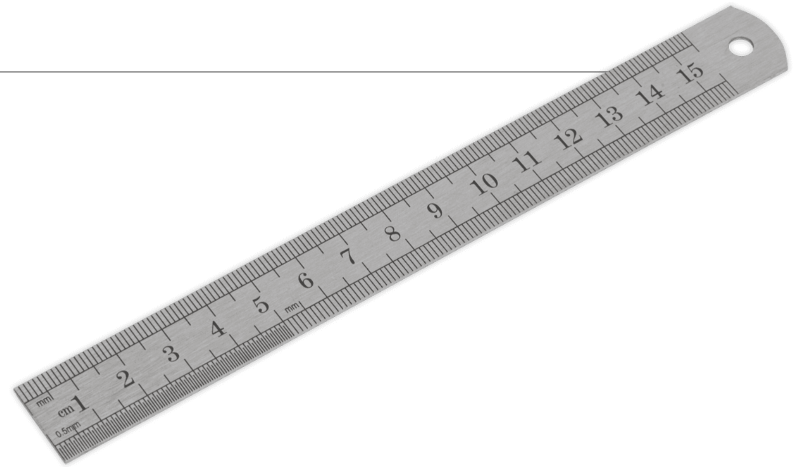
Measuring Devices

YORK COLLEGE & UNIVERSITY CENTRE

Rule

- **Purpose:**
  - Used for basic linear measurements such as length, width, or height.
  - Common in quick checks and layout work where high precision is not critical.



- **Description:**
  - A flat, straight strip of steel or stainless steel marked in millimetres and inches.
  - Often includes zero at the edge for direct measurement.
  - Typically ranges from 150 mm to 600 mm in length.

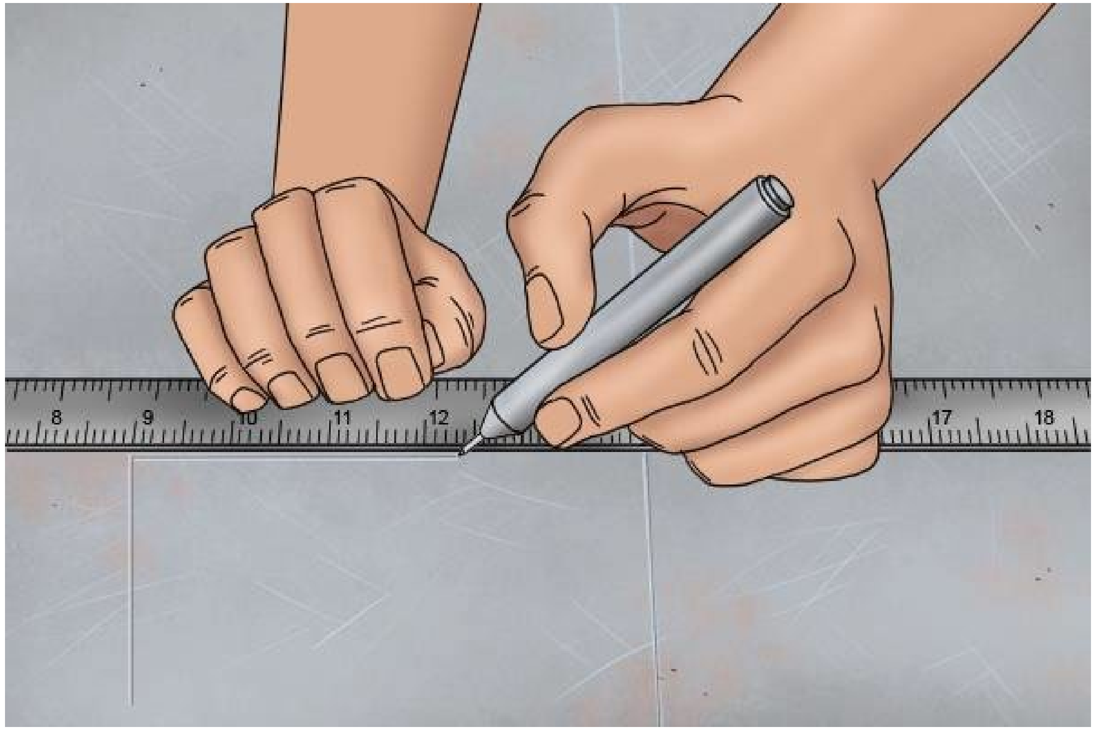
Characteristic	Value / Note
Typical resolution	1 mm
Typical accuracy	±0.5 mm
Advantages	Quick, simple, no calibration needed
Limitations	Low precision, user-dependent reading error

