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འབྲུག་རྒྱལ་ཁབ་གནས་ཚུལ།

BHUTAN STANDARD

Stone Pigment



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FOREWORD

This Bhutan Standard for Stone pigment was drafted by Sub-Committee on Stone Pigment SC 04 and adopted by Bhutan Standards Bureau after the draft finalized by the Textile and Handicraft Technical Committee TC 06 and approved by the **Governing Body in June 2025**.

This standard is subject to systematic review after five years to keep pace with the market trends, industrial and technological developments. Any suggestions and further information may be directed to the concerned Technical Committee.

1 Introduction

The use of mineral-based stone pigments in Bhutan is an ancient—visit of Zhabdrung in the 17th century—practice intricately tied to the country’s spiritual, artistic, and architectural traditions.

Traditional stone pigments have been used for centuries in Bhutanese murals, thangkas, manuscripts, and sacred architecture.

Pigment preparation was considered both a technical and spiritual practice—symbolizing purification, discipline, and devotion.

Stones were sourced from Bhutan’s geologically rich landscapes, with regional variations in mineral content contributing to unique hues and textures.

Artisans identified and selected stones based on visual inspection, experience, and local knowledge.

The traditional process involved multiple stages: stone selection, crushing, grinding, sedimentation, fermentation, and testing.

These stages refined the pigment’s texture, stability, and colour intensity—especially through fermentation and particle separation.

grading, and safe processing methods aligned with cultural heritage

2 Scope

This standard defines the procedures and requirements for producing stone-based pigments, specifically focusing on the traditional Bhutanese methods of extraction, preparation, fermentation, grading, and testing. It outlines the sample material types, step-by-step pigment processing techniques, and quality parameters to ensure consistency, safety, and adherence to Bhutan’s time-honoured pigment-making and painting practices.

3 Normative References

No normative references are cited.

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4 Terms and Definitions

For the purpose of this standard, the following definitions shall apply:

Stone Pigment (རྩོམ་མེད་ - *rdo tshon*)

Refers to the raw materials, specifically mineral-rich stones, used in the extraction of pigments for traditional Bhutanese painting. These stones are carefully sourced and processed to obtain pigments integral to Bhutan's artistic heritage.

Pigment (མེད་ - *tshon*)

Mineral pigments extracted from specific stones through processes such as crushing, pounding, grinding, and pulverization. These pigments are integral to Bhutan's artistic heritage.

Black Stone (Carbonaceous Phyllite – རྩོམ་མེད་ལྗང་མེད་)

Refers to pigments derived from carbonaceous phyllite, commonly known as Black Slate or Benighat Slate. These stones are processed to extract deep black hues, traditionally used in Bhutanese painting.

Red Stone (Ferruginous Schist – རྩོམ་མེད་ལྗང་མེད་)

Refers to pigments obtained from ferruginous schist, an iron-rich metamorphic rock. The iron content in these stones imparts a rich red color, integral to traditional Bhutanese artworks.

Brownish Yellow Stone (Limonitic Micaceous Schist – རྩོམ་མེད་ལྗང་མེད་)

Refers to pigments sourced from limonitic micaceous schist. These stones yield yellow to brown shades, commonly used in Bhutanese painting.

Red Stone (Gossan – རྩོམ་མེད་ལྗང་མེད་)

Refers to pigments extracted from red gossan, the oxidized portion of sulfide mineral deposits. The oxidation of iron minerals in these stones produces a vivid red pigment.

Greenish Yellow Stone (Gossan – རྩོམ་མེད་ལྗང་མེད་)

Refers to pigments derived from greenish yellow stone (gossan). It also gives various colour ranges depending on the mineral content.

Dark Grey/ Black Stone (Graphite – རྩོམ་མེད་ལྗང་མེད་)

Refers to pigments obtained from graphite, a naturally occurring form of crystalline carbon. The high carbon content in graphite imparts a dark grey to black color, used in Bhutanese painting.

Reddish-Brown/Black Stone (Hematite-Magnetite – རྩོམ་མེད་ལྗང་མེད་)

Refers to pigments sourced from a combination of hematite and magnetite minerals. The interplay of these iron oxides yields reddish-brown to black hues in traditional artworks.

Grey/White Stone (Quartzite – རྩོམ་མེད་ལྗང་མེད་)

Refers to pigments extracted from quartzite, a hard, non-foliated metamorphic rock. These stones provide grey to white pigments, used in Bhutanese painting.

