**Civilian Radioactive Waste
Management System**

QA: L

Management & Operating
Contractor**NEVADA WORK INSTRUCTION**Title: **LABORATORY DYNAMIC ROCK/SOIL TESTING**Instruction Number: **NWI-SPO-004Q**Revision: **0**Interim Change Notice: **N/A**Effective Date: **3/5/99**Author: **M. Schweppe**Responsible Manager: **T.R. Scotese**

Approvals:

Manager, Responsible Organization

Approval Date

Department Manager

Approval Date**CONTROLLED COPY
LAS VEGAS DOCUMENT CONTROL**COPY NO. 104118

THIS IS A RED STAMP

REVISION HISTORY

<u>Revision Number</u>	<u>ICN Number</u>	<u>EICN Number</u>	<u>Effective Date</u>	<u>Description and Reason for Change</u>
0			03/05/99	Preparation of a new procedure for the University of Texas to use for services procured by the M&O. Instruction number was changed from NWI-UTA-001Q on 1/25/99 to NWI-SPO-004Q.

1. PURPOSE AND SCOPE

This procedure defines processes for performance and reporting of geotechnical laboratory tests supporting geotechnical investigations. This procedure implements Supplement III requirements of the Office of Civilian Radioactive Waste Management (OCRWM) *Quality Assurance Requirements and Descriptions* (QARD), DOE/RW-0333P.

2. APPLICABILITY

This procedure applies to personnel responsible for dynamic rock/soil laboratory testing, under the direction of the Civilian Radioactive Waste Management System, Management and Operations Contractor. It may be used by any organizations that have the appropriate skills and equipment as specified.

3. PROCEDURE

An individual performing work subject to this NWI must accomplish that work in full compliance with this NWI. If unable to comply, the individual shall suspend work and shall resume work only after this NWI has been revised to correct the affected work practices. Process steps applicable to the given activity are to be accomplished sequentially unless otherwise indicated.

Test methods used for laboratory dynamic rock/soil testing are described in the construction section of the *Annual Book of ASTM Standards*, the most current revision. The testing procedures used are: American Society of Testing and Materials (ASTM) D2216-92, (ASTM D2216), Method for Unconfined Compressive Strength of Cohesive Soil; ASTM D2488-93, (ASTM D2488), Standard Practice for Description and Identification of Soils (Visual-Manual Procedure); ASTM D4254-91, (ASTM D4254), Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density; and PBRCTS-1, Technical Procedures for Resonant Column and Torsional Shear (RCTS) Testing of Soil and Rock Samples.

If data and process products do not meet the requirements specified in this instruction, a nonconformance report shall be processed in accordance with YAP-15.1Q, *Control of Nonconformances*. All deviations to this instruction shall be reported in accordance with AP-16.1Q, *Performance/Deficiency reporting* as applicable.

The following subsections describe acceptable alternates and details of specific procedures to be used. Terms used in this procedure are as defined in *ASTM Vol. 4.08 Soil and Rock (I): D-420-D4914* or in the QARD glossary. Refer to Section 5, References.

Instructions described in this procedure should be completed in the sequence given, except as needed to complete the work in an efficient manner, as determined by the Principal Investigator or his designated representative.

3.1 LOST, STOLEN OR DAMAGED EQUIPMENT

Responsible Person

Action

Laboratory Manager

1. Document any calibrated equipment or samples that are damaged, lost, or stolen on a Nonconformance Report (NCR) in accordance with YAP-15.1Q, *Control of Nonconformances* and note in the Scientific Notebook, in compliance with QAP-SIII-1, Scientific Investigation Control. Sections 5.5 and Section 6.1 (QA:L).
2. Check scales periodically using weights from the laboratory's calibrated weight set.
3. If scale readings deviate from calibrated values:
 - a. Clean the scale and inspect it for damage.
 - b. Retest the scale if no damage is apparent.
 - c. Ship the scale for repair if damage is apparent, or if the scale fails the retest.
 - d. Return the scale to use only after it is rechecked with calibrated weights.
4. Ensure that a record of calibrations using the laboratory's calibrated weight set is marked QA:L (indicating lifetime record) and that this record is submitted with the test reports.

