

APPENDIX A  
APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION  
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS  
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND,  
MASSACHUSETTS, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND,  
OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I  
NUCLEAR MATERIAL SECTION B  
631 PARK AVENUE  
KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA,  
PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR  
WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II  
MATERIAL RADIATION PROTECTION SECTION  
101 MARIETTA STREET, SUITE 2900  
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR  
WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION III  
MATERIALS LICENSING SECTION  
799 ROOSEVELT ROAD  
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA,  
NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH,  
OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV  
MATERIAL RADIATION PROTECTION SECTION  
611 RYAN PLAZA DRIVE, SUITE 1000  
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON,  
AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS  
TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V  
MATERIAL RADIATION PROTECTION SECTION  
1450 MARIA LANE, SUITE 210  
WALNUT CREEK, CA 94596

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

1. THIS IS AN APPLICATION FOR (Check appropriate item)

- ☒ A. NEW LICENSE  
☐ B. AMENDMENT TO LICENSE NUMBER 03-01082-01  
☐ C. RENEWAL OF LICENSE NUMBER \_\_\_\_\_

2. NAME AND MAILING ADDRESS OF APPLICANT (Include Zip Code)

John L. McClellan Mem. VA Hospital  
4300 W. 7th  
Little Rock, AR 72205

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

Above and North Little Rock facility

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Lynn McGuire, R.S.O.

TELEPHONE NUMBER

FTS: 735-2027

SUBMIT ITEMS 5 THROUGH 11 ON 8 1/2 x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL

a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

9. FACILITIES AND EQUIPMENT

10. RADIATION SAFETY PROGRAM

11. WASTE MANAGEMENT

12. LICENSEE FEES (See 10 CFR 170 and Section 170.31)

FEE CATEGORY AMOUNT ENCLOSED \$

13. CERTIFICATION. (Must be completed by applicant) THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948, 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

SIGNATURE—CERTIFYING OFFICER

TYPED/PRINTED NAME

TITLE

DATE

VINCENT J. PARRISH

DIRECTOR

3-7-85

14. VOLUNTARY ECONOMIC DATA

| ANNUAL RECEIPTS |           |
|-----------------|-----------|
| <\$250K         | \$1M-3.5M |
| \$250K-500K     | \$3.5M-7M |
| \$500K-750K     | \$7M-10M  |
| \$750K-1M       | >\$10M    |

b. NUMBER OF EMPLOYEES (Total for entire facility excluding outside contractors)

c. NUMBER OF BEDS

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION (Dollar and/or staff hours) ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? (NRC regulations permit it to protect confidential commercial or financial proprietary information furnished to the agency in confidence)

YES

NO

FOR NRC USE ONLY

|                 |              |              |          |             |
|-----------------|--------------|--------------|----------|-------------|
| TYPE OF FEE     | FEE LOG      | FEE CATEGORY | COMMENTS | APPROVED BY |
| AMOUNT RECEIVED | CHECK NUMBER |              |          | DATE        |

Item 5

1. Cs137 Sealed Source; Troxler Dwg #A-102112; Not to exceed 10mCi/source
2. Am 241:Be Sealed Source; Troxler Dwg #A-102451; Not to exceed 50mCi/source

Item 6

For use in a Troxler Model 3400 Series Surface moisture density gauge to measure properties of construction materials.

Item 7

Lynn McGuire, M.S., R.S.O. Information on file.

Item 8

Authorized users will be approved locally by the Radioisotope Safety Committee. Individual(s) using the gauge will normally attend the Troxler training course. All individuals must demonstrate knowledge of the device and be familiar with radiation protection procedures in general and specific local radiation safety procedures. Instruction will be carried out by the R.S.O.

Item 9

Gauge will be stored as described in attached application form. Device will be surveyed (for gamma and neutron) in storage location to insure radiation levels in adjacent locations are ALARA and comply with 10 CFR 20.

Item 10

See attached.

Item 11

NA. Source will be returned to manufacturer under supervision of R.S.O. in compliance with DOT regulations if necessary.

## RADIATION SAFETY PROCEDURES

### Troxler Moisture/Density Gauge

1. Only individuals approved by the Radioisotope Safety Committee may use the gauge.
2. Key control to the gauge shall be maintained by the authorized individuals.
3. Leak tests will be performed by the R.S.O. each 6 months.
4. All receipt and shipment off station of the device must be coordinated by the R.S.O.
5. Personnel monitoring devices (Supplier ANSI approved) must be worn by personnel using the device. Monitors must have gamma and neutron detection abilities.
6. The gauge must be secured against unauthorized removal while in storage.
7. In field locations, the gauge must not be left unattended.
8. During transport on the grounds, the gauge must be secured in the vehicle to prevent jostling or loss from the vehicle.
9. Transport off the NLR grounds must be in accordance with DOT regulations and under supervision of R.S.O.
10. All maintenance must be done with the source in the shielded position. If major maintenance must be performed, the device should either be (1) sent to manufacturer or (2) the R.S.O. must be contacted beforehand so the hazard can be assessed. If the source must be removed, this will only be done on advice of manufacturer and under supervision of R.S.O. Physical radiation surveys will be made and shielding devices used.
11. Emergency Procedures
  - a. In the event of physical damage to a gauge, the following will be performed.
    - (1) Immediately cordon off an area around the gauge. An area radius of 15 feet will be sufficient.
    - (2) If a vehicle is involved, it must be stopped until the extent of contamination, if any, can be established.
    - (3) A visual inspection of the gauge is to be made to determine if the source housing and/or shielding has been damaged.
    - (4) At the earliest possible time, when the situation is under control, you must contact the R.S.O. at x2027. Describe the present conditions and follow the instructions of the Radiation Safety Officer.
  - b. In the event the gauge is lost or stolen, immediately notify the

Radiation Safety Officer as listed above.

12. Use of the device (operating procedures) must be in accordance with instructions furnished by Troxler.

JOHN L. MCCLELLAN MEM. VETERANS HOSPITAL  
LITTLE ROCK, ARKANSAS

REQUEST FOR USE OF RADIOISOTOPES

1. NAME: Engineering Service, Planning & Design Section
2. TITLE OF PROJECT: Troxler Moisture Density Gauge
3. RADIOISOTOPES, CHEMICAL FORM, AND MAXIMUM ACTIVITY OF EACH TO BE IN YOUR POSSESSION AT ANY ONE TIME:  
AmBe-241 and Cs137. Surface dose Rate 15mrem/hr maximum (See attachment for more information.)
4. LOCATION WHERE RADIOISOTOPES ARE TO BE USED: Radioisotopes in the moisture/density gauge will be utilized to determine the density and moisture content of roads, road beds & backfill utility trenches for design and contract conformance at the LR and NLR Divisions.
5. LOCATION WHERE RADIOISOTOPES ARE TO BE STORED: Building 103, Rm 12A (Blueprint room). The gauge will be in a secured, locked steel cabinet. The licensed operator will have possession of the cabinet key.
6. ARE RADIOISOTOPES FOR:

LABORATORY USE N/A ESTIMATED  $\mu$ CI/EXPERIMENT N/A

ANIMAL USE N/A ESTIMATED  $\mu$ CI/EXPERIMENT N/A

7. BRIEFLY DESCRIBE HOW RADIOISOTOPES ARE TO BE USED AND HOW EXPOSURES TO PERSONNEL ARE TO BE MINIMIZED (methods, radiation safety procedures, facilities and equipment, waste disposal, etc.):
  - a. The moisture/density gauge will be used to determine the composition and characteristics of soils and pavements without destroying them or obtaining the service of a Testing Laboratory. During the past calendar year Engineering Service spent approximately \$14,500 in obtaining the services of Testing laboratories for soil and asphalt testing that could have been accomplished by this gauge. The only two alternatives we have to purchasing this moisture/density gauge is to continue contracting out this work or setting up a VAMC owned soils testing laboratory, neither of which is cost effective.
  - b. The operator of the gauge is a graduate Civil Engineer that had training in the use of these gauges in college but will receive additional training and certification at the Troxler Field Training Center in Dallas, Texas.
  - c. The storage location is 20 feet from a manned work station in Room 12A. Room 12A is accessible through two locked doors. The steel cabinet for the gauge will be locked and secured to the wall. The room has no windows. The only keys for the locker will be in the possession of the licensed operator.
  - d. Estimated exposure time to the gauge operator is 15 minutes weekly.