Various Colored Stone (Often Grey) (Schist – རྩ་མུའུ་མུག་པོ་)

Refers to pigments derived from schist, a medium-grade metamorphic rock. Depending on mineral composition, schist yields various colors, often grey, utilized in traditional art.

Brownish-Yellow Stone (Limonitic Laterite – རྩ་མུའུ་མུག་པོ་)

Refers to pigments obtained from limonitic laterite, a soil and rock type rich in iron and aluminum. These stones produce yellow-brown pigments, integral to Bhutanese painting.

Reddish-Orange Stone (Ferrallitic Laterite – རྩ་མུའུ་མུག་པོ་)

Refers to pigments sourced from ferrallitic laterite, characterized by intense weathering in tropical climates. The iron and aluminum oxides in these stones yield brown to red hues, used in traditional artworks.

Sieving (གཞིག་ཅི)

The act of separating pigment particles by size using a mesh sieve, allowing fine particles to pass through while retaining larger ones. This process ensures uniformity in particle size, which is essential for achieving consistent color and texture in the final paint.

Kneading (བརྒྱུས་ཅི)

The process of mixing pigment with a liquid medium, such as water or animal glue, to achieve a smooth and uniform consistency. Kneading ensures that the pigment particles are thoroughly wetted and evenly dispersed, facilitating optimal application and adhesion to surfaces.

Dispersion (བཟང་ཅི)

The process of evenly distributing pigment particles in a liquid medium, creating a uniform suspension. Effective dispersion prevents settling and clumping, ensuring that the paint applies smoothly and maintains consistent color throughout its use.

Sedimentation (ཆགས་བཅུག་ཅི)

The natural settling of pigment particles in a liquid medium, allowing for the separation of fine particles from the liquid. This process can be utilized to purify pigments by removing soluble impurities, resulting in a more vibrant and stable colourant.

Decantation (ཆུ་བཅོལ་ཅི)

The process of carefully pouring off the liquid portion from a mixture, leaving behind settled pigment particles. Decantation is used to separate purified pigments from the liquid medium, facilitating further processing steps such as drying or kneading.

Fermentation (རྩལ་བཅུག་ཅི/དམ་བཅུག་ཅི/རྩལ་བཅུག་ཅི)

A controlled process where microorganisms break down organic materials, sometimes used to enhance the properties of pigments. Fermentation can alter the chemical structure of certain pigments, potentially improving their color intensity, lightfastness, and binder compatibility.

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Pulverization (ཐུ་འབྲུག་ནི)

The act of grinding or crushing dried pigment particles into a fine powder using tools such as a mortar and pestle or mechanical grinders. Pulverization is a critical step in pigment preparation, as it influences the paint's texture, coverage, and overall quality.

Colour Intensity (ཚོ་རྒྱས་པ་):

Colour intensity refers to the vividness, purity, or saturation of a pigment's colour. A high-intensity pigment appears rich, bright, and vibrant, while a low-intensity pigment appears dull, muted, or washed out. Intensity is affected by the pigment's concentration, particle fineness, and purity, and it plays a key role in the visual strength and quality of the final colour in artworks or materials.

Packaging (མཐོང་སྒྲུབ་ནི)

The process of storing pigment powder in suitable containers to protect it from moisture, contamination, and degradation. Proper packaging preserves the pigment's quality and extends its shelf life, ensuring that artists have reliable materials for their work.

Labeling (འཕྲིན་པ་བྱ་ནི)

The practice of affixing appropriate labels to pigment containers, providing essential information such as pigment type, color, batch number, and any relevant safety precautions. Accurate labeling aids in inventory management, ensures traceability, and informs users about the proper handling and usage of the pigments.

Detailed Production Process of Traditional Stone Pigment

1. Material Selection for Traditional Pigment Preparation

- a. **Source Identification** (མཐོང་སྐབས་བཞག་ཞིབ་): Pigment stones are traditionally sourced from mineral-rich locations such as riverbeds, hillsides, valleys and cliffs, chosen based on ancestral/local knowledge of their colour-producing properties.
- b. **Visual Assessment** (བརྒྱུ་ཞིབ་): Stones are selected for their vibrant, uniform color with minimal to no discoloration. Impurities like sand or dark inclusions are avoided to ensure the quality of the pigment.
- c. **Trail Grinding** (ཁྲོལ་བཞག་): A small portion of the selected stone is manually ground on a hard, flat surface using a smooth, white grinding stone or metal slab. This process helps assess the quality and characteristics of the pigment, guiding decisions on further processing methods.

Note: This preliminary testing and selection ensure that only the finest materials are used, preserving the authenticity and quality of traditional Bhutanese pigments.

