumption to be extremely conservative. The reference indicated that the foils passed in a reasonable time and that there was no detectable residual body burden.

DOSE COMMITMENT SUMMARY

All of the preceding examples are considered conservative. The "ORNL Fire Test" indicated that the average loss from the Am-241 foils was 0.31%, but most of this was deposited on the tubes containing the foils, and only 0.002% became airborne and was deposited on filters. Dose commitments may be over estimated by a factor of 150. All dose commitments are less than 10 CFR 32.28, Column I limits, under normal operating conditions. In abnormal situations, the estimates indicate that Column II may be exceeded slightly, but they are all less than the Column III limits.

Tests have shown that it is unlikely that there will be significant reduction of containment from wear and abuse likely to occur in normal handling and use during the lifetime of the AIE series detector.

6. Installation

the AIE detector is intended for commercial and industrial use. It is one part of an entire fire safety system. Detector is recommended for installation in either the ceiling or under floor applications. It must be connected properly to a fire and/ or smoke detection circuit as part of a fire safety system. There is no risk to persons responsible for installing the detectors. All installations are required to be done by qualified persons.

7. Radiological Safety Instructions

As stated above, unless detectors are subjected to extraordinary damage, there is no potential for leakage of hazardous materials.

PRODUCT DISPOSAL

ALL AIE series detectors that are returned to the factory for surveying will be disposed of through facilities that are authorized to handle radioactive materials. In addition, the following is an estimate dose commitment from concentrating 20,000 smoke detectors, each containing 1.0 uCi in a public landfill. The internationally recognized dose of Am-241 is 0.0129 R/hr Ci/m. Thus the exposure rate at 1 meter from a 20 mCi Am-241 source is less than 0.26 mr/h. However, it is unlikely due to the bulk of 20,000 detectors, anyone could get closer than approximately 5 meters from the effective center of the pile. The effective exposure rate is, therefore, 10nR/hr to anyone at the pile. This rate is without consideration of shielding by the detectors non-radioactive components. A landfill operator would reside less than an hour while burying the pile. His total dose would be less than 10nR. No significant internal dose from inhalation would be expected to result from disposal of the detectors to the workers of the landfill. Assuming an unlikely 1% airborne release of activity (Am-241), doses to critical organs would be: Lungs - 0.15 rem, Liver - 4.4 rem, Bones - 2.1 rem. These dosages are less than 10 CFR 32. 28 Column III. Long term effects to local populations would be expected to be negligible. The solubility of Am02 in a gold matrix such as the foil, is extremely low and negligible activity would be expected to reach from the burial site even under the worst conditions. Radium watch dial faces and smoke detectors over many years of burial have not been found to have contaminated public landfill operation. In addition, radium is in a far more soluble chemical physical form than AM02. In our opinion, random disposal of AM-241 containing smoke detectors from accidental or normal conditions will not contribute to a measurable cumulative environmental hazard.

8. Accompanying Documents

There are no accompanying documents provided with the products. All information pertaining to radiological safety are printed on the individual product labels as well as packaging.

9. Servicing

Any ionization detectors that are returned to Hochiki America for servicing undergo the following:

1. Indicate on form provided date, model type, serial number and operator name.

2. Perform a wipe test as indicated on steps 2-4 of the finished goods prior to shipment section above.

3. Record the results on the form.

4. Perform servicing.

5. The detector is tested to insure functionality.

6. The outer cover is removed and cleaned.

7. The cover is reassembled to the unit.

8. Repeat steps 2,3 again after re-assembling unit.

9. The unit is recalibrated.

10. If any of the above cannot be completed satisfactorily the unit is disassembled and the radioactive source is disposed of properly.

11. The service technician has been trained in the proper handling of radioactive materials.

10. Leak Test

The NRC does not require periodic testing of devices that contain less than 10 microcuries of alpha emitting material. However units are wipe tested prior to and on completion of manufacture, prior to distribution as well as before and after servicing as described above.

11. Additional Information

The AIE series detector is manufactured under very strict quality control procedures and distributed in accordance with the requirements of Underwriters Laboratories UL 268 specifications, the laws of the state of California and the State Fire Marshall, the Nuclear Regulatory Commission, Factory Mutual Research, and other industrial governing bodies.

12. Product Warranty

Hochiki America warrants the equipment manufactured by it to be free from defects in material and workmanship (does not apply to batteries). Hochiki America will repair or replace, at its option, any equipment which it determines to contain defective material or workmanship. Said equipment will be returned to purchaser F.O.B., Hochiki America, California. Hochiki America shall not be obligated to repair or replace equipment which has been repaired by others, abused, improperly installed, altered, or otherwise misused or damaged in any way. HOCHIKI AMERICA WILL NOT BE RESPONSIBLE FOR ANY DISMANTLING, RE-ASSEMBLY OR RE-INSTALLATION CHARGES. We warrant our devices to DIRECT PURCHASERS ONLY for one (1) year from date of shipment, with the exception of the smoke detectors, which have a three (3) year warranty. We will replace defective goods or credit them at invoice price per our option. Merchandise that is returned for defective reasons, and found not to be defective will be returned to the sender with charges commensurate with the extent of inspection and services performed, plus freight charges. After the warranty period expires, a service charge will be made for material and labor. This warranty is in lieu of all other warranties expressed or implied. Hochiki America shall

not be liable for an special, indirect, incidental or consequential damages claimed in connection with any revision of this agreement by others.

13. Safety Analysis

As noted above it is highly unlikely that materials will accumulate to a point in which it would pose a safety hazard. The table in part 32.28 was used as a guideline to insure that accumulations do not exceed these amounts. Thus exposure dosages will be held to acceptable levels. Due to the low level nature of the radioactive source, high exposure dosages would require an ac ulation that would be unacceptable to the company to continue conducting day to day business activities. Such an accumulation would be bad business economics in terms of inventory levels. Due to the conditions of use it is highly unlikely that any damages would occur when considering the effectiveness of shielding.

Hochiki America fully intends to distribute materials to persons exempt from licensing.

AIE- Parts List

Part	Enclosure #	Material
Outer Cover	2	ACS
Enclosure	3,4	ACS
Insulation Plate	5	Polypropylene
Gasket	6	Chloroprene Sponge Rubber
Outer Electr[illegible]	7,8	SUS 302
Intermediate Electrode	9,10	SUS 302
Inner Electrod	11 11A 12	SUS 305 SUS 316 SUS 305, SUS 316
Shield Case	13	Steel w/ Solder Plating
M3 x 6 Screw	14	Steel w/ Chromate Coating
M3 Nut	15	Steel w/ Chromate Coating
Radioactive Foil	16	Americium- 241 0.98 μCi
Insert Metal	17	Copper/ Copper Alloy w/ Solder Plating
Light Guide	18	Acrylic Plastic
Contact Blade	19	Copper w/ Solder Plating
FET Terminal	20	Steel w/ Solder Plating
Contact Clip	21	Copper- Phospher Bronze w/ Solder Plating
Insect Screen	22	SUS 304

Enclosure B1

R1201021 LICENSING TRACKING SYSTEM DATE: 960425
PAGE: 1

LTS WORKSHEET

DOCKET NO : 03008210 LICENSE NO : 04-14886-01E STATUS: 0

MAIL CONTROL: 021830 RECEIPT DATE : 960418 ACTION TYPE: 4
DUE DATE : 960717

FED. GOVT : C INST. CODE : 14886 LICENSE REGION: 0

ISSUE DATE: 950109 ORIGINAL DATE: 721101 EXPIRATION DATE: 20000131

NAME : HOCHIKI AMERICA CORP. DECOM FIN ASSUR REQD: N
SUBM: _

DEPT/BUREAU: _____ CONT PLAN REQD: N APPRV: _

BUILDING : _____

STREET : 5415 INDUSTRIAL DRIVE

CITY : HUNTINGTON BEACH STATE: CA ZIP: 92649

CONTACT PERSON: GYO SHINOZAKI PHONE: 714-898-0795

PRIMARY PGM CODE : 03255 SECONDARY PGM CODES: _____

INSPECTION REGION: 4 PRIORITY CODE: 5 INSPECTION CATEGORY: E

RADIATION SAFETY OFFICER: GYO SHINOZAKI

STATES WHERE USE IS AUTHORIZED: 1
0 - ALL LISTED STATES
1 - SAME AS STATE IN ADDRESS
2 - ALL STATES
3 - NON-AGREEMENT STATES

AUTHORIZED STATES: _____ (USE ONLY IF ABOVE IS ZERO)

REPORTING IDENTIFICATION SYMBOL: _____

APPROVAL FOR: REDISTRIBUTION: N STORAGE ONLY: N
TEMPORARY JOB SITES: N INCINERATION: N
BURIAL: N

EXEMPTIONS: (1)_____ (2)_____

030-08210

HOCHIKI

HOCHIKI AMERICA CORPORATION
5415 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92649

(714) 898-0795
(310) 431-0809
ADMIN. FAX(714) 898-0659
SALES FAX(714) 892-2809

April 15, 1996

Mr. Steve Baggett
Section Chief
U.S. Nuclear Regulatory Commission
Sealed Source Safety Section
Division of Industrial and Medical Nuclear Safety
Washington, D.C. 20555

Subject: Request For Amendment To License 04-14886/01E

Dear Mr. Baggett:

Please find attached the application for amendment of our NRC license # 04-14886/01E. This amendment covers the Hochiki AIE-EA ionization type smoke detector. If you have any questions regarding this submittal please feel free to contact myself or Gyo Shinozaki.

Thank you for your cooperation in this matter.

Sincerely,

Loren L. Leimer
NS Project Leader

PENDING

021830

APPLICATION TO THE U.S. NUCLEAR REGULATORY COMMISSION FOR RADIATION SAFETY EVALUATION AND REGISTRATION OF DEVICES (REQUEST FOR AMENDMENT TO LICENSE 04-1488501E)

April 10, 1996

HOCHIKI AMERICA CORPORATION
5415 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92649
MANUFACTURER AND DISTRIBUTOR

CONTACT: GYO SHINOZAKI- RSO
LOREN LEIMER- ALT. RSO
TEL (714) 898-0795
FAX (714) 892-2809

IONIZATION TYPE SMOKE DETECTORS

Smoke detector models for submission:
Hochiki Model AIE

This series of detector is manufactured for both Hochiki customers as well as private labelled for specific customers.

RADIOACTIVE SOURCE Am-241 0.98 uCi MODELS

Amersham International
2636 S. Clearbrook Dr.
Arlington Hts., IL 60005
Model: AMMK-2812
USNRC Model: AMM-1001

NRD Inc.
2937 Alt Bl. North
Grand Island, NY 14072
Model: Model A001
USNRC Model: A-001

Radioactive material possessed under conditions of California License 2090-30 (agreement state). Sources will be leak tested at time of manufacture and distribution in compliance with 10 CFR Part 32.29 and as described within this document.

This detector is Principal Use Code **"P"** devices proposed for use under a license exemption per 10 CFR Part. 30.20).

Summary Description

The AIE series smoke detector is the industrial ionization type. It is intended to be used for the protection of life and property from fires by the detection of airborne particulates. This detector will normally be mounted on the ceiling or below the floor. A complete system will generally be comprised of a number of detector heads which are connected to and operate from a central control unit. The AIE series detector is designed in such a way that the radioactive material is not readily accessible in its location within the assembly. The outside cover protects the chamber and prevents most objects from reaching the source. During installation there is no need to remove any mechanical or electrical parts which would also preclude anyone from inadvertently coming in contact with the radioactive source.

Description, Intended Use and Operation

The AIE series ionization smoke detector is provided with a radioactive source (Am-241), 0.98 uCi to ionize the air. The detector is designed to detect an abnormal decrease in ionization current due to the combustion products created by a fire. It is installed in a fixed location. The source housing does not move during operation.

The AIE series smoke detector has two sampling chambers, an outer and an inner ionization chamber. Smoke or invisible gasses can freely penetrate the outer chamber, but the inner chamber is virtually closed to prevent easy entry. With both chambers ionized by radioactive source Am-241, a very small amount of current flows in the circuit. The presence of smoke or gases will influence the current flow in the outer chamber and will cause a change in the voltage ratio between chambers. This difference is then amplified inside the detector and transmitted to the fire alarm control unit to which it is connected.

1. Details of Construction and Use

A list of mechanical parts for the AIE series are shown on Enclosure B1. Enclosures B2 through B22 are drawings of those parts and their respective materials. The foil is captured onto the inner electrode with a retaining disc which is staked in place by a hydraulically controlled welding machine. The inner electrode is placed into the insulation plate and the intermediate electrode is then snapped over the inner electrode and into the insulation plate. One leg of the intermediate electrode snaps into the insulation plate and the other leg protrudes through the insulation plate and is soldered onto one lead of the FET. This assembly process assures that the source is protected from damage and makes it otherwise tamper proof. The outer cover protects the unit and prevents objects from approaching the source. The closest approach is approximately 2 cm. During operation the outer cover, outer electrode and the intermediate electrode prevent someone or something from contacting the source. .

The detector has been designed so that once the radioactive material has been assembled into the unit at the factory, it is inaccessible without someone removing the printed circuit board from the detector and de-soldering the one leg of the intermediate After the detector has been assembled by

the factory there would be no need for disassembly, by either the installers or other field service technicians.

The AIE series detector is tested and listed to the ANSI/ UL 268-1988 standard. This standard requires that the detector be subjected to variable ambient temperatures, humidity plunges, corrosive environments and vibration testing. After such testing, the detector shall function normally. During normal use, detector is not expected to be subjected to ambient conditions outside of the listed parameters.

Total Expected Annual Distribution

It is estimated that a total of up to 300,000 detectors will be distributed in the United States by Hochiki annually. Each detector contains a maximum of 0.98 uCi, making the maximum distribution of Am-241 in the United States 300 millicuries. The useful life of the detector is assumed to be 10 years. This is the same useful life value commonly used in other similar fire protection devices already in service in the field.

1. Labeling and Marking

Each detector is manufactured with a permanent type, self adhesive backed label which is affixed to the bottom of the detector. The label contains the model name, type of detector, serial number, amount and type of radioactive material used, distribution license number, installation instruction drawing number, where to send for service, where unit was produced and other pertinent information regarding its use. The labels are expected to last the useful life of the detector. The AIE series detectors are placed in a five piece shipping carton. Each carton is printed with the name of the radionuclide and the quantity of activity: Americium 241, 0.98 uCi..

3. Prototype Testing and Evaluation

Tests were performed on the source after it was mounted onto the inner electrode. The tests were done by the Japan Radioisotope Association. The certification of approval under the classification C 32222 of IS-Z4821 of the above mentioned part is included in Enclosure B25. Hochiki Corporation in Japan performed vibration tests on 6 completed detectors. The test consisted on 1000 cycles per minute at an amplitude of 4 mm for 60 minutes. The test results showed no leakage of the source. The results also showed there was no damage to the integrity of the operation of the detector. (See Enclosure B26). Hochiki Corporation also performed shock and impact tests with acceptable results. (See Enclosure B27).

An impact test was also performed by Hochiki America Corporation. The results showed that the there was no leakage from the detector source. The AIE series detector was dropped from a height of 6 1/2 feet. A total of 25 drops were performed , and there were some signs of physical damage. Further investigation revealed that the inner electrode that holds the RI material was not damaged and appeared to be unaffected. The outer and inner electrodes remained very solid within the insulation plate and showed no other signs of physical damage. Even though there were signs of external physical damage the internal components remained unaffected so as to protect the radioactive source and keeping it isolated from direct contact with the outside. (See Enclosure B28).

SOLUBILITY OF WATER AND BODY FLUIDS

The following tests were performed by Amersham International Corporation Radiochemical Center in England to determine solubility of the foils in water and body fluids:

Test 1 - Sample foils containing 100 uCi Am-241 in an area of 1 square cm were immersed in distilled water at 98 degrees Fahrenheit for four (4) hours. In all tests, less than 0.003 uCi Am-241 were transferred to the water.

Test 2 - Sample foils containing 1 uCi in an area of 9 square mm were immersed in distilled water for three (3) weeks. In all tests, less than .001 uCi Am-241 were transferred to the water.

Test 3 - Sample foils containing 1 uCi in an area of 9 square mm were immersed in distilled water for twelve (12) weeks. Wipe out tests and immersion tests carried out on the foils indicated less than .001 Am-241 were removed from the sample.

Test 4 - Sample foils containing 1 uCi in an area of 9 square mm were immersed in a 0.1n HCl solution for four (4) hours at 98 degrees Fahrenheit. In all tests, less than .004 uCi Am-241 were removed from the sample. HCl was chosen for this test to more closely simulate body fluids.

The following were performed by New York State University at Buffalo to determine solubility of the foils in water and body fluids for NRD Inc..

Test 1 - Sample foils containing 2 uCi Am-241 in an area of 20mm^2 were immersed in city water at 98 degrees Fahrenheit for four (4) hours. In all tests, less than 0.0001 uCi Am-241 was transferred to the water.

Test 2 - Sample foils containing 2 uCi in an area of 20mm^2 were immersed in city water for twelve (12) days. In all tests, less than .001 uCi were transferred to the water.

Test 3 - Sample foils containing 2 uCi in an area of 20mm^2 were immersed in a solution simulating digestive juices with a ph of 1.96 for seven and one half (71/2) hours - Total activity released was less than .005 uCi.

Based on Test Report May 1976 David Dooley etal.

4. Quality Control

Incoming inspections are performed when containers of radioactive material are received. The outside of the shipping container is smear tested and the results recorded. The inside of the inner container is smear tested and the results recorded. If any contamination is detected, the foils are isolated and returned to the manufacturer for disposal. If there is no contamination detected the foils are placed in the safe and the information recorded. Before the foils are dispersed to the

assembly area the inside of the container is smear tested and the results recorded and initialed. If any contamination is detected the foils are isolated and returned to the manufacturer of the foils for disposal. These tests are conducted by using a cotton tip swab wetted with alcohol. Wipes are inserted into the chamber of the Eberline SRM-100 and counted. The results are recorded on the appropriate forms. The background of the Eberline model SRM-100 will be determined by counting with the chamber empty and the results recorded in the appropriate space on the applicable form. Any wipe showing greater than 10 cpm above background will be recounted to verify results. If results continue to show more than 10 cpm above background, item(s) will be cleaned until no activity is detectable.

There are two survey meters that can be used to make these tests. Each will be calibrated by the manufacturer against known radioactive materials including americium annually. The testers are incorporated into Hochiki's equipment calibration program.

A minimum of 1% of the daily production of ionization chambers, randomly selected, will be wiped. The results will be recorded,. Any contamination detected will result in an investigation until the cause is found. Contaminated units will be properly disposed of according to applicable regulatory procedures.

FINISHED GOODS PRIOR TO SHIPMENT

All (100%) of the daily quantity of units ready for final packaging will be wiped, counted, recorded and initialed. The following are the procedures routinely performed.

1. Indicate on the form provided the lot number, date, serial numbers and the sample size of the lot checked.

2. Background of the Eberline SRM--100 currently being used will be determined by counting with the chamber empty and the results recorded on the appropriate form.

3. A cotton tip swab, wetted with alcohol, will be used to wipe the detectors. The area wiped will not exceed 100 cm per wipe.

4. Wipes will be taken through the slots in the outer enclosure until the swab touches the bug screen.

5. A maximum total of 100 detectors are to be wiped before the swab is placed in the meter and the findings recorded and initialed.

6. Any wipes showing a reading greater than 10 cpm above background will be recounted to verify results. If the wipe shows more than 10 cpm above background, the detectors will be re-wiped and the data recorded. If the detectors show the presence of contamination, they will be checked and cleaned until no activity is detectable, or the contaminated detector(s) will be disposed of by a NRC approved procedure.

Radiation Profiles

BY-PRODUCT MATERIAL

The radioactiveisotope used in the AIE series detectors is Americium - 241, manufactured by Amersham International Corporation and NRD Inc.. The activity is 0.98 uCi, the physical size is 3.6 X 3.6 mm. The Amersham part number is AMMK-2812 the NRC listed model number is AMM-1001. The NRD model number is A001 and the NRC listed model number is A001.

Each detector contains a single foil. Each detector is defined by a unique serial number. The source is mounted onto the inner electrode and crimped into place.

BY-PRODUCT, CHEMICAL & PHYSICAL FORM

The radionuclide, in the form of Americium oxide (AmO^2), is uniformly distributed and sintered in a matrix of pure fine gold at temperatures in excess of 800 degrees C. It is contained between a backing of pure silver and a front covering of gold-palladium alloy (94% gold, 6% palladium) by hot forging. **The metal layers, continuously welded, are extended by means of a power rolling mill to give required foil strips which contain 8 uCi per cm^2 and from which elements of foil are cut into sections containing 0.98 uCi each.** Encapsulating in this manner insures that there will be no physical or chemical changes in the radioactive material over the life of the detector.

RADIATION FROM SMOKE DETECTOR HEADS

Radiation dose from the detector head was measured in Tokyo, Japan by Hochiki Corporation on 2 AIE series detectors. A hologram G-M tube attached to TGS 111 Survey Meter was used in measurements. Four positions on the detector were measured, top, bottom, left and right sides. These measurements were taken at the surface of the detector, and at 5 cm and 25 cm to the center of the tube. The tube was calibrated against a Co 60 source. The dose rates are an average of the measurements from the two AIE detectors. (See Enclosure B29).

At 5 cm 3.9 uR/hr
At 25cm 1.78 uR/hr

CALCULATED DOSE RATES

A theoretical dose rate may be calculated, based on a gamma emission of 60 KeV (35%) and a specific gamma ray constant of 0.036 R/h at 1 meter from 1 Ci (Radiological Health Book, HEW, 1970.)

