Instruction Manual

Portable
Roughness Tester

14-415-4 / 14-416-2
## CONTENTS

1. Description 2
2. Specifications 3
3. Measurement Parameters 4
4. Features 5
5. Battery Installation/Replacement 6
6. Controls and Digital Display 6
7. Calibration 7
8. Operation 8
9. Probes 9
10. Probe Replacement 11
12. Maintenance 12
13. Accessory: Height Stand 13
1. Description

The Roughness tester is a portable, battery-powered instrument for checking surface roughness with the measured values displayed on a digital readout. This instrument can be used in the laboratory, inspection area, shop, or wherever on-site surface roughness testing is required.

**NOTE:** Even though this instrument is designed and built to withstand the rigors of handling and use, it is a precision instrument and should be treated with care to assure measurement accuracy and reliable performance.

*All Roughness Testers include:*
- Roughness unit
- General purpose probe
- Certified specimen (nominal)
- 9 volt alkaline battery
- Riser plate for calibration
- Screwdriver

**Model 14-415-4** is furnished with a certified specimen and 0.0004" probe.
* Probe supplied with a 90° conical diamond stylus, 0.0004" (10µm) radius per ANSI-B46, ISO and MIL specs.

**Model 14-416-2** is furnished with a certified specimen and 0.0002" probe.
* Probe supplied with a 90° conical diamond stylus, 0.0002" (5µm) radius per DIN-4768 and certain ISO specs.
### 2. Specifications

- **Measuring ranges:**
  - Ra: 0.03 µm~6.3 µm/1 µ"~250 µ"
  - Rz: 0.2 µm~25.0 µm/8 µ"~999 µ"
- **Display Resolution:** 0.01 µm/1 µ"
- **Cut-off:** 0.25mm/0.8mm/2.5mm, ANSI 2RC Filter
- **Display:** 3-digital LCD
- **Measure Accuracy:** Meets ISO and DIN standards

#### Traverse lengths and Evaluation lengths:

**Cut-off = 0.25mm/0.010"**

<table>
<thead>
<tr>
<th>Traverse length</th>
<th>Evaluation length</th>
<th>Numbers of cutoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75mm/0.030&quot;</td>
<td>0.25mm/0.010&quot;</td>
<td>1</td>
</tr>
<tr>
<td>1.25mm/0.050&quot;</td>
<td>0.75mm/0.030&quot;</td>
<td>3</td>
</tr>
<tr>
<td>1.75mm/0.070&quot;</td>
<td>1.25mm/0.050&quot;</td>
<td>5</td>
</tr>
</tbody>
</table>

**Cut-off = 0.8mm/0.030"**

<table>
<thead>
<tr>
<th>Traverse length</th>
<th>Evaluation length</th>
<th>Numbers of cutoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2mm/0.048&quot;</td>
<td>0.8mm/0.032&quot;</td>
<td>1</td>
</tr>
<tr>
<td>3.0mm/0.119&quot;</td>
<td>2.4mm/0.095&quot;</td>
<td>3</td>
</tr>
<tr>
<td>4.5mm/0.178&quot;</td>
<td>4.0mm/0.157&quot;</td>
<td>5</td>
</tr>
</tbody>
</table>

**Cut-off = 2.5mm/0.10"**

<table>
<thead>
<tr>
<th>Traverse length</th>
<th>Evaluation length</th>
<th>Numbers of cutoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0mm/0.119&quot;</td>
<td>2.5mm/0.10&quot;</td>
<td>1</td>
</tr>
</tbody>
</table>

- **Probe type:** Piezoelectric
- **Maximum stylus force:** 15.0mN/1500mgf
- **Power:** 9-volt consumer-type alkaline battery
- **Battery capacity:** Approx. 3000 measurements
- **Operating temperature:** 10°~45°C / 50°~113°F
- **Storage temperature:** 0°~60°C / 32°~147°F
3. Measurement Parameters

**Ra**  Roughness Average— the arithmetic average height of roughness irregularities measured from a mean line within the evaluation length (L).