REQUEST FOR USE OF RADIOISOTOPES - (Continued)

8. HAVE YOU HAD TRAINING AND EXPERIENCE IN THE USE OF RADIOISOTOPES? No

WHERE \_\_\_\_\_

WHEN \_\_\_\_\_

9. HAVE YOU HAD INSTRUCTION IN RADIATION SAFETY? No

WHERE \_\_\_\_\_

WHEN \_\_\_\_\_

10. OUTLINE BRIEFLY THE TYPES AND AMOUNTS OF RADIOISOTOPES YOU HAVE USED, THE RADIATION SAFETY PRECAUTIONS WHICH WERE FOLLOWED, AND THE EXTENT OF YOUR PERSONAL INVOLVEMENT IN THESE PROCEDURES:

SIGNATURE: DC Keld

DATE: 2/6/85

-----  
COMMITTEE ACTION: DATE: \_\_\_\_\_

APPROVED( )                      DISAPPROVED( )                      REQUEST CLARIFICATION  
(See below) ( )





Veterans  
Administration

In Reply Refer To:

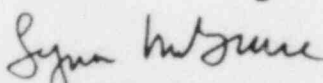
MEMO

TO: Chief, Engineering Service(138NLR)

SUBJ: Troxler moisture/density gauge

DATE: Oct. 12, 1984

1. I spoke with Dick Turner about the Troxler gauge after learning about it from John Hale and Supply. Since it does contain AmBe-241 (a neutron emitter) and Cs137(gamma) information must be submitted to the Radioisotope Safety Committee regarding its use. If approved, an amendment request will then be submitted to the Nuclear Regulatory Commission. The process will take 3-6 months.
2. Please complete the attached form and send to me. You should address at least the following:
  - a. Description of use. Also if other (non-radioactive) devices have been considered and will substitute.
  - b. Responsible user of the device. Training and experience of that person.
  - c. Controls on storage and use; device must be kept in a secured location and only designated individuals can have access to device and use it.
  - d. Indicate if someone will attend Troxler training course.

  
Lynn McGuire, RSD

# THE ROAD/READERS

## THE 3400B SERIES SURFACE MOISTURE-DENSITY GAUGES

The 3400B Series is specifically designed to measure the moisture content and density of soils, soil-stone aggregates, cement and asphalt treated bases, and asphalt paving. With suitable calibration, it can also be used to measure these parameters of other materials having approximately the same range of density and/or moisture content.

The 3400B Series incorporates the latest state-of-the-art in solid-state semiconductor design to provide a high degree of accuracy and reliability. The nuclear geometry and radioactive source design are the culmination of some twenty years of Troxler research and experience in developing instruments of this type. In addition to laboratory work, user experience of approximately 5000 instruments aided in the

selection of the required design criteria and desirable end specifications.

The 3400B Series features simultaneous moisture and density measurements in both the Backscatter and Direct Transmission test modes; greatly extended operation between battery recharges and increased battery life; liquid crystal display which allows increased readability in high ambient light conditions; greatly improved Backscatter performance; and simplified operation to reduce operator error.

*The Model 3411B contains a micro computer which holds all calibration constants and algorithms necessary to compute and display directly, wet density, moisture, dry density, percent moisture, and percent compaction in either kilograms per cubic meter or pounds per cubic foot, as chosen by the operator. The Model 3411B eliminates*

the error in wet density due to the presence of hydrogen in the measured sample. The error is created by the high mass attenuation coefficient of hydrogen. This correction has not been possible in earlier gauge models. The Model 3411B also provides a means of compensating the moisture measurement for hydrogen that is present in the measured material, and is not in the form of free water.

The Model 3401B offers the customer a quality instrument at a lower cost. A simple calculation must be made by the gauge operator and measurement results determined by the use of computer derived calibration tables. The Model 3401B can easily be converted into a Model 3411B by changing scaler modules.

**FROM TROXLER®**



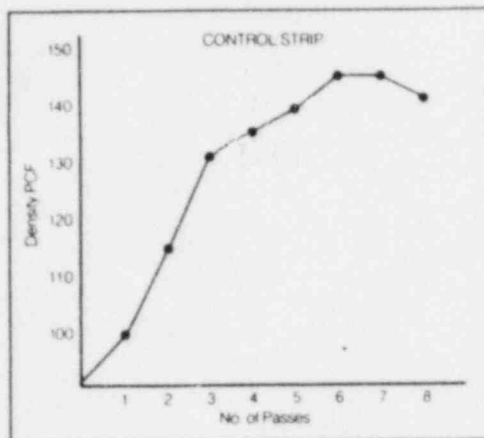
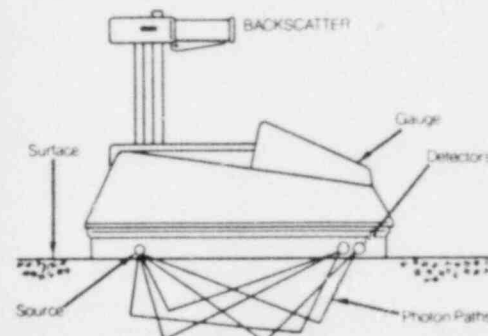


## DENSITY TEST MODES

The 3400B Series offers two test modes for measuring the density of construction materials. The operator may choose either Backscatter or Direct Transmission, depending upon the material and the thickness of the lift to be tested.

## BACKSCATTER

The Backscatter method is non-destructive and may be performed rapidly. Both the gamma source and detectors remain on the surface. Gamma rays enter the material and those scattered back into the detectors are counted. Backscatter is generally insensitive to changes in density below 3.5 inches, which limits its use to thin lifts of material. Backscatter is recommended primarily for use on asphaltic concrete. The 3400B Series has greatly improved Backscatter performance in sensitivity and reduced surface roughness error. With a .05" 100% void underneath the gauge, the surface roughness error is 4.0 PCF, which is one-half that of previous models.



A widely used Backscatter technique for stone base and asphaltic concrete lifts is the "control strip" method. The procedure involves the construction of a 400 sq. yd. test section of representative material. Compaction is accomplished with selected rollers and nuclear Backscatter tests are performed after each roller pass until no further increase in density is observed. Maximum density is determined by taking the average of 10 randomly selected tests. Nuclear tests are normally run on 2800 sq. yd. sections and must average 98% of the target density, with no single test falling below 95%. A new test section must be established when a change of material occurs or after 10 sections have been approved. The obvious advantage of the nuclear gauge on hot asphalt is a quick, on-the-spot test which pinpoints areas needing compactive effort while the asphalt can still be worked.

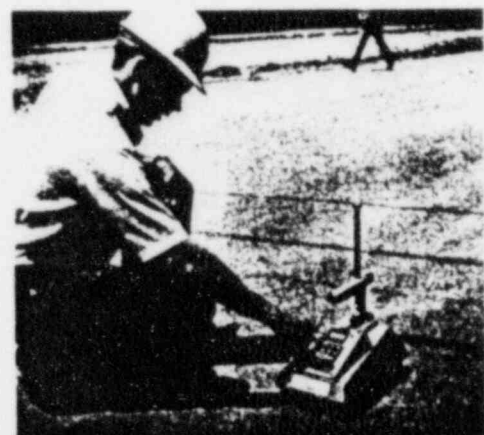
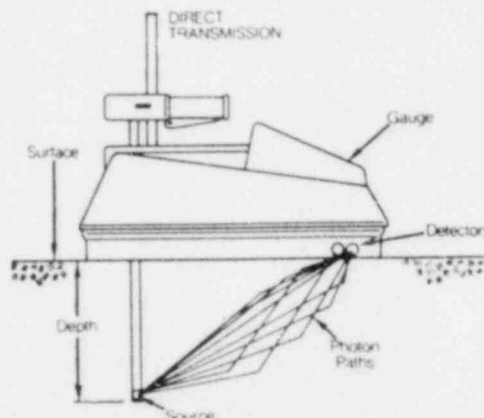
The Model 3411B allows the entry of Marshall values (maximum obtainable density of asphalt) and will compute and display percent compaction of wet density.