The calculated dose rate at 5 cm from a 1.0 uCi source, for comparison:

$$\frac{(0.036)\,(0.35)\,(1.0 \times 10^{-6})\,(100^2)}{(5.0)^2} = 4.8 \text{ uR/hr}$$

Similarly, the dose rate, 25 cm from a 1.0 microcurie source is calculated to be:

$$\frac{4.8\,(5.0)^2}{(25)^2} = 0.19 \text{ uR/hr}$$

ORNL Report TM-2864 reports an exposure rate of 0.01 mR/h 14 cm from a 13.5 uCi foil. This would translate into a dose rate of 5.0 uR/hr at 5.0 cm from a 1.0 uCi source.

RADIATION DOSE AND DOSE COMMITMENTS

To determine the external exposure dose rate it was assumed that the dose rate 5 cm from a 1.0 uCi of Am-241 is 5.7 uR/hr. From this dose rate, other distances were calculated. Such as, the dose rate 25 cm from the detector:

$$\frac{(5.7)\,(5.0)^2}{(25)^2} = .22 \text{ uR/hr}$$

The following were also calculated:

At 2cm from the source 36 uR/hr.

At 5cm from the source 5.7 uR/hr

At 25cm from the source 0.22 uR/hr

At 1m from the source 0.014 uR/hr

At 2m from the source 0.004 uR/hr

At 3m from the source 0.002 uR/hr

A number of potential exposure conditions are summarized below using the values calculated previously. It was assumed in the evaluations that the detectors were mounted on the ceiling as in a normal field installation.

Example 1

A person who works in a facility protected by one or more detectors and lives in a residence with 1 detector in the bedroom and 1 or more in the hallway. The estimated dose is:

8 hrs/day work at 1m 0.014 X 8 X 5 X 50 = 28.0 urems/y

8 hrs/day work at 2m 0.004 X 8 X 365 = 11.7 urems/y

8 hrs/day transient at 1m 0.014 X 4 X 365 = 20.4 urems/y

Total annual dose = 60 microrems or 0.060 mrems per year. If this same person were to be involved in cleaning or relocating 5 detectors and if this operation was performed 6 times a year and it took 1 hour per operation, the estimated dose would be: Body at 25 cm, 30 hours. X 0.22 = 6.6 urems/y or 0.007 mrems/y. Hands at surface, 30 hrs. X 21 = 630 urems/y or 0.63 mrems/y.

The total annual dose estimate for this person would be:

Body, 0.060 + 0.007 = 0.067 mrems/y

Hands 0.060 + 0.63 = 0.69 mrems/y

Example 2

A person who is working at a station 1 m from a lot of 100 detectors that are stacked in such a way that they would be in a cube approximately 60 cm on a side. The calculated dose rate at 1 m from this lot is 0.24 urads/hr. The estimated dose is: 0.24 X 40 X 50 = 480 urems/y or 0.48 mrems/. The same person might also handle an individual detector 1 hour per day and this additional dose would be:

Body at 25 cm 0.22 X 5 X 50 = 55 urems/y or 0.06 mrems/y

Hands at 5 cm 5.7 X 5 X 50 = 1,425 urems/y or 1.425 mrems/y

Assuming the same person was also exposed as the person in example 1, this dose would be: Body, 0.48 + 0.06 + 0.07 = 0.61 mrems/y. Hands, 0.48 + 1.425 + 0.69 = 2.6 mrems/y.

Example 3

A person working in a warehouse who is stationed 3 m from a lot of 1000 detectors. It is calculated that the dose rate 3m from such an array would be 3.1 urads/h. The estimated dose is: 3.1 X 50 X 40 = 620 urems/y or 0.62 mrems/y. Assuming the 1000 were in 10 cartons of 100 detectors each, the same person might handle each of the 10 cartons an additional 4 times a year, 1 hour per handling. It is calculated that the dose rate from a carton containing 100 detectors is 3.1 urads/h at the surface and 1.1 urads/h at 25 cm. The estimated handling dose would be: Body at 25 cm, 1.1 X 10 X 4 = 44 urems/y or 0.044 mrems/y. Hands at surface, 3.1 X 10 X 4 = 124 mrems/y or 0.124 mrems/y. Assuming the same person were also exposed as in example 1, the estimated dose would be: Body, 0.067 + 0.044 + 0.62 = 0.73 mrems/y. Hands, 0.69 + 0.124 + 0.044 = 0.86 mrems/y.

Example 4

A person who installs detectors 40 hours per week might have his hands at the surface of a detector 1/4 of the time, and at 5 cm 3/4 of the time. The body average would be 25 cm from a detector. The estimated dose would be: Body, 0.22 X 40 X 50 = 440 urems/y. Hands, 25%, 21 X 40 X 50 X 1/4 = 10500 urems/y. Hands, 75%, 5.7 X 40 X 50 X 3/4 = 8550 urems/y. Total estimate dose to hands = 19050 urems/y or 19.1 mrems/y. Assuming the same person were also exposed as in

Example 1, his estimated dose would be: Body, 0.44 + 0.067 = 0.51 mrems/y. Hands, 19.1 + 0.69 = 19.8 mrems/y.

Example 5

A person working 40 hours per week, repairing, cleaning detectors with his hands at 2 cm from the source 1/2 of his time and -5 cm from the detectors the other 1/2 of his time, the body averages 25 cm from the detector. His estimated dose would be: Body, 0.22 X 50 X 40 = 440 urems/y or 0.44 mrems/y. Hands 50% of the time 2 cm, 36X 50 X 40 X 1/2 = 36000 urems/y. Hands 50 % of the time 5 cm, 5.7 X 50 X 40 X 1/2 = 5700 urems/y. Total estimated dose to hands = 41700 urems/y or 41.7 mrems/y.

Assuming the same person was also exposed as in example 1, the estimated dose would be: Body 0.44 + 0.067 = 0.51 mrems/y. Hands, 41.7 + 0.69 = 42.4 mrems/y.

Example 6

A person who transports 10 cartons containing 100 detectors each, totaling 1000 detectors across country traveling 4000 miles. The trip took 80 hours traveling at 50 mph. The estimated dose would be: 0.31 X 80 = 24.8 urems/y or .025 mrems/y. The same person making the trip 10 more times during the year would have an estimated dose of 0.25 mrems/y. If the same person were exposed as in example 1 in addition to the 10 trips made yearly, the estimated dose would be: 1 - trip, 0.025 + 0.01 = 0.035 mrems. 10 - trips, 0.25 + 0.01 = 0.26 mrems.

EXTERNAL EXPOSURE, SUMMARY

All of the examples used are very conservative in scope, such as distances, proximity to the source, and exposure times. Examples given do not take into consideration the shielding effect provided by packaging or other materials. All the preceding estimates are + less than the limits in 10 CFR 32.28, Column I (5 mrems/y body and 50 mrems/y hands), so it is very unlikely that these limits will be exceeded.

DOSE COMMITMENT

In the following section on Dose Commitment, several unusual examples, such as fires, are considered. While the Dose Commitments may be higher in these cases, the external exposure to such personnel as described will be negligible because of the short exposure times.

Calculations of the annual intake of AM-241 to produce a 50 year dose commitment of 0.005 rems, based on the report of ICRP Committee II on Permissible Dose for Internal Radiation follow:

$$R = \frac{EF\ (RBE)\ n\ (q)\ (3.7 \times 10^{4} \times 3600 \times 24 \times 365 \times 1.6 \times 10^{-6})}{100\ m}$$

Where EF (RBE) n = effective absorbed energy per dis, MeV
q = uCi of Am-241 deposited in organ of reference
m = mass of organ of reference, grams
3.7×10^{4} = dis/sec per uCi
3600 X 24 X 365 = sec/year
1.6×10^{-6} = ergs per MeV
100 = ergs/grams per rad
and R is in units of rems/year

$$R = \frac{EF\ (RBE)\ n\ q}{m} = (1.867 \times 10^{4})$$

If bone is the organ of reference, EF (RBE) n = 280, and $m = 7 \times 10^{3}$, and $R = \frac{280\ q}{7000}$

$= (1.867 \times 10^{4}) = 747$ q rems/year.

The integrated dose over 50 years is:

$$D = \frac{R}{\lambda}\ (1 - e\ \lambda^{-t})$$

Where R = rems/year
λ = the elimination constant = 0.693/T years^{-1}
T = the effective half-life, years
t = the time of consideration, years = 50 and D is in rems

For Bone, T is 5.1×10^{4} days or 140 years, and

$$D = \frac{(747\ q)\ (140)}{0.693}\ (1 - e^{-0.2475}) = 3.30 \times 10^{4}\ q \text{ rems}$$

For the limiting dose of 0.005 rems,

$$q = \frac{0.005}{3.3 \times 10^{4}} = 1.5 \times 10^{7} \text{ uCi}$$

The fraction of Am-241 inhaled which reaches the bone, Fa is 0.063, so the amount of AM-241 inhaled per year to produce a 50 year dose of 0.005 rems, Qa is:

$$\frac{1.5 \times 10^{7}}{0.063} = 2.4 \times 10^{4} \text{ uCi}$$

Similarly, the fraction reaching the bone through ingestion, f is 2.5×10 and Qw is
$\frac{1.5 \times 10^{-7}}{2.5 \times 10^{-5}} = 6.1 \times 10^{-3}$ by ingestion.

Another set of calculations using "Whole Body" as the organ of reference was made: EF (RBE)n = 57; m = 7 X 10^4 grams

T = 1.8 X 10^4 days or 49.3 years; fa = 0.25; f = 10^{-4}

This resulted in annual intake of Am-241 to produce a dose of 0.0005 rems in 50 years as follows:

Qa = 3.7 X 10^{-5} uCi by inhalation
Qw = 9.1 X 10^{-2} uCi by ingestion

Comparing these values with similar ones for bone, it is obvious that bone is the more critical organ. Similar calculations for other organs (limiting dose is 0.015 rems) also showed that bone is the most critical organ. Therefore, all of the estimated dose commitments that follow are based on bone as the critical organ. There is no evidence that Am-241 becomes airborne and respirable from sources previously described. Forcing an upper limit on zero is difficult but will be done in order to estimate an upper limit on dose commitment. ORNL Report TM-2684 summarizes a number of tests performed on 12 smoke detectors which had been in service at least 5 years. The detectors contained a total of 78 foils (some Ra-226, some Am-241) and contained 20 to 130 uCi per detector. Foil construction was similar to what has been previously described. Some pertinent results of these tests were:

1. Only one of the smear tests on the external surface of the 12 detectors showed detectable alpha activity, and this was 20 d/m.

2. The average removable contamination on the Am-241 foils, as measured by smear tests, was 694 d/m.

3. Following a "12-week Environmental Test" at 110 degrees F and 80% relative humidity, on 20 foils (12 Ra-226, 8 Am-241), half of which were intentionally damaged. There was no detectable contamination on the interior surfaces of the test chamber, as measured by a smear test.

4. During 1 hour "Fire Tests" (925 degrees C for 1 hour), the average loss from Am-241 foils was 31% and the loss which was deposited on filters or became airborne, was 0.002%. The ORNL Report indicates that there was no detectable contamination on the interior surfaces of the test chamber after the "12-Week Environmental Test." From the report, levels down to 6 d/m could be detected, so it would be reasonable to assume that at least 20 d/m would have been detected on a smear test of the chamber. Also, from the report, it is noted that a total of 0.12 uCi were available to become airborne, as measured by smear tests on the foils at the beginning of the test. This amount is approximately 25 times the permissible contamination (0.005 uCi) on the foils used in production of the detectors and as measured by smear tests. If it is assumed that the sample in the ORNL Tests represented at least 4% of the chamber area, and 20 d/m could be detected, the maximum that could be released from a foil in a year would be:

$$\frac{20 \times 52}{12} = 87 \text{ d/m or } 3.9 \times 10^{-5} \text{ uCi}$$

If this detector were in a room of 4 X 5 X 3 meters, and there was one air change per hour, the concentration average over a year would be:

$$\frac{3.9 \times 10^{-5}}{4 \times 5 \times 3 \times 10^{6} \times 24 \times 365} = 7.4 \times 10^{-17} \text{ uCi/cc}$$

The above represents a maximum concentration of a room in a residence. Similarly, if a work place had a volume of 8 X 10 X 6 cubic meters, the concentration average over a year would be:

9.3×10^{-18} uCi/cc

If a person were exposed as in Example 1 for 12 of the 16 hours per day at home and breathed 1 X 10^{7} cc in this 16 hour period, his annual intake of Am-241 would be:

$(7.4 \times 10^{-17})(1 \times 10^{7}) \times 12/16 \times 365 = 2.0 \times 10^{-17}$ uCi/y

Also, as in Example 1, if the same person were exposed at work to 9.3 X 10^{-18} uCi/cc in this 8 hours per day and breathed 1 X 10^{7} cc in this 8 hours his annual intake of Am-241 would be:

$(9.3 \times 10^{-18})(1 \times 10^{7}) \times 5 \times 50 = 2.3 \times 10^{-8}$ uCi/y

The total intakes would be 2.2 X 10^{-7} uCi/y. As calculated previously, inhalation of 2.4 X 10^{-6} uCi/y would result in a 50 year dose commitment of 0.005 rems. The dose commitment from an intake of 2.2 X 10^{7} uCi/y would therefore be:

$$\frac{2.2 \times 10^{-7}}{2.4 \times 10^{-6}} (0.005) = 0.00046 \text{ rems}$$

The above is intended to be an upper limit on zero, since there is no evidence to show that Am-241 becomes airborne under normal conditions. It can also be said that in Examples 2- 6 previously described, that there is a negligible release of Am-241 to be respirable, even though quantities of 100 or 1000 detectors are involved.

Estimated Dose Commitments under abnormal conditions are calculated in the following examples:

Example 7

If a fire should occur in a 4 X 5 X 3 meter room, and 0.31% of the 1.0 uCi Am-241 source should become airborne, the average concentration might be:

$$\frac{0.0031 \times 1.0}{4 \times 5 \times 3 \times 10^{6}} = 5.2 \times 10^{-11} \text{ uCi/cc}$$

If a person were to remain in this room for 5 minutes, he might inhale:

$$5.2 \times 10^{-11} \times 2 \times 10^{7} \times \frac{5}{60 \times 24} = 3.6 \times 10^{-6} \text{ uCi}$$

If as previously calculated, inhalation of 2.4×10^{-6} uCi/y would result in a 50 year dose commitment of 0.005 rems, inhalation of 3.6×10^{-6} uCi would result in a 50 year dose commitment of approximately 0.0075 rems.

Example 8

If a fire occurred in an area having a volume of 8 X 10 X 6 cubic meters and containing 10 detectors, and 0.31% of the 100 uCi became airborne, the average concentration might be:

$$\frac{0.0032 \times 100}{8 \times 10 \times 6 \times 10^{6}} = 6.7 \times 10^{-10} \text{ uCi/c}$$

However, it would take some period of time for the airborne contamination to become evenly distributed in a room of this size. The heat from such a fire would preclude any person from being in close proximity of the fire. There would be at least a dilution factor of 10 to where a person might be during the first few minutes of the fire. Assuming a person might take 5 minutes to evacuate, he might inhale:

$$6.7 \times 10^{-11} \times 2 \times 10^{7} \times \frac{5}{60 \times 24} = 4.7 \times 10^{-6} \text{ uCi}$$

This corresponds to a 50 year dose commitment of:

$$\frac{4.7 \times 10^{-6}}{2.4 \times 10^{-6}} (0.005) = 0.010 \text{ rems}$$

If a person fighting the fire would enter the room after the airborne contamination had been distributed throughout the volume, and the person was not wearing a respirator and he remained 1/2 an hour, he might inhale:

$$\frac{6.7 \times 10^{-10} \times 2 \times 10^{7}}{2 \times 24} = 2.8 \times 10^{-4} \text{ uCi}$$

Note: Water or other fire-fighting materials would tend to reduce the airborne contamination. This corresponds to a 50 year dose commitment of:

$$\frac{2.8 \times 10^{-4}}{2.4 \times 10^{-6}} (0.005) = 0.58 \text{ rems}$$

Example 9

If a fire should occur in an area having a volume of 30 X 50 X 6 cubic meters and there were 1000 detectors present and 0.31% of the 1000 uCi became airborne, the average concentration would be:

$$\frac{0.0031 \text{ X } 1000}{30 \text{ X } 50 \text{ X } 6 \text{ X } 10^{6}} = 3.4 \text{ X } 10^{-10} \text{ uCi/cc}$$

Again assuming there would be a dilution factor of at 10 where a person might be during the first few minutes of the fire, and delayed his exit for 5 minutes, the person might inhale:

$$3.4 \text{ X } 10^{-11} \text{ X } 2 \text{ X } 10^{7} \text{ X } \frac{5}{60 \text{ X } 24} = 2.4 \text{ X } 10^{-6} \text{ uCi}$$

This corresponds to a 50 year dose commitment of:

$$\frac{2.4 \text{ X } 10^{-6}}{2.4 \text{ X } 10^{-6}} 0.005) = 0.005 \text{ rems}$$

If a fire fighter entered the area after the airborne contamination had distributed throughout the volume, and was not wearing respiratory protection, and he remained for 1/2 hour, he might inhale:

$$\frac{3.4 \text{ X } 10^{-10} \text{ X } 2 \text{ X } 10^{7}}{2 \text{ X } 24} = 1.4 \text{ X } 10^{-4} \text{ uCi}$$

This corresponds to a 50 year dose commitment of:

$$\frac{1.4 \text{ X } 10^{-4}}{2.4 \text{ X } 10^{-6}} (0.005) = 0.29 \text{ rems}$$

Example 10

A person who would be cleaning up after the fire described in Example 9 might be exposed to 0.0031 X 1000 = 3.1 uCi of contamination which might have become airborne. Dunster Health Physics (Vol. 8, No. 4, Aug. "62") indicates a re-suspension factor when rummaging through dusty building rubble in an enclosed and unventilated space would be:

$2 \text{ X } 10^{-6} \text{ m}^{-1}$

Assuming the 3.1 uCi were in an area of 6 X 6 square meters, the concentration in the room would be:

$$\frac{3.1 \text{ X } 2 \text{ X } 10^{-6}}{6 \text{ X } 6} = 1.7 \text{ X } 10^{-7} \text{ uCi/m}^{3} \text{ or } 1.7 \text{ X } 10^{-13} \text{ uCi/cc}$$

If a person were to work 8 hours under these conditions, he might inhale:

$$1.7 \text{ X } 10^{-13} \text{ X } 2 \text{ X } 10^{7} \text{ X } \frac{8}{24} = 1.1 \text{ X } 10^{-6} \text{ uCi}$$

This corresponds to a 50 year dose commitment of:

$\frac{1.1 \times 10^{-6}}{2.4 \times 10^{-6}}$ (0.005) = 0.0023 rems

Example 11

In the unlikely event that a person should swallow a foil and the total activity (1.0 uCi) were ingested as previously calculated, and the quantity ingested in a year is 6.1×10^{-3} uCi to produce a 50 year dose commitment of 0.005 rems, the dose commitment would be:

$\frac{1.0}{6.1 \times 10^{-3}}$ (0.005) = 0.82 rems

An actual case history (Health Physics, Vol. 33 No. 5, Dec. 1977) indicate the scenario in above assumption to be extremely conservative. The reference indicated that the foils passed in a reasonable time and that there was no detectable residual body burden.

DOSE COMMITMENT SUMMARY

All of the preceding examples are considered conservative. The "ORNL Fire Test" indicated that the average loss from the Am-241 foils was 0.31%, but most of this was deposited on the tubes containing the foils, and only 0.002% became airborne and was deposited on filters. Dose commitments may be over estimated by a factor of 150. All dose commitments are less than 10 CFR 32.28, Column I limits, under normal operating conditions. In abnormal situations, the estimates indicate that Column II may be exceeded slightly, but they are all less than the Column III limits.

Tests have shown that it is unlikely that there will be significant reduction of containment from wear and abuse likely to occur in normal handling and use during the lifetime of the AIE series detector.

6. Installation

the AIE detector is intended for commercial and industrial use. It is one part of an entire fire safety system. Detector is recommended for installation in either the ceiling or under floor applications. It must be connected properly to a fire and/ or smoke detection circuit as part of a fire safety system. There is no risk to persons responsiole for instailing the detectors. All installations are required to be done by qualified persons.

7. Radiological Safety Instructions

As stated above, unless detectors are subjected to extraordinary damage, there is no potential for leakage of hazardous materials.

PRODUCT DISPOSAL

ALL AIE series detectors that are returned to the factory for surveying will be disposed of through facilities that are authorized to handle radioactive materials. In addition, the following is an estimate dose commitment from concentrating 20,000 smoke detectors, each containing 1.0 uCi in a public landfill. The internationally recognized dose of Am-241 is 0.0129 R/hr/Ci/m. Thus the exposure rate at 1 meter from a 20 mCi Am-241 source is less than 0.26 mr/hr. However, it is unlikely due to the bulk of 20,000 detectors, anyone could get closer than approximately 5 meters from the effective center of the pile. The effective exposure rate is, therefore, 10nR/hr to anyone at the pile. This rate is without consideration of shielding by the detectors non-radioactive components. A landfill operator would reside less than an hour while burying the pile. His total dose would be less than 10nR. No significant internal dose from inhalation would be expected to result from disposal of the detectors to the workers of the landfill. Assuming an unlikely 1% airborne release of activity (Am-241), doses to critical organs would be: Lungs - 0.15 rem; Liver - 4.4 rem; Bones - 2.1 rem. These dosages are less than 10 CFR 32: 28 Column III. Long term effects to local populations would be expected to be negligible. The solubility of Am02 in a gold matrix such as the foil, is extremely low and negligible activity would be expected to reach from the burial site even under the worst conditions. Radium watch dial faces and smoke detectors over many years of burial have not been found to have contaminated public landfill operation. In addition, radium is in a far more soluble chemical physical form than AM02. In our opinion, random disposal of AM-241 containing smoke detectors from accidental or normal conditions will not contribute to a measurable cumulative environmental hazard.