2. Material Types (མཐོང་སྐབས་བཞག་ཞིབ་)

The material types provide an overview of traditional stone pigments used in traditional Bhutanese artists. Each entry includes the scientific name, common English name, Dzongkha name, and a colour description as follows:

Sl. No.	Scientific Name	Common English Name	Dzongkha Name	Description of Colour
1	Carbonaceous Phyllite	Black Slate/Benighat Slate	དོ་གནག་པོ་ (Do-nag) / རྩ་གསལ་དོག་ (chag dog)	Deep black to charcoal grey, often with a subtle bluish or brownish undertone
2	Ferroginous Schist	Iron-rich Schist	དོ་མཚལ་ (Rdo-mtshal)	Vivid red to brick red, depending on iron oxide concentration
3	Limonitic Micaceous	Limonitic Mica-Schist	དོ་ལེང་ལྷག་ (rdo-ser-nag)	Earthy yellow to yellowish-brown with a slight sheen from mica
4	Gossan (Red)	Red Gossan	དོ་ལི་དམར་ (Do-li-dmar)	Intense red to crimson with rust-like appearance
5	Gossan (Yellow-Brown)	Yellow-Brown Gossan	དོ་ཕུང་ལེར་ (Do-pang-ser)	Warm ochre, brownish-yellow to golden brown
6	Graphite	Graphite	དོ་ཁྱུ་བལ་ (Kya-thal)	Smooth dark grey to near black, often slightly metallic

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7	Haematite Magnetite	Hematite-Magnetite	དོ་སྒྱུག/དོ་ནག་པོ་(<i>Do-smug/Do-nag</i>)	Deep reddish-brown to black, depending on blend ratio of hematite and magnetite
8	Quartzite	Quartzite	དོ་ཀླུ་(<i>Do-kar</i>)	Pale grey to nearly white, may contain slight translucence or sparkle
9	Schist	Schist	དོ་སྒྱུང་མུ་(<i>do-spang-skya</i>) ལྷང་ཁུ་(<i>ljang-khu</i>) སྒྱུ་ཐལ་(<i>skya-thal</i>) གནག་པོ་(<i>gnag-po</i>) དངུལ་མདོག་(<i>dnagul-mdog</i>)	Exhibits a wide colour range, typically spanning from light silvery and greenish tones to medium grey, bluish-grey, and deep charcoal or near black, depending on mineral composition and layer
10	Limonitic Laterite	Limonitic Laterite	དོ་སེར་ནག་(<i>Ser-nag</i>)	Ranges from yellow ochre to muddy brown
11	Ferrallitic Laterite	Ferrallitic Laterite	དོ་ལེ་ནག་(<i>Li-nag</i>)	Rich reddish-brown to earthy brown

Note: The list of material types (pigment types) is not exhaustive and is based on the samples referred to in this document.

3. Pre-Grinding Preparation of Stone Pigments (གཤམ་སྒྲིག)

4. Cleaning the Pigment Stone: (དོ་སྒྱུ་ལྗང་ལྷོ་བྱེད་)

- Soaking for Stubborn Residues (ཆུ་ནང་ཐུང་བྱེད་):** For stones with persistent residues, soak them in water to loosen contaminants before scrubbing.
- Rinsing (ལུས་བྱེད་):** Wash the collected stone pigment with clean water (preferably running water), using a stiff-bristled brush to remove surface dirt and impurities.
- Drying (སྒྲིག་བྱེད་):** After cleaning, ensure the stones are thoroughly dried to prevent them from becoming tacky and attracting external residues during grinding.

5. Fragmentation of Stones: (བྱི་བཀལ་སྒྲིག་བྱེད་)

- Breaking Down (བྲུས་བྱེད་):** Place the dried stones on a stable surface and use a hammer to break them into smaller, manageable pieces.
- Size (ཚད་མཉམ་བྱེད་):** Aim for uniform fragment sizes that fit comfortably within the mortar, facilitating consistent grinding.

Note: Following these procedures, you ensure the preparation of high-quality pigments suitable for traditional Bhutanese art, while maintaining safety and efficiency throughout the process.