\[ Ra = \frac{1}{L} \int |y| \, dx \approx \frac{y_1 + y_2 + y_3 + \ldots + y_n}{n} \]

**Rz**  Maximum Roughness Depth— the largest of the peak-to-valley roughness depths in the evaluation length.
4. Features

1. Digital display
2. Start button
3. Parameter selection button
4. Cut-off selection button
5. Traverse length switch
6. in/mm switch
7. On/Off switch
8. Output connector (optional)
9. Battery compartment (9V alkaline)
10. Battery compartment cover
11. Protective cover
12. "V" feet
13. Probe holding block
14. Probe
5. **Battery installation / replacement (Alkaline ONLY)**

1. Remove Protective Cover from the gage base and slide Battery Compartment Cover off end of the gage.
2. Install/replace battery and replace Battery Compartment Cover.
3. Set On/Off switch for "on" to check battery condition (see next section).

6. **Controls and digital display**

![Diagram of control panel]

1. Set power switch to "On". It should display "1-000". If there is no display or if it displays "8-888", it indicates a weak battery, and you must remove and replace the battery.
2. Set mm/inch switch for Metric (µm) or Inch (µ"). Set cut-off selection switch for 0.25mm, 0.8mm, 2.5mm, based on the roughness value to be estimated. Refer to Table 1.
   
   Set traverse length switch for 1, 3 or 5. Refer to Specification section's traverse length for detail.
3. Press and release "Start" button. The readout should display "1-X.XX" (Ra). If the readout displays "8-888", it is indicating a low battery and you need to replace the battery.
4. If the Ra or Rz value displayed is out of the measuring range which accordance with selected Cut-off, then re-select the Cut-off. Refer to table 1.
5. The digital display will alternate between "2-X.XX" (Rz) by pressing and releasing the parameter selection button.

**Table 1:**

<table>
<thead>
<tr>
<th>Measuring ranges (Ra)</th>
<th>Measuring ranges (Rz)</th>
<th>Cut-off (um)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.03µm Ra 0.1µm</td>
<td>0.1µm Rz 0.5µm</td>
<td>0.25mm</td>
</tr>
<tr>
<td>0.1µm Ra 2.0µm</td>
<td>0.5µm Rz 10.0µm</td>
<td>0.8mm</td>
</tr>
<tr>
<td>2.0µm Ra 6.3µm</td>
<td>10.0µm Rz 50.0µm</td>
<td>2.5mm</td>
</tr>
</tbody>
</table>
7. Calibration

**Prior to operating the tester, its calibration should be checked.**

1. The tester is calibrated using the reference specimen. Set cut-off selection switch to position "0.8mm", set the traverse length switch to position "5" and set the mm/inch switch to position "Metric". Place the specimen into the groove of the calibration plate and place the tester on the calibration plate. Make sure that the probe stylus is in the middle of the specimen.

2. Press and release the Start button and take a reading from the center of the specimen. If the reading is within ±0.02µm of the value stated on the calibration certificate, calibration is within tolerance. If the reading differs from the value stated on the calibration certificate by more than ±0.02µm, take additional readings around the central area of the specimen. If the reading still differs by more than the allowable tolerance, recalibrate the tester using the procedure below.

   A. Using a screwdriver, carefully adjust the calibration control as follows:
      - Clockwise to increase the displayed Ra value, or
      - Counter clockwise to decrease the displayed Ra value.

   B. After adjusting the calibration control, remeasure the reference specimen to assure that the tester is within the calibration tolerance.

   C. When calibrating with a Small Bore Probe or Groove Bottom Probe, the probe should be in the 180° position. Make sure that the tester base is at the same height as the surface of the calibration specimen.
8. Operation

The tester will operate in any one of four probe positions. Selection of the proper position depends on the application.

When changing probe positions, gently grasp the probe by its body, (NEVER HANDLE THE PROBE BY ITS SKID OR STYLUS END). During the measuring cycle, the probe stylus and skid should be in contact with a surface and the setup should be properly aligned otherwise any readings obtained are not valid and are not to be used for measurement or tester performance evaluation purposes. The tester can be hand held or placed on a surface in any attitude. It will operate in virtually any position, horizontally/vertically, or at any angle in between, even upside-down.