If proctor densities are not used for compaction control, the specific gravity of the solids may be entered instead of the proctor value. This will enable the operator to determine the percent solids. A simple subtraction will then allow the operator to determine percent voids.

## DIRECT TRANSMISSION

Direct Transmission is a pseudo non-destructive test which places the gamma source into the material by means of a punched access hole. Standard gauges have eight inch depth capabilities in two inch increments. One inch increments are available by special

order. A special twelve inch depth capability with one or two inch increments may also be ordered. Gamma rays are transmitted from the source through the material to be measured to the detectors located on the surface. The average density of the lift of material is determined. Direct Transmission allows the operator to choose the depth of measurement and greatly reduces error resulting from surface roughness and chemical composition of the test material. Gauge precision is also improved. Direct Transmission is used primarily for testing medium to thick lifts of soil, stone base, and asphalt.



The 3411B also allows the entry of Proctor values for soil and soil aggregate. The micro computer will process the data and display percent moisture and percent compaction of dry density.

Current approved standards for nuclear density testing include ASTM D-2922-78, "Standard Test Method For Density Of Soil And Soil-Aggregate In Place By Nuclear Methods" (Shallow Depth); and ASTM D-2950-74, "Standard Test Method For Density Of Bituminous Concrete In Place By Nuclear Method."

## MOISTURE

The moisture measurement is non-destructive with the neutron source and detector both located on the surface of the test material. A field of fast neutrons enters the material and thermalization occurs after a series of collisions between the neutrons and hydrogen atoms present in the test material. The helium-3 detector, located in the gauge, detects the thermal neutrons.

It is suggested that factory moisture calibration data be compared to oven dry methods and adjustments be made, if necessary. *The Model 3411B has a "built-in" provision to allow the insertion of a correction factor for hydrogen which is not contained in the free water removed during standard oven drying procedures. This correction factor automatically adjusts for changes in the dry density of the soil which contains the moderator or neutron absorber.*

The ASTM Standard D-3017-78 "Standard Test Method For Moisture Content Of Soil And Soil-Aggregate In Place By Nuclear Methods" (Shallow Depth) is the current approved standard. The 3400B Series instruction manual details the procedure for obtaining moisture correction factors.

## MECHANICAL STRUCTURE

The 3400B Series instruments are housed in a permanent-mold aluminum casting which is heat treated and annealed to provide a rugged structure which is immune to physical damage except for major accidents. There are no openings from the bottom surface to the interior which would allow ground water or soil to enter the instrument. All topside openings are gasketed to maintain a clean environment. The instrument can sustain repeated drops from twelve inches (30 cm.) on a one-inch (2½ cm.) steel ball placed on the unyielding surface without damage or alteration of calibration. The exterior of the housing is either anodized or coated with epoxy paint.

The source rod is manufactured from stainless steel, hardened to 45-55 Rockwell C to reduce wear and insure proper indexing of the measurement geometry. The source rod is positioned in stainless steel linear bearings. The indexing mechanism is made from 4130

steel, hardened to 45 Rockwell C so that any wear is produced on parts which are easily replaced.

All interior parts are either anodized aluminum or stainless steel to prevent corrosion.

## RADIOLOGICAL

The instrument contains two sealed sources — an eight millicurie glass-bead source of cesium-137 to provide gamma radiation for the density measurement and a forty millicurie americium-241 beryllium source yielding seventy thousand neutrons per second for the moisture determination. Both sources are doubly encapsulated in stainless steel, and fusion welded.

All biological shielding is constructed of tungsten having a specific gravity of eighteen, a high gamma attenuation coefficient and a melting point of over 3,000°C. While more expensive than lead, tungsten insures permanent protection since it does not cold flow nor melt under conditions likely to be imposed on the instrument by fire.

Radiation levels on any surface of the instrument are less than fifteen millirem-per-hour, including both gamma and neutron. The dose rate at four inches (10 cm.) from any surface of the gauge are less than five millirem per hour. Packed in its transport or shipping case, the instrument meets all applicable requirements of the Department of Transportation under 7A designation.

## BATTERIES

The 3400B Series operates on two nickel-cadmium battery packs with a capacity of 40 watt hours. *A 3400B Series gauge can operate for approximately eight weeks on a full charge. Under normal conditions and using recommended charging procedures, the battery packs should never need replacing.* Recharge may be made overnight by use of a 110/220 volt 50-60 Hz charger or by means of a DC charger plugged into a cigarette lighter using 12 volt vehicle power.

## DETECTORS

Two high temperature platinum lined Geiger-Mueller detectors are used for density determinations. Platinum greatly increases the efficiency and life of these detectors which are manufactured to rigid Troxler specifications. Years of research and nuclear gauging experience have contributed to the design of these highly efficient detectors.

One helium-3 detector is used for the moisture measurement. This detector is specifically designed for use in the Troxler 3400B Series. This helium-3 detector is totally insensitive to gamma radiation below one Mev. This insures no interaction from the cesium-137 gamma source.

## ELECTRONIC ASSEMBLIES

*All 3400B electronic assemblies are packaged in modules which allow 100% field replacement by unskilled personnel. No adjustments or plateau procedures are required to obtain stable operation of the detectors. High voltage and counting thresholds are stable to within  $\pm 0.1\%/^{\circ}\text{C}$ . All components are selected to insure operation over an ambient temperature range of  $-10^{\circ}\text{C}$ . to  $70^{\circ}\text{C}$ . All electronic circuits utilize CMOS large-scale integrated circuits for increased reliability, reduced complexity, and longer battery life.*

Three timing periods have been included which allow measurements to be made in either fifteen seconds, one minute, or four minutes. Timing periods are separated by statistical factors of two. The four digit liquid crystal display indicates readings which are one minute rates regardless of the timing period selected. *Bright sunlight enhances the readability of the liquid crystal display and shading is never required.* Notations are included to indicate a low battery condition and that the instrument is in the process of accumulating data.

Model 3411B reference standard counts for both moisture and density are stored in accumulators and can be addressed and read at any time. The accumulator contains both the moisture and density measurement counts in addition to the standard counts and any one of the four may be addressed and displayed as desired.

The 3411B micro computer has 3 user activated test routines which will verify proper operation of panel switches.

key board, and display. It is factory programmed with calibration constants to compute wet density, dry density, moisture, percent moisture, and percent compaction. Results may be displayed in either U.S. Customary or metric units.

The micro computer automatically corrects wet density readings for errors caused by the high mass attenuation coefficient of hydrogen found in the measured material. The true hydrogen density is evaluated, prior to any corrections for moisture content, and is used to correct the wet density which significantly improves the density accuracy. The Model 3411B also allows the insertion of a K factor to correct for hydrogen in the measured material which is not contained as free water. This moisture correction factor is applied, after comparison of conventional and nuclear moisture test data, by means of moisture correction switches located at the bottom of the scaler module. Plus or minus corrections may be entered by the operator. The K factor automatically adjusts for changes in dry density. This is necessary since the material causing the error by moderation of fast neutrons or absorption of thermal neutrons is contained in the dry soil and is not a part of the moisture content.

## CALIBRATION

The Troxler moisture and density calibration technique is the unique product of years of research and development. Only Troxler customers have the advantage of this sophisticated and accurate calibration method.

## DENSITY CALIBRATION

Count rate data is accumulated on five standard density blocks for the determination of density versus count rate computations and one standard density block to verify calibration accuracy. Specific gravities of the three metallic standard blocks are known to an accuracy of 0.1%, and of the natural material standards to 0.2%. A standard deviation of less than  $\pm 15$  PCF is assured for all data points.

Gauge response to density is by computer evaluation of the arithmetic

function:  $\text{Count Ratio} = A \cdot \text{EXP}(-B \cdot d) - C$ ; where  $d$  = density and A, B & C are constants determined on magnesium and aluminum standard blocks, and a combination magnesium and aluminum standard block. These constants obtained on the metallic standards determine the general shape of the calibration curve. Data is then taken on the limestone and granite standards and the values for the constant B are computed for these natural materials. The average of these two B values will produce a density calibration suitable for normal soils. A calibration validity check is then performed on a low density standard. In order to eliminate long-term effects of source decay and electronic drift, all data is normalized to a reference standard and expressed as a ratio. The calibration constants are stored in non-volatile memory in the Model 3411B.