6. Traditional Process for preparation of Stone pigment (རང་ལྷགས་རྩི་ཚོན་བཟོ་ཐངས་)

- a. **Preparing the Grinding Equipment (རྩི་ཚོན་བཟུང་ཁྱེད་):** Select clean, uncontaminated equipment, such as a stainless steel bowl (ལྷགས་ཁྱེད་/བཟུང་ཁྱེད་). Place a mortar or glass tool inside the bowl, ensuring that all surfaces are clean and free from impurities. Lightly etch or frost the surface to create a textured area that enhances the grinding efficiency.
- b. **Grinding with a Muller (བཟུང་ཁྱེད་ལ་བཟོ་ཁྱེད་):** There are two primary grinding techniques—one involves directly roughing the stone against the mortar (བཟུང་ཁྱེད་), and the other uses a muller. For the latter, transfer the coarse pigment onto the prepared flat surface. Using a muller, gently press and move it in circular motions over the pigment. Add a small amount of water as needed, kneading the mixture to achieve a smooth, creamy consistency. Continue grinding until the pigment reaches the desired fineness, ideally around 0.25 microns.
- c. **Levigation (བཟུང་ཁྱེད་):** Following mulling, it involves mixing the finely ground pigment with a small amount of liquid—such as water, milk, honey, or hideglue—to form a paste. This mixture is then gently ground, allowing it to get finer particles from any remaining larger particles. The process enhances the pigment's uniformity and texture, making it more suitable for precise artistic applications.
- d. **Sedimentation and Decantation (ཚོན་ཐངས་ལ་བཟོ་ཁྱེད་):** After levigating the pigment into a fine paste, place it in a clean container and add water to create a suspension. Allow the mixture to stand undisturbed for several hours or days, enabling particles to settle based on size and density. Carefully decant the upper layers, which contain finer particles, into separate containers. This process yields pigment fractions of varying fineness, suitable for different artistic applications.

7. Fermentation (ཐུལ་བཟུང་ཁྱེད་/ཏན་བཟུང་ཁྱེད་/རྩི་ཚོན་བཟོ་ཁྱེད་)

- a. **Fermentation (ཐུལ་བཟུང་ཁྱེད་/ཏན་བཟུང་ཁྱེད་/རྩི་ཚོན་བཟོ་ཁྱེད་):** After separating pigment layers through sedimentation and decantation, transfer each layer (top, middle, bottom) into separate containers. Add clean water to each container, ensuring the water level is slightly above the pigment. Seal the containers—airtight containers and store them in a cool, shaded area for a period ranging from one to six months. Traditionally, the longer the fermentation period, the better the result. Prolonged soaking allows for natural biochemical processes that can enhance the pigment's quality, resulting in improved texture, stability, and colour intensity.

8. Drying and Pulverization

- a. **Drying (བརྩོམ་ཁྱེད་):** The final step in pigment preparation, drying removes moisture and stabilizes pigments for storage or use. Methods include sun drying by spreading pigments under sunlight with a thin cloth to protect from direct exposure to sunlight and aid evaporation, shade drying in a well-ventilated shaded area, and controlled drying using equipment like dehumidifiers/dryers to regulate temperature and humidity. After drying, pigments can be stored as solid blocks or processed into powder form through pulverization, depending on intended preference.

- b. **Pulverization** (ཕུ་འཕགས་ཁྱིུ་བཟུལ་ནི): Pulverization is an optional step in pigment preparation, employed when storing pigments in powder form. After drying, the pigment is ground into a fine powder using a mortar and pestle. To prevent the loss of fine particles during this process, it's advisable to cover the mortar with a cloth or plastic wrap while grinding.

9. Packaging and Labeling

- a. **Packaging and Labeling** (ཕྱི་ཕུང་དེ་དང་ཁ་ཡིག་བཟུལ་ནི): After drying and, if desired, pulverizing the pigment, store it in airtight, non-reactive containers—such as sealed glass jars or high-quality plastic containers—to protect against moisture, air, and contaminants. This applies to both solid blocks and powder forms. Label each container clearly with essential information, including pigment type, color, batch number, and any relevant safety precautions. Proper packaging and labeling preserve pigment quality, ensure safe handling, and facilitate efficient inventory management.

10. Safety Reminder (ཉེན་སྲུང་དྲན་པ་སྒྲོལ་བ་)

- a. Always wear appropriate personal protective equipment (PPE), including gloves, safety goggles, and a dust mask or respirator.
- b. Work in well-ventilated areas to minimize inhalation of dust and fumes.
- c. Handle all pigments with care, treating them as potentially hazardous substances.
- d. Clean your workspace thoroughly after each session to prevent contamination.
- e. Store pigments securely in labeled containers in a safe place.
- f. Always store natural stone pigments in airtight, non-reactive containers like glass jars to prevent moisture and contamination. Keep them in a cool, dark place away from direct sunlight and heat sources to maintain their quality and extend shelf life.

Note: By adhering to these precautions, you ensure not only your safety in terms of time, resources, and health, but also contribute to the preservation of traditional practices—safeguarding them to inspire future generations.