8. Accompanying Documents

There are no accompanying documents provided with the products. All information pertaining to radiological safety are printed on the individual product labels as well as packaging.

9. Servicing

Any ionization detectors that are returned to Hochiki America for servicing undergo the following:

1. Indicate on form provided date, model type, serial number and operator name.

2. Perform a wipe test as indicated on steps 2-4 of the finished goods prior to shipment section above.

3. Record the results on the form.

4. Perform servicing.

5. The detector is tested to insure functionality.

6. The outer cover is removed and cleaned.

7. The cover is reassembled to the unit.

8. Repeat steps 2,3 again after re-assembling unit.

9. The unit is recalibrated.

10. If any of the above cannot be completed satisfactorily the unit is disassembled and the radioactive source is disposed of properly.

11. The service technician has been trained in the proper handling of radioactive materials.

10. Leak Test

The NRC does not require periodic testing of devices that contain less than 10 microcuries of alpha emitting material. However units are wipe tested prior to and on completion of manufacture, prior to distribution as well as before and after servicing as described above.

11. Additional Information

The AIE series detector is manufactured under very strict quality control procedures and distributed in accordance with the requirements of Underwriters Laboratories UL 268 specifications, the laws of the state of California and the State Fire Marshall, the Nuclear Regulatory Commission, Factory Mutual Research, and other industrial governing bodies.

12. Product Warranty

Hochiki America warrants the equipment manufactured by it to be free from defects in material and workmanship (does not apply to batteries). Hochiki America will repair or replace, at its option, any equipment which it determines to contain defective material or workmanship. Said equipment will be returned to purchaser F.O.B., Hochiki America, California. Hochiki America shall not be obligated to repair or replace equipment which has been repaired by others, abused, improperly installed, altered, or otherwise misused or damaged in any way. HOCHIKI AMERICA WILL NOT BE RESPONSIBLE FOR ANY DISMANTLING, RE-ASSEMBLY OR RE-INSTALLATION CHARGES. We warrant our devices to DIRECT PURCHASERS ONLY for one (1) year from date of shipment, with the exception of the smoke detectors, which have a three (3) year warranty. We will replace defective goods or credit them at invoice price per our option. Merchandise that is returned for defective reasons, and found not to be defective will be returned to the sender with charges commensurate with the extent of inspection and services performed, plus freight charges. After the warranty period expires, a service charge will be made for material and labor. This warranty is in lieu of all other warranties expressed or implied. Hochiki America shall

not be liable for an special, indirect, incidental or consequential damages claimed in connection with any revision of this agreement by others.

13. Safety Analysis

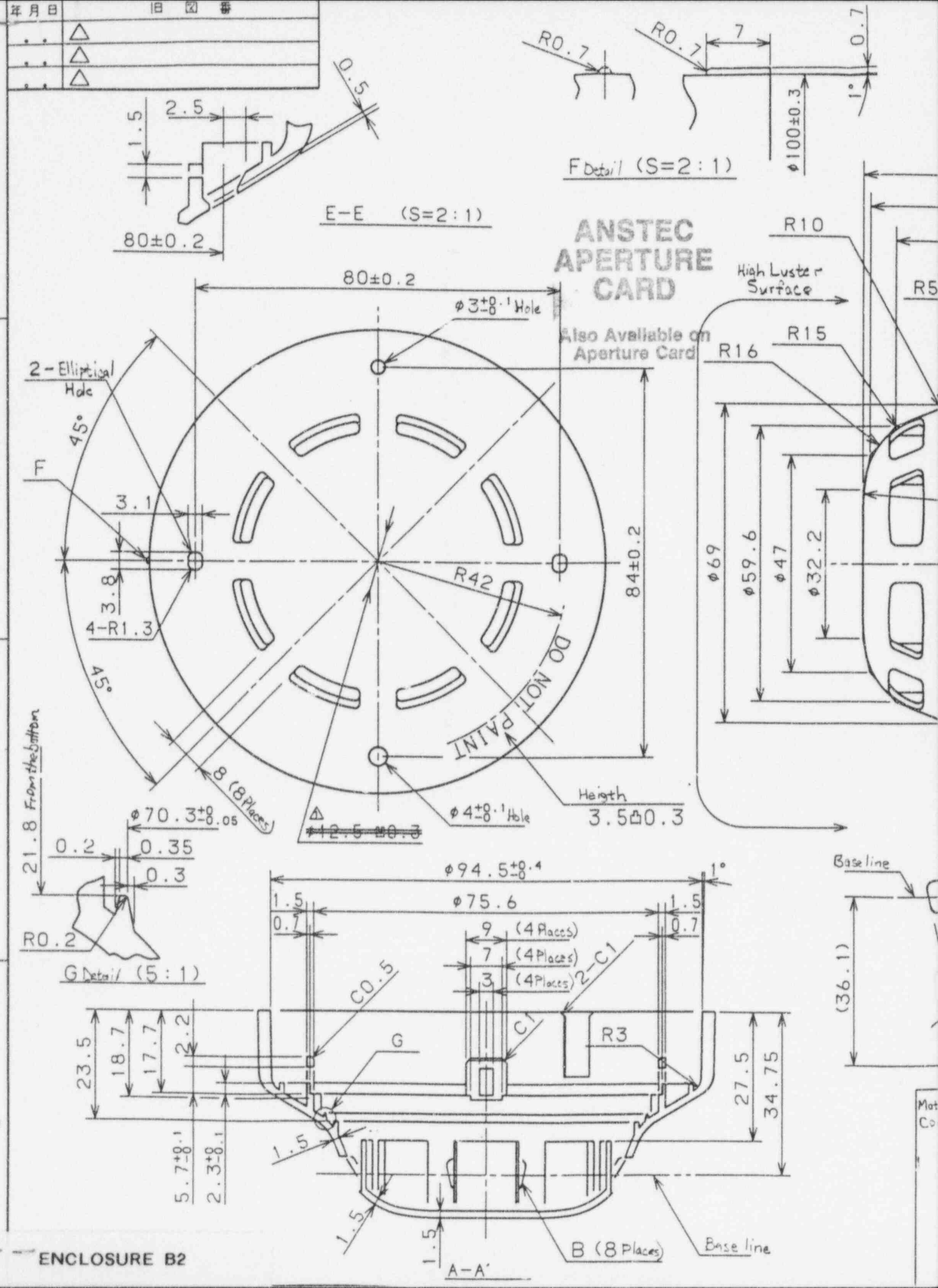
As noted above it is highly unlikely that materials will accumulate to a point in which it would pose a safety hazard. The table in part 32.28 was used as a guideline to insure that accumulations do not exceed these amounts. Thus exposure dosages will be held to acceptable levels. Due to the low level nature of the radioactive source, high exposure dosages would require an accumulation that would be unacceptable to the company to continue conducting day to day business activities. Such an accumulation would be bad business economics in terms of inventory levels. Due to the conditions of use it is highly unlikely that any damages would occur when considering the effectiveness of shielding.

Hochiki America fully intends to distribute materials to persons exempt from licensing.

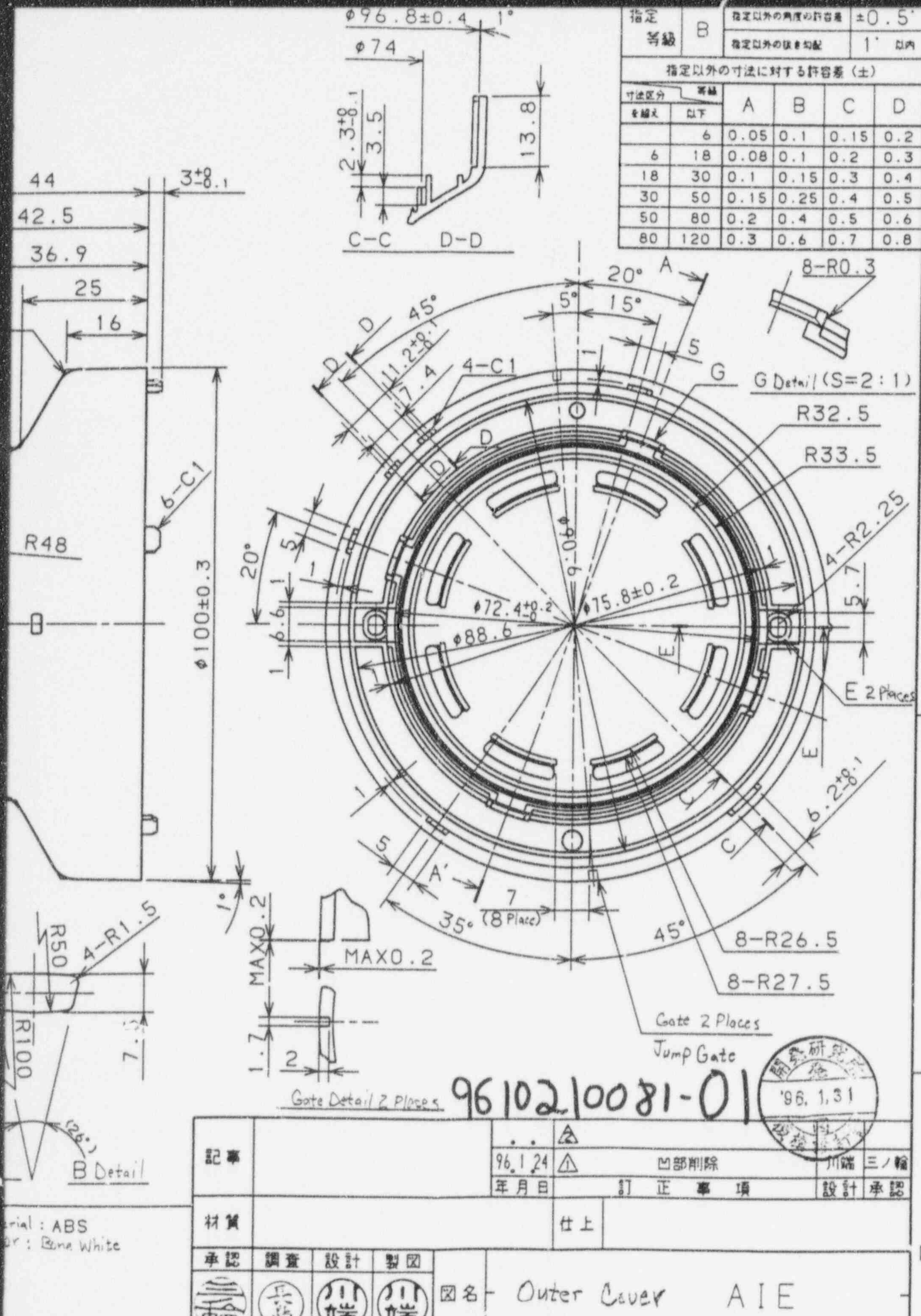
AIE- Parts List

Part	Enclosure #	Material
Outer Cover	2	ACS
Enclosure	3,4	ACS
Insulation Plate	5	Polypropylene
Gasket	6	Chloroprene Sponge Rubber
Outer Electrode	7,8	SUS 302
Intermediate Electrode	9,10	SUS 302
Inner Electrod	11 11A 12	SUS 305 SUS 316 SUS 305, SUS 316
Shield Case	13	Steel w/ Solder Plating
M3 x 6 Screw	14	Steel w/ Chromate Coating
M3 Nut	15	Steel w/ Chromate Coating
Radioactive Foil	16	Americium- 241 0.98 μCi
Insert Metal	17	Copper/ Copper Alloy w/ Solder Plating
Light Guide	18	Acrylic Plastic
Contact Blade	19	Copper w/ Solder Plating
FET Terminal	20	Steel w/ Solder Plating
Contact Clip	21	Copper- Phospher Bronze w/ Solder Plating
Insect Screen	22	SUS 304

Enclosure B1



ENCLOSURE B2



指定等級	B	指定以外の角度の許容差	±0.5°
		指定以外の抜き勾配	1° 以内

指定以外の寸法に対する許容差（±）

寸法区分 を越え	以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8

Computer No 1400-02155

REV.	DATE	BY	CHANGE
1	4-24-96	HC	Initial Release

HOCHIKI
HOCHIKI AMERICA CORP.
HUNTINGTON BEACH, CA

TITLE: Outer Cover AIE
DRAWING NO.: HA-01-154

CONTROLLED ENGINEERING
DATE: 4/10/1996

開発研究所 '96.1.31

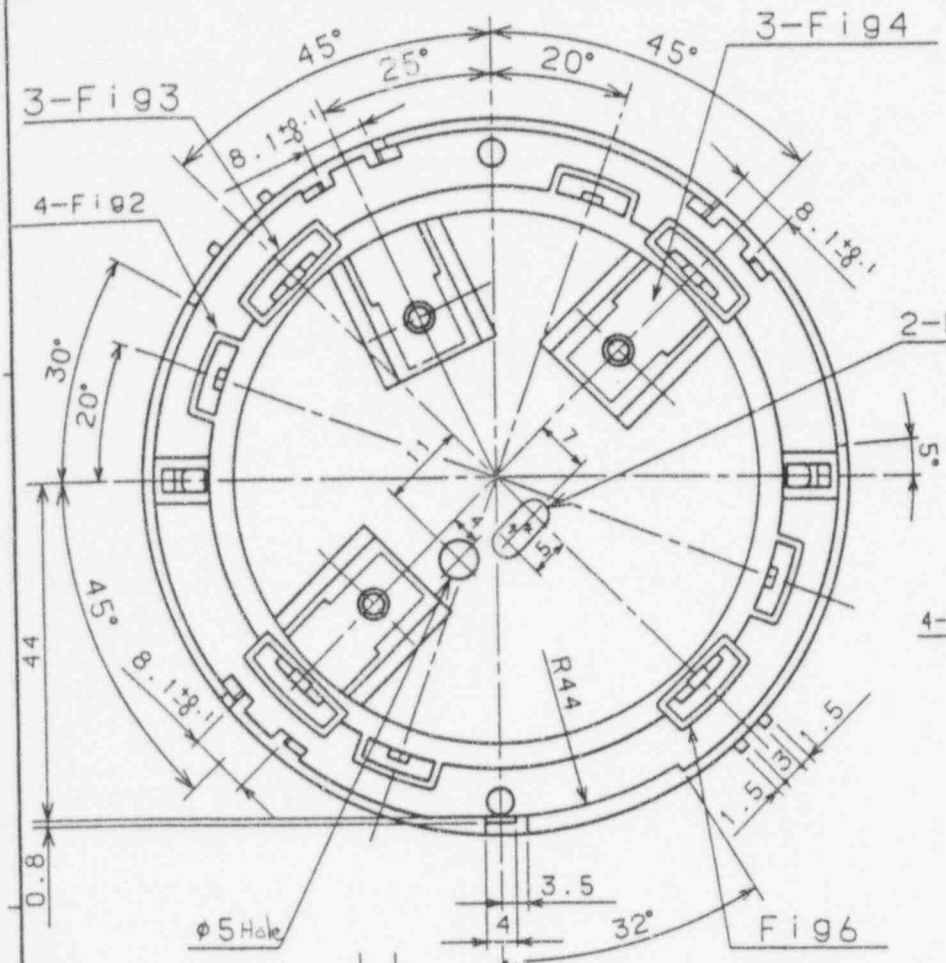
9610210081-01

Material : ABS
Color : Bone White

記事		△			
	96.1.24	△	凹部削除	川端	三ノ輪
	年月日		訂正事項	設計	承認
材質		仕上			

承認	調査	設計	製図	図名	Outer Cover AIE
三ノ輪	玉露	川端	川端		
縮尺		設計年月日		図番	2-3-275-0418-152
1:1		95.11.06			
単位	mm	第3角法			ホーチキ株式会社

年月日	旧 図 番
. .	△
. .	△
. .	△



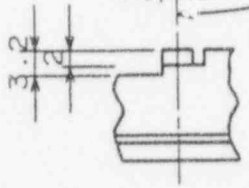
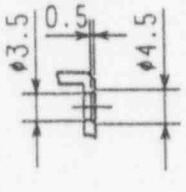


Fig6

Fig1



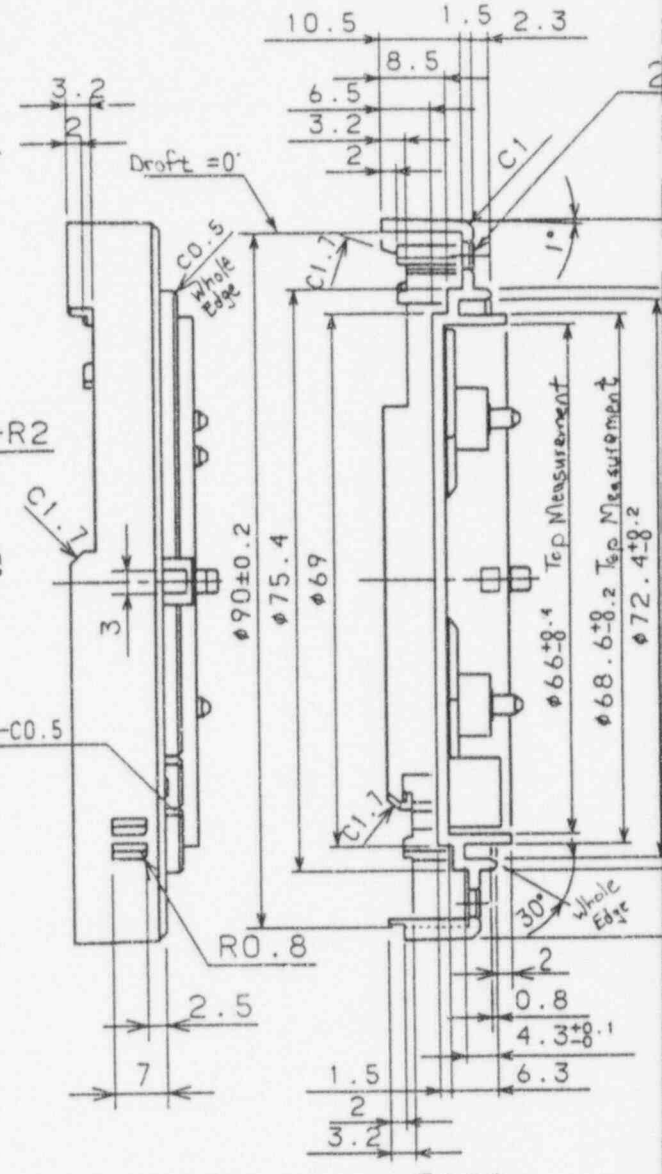


Fig4

Fig2

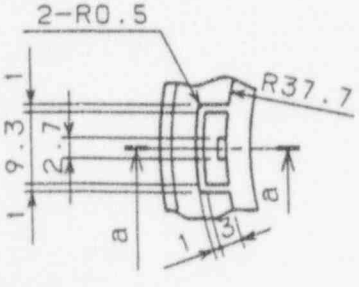
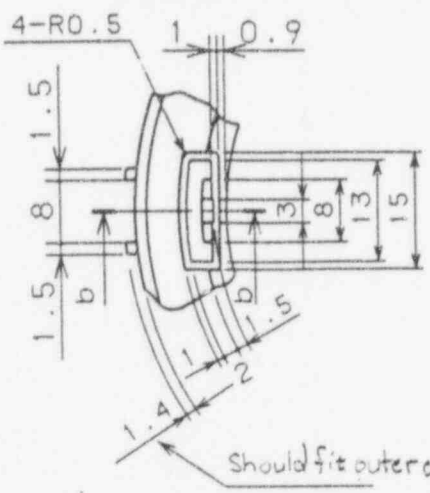
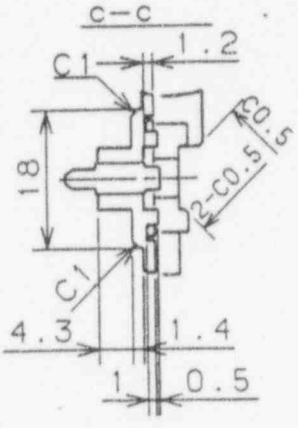
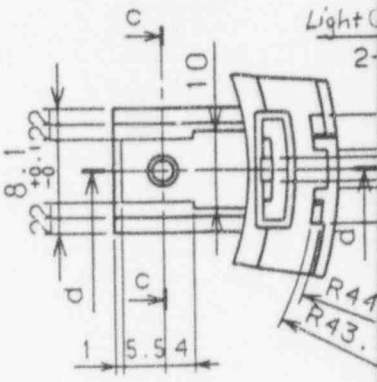
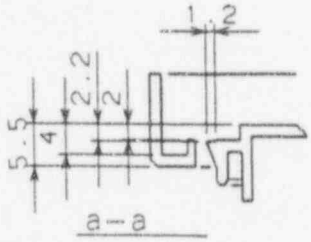