3.2 CALIBRATION OF LABORATORY EQUIPMENT

Laboratory Manager

1. Calibrate or ensure calibration of Measuring and Test Equipment in accordance with QAP-12-1, *Control of Measuring and Test Equipment and Calibration Standards*.
2. Ensure that balances are checked using a YMP recognized calibrated weight set before weighing any YMP samples and rechecked at least weekly thereafter during the testing period.
3. Ensure the following equipment to be used for the performance of tests initiated under this NWI is calibrated by a YMP Qualified Supplier List (QSL) vendor.

Responsible Person

Action

Laboratory Manager

- a. Calibrated Weight Set (for use in testing water content, paragraph 3.5.1; unit weight and density of soil, paragraph 3.5.2; shear modulus and damping of soils/rock, paragraph 3.5.3; torsional shear, paragraph 3.5.4).

NOTE: Weights ranging from 1g to 2,000g will be measured to stated tolerances.

NOTE: Equipment listed is general and can be substituted by a comparable equal.

- b. Universal Counter (shear modulus and damping of rock/soils, paragraph 3.5.3; torsional shear, paragraph 3.5.4).
 - Range... DC coupled: 0 to 100 MHz.
AC coupled: 1MOhms, 30 Hz to 100MHz.
50 Ohms, 1 MHz to 100 MHz.
 - Sensitivity: 15-mV rms. sine wave to 20 MHz.
35 mV rms. Sine wave to 100 MHz.
100 mV peak-to-peak at a minimum pulse width of 5 ns.

NOTE: Sensitivity can be continuously varied to 150-mv rms.

- Dynamic Range (X1):
 - 45 mV to 5V peak-to-peak, to 20 MHz.
 - 100 mV to 2.5V peak-to-peak, to 100 MHz.
- Signal Operating Range, DC: $\pm 5V$ DC.
- Trigger Level:
 - Range:
 - Manual: Continuously adjustable over ± 5.1 v, displayed by Read Levels in 20 mV steps. In (X10), $\pm 51V$ displayed in 200 mV steps.
 - Preset: 0V Sensitivity Mode.
 - Auto Trigger:
Accuracy (Read Levels): (X1): ± 30 mV $\pm 1\%$ of trigger level reading.
(X10): ± 300 mV $\pm 1\%$ of trigger level reading
- Coupling AC or DC switch selectable.
- Trigger Slope: independent selection of + or - slope.
- Impedance $\pm$: 1 MOhms shunted by <60 pF or 50Ohms, switch selectable.

Civilian Radioactive Waste Management System

Management & Operating Contractor

Responsible Person

Action

Laboratory Manager

- Damage Level: 500 Ohms: 5mV rms.
1 MOhms, (X1): 0 to 3.5 kHz: 200V (DC +peak AC).
35 kHz to 100 kHz: 5×10^5 V rms. Frequency >100 kHz: 5V rms.
1 MOhms, X10: 0 to 35 kHz: 200V (DC + peak AC).
3.5 kHz to 100 kHz: 5×10^6 V rms. Frequency >100 kHz: 50V rms.

- c. Multimeter (shear modulus and damping of rock/soils, paragraph 3.5.3; torsional shear, paragraph 3.5.4).

Frequency/Period Characteristics

	Voltage (AC or DC Coupled)	Current (AC or DC Coupled)
Freq. Range	1 Hz – 10 MHz	1 Hz – 100 kHz
Period Range	1 sec – 100 ns	1 sec - 10 μ s
Input Signal Range	700 V rms. – 1 mV rms.	1 A rms. – 10 μ A rms.
Input Impedance	1 MOhms $\pm$ 15% with < 140 pF	0.1 – 730 Ohms ²

Accuracy

Range	24 Hour – 2 Year 0°C – 55°C
1 Hz – 40 Hz 1 s – 25 ms	0.05% of Reading
40 Hz - 10 Hz 25 ms – 100 nanoseconds	0.01% of Reading

Reading Rates

Resolution	Gate Time	Readings/Sec
0.00001%	1 s	0.95
>0.0001%	100 ms	9.6
>0.001%	10 ms	73
>0.01%	1 ms	215
>0.1%	100 microseconds.	270

- d. Dynamic Signal Analyzer (shear modulus and damping of rock/soils, paragraph 3.5.3; torsional shear, paragraph 3.5.4).