Comprehensive Overview of Stone Pigment Processing



6. Pigment Grading (དུའི་ཁྱེད་ཀྱི་ཁྱེད་)

This grading system classifies mineral pigments based on traditional Bhutanese methods, particularly their fermentation duration, sedimentation layer, and physical qualities such as color intensity, texture and bleed resistance. While these traditional grades (A, B, and C) reflect long-established artisanal practices, all pigments must also meet the technical test parameters defined in the national standard to qualify for product certification.

Grade A – Premium Fermented Stone Pigment (དུའི་ཁྱེད་དང་ཁྱེད་)

Grade A pigments are traditionally sourced from the uppermost layer (active layer) during sedimentation, which is known to yield the highest colour intensity due to its concentration of fine, **light-reflective particles**. These pigments also undergo a minimum of six months of fermentation, a process that further enhances their stability and bleed resistance. When mixed with water (without binders) and applied to a substrate, Grade A pigments exhibit high colour intensity and minimal colour migration. In order to qualify as Grade A, the pigment must also pass the test parameter outlined in this standard.

Grade B – Standard Fermented Stone Pigment (དུའི་ཁྱེད་གཉིས་པ་)

Grade B pigments are sourced from mid-layer sedimentation and undergo a minimum of three months of fermentation, resulting in lower colour intensity compared to Grade A pigments. They exhibit moderate stability but may be slightly more prone to bleeding. Grade B pigments may have a slightly coarser texture than Grade A, but should not contain large, detectable particles. To qualify as Grade B, the pigment must pass the test parameters outlined in this standard.

Grade C – Basic Stone Pigment (དུའི་ཁྱེད་གསུམ་པ་)

Grade C pigments are typically obtained from the lower layers of sedimentation and may have undergone minimal or no fermentation. These pigments often exhibit lesser colour intensity compared to Grade A and B, lower stability, higher susceptibility to bleeding, and a coarser texture compared to higher-grade pigments. In order to qualify as Grade C, the pigment must also pass the test parameter outlined in this standard.

Pigment Grading Chart (དུའི་ཁྱེད་ཁྱེད་ཁྱེད་)

Grade	Layer Source	Fermentation	Purity & Stability	Texture
Grade A <i>Premium</i>	Top layer	≥ 6 months	Very stable, high purity	Very fine, smooth, no detectable grains, with higher colour intensity
Grade B <i>Standard</i>	Middle layer	≥ 3 months	Moderately stable	Fine, may feel slightly grainy and lesser colour intensity comparing to Grade A
Grade C <i>Basic</i>	Bottom layer	Minimal or none	Least stable	Coarser feel, minor grain presence, and lesser colour intensity compared to Grade B.

Detailed Stone Pigment Testing Procedures

7. Test (འདྲན་ཁྱེད་)

To assess the purity, authenticity, and quality of the pigment, simple observation-based techniques will be employed. These methods—including burn test, pigment fineness evaluation, and water suspension test—will help verify the pigment’s stability, resistance to fading, and risk of adulterants, ensuring it meets this standard for genuine stone pigment for artistic, cultural, or industrial use. The purpose of these tests is to confirm genuine mineral origin, workability, and long-term durability.

1. Burn Test (for Organic Adulterants) (བསྐྱོད་ཁྱེད་)

- a. **Smoke Observation (དུ་ཕྱུད་)**: The most critical indicator of purity is the presence or absence of smoke during heating. As the pigment sample is gradually heated, observe the smoke carefully. Genuine mineral pigments will produce little to no visible smoke when heated. The appearance of thick or coloured smoke, particularly black smoke, strongly suggests the presence of organic contaminants such as plant-based binders, synthetic additives, or carbon-based materials. The intensity and colour of the smoke can help differentiate between types of impurities—white smoke may indicate moisture or volatile compounds, while dark smoke points to carbon-based adulterants.
- b. **Odor Analysis (ཇི་ཕྱུད་)**: A pure mineral pigment will remain odorless even under high heat. The moment any noticeable odor is detected during heating, the pigment likely contains organic impurities. Distinct smells provide clues about the type of contaminant—a sweet, caramel-like odor suggests natural gums or sugars, while a sharp, acrid, or plastic-like smell indicates synthetic polymers or resins. Some organic binders, such as hideglue, may emit a characteristic burnt protein smell. The absence of any odor strongly supports the pigment’s mineral purity.
- c. **Residue Inspection (མ་རྩ་དུ་ཕྱུད་)**: After heating, the remaining residue must be examined closely. Pure mineral pigments typically retain their original form, showing no significant change other than possible sintering (fusing into a harder mass). In contrast, contaminated pigments leave behind telltale residues—fine ash indicates carbon-based impurities, while sticky or melted residues suggest the presence of binders or synthetic additives. Rub the residue between fingers; pure mineral pigments feel gritty and unchanged, whereas adulterated samples may crumble into soot or leave greasy traces. A magnifying lens can help identify subtle residues that are not immediately visible.
- d. **Secondary Observations (ཐུགས་ཀྱིས་དུ་ཕྱུད་)**: While not definitive, additional observations can support purity assessment. Note how quickly the pigment reacts to heat—organic-rich samples often ignite or smoke rapidly, while pure minerals resist burning. Some mineral pigments may change colour when heated (e.g., darkening or reddening), but this alone does not confirm impurity unless accompanied by other signs like smoke or odor. Comparing the test sample with a known pure reference under identical conditions improves accuracy.