Fig3

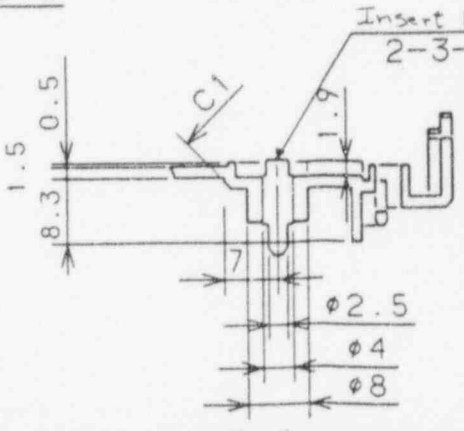




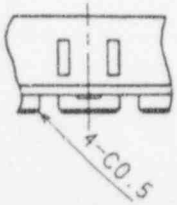


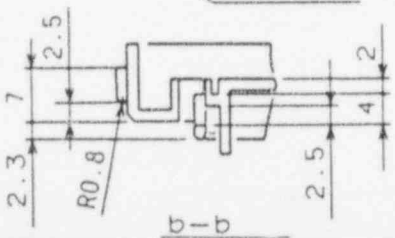


a-a



d-d





b-b

ENCLOSURE B3

指定等級	B	指定以外の角度の許容差	± 0.5°
		指定以外の抜き勾配	1° 以内

指定以外の寸法に対する許容差（±）

寸法区分 を超え	以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8
120	180	0.4	0.9	1.0	1.1
180	250	0.6	1.2	1.3	1.4
250	500	0.8	1.5	1.7	1.9

Material : ABS
Color : Bone White

Computer No. 1400-02253

-Fig1 Hole

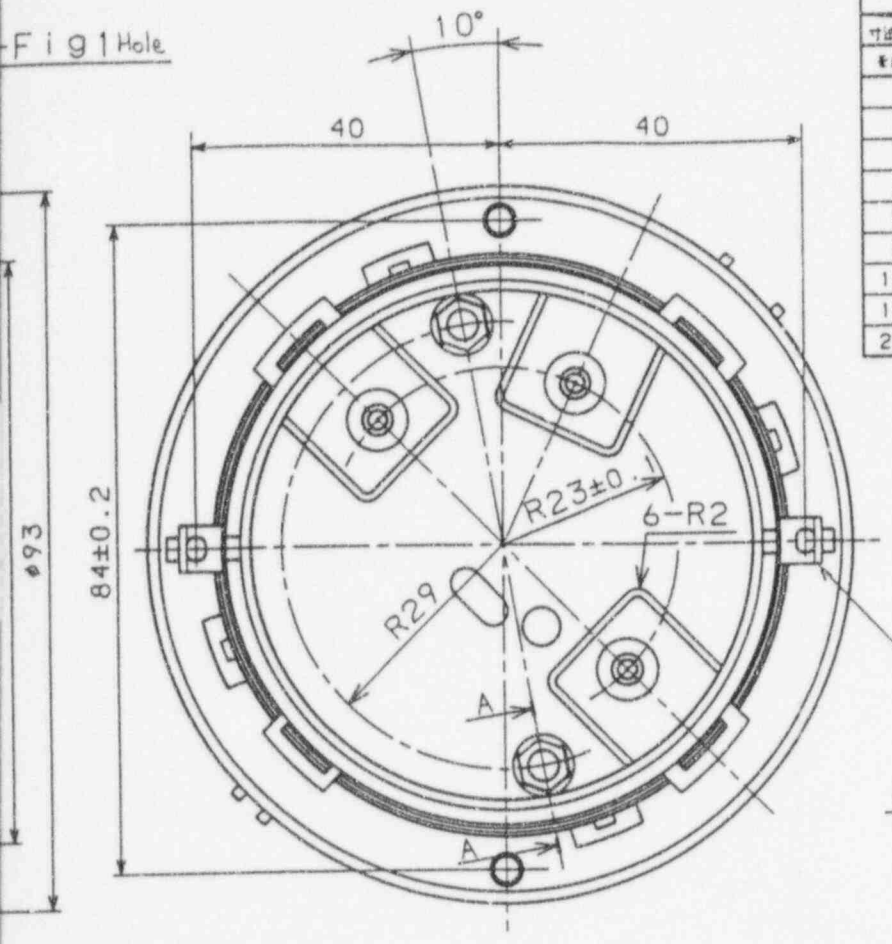


Fig6

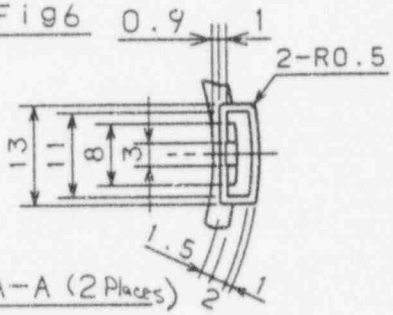
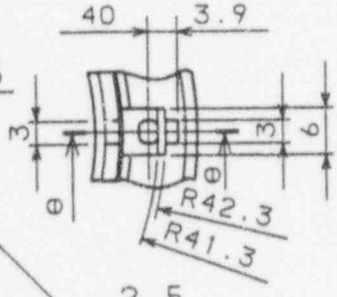
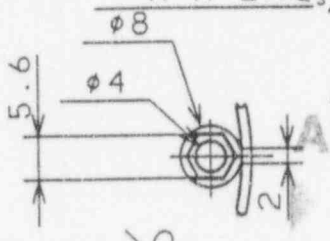
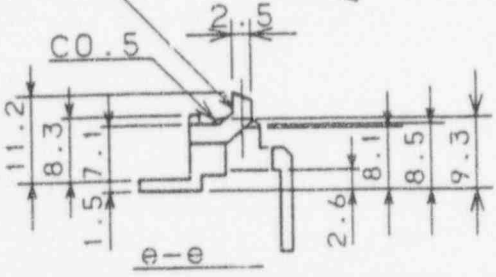


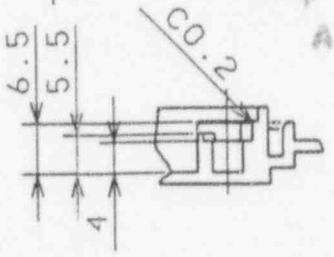
Fig5



A-A (2 Places)







'98. 1.31

CONTROLLED DATE: 4/10/1998 ENGINEERING

記事	Need Light Guide 2 Pcs. Need Insert Metal 3 pcs.	年月日	訂正事項	設計	承認
材質		仕上	9610210081-02		

承認	調査	設計	製図	図名	Enclosure AIE
				図番	2-3-275-0419-151
縮尺		設計年月日			
1:1		95.11.06			
単位	mm	第3角法		ホーチキ株式會社	

DRAWN BY	HC	DATE	11-6-95	SCALE	
CHECKED BY					
APPROVED BY					
DRAWING NO.	HA-01-156				

HOCHIKI AMERICA CORP.
3913 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92649

TITLE Enclosure AIE

REV.	DATE	BY	CHANGE
—	4-9-98	HC	Initial Release

-0119
5-0119

ide ALG 0388
3-275-0388

ENCLOSURE B4

REV.	DATE	BY	CHANGE
—	7-9-96	HC	Initial Release

DRAWN BY: HC	DATE: 11-6-95	HOCHIKI AMERICA CORP. 3413 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649
CHECKED BY: Brian D'Lima	DATE	
APPROVED BY: [illegible]	SCALE	
DRAWING NO. HA-01-138		TITLE Assembly Enclosure AIE

DATE: 4/10/1996
ENGINEERING

1 2 3 4

年月日	旧図番
. .	△
. .	△
. .	△

△ Hex Nut M3
2-5-705-0302

Enclosure AIE
2-3-275-0419

B-B (2places)

A

B

B

A

Place in three positions
rivet securely

Contact Blade
2-3-295-0459

A-A

△ Shield Case AIE
2-3-295-0468

'96. 1. 31

. .	△2			
95.12.18	△1 シールドケース、ナット追加	川端	三ノ輪	
年月日	訂正事項	設計	承認	
記事				

材質	
仕上	

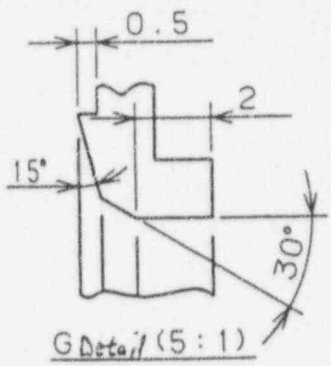
承認	調査	設計	製図	設計年月日
		川端	川端	95.11.06
縮尺	1:1	単位	mm	第3角法

図名	Enclosure Assembly AIE
図番	2-1-490-0348-162

ホーチキ株式会社

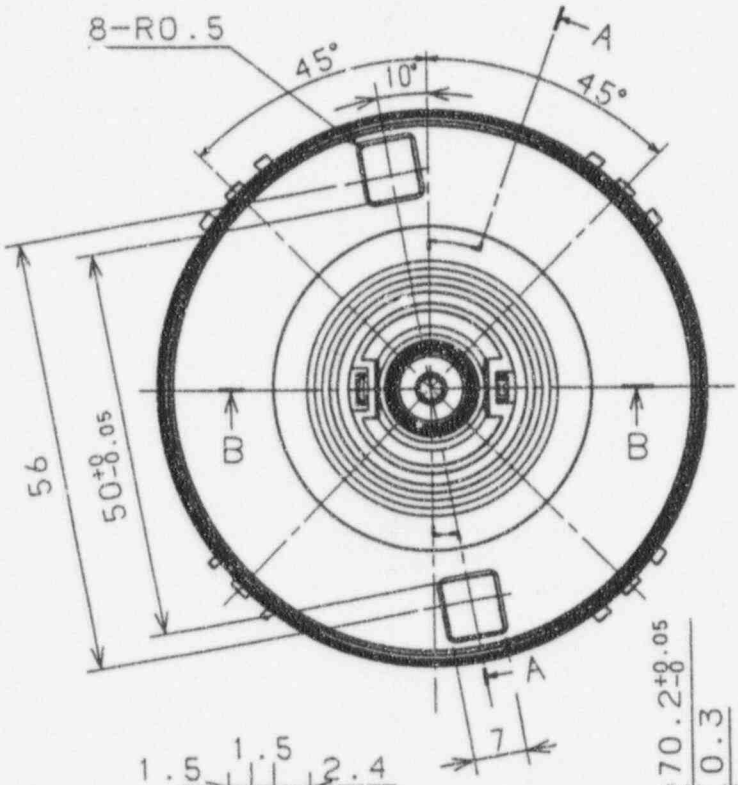
年月日	旧 図 番
. .	△
. .	△
. .	△

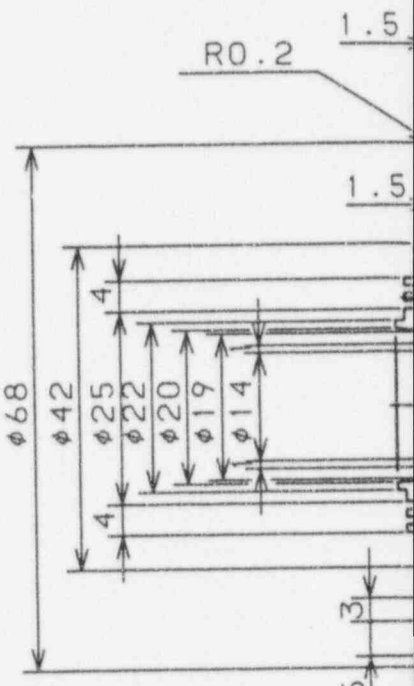
Do not use rust preventative on tooling.
Do not use mold release on tooling.

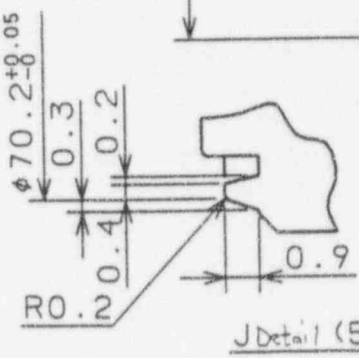


G Detail (5 : 1)

CONTROLLED
DATE: 4/10/96
ENGINEERING







J Detail (5 : 1)

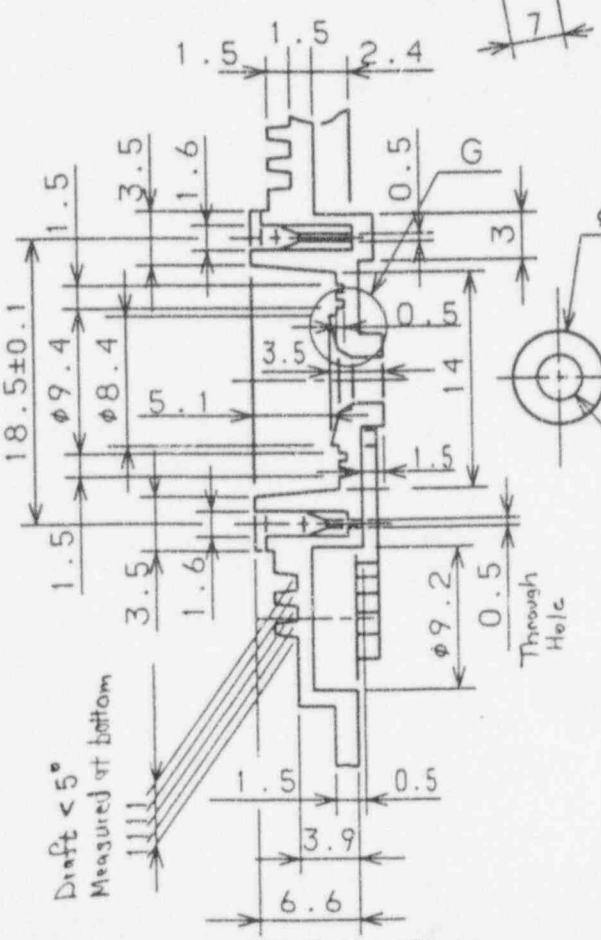
REV.	H-A No. PC	Initial Release	
DRAWN BY	DATE		
CHECKED BY	DATE		
APPROVED BY	SCALE		
DRAWING NO.			

HOCHIKI AMERICA CORP.
3415 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92649

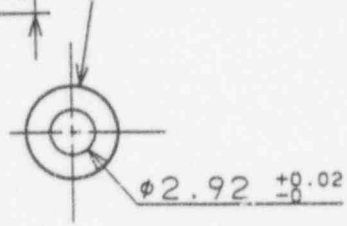
TITLE: Insulation Plate ASS'Y

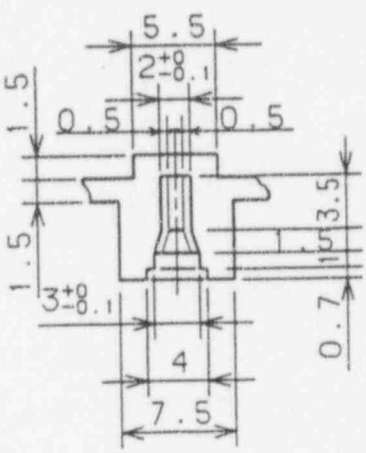
HA-01-153

Computer No 1400-02235



B-B (2 : 1)





C-C (2 : 1)

ENCLOSURE B5

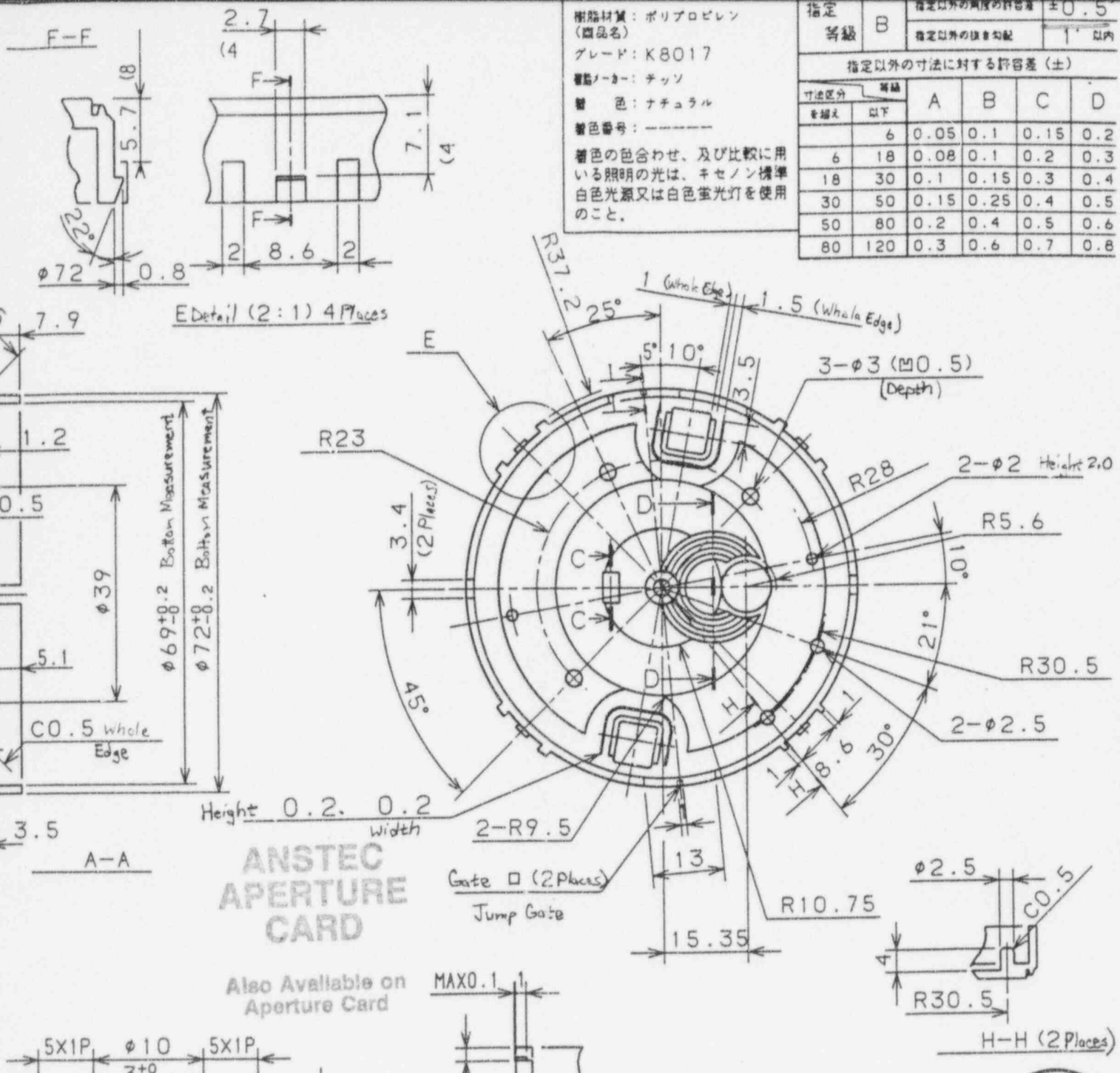
樹脂材質：ポリプロピレン
（商品名）
グレード：K8017
着色メーカー：チッソ
着　色：ナチュラル
着色番号：――――

着色の色合わせ、及び比較に用いる照明の光は、キセノン標準白色光源又は白色蛍光灯を使用のこと。

指定等級	B	指定以外の寸度の許容差	±0.5
		指定以外の抜き勾配	1° 以内

指定以外の寸法に対する許容差（±）

寸法区分を超え	以下	等級 A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8



'96. 1. 31

9610210081-03

記事	防錆剤の付着無きこと。離型剤は使用しないこと。	年月日	訂正事項	設計	承
		⚠2			
		⚠1			
材質	Material; Polypropylene	仕上			

承認	調査	設計	製図	図名	Insulation Plate AIE
		川端	川端		
縮尺		設計年月日		図番	2-3-275-0420-151
1:1		95.11.06			
単位	mm	第3角法			ホロヲ株式会社

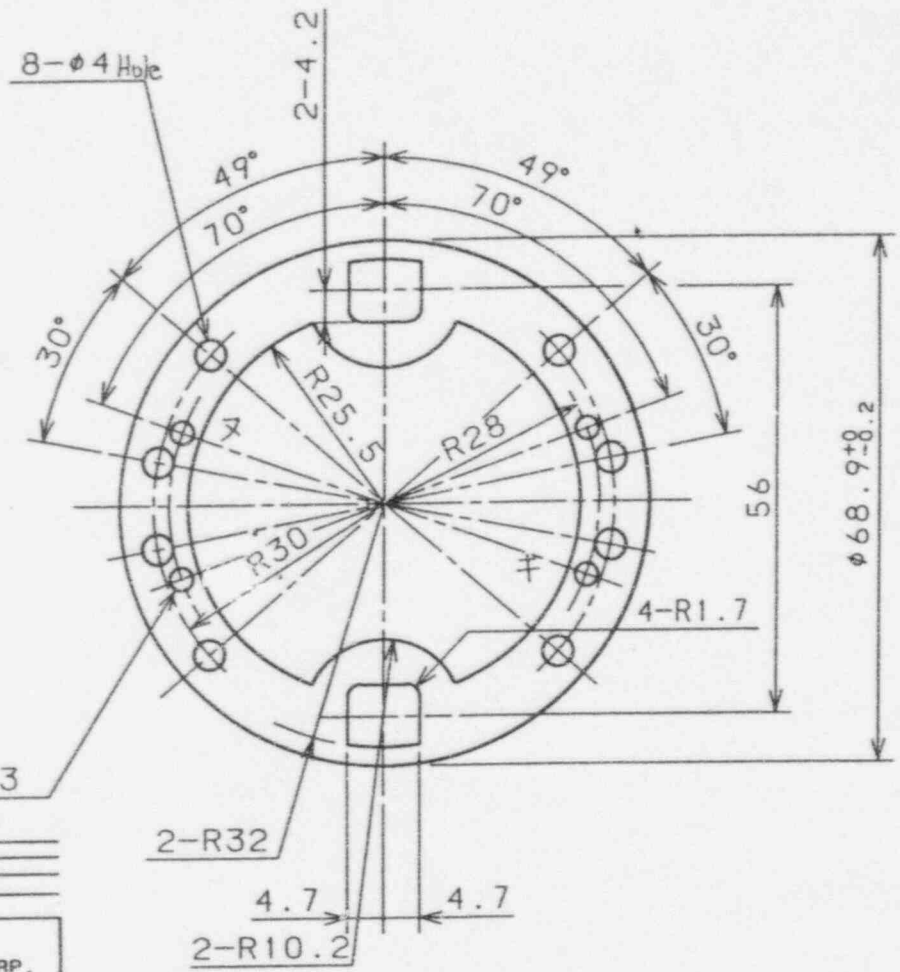
年月日	旧 図 番
. .	△
. .	△
. .	△

指定等級	B	指定以外の角度の許容差	±
		指定以外の丸み勾配	以内

指定以外の寸法に対する許容差（±）

寸法区分 を超え	以下	等級 A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8
120	180	0.4	0.9	1.0	1.1
180	250	0.6	1.2	1.3	1.4
250	500	0.8	1.5	1.7	1.9