Responsible Person

Action

Laboratory Manager

- Measurement Range: 64 μ Hz to 100 kHz, both channels, single- and dual-channel operation.
- Accuracy: $\pm 0.004\%$ of frequency reading.
- Resolution: Span/800, both channels, single- or dual-channel operation, Linear Resolution mode.

Spans:	Base Band	Zoom
# of spans	66	65
Min span	10.24 MHz	20.48 MHz
Max span	100 kHz	100 kHz
Time record (Sec)	800/span	800/span

Window Parameters	Flat top	Hann	Uniform
Boise Equiv. Band Width (% of span)	0.478	0.188	0.125
3 dB Band Width (% of span)	0.45	0.185	0.125
Shape factor (60dB Band Width /3dB Band Width)	2.6	9.1	716

Typical Real Time Bandwidths

Single channel, single display	2.5 kHz
Single channel, Fast Averaging	10 kHz
Dual-channel, single display	2 kHz
Dual-channel, Fast Averaging	5 kHz
Throughput to CS/80 disc Single-Ch.	10 kHz
Throughput to CS/80 disc Dual-Ch.	5 kHz

Absolute Accuracy: Single Channel (Channel 1 or Channel 2)

± 0.15 dB $\pm 0.015\%$ of input range (+27 dBV to -40 dBV).

± 0.25 dB $\pm 0.025\%$ of input range (-41 dBV to -51 dBV)

DC Response: Auto-Cal and Auto-Zero on

Input Range (dBV rms.)	dc Level
+27 to -35	>30 dB below full scale
-36 to -51	>20 dB below full scale

Responsible Person

Action

Laboratory Manager

- e. Charge Amplifier (shear modulus and damping of soils/rock, paragraph 3.5.3; torsional shear, paragraph 3.5.4).
 - Source Capacitance... 30,000pf maximum
 - Maximum Input... +/- 10,000 PCMB
 - Gain:
 - Maximum Gain is 250 MV/PCMB adjustable.
 - 0.1, 1, 10 g, psi or lbs. with 100 to 1000 Range:
 - 1,10,100 g, psi, or lbs. with 10 to 100 PCMB Transducer Sensitivity.
 - 10,100, 1000 g, psi, or lbs. with 1 to 10 PCMB Transducer Sensitivity.
 - 100, 1,000, 10,000 g, psi or lbs. with 0.1 to 1 PCMB Transducer Sensitivity.
 - Meter Spec: Meter Accuracy +/- 3% F.S. (Full Scale Corresponds to Output Voltage of 5 Volts Peak-to-peak Frequency Resp. +/-5% from 10 Hz to 10kHz).
 - System Accuracy: +/-2% (At 1000 Hz-Room Temp. with Source Capacitance of 3500 pf or Less.
 - Frequency Response: +/-5% 1 Hz to 10,000 Hz.
 - Total Harmonic Distortion: 1% Maximum.
 - Output Connection: Single-ended, one side connected to circuit ground.
 - Output Impedance: 100 Ohms Maximum.
 - Output-Maximum Linear Voltage: 5 Volts Peak-to-peak with a three times over range capability on the first two ranges.
 - Output-Maximum Linear Current... +/-0.1 mA Peak.
 - Residual Noise: Less than 0.3% of Full Scale Output With 1000 pf Source Capacitance.
 - Temperature Range: + 40 Deg. F to 125 Deg. F.
 - Power Requirements: 105-125 Volts AC 60 Hz 25 Watts.
- f. Accelerometer (shear modulus and damping of soils/rock, paragraph 3.5.3; torsional shear, paragraph 3.5.4).
 - Nominal Sensitivity:: 60 PCMB/g...100mV/g
 - Cross Axis: 5%
 - Acoustic: 0.01g @150 dB SPL