Gauge parameters of precision, composition error, surface roughness error, and the root-mean-square sum of errors are determined for each gauge to predict probable field error. Computer calibration printouts are furnished for each density test mode and depth from 70 PCF to 170 PCF in  $\frac{1}{2}$  PCF increments. Metric calibrations are available upon request.

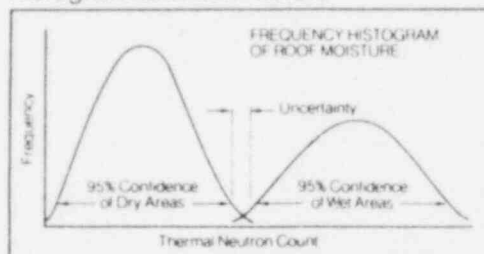
## MOISTURE CALIBRATION

Two moisture calibration standards, magnesium, which represents zero moisture, and a permanent moisture standard which is 36 PCF moisture, are used for the 3400B moisture calibration. Count rate data is normalized to a moisture standard count to eliminate the effect of long-term electronic drift in the instrument. These count ratios are then used to solve the equation:  $\text{Count Ratio} = E + F \times M$ , where  $E$  = gauge response at zero moisture content,  $F$  = slope of the moisture curve, and  $M$  = moisture content. In the Model 3411B, the moisture calibration constants are stored in a non-volatile memory.

The moisture performance parameters of precision, surface roughness, and the expected field error are determined for each gauge. Computer moisture calibration printouts are provided for a range of 0 PCF to 40 PCF in  $\frac{1}{4}$  PCF increments.

## SPECIAL ROOF MOISTURE APPLICATION

The 3400B Series can be used to evaluate the degree of water migration within layers of a built-up flat roof. A ten by ten foot grid is laid out on the roof and non-destructive nuclear moisture counts are taken at grid intersections. A frequency histogram is next plotted of all the data points and used to identify wet and dry areas. A typical bimodal histogram is shown below.



With this type of distribution, the 95% confidence limits can be established for a normal distribution. Core samples are taken in areas which indicate definite wet conditions to determine the amount of moisture present. Once the wet threshold has been determined, a gridded roof drawing can be prepared and used to map the roof for repairs.

## LICENSING INFORMATION

The radioactive sources are by-product materials and do require a special license which is issued by an "agreement state" or by the Nuclear Regulatory Commission. Troxler will assist the customer in obtaining and completing the proper license application. Required radiological safety training courses are held periodically in the home office and in Troxler branch offices. A nominal fee is charged. Field training may also be arranged for a fee covering the instructor's time and applicable expenses.



**MEASUREMENT SPECIFICATIONS**

| <u>BACKSCATTER DENSITY</u>     | <u>25 MIN</u> | <u>1 MIN</u> | <u>4 MIN</u> |        |
|--------------------------------|---------------|--------------|--------------|--------|
| Precision at 120 PCF           | 1.04          | .52          | .26          | ±PCF   |
| Composition Error at 120 PCF   | 2.5           | 2.5          | 2.5          | ±PCF   |
| Surface Error (.05" 100% void) | 4.0           | 4.0          | 4.0          | -PCF   |
| Expected Total Error           | 3.9           | 3.4          | 3.3          | ±PCF   |
| Depth of Measurement (98%)     | 4.0           | 4.0          | 4.0          | inches |

**DIRECT TRANSMISSION DENSITY**

|                                |     |     |     |        |
|--------------------------------|-----|-----|-----|--------|
| Precision at 120 PCF 6" Depth  | .48 | .24 | .12 | ±PCF   |
| Composition Error at 120 PCF   | 1.4 | 1.4 | 1.4 | ±PCF   |
| Surface Error (.05" 100% void) | 0.9 | 0.9 | 0.9 | -PCF   |
| Expected Total Error           | 1.8 | 1.6 | 1.5 | ±PCF   |
| Depth of Measurement           | 2-8 | 2-8 | 2-8 | inches |

**MOISTURE CONTENT**

|                                |     |     |     |        |
|--------------------------------|-----|-----|-----|--------|
| Precision at 15 PCF            | .64 | .32 | .16 | ±PCF   |
| Surface Error (.05" 100% void) | 1.1 | 1.1 | 1.1 | -PCF   |
| Expected Total Error           | 1.5 | .90 | .70 | ±PCF   |
| Depth of Measurement at 15 PCF | 7.0 | 7.0 | 7.0 | inches |

**RADIOLOGICAL SPECIFICATIONS**

|                      |   |
|----------------------|---|
| Gamma Source         | 8 mCi cesium-137<br>(Troxler Drawing #A-102112)                                   |
| Neutron Source       | 40 mCi americium 241.be,<br>70,000 neutrons/second<br>(Troxler Drawing #A-102451) |
| Source Encapsulation | Stainless steel doubly encapsulated   |
| Shielding            | Tungsten and lead   |
| Surface Dose Rates   | 15 mrem/hr maximum,<br>neutron and gamma  |
| Shipping Case        | DOT 7A, Yellow II Label,<br>0.1 Transport Index                                   |

**MECHANICAL SPECIFICATIONS**

|                               |                               |
|-------------------------------|-------------------------------|
| Case                          | Epoxy finish aluminum casting |
| Vibration Test                | 0.1 inches at 12.5 Hz         |
| Drop Test on 1" Steel Ball    | 12 inch height                |
| Operating Temp:               |                               |
| Ambient                       | -10°C to 70°C                 |
| Surface                       | 175°C                         |
| Size                          | 14.5 x 9 x 7.2 inches         |
| (excluding handles)           | (36.3 x 22.5 x 18 cm)         |
| Total Height                  | 19.5 inches (49 cm)           |
| Weight                        | 36 pounds (16.4 Kgm)          |
| Shipping Weight with ABS case | 85 pounds (38.6 Kgm)          |

**ELECTRICAL SPECIFICATIONS**

|  |  |
|--|--|
| Timer Accuracy and Stability             | ± .005%<br>± .0002%/°C                   |
| Readout<br>(direct sunlight viewing LCD) | 4 digits                                 |
| Number of Count Registers                | 2-Model 3401B/<br>4-Model 3411B          |
| Stored Power                             | 40 watt-hours                            |
| Power Consumption                        | 0.12 watts                               |
| Recharge Time                            | 16 hours                                 |
| Charger Input                            | 110/220 VAC,<br>50-60 Hz or<br>12-14 VDC |

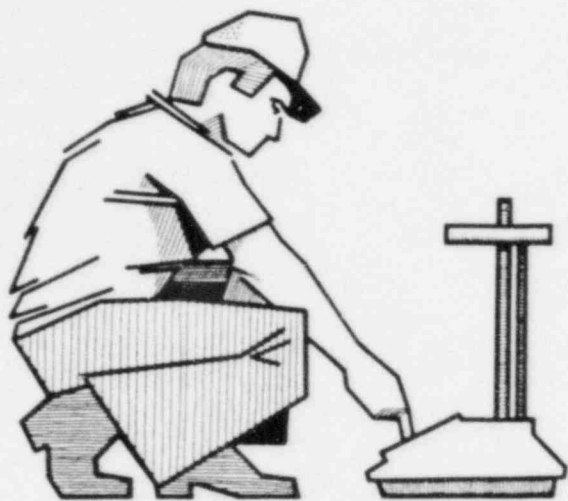
**ACCESSORIES****ACCESSORIES SUPPLIED WITH GAUGE**

Scraper plate/drill rod guide  
Drill rod  
110/220V, 50-60 Hz charger  
Heavy-duty cardboard shipping container with insert  
Reference Standard  
Manual  
Calibration table

**OPTIONAL ACCESSORIES**

Metric calibration  
12 inch (30 cm) depth  
1 inch (2.5 cm) increments  
High impact plastic ABS transport case  
3400 Series tool kit  
Model 3880 leak test kit  
Molykote lubricant, spray & paste  
2 amp buss type GMW fuse  
Radiological survey meter  
Model 3940 Scaler Test Station  
Model 3954 PROM Programmer  
Model 3960 Microprocessor Test Station  
12-14 VDC charger

# Nuclear Gauge and Radiation Safety Training by Troxler



TROXLER ELECTRONIC LABORATORIES, INC. historically has stressed the necessity for a comprehensive, in depth, course of instruction that leads to an understanding of nuclear theory as it relates to our total gauge line, field applications, gauge calibration and radiological safety. Proper field operation and maintenance procedures are stressed to ensure that tests are performed with maximum effectiveness and that the resulting data is accurately interpreted.