Rule

1. Align the rule carefully with the part edge.

2. Read the value at the line of measurement (avoid parallax).

3. If measuring depth or height, use the rule's edge as a reference surface.



Vernier Callipers

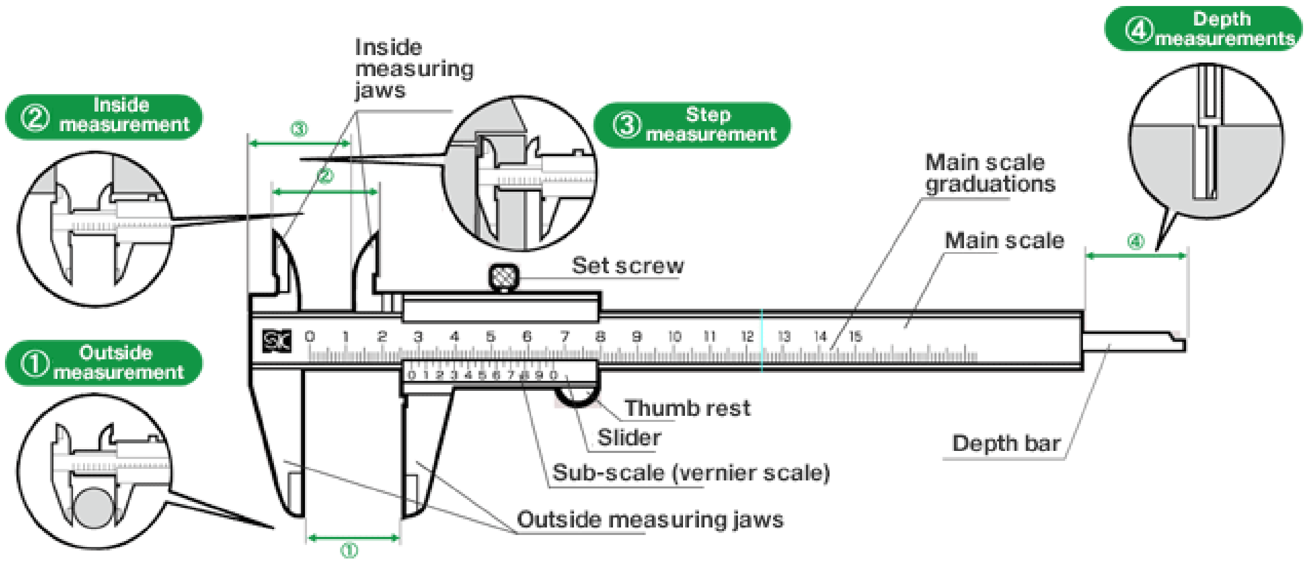
- **Purpose:**
  - Used to measure external, internal, and depth dimensions with higher precision than a rule.
  - Common in workshops for checking diameters, widths, and depths of components.

- **Description:**
  - Consists of a main scale and a vernier scale that slides along it.
  - Two pairs of jaws (external and internal) plus a depth rod.
  - The vernier scale allows readings between the smallest divisions on the main scale.

Characteristic	Typical Value / Note
Resolution	0.02 mm (manual) 0.01 mm (digital)
Accuracy	±0.02–0.03 mm
Advantages	Versatile, measures inside/outside/depth
Limitations	Requires skill, prone to parallax (manual), sensitive to dirt

