UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

USBR 9300-89

PROCEDURE FOR

CHECKING, ROUNDING, AND REPORTING OF LABORATORY DATA

INTRODUCTION

This procedure is under the jurisdiction of the Concrete and Structural Branch, code D-3730, and the Geotechnical Services Branch, code D-3760, of the Research and Laboratory Services Division, Denver Office, Denver, Colorado. The procedure is issued under the fixed designation USBR 9300. The number immediately following the designation indicates the year of acceptance or the year of last revision.

1. Scope

1.1. This designation outlines procedures for checking data on laboratory data forms, rounding numbers, and recording and reporting of the data.

1.2 This procedure is to be used by Bureau of Reclamation laboratories engaged in testing of cement, concrete, aggregates, soil, and rock, and is to be used to provide uniformity and consistency in handling data, data forms, and reports.

2. Applicable Documents

2.1 *USBR Procedures*:
USBR 3000 Using Significant Digits in Calculating and Reporting Laboratory Data

2.2 *ASTM Standards*:
E 29 Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values
E 380 Metric Practice

2.3 *Bureau Document*:
Metric Manual

3. Terminology

3.1 *A Term Specific to This Designation Is*:

3.1.1 *Rounding.*-The process of reducing the number of digits in a number according to rules relating to the required accuracy of the value.

4. Recording Data on Original Data Forms

4.1 The heading of each data form must be completed in full. The initials and surname of appropriate persons are to be entered in the space for "tested by," "computed by," and "checked by" (see example on fig. 1).

4.2 The portion of the data form for auxiliary tests must show the year of the version of the procedure used (see fig. 1).

NOTE 1.-Since procedures may be revised, it is important that the version of the procedure used be identified.

4.3 All measured or computed data are to be recorded in a legible manner on the data form. If a number is computed or recorded erroneously, draw a line through the incorrect number and write the correct value to the side or above the incorrect entry. In No Circumstance Shall the Original Value Be Erased or Written Over.

4.4 All measured or computed data must be recorded as specified in the procedure (e.g., "record to the nearest 0.01 lbm"). For those cases, where the number of digits is not specified, a value should be recorded to one more digit than prescribed by the rules of significant digits as described in USBR 3000.

4.5 Any observation made during the test that might have an effect on the results, or on use of the results, should be written on the data form. If information is placed on the back of the form, clearly indicate on the front that additional information is on the back.

5. Checking Data on Original Data Forms

5.1 All numerical data that are the result of a calculation must be checked by an individual other than the person who computed and recorded the data.

5.2 All data transferred to a data form from another source, such as other data forms, calibrations values, etc., shall be checked by an individual other than the person recording the data.

5.3 All recorded data that are correct must show a checkmark, preferably in red, by each number checked (see fig. 1).

NOTE 2.-Example data forms included in the other USBR procedures contained in this manual do not show checkmarks in order to illustrate the required data in a neat and legible manner. Completed data forms should be similar to figure 1 or 2.

5.4 If recorded data are incorrect, draw a line through the number and write the correct number to the side or above the incorrect value. In No Circumstance Shall the Original Value Be Erased or Written Over.

5.4.1 The same method or system of computation must be used for checking the data as was used in calculating the recorded values.

NOTE 3.–Numbers calculated by "chain" computations with a calculator or computer may result in different values than rounding values for each entry and using the rounded value in subsequent calculations. The calculator or computer carries more digits than the rounded number when a "chain" computation is being used.

5.4.2 Data corrected by the checker should be verified by a person other than the checker and a checkmark shown by the correct value. An entry should be made on the data form "corrections verified by _____(Name)_____."

5.5 The name of the checker and the date the data were checked must be entered on the form heading. The last name of the checker must be completely written out.

5.6 It is the responsibility of the checker to ensure that all numbers are correct, recorded to the proper number of places specified in the procedure, and that rounding is in conformance with this designation. The checker should also review the measured data for reasonableness (e.g., a recorded mass of 179 lbm when the maximum capacity of a scale is known to be 100 lbm).

5.7 If necessary changes are made to data subsequent to the final checking, changes must be checked and the changes explained in the *Remarks* section of the data form.

6. Checking Data Presented on Graphs, Tables, and Figures Reporting Laboratory Data

6.1 All data shown on graphs, tables, and figures must be checked by an individual other than the person who originally prepared the graph, table, or figure.

6.2 The original figure should not show checkmarks for each value. It is recommended that a copy of the original graph or figure be made and checkmarks be placed by each value on the copy (see example on fig. 2).

6.3 Once the graph, table, or figure is considered correct, the name of the person who prepared the graph, table, or figure; the date prepared; the name of the checker; and the date the data were checked must be entered in the space provided or in the lower left corner of the original graph, table, or figure.