Troxler engineers conduct these instructional programs with support from research, service and experienced field personnel. An effort is made to tailor the presentation of subject matter to the background and experience of the program participants. Group interaction and discussion of the material being presented is encouraged.

## TRAINING SCHEDULE SUBJECTS

- |  |   |
|--|---|
| I. RADIOLOGICAL SAFETY                     | II. THEORY OF MEASUREMENT                                       |
| A. Atomic Structure                        | A. Gamma Radiation and Matter                                   |
| B. Radiation Characteristics               | B. Test Modes   |
| 1. Types of Radiation                      | C. Neutron Radiation and Matter                                 |
| 2. Types of Sources                        |   |
| 3. Units of Radiation Dose                 | III. FIELD MEASUREMENT PROCEDURES<br>AND GAUGE APPLICATION      |
| C. Hazards of Exposure to Radiation        |   |
| D. Levels of Radiation from Troxler Gauges | IV. DEMONSTRATION OF GAUGE OPERA-<br>TION AND FIELD MEASUREMENT |
| E. Methods of Controlling Radiation Dose   | V. FACTORY CALIBRATION  |
| 1. Working Time                            | VI. PERIODIC MAINTENANCE  |
| 2. Working Distance                        | VII. FIELD TROUBLESHOOTING AND<br>SERVICE                       |
| 3. Shielding                               | VIII. COURSE REVIEW   |
| F. NRC and State Regulations               |   |
| 1. Handling Procedures                     |   |
| 2. Personnel Monitoring                    |   |
| 3. Security                                |   |
| 4. Records and Reports                     |   |
| 5. Incidents                               |   |
| 6. Transport and Shipping                  |   |
| G. Leak Test Procedures                    |   |

## LICENSING

Radioactive materials used in Troxler gauges require licensing by the United States Nuclear Regulatory Commission or agreement states. In addition, registration or licensing by non-agreement state agencies may be required. Completion of the approved Troxler instructional program satisfies the training requirements of these agencies for users and radiation safety officers. A certificate is issued upon completion of the course. Assistance in obtaining and completion of proper radioactive materials license application forms is also provided.

## COURSE ARRANGEMENTS

Training courses are held on the first Thursday of each month in Troxler's Research Triangle Park, North Carolina home office. The Research Triangle Park is located between the cities of Raleigh and Durham adjacent to Interstate 40, and minutes from the Raleigh-Durham airport. Troxler will provide directions and lodging information upon request.

Field training courses at your location can be arranged by contacting the North Carolina office or the Troxler branch office which serves your area. Fees for the in-plant or field training courses will be quoted upon request.

TROXLER ELECTRONIC LABORATORIES, INC.  
P.O. Box 12057 — Cornwallis Road  
Research Triangle Park, North Carolina 27709  
(919) 549-8661

SOUTHERN BRANCH OFFICE  
P.O. Box 110629  
Nashville, TN 37211  
(615) 331-8537

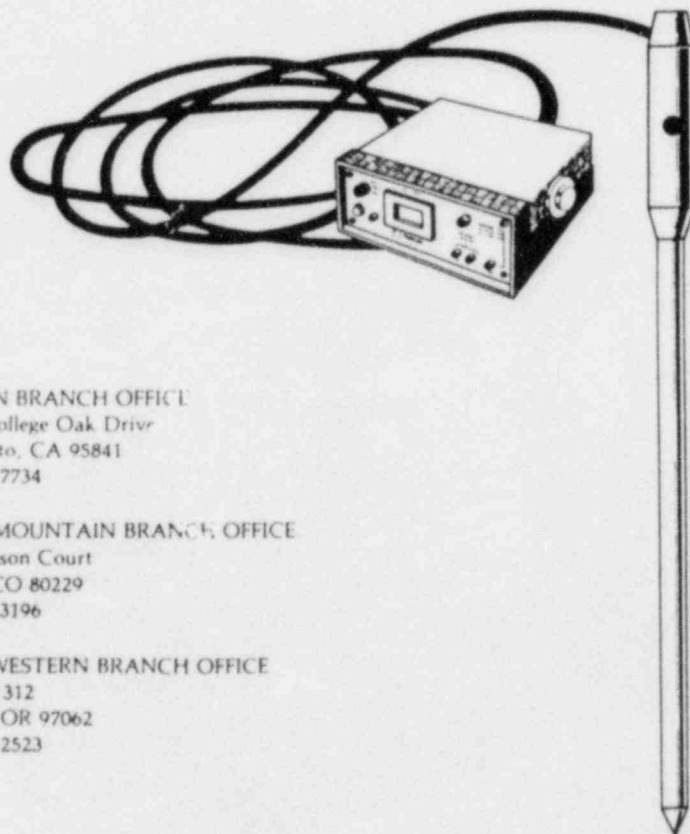
CENTRAL BRANCH OFFICE  
37635 N. RT. 59  
Lake Villa, IL 60046  
(312) 587-7273

SOUTHWESTERN BRANCH OFFICE  
2000 E. Randol Mill Road — Suite 605  
Arlington, TX 76011  
(817) 275-0571

WESTERN BRANCH OFFICE  
5041-H College Oak Drive  
Sacramento, CA 95841  
(916) 332-7734

ROCKY MOUNTAIN BRANCH OFFICE  
900 Clarkson Court  
Denver, CO 80229  
(303) 288-3196

NORTHWESTERN BRANCH OFFICE  
P.O. Box 312  
Tualatin, OR 97062  
(503) 638-2523



Amarillo  
20th

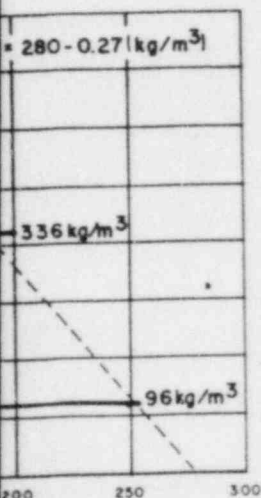


ture content generally  
normalized curves is  
of moisture content  
the neutron method is  
depth of measurement is  
thermalized neutrons  
data, we can express  
and the moisture con-

M (kg/m<sup>3</sup>)

17 M (PCF)

and is valid over the



urement

## XII. RADIOLOGICAL SAFETY

This section will provide the gauge operator with a general understanding of the type and characteristics of the radioactive material contained in this gauge and the resulting radiation. A more in-depth review of the radiological information is obtained by attending a Troxler Nuclear Gauge Training Course.

### A. Types of Radiation

The radioactive materials in the Model 3400 produce two types of radiation. First, gamma radiation is used to measure the density of the material. Gamma rays or gamma "photons" are a form of electromagnetic radiation or a highly penetrating form of pure energy. Section X-A of this Manual provides a discussion of how gamma rays interact with matter and how density measurements are accomplished. Second, neutron radiation is used to measure the moisture content of material. Neutrons are very small, dense particles that exist in the nucleus of almost every atom. Neutron radiation, like gamma radiation, is a highly penetrating form of ionizing radiation. Section X-B of this Manual provides a discussion of how neutron radiation interacts with matter and moisture measurements.

### B. Types of Sources

The 3400 Series Surface Moisture-Density Gauge contains a Cesium-137 gamma source for measuring density and an Americium-241:Beryllium neutron source for measuring moisture content. Both of these sources meet the regulatory requirements of the United States and international authorities as "SPECIAL FORM" or sealed source material. Except for the direct radiation hazards, the sources are extremely safe.