ENCLOSURE B6



CONTROLLED
DATE: 4/10/1996
ENGINEERING

t=1.5

REV.	DATE	BY	CHANGE
−	4-9-96	HC	Initial Release

DRAWN BY: HC DATE: 11-6-95
CHECKED BY:
APPROVED BY:
DRAWING NO. HA-01-137
SCALE:

HOCHIKI
HOCHIKI AMERICA CORP.
9413 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92646
TITLE Gasket AIE

Computer No. 2500-00030

'95. 1.31

年月日	訂 正 事 項	設計	承認
. .	△2		
. .	△1		
記事			

材質	Chloroprene Sponge Rubber Closed cell
仕上	

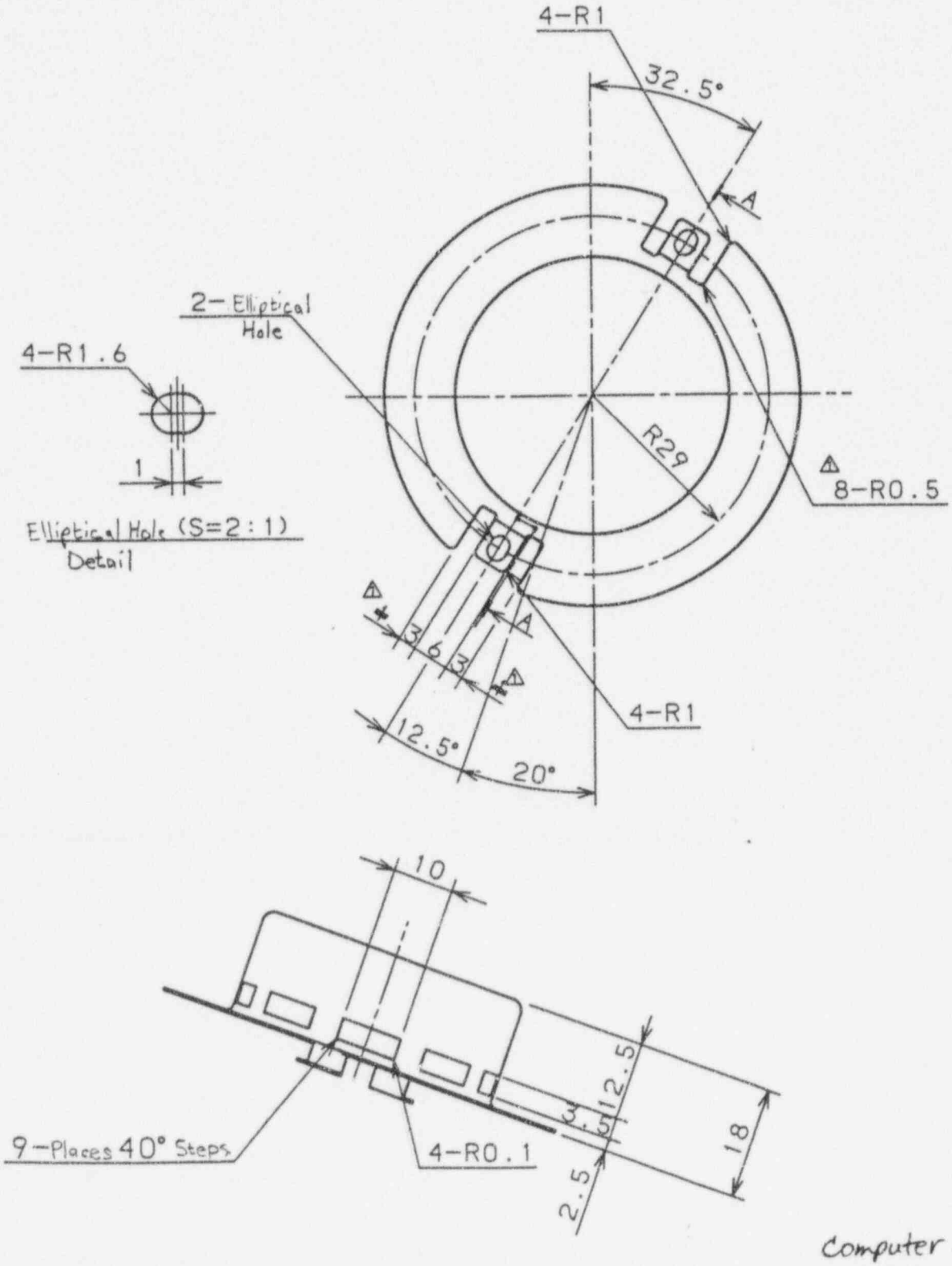
承認	調査	設計	製図	設計年月日
				95.11.06
縮尺	1:1	単位	mm	第3角法

図名	Gasket AIE
図番	2-3-184-0146-151

ホーチキ株式会社

原図保管

年月日	旧 図 番
. .	△
. .	△
. .	△

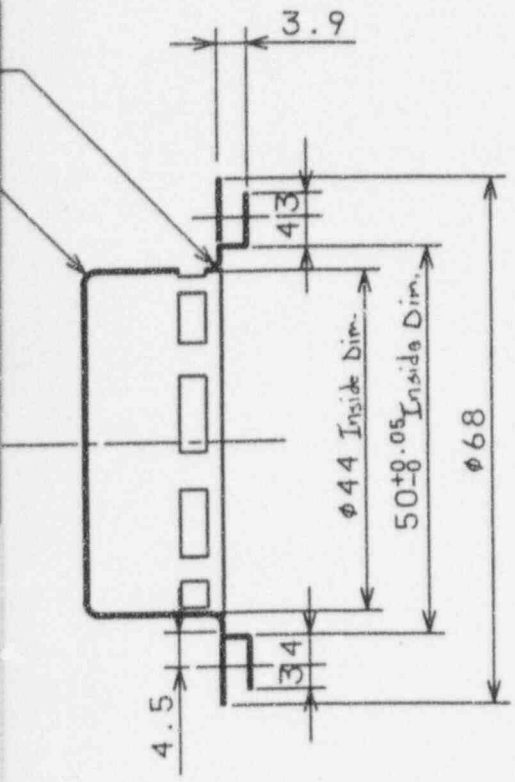


Computer No. 2800-

指定等級	B	指定以外の角度の許容差	±0.5
		指定以外の抜き勾配	以内

指定以外の寸法に対する許容差（±）

寸法区分 を超え	以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8



A－A

9610210081-04

REV.	DATE	BY	CHANGE
—	4-9-96	HC	Initial Release

DRAWN BY: HC	DATE 11-6-95	HOCHIKI AMERICA CORP. 3413 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649
CHECKED BY:	UNITS	
APPROVED BY:	SCALE	TITLE Outer Electrode AIE
DRAWING NO. HA-01-155		

記事	Finish: Remove ---- Grease	96.1.31 年月日	⚠ 形状変更 訂正事項	川端 設計	三ノ輪 承認
材質	SUS304-CP t=0.4	仕上	脱脂		

承認	調査	設計	製図	図名	Outer Electrode AIE
三ノ輪	長島	川端	川端		
縮尺	1:1	設計年月日	95.11.06	図番	2-3-295-0469-152
単位	mm	第3角法		ホーチキ株式会社	

1101

REV.	DATE	BY	CHANGE
—	4-7-96	HC	Initial Release

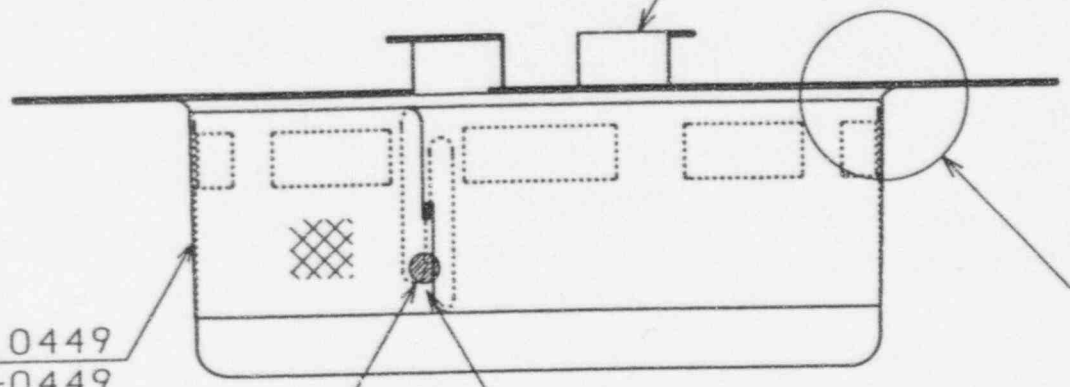
年月日	旧 図 番
. .	△
. .	△
. .	△

DRAWN BY: HC DATE: 4-6-95
CHECKED BY:
APPROVED BY: DATE:
SCALE
DRAWING NO. HA-01-145

HOCHIKI
HOCHIKI AMERICA CORP.
9415 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92646
TITLE Assembly Outer Electrode AIE

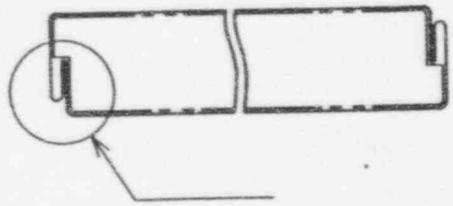
ENCLOSURE B8

Outer Electrode AIE
2-3-295-0469



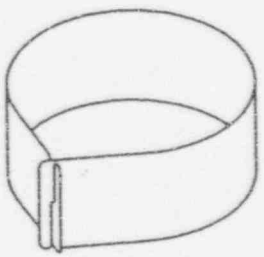
Insect Screen ALG 0449
2-3-295-0449

Spot Weld 3 Places (120°)
One place must be as shown

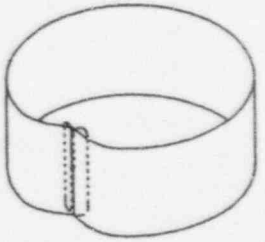


Caution- Assembly of screen is important

Incorrect



OK



DATE: 4/10/1996
ENGINEERING

年月日	訂 正 事 項	設計	承認
. .	△		
95.2.1	△ 防虫網の合わせ方追加	川端	三ノ輪
記事	---		

材質	---
仕上	---

承認	調査	設計	製図	設計年月日
三ノ輪	長谷	川端	川端	95.11.06
縮尺	---	単位	mm	第3角法

図名 Outer Electrode Assembly AIE
図番 2-1-490-0351-162
ホーチキ株式会社
原図保管

REV.	DATE	BY	CHANGE
—	4-9-96	HC	Initial Release

DRAWN BY: HC	DATE: 4-8-95	HOCHIKI AMERICA CORP.	
CHECKED BY: James C Young	UNITS	5413 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649	
APPROVED BY:	SCALE	TITLE: Intermediate Electrode AIE	
DRAWING NO. HA-01-146			

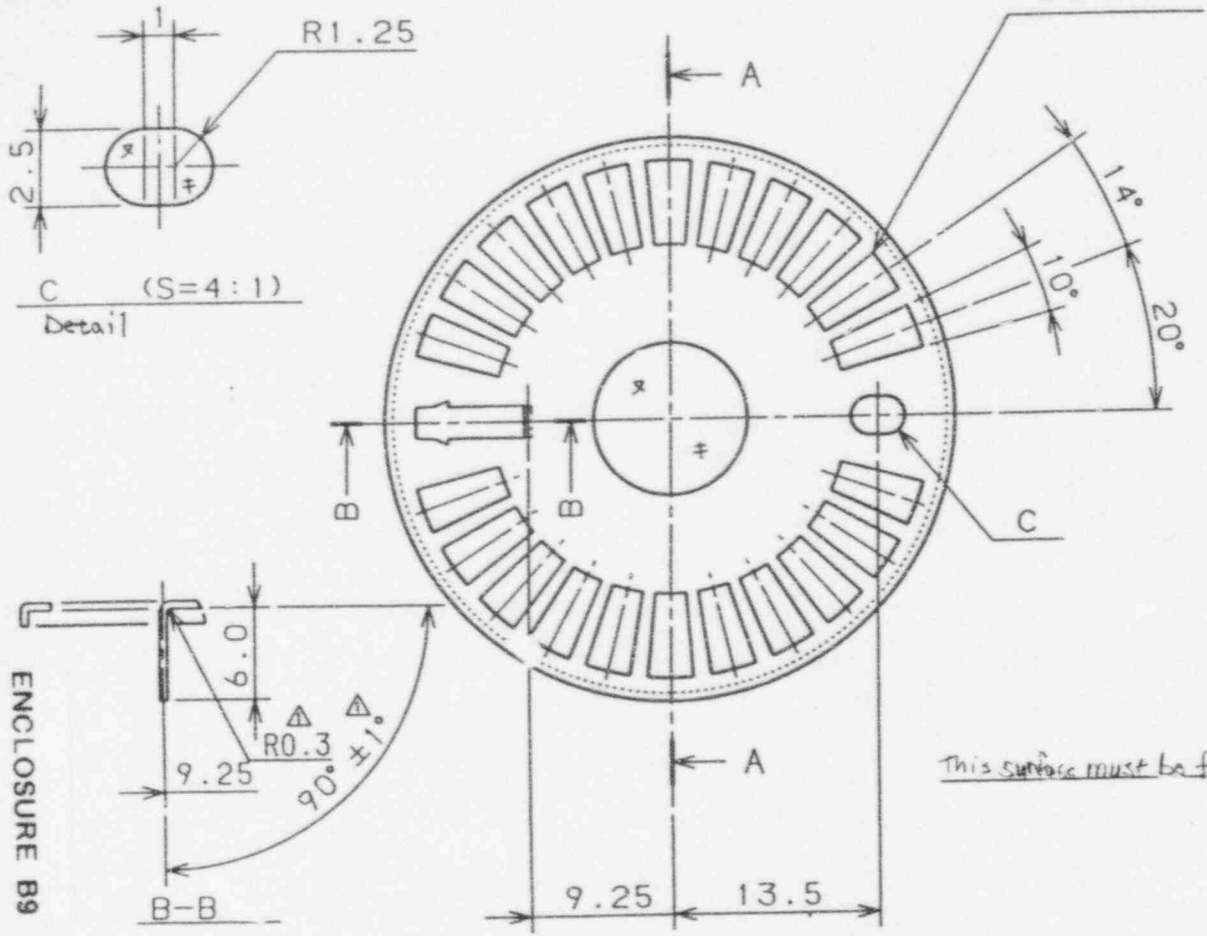
Computer No. 2800-01071

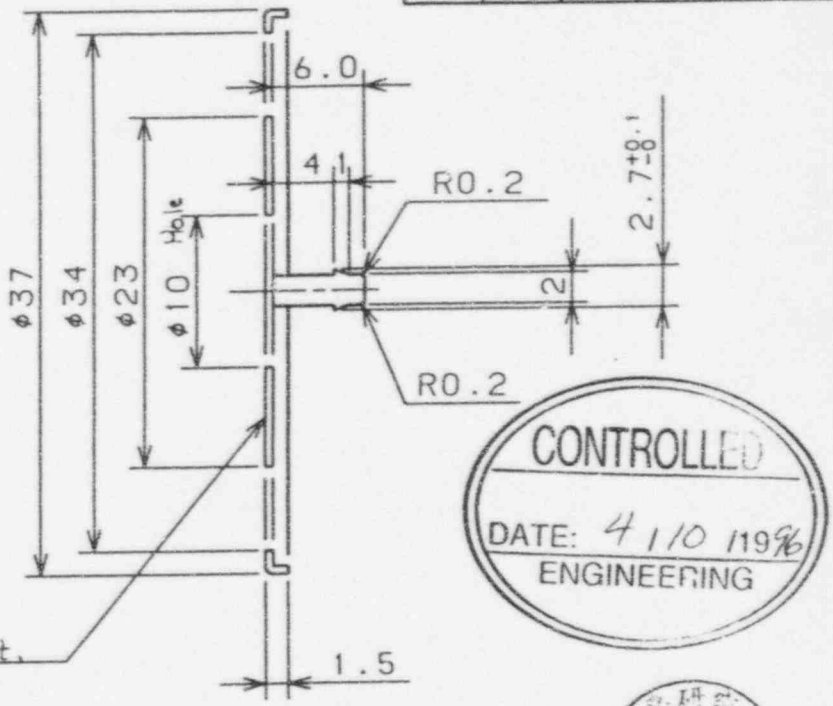
年月日	旧図番
. .	△
. .	△
. .	△

指定等級	B	指定以外の角度の許容差	±
		指定以外の注を勾配	以内

指定以外の寸法に対する許容差（±）

寸法区分 を超え	以下	等級 A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5





CONTROLLED
DATE: 4/10/1996
ENGINEERING

'96. 1.31

Intermediate Electrode

. .	⚠			材質	Material SUS304 t=0.5	承認	調査	設計	製図	設計年月日
96.1.31	⚠ R指示、角度公差追加	川端	三ノ輪			三ノ輪	長島	川端	川端	95.11.08
年月日	訂正事項	設計	承認	仕上	Finish 脱脂 Remove Grease	縮尺	2:1	単位	mm	第3角法
記事	———									

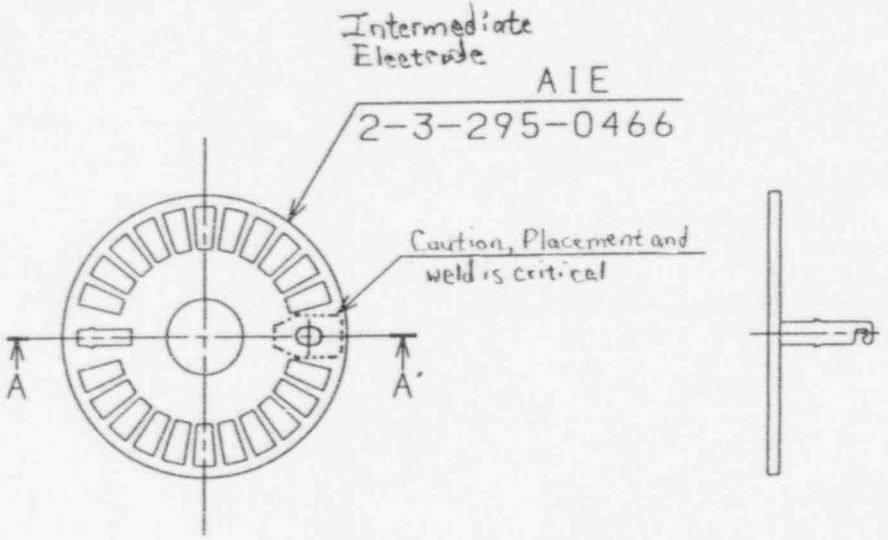
図名	中間電極 AIE
図番	2-3-295-0466-152
	ホーチキ株式会社
	原図保管

