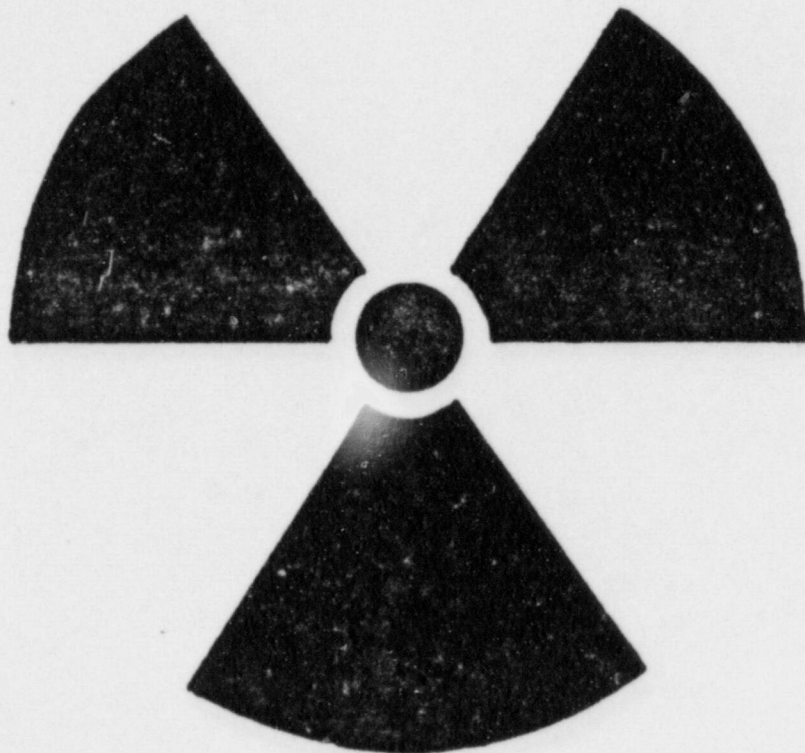


U.S. NUCLEAR REGULATORY COMMISSION (NRC)

LICENSE APPLICATION FOR
RENEWAL OF NRC BYPRODUCT
MATERIAL LICENSE

21-01222-05

FOR THE
MC-1 TESTER DENSITY AND MOISTURE
NUCLEAR METHOD



8705110083 870430
REG3 LIC30
21-01222-05 PDR



U.S. ARMY TANK - AUTOMOTIVE COMMAND (TACOM)

WARREN, MICHIGAN 48397-5000



CONTROL NO. 80958

FORM NRC-313 I
(3-80)
10 CFR 30

U.S. NUCLEAR REGULATORY COMMISSION

1. APPLICATION FOR:
(Check and/or complete as appropriate)

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

a. NEW LICENSE

See attached instructions for details.

b. AMENDMENT TO:
LICENSE NUMBER

Completed applications are filed in duplicate with the Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety, and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or applications may be filed in person at the Commission's office at 1717 H Street, NW, Washington, D. C. or 7915 Eastern Avenue, Silver Spring, Maryland.

X c. RENEWAL OF:
LICENSE NUMBER
21-01222-05

2. APPLICANT'S NAME (Institution, firm, person, etc.)

Department of the Army (313) 574-8529

TELEPHONE NUMBER: AREA CODE - NUMBER EXTENSION

3. NAME AND TITLE OF PERSON TO BE CONTACTED
REGARDING THIS APPLICATION

RICHARD M. GRNYA, (313) 574-8529

TELEPHONE NUMBER: AREA CODE - NUMBER EXTENSION

4. APPLICANT'S MAILING ADDRESS (Include Zip Code)
(Address to which NRC correspondence, notices, bulletins, etc., should be sent.)

US Army Tank-Automotive Command
Warren, MI 48397-5000

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED
(Include Zip Code)

Soil testers will be possessed, maintained and used by US DOD installations and activities worldwide under the control of Department of the Army military or Civilian Personnel.

(IF MORE SPACE IS NEEDED FOR ANY ITEM, USE ADDITIONAL PROPERLY KEYED PAGES.)

6. INDIVIDUAL(S) WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL
(See Items 16 and 17 for required training and experience of each individual named below)

FULL NAME

TITLE

Individuals trained in accordance with
a. TB 385-103 assigned to Army units authorized to use the tester.

b. (See Supplement A)

c.

7. RADIATION PROTECTION OFFICER

TACOM, Karen Lapajenko (Alternate RPO)

TACOM, Edward Zobel, (RPO) See Supplement B.

Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.

8. LICENSED MATERIAL

LINE NO.	ELEMENT AND MASS NUMBER A	CHEMICAL AND/OR PHYSICAL FORM B	NAME OF MANUFACTURER AND MODEL NUMBER (If Sealed Source) C	MAXIMUM NUMBER OF MILLICURIES AND/OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME D
(1)	CS- 137	Sealed Source	Campbell Pacific Nuclear BRC MC Series	10 mci/unit
(2)	AM-241-BE	Sealed Source	Campbell Pacific Nuclear BRC MC Series	50 mci /AM241-Be/ unit
(3)	Total Quantity of 200 Density-Moisture Gages Required			
(4)	(See Supplement C, Military Specification).			

DESCRIBE USE OF LICENSED MATERIAL

E

(1) Commercial unit to be used by Department of the Army throughout the United States and overseas for Depth Density and Moisture Measurements of soil and asphalt.

(2) Soil testers will be returned to the manufacturer for repair.

(3)

(4)

FREE EXEMPT

CONTROL NO. 80958

9. STORAGE OF SEALED SOURCES

LINE NO.	CONTAINER AND/OR DEVICE IN WHICH EACH SEALED SOURCE WILL BE STORED OR USED.	NAME OF MANUFACTURER	MODEL NUMBER
	A.	B.	C.
(1)	Self Contained in each gage	Campbell Pacific Nuclear	MC-1
(2)	Gage carried and stored in ac transport case.		
(3)			
(4)			

10. RADIATION DETECTION INSTRUMENTS

LINE NO.	TYPE OF INSTRUMENT	MANUFACTURER'S NAME	MODEL NUMBER	NUMBER AVAILABLE	RADIATION DETECTED <i>(alpha, beta, gamma, neutron)</i>	SENSITIVITY RANGE <i>(milliroentgens/hour or counts/minute)</i>
	A	B	C	D	E	F
(1)	Survey (6665-00921-0846)	Eberline and Others	AN/PDR 27	1 per storage site	Beta/Gamma	1-500 mr/hr
(2)						
(3)						
(4)						

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

<input checked="" type="checkbox"/> a. CALIBRATED BY SERVICE COMPANY NAME, ADDRESS, AND FREQUENCY Lexington-Blue Grass Army Depot Activity or Sacramento Army Depot depending on location 3 month intervals using NBS traceable.	<input type="checkbox"/> b. CALIBRATED BY APPLICANT Attach a separate sheet describing method, frequency and standards used for calibrating instruments. See Supplement D.
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12. PERSONNEL MONITORING DEVICES

TYPE <i>(Check and/or complete as appropriate.)</i>	SUPPLIER <i>(Service Company)</i>	EXCHANGE FREQUENCY
A	B	C
<input checked="" type="checkbox"/> (1) FILM BADGE <input type="checkbox"/> (2) THERMOLUMINESCENCE DOSIMETER (TLD) <input type="checkbox"/> (3) OTHER <i>(Specify):</i> _____ _____ _____	Supplied and analyzed by Lexington-Blue Grass Army Depot Activity. See attached TB.	<input checked="" type="checkbox"/> MONTHLY <input type="checkbox"/> QUARTERLY <input type="checkbox"/> OTHER <i>(Specify):</i> _____ _____ _____

13. FACILITIES AND EQUIPMENT (Check where appropriate and attach annotated sketch(es) and description(s).)

- a. LABORATORY FACILITIES, PLANT FACILITIES, FUME HOODS *(Include filtration, if any), ETC.*
- b. STORAGE FACILITIES, CONTAINERS, SPECIAL SHIELDING *(fixed and/or temporary), ETC.*
- c. REMOTE HANDLING TOOLS OR EQUIPMENT, ETC. See Supplement E, TB 385-103.
- d. RESPIRATORY PROTECTIVE EQUIPMENT, ETC.

