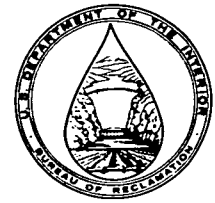




UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION



USBR 1000-89

PROCEDURE FOR STANDARDS FOR LINEAR MEASUREMENT DEVICES

INTRODUCTION

This procedure is under the jurisdiction of the Geotechnical Services Branch, code D-3760, Research and Laboratory Services Division, Denver Office, Denver, Colorado. The procedure is issued under the fixed designation USBR 1000. The number immediately following the designation indicates the year of acceptance or the year of last revision.

1. Scope

1.1 This designation outlines the procedure for ordering and maintaining quality control of linear measurement devices to be used for laboratory and field applications. Minimum requirements for tapes, calipers, micrometers, and gauge blocks are outlined in this designation. It is strongly recommended that a certificate of inspection certifying that the linear measurement device meets the standards of the applicable Federal specifications be obtained when purchasing these devices.

2. Applicable Documents

2.1 Federal Specifications:

GGG-T-106D Tape Measuring, General Use
GGG-R-791F Rules, Measuring
GGG-C-111B Calipers and Gages, Vernier
GGG-C-105B Caliper, Micrometer (Inside, Outside, Tube) and Gage, Depth Micrometer
GGG-C-15C Gage Blocks and Accessories

3. Significance and Use

3.1 Accurate linear measurements must be taken to obtain proper values from laboratory and field tests.

3.2 The information in this designation is to be used whenever any of the linear measurement devices listed in paragraph 5 are purchased.

3.3 With the exception of tapes and rules, linear measurement devices should be returned to the manufacturer or to an appropriate certification agency biennially for recertification.

4. Terminology

4.1 *Traceability Certificate.*—A certificate of inspection certifying that a linear measurement device meets the Federal specifications for its particular grade or model and that its accuracy is traceable to the National Institute of Standards and Technology (National Bureau of Standards) or the international standard of length.

5. Apparatus

5.1 *Flexible Metal Printed Tape.*—A device used to obtain accurate linear measurements and is usually enclosed

in a roll-up case. Flexible metal printed tapes should meet the requirements of Federal Specification GGG-T-106D. The tapes are to be housed in a suitable case. Inch-pound scale tapes having a length of 6, 8, or 12 feet are generally adequate for most laboratory and field applications. Metric scale tapes having a length of 2 to 3 meters are generally adequate for most laboratory and field applications. A certificate of inspection certifying that the flexible metal printed tape meets Federal specifications is to be obtained from the manufacturer when ordering the tape.

5.2 *Engraved Metal Rule.*—A device manufactured from tool steel which is used to obtain accurate linear measurements. Engraved metal rules should meet the requirements of Federal Specification GGG-R-791F. The rule is to be constructed in one piece without joints and is to be made of tool steel. A certificate of inspection certifying that the engraved metal rule meets Federal specifications is to be obtained from the manufacturer when ordering the rule.

5.3 *Hardwood Rule.*—A device used to obtain accurate linear measurements manufactured from hardwood. The hardwood rule should meet the requirements of Federal Specification GGG-R-791F. The hardwood rule is to be constructed in one piece of well-seasoned hardwood from birch, boxwood, or hard maple. The wood is to be straight-grained and clear throughout. A rule that is marked with the inch-pound scale (1/8-inch graduations) on one face and the metric scale (1-cm graduations) on the other face is adequate for most laboratory and field applications.

5.4 *Vernier or Dial Calipers.*—A measuring device which consists of a main scale with a fixed jaw and a sliding jaw with an attached vernier and is used to obtain precise inside, outside, or depth measurements. Vernier or dial calipers should meet the requirements of Federal Specification GGG-C-111B. Inch-pound scale vernier or dial calipers which have a measuring range of 0 to 6 inches must be graduated to read in thousandths of an inch (0.001 in). Metric scale vernier or dial calipers which have a measuring range of 0 to 150 mm must be graduated to read in two one-hundredths of a millimeter (0.02 mm). A certificate of inspection certifying that the vernier or dial caliper meets Federal specifications is to be obtained from the manufacturer when ordering the calipers.

5.5 *Outside Micrometer.*—A device which is used to obtain precise outside measurements. Outside micrometers should meet the requirements of Federal Specification

GGG-C-105B. Inch-pound scale outside micrometers which have a measuring range of 0 to 1.000 inch must be graduated to read to at least one-thousandth of an inch (0.001 in). Metric scale outside micrometers which have a measuring range of 0 to 25 mm must be graduated to read to at least two one-hundredths of a millimeter (0.02 mm). A certificate of inspection certifying that the outside micrometer meets the Federal specification is to be obtained from the manufacturer when ordering the micrometer.

5.6 *Inside Micrometers.*—A device which is used to obtain precise inside measurements. Inside micrometers should meet the requirements of Federal Specification GGG-C-105B. Inch-pound scale inside micrometers which have a measuring range of 2 to 12 inches must be graduated to read to at least one-thousandth of an inch (0.001 in). Metric scale inside micrometers which have a measuring range of 50 to 300 mm must be graduated to read to at least two one-hundredths of a millimeter (0.02 mm). A certificate of inspection certifying that the inside micrometer meets Federal specifications is to be obtained from the manufacturer when ordering the micrometer.