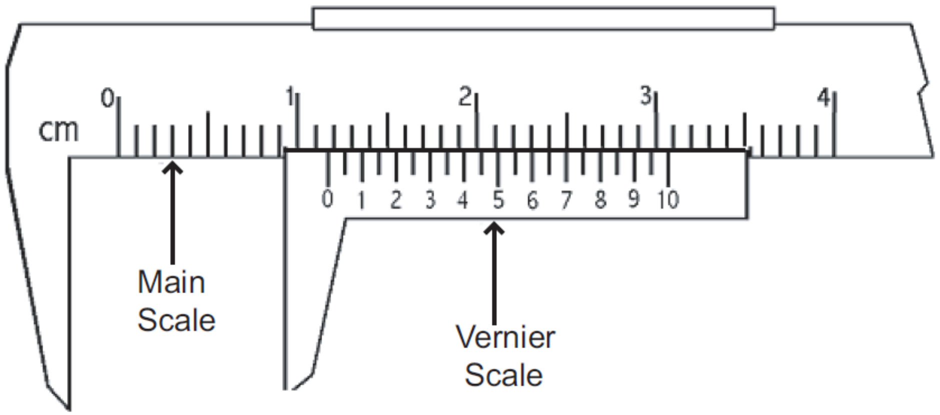
Vernier Callipers

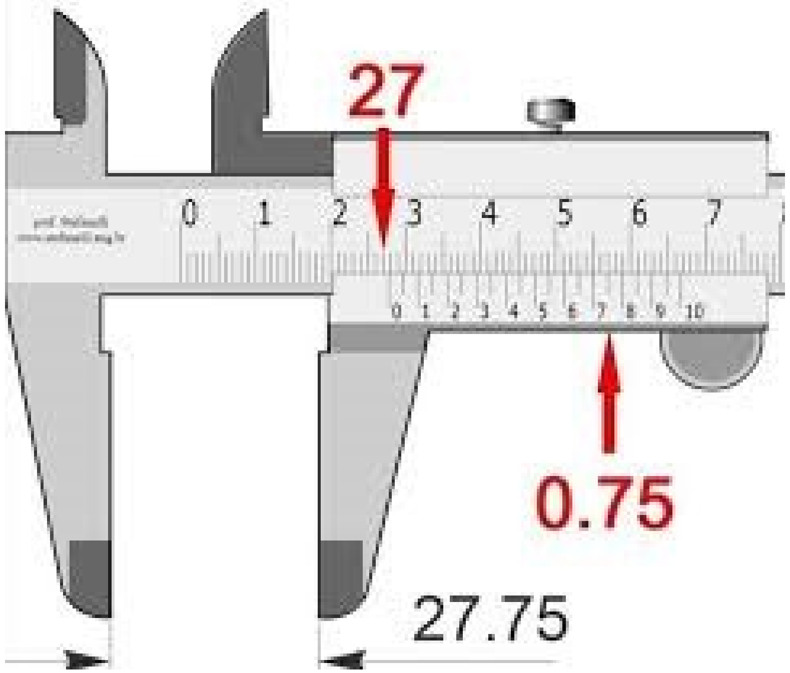
1. Zero the calliper before use (close jaws and check reading).
2. Clamp the jaws gently on the component — avoid excessive pressure.
3. Read the main scale first, then add the vernier scale value.
4. For depth, extend the depth rod until it touches the surface.



Vernier Callipers

- When reading a vernier calliper, we follow these steps
- First, we look at the 1mm increments to see the whole mm
- Secondly, we look at the vernier scale and see what line lines up with a line on the 1mm scale, this becomes our decimals





Micrometre

- **Purpose:**
  - Used for high-precision measurement of small dimensions such as diameter, thickness, or depth.
  - Provides greater accuracy than vernier callipers due to finer screw pitch and mechanical amplification.

- **Description:**
  - Operates using a spindle and anvil connected by a screw thread (typically 0.5 mm per revolution).
  - A thimble scale and sleeve scale combine to give fine readings.
  - Common types:
    - Outside micrometre – measures external diameters or thickness.
    - Inside micrometre – measures internal diameters.
    - Depth micrometre – measures hole or slot depths.