14. WASTE DISPOSAL

a. NAME OF COMMERCIAL WASTE DISPOSAL SERVICE EMPLOYED
 None.

b. IF COMMERCIAL WASTE DISPOSAL SERVICE IS NOT EMPLOYED, SUBMIT A DETAILED DESCRIPTION OF METHODS WHICH WILL BE USED FOR DISPOSING OF RADIOACTIVE WASTES AND ESTIMATES OF THE TYPE AND AMOUNT OF ACTIVITY INVOLVED. IF THE APPLICATION IS FOR SEALED SOURCES AND DEVICES AND THEY WILL BE RETURNED TO THE MANUFACTURER, SO STATE.

See Supplement E, TB 385-103. Soil Testers will be returned to manufacturer for disposal. See Supplement G, Environmental Statement.

INFORMATION REQUIRED FOR ITEMS 15, 16 AND 17

Describe in detail the information required for items 15, 16 and 17. Begin each item on a separate page and key to the application as follows:

15. **RADIATION PROTECTION PROGRAM.** Describe the radiation protection program as appropriate for the material to be used including the duties and responsibilities of the Radiation Protection Officer, control measures, bioassay procedures (*if needed*), day-to-day general safety instruction to be followed, etc. If the application is for sealed source's also submit leak testing procedures, or if leak testing will be performed using a leak test kit, specify manufacturer and model number of the leak test kit. (See Supplement E, TB 385-103 and Supplement F).
16. **FORMAL TRAINING IN RADIATION SAFETY.** Attach a resume for each individual named in Items 6 and 7. Describe individual's formal training in the following areas where applicable. Include the name of person or institution providing the training, duration of training, when training was received, etc.
 - a. Principles and practices of radiation protection.
 - b. Radioactivity measurement standardization and monitoring techniques and instruments.
 - c. Mathematics and calculations basic to the use and measurement of radioactivity.
 - d. Biological effects of radiation.
17. **EXPERIENCE.** Attach a resume for each individual named in Items 6 and 7. Describe individual's work experience with radiation, including where experience was obtained. Work experience or on-the-job training should be commensurate with the proposed use. Include list of radioisotopes and maximum activity of each used.

18. CERTIFICATE

(This item must be completed by applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 30, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our 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.

a. LICENSE FEE REQUIRED <i>(See Section 170.31, 10 CFR 170)</i>	b. CERTIFYING OFFICIAL <i>R. M. Grnya</i> R.M. GRNYA, Safety Director, GM-14
(1) LICENSE FEE CATEGORY:	c. NAME (Type or print) <i>AMSTA-CZ, X46194</i> ARTHUR HOLMES, JR <i>Arthur Holmes</i> d. TITLE Major General, USA Commanding
(2) LICENSE FEE ENCLOSED: \$	e. DATE JAN 3 1986

SUPPLEMENT A

License Renewal 21-01222-05

1. Reference: Item 6.
2. Individuals who use the tester must successfully complete the training course conducted by the US Army Tank-Automotive Command New Equipment Training Branch, Warren, MI or the U.S. Army Engineers School, Fort Belvoir, VA. Copies of the Program of Instruction for these courses are attached in Supplement A. Trainees receive classroom lectures and "hands on" training in the proper operation, use, and safety of the tester. Trainees must successfully pass a written exam at the end of the class with a minimum score of 75 percent. Trainees will be able to perform, satisfactorily, density and moisture content tests in the field using the nuclear density-moisture tester while observing all necessary safety precautions. Each student is tested in a "hands-on" mode to insure they are aware of all safety precautions and operational procedures. The trainee will then receive a certificate which must be shown to the local Radiation Protection Officer (LRPO) at a unit which has a tester. The LRPO will check the individual in the operation of the tester prior to allowing the individual to use the tester. Replacement personnel to the units having a tester must also prove they have successfully completed the training course and are required to be checked out in the operation of the tester by the LRPO.
3. The duration of the training class taught by the New Equipment Training Branch is sixteen hours. A breakdown of the hours and subjects of training is contained in the Program of Instruction.
4. The breakdown of the training class taught by the US Army Engineer School is as follows: Four hours of specialized classroom lecture are taught which includes two hours of radiation safety principles, one hour concerning transportation, storage, and all emergencies, and one hour concerning wipe test procedures and recordkeeping. The trainees then receive four hours of training in the operation and use of the tester. Finally, the trainees receive a one hour test which covers the lecture material and the operation and use of the tester. The total training class takes nine hours to complete.
5. Instructors for the training class have received their training from either the President of Campbell Pacific Nuclear, Mr. Patrick Campbell, or a certified instructor trained through previously certified instructors at the U.S. Army Tank-Automotive Command New Equipment Training Branch or the U.S. Army Engineer School. All of the instructors will be trained and certified by a certified instructor from the U.S. Army Tank-Automotive Command, New Equipment Training Branch and the U.S. Army Engineer School.

COURSE TITLE: OPERATION/OPERATOR MAINTENANCE
TESTER, DENSITY AND MOISTURE,
NUCLEAR METHOD

DATE: OCTOBER 1985

FROM: U.S. ARMY TANK-AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

ANNEX NO: I

LESSON PLAN: I

LESSON TITLE: WELCOME AND ORIENTATION

TYPE: CONFERENCE

TIME ALLOTTED: ONE HOUR

PERSONNEL REQUIRED: ONE INSTRUCTOR

CLASS PRESENTED TO: SOIL ANALYSTS

REFERENCE: TM 5-6635-386-12&P

TOOLS, EQUIPMENT
AND MATERIALS: NUCLEAR TESTER, HANDOUTS

STUDENT UNIFORM: MILITARY BDUs, CIVILIAN WORK CLOTHES

STUDY ASSIGNMENTS: NONE

I. INTRODUCTION

A. THE INSTRUCTOR WILL EXTEND THIS WELCOME AND THEN PROCEED WITH THE OUTLINE OF PROGRAM OF INSTRUCTION, REGISTRATION, ETC.

B. OBJECTIVE OF COURSE. AT THE END OF THIS COURSE YOU WILL BE ABLE TO:

1. DESCRIBE THE CHARACTERISTICS OF THE TESTER.
2. OPERATE THE TESTER SAFELY.
3. DO MAINTENANCE ON TESTER.
4. KNOW EMERGENCY PROCEDURES.
5. KNOW HOW TO TRANSPORT TESTER.
6. DO ALL SURVEYS AND TEST.
7. KNOW WHO CAN AND WHO CAN'T USE THE TESTER.
8. DETERMINE THE DENSITY AND MOISTURE OF THE SOIL.
9. WHO TO CONTACT IF YOU NEED HELP.
10. TB 385-103

C. PROCEDURES:

1. CLASSROOM CONFERENCE AND DEMONSTRATION
2. ON SITE DEMONSTRATION TAKING MEASUREMENT OF THE SOIL.

D. REVIEW AND CRITIQUE:

1. ANSWER STUDENT QUESTIONS.
2. REVIEW MAIN OBJECTIVE

CONTROL NO. 80958

COURSE TITLE: OPERATION/OPERATOR MAINTENANCE
TESTER, DENSITY AND MOISTURE,
NUCLEAR METHOD

DATE: OCTOBER 1985

FROM: U.S. ARMY TANK-AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

ANNEX NO: II

LESSON PLAN: I

LESSON TITLE: TESTER FAMILIARIZATION

TYPE: CONFERENCE DEMONSTRATION

TIME ALLOTTED: TWO HOURS

PERSONNEL REQUIRED: ONE INSTRUCTOR

CLASS PRESENTED TO: SOIL ANALYSTS

REFERENCE: TM 5-6635-386-12&P, TB 385-103
COURSE PROGRAM OF INSTRUCTION

TOOLS, EQUIPMENT
AND MATERIALS: NUCLEAR TESTER

STUDENT UNIFORM: MILITARY BDUs, CIVILIAN WORK CLOTHES

STUDY ASSIGNMENTS: NONE

I. INTRODUCTION

A. REASONS

1. GENTLEMEN, CURRENTLY AUTHORIZED SOILS TEST EQUIPMENT REQUIRES THE REMOVAL, DRYING AND WEIGHING OF SIZABLE SAMPLES TO DETERMINE DENSITY AND MOISTURE CONTENT. THIS IS A TIME CONSUMING METHOD (UP TO 24 HOURS) AND OFTEN LARGE SEGMENTS OF THE PROJECT MUST BE RECONSTRUCTED BECAUSE OF THE LACK OF CLOSE FOLLOWUP OF CONSTRUCTION WITH MOISTURE DENSITY TESTS. THE TESTER, OF WHICH THE USE OF IS TAUGHT IN THIS COURSE, FILLS THIS NEEDED FOLLOWUP.