Notes: Combining these observations allows for a reliable judgment on pigment purity. If the sample produces no smoke, no odor, and leaves no ash or sticky residue, it is likely a pure mineral pigment. Any deviation from this—especially visible smoke, detectable odor, or unusual residue—indicates contamination. For critical applications, this test should be supplemented with sedimentation or alkaline (acid) tests to rule out inorganic adulterants. The burn test remains one of the fastest and most accessible methods for detecting organic impurities in traditional pigments.

2. Pigment Fineness Evaluation (ཉིང་དཔྱད་)

Purpose and Traditional Significance (བར་ལྟགས་གནས་ཚད་): The fineness evaluation by rubbing (བརྒྱུ་རྒྱུ་དཔྱད་) between the distal pads of the thumb and index finger serves as a fundamental quality assessment in pigment, where the tactile experience reveals critical information about processing quality that visual inspection alone cannot determine. This helps to detect subtle variations in particle size distribution through direct finger contact, with the most prized pigments exhibiting a characteristic velvety smoothness indicative of optimal refinement.

Preparation and Sampling Methodology (སྒྱུ་ཚད་ལྟགས་ཚད་): Proper evaluation begins with careful preparation of both the testing environment and the pigment sample itself, following time-honoured protocols to ensure accurate assessment. The tester selects a quiet space with natural proper light (preferred under natural light), avoiding direct light that could alter perception. Prepares a clean testing surface—preferably borosil glass or marble. A small quantity of thoroughly dried pigment, approximately equivalent to three grains of rice, should be placed onto the testing surface. The evaluator’s hands shall be washed with clean water with soap and thorough drying to remove any oils or residues that might interfere with tactile sensitivity, while the nails are kept short and smooth to prevent accidental particle crushing during examination.

The Rubbing Technique (བརྒྱུ་རྒྱུ་དཔྱད་): The actual testing procedure involves a series of deliberate, practiced motions designed to expose the pigment’s true texture through controlled manipulation. The tester gathers the sample between the distal pads of the thumb and index finger, applying just enough pressure to maintain contact without compression, then initiates a slow rubbing motion to separate and reveal their inherent characteristics while preventing excessive heat buildup from friction that could alter the material’s properties. Throughout the process, the evaluator maintains consistent pressure and speed, monitoring not only the immediate tactile feedback but also subtle changes in resistance and temperature that provide additional quality indicators.

Interpretation and Grading Standards (དཔྱད་ཉིང་གཞི་སྒྲིག་ཚད་): The assessor team (Experienced practitioners) discern multiple quality tiers through nuanced differences in finger sensation, with classification systems that have remained largely unchanged for centuries. The highest-grade pigments (Grade-A) produce an almost liquid smoothness with no detectable particle boundaries, seeming to melt away between the fingers while leaving behind a faint, even coloration that indicates perfect particle uniformity. Intermediate quality materials (Grade-B) exhibit a soft granularity reminiscent of fine silk powder, with occasional barely perceptible irregularities that still permit most artistic applications without compromise. Clearly gritty textures with sharp edges and inconsistent particle size automatically relegate pigments to the lowest grade (Grade-C), often requiring reprocessing or being reserved for base applications where refinement proves unnecessary.

Notes: While this traditional method provides rapid, cost-effective assessment of pigment particle size through tactile sensitivity, its subjective nature requires experienced evaluators and controlled conditions for reliable results. The test effectively identifies coarse impurities but may miss ultra-fine contaminants, necessitating complementary methods like sedimentation or microscopy for comprehensive quality control. Though valued for preserving artisanal knowledge, modern applications should combine it with instrumental analysis to maintain consistency between assessors and across production batches, particularly for high-value or conservation-grade pigments where precise particle distribution is critical.