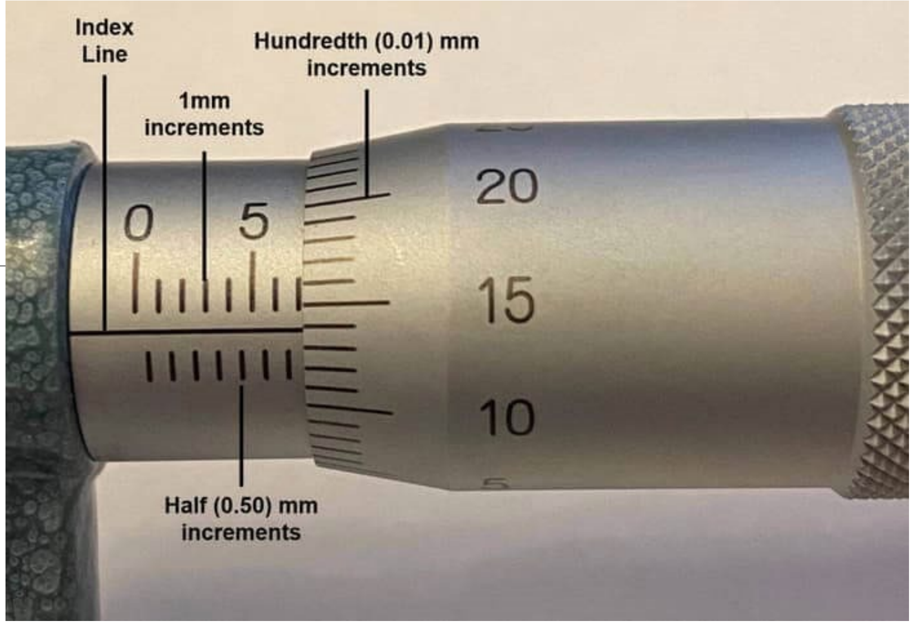
Characteristic	Typical Value / Note
Resolution	0.01 mm (mechanical), 0.001 mm (digital)
Accuracy	±0.005–0.01 mm
Advantages	Very precise, repeatable, mechanical consistency
Limitations	Measures one dimension only, limited range, sensitive to temperature and dirt

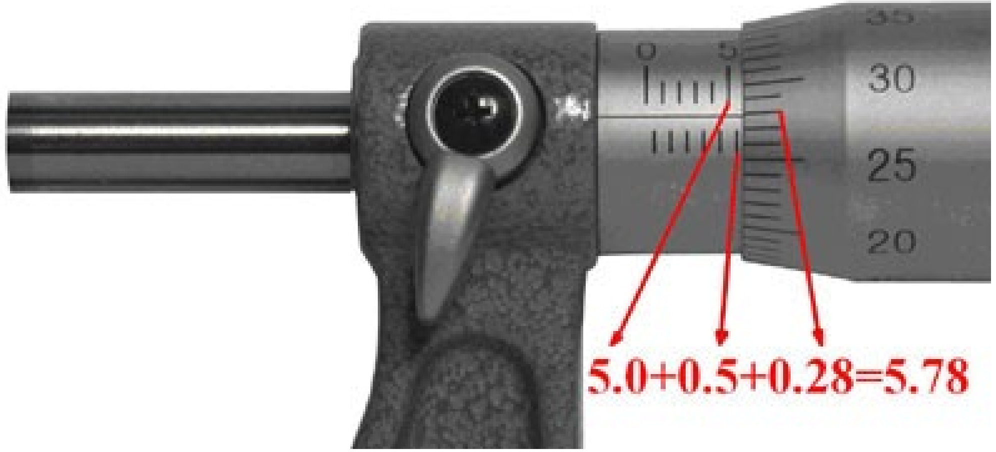
Micrometre

1. Clean the anvil and spindle faces.
2. Zero the instrument using a setting gauge or reference piece.
3. Place the part between the anvil and spindle.
4. Use the ratchet stop to apply consistent measuring force.
5. Read the sleeve and thimble scales to obtain the total measurement.

Micrometre

- When reading a micrometre, we follow these steps
- First, we look at the 1mm increments to see the whole mm
- Secondly, we look at the 0.5mm increments and we add it the first value
- Thirdly we see what line lines up on the secondary scale and then also add that value as a decimal





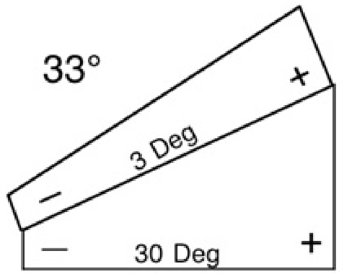
Angular Gauge

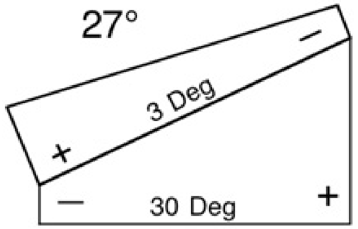
- **Purpose:**
  - Used to set or check precise angles on tools, jigs, or components.
  - Common in machining, inspection, and fixture setup.

- **Description:**
  - Made of hardened steel or ceramic blocks with accurately ground angles.
  - Can be stacked or combined to form required angles.
  - Provide standard angular references similar to slip gauges for linear measurement.