2. THIS NUCLEAR MOISTURE AND DENSITY TESTER IS COMMERCIAL IN NATURE. IT IS A SINGLE UNIT DEVICE CONTAINING A PROBE SYSTEM AND ALL NECESSARY ELECTRONIC CIRCUITRY. THE TESTER IS A MANUFACTURER'S MODEL OF A STANDARD PRODUCT WHICH IS PRODUCED AND MARKETED BY HIM. THIS TESTER IS INHERENTLY ACCURATE AND EQUAL TO THE OLDER FORMS OF SOIL MEASUREMENT.

3. THIS COURSE WILL PROVIDE A MINIMUM BACKGROUND IN NUCLEAR PHYSICS. HEALTH AND SAFETY REGULATIONS GOVERNING USE OF RADIOACTIVE MATERIAL WILL BE STRESSED. THE COURSE WILL ALSO PROVIDE AN UNDERSTANDING OF THE TEST METHOD AND PROVIDE INSTRUCTION IN PROPERLY RECORDING INFORMATION ON TEST FORM.

B. OBJECTIVE

TO TEACH THE STUDENTS TO BE ABLE TO:

1. DESCRIBE THE CHARACTERISTICS AND EXPLAIN THE TABULATED DATA OF THE TESTER.

2. LOCATE AND IDENTIFY PERTINENT COMPONENTS AND CONTROLS OF THE TESTER.

3. EXPLAIN THE FUNDAMENTAL NUCLEAR PHYSICS PRINCIPLES, HEALTH AND SAFETY REGULATIONS GOVERNING USE OF RADIOACTIVE MATERIALS USED IN THE TESTER.

C. PROCEDURES

1. THE CONFERENCE WILL COVER THE GENERAL CHARACTERISTICS OF THE TESTER AND THE TABULATED DATA.

2. A DEMONSTRATION WILL FOLLOW DURING WHICH THE LOCATION OF COMPONENTS WILL BE POINTED OUT.

II. EXPLANATION

NOTE: USING OVERHEAD PROJECTOR LIST THE MAIN POINTS OF THE TABULATED DATA CONNECTED WITH TESTER.

A. GENERAL

1. THE TESTER MEASURES DENSITY AND MOISTURE OF CONSTRUCTION MATERIALS USING RADIOACTIVE SOURCES AND INTERNAL ELECTRONICS.

2. MEASUREMENTS CAN INCLUDE THE DETERMINATION OF PERCENT COMPACTION OF SOILS AND OTHER RELATED CONSTRUCTION MATERIALS.

B. TESTER DATA

1. MANUFACTURER: CAMPBELL PACIFIC NUCLEAR CORP.

2. PORTA PROBE MC-I (SIMULTEST).

3. COMPLETE NOMENCLATURE; TESTER, DENSITY AND MOISTURE NUCLEAR METHOD.

4. CAPABILITY OF THE TESTER IS:

- a. DIRECT TRANSMISSION
- b. BACKSCATTER
- c. THERMAL NEUTRON MOISTURE

5. SINGLE UNIT

6. THE TESTER IS WIRED INTERNALLY TO ACT AS THE READ OUT FOR DEPTH MEASURING EQUIPMENT, THUS INCREASING ITS UTILITY.

7. INTERNAL RECHARGEABLE (NICKEL CADMIUM) BATTERY PACK.

8. SCALER SYSTEM

TIMING OPERATION: $\frac{1}{4}$, $\frac{1}{2}$, 1, 2 MINS CIRCUITRY (MODULE TYPE DIGITAL READOUT).

9. TRANSMISSION ROD HAS A LOCKING DEVICE. PERMANENT MARKINGS IN 2 INCH INCREMENTS FROM 2 TO A MAXIMUM OF 8 INCHES.

10. WEIGHT OF TESTER - 32#

11. TESTER USES 10 MC CESIUM 137 AND 50 MC AMERICIUM 241.

C. TESTER FAMILIARIZATION

- 1. SHOW TESTER AND COMPONENTS.

III. REVIEW AND CRITIQUE

A. ANSWER STUDENT QUESTIONS.

B. REVIEW MAIN OBJECTIVES.

- 1. THE CHARACTERISTICS AND DATA OF THE TESTER.
- 2. IDENTIFICATION AND LOCATION OF TESTER COMPONENTS.

C. CLOSING STATEMENT:

GENTLEMEN, THE INFORMATION THAT YOU HAVE RECEIVED DURING THIS PERIOD WILL BE A GREAT ASSET TO YOU DURING THE REMAINDER OF THE COURSE.

COURSE TITLE: OPERATION/OPERATOR MAINTENANCE
TESTER, DENSITY AND MOISTURE,
NUCLEAR METHOD

DATE: OCTOBER 1985

FROM: U.S. ARMY TANK-AUOTMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

ANNEX NO: III

LESSON PLAN: I

LESSON TITLE: GAMMA AND NEUTRON RADIATION, SOURCE
NOMENCLATURE, DOSE CALCULATIONS, TESTER
COST CALCULATIONS, TESTER SOURCES

TYPE: CONFERENCE

TIME ALLOTTED: TWO HOURS

PERSONNEL REQUIRED: ONE INSTRUCTOR

CLASS PRESENTED TO: SOIL ANALYSTS

REFERENCE: COURSE PROGRAM OF INSTRUCTION
TM 5-6635-386-12&P, TB 385-103

TOOLS, EQUIPMENT
AND MATERIALS: NUCLEAR TESTER

STUDENT UNIFORM: MILITARY BDUs, CIVILIAN WORK CLOTHES

STUDY ASSIGNMENTS: NONE

CONTROL NO. 80958

I. INTRODUCTION

A. REASONS

1. WE ARE CONCERNED WITH ONLY THE GAMMA AND NEUTRON RADIATION FOR PURPOSES OF SOIL TESTING.
2. GAMMA RADIATION (CESIUM) IS SUEFUL FOR THE TOTAL MASS MEASUREMENT OF HEAVY MATERIALS AND IS USED TO DETERMINE TOTAL DENSITY OF SOIL.
3. THE MOISTURE CHANNEL IS IN REALITY A "HYDROGEN ANALYZER". IT IS POSSIBLE TO MEASURE WATER ON A CONSTRUCTION SITE BECAUSE THE ONLY FORM OF HYDORGEN WE NORMALLY SEE ON A SOIL SITE IS FREE WATER, THE VERY FEATURE WE ARE TRYING TO MEAUSRE.
4. COURSE CALCULATIONS CAN BE EASILY DONE AND CAN ALSO BE MINIMIZED.

B. OBJECTIVES

TO TEACH THE STUDENT TO BE ABLE TO:

1. UNDERSTAND HOW GAMMA AND NEUTRON RADIATION IS EMPLOYED IN TESTER.
2. MAKE A DOSE CALCULATION.

C. PROCEDURES

THE CONFERENCE WILL COVER PRINCIPLES OF NUCLEAR PHYSICS FOR SOIL MEASUREMENT IN ADDITION TO DOSE CALCULATION.

II. EXPLANATION

A. GENERAL

1. VARIOUS ELEMENTS, BOTH NATURALLY OCCURING (RADIUM) AND REACTOR

PRODUCED (CESIUM AND AMERICIUM) ARE UNSTABLE AND ARE SLOWLY DECAYING TO A MORE STABLE STATE. THE ACT OF DECAY PRODUCES EMISSIONS OF ENERGY UPON DISINTEGRATION OF THE ATOMS. THESE EMISSIONS ARE EITHER GAMMA RAYS OR ARE ACTUAL PARTICLES OF MATERIAL (NEUTRONS FOR EXAMPLE).

2. GAMMA RADIATION OCCURS SPONTANEOUSLY FROM THE CESIUM SOURCE MATERIAL.

3. NEUTRON EMISSION OCCURS WHEN AN ALPHA PARTICLE EMITTER (AMERICIUM) IS MIXED WITH BERYLLIUM POWDER IN A TIGHTLY COMPRESSED PELLET. THE SUFFIX "BE" IS ATTACHED TO THE ALPHA SOURCE NAME TO DENOTE ITS USE AS A NEUTRON SOURCE.

4. THESE EMISSIONS ARE DETECTED BY APPROPRIATE DETECTORS. THE RESULTANT SIGNALS ARE DISPLAYED ELECTRONICALLY AS AN INDEX OF SOIL DENSITY AND MOISTURE.