### C. Source Encapsulation

To meet the requirements as "SPECIAL FORM," the radioactive material must be encapsulated to prevent contamination. The first encapsulation is provided for in that the metallic Cesium material is an integral part of a glass bead. The glass bead is then fusion welded inside a stainless steel capsule. This source capsule is fusion welded into the 3400 source rod to provide for a triple encapsulation. The Americium-241:Beryllium material is compressed into pellet form. This pressed pellet is fusion welded in two separate stainless steel capsules and is contained within the instrument in another stainless steel housing embedded in lead. The activity of these sources is a nominal 8 millicuries of Cesium-137 and a nominal 40 millicuries of Americium-241:Beryllium.

### D. Radiation Exposure Limitations

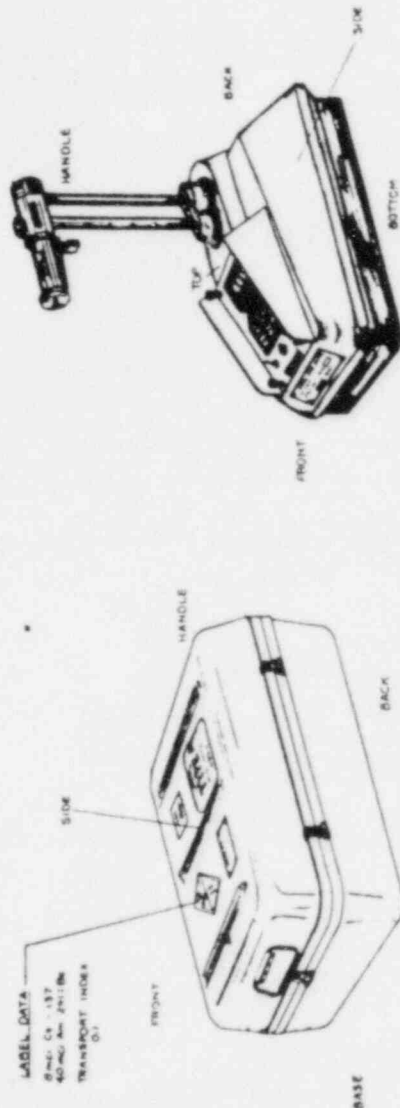
Current radiation regulations limit the radiation exposure of an individual utilizing a source of radiation on the job to 1250 millirem in a calendar quarter for a maximum of 5000 millirem in one (1) year. FIGURE 17 is a radiation profile detailing the radiation levels associated with the Model 3400 gauge. Under average conditions, a full-time operator working a 40-hour week can expect to receive about 4 millirem per week or 50 millirem per quarter.

### E. Means of Exposure Limitations

Radiation exposure associated with the 3400 Series gauge is very low in comparison with other types of ionizing radiation devices employed in the workplace. Regardless of this, operators shall be mindful of the concept of "ALARA," which means to keep your radiation exposure "As Low As Reasonably Achievable."

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18785

## XII-1. RADIATION PROFILE



| 3400 SERIES RADIATION DOSE RATES (mrem/hr) |       |         |       |       |         |       |       |         |        |       |         |
|--|-------|---------|-------|-------|---------|-------|-------|---------|--------|-------|---------|
| SURFACE                                    |       |         | 10 CM |       |         | 30 CM |       |         | 100 CM |       |         |
| Gauge                                      | Gamma | Neutron | Total | Gamma | Neutron | Total | Gamma | Neutron | Total  | Gamma | Neutron |
| FRONT                                      | 4.0   | 1.0     | 5.0   | 4.0   | 50      | 0.9   | 16    | 10      | 26     | 06    | 01      |
| SIDE                                       | 14    | 1.0     | 15    | 15    | 50      | 2.0   | 18    | 10      | 28     | 02    | 01      |
| TOP  | 13    | 1.0     | 14    | 23    | 50      | 3.0   | 60    | 10      | 70     | 10    | 01      |
| BACK                                       | 6.0   | 0.5     | 6.5   | 32    | 50      | 0.7   | 20    | 05      | 25     | 08    | 01      |
| BOTTOM                                     | 6.0   | 3.0     | 9.0   | 70    | 1.0     | 1.7   | 16    | 10      | 26     | 05    | 01      |
| HANDLE                                     | 20    | 32      | 52    | 09    | 21      | 30    | 01    | 05      | 06     | —     | —       |
| TRANSPORT CASE                             |       |         |       |       |         |       |       |         |        |       |         |
| GAGE HANDLE                                | 08    | 10      | 18    | 06    | 05      | 11    | 03    | 02      | 05     | 01    | 01      |
| GAGE BASE                                  | 90    | 1.0     | 1.9   | 31    | 20      | 51    | 12    | 08      | 20     | 09    | 02      |
| GAGE FRONT                                 | 60    | 1.0     | 1.6   | 35    | 20      | 55    | 15    | 06      | 23     | 06    | 02      |
| GAGE BACK                                  | 25    | 1.0     | 3.5   | 12    | 20      | 14    | 14    | 08      | 22     | 04    | 02      |
| GAGE SIDES                                 | 2.0   | 1.8     | 3.8   | 90    | 40      | 12    | 25    | 10      | 35     | 06    | 02      |

NOTE:  
 1. GAUGE MEASUREMENTS MADE WITH A VICKERS MODEL 2025 IONIZATION CHAMBER CALIBRATED ON 170  
 2. NEUTRON DOSE RATES CALCULATED USING 18 MeV NEUTRON ENERGY  
 3. NEUTRON DOSE RATES FOR A 1000 Ci 252Cf SOURCE  
 4. NEUTRON DOSE RATES FOR A 1000 Ci 252Cf SOURCE  
 5. NEUTRON DOSE RATES FOR A 1000 Ci 252Cf SOURCE  
 6. NEUTRON DOSE RATES FOR A 1000 Ci 252Cf SOURCE  
 7. NEUTRON DOSE RATES FOR A 1000 Ci 252Cf SOURCE  
 8. NEUTRON DOSE RATES FOR A 1000 Ci 252Cf SOURCE  
 9. NEUTRON DOSE RATES FOR A 1000 Ci 252Cf SOURCE  
 10. NEUTRON DOSE RATES FOR A 1000 Ci 252Cf SOURCE

No matter how low the exposure, we should limit the exposure in three ways to limit and shielding.

### 1. Time

Radiation exposure example, if a person's hand is on the surface of the gauge for 15 millirem. If the exposure would be the hand would be in the radiation field, gauge, exposure time required to

### 2. Distance

Radiation exposure example, if we had a gauge 10 millirem per hour of 2.5 millirem as close as necessary to the gauge vehicle, therefore the gauge is not work traffic.

### 3. Shielding

The last means of shielding is by positioning the gauge. For the Cesium-137 or "safe" position shield. For products are necessary

Figure 17

| EXPOSURE RATE (mR/hr) | 1.0  | 1.5  | 2.0  | 2.5  | 3.0  | 4.0  | 5.0  | 6.0  | 7.0  | 8.0  | 9.0  | 10.0 | 15.0 | 20.0 | 25.0 | 30.0 | 40.0 | 50.0 | 60.0 | 70.0 | 80.0 | 90.0 | 100.0 | 150.0 | 200.0 | 250.0 | 300.0 | 400.0 | 500.0 | 600.0 | 700.0 | 800.0 | 900.0 | 1000.0 |
|-----------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| TOP                   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| FRONT                 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| BACK                  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| RIGHT SIDE            | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| LEFT SIDE             | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| WHEELS                | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| UNDER                 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| TRANSPORT CASE        | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| GAUGE HANDLE          | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| GAUGE BASE            | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| GAUGE FRONT           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| GAUGE BACK            | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| GAUGE SIDES           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |

NOTES:  
 1. GAMMA MEASUREMENTS MADE WITH A VICTOREEN MODEL 8055 CALIBRATION CHAMBER CALIBRATED AT 8.7 MR/hr.  
 2. NEUTRON MEASUREMENTS MADE WITH A VICTOREEN MODEL 8055 CALIBRATION CHAMBER CALIBRATED AT 1.0 MR/hr.  
 3. NEUTRON RATES ARE FOR 0.01-CI 241-AM SOURCE AND 40-42 IN. 241-AM NEUTRON SOURCE WITH A FIELD OF 7.0 x 10<sup>4</sup> NEUTRONS PER SECOND

No matter how low the exposure rate, if means are available to limit the exposure, we should use them. In radiation safety, there are three ways to limit or reduce exposure. These are time, distance, and shielding.