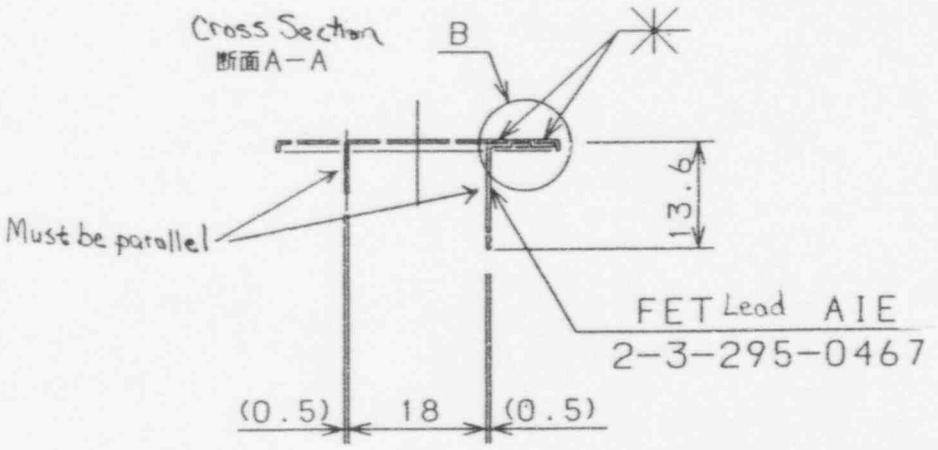
年月日	旧図番
. .	△
. .	△
. .	△

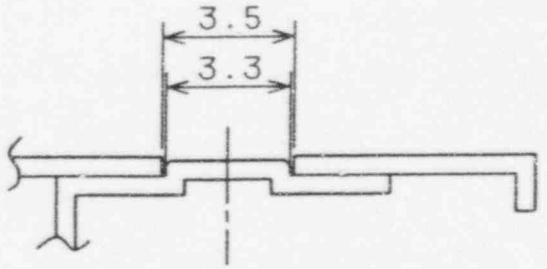
指定等級	B	指定以外の角度の許容差	±0.5°
		指定以外の注き勾配	以内

指定以外の寸法に対する許容差（土）

寸法区分 を超え	以下	等級 A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5







B (S=5:1)
Cross Section

CONTROL
DATE: 4/10/1996
ENGINEERING

'96. 1.31

Intermediate Electrode

ENCLOSURE B10

年月日	訂正事項	設計	承認
. .	△4		
. .	△1		
記事	---		

材質	---
仕上	---

承認	調査	設計	製図	設計年月日
	長島	川端	川端	95.11.08
縮尺	1:1	単位	mm	第3角法

図名	Assembly AIE
図番	2-1-490-0349-161
	ホーチキ株式会社
原図保管	

年月日	旧 図 番
. .	△
. .	△
. .	△

CONTROLLED
DATE: 4/10/1996
ENGINEERING

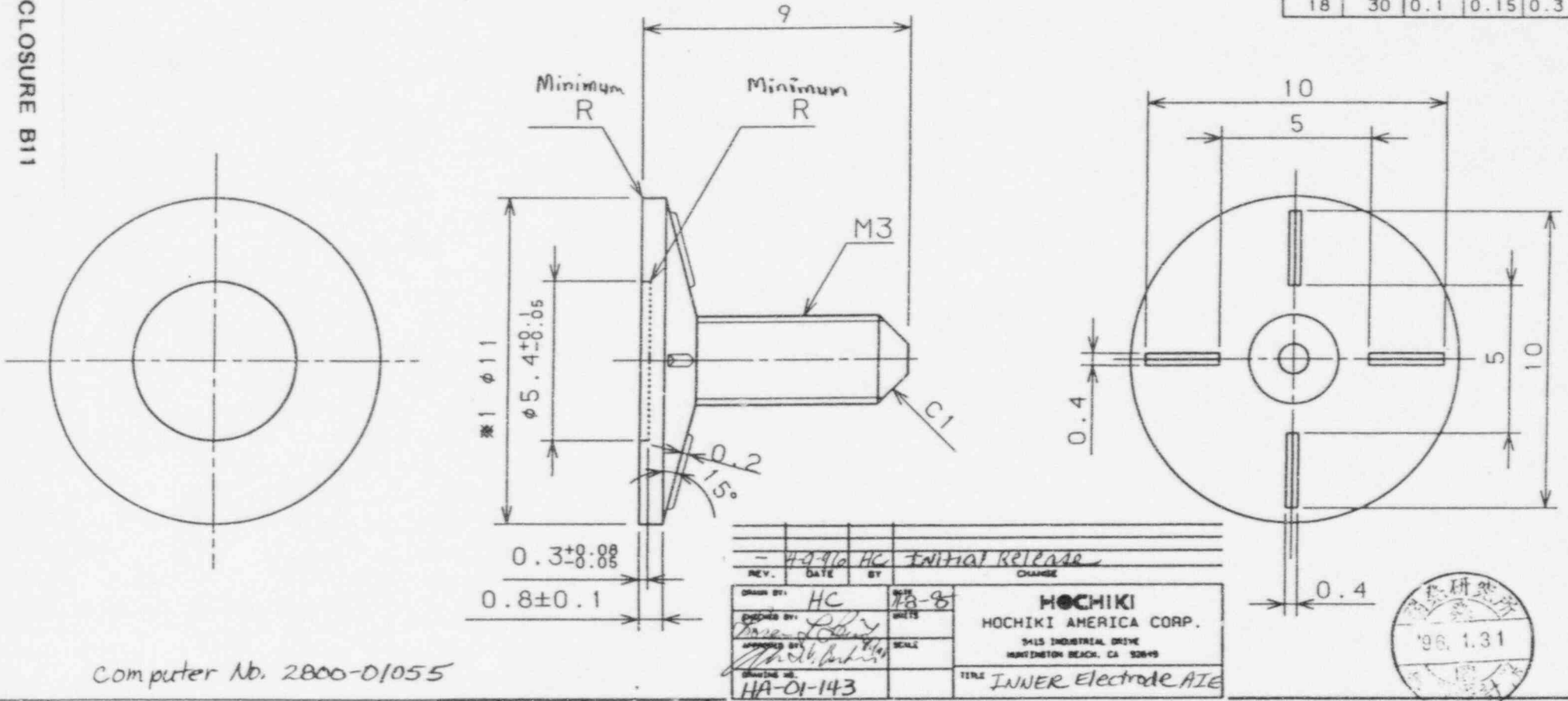
指定等級	B	指定以外の角度の許容差	±0.5°
		指定以外の面取り記	以内

指定以外の寸法に対する許容差（±）

寸法区分 を超え	寸法区分 以下	等級 A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4

ENCLOSURE B11

※1. RI Holder (2-3-295-0077)
The space between the RI and RI holder should be less than 0.2mm.



Computer No. 2800-01055

REV.	DATE	BY	CHANGE
—	4-9-96	HC	Initial Release

DRAWN BY: HC	DATE: 4-8-96	HOCHIKI HOCHIKI AMERICA CORP. 3415 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649	
CHECKED BY:	SHEETS		
APPROVED BY:	SCALE		
DRAWING NO. HA-01-143		TITLE INNER Electrode AIE	

'96. 1.31

年月日	訂 正 事 項	設計	承認
. .	②		
. .	①		
記事			

材質	Material SUS305
仕上	Finish 脱脂 Remove Greast

承認	調査	設計	製図	設計年月日
	長島			95.11.08
縮R	5:1	単位	mm	第3角法

図名	Inner Electrode AIE
図番	2-3-315-0121-151

ホーチキ株式会社

原図保管

ENCLOSURE B11A

Converter NO 2800-00131

REV.	DATE	BY	CHANGE
—	4-4-96	HC	Initial Release

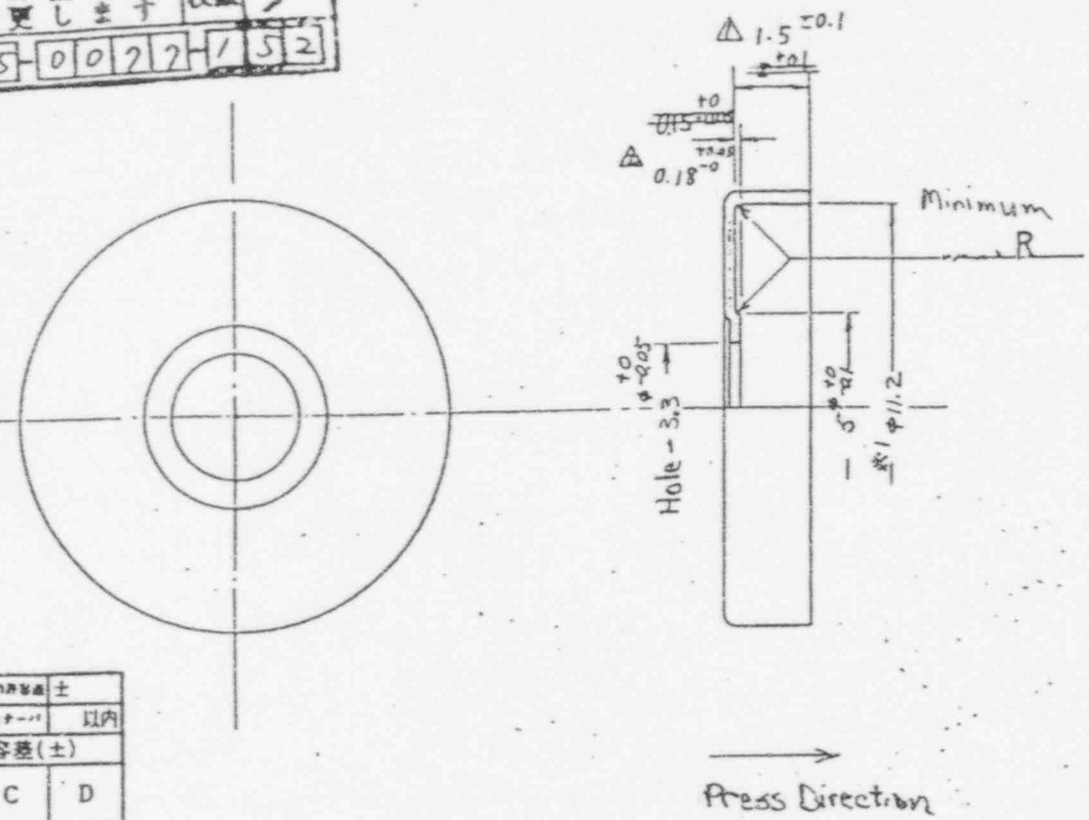
DRAWN BY: HC	DATE 2-3-5?	HOCHIKI HOCHIKI AMERICA CORP. 3415 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649
CHECKED BY: [signature]	DATE	
APPROVED BY: [signature]	SCALE	
DRAWING NO. HA-01-152		TITLE Holding Plate AIE

関係仕様書及図面	名称	番号
記事		

年月日	訂正事項	設計	承認
58.11.18	⚠1 寸法変更	栄田	
59.7.3	⚠2 寸法変更	〃	

一新コードー	この図番に変更します	改訂	/
図面	2-3-295-0022-152		

CONTROLLED
DATE: 4/10/1996
ENGINEERING



※1. Distance between inner electrode and RI holder should be less than 0.2mm

⚠ 2. Barrel Finish Polishing (バレル研磨による)

改訂 91-2043

t : 0.3

Material: SUS 316

Finish: Remove Grease

指定等級	B	指定以外の角度の許容差	±
		指定以外の抜きテーパ	以内

指定以外の寸法に対する許容差(±)

寸法区分 を超え	以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8
120	180	0.4	0.9	1.0	1.1
180	250	0.6	1.2	1.3	1.4
250	500	0.8	1.5	1.7	1.9

開発研究所 ㊞ '96.1.31 図 技術設計課

				2		
	/	SUS316	脱脂	1		
		材質	仕様	部番	名称	
G-	G-	承認	調査	設計	製図	縮尺 5/1
		[stamp]	[stamp]	栄田	栄田	単位 —
			57.8.27	S57-8-24		第3角法

図名 RI Holding Plate AIE

図番 ~~DAA-0002~~

ホーチキ株式会社

SIZE-A4

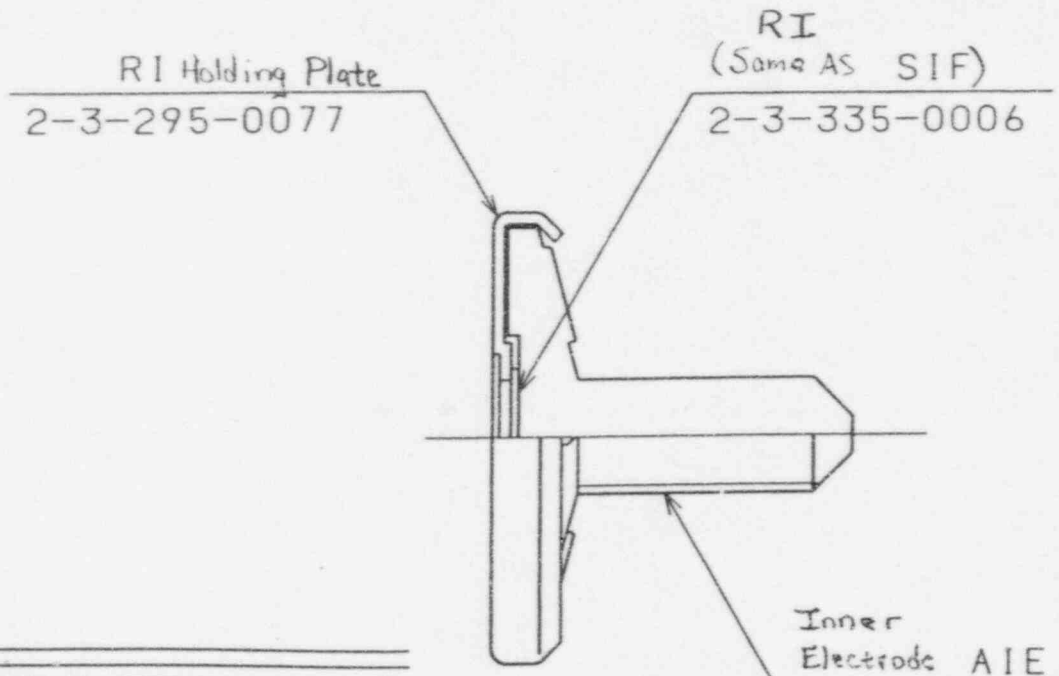
原子力保安品質設計部

月日	旧 図 番
. .	△
. .	△
. .	△

Notes:

1. Press force should be 2-3 Kg·cm
   Holding plate should not be loose
2. No dust should be on the surface of the RI.

ENCLOSURE B12



CONTROLLED
DATE: 4/10/1996
ENGINEERING

REV.	DATE	BY	CHANGE
—	4-9-96	HC	Initial Release

DRAWN BY: HC	DATE: 11-8-95	HOCHIKI AMERICA CORP. 3415 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649
CHECKED BY:	DATE:	
APPROVED BY:	SCALE:	
DRAWING NO. HA-01-148		TITLE: Assembly Inner Electrode AIE

9.6.1.31

Inner Electrode

月日	訂 正 事 項	設計	承認
. .	⚠		
. .	⚠		
2事	---		

材質	---	承認	調査	設計	製図	設計年月日
仕上	---		長岳	川端	川端	95.11.08
		縮R	5:1	単位	mm	第3角法

図名	Assembly AIE
図番	2-1-490-0350-161
	ホーチキ株式会社
原図保管	

REV.	DATE	BY	CHANGE
-	4-9-96	HC	Initial Release

DRAWN BY: HC	DATE: 11-8-95	HOSHIKI AMERICA CORP.	
CHECKED BY:	SHEET	5415 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649	
APPROVED BY:	SCALE		
DRAWING NO. HA-01-151		TITLE Shield Case AIE	

Computer No. 2800-01045

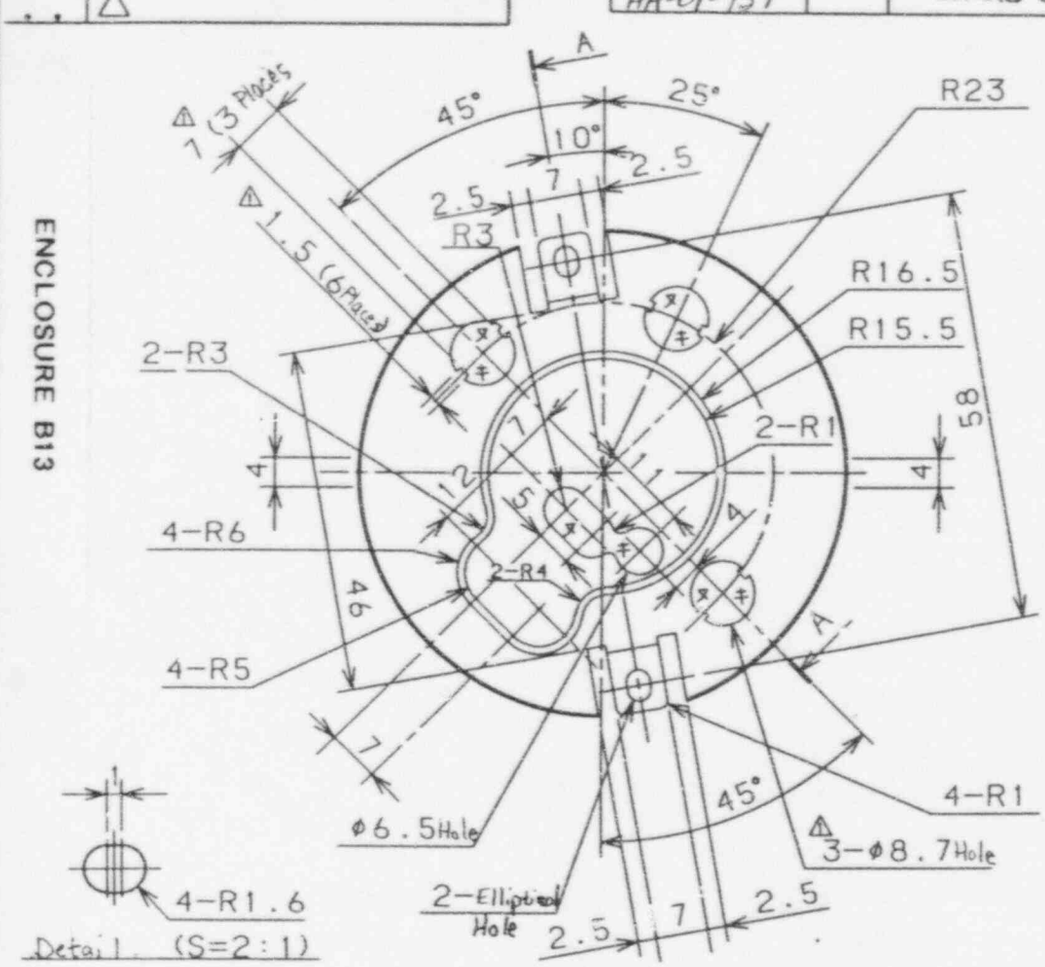
年月日	旧図番
. .	△
. .	△
. .	△

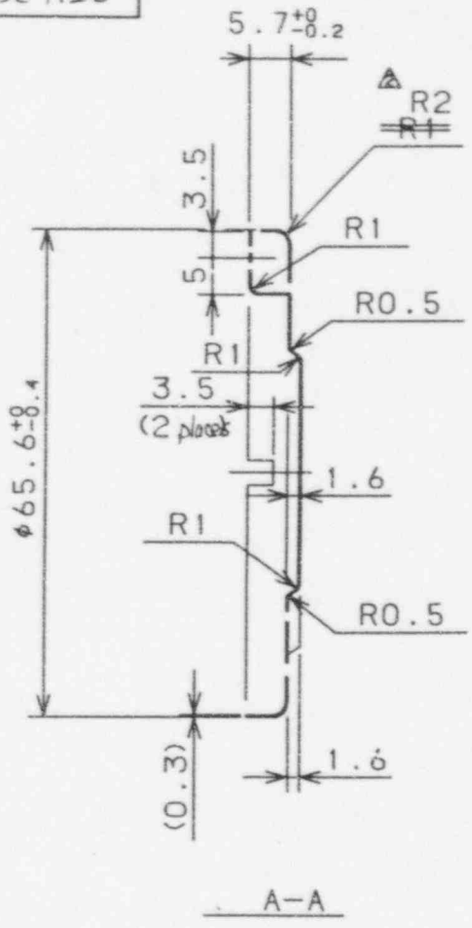
指定等級	B	指定以外の角度の許容差	±
		指定以外の抜き勾配	以内

指定以外の寸法に対する許容差 (±)

寸法区分 を越え	等級 以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6

ENCLOSURE B13





CONTROLLED
DATE: 4/10/1996
ENGINEERING

Each corner should be minimum Radius except where specified.