7. Rounding Numbers

7.1 When a numerical value is to be rounded to fewer digits than the total number available, the following procedure is to be followed:

When the first digit dropped is:	*The last digit retained is:*	*Examples*
< 5	Unchanged	2.44 to 2.4
> 5	Increased by 1	2.46 to 2.5
Exactly 5	Increased by 1	2.55 to 2.6
5 followed only by zeros	Increased by 1	2.5500 to 2.6

The same rules apply when rounding a number with many digits to a number with few digits. A computer or calculator may display the answer to a computation as ten digits and the answer is to be recorded to two digits. For example, the number 2.3456789 would be rounded to 2.3; the first digit dropped would be the 4.

Other examples:

2.49999 to 2.5
2.49999 to 2
2.55555 to 2.56
2.55555 to 3
2.50000 to 3

7.2 The examples shown above, exactly 5 or 5 followed by zeros, are rounded differently than indicated in the USBR *Metric Manual*, ASTM E 380, and ASTM E 29. These documents all indicate that the number is to be rounded to the closest even number. In the example (shown above) 2.50000 would be rounded to 2 and not 3. Unfortunately, calculators and computers do not follow this rule and always round up. Recognizing the wide-spread use of calculators and computers, the policy as stated in subparagraph 7.1 should be followed.

8. Reporting Data

8.1 Data reported as result(s), of the test, must conform with instructions in the respective procedure, since some reported values are different than what is recorded on the data form. (For example, the computed value for liquid limit of a soil is recorded on the data form to the nearest 0.1 percent but is to be reported to the nearest 1 percent.) If the reported value is not specified, the data should be reported in accordance with the rules of significant digits as described in USBR 3000.

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LABORATORY COMPACTION TEST

Designation USBR 5500 - 89

SAMPLE NO.	PROJECT	FEATURE
55T-13 ✓	Example	XYZ Dam

TESTED BY	DATE	COMPUTED BY	DATE	CHECKED BY	DATE
A. Green	5/28/89	B. Brown	5/29/89	C. White	5/29/89

Blows per layer 25 ✓ No. of layers 3 ✓ Height of drop 18.0 ✓ in

Mass of tamping rod 5.50 ✓ lbm Volume of mold 0.0497 ✓ ft^3

Specimen No.		1	2	3	4	5		
Wet unit weight determinations								
Water added	(g or ml)	~~180~~ 80	160	240	330	420		
Mass of mold + wet soil	(lbm)	11.13	11.52	11.87	11.84	11.69		
Mass of mold	(lbm)	5.41	5.41	5.41	5.41	5.41		
Mass of wet soil	(lbm)	5.72 ✓	~~6.41~~ 6.11 ✓	6.46 ✓	6.43 ✓	6.28 ✓		
Wet unit weight	(lbf/ft^3)	115.1 ✓	~~129.0~~ 122.9 ✓	130.0 ✓	129.4 ✓	126.4 ✓		
Penetration resistance determinations								
Needle No.		40	40	20	10	4		
Area of needle	(in^2)	1/40	1/40	1/20	1/10	1/4		
Penetrometer reading	1	72	45	50	50	40		
	(lbf) 2	73	47	49	49	37		
	3	72	46	51	49	39		
Average reading	(lbf)	72 ✓	46 ✓	~~60~~ 50 ✓	49 ✓	39 ✓		
Penetration resistance	(lbf/in^2)	2880 ✓	1840 ✓	1000 ✓	490 ✓	156 ✓		
Moisture content determinations								
Dish No.		15	44	45	55	20		
Mass of dish + wet soil	(g)	382.4	386.7	382.1	381.5	369.5		
Mass of dish + dry soil	(g)	359.1	359.6	352.4	347.3	330.6		
Mass of dish	(g)	129.4 ✓	133.8 ✓	140.6 ✓	138.6 ✓	118.0 ✓		
Mass of water	(g)	23.3 ✓	27.1 ✓	29.7 ✓	34.2 ✓	38.9 ✓		
Mass of dry soil	(g)	229.7 ✓	225.8 ✓	211.8 ✓	208.7 ✓	212.6 ✓		
Moisture content	(% of dry mass)	10.1 ✓	12.0 ✓	14.0 ✓	16.4 ✓	~~18.2~~ 18.3 ✓		
Dry unit weight determinations								
Dry unit weight	(lbf/ft^3)	104.5 ✓	109.7 ✓	114.0 ✓	111.2 ✓	106.8 ✓		

Remarks: Corrections verified by D. Black .

