Arctic Alaska Testing Laboratories

Testing
Chemical
Material
Inspection
Exploration

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March 19, 1985

Nuclear Regulatory Commission
1450 Maria Lane, Suite 210
Walnut Creek, California 94596

Attention: Beth Redlinger

Gentlemen:

We are requesting our license (#50-23204-01) be amended to allow Randall K. Fletcher, our Lab Supervisor, to teach a Nuclear Moisture Density Gauge course. The course will be given to employees of this firm on an "as needed" basis, probably twice a year. Teaching the course "in house" will be more convenient for us since the State of Alaska DOT course is only offered once a year at a time that conflicts with our work schedule. In addition, we have need of at least a second course annually, due to seasonal personnel turnover.

Enclosed is the proposed course outline, instructor qualifications, written test, "hands on" test, and a check for sixty dollars to cover the fee.

Any suggestions you may have regarding the course, or to improve its contents, will be welcome.

Sincerely,

ARCTIC ALASKA TESTING LABORATORIES
A division of SHANNON & WILSON, INC.

By Rohn D. Abbott
Rohn D. Abbott, P.E.
Vice President and Manager

RDA:mkb

FINAL TEST WRITTEN PORTION

1. Name the three ways to minimize exposure to radiation.

   (1) Time (2) Distance (3) Shielding

2. What two devices are used for personnel radiation monitoring?

   (1) Film Badge (2) Dosimeter

3. When transporting a gauge in an automobile, what is the minimum distance it must be kept from yourself or passengers?

   3 feet

4. If loss, theft or damage should occur, and the radiation protection officer cannot be reached, what two agencies must be notified?

   State Department of Health and Social Services and NRC at Walnut Creek California

5. What position should the power/time switch be set at to do a standard count?

   Slow

6. How many radioactive sources are found in Troxler 3400 series gauges?

   Two

7. Where are the above sources located in the gauge?

   In the source rod, and in the center of the gauge base

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8. What are the names of the radioactive sources used in Troxler 3400 series moisture/density gauges?

   Cesium-137 and Americium 24±: Beryllium

9. Which of the sources from question eight (8) is located in the base of the gauge?

   Americium 241: Berrylium

10. What is the maximum amount of radiation a person can accumulate per calendar quarter according to NRC regulations?

    1250 Millirems

11. Under average conditions, how much radiation can a person expect to receive per calendar quarter operating a 3400 series gauge?

    50 Millirems

12. Should the gauge be damaged, and there is any reason to suspect a source capsule may be leaking, what action should you take?

    Cordon off area around gauge for distance of 100 feet if possible, and stay on the site to warn people to stay away, notify radiation protection officer or local authorities and NRC

13. Are you authorized to remove the source rod to perform maintenance?

    No

14. When doing a leak test you must wipe around the source rod cavity and the:

    a. Gauge Base
    b. Printed Circuit Board

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* c. Yellow and magenta label in center of gauge base

d. Detector tubes

15. What are the four particles escape the source containers given off by nuclear gauges?

Alpha, Beta, Gamma, Neutron

16. Which of the above four types of radioactive particles given off by nuclear gauges?

Gamma and Neutron

17. In Troxler 3400 series gauges, what material is the gamma source shielding made of?

Tungsten

18. If the dose rate one foot from a source is twenty MREM/hour, what is the dose rate at two feet?

5 MREM/hr

19. What is the half life of the Cesium source used in Troxler gauges?

30 Years

20. Where are protons found in the atom?

Nucleus

21. The helium -3 tube will detect what type of neutron?

Thermalized or slowed neutron

22. The depth at which the gauge measures moisture is constant.

_____ True
__X__ False

23. Who in our organization is responsible for maintaining the files, regulations and safety information regarding nuclear gauges?

Radiation Protection Officer

24. What is the unit of measure used by the government in settling limits of exposure to radiation?

REM

25. What atomic particle does a gamma photon collide with that effects the density measurement?

Electron

26. What element effects the moisture measurement?

Hydrogen

27. Where should the source rod be when taking a standard count?

Safe or storage position

28. Which of the two sources found in a 3400 series gauge is used to measure density?

Cesium-137

29. What percentage of shift in the density standard count, as compared to an average of the previous four counts would indicate an abnormality in gauge operation?

1% or more

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30. How much further than the depth of measurement should the drill pin be driven into the soil?

