

Granite Square Ruler Introduction

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1. Product Introduction

1.1 Definition and Function

A granite square ruler is a precision measuring instrument fabricated from high-quality natural granite. Shaped in a right-angled square, it features two mutually perpendicular surfaces that serve as reference planes for accurately measuring geometric accuracy, including perpendicularity, parallelism, and straightness. Its core function is to provide a highly stable and accurate standard for inspecting the angular and linear dimensions of workpieces, fixtures, and machine tools. For instance, in the assembly of precision CNC machines, a granite square ruler can be used to check whether the spindle axis is perpendicular to the worktable. By comparing the surfaces of the machine components with the perpendicular surfaces of the square ruler, any deviation from the ideal 90-degree angle can be precisely detected, ensuring the machine's machining accuracy and proper operation.

1.2 Structure and Components

- **Base Material:** Constructed from dense, fine-grained granite, the square ruler benefits from the material's excellent physical properties. Granite has a low coefficient of thermal expansion, which means it maintains its dimensions even under significant temperature fluctuations, ensuring consistent measurement accuracy. It is also highly resistant to corrosion, wear, and magnetic interference, enabling long-term and reliable use in various industrial environments.
- **Surfaces:** The two main working surfaces of the granite square ruler are precision ground and lapped to achieve an extremely high level of flatness and perpendicularity. The flatness tolerance can be as low as a few micrometers, and the perpendicularity between the two surfaces is typically within very tight limits, often within 0.001 - 0.003 mm over a specified length. The surfaces are polished to a smooth finish, reducing friction when in contact with workpieces and ensuring accurate measurement results.
- **Shape and Dimensions:** Granite square rulers usually come in rectangular or square shapes, with common sizes such as 100×100 mm, 200×200 mm, 300×300 mm, etc. Larger sizes are suitable for inspecting larger workpieces or machine components, while smaller ones are more convenient for measuring smaller parts or in confined spaces. Some square rulers may have additional features, like holes or grooves on the surfaces, which can be used for mounting fixtures or accessories during measurement operations.

1.3 Working Principle

The working principle of a granite square ruler is based on its precise geometric design and the stability of its material. When measuring perpendicularity, one surface of the square ruler is firmly placed against a reference surface of the workpiece or machine tool, and the other surface is used to check the perpendicularity of the target surface. A dial indicator or other measuring devices can be used in combination with the square ruler. If the target surface is perpendicular to the reference surface, the reading of the dial indicator will remain constant as it moves along the surface of the square ruler; any variation in the reading indicates a deviation from perpendicularity. When measuring parallelism, the square ruler is placed between two surfaces, and the distance between the surfaces and the square ruler is

measured at multiple points. Consistent measurements across these points indicate parallelism, while differences suggest a lack thereof. The stable nature of the granite material ensures that the reference surfaces of the square ruler remain accurate during the measurement process, providing reliable and repeatable results.

2. Application Scenarios

2.1 Precision Machining

In precision machining, granite square rulers are essential for quality control. They are used to check the perpendicularity of machine tool slides, the alignment of fixtures, and the flatness of workpieces after machining. For example, in the production of high-precision molds, the square ruler can be used to verify that the sides of the mold cavity are perpendicular to the base, which is crucial for the proper release of the molded products and the overall quality of the molds. Additionally, when setting up a machining operation, the granite square ruler helps ensure that the workpiece is correctly positioned, and the cutting tool will move along the desired perpendicular or parallel paths, improving the accuracy and quality of the machined parts.

2.2 Metrology and Calibration

Metrology and calibration laboratories rely on granite square rulers as reference standards. They are used to calibrate other measuring instruments, such as angle gauges, spirit levels, and coordinate measuring machines. By comparing the measurements of these instruments with the known accuracy of the granite square ruler, technicians can adjust and verify the accuracy of the instruments. This process is vital for maintaining the traceability and reliability of measurement results in various industries, ensuring that all measurements are consistent and accurate.

2.3 Aerospace and Defense Manufacturing

In the aerospace and defense industries, where components must meet extremely strict tolerances, granite square rulers play a critical role. They are used to inspect the perpendicularity and flatness of aircraft structural parts, engine components, and missile guidance systems. For example, in the assembly of aircraft wings, the square ruler is used to ensure that the ribs and spars are perpendicular to each other, which is essential for the structural integrity and aerodynamic performance of the wing. The high precision and stability of the granite square ruler help detect even the slightest deviations, ensuring the safety and reliability of aerospace and defense equipment.