Civilian Radioactive Waste Management System

Management & Operating Contractor

Responsible Person

Action

Laboratory Manager

- Frequency Response: 2Hz to 5kHz.
- Resonant Frequency: 25kHz.
- Vibration: 1000g sinusoidal.
- Shock: 2,000g
- Linearity: +/-1% per 300 g.
- Humidity: Epoxy seal.
- Altitude: No effect.
- Output Resistance: 2×10^{18} Ohms.
- Capacitance: 700 pf.
- Grounding: grounded to case.
- Temperature: Standard: -100°F to +350°F.
High-Temperature: -100°F to +500°F
- Mounting: #10-32 detachable stud
- Cable: 10 ft @ 300 pf
- Connector: Coaxial #10-32 thread.

g. Gage Blocks listed below :

- 0.010 inches
- 0.020 inches
- 0.030 inches
- 0.040 inches
- 0.050 inches
- 0.070 inches

h. Signal Conditioner (shear modulus and damping of soils/rock, paragraph 3.5.3; torsional shear, paragraph 3.5.4).

- Input Sensitivity: +/-17 mV/v for +/-10 V DC current
- Maximum Input: 2.5 Vrms, 5kHz.
- Transducer Excitation: 5 Vrms, 5 kHz.
- Transducer Configuration: 2 arm VR or LVDT type.
- Zero Adjustment: +/- 10 mV/V
- Output: 0 to +/- 10 Vdc; 10 mA into 1 kOhm load-Short-circuit protected.
- Output impedance: 10 Ohms, nominal.
- Frequency Response: Flat (+/-5%) 0 to 1000 Hz.
- Linearity: +/- 0.05% FS.
- Stability: +/- 0.1% long term.
- Temperature Range: 0 to 185 Deg F.
- Thermal Effects: Zero: 0.005% per Deg F.
Span: 0.01% per Deg F.

Civilian Radioactive Waste Management System

Management & Operating Contractor

Responsible Person

Action

Laboratory Manager

- Internal Power Supply:
- Carrier: 5 Vrms, 5kHz to each channel.
- DC Power: +/- 15Volts DC to each channel.
- AC Power Required: 115 Volts AC, 50 to 400 Hz, 3 VA

- i. Pressure Transducer (shear modulus and damping of soils/rock 3.5.3, torsional shear 3.5.4).
- Range Full Scale--80 psi

3.3 ASSIGNMENT OF TESTS

Control of samples submitted for testing will be in accordance YAP SII.1Q, *Submittal, Review, and Approval of Requests for Yucca Mountain Site Characterization Project Geologic Specimens* and YAP SII.4Q, *Collection, Submission, and Documentation of Non-core and Non-cuttings Samples to the Sample Management Facility for Site Characterization*.

**Principal Investigator
or
Responsible Manager**

1. Submit samples and a written list of required tests for each sample to the analytical laboratory.
2. Select from the following the tests that are needed.
 - a. Water content of soil and rock.
 - b. Minimum unit weight and density of soil and rock.
 - c. Modulus and damping of soil or rock by the resonant column method.
 - d. Modulus and damping of soil or rock by the torsional shear method.

Lead Investigator

3. Review the requested tests specified for applicability and appropriateness.
4. Inform the Principal Investigator or his designated representative if, as a result of the review in Paragraph 3.3.2, any of the testing cannot be performed and present reasons.

3.4 SCHEDULING TESTS

Laboratory Manager

1. Schedule the testing, providing specific assignments to qualified laboratory technicians.

Civilian Radioactive Waste Management System

Management & Operating Contractor

Responsible Person

Action

Laboratory Manager

2. Assign required testing to laboratory technicians.
3. Ensure that only ASTM procedures and PBRCTS-1 procedures are performed, as determined in Paragraph 3.4.4.
4. Enter the following information for each test on a laboratory report as specified by the ASTM Standard for that test and/or PBRCTS-1:
 - a. The original sample identification numbers (ID), the borehole identification, and depth interval or depth of sample.
 - b. A sample description, in accordance with ASTM D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), as described below.
 - c. A sample description indicating the method of sampling (i.e., tube, core, or bulk).

NOTE: The specimen subjected to the test procedures described in the NWI could consist of the entire sample requested from the Sample Management Facility or a representative subset. The description of the sample must reference the specimen identification and its disposition.

NOTE: The data derived from tests described below in this NWI will be entered on the laboratory reports that were initiated in this step.