5. RADIOACTIVITY, BOTH GAMMA (CESIUM) AND NEUTRON (AMERICIUM), MAY BE THOUGHT OF AS BEING SIMILAR TO LIGHT FROM A LIGHT BULB. THE LIGHT RAYS DIMINISH RAPIDLY AS WE MOVE AWAY FROM THE BULB AND THEY HAVE THE ABILITY TO PENETRATE VARIOUS MATERIALS TO SOME DEGREE, RANGING FROM NEARLY COMPLETE PENETRATION (GLASS) TO NEARLY COMPLETE BLOCKAGE (METAL SHIELD).

6. RADIATION OBEYS THE SAME RULES, ALTHOUGH ITS PENETRATION CAPABILITIES ARE GENERALLY MUCH GREATER THAN LIGHT. THE FARTHER WE ARE FROM THE SOURCE, THE SAFER WE ARE AND THE MORE ABSORBING MATERIAL (SHIELDING) WE PLACE BETWEEN OURSELVES AND THE SOURCE, THE SAFER WE ARE. IT IS IMPOSSIBLE TO SHIELD ANY RADIOACTIVE

SOURCES COMPLETELY: HOWEVER, CAREFUL, TESTER DESIGN AND APPROPRIATE CHOICE OF SHIELDING MATERIALS CAN REDUCE THE RADIATION TO AN ACCEPTABLE LEVEL.

B. GAMMA RADIATION

1. GAMMA RADIATION IS ENERGY CAPABLE OF PENETRATION OF SEVERAL INCHES OF MOST MATERIALS. IT IS HIGH ENERGY "LIGHT RAY" ENERGY. IT IS USEFUL FOR THE TOTAL MASS MEASUREMENT OF HEAVY MATERIALS AND IS USED TO DETERMINE TOTAL DENSITY OF SOIL. GAMMA RADIATION IS EMITTED BY A CESIUM SOURCE. CESIUM REQUIRES LESS SHIELDING (0.66 MILLION ELECTRON VOLTS).
2. CESIUM (REACTOR PRODUCED) REQUIRES A LICENSE FOR USE ANYWHERE IN THE U.S. AND IN FOREIGN COUNTRIES.

C. NEUTRON RADIATION

1. NEUTRON RADIATION, AMERICIUM, CONSISTS OF SMALL PARTICLES EMITTED FROM THE SOURCE AT AN AVERAGE ENERGY LEVEL OF APPROXIMATELY 5.0 MEV, THIS IS KNOWN AS "FAST" NEUTRON EMISSION. NEUTRON DETECTORS "SEE" ONLY SLOW, OR "THERMAL" NEUTRONS, THEREFORE, THE FAST NEUTRONS SLOW DOWN BY COLLIDING WITH OTHER OBJECTS MUCH LIKE A RIFLE BULLET BOUNCING FROM ROCK TO ROCK.
2. THE ONLY ATOM WHICH CAN MARKEDLY SLOW DOWN A FAST NEUTRON, AND WHICH WE WOULD LIKELY SEE IN SOIL, IS HYDROGEN. WHEN A FAST NEUTRON HITS A HYDROGEN ATOM THE NEUTRON IS MARKEDLY SLOWED DOWN. A FEW COLLISIONS WITH HYDROGEN ATOMS REDUCES A FAST NEUTRON TO THE SLOW OF "THERMAL" ENERGY AT WHICH THE MOISTURE DETECTORS IN THE SOIL TESTER CAN "SEE" THE SLOW NEUTRON. IT IS POSSIBLE TO

MEASURE WATER ON A CONSTRUCTION SITE BECAUSE THE ONLY FORM OF HYDROGEN WE SEE ON A SOIL SITE IS FREE WATER, THE VERY FEATURE WE ARE TRYING TO MEASURE.

D. SOURCE NOMENCLATURE

1. CERTAIN TERMS ARE USED TO DESCRIBE RADIATION FACTORS IMPORTANT TO US AS USERS AND WE WILL EXPLAIN THEM HERE:

CURIE IS A TERM USED TO DESCRIBE THE SIZE OF A RADIOACTIVE SOURCE. IT TELLS US THAT WE HAVE A QUANTITY OF MATERIAL DISINTEGRATING AT THE RATE OF 3.7×10^{10} DISINTEGRATIONS PER SECOND. THIS IS NOT AN INDEX OF HOW DANGEROUS THE SOURCE MIGHT BE, ONLY AN INDEX OF QUANTITY OF THE MATERIAL IN QUESTION.

2. WE DEAL IN SMALL QUANTITIES OF MATERIAL AND USE ONLY MILLICURIES OF RADIOACTIVE MATERIAL.

3. TO KNOW THE POTENTIAL DANGER OF A SOURCE WE HAVE TO KNOW THE CURIE SIZE, THE TYPE OF MATERIAL, AND TYPE OF EMISSIONS IT IS PRODUCING.

4. ROENTGEN. IS A TERM DESCRIBING THE AMOUNT OF RADIATION ACCUMULATED, OR DOSE, OR EXPOSURE. A ROENTGEN OF RADIATION COULD BE ACCUMULATED BY STANDING NEAR A LARGE RADIOACTIVE, UNSHIELDED SOURCE FOR A SHORT TIME OR NEAR A SMALL, UNSHIELDED SOURCE FOR A LONG TIME.

5. REM. IS A BETTER TERM FOR HUMAN EXPOSURE ACCUMULATION THAN ROENTGEN BECAUSE IT HAS BEEN CORRECTED FOR EFFECTS ON MANKIND. THUS (DOSE EQUIVALENT) SOME RADIATION IS HIGHLY PENETRATING AND WOULD BE MORE POTENTIALLY DANGEROUS THAN OTHER FORMS. WE DEAL IN SMALL AMOUNTS OF RADIATION AND SHALL WORK WITH MILLIREMS.

6. MILLIREM/HOUR (MREM/HR). IS A TERM USED TO DESCRIBE THE "BRIGHTNESS" OF A RADIOACTIVE GAMMA SOURCE. IT IS THE STRENGTH OF THE RADIATION AT THE POINT OF MEASUREMENT. BECAUSE WE DEAL WITH SMALL SOURCES WELL SHIELDED WE WILL BE INVOLVED WITH ONLY MILLIREMS OF RADIATION AND WITH LEVELS WHICH ARE ONLY IN THE MILLIREM/HOUR RANGE.

E. SOIL TESTER SOURCES

1. THE MOST COMMON SOIL TESTER SOURCES ARE: CESIUM 137 FOR GAMMA EMISSION, AMERICUM 241/BE FOR NEUTRON EMISSION.
2. ALL SOURCES ARE SUPPLIED IN A SEALED STAINLESS STEEL CAPSULE DOUBLE ENCAPSULATED AND FURTHER WELDED INTO A STAINLESS STEEL SOURCE ROD (CESIUM) OR LOCATED PER MANENTLY IN THE GAUGE HOUSING (AMERICIUM).
3. SOURCES SHOULD NEVER BE REMOVED FROM THEIR MOUNTINGS AND NO ATTEMPT SHOULD EVER BE MADE TO REPAIR THEM. CONTACT TACOM SAFETY IN THE EVENT OF DAMAGE TO A SOURCE. SEE THE SECTION REGARDING EMERGENCY PROCEDURES IN THE RADIATION PRECAUTION SECTION OF THE TM 5-6635-386-12&P.

F. DOSE CALCULATIONS

1. RADIATION DOSE CALCULATIONS ARE EASILY DONE IF THE OEPRATOR KNOWS THE RADIATION LEVEL IN WHICH HE IS WORKING AND THE TIME OR DURATION OF EXPOSURE. MERELY MULTIPLY THE MREM/HR VALUE TIMES THE DURATION OF EXPOSURE. THE RESULT IS MREM DOSE ACCUMULATED.

2. AN ACCEPTED LEVEL FOR MAXIMUM OCCUPATIONAL ACCUMULATION, BY EDICT OF THE NUCLEAR REGULATORY COMMISSION IS 5.0 REM/YEAR. THIS IS EQUAL TO 100 MREM/WEEK ALLOWING FOR VACATIONS.

3. NORMAL OPERATING PROCEDURES REQUIRE THE USER TO HANDLE THE TESTER FOR APPROXIMATELY 10 SECONDS PER TEST AND A BUSY DAY WOULD NORMALLY RESULT IN APPROXIMATELY 30 TESTS PER DAY BEING TAKEN. THIS WOULD BE 1/400 OF THE ALLOWED DOSAGE. THE TESTER IS SAFE FOR THE INTENDED PURPOSE. THE OPERATOR MUST NOT SET THE TESTER IN HIS LAP, NOR ATTEMPT TO REPAIR THE RADIOACTIVE SOURCE IN ANY FASHION.