5.7 *Depth Micrometers.*—A device which is used to obtain precise depth measurements. Depth micrometers should meet the requirements of Federal Specification GGG-C-105B. Inch-pound scale depth micrometers which have a measuring range of 0 to 10 inches must be graduated to read to at least one-thousandth of an inch (0.001 in). Metric scale depth micrometers which have a measuring range of 250 mm must be graduated to read to at least two one-hundredths of a millimeter (0.02 mm.) A certificate of inspection certifying that the depth micrometer meets Federal specifications is to be obtained from the manufacturer when ordering the micrometer.

5.8 *Rectangular Gauge Blocks.*—Precision steel rectangular gauge blocks are designed to be used individually. Gauge blocks are suitable for checking dial caliper, vernier caliper, micrometer caliper, and dial indicator travel. Inch-pound and metric scale gauge blocks are to be compatible with the calibration requirements; i.e., dial gauges, calipers, etc. A certificate of inspection certifying that the rectangular gauge blocks meet Federal specifications is to be obtained from the manufacturer when ordering the gauge blocks.

5.9 *Square Gauge Blocks.*—Precision steel square gauge blocks are designed for stack assembly. An accessory hole is drilled through the center of each gauge block to allow the tie rod to pass through for assembly. A certificate of inspection certifying that the square gauge blocks meet Federal specifications is to be obtained from the manufacturer when ordering the gauge blocks.

6. Precautions

6.1 *Safety Precautions.*—Examine the linear measurement devices (as received or before their use) for sharp edges or burrs.

6.2 *Technical Precautions:*

6.2.1 Examine the linear measurement devices for bent or missing components each time they are used.

6.2.2 Store the linear measurement devices in a suitable case when not in use.

6.2.3 Occasionally rub or wipe the linear measurement device with an oily rag if it is used in a wet or damp environment (not applicable for hardwood rules).

6.2.4 Use extreme caution when marking control numbers on linear measurement devices. Under no circumstances should the precision gauge blocks be marked or scribed by the purchaser. The manufacturer stamps the dimensions and serial number on the block at the time of manufacture and calibration.

7. Calibration and Standardization

7.1 Verify that the certificate of inspection is current. If it is not current, the linear measurement device should not be used.

It is recommended that linear measurement devices be returned to the manufacturer or to an appropriate certification agency biennially for recertification.

8. Conditioning

8.1 Not applicable, special conditioning requirements are not needed for this procedure.

9. Procedure

9.1 *Purchasing:*

9.1.1 All information is to be recorded on the "Linear Measurement Device Acceptance Form" as shown on figure 1.

9.1.2 Determine the type of measurement device that is needed, e.g., when determining the volume of relative density measures, one needs a depth micrometer with a measuring range of 0 to 10 inches and an inside micrometer with a measuring range of 2 to 12 inches.

9.1.3 Determine the nominal range of the item or items to be measured.

9.1.4 Obtain a catalog from a reputable supplier that supplies precision linear measurement devices.

9.1.5 Determine if the supplier can furnish the linear measurement device needed to accomplish the task.

9.1.6 Determine if the supplier can furnish a certificate of inspection and if construction and accuracy comply with applicable Federal specifications.

9.2 Upon receipt of the linear measurement device, the following items should be noted.

- Date of receipt
- Type of linear measurement device
- Name of the manufacturer
- Serial number of the linear measurement device
- Are the range and scale markings on the linear measurement device as specified on the purchase order?
- Check the certificate of inspection to ensure that it is current and that the data listed on it are applicable to the device (serial number and type).

10. Interpretation of Results

10.1 Use the instructions and tables listed in the applicable Federal specifications to aid in determining if the

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linear measurement device complies with the special requirements.

10.2 If the linear measurement device meets all of the specified requirements, accept the device; if it does not, it is to be rejected and returned to the manufacturer.

11. Report

11.1 The report is to consist of a completed "Linear Measurement Device Acceptance Form." This information (fig. 1) should be filed with the laboratory equipment calibration records.

7-2300 (12-86) Bureau of Reclamation	LINEAR MEASUREMENT DEVICE ACCEPTANCE FORM	Designation USBR 1000 <u>8 9</u>
<p>PART 1. (COMPLETE WHEN ORDERING THE LINEAR MEASUREMENT DEVICE.)</p> <p>1. ORDERED BY <u>Example</u> DATE <u>6/17/89</u></p> <p>2. TYPE OF LINEAR MEASUREMENT DEVICE <u>Depth micrometer</u></p> <hr/> <p>3. NOMINAL MEASURING RANGE REQUIREMENTS <u>0-10 inches</u></p> <p>4. SCALE MARKING REQUIREMENTS <u>0.001 inch</u></p> <p>5. NAME AND ADDRESS OF SUPPLIER <u>Example</u></p> <hr/> <p>6. IS A CERTIFICATE OF INSPECTION FURNISHED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO</p>		
<p>PART 2. (COMPLETED UPON RECEIPT OF THE LINEAR MEASUREMENT DEVICE.)</p> <p>1. RECEIVED BY <u>Example</u> DATE <u>8/26/89</u></p> <p>2. TYPE OF LINEAR MEASUREMENT DEVICE <u>Depth micrometer</u></p> <p>3. NAME OF MANUFACTURER <u>Example</u></p> <p>4. SERIAL NUMBER <u>DM-4967550</u></p> <p>5. DO THE RANGE AND SCALE MARKINGS COMPLY WITH THE SPECIFIED REQUIREMENTS?</p> <p style="padding-left: 20px;"><input checked="" type="checkbox"/> YES <input type="checkbox"/> NO</p> <hr/> <p>6. IS THE CERTIFICATE OF INSPECTION VALID? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO</p>		
<p><input checked="" type="checkbox"/> ACCEPT <input type="checkbox"/> REJECT</p>		

Figure 1. - Linear measurement device acceptance form — example.