2 inches

31. Which of the below values are valid for an asphalt measurement?

* a. Wet density
b. Dry density
c. Moisture content
d. None of the above

32. What must be done extra carefully when using the backscatter mode?

Standard Count, Depth Selection, Surface preparation, Battery Charge

33. If the battery alarm is showing, how long must the machine stay on the charger to reach full charge?

14 hours

34. When cleaning the sliding shield assembly, the source rod should be in what position?

Safe or storage

35. What types of lubricants should never be used on the sliding block or scraper ring?

Oil or grease based lubricants

36. In order to insure the gauge is functioning correctly, and for security reasons, you should sit directly in front of the gauge, and watch the counts accumulate when taking a measurement.

_____ True
_X_ False

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37. When determining side wall reflection correction for a trench measurement you should obtain a daily standard count, enter the trench, place the gauge on the standard block, and press what key or keys to obtain the count that determines the correction?

Measure

38. What value moisture or density is being corrected in the above procedure?

Moisture

39. When taking a test how is the depth at which it is taken determined?

Lift thickness

40. When using a 2400 series instrument, does it matter whether you test density or moisture first?

No

41. What percentage of drift is acceptable in the moisture standard count as compared to an average of the previous four counts?

2%

42. A density count ratio is obtained by dividing what by what?

Density count by density standard count

43. How often must leak tests be made?

6 months

44. If a nuclear gauge contains two or more sources, how many pieces of filter paper will be used doing a leak test?

One

45. When doing a leak test, is it necessary to expose the source rod?

No

46. How many sources are found in a 2400 series gauge?

Two

47. Where is/are the source/sources located in a 2400 series gauge?

Source rod

48. By what percentage will the Cesium-137 source decay each year?

2%

49. No special steps are required to transport a nuclear gauge on a commercial carrier.

_____ True
__X__ False

50. What information must appear on a nuclear moisture density data sheet (10 items).
(1) Date (2) Time (3) Persons name (4) WO number (5) Project (6) Standard counts, (7) Proctor or Marshall value used (8) WD, (9) DD, (10) % Moisture

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HOURS

I. Introduction to Nuclear Gauges 1

A. Uses

1. Soil density and moisture content
2. Asphalt density
3. Other uses

B. Advantages

1. Speed
2. Portability
3. Accuracy

C. Disadvantages

1. Safety
2. Calibration of H_2O
3. External factors that effect data

2. Radiation Theory 2

A. Atomic Structure

1. The Atom
   a. Neutron and Protons charges and weights
   b. Electrons charge and weight

B. Definition of Radiation

1. Units of measure of radioactivity
   a. Curie
   b. REM
   c. RAD
   d. Half-life

C. Radioactive Particles

1. Alpha
2. Beta
3. Gamma
4. Neutron

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D. Particle Reactions with Matter
   1. Gamma
   2. Alpha
   3. Neutron
      a. Thermalization

3. Radiation Safety 2
   A. Allowable Limits
      1. Anticipated dosage from gauges
   B. Minimizing Exposure
      1. Time
      2. Distance, inverse square law
      3. Shielding
   C. Personnel Monitoring
      1. Film badges
      2. Dosimeters
      3. Survey Meter
      4. Reports

4. License Conditions 1
   A. Who May Operate
   B. Where
   C. Who does maintenance
   D. Transporting Gauges
      1. Private or company auto
      2. Commercial carrier
         a. Ground
         b. Air
   E. Emergency Procedures
      1. Who to notify
      2. Actions to take on site
         a. Secure area
         b. Keep people away

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5. Theory of Gauge Operation 1
   A. Density
      1. Direct Transmission Geometry
      2. Backscatter Geometry
   B. Moisture Geometry
      1. Problem elements

6. Common Features of Nuclear Gauges 1
   A. Calibration and Specifications
      1. Factory calibration
         a. Density
         b. Moisture
      2. Operator Calibration
         a. Standard counts
         b. Moisture corrections
      3. Gauge Specifications
         a. 2400 Series
         B. 3400 Series

   B. Using the Gauge 2
      1. Site selection
      2. Testing frequency
      3. Site preparation
      4. Gauge positioning
      5. Operator positioning
      6. Depth selection