NOTE: NEVER EXPOSE THE SOURCE UNNECESSARILY! DO NOT TOUCH THE EXPOSED SOURCE.

G. TESTER DOSE CALCULATIONS

1. THE AVERAGE RADIATION LEVEL AT 2' FROM THE TESTER IS LESS THAN 0.5 MREM/HR.

2. THE AVERAGE LEVEL ON THE SURFACES IS 5 MREM/HR.

3. WE ARE PRIMARILY INTERESTED IN WHOLE BODY DOSE NOT JUST THE FINGERS AND FEET. ACCORDINGLY, THE 2' DISTANCE REPRESENTS THE PROBABLE POSITION OF THE BODY FROM THE TESTER WHEN WE ARE TAKING DENSITY AND MOISTURE READINGS.

4. NORMAL OPERATING PROCEDURES REQUIRE THE OPERATOR TO HANDLE THE TESTER FOR APPROXIMATELY 10 SECONDS PER TEST AND A BUSY DAY MAY REQUIRE 30 TESTS PER DAY. IF AN OPERATOR WORKS AT THE TESTING FOR A FIVE DAY WEEK, HOW MUCH RADIATION WOULD HE ABSORB?

10 SECONDS X 30 TESTS = 300 SECONDS/DAY - 5 MINUTES. 5 MINUTES/DAY
OF CLOSE TESTER CONTACT x 5 DAYS = 25 MINUTES/WEEK - ROUND OFF
TO 1/2 HOUR.

1/2 HOUR X 0.5 MREM/HR = 0.25 MREM ACCUMULATION.

THIS IS ONLY 1/400 THE ALLOWED DOSE!

IT IS APPARENT THAT THE OPERATOR, FOLLOWING THE PRESCRIBED
OPERATING PROCEDURES, WOULD NOT ACCUMULATE ANY EXCESSIVE EXPOSURE.
THE TESTER IS SAFE FOR THE INTENDED PURPOSE.

III. REVIEW AND CRITIQUE

- A. ANSWER STUDENT QUESTIONS.
- B. REVIEW MAIN OBJECTIVES:
 - 1. GAMMA AND NEUTRON RADIOACTIVITY
 - 2. SOURCE NOMENCLATURE
 - 3. DOSE CALCULATIONS.
 - 4. TESTER DOSE CALCULATIONS
 - 5. SOIL TESTER SOURCES

COURSE TITLE: OPERATION/OPERATOR MAINTENANCE
TESTER, DENSITY AND MOISTURE,
NUCLEAR METHOD

DATE: OCTOBER 1985

FROM: U.S. ARMY TANK-AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

ANNEX NO: IV

LESSON PLAN: I

LESSON TITLE: LICENSING, TRANSPORTATION, STORAGE, HEALTH
AND SAFETY CONSIDERATIONS, LEAK TESTS,
EMERGENCIES, SERVICE AND MAINTENANCE

TYPE: CONFERENCE

TIME ALLOTTED: FOUR HOURS

PERSONNEL REQUIRED: ONE INSTRUCTOR

CLASS PRESENTED TO: SOIL ANALYSTS

REFERENCE: TM 5-6635-386-12&P

TOOLS, EQUIPMENT
AND MATERIALS: NUCLEAR TESTER, LEAK TEST KIT

STUDENT UNIFORM: MILITARY BDUs, CIVILIAN WORK CLOTHES

STUDY ASSIGNMENTS: NONE

CONTROL NO. 80958

I. INTRODUCTION

A. REASONS

THIS LESSON PLAN TAKES INTO CONSIDERATION THE NECESSITY OF THE OPERATOR LEARNING ABOUT THE FOLLOWING ITEMS CONNECTED WITH TESTER:

1. LICENSING OF THE TESTER.
2. SHIPPING OR TRANSPORTATION OF THE TESTER.
3. HEALTH AND SAFETY CONSIDERATIONS
4. LEAK TESTING OF TESTER
5. EMERGENCIES AND MAINTENANCE

B. OBJECTIVE

TO TEACH THE STUDENT TO BE ABLE TO:

1. UNDERSTAND IMPORTANCE OF LICENSE FOR THE TESTER.
2. UNDERSTAND LICENSE FOR THE TESTERS USED BY U.S. ARMY PERSONNEL FALLS UNDER LICENSE HELD BY THE U.S. ARMY TANK-AUTOMOTIVE COMMAND.
3. UNDERSTAND CONTENT OF THE LICENSE FOR TESTER AND THE NECESSITY FOR STRICT ADHERENCE TO THE CONDITIONS CONTAINED IN THE LICENSE.
4. UNDERSTAND THAT THE LOCAL RADIATION PROTECTION OFFICER IS RESPONSIBLE FOR THE GENERAL ADHERENCE TO THE LICENSE.
5. UNDERSTAND TRANSPORTATION REGULATIONS.
6. UNDERSTAND TWO MAJOR CONSIDERATIONS AS TO HEALTH AND SAFETY.
7. BE ABLE TO PERFORM LEAK TEST.
8. UNDERSTAND WHAT TO DO IN THE EVENT OF AN EMERGENCY.

II. EXPLANATION

A. GENERAL

RADIOACTIVE MATERIAL CAN ONLY BE TRANSFERRED TO OTHERS IF THE OTHER PARTY IS APPROPRIATELY LICENSED TO RECEIVE AND POSSESS OR USE THE MATERIAL. A TRANSFER MUST FIRST BE APPROVED BY THE TACOM NICP ITEM MANAGER BEFORE THE TRANSFER CAN BE ACCOMPLISHED.

B. LICENSES

1. THE PRIMARY LICENSING AGENCY IN THE U.S. IS THE NUCLEAR REGULATORY COMMISSION WHICH HAS JURISDICTION OVER REACTOR PRODUCED ISOTOPES.
2. THE LICENSE TO PURCHASE, USE AND STORE THIS TESTER IS HELD BY THE U.S. ARMY TANK-AUTOMOTIVE COMMAND. IT SPELLS OUT THE CONDITIONS UNDER WHICH THE SOURCES CAN BE USED FOR THE MEASUREMENT OF MOISTURE AND DENSITY OF CONSTRUCTION MATERIALS.
3. THE LICENSE SPELLS OUT THE CONDITIONS UNDER WHICH THE TESTER CAN BE USED AND STRICTLY LIMITS THE USER.
4. IT IS ESSENTIAL THAT THE OPERATOR READ AND UNDERSTAND THE LICENSE UNDER WHICH HE PROPOSES TO USE THE TESTER.
5. THE LICENSE DICTATES THE USE OF MATERIALS AND THIS MUST NOT VARY. YOUR LICENSE WILL STIPULATE THAT THE MATERIAL IS TO BE USED FOR THE MEASUREMENT OF MOISTURE AND DENSITY OF CONSTRUCTION MATERIALS, IT CANNOT BE USED FOR OTHER PURPOSES. AN ATTEMPT TO X-RAY AN OBJECT WITH THE TESTER MIGHT BE MODERATELY SUCCESSFUL, BUT IT IS ILLEGAL. THE LICENSE MUST BE FOLLOWED TO THE LETTER.

6. THE LICENSE WILL REQUIRE THAT ONE PERSON BE DESIGNATED AS THE LOCAL RADIATION PROTECTION OFFICER (LRPO). HE IS RESPONSIBLE FOR THE GENERAL ADHERENCE TO THE LICENSE, AND IS THE PERSON WHO SHOULD BE CONTACTED IMMEDIATELY IN THE EVENT OF AN EMERGENCY.

C. TRANSPORTATION

1. THE U.S. GOVERNMENT D.O.T. REGULATIONS CONTROL THE TRANSPORTATION OF RADIOACTIVE MATERIALS ON PUBLIC ACCESSWAYS. ALL TESTERS ARE IN TYPE 7A SHIPPING AND STORAGE CONTAINERS AND HAVE D.O.T. YELLOW LABEL II'S. YELLOW LABEL II'S MEAN THE OUTSIDE OF THE CONTAINER HAS LESS THAN 50 MREM/HR ON ANY SURFACE AND LESS THAN 1.0 MREM/HR AT 1 METER FROM ANY SURFACE. UNDER THESE CONDITIONS NO PLACARDING OF THE VEHICLE IS REQUIRED. THE CASE MUST BE LOCKED DURING TRANSPORTATION TO PREVENT UNAUTHORIZED ENTRY INTO CASE. ANYONE CAN TRANSPORT THE TESTER, HOWEVER, ONLY PROPERLY TRAINED AND LICENSED OPERATORS CAN USE THE TESTER WHEN TRANSPORTED ON COMMERCIAL CARRIERS, A "SHIPPER'S CERTIFICATION FOR RADIOACTIVE MATERIALS" FORM SHOULD BE AFFIXED TO THE OUTSIDE OF THE CASE.