'96. 1. 31

年月日	訂正事項	設計	承認
96.1.31	△2 角R変更	川端	三ノ輪
95.12.18	△1 抜き孔形状変更	川端	三ノ輪
記事	---		

材質	Material: Preplated solder(96/10) coated Steel t=0.3
仕上	---

承認	調査	設計	製図	設計年月日
車田	長島	川端	川端	95.11.08
縮R	1:1	単位	mm	第3角法

図名	Shield Case AIE
図番	2-3-295-0468-153
	ホシキ株式会社
原図保管	

年月日	旧図番
. .	△
. .	△
. .	△

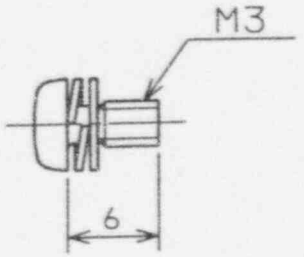
REV.	DATE	BY	CHANGE
—	4-9-96	HC	Initial Release

DRAWN BY: HC — DATE: 4-9-96
CHECKED BY: — DATE:
APPROVED BY: — SCALE:
DRAWING NO.: HA-01-150

HOCHIKI
HOCHIKI AMERICA CORP.
9413 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92646

TITLE: Screw Machine M3X6 AIE

ENCLOSURE B14



CONTROLLED
DATE: 4/10/1996
ENGINEERING

Cross Recessed Head Machine Screw
With Flat Washer and Spring Washer M3X6

(JIS B 1188)

Plating: Chromate coating on electroplated Zinc (JIS) H8625

Computer No. 2825-00135

'96. 1.31

年月日	訂正事項	設計	承認
. .	△		
. .	△		
記事	---		

材質	Material Steel
仕上	

承認	調査	設計	製図	設計年月日
				95.11.09
縮尺	---	単位	mm	第3角法

図名	AIE Machine Screw M3X6
図番	2-5-002-3061-151
	ホーチキ株式会社
	原図保管

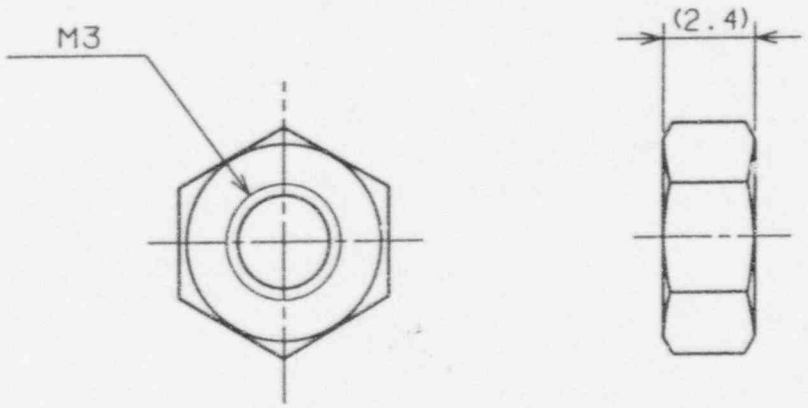
年月日	旧図番
. .	△
. .	△
. .	△

REV.	DATE	BY	CHANGE
—	4-9-96	HC	Initial Release

DRAWN BY: HC	DATE 11-8-95	HOCHIKI AMERICA CORP.
CHECKED BY:	UNITS	9413 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649
APPROVED BY:	SCALE	TITLE Nut, Hex M3
DRAWING NO. HA-01-136		

Hex Nut M3 Style 1 (Grade A) Both Sides)
(JIS B 1181)

ENCLOSURE B15



CONTROLL
DATE: 4 / 10 / 1996
ENGINEERING

関数研究所
'96. 1.31

Computer No. 2825-00185

年月日	訂正事項	設計	承認
. .	2		
. .	1		
記事	---		

材質	Material: Steel
仕上	Finish: Chromate

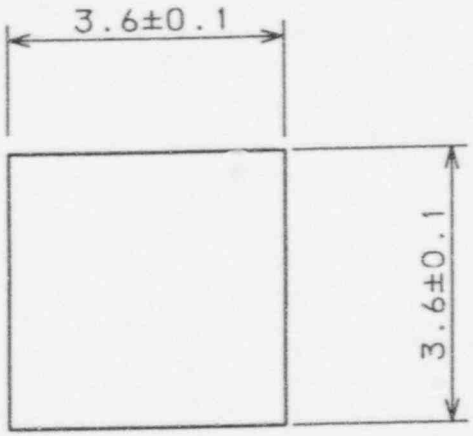
承認	調査	設計	製図	設計年月日
				95.11.08
縮尺	5:1	単位	mm	第3角法

図名	Hex Nut M3
図番	2-5-705-0302-151
	ホーチキ株式会社
	原図保管

年月日	旧 図 番
. .	△
. .	△
. .	△

1. Name : Americium Alpha Foil
2. Isotope : Am241
3. Code : AMMQ 1220.Pd Face
4. Activity : 3.6×10^4 Bq (0.98μCi)

ENCLOSURE B16



CONTROLLED
DATE: 4/10/1996
ENGINEERING

REV.	DATE	BY	CHANGE
—	4-1-96	HC	Initial Release

Drawn BY: HC	DATE: 3-1-96	HOCHIKI AMERICA CORP. 5413 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649
CHECKED BY:	SCALE	
APPROVED BY:		
Drawing NO. HA-01-149		TITLE Foil Radio Isotope AIE

t=0.2

'96.2.-1

Computer No. 2500-00025

注) Pd Face Surface Ag, opposite Side Au.

年月日	訂 正 事 項	設計	承認
. .	⚠		
. .	①		
記事	---		

材質	---
仕上	---

承認	調査	設計	製図	設計年月日
三浦	長島	川端	川端	96.2.1
縮尺	10:1	単位	mm	第3角法

図名	Foil, Radio Isotope AIE
図番	2-3-335-0020-151
	ホチキ株式会社

原図保管

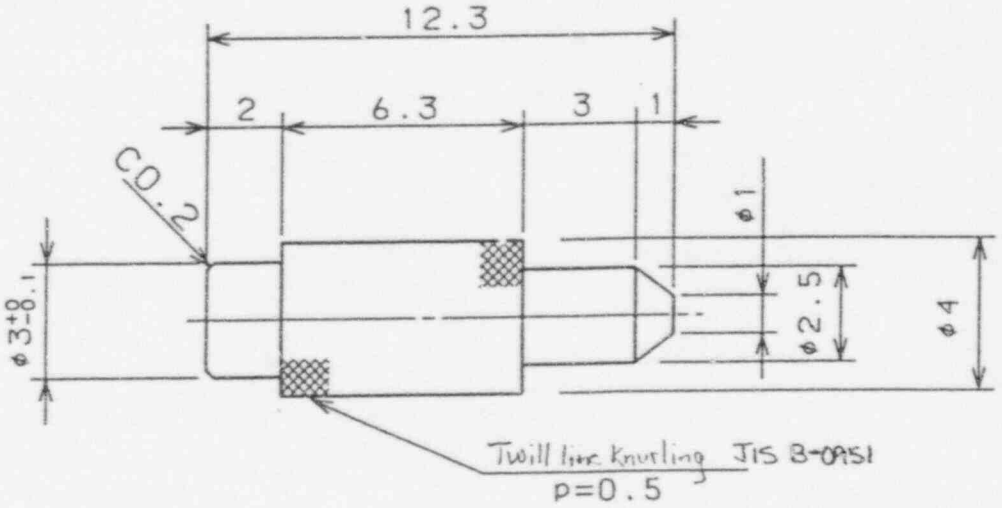
年月日	旧図番
. .	△
. .	△
. .	△

指定等級	B	指定以外の角度の許容差	±
		指定以外の値を切記	以内

指定以外の寸法に対する許容差（±）

寸法区分 を超え	以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8
120	180	0.4	0.9	1.0	1.1
180	250	0.6	1.2	1.3	1.4
250	500	0.8	1.5	1.7	1.9

ENCLOSURE B17



CONTROLLED
DATE: 4/10/1996
ENGINEERING

REV.	DATE	BY	CHANGE
—	4-9-96	HC	Initial Release

DRAWN BY: HC — DATE: 12-1994
CHECKED BY:
APPROVED BY:
DRAWING NO. HA-01-139
UNITS
SCALE
HOCHIKI
HOCHIKI AMERICA CORP.
5415 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92649
TITLE Insert Metal AIE

N.C.C
'96. 1. 31

Computer No. 2800-01017

年月日	訂正事項	設計	承認
. .	△2		
. .	△1		
記事			

材質	Copper or Copper alloy C1100W-1/2H
仕上	Finish: Solder Plating 90% Sn 10% Pb

承認	調査	設計	製図	設計年月日
三輪	渋	富沢	富沢	94.12.19
縮R	5:1	単位	mm	第3角法

図名	Insert Metal
図番	2-3-315-0119-151

ホーチキ株式会社

年月日	旧図番
. .	△
. .	△
. .	△

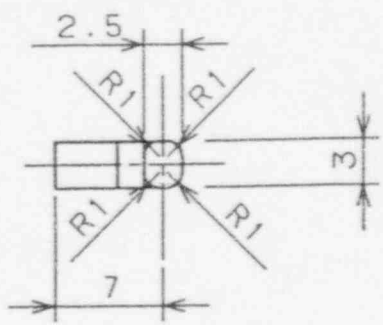
CONTROLLED
DATE: 4/10/1996
ENGINEERING

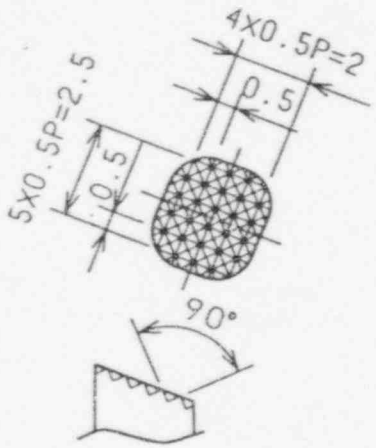
指定等級	B	指定以外の角度の許容差	±0.5°
		指定以外のはき知記	1° 以内

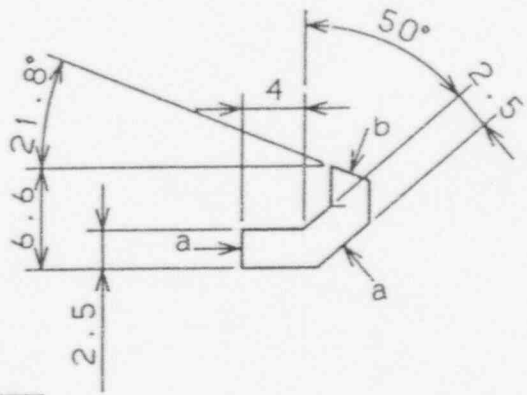
指定以外の寸法に対する許容差（±）

寸法区分 超	寸法区分 以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8
120	180	0.4	0.9	1.0	1.1
180	250	0.6	1.2	1.3	1.4
250	500	0.8	1.5	1.7	1.9

ENCLOSURE B18







b Detail (5 : 1)

Material : Acrylic
Grade : VH
Manufacturer: Mitsubishi Rayon
Color : Clear

N. C. C
商品設計課

Finish:
注) a) Mirror Surface
b) Diamond Cut Surface

開発研究所 '96. 1.31 設計図

REV.	DATE	BY	CHANGE
—	4.9.96	HC	Initial Release

DRAWN BY: HC 7/7/94
CHECKED BY:
APPROVED BY:
DRAWING NO. HA-01-141
UNITS
SCALE
HOCHIKI
HOCHIKI AMERICA CORP.
9415 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92649
TITLE ALG Plastic Light Guide

Computer No. 1400-02400

Light Guide

年月日	訂正事項	設計	承認
. .	△2		
. .	△1		
記事			

材質		承認	調査	設計	製図	設計年月日
仕上						'94-11-07
		縮尺	2:1	単位	mm	第3角法

図名	ライトガイド ALG 0388
図番	2-3-275-0388-151

ホーチキ株式会社

原図保管

年月日	旧図番
. .	△
. .	△
. .	△

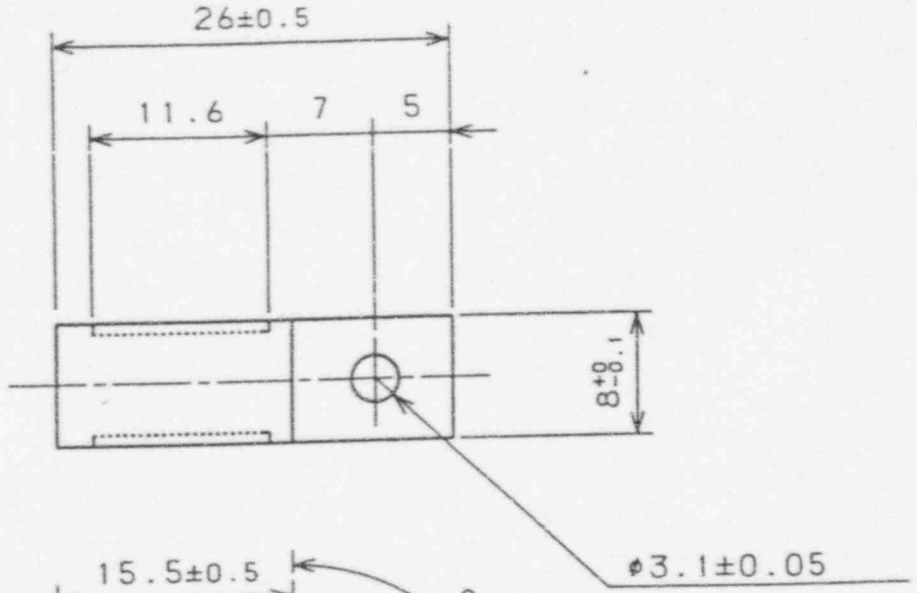
指定等級	B	指定寸法の角度の許容差	± 1°
		指定寸法の位置記号	記号

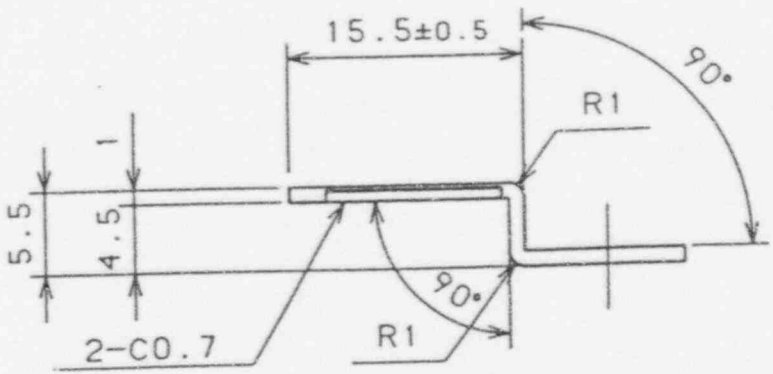
指定以外の寸法に対する許容差 (±)

寸法区分 を超え	以下	等級 A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8
120	180	0.4	0.9	1.0	1.1
180	250	0.6	1.2	1.3	1.4
250	500	0.8	1.5	1.7	1.9

REV.	DATE	BY	CHANGE
–	4-9-96	HC	Initial Release.

DRAWN BY: HC	DATE 12-9-94	HOCHIKI AMERICA CORP.
CHECKED BY:	UNITS	3413 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649
APPROVED BY:	SCALE	
DRAWING NO. HA-01-157		TITLE Contact Blade AIE





Press Direction

CONTROLLED
DATE: 4/10/1996
ENGINEERING

N.C.C
商品設計課

t=1.0

'96. 1.31

ENCLOSURE B19

Computer No 2800-01021

年月日	訂正事項	設計	承認
. .	△		
. .	△		
記事			

		承認	調査	設計	製図	設計年月日
材質	Copper or Copper alloy C2680P t=1.0					
仕上	Finish: Solder Plate 90% Sn 10% Pb	縮R	2:1	単位	mm	第3角法

図名	Contact Blade AIE
図番	2-3-295-0459-151
	ホーチキ株式会社

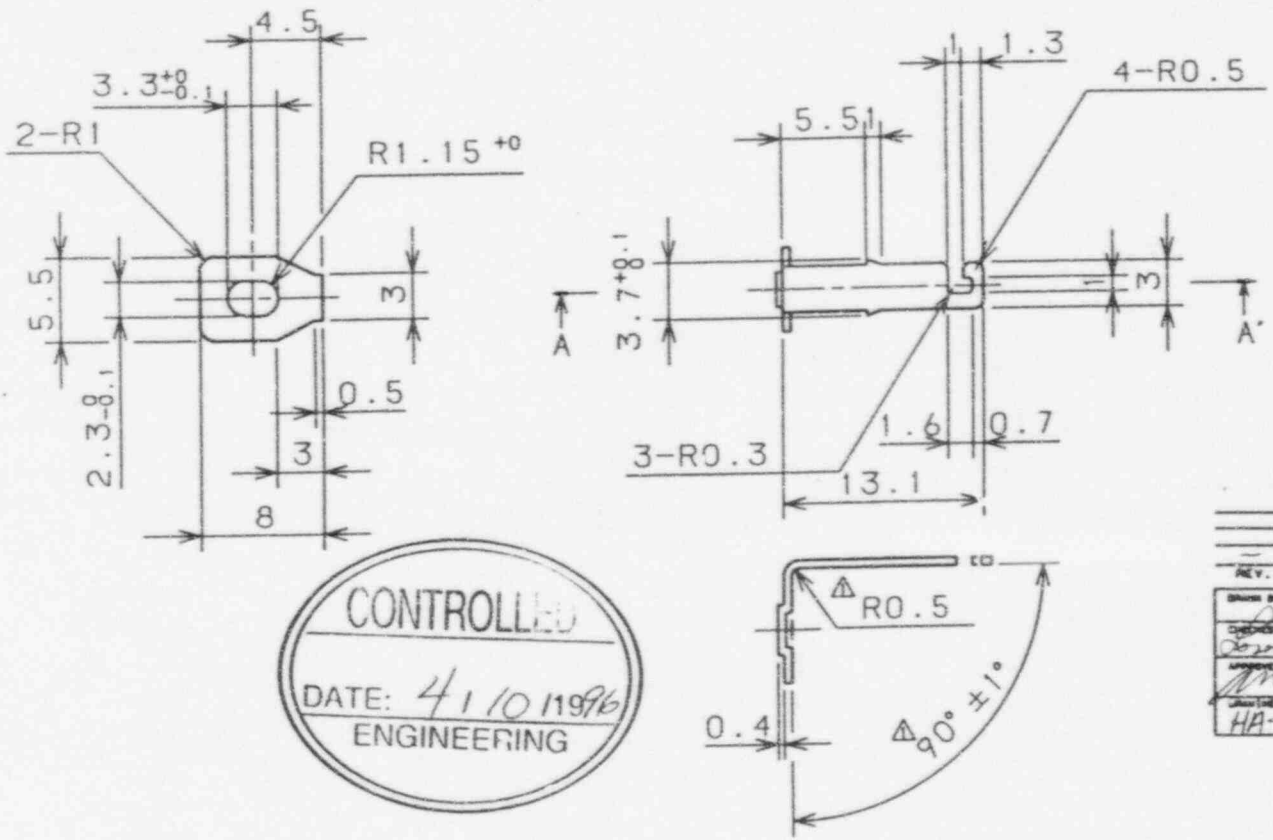
年月日	旧図番
. .	△
. .	△
. .	△

指定等級	B	指定以外の角度の許容差	±0.5°
		指定以外の注を勾配	以内

指定以外の寸法に対する許容差（±）

寸法区分を越え	以下	等級 A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.1	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8
120	180	0.4	0.9	1.0	1.1
180	250	0.6	1.2	1.3	1.4
250	500	0.8	1.5	1.7	1.9

ENCLOSURE B20



CONTROLLED
DATE: 4/10/1996
ENGINEERING

REV.	DATE	BY	CHANGE
—	4-9-96	HC	Initial Release

DRAWN BY: HC	DATE: 11-8-95	HOCHIKI AMERICA CORP.
CHECKED BY:	UNITS	5413 INDUSTRIAL DRIVE HUNTINGTON BEACH, CA 92649
APPROVED BY:	SCALE	TITLE: FET Terminal ASSY
DRAWING NO.: HA-01-147		

Material;

Computer No. 2800-01095

A-A'

FET Terminal

'96. 1. 31

年月日	訂正事項	設計	承認
. .	△		
96.1.31	△1 R指示、角度公差追加	川端	三ノ輪
記事	――		

材質	△Material Preplated Steel Solder Plate (96%Sn 以上) T= 0.5mm
仕上	△

承認	調査	設計	製図	設計年月日
三ノ輪	長島	川端	川端	95.11.08
縮尺	2:1	単位	mm	第3角法

図名	FET ASSY
図番	2-3-295-0467-152
	ホーチキ株式会社
	原図保管

指定等級	B	指定以外の角度の許容差	±
		指定以外の区分記号	以内

指定以外の寸法に対する許容差（±）

寸法区分 を超え	以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4

REV.	DATE	BY	CHANGE
—	4.9.96	HC	Initial Release

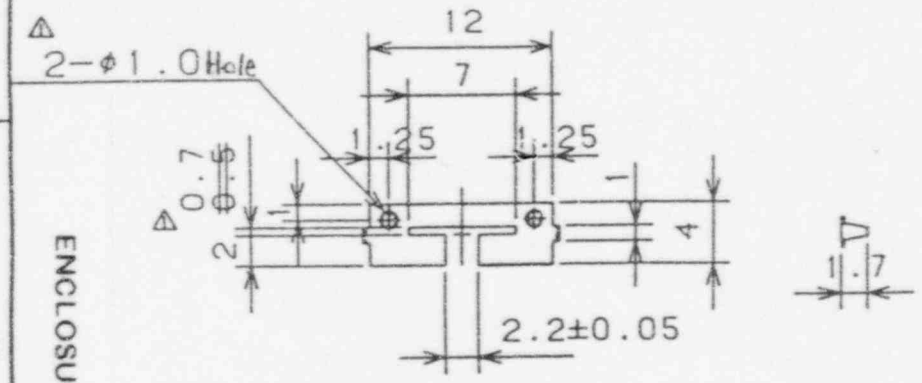
DRAWN BY: HC — DATE: 9-21-63
CHECKED BY:
APPROVED BY: — DATE: 4-10-96
Drawing No. HA-01-140 — SCALE

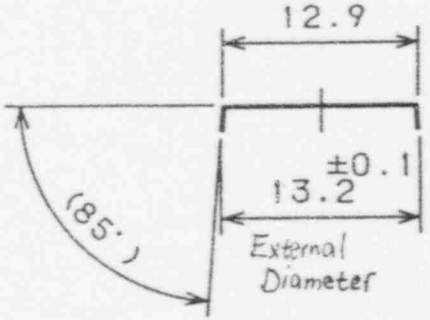
HOCHIKI
HOCHIKI AMERICA CORP.
5415 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92649

