



Powder and crystalline samples may require liquification to ensure color measurement accuracy. Image Source: Shutterstock user easyshutter

Measuring the color of liquids can be an important part of creating aesthetically pleasing products and ensuring proper formulation. From beverages to [beauty products](#), pharmaceuticals to petrochemicals, spectrophotometric color measurement plays an essential role in quality control.

However, spectrophotometric analysis of liquids is also vital to measure the color of some powder or crystalline materials that are not ultimately destined for liquid states. This is due to the fact that particulate surfaces may present unique challenges to color measurement as the result of optical reflection and refraction, compromising the spectrophotometer's ability to detect small color differences. Dissolving or heating powders and crystalline materials can eliminate this optical noise, allowing for more accurate color measurement.

But while transforming materials to liquid forms can correct for the color measurement difficulties presented by particulates, working with hot liquids can create new challenges. As such, using the right instrumentation, accessories, and measurement methods is critical to ensuring accuracy of color measurement and obtaining meaningful data.



Spectrophotometric color measurement of hot liquids can be complicated by a number of factors.
Image Source: Shutterstock user Leigh Prather

Considerations for Measuring Hot Liquids

Hot liquids can present a number of challenges for accurate color measurement, including:

- **Accessory suitability:** High heat can alter the structure of some accessories, including cuvettes and caps, leading to discoloration or damage. Additionally, accessories must be easy to handle and appropriate for volatile liquids.
- **Temperature stability:** In order to ensure a complete and stable liquid state, the temperature must remain consistent. Unstable temperature may lead to unwanted material or color changes in the sample, interfering with your ability to obtain accurate color measurements. As noted above, temperature must be compatible with your accessories; the inability to produce precise and stable temperatures may lead to inadvertent damage of even robust materials.
- **Instrument damage:** Just as hot liquids may damage accessories, they can also damage the spectrophotometer itself. Specifically, heat can damage the sensor, and care must be taken to avoid this potentially costly effect.

Overcoming these challenges depends on selecting the appropriate tools and methods for measuring hot liquid samples.



Maintaining temperature control of hot liquid samples is essential to producing reliable color data.
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Choosing the Right Instruments, Accessories, and Methods

The first step to accurate color measurement is choosing [a technologically advanced spectrophotometer](#) designed for transmission color measurement. However, accuracy of measurement can only be ensured if proper tools and measurement methods are used. As such, it is critical to select instrumentation that is designed for compatibility with high-quality accessories designed for hot liquid samples and facilitates proper methodology. To achieve accurate measurement, consider the following:

- **Vial Design:** Vials must be made with high-quality materials that are not compromised by high temperatures or sample volatility. Borosilicate glass is ideal for measuring hot and volatile liquid samples, as it is extremely durable and [can be heated to around 400°C](#), “which is higher than any application should require.” In addition, it provides excellent light transmission, longevity, and easy cleaning using a range of methods. It is also important to consider vial shape and size; look for a rounded vial that is easy to grasp with tongs or mitts and ensure that the vials are [available in the size appropriate for your samples](#), your spectrophotometer, and your heating mantle. Screw-on caps that are designed to avoid contact with the heating mantle and are compatible with a range of liners as well as a variety of cleaning procedures are also important for safety and color measurement accuracy. HunterLab recommends the use of ISO compliant vials. ISO 8362-4:2011 specifies the shape, dimensions and capacities of glass vials for injectable preparations. It also specifies the material from which such containers are made and the performance requirements for the containers. ISO compliant vials are by default manufactured to tighter specifications and tolerances, and they are more consistent dimensionally than non- ISO compliant vials.

- **Heating Mantle and Temperature Controller:** Temperatures up to 100°C can be achieved using a water bath, and temperatures above 300°C typically rely on the use of a hot air furnace. However, if you are heating samples from 100°C to approximately 250°C, a heating mantle is recommended. Combining your heating mantle with a temperature controller designed to automatically and reliably produce your desired temperature is essential to ensuring that your sample is properly prepared and stable. Without the temperature controller, it is possible to overheat or underheat your sample, resulting in inaccurate measurement. Choosing a heating mantle that can heat multiple samples can help improve efficiency.
- **Heating Location:** Regardless of how samples are heated, heating should always take place within the vial and outside your spectrophotometer to prevent damage to its sensors.

The best spectrophotometer manufacturers will provide a complete range of accessories appropriate for hot liquid color measurement, ensuring you can measure liquefied powder and crystalline samples with ease. The [HunterLab Vista](#), for example, is designed to simultaneously measure color and haze in liquid samples with the highest level of accuracy and is engineered for compatibility with hot liquid samples and state-of-the-art hot liquid sample accessories. HunterLab's vials for the Vista are designed around ISO vial specifications, which means these vials are guaranteed to fit properly in our vial holders. Additionally, the Vista comes with EasyMatch Essentials, a [customizable software](#) package that will allow you to gain greater insight into your products and processes via flexible data collection, display, and storage.

HunterLab Innovation

HunterLab has been a leader in spectrophotometric color measurement for over 60 years. Today, we offer a comprehensive line-up of [portable, benchtop, and on-line instruments](#) designed to meet the diverse needs of our customers. We also offer all the accessories necessary for safe and reliable hot liquid color measurement, including heating mantles, temperature controllers, and a range of cuvettes, caps, and cap liners. [Contact us](#) to learn more about our innovative instruments, customizable software packages, and world-class customer support services.