2. THE TESTER CANNOT BE TRANSPORTED ON COMMERCIAL PASSENGER AIRCRAFT.

3. YOUR VEHICLE SHOULD ALWAYS BE LOCKED WHEN THE TESTER IS STORED THEREIN, AND THE TESTER SHOULD BE SECURELY FASTENED DOWN TO THE BED IN AN OPEN PICKUP TRUCK.

D. STORAGE

WHEN STORED, THE TESTER SHALL BE STORED IN ITS SHIPPING CASE IN A LOCKED AREA WITH KEY ACCESS ONLY BY THE LICENSED OPERATORS AND LRPO. POST A PERMANENT CAUTION - RADIOACTIVE MATERIAL SIGN ON THE STORAGE AREA DOOR. RECOMMEND THAT THE LOCAL FIRE DEPARTMENT BE CALLED IN FOR A REVIEW OF THE STORAGE LOCATION AND TOLD OF THE NATURE OF THE DEVICE STORED THEREIN.

E. HEALTH AND SAFETY CONSIDERATION

1. TWO MAJOR CONSIDERATIONS ARE PROTECTION OF THE OPERATOR AND PROTECTION OF THE GENERAL PUBLIC.
2. PROTECTION OF THE OPERATOR IS ACHIEVED THROUGH ADHERENCE TO THE MANUFACTURER'S INSTRUCTIONS, AND SUCCESSFUL COMPLETION OF THE OPERATOR'S TRAINING COURSE.
3. PROTECTION OF THE GENERAL PUBLIC IS ACHIEVED THROUGH THE PREVIOUSLY MENTIONED PROTECTION FOR THE OPERATOR COMBINED WITH RESTRICTION TO ACCESS TO THE DEVICE BY UNTRAINED AND UNINFORMED INDIVIDUALS. THE RESPONSIBILITY FOR THIS LIES PRIMARILY WITH THE LICENSED OPERATORS WHO KEEP THE TESTER SAFELY AWAY FROM UNAUTHORIZED PEOPLE.
4. THE OPERATORS ARE REQUIRED TO WEAR BETA-GAMMA FILM BADGES. THEY RECORD THE BETA-GAMMA ABSORPTION OF THE USER WITH EXCELLENT ACCURACY. A NEUTRON FILM BADGE IS NOT REQUIRED TO BE WORN.

F. LEAK TESTING

1. THE LICENSE REGULATIONS REQUIRE THAT ALL SEALED SOURCES BE "LEAK TESTED" OCCASIONALLY TO INSURE THAT THE RADIOACTIVE MATERIAL IS ALL SECURE IN THE SOURCE AND NONE HAS LEAKED OUT.

2. THE LEAK TEST WILL BE CONDUCTED AT INTERVALS NOT TO EXCEED SIX MONTHS. THE TEST SAMPLE SHALL BE TAKEN FROM THE SURFACES OF THE TESTER IN WHICH THE SEALED SOURCE IS PRESENTLY MOUNTED. RECORD OF LEAK TEST RESULTS SHALL BE KEPT IN UNITS OF MICRO-CURIES AND MAINTAINED FOR INSPECTION.
3. SHOW TWO AREAS WHERE LEAK TEST IS TAKEN.

G. EMERGENCIES

1. THE OPERATOR SHOULD ATTEMPT TO PREVENT EXPOSURE TO HIMSELF AND TO OTHERS AND MUST INSURE THAT THE RADIOACTIVE MATERIALS DO NOT ESCAPE THE CAPSULE AND CONTAMINATE THE AREA.
2. IN THE EVENT OF TESTER DAMAGE PROTECT PEOPLE, KEEP THEM AWAY, KEEP THEM OUT OF THE IMMEDIATE AREA UNTIL YOU ARE CERTAIN EVERYTHING IS ALL RIGHT.
3. PROTECT THE TESTER FROM FURTHER DAMAGE. GET IT BACK TO ITS STORAGE AREA WHEN YOU ARE CERTAIN IT IS MOVEABLE.
4. PROTECT THE SURROUNDING AREA FROM CONTAMINATION.
5. CALL FOR HELP FROM YOUR LRPO WHO SHOULD IMMEDIATELY CONTACT THE TACOM SAFETY OFFICE.
6. A DECISION POINT MAY BE EXERCISED IF:
 - a. THE TESTER IS DAMAGED BUT IS INTACT AND THE SOURCES ARE IN PLACE AND NOT DAMAGED (DROPPED, MINOR RUNOVER, FLOOD).
 - b. THE TESTER IS DAMAGED, IS TORN OPEN OR IS NOT IN A CONDITION TO DETERMINE SOURCE INTEGRITY (FIRE, MAJOR RUNOVER, BURIED).

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7. IN THE EVENT OF PARAGRAPH 6a:

THE OPERATOR SHOULD CLOSE THE SHUTTER IF POSSIBLE, PLACE THE TESTER IN ITS SHIPPING CASE, PLACE THE CASE IN THE STORAGE LOCATION AND CALL THE TACOM SAFETY OFFICE.

8. IN THE EVENT OF PARAGRAPH 6b:

THE OPERATOR SHOULD FREEZE THE SITE, STOP THE VEHICLE IF INVOLVED, GET THE DRIVER OUT OF THE VEHICLE, ROPE OFF THE AREA AROUND THE SITE, KEEP PEOPLE FROM WALKING THROUGH THE SITE, AND SHOULD CALL THE TACOM SAFETY OFFICE FOR HELP. JUST KEEP PEOPLE OUT OF THE DAMAGE AREA UNTIL IT IS CLEARED BY THE LRPO.

9. FIRE:

IN THE CASE OF DAMAGE TO THE TESTER BY FIRE NOTIFY ALL PERSONS WHO ARE IN THE AREA BUT NOT DIRECTLY INVOLVED WITH THE INCIDENT TO CLEAR THE AREA. NOTIFY THE FIRE FIGHTERS AND OTHER EMERGENCY PERSONNEL AS REQUIRED. ATTEMPT TO EXTINGUISH FIRES USING AVAILABLE FIRST-AID TYPE EXTINGUISHER. EFFORTS SHOULD BE MADE TO PREVENT WATER OR FIRE FIGHTING EQUIPMENT CHEMICALS FROM COMING IN CONTACT WITH THE RADIOACTIVE SOURCE. NOTIFY LRPO.

H. SERVICE AND MAINTENANCE

1. THE TESTER IS FIELD SERVICEABLE WITHOUT REMOVING THE SOURCE.
2. BATTERY ASSEMBLIES CAN BE REMOVED WITH SIMPLE SCREWDRIVERS.
3. OPERATORS CAN ALSO REPLACE THE FUSE ON THE BATTERY ASSEMBLY.
4. RECOMMEND NO OTHER MECHANICAL SERVICE OTHER THAN THE AUTHORIZED CLEANING OF THE SHUTTER. IF SHUTTER IS DAMAGED OR JAMMED CONTACT THE TACOM SAFETY OFFICE.

III. REVIEW AND CRITIQUE

A. ANSWER STUDENT QUESTIONS

B. REVIEW MAIN OBJECTIVES:

1. LICENSE FOR THE TESTER
2. TRANSPORTATION REGULATIONS AND THE TESTER
3. HEALTH AND SAFETY IN CONNECTION WITH USING TESTER
4. LEAK TESTING OF THE TESTER
5. EMERGENCY PRECAUTIONS AND THE TESTER

COURSE TITLE: OPERATION/OPERATOR MAINTENANCE
TESTER, DENSITY AND MOISTURE,
NUCLEAR METHOD

DATE: OCTOBER 1985

FROM: U.S. ARMY TANK-AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

ANNEX NO: V

LESSON PLAN: I

LESSON TITLE: MEASURING OR TAKING A TEST: DETERMINING
DENSITY AND MOISTURE FROM CALIBRATION
CHARTS; DETERMINE DRY WEIGHT; COMPUTE
PERCENT COMPACTION; COMPUTE PERCENT
MOISTURE. WORK SHEET PREPARATION

TYPE: CONFERENCE AND DEMONSTRATION

TIME ALLOTTED: FOUR HOURS

PERSONNEL REQUIRED: ONE INSTRUCTOR

CLASS PRESENTED TO: SOIL ANALYSTS

REFERENCE: TM 5-6635-386-12&P

TOOLS, EQUIPMENT
AND MATERIAL: NUCLEAR TESTER, CALCULATOR

STUDENT UNIFORM: MILITARY BDUs, CIVILIAN WORK CLOTHES

STUDY ASSIGNMENTS: NONE

I. INTRODUCTION

A. REASONS

1. THE FOLLOWING OPERATIONS ARE REQUIRED TO TAKE A FIELD TEST; TAKE A STANDARD COUNT; PREPARE THE SITE; TAKE A READING ON THE SITE; DETERMINE THE MOISTURE AND DENSITY FROM THE CALIBRATION CHARTS; COMPUTE PER CENT COMPACTION.
2. YOU AS A SOILS ANALYST WILL HAVE TO BE ABLE TO GO THROUGH THIS SEQUENCE OF OPERATIONS.