   C. Special Situations 1
      1. Trench measurements
      2. Asphalt measurements

   D. Maintenance and Troubleshooting 1
      1. Battery
      2. Cleaning
      3. Lubrication

4. Gasket replacement
5. Scaler replacement
6. Stability checks
7. Drift checks

E. Limitations of Nuclear Gauges ½

7. Using the 240 Series and the 3401B

A. Collecting Counts 1
1. Power time switch
2. Moisture
3. Density

B. Interpreting Data ½
1. Count ratio
2. Conversion tables

C. Limitations of 2400 Series

8. Using the 3411B Series 2

A. The keyboard
1. The display
2. switches

B. Taking Measurements
1. Collecting data
2. Interpreting Data

C. 3411 B Test Functions
1. Display test
2. Rotary switch test
3. Keyboard test
4. Error codes

9. Student Hands on Exercise

A. Safety Review 3

B. Normal Uses
1. Soils
2. Aspnalt
3. Trenches

C. Troubleshooting Problems
   1. Suspected error in moisture
   2. Suspected error in density
   3. Standard count errors
   4. Other gauge electronic failures

10. Asphalt Gauge — 1
    A. Capabilities and Limitations
    B. Calibration
    C. Sample Preparation
    D. Special Safety Precautions

11. Leak Test Procedures — ½

12. Review — 1½

13. Final Test — 1

Third Day

HANDS ON EXAM

Task : The student will be required to correctly take two moisture density tests in a preselected area. At one site the student will be required to troubleshoot a problem with the moisture measurement (this will be accomplished by contaminating a small subsurface portion of soil with oil). The student will be graded on the following:

1. Correct wear of film badge or dosimeter
2. Correct site preparation to include:
   a. Filling surface voids
   b. Driving pin to correct depth
   c. Correctly removing pin
3. Positioning gauge
4. Using correct keys to accumulate counts
5. Using correct keys to process and display data
6. Correctly recording data, and filling out data sheet
7. Did the operator apply principles of time, distance, and shielding to minimize his exposure
8. Did the student insure that observers stayed at least 15 feet from the gauge while the test is in progress
9. Did the student take a sample of the suspect material for moisture correction.
10. Return the source rod to the safe position and lock it.

INSTRUCTOR QUALIFICATIONS

Randall K. Fletcher will be the sole instructor for the course. Mr. Fletcher was in the Army from December, 1972 through March, 1984, and received biannual training in Chemical Biological and Radiological warfare. Included in this training was Radiological terms, means to protect oneself from radiation hazards, plotting fallout patterns, determining weapon yield, and decontamination procedures. In addition to the above which all members of combat arms units receive, Mr. Fletcher was unit armorer at Ft. Richardson from July, 1976 through December, 1976. While in this position he was responsible for 126 M-16 rifles equipped with low light front sights. These used a radium source of minute quantity. Weekly radiological surveys were required and daily accountability.

Mr. Fletcher was assigned to the 326th Engineer Battalion at Ft. Campbell, Kentucky in May of 1978 where he began "On The Job Training" with the Campbell Pacific gauges. Mr. Fletcher was responsible for compaction control of a 4000 ft. dirt runway from June, 1978 through August 1978. This was accomplished with the Campbell Pacific gauge exclusively. In May of 1979 Mr. Fletcher was transferred to the 20th Engineer Battalion, Ft. Campbell, Kentucky where he was responsible for the use, record keeping and accountability of that units nuclear gauge.

In September of 1979, Mr. Fletcher was assigned to the Cold REgions Research and Engineering Laboratory at Ft. Wainwright, Alaska. In March of 1980 he completed the Army Material Quality Specialist course which included a two day course on nuclear moisture density testers. This course is based on the manufacturers courses, and was given at Ft. Belvoi, Virginia. Upon returning to CRREL Mr. Fletcher was able on an "as needed" basis to borrow gauges from the State of Alaska Department of Transportation.

Mr. Fletcher left the army in March, 1984 and began employment at Shannon & Wilson in his current capacity as Laboratory Supervisor. Part of his duties include supervising the use of the companies gauges. This

includes all maintenance, record keeping, storage, and transportation of the gauges.

In the course of his duties he has familiarized himself with the regulations published by the NRC regarding nuclear moisture density gauges, including personnel monitoring, safety, use, storage, records, leak testing, and transportation.

Mr. Fletcher has been designated by this organization as "Radiation Protection Officer."