### 1. Time

Radiation exposure is denoted in an exposure level per time. For example, if a person were to place his or her hand on the back surface of the gauge for 1-hour, the exposure to the hand would be 15 milliRms. If the hand were held on the gauge for 30-minutes, the exposure would be 7.5 milliRms. For 2-hours, the exposure to the hand would be 30 milliRms. The longer a person stays in a radiation field, the greater the exposure. In using the 3400 gauge, exposure is lowered by only being with the gauge for the time required to take the measurement.

### 2. Distance

Radiation exposure decreases drastically over distance. For example, if we had a source of radiation that at 2 feet has a level of 10 milliRms per hour, the same source at 4 feet would have a level of 2.5 milliRms per hour. In using the 3400 gauge, stand only as close as necessary to see the display of readings. In transporting the gauge, keep the gauge in the cargo compartment of the vehicle, thereby increasing the distance from the source. When the gauge is not in use, store it in a safe place away from normal work traffic.

### 3. Shielding

The last means of decreasing radiation exposure is to place something between you and the source to stop the radiation. In the 3400 gauge, the Americium-241:Beryllium neutron source is sufficiently low in neutron output to negate the need for any shielding. For the Cesium-137 gamma source, when the gauge is in the shielded or "safe" position, the source is completely encased by a tungsten shield. For practical use of the gauge, no other shielding methods are necessary.

## LICENSING REQUIREMENTS

This section provides a general discussion of the licensing requirements that apply in the United States. Users of this gauge in other countries should contact the Troxler International, Ltd. agent covering their area or the factory for a discussion of the appropriate regulatory requirements.

### A. Specific License

The possession and use of the radioactive material in this gauge requires that the user maintain a specific license issued by the United States Nuclear Regulatory Commission or equivalent agreement state licensing agency. Troxler Electronic Laboratories, Inc. will provide assistance and information to obtain the necessary license.

### B. Radiation Safety Program

The specific license dictates that the user of nuclear gauges maintain control of the gauges in such a manner that the operator and general public will not be unnecessarily exposed to radiation. To determine exactly what requirements apply to your operation, you should review your licensing document and the radiation safety procedures that accompanied your license application. The following requirements are generally accepted by all licensing agencies.

### C. Personnel Monitoring

Current regulations do not require the use of personnel monitoring to utilize Troxler nuclear gauges. Regardless of this, most licensing agencies require that the operators of nuclear gauges wear film badges to document the actual radiation exposure. Each operator of the gauge should wear the film badge when operating the equipment. When the equipment is not being utilized, the film badge should be kept in a radiation free area. The reports of radiation exposure supplied by the film badge processor must be maintained on file and available for review by the licensing agency.

### D. Security

The regulations require that users of nuclear gauges provide all necessary security to prevent unauthorized use or removal of this gauge. This applies both to when the gauge is being stored between utilization and when the gauge is being transported to a job site.

### E. Leak Test

The regulations require that the gauge be leak tested at intervals not to exceed six months. To ensure that the radioactive material is securely contained in the gauge. The leak test should be performed using the Troxler Model 3880 Leak Test Kit and accompanying instructions. To perform the test on the Model 3400 gauge, first remove the scaler modular from the front of the gauge. Looking down into the cavity of the scaler, you will see a yellow radiation label approximately in the middle of the gauge base and to the top of the circuit board. Wipe the yellow label. Second, turn the gauge on one side. On the bottom of the gauge you will see the opening through which the source rod indexes. Wipe around and into this opening. Please note that the source rod remains in the shielded or "safe" position during this procedure.

### F. Notice To Employees

Figure 18 is an example of the Notice To Employees that must be posted in your facility so that individuals utilizing the equipment or entering the area where the gauge is stored can see it. The licensing agency will supply you with this form.

UNITED STATES NUCLEAR REGULATORY COMMISSION  
Washington, D.C. 20555

## NOTICE TO EMPLOYEES

### STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 18)

In Part 20 of the Rules and Regulations, the Nuclear Regulatory Commission has established standards for your protection against radiation. Records of your radiation exposure must be maintained. In Part 18 of the Rules and Regulations, the Nuclear Regulatory Commission has established certain provisions for the actions of workers engaged in NRC licensed activities.

Measure in terms of any applicable laws and regulations. The Commission has established certain provisions for the actions of workers engaged in NRC licensed activities.



Form NRC-3  
Rev. 1-78  
NRC USE ONLY  
NRC 318 20

#### YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to:  
1. Advise these NRC regulations and the conditions of the NRC license to all employees under the license.



must be posted  
nt or entering  
ensing agency

| REGION | ADDRESS  | TELEPHONE    |                     |
|--------|--|--------------|---------------------|
|        |  | DAYTIME      | NIGHTS AND HOLIDAYS |
| I      | Region I: Office of Inspection and Enforcement and Training<br>Bureau of Prisons<br>Washington, D.C. 20535   | 202 377-6000 | 202 377-6000        |
| II     | Region II: Office of Inspection and Enforcement<br>101 Riverside Drive<br>Albany, New York 12243             | 518 267-4000 | 518 267-4000        |
| III    | Region III: Office of Inspection and Enforcement<br>700 Pennsylvania Road<br>Oak Park, Illinois 60452        | 708 626-2600 | 708 626-2600        |
| IV     | Region IV: Office of Inspection and Enforcement<br>811 Ryan Plaza Drive<br>Arlington, Texas 76012            | 817 266-2601 | 817 266-2601        |
| V      | Region V: Office of Inspection and Enforcement<br>1000 N. California Boulevard<br>San Jose, California 95131 | 415 862-3700 | 415 862-3700        |

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#### G. Incidents

In the event that the gauge is lost, stolen, or physically damaged to the extent that the source shielding could be compromised, you must immediately notify the licensing agency.

#### H. Disposal

The regulations require that the disposal of radioactive material be accompanied by very restrictive methods. In general, you can transfer the gauge to another authorized licensee or the instrument can be returned to our factory for final disposal. If outside the United States, contact your local Troxler representative or the factory.

#### I. Record Keeping

The following documentation should be maintained and available for review by the licensing agency:

##### 1. Leak Test Report

To verify that the Leak Test as described in Item E of this section has been accomplished, you must maintain on file a copy of each Leak Test Report.

##### 2. Personnel Monitoring Report

A copy of each Film Badge Report must be maintained on file. The Film Badge Report must contain each individual's name, Social Security number, and date of birth, along with the actual exposure received.

##### 3. Inventory, Receipt and Transfer records

A utilization log should be established to document the location of the gauge(s) at all times. This log should be set up so that when the gauge is removed from the storage area, a sign-out is made on the log. Again, when the gauge is returned to storage, it should be signed in.

##### 4. Source Certificate

Each new gauge shipped from Troxler Electronic Laboratories, Inc. will be accompanied by a Certificate denoting the information concerning the radioactive material employed in the gauge. The original source Certificate should be maintained on file and a copy carried with the gauge at all times.

##### 5. Transport Package Certification

Regulations require that the gauge be transported and shipped in a properly tested and approved container. To this end, all Troxler gauges are shipped as a U.S.D.O.T. 7A Type A package. A complete Report of the required testing and evaluation is maintained on file at Troxler corporate headquarters. Please note that the Troxler certification may be used only when the gauge is transported in its accompanying transport case. If any other container is used for transport, additional testing would be required.

##### 6. Transportation - Bill of Lading

The Regulations of the U.S.D.O.T. require that you have a properly prepared shipping document when transporting the gauge. An example of the information that needs to be on this document is shown in Item D of Section XIV of this Manual.

#### XIV. TRANSPORTATION

The transport  
conformance  
international  
gauges and

##### A. Test

The source  
certified  
active material  
has been tested

##### B. Label

The Model  
"Yellow I  
three fee  
label.

##### C. Transport

Certain requirements  
to a job :  
enger area  
authorized personnel

##### D. Transport

The transport  
vent damage  
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#### XIV. TRANSPORTATION AND SHIPPING

The transportation of devices containing radioactive material requires conformance with the United States Department of Transportation and International Atomic Energy Association Regulations. Troxler nuclear gauges and transport cases meet or exceed the appropriate requirements.