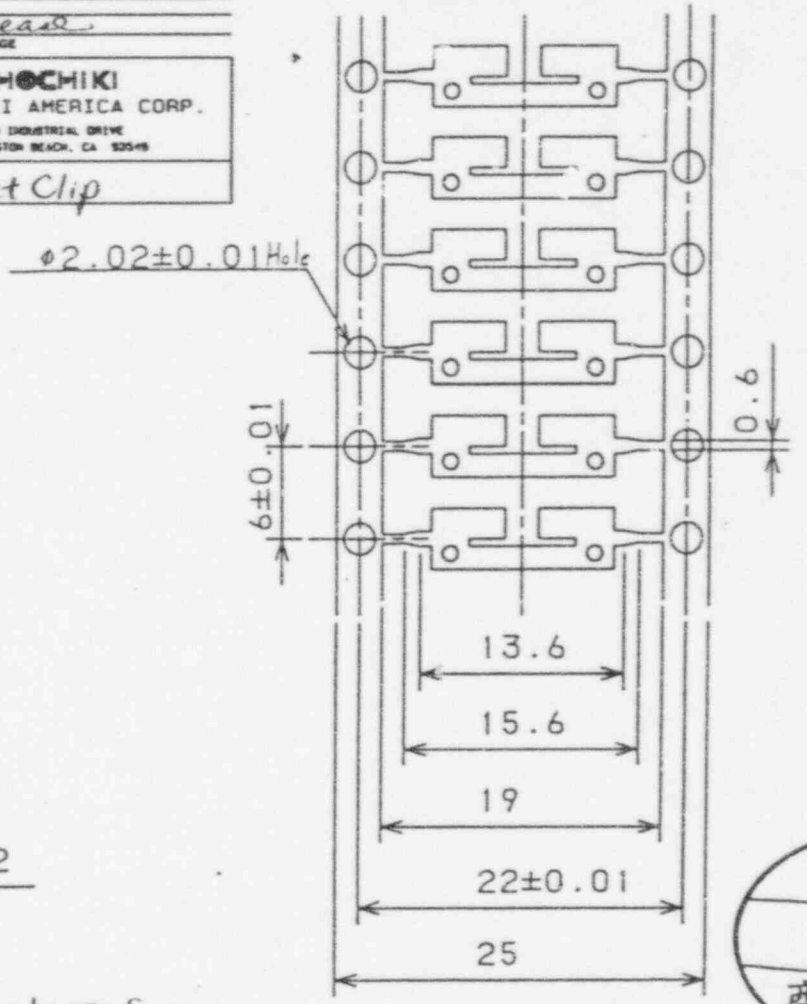
TITLE: Contact Clip

CONTROLLED DOCUMENT
DATE: 4/10/1996
ENGINEERING

ENCLOSURE B21







t=0.2

Material : Copper phosphor bronze for springs JIS H-3130

Plating : Solder Plate 90% Sn 10% Pb

Computer No. 2800-00066

発行
91-2079
商品設計課

記号	訂正事項	設計
⚠	⚠φ1.0孔2ヶ所追加、及び寸法変更	森田
91.11.13		
年月日		
記事		

材質		仕上	

承認	調査	設計	製図	設計年月日	枚数
早川	上申	八島	八島	63.9.21	/
縮尺	2/1	単位	mm	第3角法	

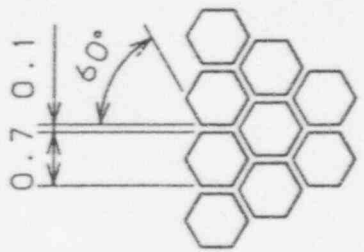
図名	Contact Clip
図番	2-3-295-0298-152

ホーチキ株式会社

年月日	旧図番
. .	△
. .	△
. .	△

CONTROLLED
DATE: 4/10/1996
ENGINEERING

FIG. 1 Mesh Pattern S=5:1



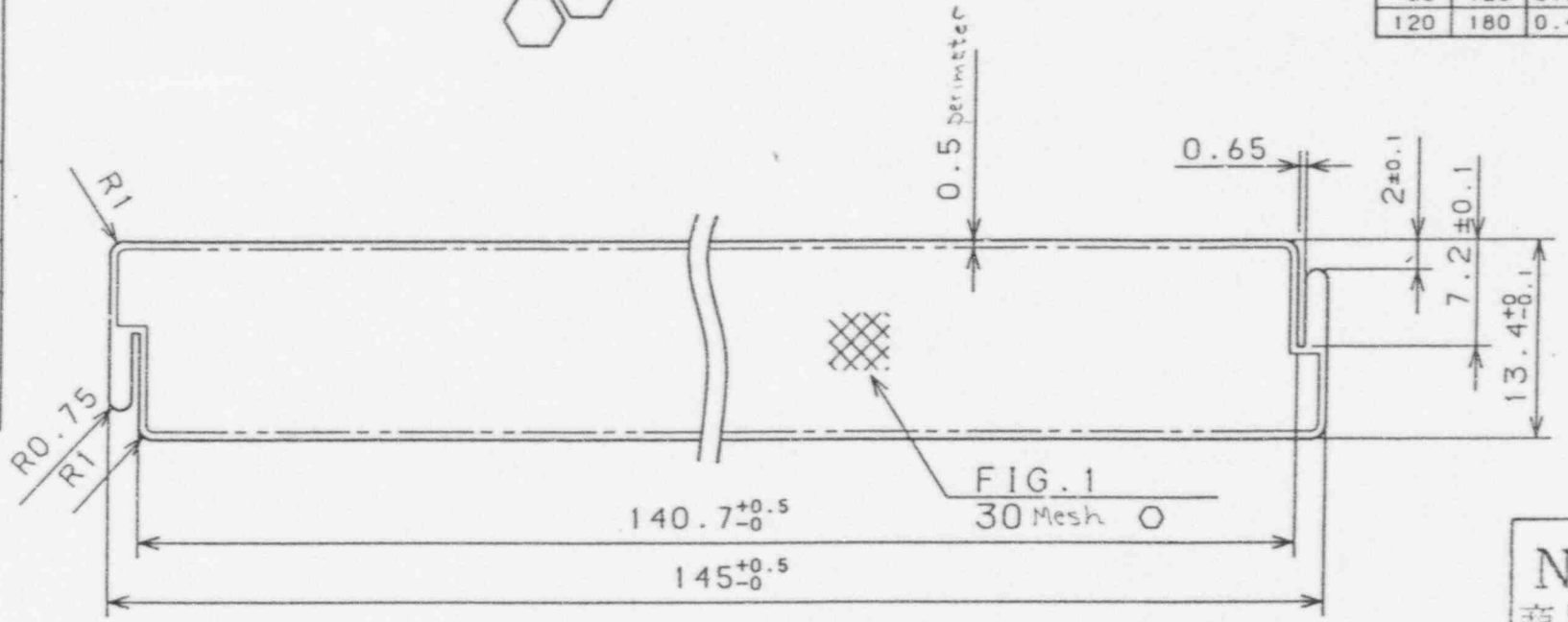
指定等級	A	指定以外の角度の許容差	±0.5
		指定以外のほぼ勾配	以下

指定以外の寸法に対する許容差（±）

寸法区分 超	以下	A	B	C	D
	6	0.05	0.1	0.15	0.2
6	18	0.08	0.1	0.2	0.3
18	30	0.1	0.15	0.3	0.4
30	50	0.15	0.25	0.4	0.5
50	80	0.2	0.4	0.5	0.6
80	120	0.3	0.6	0.7	0.8
120	180	0.4	0.9	1.0	1.1

HOCHIKI AMERICA CORP.
9113 INDUSTRIAL DRIVE
HUNTINGTON BEACH, CA 92646
TITLE Insect Screen ALG
DRAWN BY HC
DATE 4-30-94
SCALE
DESIGNED BY
APPROVED BY
DRAWING NO. HA-0-142

REV. A DATE 4-30-94 BY HC CHANGE Initial Release



ENCLOSURE B22

Computer No. 2800-01121

N.C.C
商品設計課
'96. 1. 31

年月日	訂正事項	設計	承認
. .	⚠		
. .	⚠		
記事			

Material

材質	SUS304 t=0.1
仕上	Finish 脱脂 Remove Grease

承認	調査	設計	製図	設計年月日
	愛国	沢	沢	94.09.30
縮尺	2:1	単位	mm	第3角法

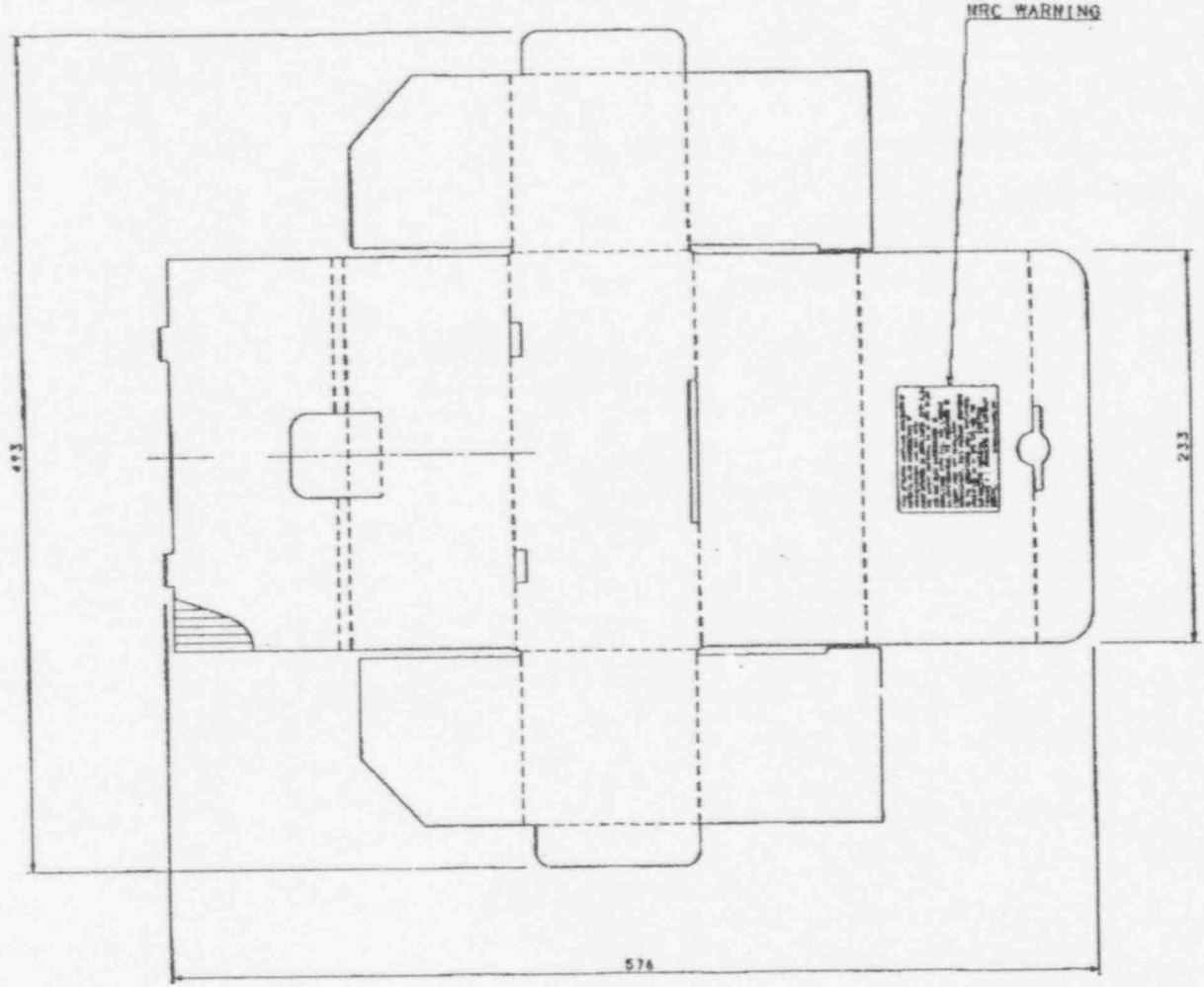
図名	防虫網 ALG 0449
図番	2-3-295-0449-151

ホーチキ株式会社

原図保管

HOCHIKI OVERSEAS

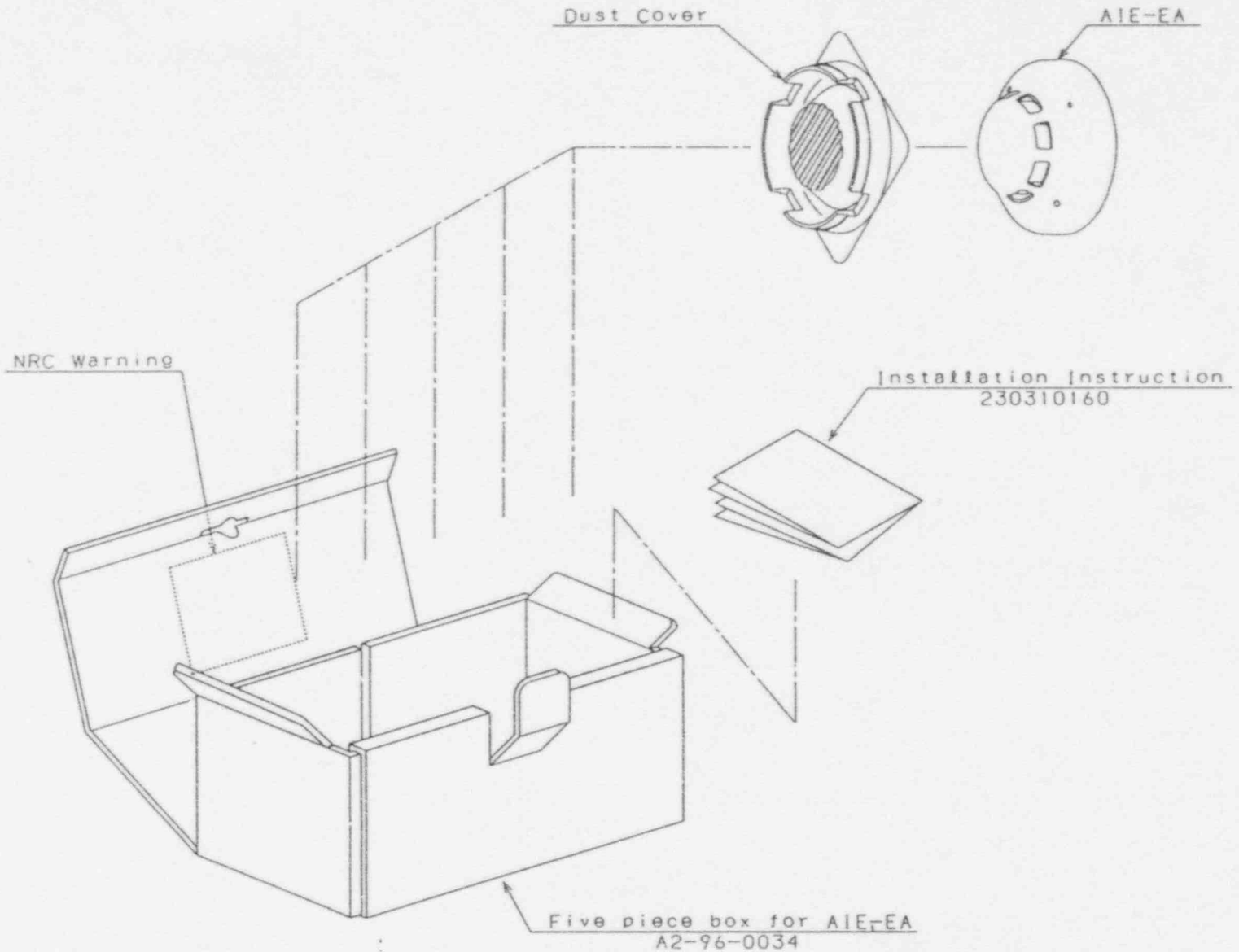
ENCLOSURE B23



NRC WARNING

THIS DETECTOR CONTAINS RADIOACTIVE MATERIAL:0.98 MICROCURIES OF AMERICIUM-241 AND HAS BEEN MANUFACTURED IN COMPLIANCE WITH U.S. NRC SAFETY CRITERIA IN 10 CFR 32.27 AND HAS BEEN DISTRIBUTED IN COMPLIANCE WITH U.S. NRC LICENSE NO.04-14886-01E. THE PURCHASER IS EXEMPT FROM ANY REGULATORY REQUIREMENT. THIS PACKAGE CONFORMS TO THE CONDITIONS AND LIMITATIONS SPECIFIED IN 49 CFR 173.422 FOR RADIOACTIVE MATERIAL. EXCEPTED PACKAGE - INSTRUMENTS OR ARTICLES UN2910.

DRAWN J. Kuwabata	DATE 10.APR.'96	TITLE Five piece box for AIE-EA
CHECKED J. Ozawa	UNIT mm	DWG NO. A2-96-0034
APPROVED A. Kimura	SCALE ---	HOCHIKI CORPORATION



DRAWN Y. Kawabata	DATE 9.FEB.'96	TITLE AIE-EA Package
CHECKED	UNIT ---	DWG NO. A2-96-0033
APPROVED	SCALE ---	HOSHIKI CORPORATION

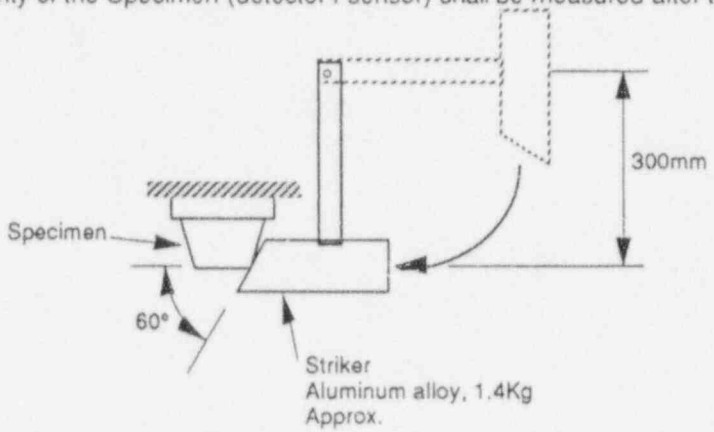
ENCLOSURE B24

VIBRATION TEST REPORT

TEST ITEM	VIBRATION TEST (SINE WAVE, SYMPATHETIC POINT)
SPECIMEN	IONIZATION TYPE SMOKE SENSOR : MODEL AIE-EA
TEST METHOD	[Sine Wave] Under supplying the power to the sensor, it will be forced to the vibration of 1000 cycles per minutes and amplitude of 4mm for 60 minutes. 7 sensors shall be mounted in up side. The sensors shall be tested for both of vertical and horizontal vibration. [Sympathetic point] Frequency of vibration : 0 ~ 150Hz, vibration acceleration : 3G Sweep method : Logarithm Sweep Sweep time : (10~150~10Hz/15 minutes) x 2 cycles 7 sensors shall be mounted in up side. The sensors shall be tested for both of vertical and horizontal vibration of 4 cycles each.
STANDARD FOR JUDGMENT	The sensor should not generate a fault signal during the test. The sensor should not have a trouble on the structure and the function after test.
TEST RESULT	There was no fault signal generated during the test. There was no trouble on the function and structure of the sensor. There was not significant sensitivity (analogue output) drift of the sensor.
JUDGMENT	OK
COMMENT	In consideration of this test, the ionization smoke sensor model AIE-EA meet the requirement for vibration in normal environment to install and operate.

Date : 9-Nov.-1995

VIBRATION TEST REPORT

TEST ITEM	SHOCK TEST & IMPACT TEST (CONFORMED TO EN54-PART7)
SPECIMEN	IONIZATION TYPE SMOKE SENSOR : MODEL AIE-EA
TEST METHOD	[SHOCK TEST] The testing shall be performed using similar apparatus described in EN54-Part7. The specimen should be mounted on proper position and energized. The steel block weighting 1Kg shall be dropped six times on to the center of the upper horizontal face of the beam from a height of 700mm. The sensitivity of the Specimen (detector / sensor) shall be measured after testing. [IMPACT TEST] The testing shall be performed using the apparatus shown as follows. The specimen should be mounted on proper position and energized. The striker weighting 1.4Kg is mounted on the shaft so that its long axis is at a radial distance of 300mm from the axis of rotation of the assembly. The striker shall be released three times from the horizontal position of the shaft. The sensitivity of the Specimen (detector / sensor) shall be measured after testing. 
STANDARD FOR JUDGMENT	The sensor should not generate a fault signal during the test. The sensor should not have a trouble on the structure and the function after test.
TEST RESULT	There was no fault signal generated during the test. There was no trouble on the function and structure of the sensor. There was not significant sensitivity (analogue output) drift of the sensor.
JUDGMENT	OK
COMMENT	In consideration of this test, the ionization smoke sensor model AIE-EA meet the requirement for vibration in normal environment to install and operate.

Date : 9-Nov.-1995

DATA SHEET

NO. 1

Test Item	Measurement of Radiation (AIE-EA)	Date	15th· 3· '96	
		Approved	Checked	Tested
		m. Shibata	S. Harasaki	M. Kuwano

	Distance	TOP C/M	TOP μR/hr	BOTTOM C/M	BOTTOM μR/hr	RIGHT C/M	RIGHT μR/hr	LEFT C/M	LEFT μR/hr
No 1	0 cm	140	18.6	105	8.6	100	7.1	95	5.7
	5 cm	110	10.0	85	2.9	80	1.4	80	1.4
	25 cm	100	7.1	75	0	75	0	75	0
No 2	0 cm	150	21.4	115	11.4	110	10.0	105	8.6
	5 cm	100	7.1	90	4.3	90	4.3	90	4.3
	25 cm	80	1.4	75	0	75	0	80	1.4

Remarks: C/M of Back Ground = 75

GM SURVEY METER
MODEL : TGS-Ⅲ
SER. No. : 86R976

Test Condition	Room Temp.	Room Humid.	Pressure	Air Velocity	Box Temp.
	24.0 ℃	53 %RH	1007hPa	——— cm/S	——— ℃

ホーチキ株式会社

ENCLOSURE B29