3. Water Suspension Test for Pigment Purity Evaluation (ཆུ་བཟང་ཁྱེད་ཁྱེད་)

Selection of Testing Vessel and Water (རྩོད་ཁྱེད་ཁྱེད་): A straight, clear container shall be chosen—preferably glass cylinder about 20 cm tall. Clean distilled water is preferred, poured to fill three-quarters of the cylinder. The water must be free of sediment and at ambient temperature, as cold water can slow settling patterns unnaturally.

Pigment Introduction and Initial Wetting (རྩོད་ཁྱེད་ཁྱེད་): A pinch of dry pigment (approximately 0.5g) is gently scattered across the water's surface without submerging. The vessel is then tilted at a 45-degree angle and slowly returned upright exactly three times - this motion ensures even wetting without creating disruptive currents that could affect later sedimentation observations.

First-Stage Settling Observation (0-30 minutes) (ཆུ་བཟང་ཁྱེད་ཁྱེད་ (ཁྱེད་ཁྱེད་): Immediate particle behaviour reveals processing quality. Superior pigments disperse like smoke through water, creating uniform coloration. Inferior products may show rapid sinking of coarse particles (indicating incomplete grinding), floating aggregates (suggesting organic contamination), or uneven dispersion patterns (revealing density inconsistencies). This phase is best observed against proper light (Preferred under natural light) with a white background.

Intermediate Observation (1-6 hours) (ཆུ་བཟང་ཁྱེད་ཁྱེད་ཁྱེད་ (ཁྱེད་ ༡ - ༦ ཁྱེད་): After 1-6 hours, the true character of the pigment will emerge in the water. Well-prepared pigments show three natural divisions—the topmost water becomes nearly clear like mountain spring water, the middle portion holds the pigment's true colour in even suspension like diluted ink, while the bottom gathers only a thin, uniform layer of settled material. Poor quality pigments will show either remaining murky throughout, showing sudden changes between layers like steps in a terrace, or having stray particles that stubbornly hang between layers like dust in sunlight. These signs tell the pigment deserves further testing or should be set aside.

Final Judgment (12-24 hours) (ཆུ་བཟང་ཁྱེད་ཁྱེད་ཁྱེད་ (ཁྱེད་ ༡༢ - ༢༤ ཁྱེད་): After leaving undisturbed overnight, the assessors will examine the vessel at first light (or in proper shadow less light). Good pigment reveals itself through peaceful separation—the upper water becomes completely transparent, the colour graduates softly from light to dark, and the settled portion forms a firm, undisturbed bed at the bottom. Assessors may gently blow across the water's surface—if the bottom sediment stirs up easily like disturbed pond mud, the pigment lacks refinement. True quality pigment settles so completely that even when the vessel is tilted slightly, the lower layers hold their position.

Layer Separation and Practical Validation (ཆུ་བཟང་ཁྱེད་ཁྱེད་ཁྱེད་): The final step involves carefully decanting or pipetting each layer for individual testing. The topmost suspension (colloidal fraction) is reserved for premium (Grade-A) applications, the middle portion (Grade-B) for general use, and the sediment (Grade-C) is either reprocessed or discarded. Each fraction undergoes traditional validation: brushed on test papers—colour intensity and bleeding test, mixed with binders, or compared against reference samples from master batches. This physical testing confirms the visual observations from sedimentation behaviour.

Note: This time-honoured traditional method remains one of the most reliable ways to judge pigment quality through natural sedimentation. The key lies in patient observation—allowing water and time to reveal the pigment's true character. Superior pigments settle peacefully into distinct, stable layers with clear water above, while flawed materials show through cloudy water, uneven settling, or stubborn floating particles. Traditional practitioners emphasize testing at

consistent times of day and comparing against known reference samples. Though simple in execution, this test captures essential truths about particle size, purity, and workability that have guided artisans for centuries. For critical applications, its findings should be verified through additional tests like finger-rubbing or burn evaluation to confirm both mineral quality and organic purity.

Overview of Stone Pigment Testing Procedures



8. Tools and Equipment (ཕྱོད་ཆས་)

The table below outlines the essential tools and equipment used in traditional pigment extraction and preparation. Each item plays a specific role in ensuring precision, safety, and quality throughout the process—from stone crushing to pigment refinement and handling.