Characteristic	Typical Value / Note
Typical Range	0°–90° (in combinations)
Accuracy	±0.01°
Advantages	Compact, quick to use, no calibration drift
Limitations	Fixed angles only, delicate surfaces

Angular Gauge





1. Clean the gauge blocks and your hands to remove oil or dust.
2. Select blocks that add up to the required total angle.
3. Wring the blocks together with a gentle sliding and twisting motion until they adhere.
4. Place the assembled gauge against the tool or component surface.
5. Check for light gaps or misalignment to verify the angle.
6. After use, separate carefully, clean, and lightly oil before returning to storage.

Slip Gauges (Gauge Blocks)

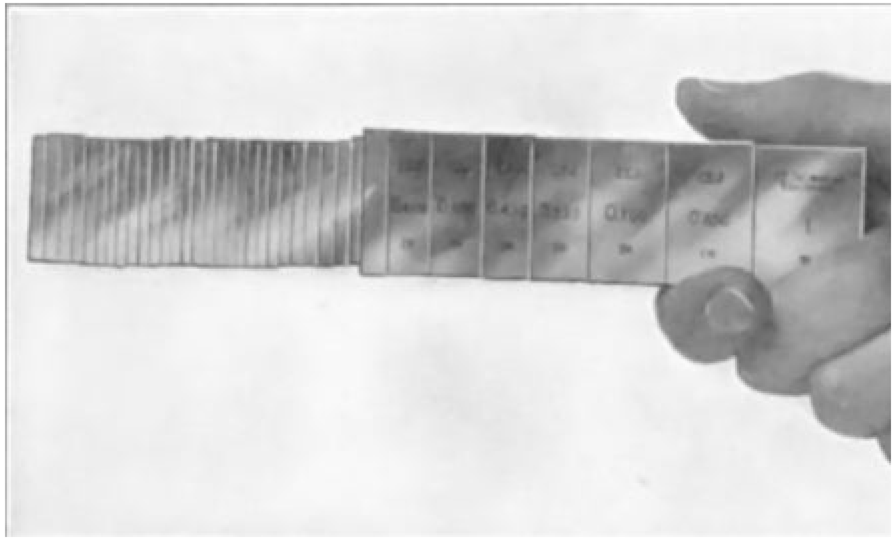
- **Purpose:**
  - Provide precise length standards for calibration and dimensional checking.
  - Foundation of traceable measurement systems in engineering.

- **Description:**
  - Made of steel, carbide, or ceramic with optically flat faces.
  - Supplied in sets (e.g., 81 or 103 blocks).
  - Surfaces are so flat they can adhere together by molecular attraction – “wringing.”

Characteristic	Typical Value / Note
Resolution	As fine as ±0.0001 mm
Advantages	Extremely accurate, stable reference
Limitations	Fragile, time-consuming to use, sensitive to dirt & temperature

Slip Gauges (Gauge Blocks)

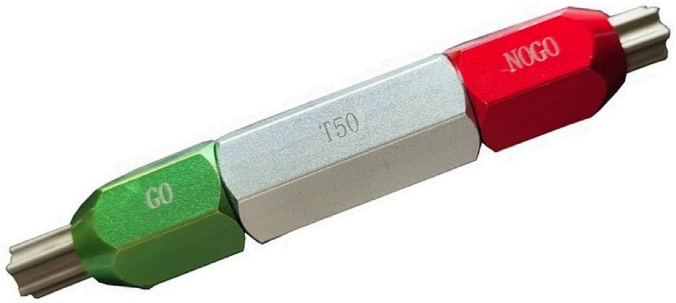
1. Clean the gauge blocks and your hands to remove oil or dust.
2. Select blocks that add up to the required total length.
3. Wring the blocks together with a gentle sliding and twisting motion until they adhere.
4. Place the wrung stack under or between the instrument jaws to provide a reference length.
5. After use, separate carefully, clean, and lightly oil before returning to storage.