##### A. Test and Certifications

The source of radioactive material in Troxler gauges has been tested and certified by the appropriate competent authority as "SPECIAL F" radioactive material. The packaging of the gauge in its shipping container has been tested and meets the requirements for a "Type A" package.

##### B. Labeling

The Model 3400 Series gauge and transportation case are labeled with two "Yellow II" radiation labels denoting the radiation exposure rate at three feet from the device and a U.S.D.O.T. 7A "Type A" packaging label.

##### C. Transportation by Motor Vehicle

Certain requirements must be met by the user when transporting the gauge to a job site. In general, the gauge cannot be transported in the passenger area of the vehicle. The gauge must be secured to prevent unauthorized removal.

##### D. Transportation by Common Carrier

The transport case must be used when shipping by common carrier to prevent damage to the gauge electronics. If the means of shipment is by air, the package must be accompanied by a properly completed bill of lading and a "Shipper's Certification for Radioactive Material." An example of the shipper's Certification for shipment inside the United States is shown on Figure 19. In the United States, the package must be carried on a "Cargo Only" aircraft. For shipment outside the United States, the Shippers Certificate is shown in Figure 20.

If the means of shipment is by a commercial trucking line, the bill of lading must include the following description:

RADIOACTIVE MATERIAL

SPECIAL FORM, N.O.S., UN2974

Cesium-137. 0.008 Ci

Type A Package

Radioactive "Yellow II"

Transport Index 0.01

460641  
18785

## MATERIALS DATA INPUT - INDUSTRIAL, MEDICAL, SOURCE/SPECIAL NUCLEAR

## A. TYPE OF ACTION AND IDENTIFICATION CODES

|   |   |   |  |               |                     |                               |
|---|---|---|--|---------------|---------------------|-------------------------------|
| <input type="checkbox"/> NEW LICENSE                  | <input type="checkbox"/> AMENDMENT TO RENEW LICENSE | <input type="checkbox"/> AMENDMENT TO TERMINATE       | <input checked="" type="checkbox"/> VOID | DOCKET NUMBER | MAIL CONTROL NUMBER | CHANGE NAME/ADDRESS ("X" box) |
| <input type="checkbox"/> NEW LICENSE AND NEW LICENSEE | <input checked="" type="checkbox"/> OTHER AMENDMENT | <input type="checkbox"/> CLERICAL CHANGE NO AMENDMENT | 4  | 030-01212     | 18785               | <input type="checkbox"/>      |

## B. INDICATIVE INFORMATION

|  |   |                                   |
|--|---|-----------------------------------|
| INDIVIDUAL LICENSEES                                       | NAME (Last, First, Middle)  | NAME (Last, First, Middle)        |
|  | NAME (Last, First, Middle)  | NAME (Last, First, Middle)        |
|  | NAME (Last, First, Middle)  | NAME (Last, First, Middle)        |
| ORGANIZATION   | ORGANIZATION NAME (Alphabetical Sequence)<br>V. A. Medical <del>State</del> <i>LFMB</i> |                                   |
| LICENSEES  | DEPARTMENT OR BUREAU  |                                   |
| ADDRESS  | BUILDING, STREET<br>300 East Roosevelt Rd.  | CITY<br>Little Rock               |
|  | STATE<br>AR   | ZIP CODE<br>72206                 |
| TYPE OF APPLICANT  | <input type="checkbox"/> U.S. GOVERNMENT AGENCY   | DATE REQUEST RECEIVED<br>03/18/85 |
|  | <input type="checkbox"/> INDIVIDUAL LICENSEE  | INSTITUTION CODE<br>01082         |
|  | <input type="checkbox"/> ORGANIZATIONAL LICENSEE  | PENDING PROG. CODE                |
| SECONDARY PROGRAM CODES (As required)                      |   |                                   |
| #1   | #2  | #3                                |
| Request is for moisture density gauge. New license set up. |   |                                   |
| LICENSE NUMBER<br>03-01082-01                              | DATE LICENSE ISSUED FOR ACTION COMPLETED<br>05/21/85                                    | EXPIRATION DATE                   |

## C. STATISTICAL INFORMATION

|  |                            |                            |                       |                          |
|--|----------------------------|----------------------------|-----------------------|--------------------------|
| MEDICAL CATEGORY   | FOR HUMAN USE ONLY         | FOR HUMAN AND NONHUMAN USE | FOR NONHUMAN USE ONLY |                          |
| POSSESSION OF THE MATERIAL IS AUTHORIZED IN ONE OF THE FOLLOWING AREAS |                            |                            |                       |                          |
| AND/OR IN THE STATE(S), TERRITORY(IES), COUNTRY CHECKED (At right)     | SAME AS "STATE" IN ADDRESS |                            | ALL STATES            | ALL NON AGREEMENT STATES |
|  | AL ALABAMA                 | GA GEORGIA                 | MD MARYLAND           | NJ NEW JERSEY            |
|  | AK ALASKA                  | HI HAWAII                  | MA MASSACHUSETTS      | NM NEW MEXICO            |
|  | AZ ARIZONA                 | ID IDAHO                   | MI MICHIGAN           | NY NEW YORK              |
|  | AR ARKANSAS                | IL ILLINOIS                | MN MINNESOTA          | NC NORTH CAROLINA        |
|  | CA CALIFORNIA              | IN INDIANA                 | MS MISSISSIPPI        | ND NORTH DAKOTA          |
|  | CO COLORADO                | IA IOWA                    | MO MISSOURI           | OH OHIO                  |
|  | CT CONNECTICUT             | KS KANSAS                  | MT MONTANA            | OK OKLAHOMA              |
|  | DE DELAWARE                | KY KENTUCKY                | NE NEBRASKA           | OR OREGON                |
|  | DC WASHINGTON DC           | LA LOUISIANA               | NV NEVADA             | PA PENNSYLVANIA          |
| FL FLORIDA   | ME MAINE                   | NH NEW HAMPSHIRE           | RI RHODE ISLAND       |                          |
|  |                            |                            |                       |                          |

## D. POSSESSION LIMITS OF SOURCE AND SPECIAL NUCLEAR MATERIALS AND TRITIUM

|                         |        |              |             |              |                      |        |
|-------------------------|--------|--------------|-------------|--------------|----------------------|--------|
| SOURCE MATERIAL CEILING |        | G GRAMS      | SNM CEILING | G GRAMS      | H. FOR POWER REACTOR |        |
|                         |        | Kg KILOGRAMS |             | Kg KILOGRAMS | ("X" box)            |        |
| MATERIAL                | AMOUNT | UNIT         | CONFIG      | ENRICH       | MATERIAL             | AMOUNT |
| U-235                   |        | G            | S           |              |                      |        |
|                         |        | Kg           | UN          |              |                      |        |
| U-233                   |        | G            | S           |              |                      |        |
|                         |        | Kg           | UN          |              |                      |        |
| Plutonium               |        | G            | S           |              |                      |        |
|                         |        | Kg           | UN          |              |                      |        |
| Uranium                 |        | G            | S           |              |                      |        |
|                         |        | Kg           | UN          |              |                      |        |
| Thorium                 |        | G            | S           |              |                      |        |
|                         |        | Kg           | UN          |              |                      |        |
|                         |        | G            | S           |              |                      |        |
|                         |        | Kg           | UN          |              |                      |        |
|                         |        | G            | S           |              |                      |        |
|                         |        | Kg           | UN          |              |                      |        |
| H3-Tritium              |        | CURIES       |             | RIS CODES    |                      |        |
|                         |        | MILLCURIES   |             |              |                      |        |
|                         |        | MICROCURIES  |             |              |                      |        |

\* Use two digit codes.

S-SEALED

UNS-UNSEALED

NOTE TO: License Fee Management Branch, ADM

FROM: Region 4

SUBJECT: VOIDED APPLICATION

Control Number

18785

Applicant

VA Med. Ctr.

Date Voided

5/21/85

Reason for Void

Applicant wanted to  
add a Tropter gauge to  
human use lic. Request  
set up as new lic.

Signature

J. A. Marshall

Attachment:  
Application

gh  
L5MB

ML40