5. Ensure the laboratory report, as specified and included in the ASTM Standards and/or the technical procedure PBRCTS-1, is signed by the laboratory personnel performing the test, the reviewers of calculations, and the reviewers of the document.
6. Ensure laboratory personnel control samples that have been subdivided or analyzed in accordance with laboratory practice, such that one label is affixed to or accompany each subdivided portion.

Civilian Radioactive Waste Management System

Management & Operating Contractor

<u>Responsible Person</u>	<u>Action</u>
Laboratory Manager	<ol style="list-style-type: none">7. Ensure that physical markings placed on the sample or its subset are:<ol style="list-style-type: none">a. Clear and legible.b. Non-detrimental to the sample or specimen content or form.c. Traceable to the original unique identifier for each part of the subdivided sample.d. Not obliterated or hidden by surface treatments or sample preparations unless other means of identification are substituted.8. Return the unused sample to controlled storage.

NOTE: Samples subjected to destructive testing (including any testing of sealed soil samples) procedures may be discarded.

3.5 CONDUCT OF LABORATORY TESTING

Procedures to be used for the designated tests are described in the following subsections. All tests performed will be conducted in accordance with the ASTM Standard Methods and/or the attached procedure PBRCTS-1, as directed below.

Test results of ASTM tests will be recorded in accordance with ASTM Standards as specified in the specific ASTM procedure. ASTM Standards are specific as to the content of the report for each specific procedure.

The results of tests conducted under procedure PBRCTS-1 will be recorded in accordance with QAP-SIII-1, Rev 3, *Scientific Investigation Control*, Section 5.

Lead Investigator	Determine whether a test may be performed on a sample based on the condition of the sample or criteria specified by the specific ASTM procedure or technical procedure PBRCTS-1, <i>Technical Procedures for Resonant Column and Torsional Shear (RCTS) Testing of Soil and Rock Samples</i> .
-------------------	--

Responsible Person

Action

3.5.1 Water Content

Laboratory Technician

1. Perform the water content test in accordance with ASTM D 2216, unless instructed by the Laboratory Manager that the test cannot be performed on the specimen.
2. Record results for each sample in the laboratory Water Content Report initiated in Paragraph 3.4.4.
3. Return the unused sample to storage in accordance with established laboratory practice. Paragraph 3.4.6.

3.5.2 UNIT WEIGHT AND DENSITY OF SOIL AND ROCK

Laboratory Technician

1. Perform the unit weight test on tube specimens, core, or bulk samples in accordance with ASTM D 4254, unless instructed by the Laboratory Manager or Lead Investigator that the test cannot be performed on the specimen.
 - a. Measure and record in the Unit Weight and Density report the weight of the specimen to the nearest gram.
 - b. Measure and record in the Unit Weight and Density report the length of the cylindrical soil or rock specimen to the nearest millimeter at the center and at three points on the circumference.
 - c. Measure and record in the Unit Weight and Density report the diameter of the cylindrical soil specimen at the two ends and at the mid-height of the specimen.
 - d. Determine and record in the Unit Weight and Density report the water content of the soil specimen in accordance with Paragraph 3.4.4.
 - e. Calculate the average diameter of the cylindrical soil specimen and the average area.
 - f. Calculate and record in the Unit Weight and Density Report the density of the soil as the specimen mass divided by the specimen volume, where the specimen volume is equal to the average specimen height times the average specimen area.

Responsible Person

Action

Laboratory Technician

NOTE: If the tube or specimen is deformed or if the soil specimen has voids resulting from gravel in the soil that has been displaced relative to the remainder of the specimen, the specimen must not be used for a unit weight or wet density test.

2. Record results for each test in the laboratory Unit Weight and Density Report initiated in Paragraph 3.4.4. above.
3. Return the unused sample to storage in accordance with established laboratory practice. Paragraph 3.4.6.