B. OBJECTIVES

TO TEACH THE STUDENTS TO BE ABLE TO:

1. KNOW THE DIFFERENCE BETWEEN MANUAL AND AUTOMATIC STANDARD COUNTS.
2. MEASURE OR TAKE A STANDARD TEST & FIELD COUNT.
3. COMPUTE A PER CENT COMPACTION
4. STORE THE TESTER AWAY

II. APPLICATION

A. STANDARD COUNT

1. AS WITH ANY MEASUREMENT TOOL, IT IS NECESSARY TO CHECK THE TESTER AGAINST A REFERENCE STANDARD PERIODICALLY TO INSURE CONTINUED ACCURATE OPERATION.
2. THIS IS ACHIEVED WITH THE TESTER BY THE TAKING OF A STANDARD COUNT. VARIATIONS IN TESTER PERFORMANCE WILL AFFECT THE STANDARD COUNT IN THE SAME PROPORTION AS THEY WILL AFFECT THE FIELD COUNT.

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3. THE FINAL DENSITY COUNT OR MOISTURE COUNT IS OBTAINED BY DIVIDING THE FIELD COUNT BY THE STANDARD COUNT TO OBTAIN A RATIO. THE RATIO IS REFERRED TO THE CALIBRATION CHARTS.

4. SHOULD VARIATIONS IN TESTER PERFORMANCE OCCUR, THESE VARIATIONS WILL AFFECT BOTH THE FIELD AND STANDARD COUNTS PROPORTIONATELY, THUS THE FINAL RATIO REMAINS CONSTANT AND THE TESTER REMAINS ACCURATE.

5. THERE ARE TWO METHODS OF TAKING A STANDARD COUNT. BOTH USE THE SAME MECHANICAL SETUP. THEY DIFFER ONLY IN THE METHOD OF ACCUMULATING THE FINAL STANDARD COUNT RESULT. THE AUTOMATIC METHOD IS USED FOR ROUTINE DAILY STANDARD COUNT. THE MANUAL METHOD IS USED FOR PERIODIC TESTER EVALUATION.

B. AUTOMATIC STANDARD COUNT

PRESS LOCK AND STANDARD SIMULTANEOUSLY AND THE TESTER WILL ERASE ALL FOUR MEMORIES AND INITIATE A FOUR MINUTE COUNT INTO ALL FOUR MEMORIES. THIS PROVIDES A CHECK ON THE PERFORMANCE OF THE MEMORIES. AT THE END OF THE FOUR MINUTE COUNT, THE STANDARD COUNT WILL BE IN THE D-STANDARD AND M-STANDARD MEMORIES.

C. TO TAKE A MANUAL STANDARD COUNT

1. STAND THE SHIPPING CASE ON END AND PLACE THE REFERENCE STANDARD ACROSS THE PROTECTIVE STRIPS ON THE CASE. THREE BUTTONS ON THE REFERENCE STANDARD FIT INTO ACCOMMODATING DEPRESSIONS IN THE BOTTOM OF THE TESTER.

2. PLACE THE SOURCE ROD IN SAFE POSITION AND BE SURE THE TESTER IS AT LEAST FIVE FEET FROM NEARBY OBJECTS.
3. SUCCESSIVELY ACCUMULATE TEN $1/4$ MINUTE COUNTS
4. ADD THESE UP, TAKE AN AVERAGE, DETERMINE THE SQUARE ROOT OF THE AVERAGE AND THEN ADD AND SUBTRACT THIS SQUARE ROOT TO THE AVERAGE. THE RESULTANT HIGH AND LOW LIMITS WILL INCLUDE 68% OF THE NUMBERS IN THE SERIES AND 32% WILL BE HIGHER OR LOWER THAN THE LIMITS.

D. FILL OUT STUDENT WORKSHEET AS FOLLOWS

1. ENTER STANDARDS FOR WET STANDARD AND DENSITY STANDARDS IN APPROPRIATE BLOCKS AT TOP OF STUDENT WORKSHEET. STANDARD IS PREDETERMINED.
2. DETERMINE DENSITY COUNT. ENTER COUNT IN BLOCK 3 FOR FIELD TEST.
3. DIVIDE DENSITY COUNT BY STANDARD DENSITY TO DERIVE DENSITY COUNT RATIO.
4. WITH CHART WHICH IS SUPPLIED WITH TESTER FIND WET DENSITY, ENTER IN BLOCK 4.
5. DIVIDE BLOCK 5 BY BLOCK 1.
6. DETERMINE WATER COUNT, ENTER IN BLOCK 5
7. DIVIDE WET COUNT BY WET STANDARD TO GET WET COUNT RATIO, ENTER AMOUNT.
8. FROM CHART DETERMINE WET PCF (WET POUNDS CUBIC FOOT).
9. SUBTRACT BLOCK 6 FROM BLOCK 4, MAKE THE ENTRY.

10. FOR PERCENTAGE OF WATER DIVIDE BLOCK 7 INTO BLOCK 6
AND MULTIPLY BY 100.

11. TAKE CORRECTIVE ACITONS IF REQUIRED.

E. COMPLETION OF TEST

UPON COMPLETION OF THE TEST IT IS ONLY NECESSARY TO STORE THE
TESTER. REMOVE THE BATTERIES FROM THE TESTER PRIOR TO STORING
THE TESTER IN THE CASE IF THE TESTER WILL NOT BE USED IN MORE
THAN ONE WEEK.

III. REVIEW AND CRITIQUE

A. ANSWER STUDENT QUESTIONS.

B. REVIEW MAIN OBJECTIVE

1. HOW TO MEASURE OR TAKE TEST

2. STORAGE OF TESTER

COURSE TITLE: OPERATION/OPERATOR MAINTENANCE
TESTER, DENSITY AND MOISTURE,
NUCLEAR METHOD

DATE: OCTOBER 1985

FROM: U.S. ARMY TANK-AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

ANNEX NO: VI

LESSON PLAN: I

LESSON TITLE: REVIEW, TEST, GRADUATION

TYPE: CONFERENCE

TIME ALLOTTED: TWO HOURS

PERSONNEL REQUIRED: ONE INSTRUCTOR

CLASS PRESENTED TO: SOIL ANALYSTS

REFERENCE: TM 5-6635-386-12&P

TOOLS, EQUIPMENT
AND MATERIALS: NONE

STUDENT UNIFORM: MILITARY BDUs, CIVILIAN WORK CLOTHES

STUDY ASSIGNMENTS: NONE

CONTROL NO. 80958

I. REVIEW

- A. REVIEW ALL MATERIAL AND INFORMATION THAT WAS PUT OUT IN CLASS.
- B. ANSWER ALL QUESTIONS THAT THE STUDENTS HAVE.

II. TEST

- A. GIVE TEST
- B. GRADE TEST; PASSING GRADE IS 75%
- C. PEOPLE WHO DON'T SCORE 75% DON'T RECEIVE A CERTIFICATE.