With the probe positioned on the workpiece surface to be measured, carefully adjust the tester and workpiece setup so that the Reference line (the upside of the Probe Mounting Block) is parallel to the bottom of the tester housing and parallel to the workpiece’s surface (see below). This ensures that the probe skid and stylus are flush to the work surface even though the probe body will be at an angle to the work surface.
General Purpose Probe (14-417-0 or 14-418-8)

- For most surface roughness applications. **14-417-0** has a 90° conical diamond stylus, 0.0004"/10µm radius per ISO specifications. **14-418-8** has a 90° conical diamond stylus, 0.0002"/5µm radius per DIN standards.

Traverse Chisel Probe (14-421-2)

- For gaging sharp edges or small O.D.’s where the probe is aligned at 180° or in closed position 90° diamond chisel stylus, 0.0004"/10µm radius.

Parallel Chisel Probe (14-422-0)

- For gaging sharp edges or small O.D.’s where probe is perpendicular (in 90° or 270° position) to axis of traverse. 90° diamond chisel stylus, 0.0004"/10µm radius.
Small Bore Probe (14-419-6 or 14-420-4)

- For measuring small bores (min. inside diameter of 5.0mm, up to a depth of 15.0mm). 90° conical diamond stylus, 0.0004”/10µm radius for 14-419-6; 0.0002”/5µm radius for 14-420-4.

Groove Bottom Probe (14-423-8)

- For measuring the bottoms of "O" ring grooves, recesses and holes to a depth of 6.0mm. Also used for short lands and shoulders. 90° conical diamond stylus, 0.0004”/10µm radius.
10. Probe Replacement

1. Turn the tester upside down and swivel the probe to its 90° position.
2. Loosen the knurled locking collar by turning it counter-clockwise approximately 3 turns until the access slot is aligned with the probe pin slot in the probe mounting block. Grasp the probe by its body section and carefully withdraw the probe from its mounting block and the knurled locking collar. Do not grasp the probe by its skid and stylus end. Do not remove the knurled locking collar from the probe mounting block loosen it only enough to slide the probe out easily.
3. Reverse the procedure to install a probe, aligning the pin on the bottom of the probe body with the access slot in the locking collar. Make sure that the probe is fully inserted into the probe mounting block so that the electrical connector is completely engaged before tightening the locking collar. Finger tighten only.
4. Check the tester’s calibration after changing probes.
11. Maintenance

Protection & Storage

To protect the tester when not in use, always return the probe to its closed position and replace the Protective Cover on the tester unit. When not in use, always keep the tester and its accessories in the fitted case.

Cleaning

To clean the tester unit, use a soft, lint-free cloth moistened with a mild, non-abrasive, liquid cleaning agent. Using a magnifier, periodically inspect the probe skid and stylus area for dust, dirt or other contamination. To clean the probe skid and stylus, use a soft (camel’s hair) artist’s brush moistened with denatured alcohol.

Repairs

If you encounter any trouble with the tester please contact the Service Department at the phone number listed on the back cover of this manual.

Do not disassemble the unit or attempt any further repairs.
The Height Stand is intended to be used on a surface plate or other suitably flat surface to measure workpiece surfaces ranging in height from flush with the work surface to a maximum height of approximately 6.9"/175mm. The tester probe can be in either its 90° or 180° position.

1. Mount the tester in the bracket on the height stand using the captive screw in the base of the bracket. The screw mates with the tapped hole in the bottom of the tester housing. Tighten the screw finger tight.

2. Position the height stand so that the probe is above the workpiece surface to be measured. Use the coarse height adjustment to bring the probe skid and stylus slightly in contact with the surface. Use the fine adjustment to make the Reference Line (the upside of the mounting block) parallel to the bottom of the tester housing.

3. Once the setup is correctly adjusted and the probe is properly positioned on the workpiece surface, gently press and release the Start button on the tester to make the measurement.