3.5.3 SHEAR MODULUS AND DAMPING OF SOIL AND ROCK

Laboratory Technician

1. Obtain tube samples, core, or bulk samples to be tested.
2. Ensure that particle size is in accordance with ASTM D-4015, *Standard Test Methods for Modulus and Damping of Soils by the Resonant-Column Method*, Section 7.2, by passing the material to be tested through a 1/2-inch sieve.
3. Prepare and test the specimen in accordance with procedure PBRCTS-1, as described by Ladd, 1978, unless instructed by the Laboratory Manager that the test cannot be performed on the specimen.
4. Ensure that particle size of the sample is in accordance with the following criteria given in ASTM D-4015, *Standard Test Methods for Modulus and Damping of Soils by the Resonant-Column Method*: "The largest particle contained within the test specimen shall be smaller than one tenth of the specimen diameter except that, for specimens having a diameter of 70mm (2.8 in.) or larger, the largest particle size shall be smaller than one sixth of the specimen diameter."
5. Measure and record the maximum particle size, if particle sizes exceed the criteria described in Paragraph 3.5.3.4, in the test data report under "Remarks."
6. Return the unused sample to storage in accordance with established laboratory practice. Paragraph 3.4.6.

<u>Responsible Person</u>	<u>Action</u>
Principal Investigator or Responsible Manager	7. Estimate the in situ mean effective stress using the sample depth, estimated soil density, location of the water table (if appropriate), and the estimated coefficient of earth pressure at rest (unless advised, use a value of 0.5).
Laboratory Technician	8. Apply an initial confining pressure equal to 0.25 times the estimated in situ mean effective stress and record LVDT readings until full consolidation is achieved as indicated by vertical-height-change measurements. 9. Determine the specimen's maximum shear modulus by performing a low amplitude (<0.001%) resonant column test. 10. Repeat Steps 8 and 9, with a confining pressure equal to 0.5 times the estimated in situ mean effective stress. 11. Repeat Steps 8 and 9, with a confining pressure equal to 1.0 times the estimated in situ mean effective stress. 12. Repeat Steps 8 and 9, with a confining pressure equal to 2.0 times the estimated in situ mean effective stress. 13. Record results for each sample in the laboratory Resonant-Column Test Report initiated in Paragraph 3.4.4 above.

3.5.4 RESONANCE AND CYCLIC TORSIONAL TESTING

Laboratory Technician	1. Estimate the in situ soil density based on in situ penetration resistance testing and/or laboratory test results and/or from Paragraph 3.5.2 of this instruction. 2. Estimate the in situ mean effective stress using the sample depth, estimated soil density, location of the water table (if appropriate), and the estimated coefficient of earth pressure at rest (unless advised, use a value of 0.5). 3. Prepare and test the specimen in accordance with PBRCTS-1, as described by Ladd, 1978, unless specifically instructed by the laboratory manager that the test cannot be performed. 4. Return the unused sample to storage in accordance with established laboratory practice. Section 3.4.6.
------------------------------	---

Civilian Radioactive Waste Management System

Management & Operating Contractor

Responsible Person

Action

Laboratory Technician

5. Apply an initial confining pressure equal to 0.25 times the estimated in situ mean effective stress and record LVDT readings until full consolidation is achieved as indicated by vertical-height –change measurements.

NOTE: Confining stress is used with rock samples, but consolidation time is significantly less than for soil samples.

6. Determine the specimen's maximum shear modulus by performing a low amplitude (<0.001%) resonant column test, as provided in Paragraph 3.5.3.9.
7. Repeat Steps 5 and 7, with a confining pressure equal to 0.5 times the estimated in situ mean effective stress.
8. Repeat Steps 5 and 7, with a confining pressure equal to 1.0 times the estimated in situ mean effective stress.
9. Estimate the torque (based on the input voltage to the driving system) required to twist the specimen at the various levels of selected shear strain values.
10. Test the sample in torsional shear using increasing strain values varying from 0.001% to 0.2%, with the maximum strain being dependent on the stiffness of the soil or rock and on the loading capacity of the laboratory equipment.
11. Test the sample in torsional resonance using increasing strain values varying from 0.001% to 0.2%, with the maximum strain being dependent on the stiffness of the soil or rock and on the loading capacity of the laboratory equipment.
12. Repeat Steps 5 and 7, with a confining pressure equal to 2.0 times the estimated in situ mean effective stress.
13. Repeat Steps 5, 7, 10, 11, and 12, with a confining pressure equal to 4.0 times the estimated in situ mean effective stress.

NOTE: Care should be taken to ensure the recording of all values for testing conditions and test data.