III. GRADUATION

- A. PASS OUT CERTIFICATE OF TRAINING
- B. END CLASS

LESSON PLAN

FIELD DENSITY II



AUGUST 1985

51G10-B-020-070

US ARMY ENGINEER SCHOOL - FORT BELVOIR, VIRGINIA

STOCK NUMBER: _____

LESSON OUTLINE

LESSON: FIELD DENSITY II

TIME	SUBJECT MATTER OUTLINE	INSTRUCTIONAL TACTICS
00:00	<p><u>INTRODUCTION</u></p> <p>During a previous class on field density we discussed how to determine density using the sand cone apparatus, this method is time consuming and must be planned in advance to minimize a hold-up in earthwork while quality control is done. As a result Project officer's and NCO's are reluctant to delay work in the interest of quality control.</p> <p>Up to now we have been working and adjusting soils to optimize their usefulness as construction materials, the Nuclear Densometer now allows us to maximize the effectiveness of our time to do our jobs better. Fast and accurate measurements allow us a much greater role in the quality control aspects of construction projects.</p> <p>During this period you will learn radiation protection and safety, transportation, storage and emergency procedures, leak/wipe testing and proper record keeping, and operation of the guage.</p>	
00:01	<p><u>DEVELOPMENT</u></p> <p>1. Video presentation</p>	<p>Show video tape: "Introduction to the Nuclear Moisture/Density Guage"</p>
00:25	<p>2. Video presentation</p>	<p>Show video tape: "Taking a Measurement with the Nuclear Moisture/Density Guage"</p>
<p>Break at instructor's discretion</p>		

TIME	LESSON OUTLINE	INSTRUCTIONAL TACTICS
03:00	<p>4. Transportation, Storage, and Emergency Procedures</p> <p>a. Transportation</p> <p>b. Storage</p> <p>c. Emergency Procedures</p>	<p>Discuss proper labeling of radioactive material containers.</p> <p>Discuss transportation regulations to include: types of carriers; proper labeling of containers.</p> <p>Discuss use of "Letter of Instruction" covering transportation of gauge in vehicles.</p> <p>Discuss use of survey equipment (i.e. AN/PDR-27) to perform storage room surveys.</p> <p>Explain limits of radiation levels both inside and outside of storage areas for unoccupied and occupied areas.</p> <p>Discuss importance of protecting human life first, destruction of property due to a radiation incident secondly.</p> <p>Discuss first action the clearly define the "decision point" and actions that follow.</p> <p>Discuss disposition of tester, note importance of proper handling of radioactive materials as a "Birth to Death" tracking of radioactive materials.</p>
		Break at instructor's discretion
04:00	<p>5. Leak/Wipe Testing and Proper Record Keeping</p> <p>a. Leak/Wipe Test</p>	<p>Demonstrate visually to students the proper way to perform leak/wipe tests. Show two sources and their locations. Explain that test is performed by LRPO once every six months with soapy water and a cotton swab. (AN/PDR-27 radiacmeter readings should be taken on swabs before mailing in.)</p>

TIME	LESSON OUTLINE	INSTRUCTIONAL TACTICS
	b. Proper Record Keeping	Discuss reasons why we need to keep a good, accurate record of the usage of the MC-1. (Good ex. of a User Log is on pg.51 in the workbook.) Minimum of information maintained should be the two std. counts and User's name.
		Break at instructor's discretion
05:00	<p>6. Operation of the Gauge</p> <p>a. Familiarize functions of key board</p> <p>b. Identify Components of the CPN Mdl MC-1 gauge</p>	<p>Discuss functions of each key and emphasize the prevention of accidental activation of tester by use of the clear key. Operator has little time once a testing sequence has started, the clear key is the surest way to prevent accidental exposure.</p> <p>Discuss deletion of D-only and M-only keys.</p> <p>Discuss each component.</p> <p>Explain proper usage and maintenance.</p> <p>Discuss reference standard and associated calibration charts or graphs.</p> <p>Demonstrate use of charts and graphs for BS, AC, 2", 4", 6", 8", and moisture content functions.</p> <p>Discuss importance of keeping reference standard and associated charts or graph together as a team. (Use from gauge to gauge is okay as long as they are used together.)</p>
		Break at instructor's discretion
06:00	c. Determine standard counts	<p>Discuss difference between manual and automatic standard counts.</p> <p>Explain importance of manual standard counts and use of standard deviation to evaluate accuracy of the gauge.</p>

TIME	LESSON OUTLINE	INSTRUCTIONAL TACTICS
		<p>Explain what poor results mean.</p> <p>Discuss use of automatic standard counts for daily testing.</p> <p>Instructor will demonstrate manual standard count and will determine percent of standard deviation with class.</p>
		<p>Break at instructor's discretion</p>
07:00	<p>d. Testing procedures for Backscatter and Asphaltic Concrete</p>	<p>Explain surface preparation, roughness error, and trenchwall effect.</p> <p>Demonstrate tester use by performing series of tests on classroom floor.</p> <p>Determine results of tests with class</p>
	<p>e. Testing procedures for direct transmission</p>	<p>Demonstrate proper use of guideplate and drill pin for site preparation.</p> <p>Perform a series of tests at different depths and have class calculate results</p> <p>Discuss use of results to determine corrective actions if necessary.</p>
		<p>Break at instructor's discretion</p>
08:00	<p>7. Practical exercise</p>	<p>Transport students and instructors to field site for hands-on familiarization</p> <p>Perform BS; AC, and direct transmission measurements.</p> <p>Give students compaction specification and direct them to determine if test area is within specifications or are corrective actions necessary.</p>
		<p>Break at instructor's discretion</p>

TIME	LESSON OUTLINE	INSTRUCTIONAL TACTICS
11:00	8. Written Examination	Administer the written examination to students for licsening as nuclear densometer operators. Students must acheive a 75% score to be licensed as operators. Additionally, they must pass a hands-on test administered during end-of-course stakes.

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ORIENTATION SHEET
Materials Quality Specialist Course

<u>SEGMENT</u>	<u>BLOCKS</u>	<u>LESSON</u>
Geology		
SOILS	Soils Engineering I Soils Engineering II SOILS ENGINEERING III	Theory of compaction Compaction lab California Bearing Ratio CBR Lab Field Density I Soils Stabilization FIELD DENSITY II
Concrete Flexible Pavements Field Training Exercise MQSC Stakes		

18 NOV 1985

AMSTA-MBS

SUBJECT: Interim Change TM 5-6635-386-12&P

HQDA (DAAG-PAP)
Alexandria, VA 22331-0302

1. In accordance with provisions of Paragraph 1-15 C. (3) AR 310-3, enclosed for printing, is the Camera Ready Copy of Interim Change to TM 5-6635-386-12&P pertaining to Operator's and Organizational Maintenance Manual for Tester, Density and Moisture (Soil and Asphalt) Nuclear Method Campbell Pacific Model MC-1 (CCE) (NSN 6635-01-030-6896).
2. Interim change falls within the area of Paragraph 1-15 a. (2) (a) of AR 310-3 and has been coordinated with the Publications Control Officer in this Directorate.
3. Distribution of printed copies should be made in accordance with DA Form 12-34C requirements for TB Engineer Series.
4. Point of Contact at this command in the Maintenance Directorate is Mr. George G. Pulido, Jr., AMSTA-MBS, AV 786-7411.

Encl

R. B. PAOLETTI
Acting Dep Dir of Maint (NMP)

CF:

AMSTA-MBS _____

AMSTA-MB _____

AMSTA-MBP _____

AMSTA-MVC _____

✓ AMSTA-CZ _____

Headquarters
Department of the Army
Washington, DC

TM 5-6635-386-12 & P
Interim Change No.

MC-1 (CCE) Series TM 5-
Tester, Density and Moisture, Nuclear Method

Justification. This interim change includes a change in Operator Procedure to eliminate an unsafe condition that could result in death or injury to personnel due to illustration of an unsafe testing procedure using a Nuclear Source of Energy.

Expiration. This interim change expires two years from date of publication and will be destroyed at that time unless sooner rescinded or superceded by a permanent change.

1. TM 5-6635-386-12 & P, 10 September 1985, is changed as follows:

Page a, second to the last paragraph. The line reads "the tester operator shall not carry the tester except by its carrying handle". The line should read that "the tester shall be carried by its carrying handle in the safe position".

Page 1-17 Figure 1-7. Delete.

Page 1-17 Under "Note" delete procedural steps 1 through 4 and substitute new steps 1 through 8 as follows:

POSITIONING SOURCE IN PREPARED HOLE

1. Place tester on prepared site so that the source tube hole is positioned reasonably close to the hole in the surface to be tested.
2. Standing slightly behind the tester with your feet placed comfortably apart, flex your knees and bend your body slightly forward above the waist.
3. Brace your right elbow on your right knee, placing the fingers of your right hand under the cast lip of the tester.
4. Put your left hand on the source tube handle.
5. Allowing the left edge of the tester to remain in contact with the surface, lift the right edge of the tester two to four inches above the surface.