2.4 Optical Instrument Manufacturing

Optical instrument manufacturing requires high levels of precision, and granite square rulers are used to ensure the proper alignment of optical components. They are used to check the perpendicularity of lens mounts, the flatness of mirrors, and the alignment of optical benches. Accurate alignment is crucial for the performance of optical instruments, such as telescopes, microscopes, and cameras. By using granite square rulers, manufacturers can ensure that the optical components are positioned correctly, resulting in clear and sharp images.

3. Maintenance and Troubleshooting

3.1 Maintenance

- **Regular Cleaning:** After each use, the granite square ruler should be cleaned thoroughly. Use a soft-bristle brush and a mild cleaning agent to remove any dirt, debris, metal shavings, or oil from the surfaces. Avoid using abrasive cleaners or tools

that could scratch the surface. Rinse the square ruler with clean water and dry it carefully using a clean, lint-free cloth. Regular cleaning helps prevent the accumulation of contaminants that could affect the measurement accuracy.

- **Inspection for Damage:** Periodically inspect the granite square ruler for any signs of damage, such as cracks, chips, or scratches. Even minor damage on the working surfaces can cause inaccuracies in measurement. Check the edges and corners of the square ruler, as these areas are more prone to damage during handling. If any damage is detected, the square ruler should be repaired or replaced immediately.
- **Proper Storage:** Store the granite square ruler in a clean, dry place. It is recommended to use a protective case or a dedicated storage rack to prevent the square ruler from being damaged during storage. Avoid storing the square ruler in an environment with high humidity or extreme temperatures, as these conditions can cause the granite to expand, contract, or corrode. When not in use, the square ruler should be placed on a stable and level surface to prevent deformation.
- **Calibration:** Regular calibration is necessary to maintain the accuracy of the granite square ruler. Calibration should be carried out using a high-precision reference standard, such as a master granite square ruler or a calibrated angle block. The calibration process involves checking the flatness and perpendicularity of the square ruler against the reference standard and making any necessary adjustments. Calibration intervals may vary depending on the frequency of use and the criticality of the measurements, but generally, it is advisable to calibrate the granite square ruler at least once a year.

3.2 Troubleshooting

- **Inaccurate Measurements:** If the measurements taken using the granite square ruler are inaccurate, first check if the square ruler is clean and undamaged. Re-clean the square ruler and perform a detailed inspection for any signs of wear or damage. If the square ruler appears to be in good condition, the issue may be related to calibration. Re-calibrate the square ruler as per the calibration procedure. Additionally, ensure that the measuring devices used in conjunction with the square ruler, such as dial indicators, are properly calibrated and used correctly.
- **Surface Irregularities:** If the surfaces of the granite square ruler show irregularities, such as small bumps or depressions, it may be due to damage or wear. For minor surface imperfections, a professional may be able to refinish the surface through precision grinding and lapping. However, if the damage is severe, the square ruler may need to be replaced.
- **Perpendicularity Deviation:** If the perpendicularity between the two surfaces of the granite square ruler is found to be off, it could be due to damage, improper handling, or long-term wear. First, check for any visible damage on the edges or surfaces. If no damage is apparent, re-calibrate the square ruler. If the problem persists, it may be necessary to send the square ruler to a professional calibration laboratory for repair or adjustment.

4. Performance Characteristics

- **High Precision:** Granite square rulers offer extremely high precision in measuring geometric accuracy. With flatness and perpendicularity tolerances within very tight

limits, they are capable of detecting even the slightest deviations in workpieces, making them suitable for applications that demand the highest level of precision, such as in ultra-precision machining and high-end metrology.

- **Dimensional Stability:** Due to the low thermal expansion coefficient of granite, the dimensions of the square ruler remain stable under varying temperature conditions. This stability ensures consistent measurement results over time, reducing the need for frequent recalibration and minimizing errors caused by thermal effects.
- **Durability:** Made from durable natural granite, square rulers are resistant to corrosion, wear, and impact. They can withstand the rigors of regular use in industrial environments without significant degradation in performance, providing long-term reliability for measurement tasks.
- **Vibration Damping:** The dense structure of granite effectively absorbs vibrations, providing a stable platform for measurement. This vibration-damping property helps eliminate errors caused by external disturbances, enabling more accurate and reliable measurements, especially in environments with machinery or other sources of vibration.
- **Ease of Use:** Granite square rulers have a simple and straightforward design, making them easy to use for operators with basic knowledge of measurement techniques. Their smooth surfaces and stable structure allow for quick and accurate alignment with workpieces, improving the efficiency of the measurement process.