Civilian Radioactive Waste Management System

Management & Operating Contractor

Responsible Person

Action

Laboratory Technician

14. Record results for each sample in the laboratory Resonance and Cyclic Torsional Testing report initiated in Paragraph 3.4.4 above.

3.6 DISPOSITION OF SAMPLES

Laboratory Manager

1. Return samples, sample remnants, and untested specimens after the conclusion of testing under this NWI to the Sample Management Facility in accordance with NWI-SMF-001Q, *Removal of Whole and Other Specimens from Samples by the Sample Management Facility for Shipment and Remnant Return*.
2. Ensure that a record of sample control marked QA:L (indicating lifetime record) will accompany the samples returned to the Sample Management Facility.

4. RECORDS

The following records for Laboratory Dynamic Rock/Soil Testing resulting from this NWI will be submitted to the Technical Data Management System (TDMS) in accordance with YAP-SIII.3Q, *Processing of Technical Data on the Yucca Mountain Site Characterization Project*.

4.1 IDENTIFICATION AND DISPOSITION OF RECORDS

The following quality assurance (QA) records generated as a result of this procedure shall be prepared for submittal to the YMP Principal Investigator or Responsible Manager, for subsequent submittal to the YMP Records Processing Center as records packages in accordance with AP-17.1Q, *Record Source Responsibilities for Inclusionary Records*.

NOTE: The title of the record package should include the sample type and the year the samples were collected.

4.1.1 Records Packages

QA lifetime records:

- Written Sample Test Specifications.

- Laboratory Test Report (for each test used) including the following, as applicable:
 - Laboratory Water Content Report
 - Laboratory Unit Weight and Density Report
 - Laboratory Resonant-Column Report
 - Laboratory Torsional Shear Test Report

NOTE: Although laboratory report format may be variable, report content will conform to ASTM Standard Method criteria and/or technical procedure PBRCTS-1, Technical Procedures for Resonant Column and Torsional Shear (RCTS) Testing of Soil and Rock Samples. Section 3.2.

- Calibration record for scales and other sensory devices
- Sample Control Record

QA nonpermanent records: None

QA not applicable records: None

4.1.2. Individual Records

None

4.2. IDENTIFICATION AND DISPOSITION OF EXCLUSIONARY MATERIALS

Not Applicable

5. REFERENCES

- A. *Quality Assurance Requirements and Description*, DOE/RW-0333P
- B. YAP-15.1Q, *Control of Nonconformances*
- C. AP-16.1Q, *Performance Deficiency Reporting*
- D. QAP-12-1, *Control of Measuring and Test Equipment and Calibration Standards*.
- E. AP-17.1Q, *Record Source Responsibilities for Inclusionary Records*.
- F. YAP-SII.1Q, *Submittal, Review, and Approval of Requests for Yucca Mountain Site Characterization Project Geologic Specimens*.
- G. YAP-SII.4Q, *Collection, Submission, and Documentation of Non-core and Non-cuttings Samples to the Sample Management Facility for Site Characterization*.
- H. NWI-SPO-003Q, *Laboratory Geotechnical Testing of Soil Samples*.

Civilian Radioactive Waste Management System

Management & Operating Contractor

- I. ASTM D2216-92. Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
- J. ASTM D2488-93. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
- J. ASTM D4015-92 (Reapproved 1995), Standard Test Methods for Modulus and Damping of Soils by the Resonant Column Method.
- K. ASTM D4254-91. Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- L. Ladd, R.S., "Preparing Test Specimens Using Undercompaction," *Geotechnical Testing Journal*, Vol. 1, No. 1, March 1978, pp. 16-23 (Note: This reference is copyrighted by ASTM.).
- M. PBRCTS-1, *Technical Procedures for Resonant Column and Torsional Shear (RCTS) Testing of Soil and Rock Samples*, 1993. Department of Civil Engineering, University of Texas, Austin, Texas.
- N. Annual Book of ASTM Standards (1998), Vol. 4.08 Soils and Rock, West Conshohocken, Pennsylvania, American Society of Testing and Materials.

6. EXHIBIT

PBRCTS-1, Rev. 0, 1993, Technical Procedures for Resonant Column and Torsional Shear (RCTS) Testing of Rock and Soil Samples, University of Texas, Austin, College of Engineering, Geotechnical Engineering Center.