Go/No-Go Gauges

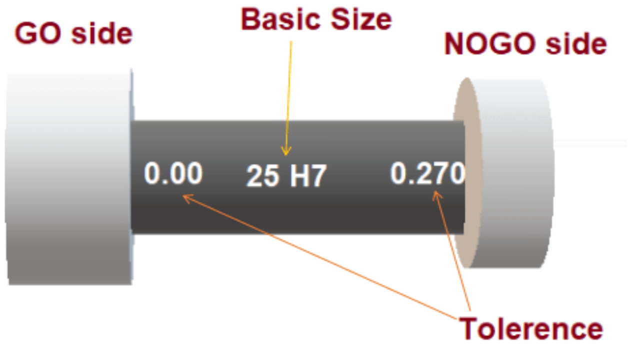
- **Purpose:**
  - Used for rapid inspection to determine if a part lies within tolerance limits.
  - Common in mass production and quality control.

- **Description:**
  - Each gauge has two limits:
    - “Go” end checks minimum dimension (should fit).
    - “No-Go” end checks maximum dimension (should not fit).
  - Available as plug gauges (holes) or ring gauges (shafts).



Characteristic	Typical Value / Note
Accuracy	±0.01–0.02 mm
Advantages	Fast, no interpretation, ideal for repetitive checks
Limitations	Gives no actual size, only fit/no-fit result

Go/No-Go Gauges



1. Ensure the gauge and component are clean and free from burrs.
2. Identify the “Go” and “No-Go” ends of the gauge.
3. Insert the Go end into or onto the part — it must fit without force.
4. Insert the No-Go end — it must not fit.
5. Record the result as pass or fail based on the outcome.
6. After use, clean and store the gauge to prevent wear or damage.

Go/No-Go Gauges

Dial Test Indicator (DTI)

- **Purpose:**
  - Used to measure small deviations, alignment errors, and surface flatness.
  - Commonly applied in machining, setup, and inspection to detect runout or misalignment.

- **Description:**
  - A spring-loaded plunger moves a needle on a dial to show displacement.
  - Available in lever-type (test indicator) or plunger-type (dial indicator) designs.
  - Mounted on a magnetic stand for positioning against work surfaces.

Characteristic	Typical Value / Note
Resolution	0.01 mm (standard) / 0.001 mm (high precision)
Accuracy	±0.005–0.02 mm
Advantages	Detects very small deviations, ideal for alignment work

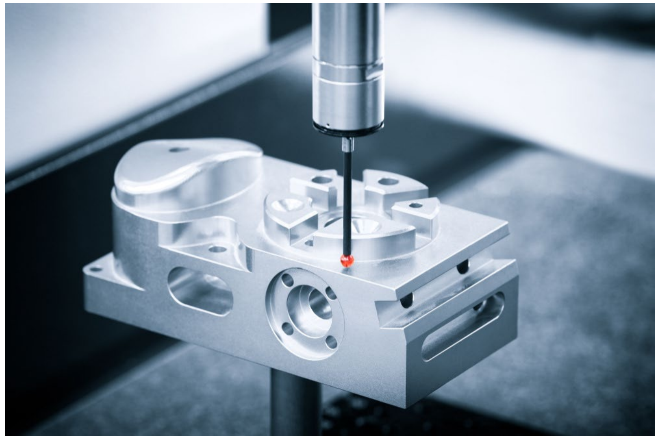
Dial Test Indicator (DTI)

1. Mount the DTI securely using a magnetic base or fixture.
2. Zero the dial by adjusting the bezel against a reference surface.
3. Move or rotate the workpiece — the needle shows variation from zero.
4. Read the total movement on the dial to determine error or runout.
5. Record maximum and minimum readings for analysis.

Dial Test Indicator (DTI)

Coordinate Measuring Machine (CMM)

- **Purpose:**
  - Used to measure complex geometries in three dimensions with high precision.
  - Common in quality control, inspection, and reverse engineering.



- **Description:**
  - A CMM uses a probe (touch-trigger, scanning, or optical) to detect part surfaces.
  - The probe moves along X, Y, and Z axes, recording exact coordinates.
  - Controlled manually or by computer using CNC or software interface.

Characteristic	Typical Value / Note
Resolution	Up to 0.001 mm
Accuracy	±0.002–0.01 mm
Advantages	Extremely precise, automated, handles complex parts

Coordinate Measuring Machine (CMM)

1. Secure the workpiece on the CMM table.
2. Reference (home) the machine to establish coordinate axes.
3. Probe key features or surfaces as defined in the measurement program.
4. Software calculates distances, angles, and geometric tolerances.
5. Review measurement report for deviations from design dimensions.