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Sl. No.	Tools & Equipment Name (EN/DZ)	Functionality
1	Hammer (མོར)	A hammer is used to manually break down pigment stones into smaller fragments for further processing. For larger volumes, mechanical tools such as a crusher or grinder may be used as alternatives.
2	Mortar and Pestle (ཚོ་ཀུ་དང་ཕོ་ཕྱི)	A mortar and pestle are used for manually grinding pigment stones into a fine powder, allowing for greater control over texture and consistency during the preparation process.
3	Mesh Sieves (གཤིག་མ)	Mesh sieves are used to separate ground pigment particles by size. They are particularly useful for sifting crushed stone material to isolate fine powder from coarse gravel and chips, ensuring uniform particle size for further processing or application.
4	Filtration Apparatus (བཟུགས་ཆས་)	Filtration apparatus, such as muslin cloths or other fine fabric materials, are used as the primary medium to separate liquid extracts from solid residues immediately following the extraction process. This initial filtration stage precedes levigation and sedimentation, ensuring that only suspended fine particles remain in the liquid for further settling, purification, and refinement.
5	Containers (ཉོད་ཆས་)	Containers are used to hold pigment stones, solvents, or pigment suspensions during various stages of processing. For pigment preparation, glass jars or buckets are preferred due to their chemical stability and transparency, which allows easy observation of the contents. Alternatively, containers made of chemically resistant plastic or stainless steel may be used, provided they do not react with the solvents or alter the properties of the pigments.
6	Measuring Spoons/Cups (འཇམ་ཆས་)	Measuring spoons and cups are used to ensure accurate and consistent measurements of ingredients—such as binders, solvents, or additives—during pigment preparation. They help maintain precise proportions, which is essential for achieving desired consistency, color quality, and reproducibility in traditional pigment processing.
7	Glass Muller (བུལ་ཤིང་)	A glass muller is a handheld tool used to grind and thoroughly mix powdered pigment with a binding agent on a flat, smooth surface—typically a glass or stone grinding plate. This process ensures a uniform, fine paste with consistent texture and color, essential for preparing high-quality paints and inks.
8	Claypot (ས་ཇ་)	A claypot (preferably unglazed) is traditionally used in pigment processing for fermentation, aging, and color enhancement. Its porous and alkaline nature supports microbial activity, regulates pH, and allows slow oxidation—improving pigment stability, texture, and hue.
9	Stirrers (འཇུག་པ་)	Stirrers (preferably made of wood) are used to mix stone and solvent during the extraction process, ensuring thorough contact between the solvent and stone particles for efficient pigment extraction.

10	Dehydrator/Dryer (སྐྱ་ཆས)	A dehydrator or dryer is used to remove residual solvent and moisture from extracted pigments, converting them into a dry, stable form. The device should include options for temperature monitoring and adjustment to ensure precise control over the drying process, preventing degradation or alteration of pigment properties.
11	Safety Goggles (ཉེན་སྲུང་མིག་ཤེལ)	Safety goggles are protective eyewear designed to shield the eyes from chemical splashes, dust, and other hazards. They are essential when handling pigments, solvents, or any other substances that may pose a risk to the eyes during grinding, extraction, or mixing processes.
12	Protective Gloves (ཉེན་སྲུང་ལག་སྒུབ)	Protective gloves are worn to safeguard the hands from direct contact with harmful chemicals, solvents, or rough materials during pigment preparation. These gloves should be chemical-resistant and durable, preventing skin irritation, burns, or absorption of toxic substances.
13	Face Mask/Respirator (ཁ་རས)	A face mask or respirator is used to protect the respiratory system from inhaling harmful dust, fumes, or vapors that may be released during pigment grinding, mixing, or drying processes. A mask with a proper filtration system is recommended for handling fine particulate matter or volatile organic compounds (VOCs).
14	Lab Coat/Apron (ཁྱེད་ཆས)	A lab coat or apron provides personal protection from spills, splashes, and contamination when working with solvents, pigments, or other chemicals. It serves as a barrier between hazardous materials and the skin or clothing, ensuring safety during pigment processing tasks.
15	Ventilation System (རྒྱུ་ཤོ)	A proper ventilation system ensures a constant flow of fresh air and the removal of harmful fumes, gases, and dust from the workspace. This system is essential to maintain a safe working environment when handling solvents, pigments, or other chemicals that may release toxic or irritant vapors.
16	First Aid Kit (སྐྱོ་བུར་སྐྱོ་སྒྲུབ)	A first aid kit is a collection of essential medical supplies and equipment for treating minor injuries, chemical burns, or other accidents that may occur during pigment processing. It should include items such as bandages, antiseptics, eye wash, burn cream, and any necessary medications for immediate response.

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