Auxiliary tests:

USBR 5205 - 89
USBR 5300 - 89
USBR 5320 - 89
USBR 5505 - 89

GPO 849-889

Figure 1. - Checked data sheet — example.

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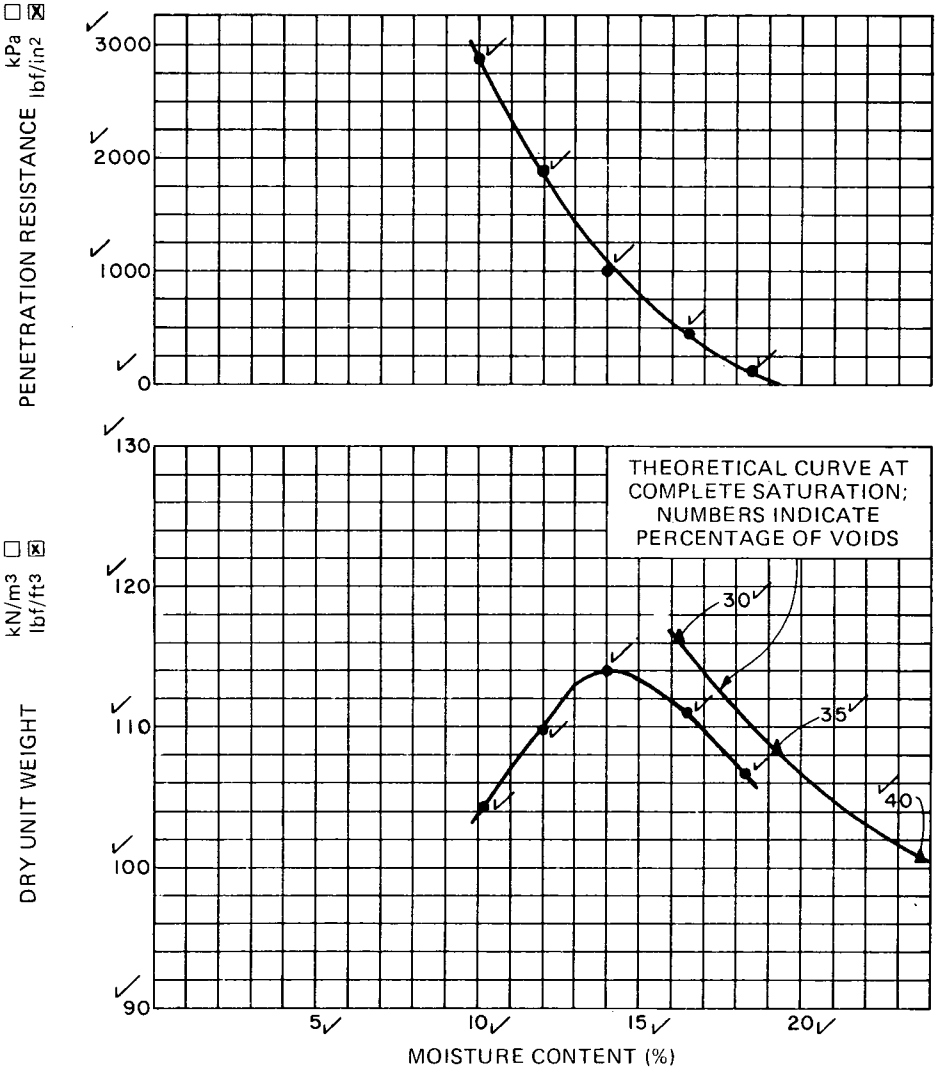
COMPACTION - PENETRATION RESISTANCE CURVES

Designation USBR 5500 - 89

SAMPLE NO.	FEATURE	PROJECT
55T-13	XYZ Dam	Example

Hole No. AP-5A Plotted by B. Brown Date 5/28/89

Depth 3.2 - 7.8 ft ☒ m ☐ Checked by C. White Date 5/29/89



CLASSIFICATION SM

Gravel	13	%
Sand	50	%
Fines	37	%

ATTERBERG LIMITS

Liquid Limit	33	%
Plasticity Index	4	%
Shrinkage Limit		%

SPECIFIC GRAVITY

Minus No. 4	2.66	
Plus No. 4		
Bulk		
Apparent		
Absorption		%

Remarks

COMPACTION

Method

Percent larger than tested	13	
Maximum dry unit weight	114.0	☐ kN/m3 ☒ lbf/ft3
Optimum moisture content	14.0	%
Degree of saturation @ opt		%
Penetration resistance @ opt	1000	☐ kPa ☒ lbf/in2

GPO 848-759

Figure 2. - Checked plotting — example.