



Color Measurement of Plastic Pellets Using HunterLab Instruments

In the plastics industry, the color of plastic pellets is often measured before the pellets are extruded, or molded, into a final product. Plastic pellets are typically translucent and non-uniform in size. Therefore, special accessories and presentation techniques are required to provide repeatable results. This Applications Note is designed to describe the preferred methods of measuring plastic pellets using the various HunterLab instruments.

In general, a sampling of a number of plastic pellets should be measured together in order to obtain an overall average of the color for the group. Several readings of the group should be averaged for the final result, preferably with replacement of the sample between measurements. Recommended procedures for each instrument type are described below. Section IV, “How to Determine the Number of Measurements to Average,” applies to all the procedures discussed below except the on-line (SpectraProbe XE) procedure.

I. **45°/0° Bench Top/Hand-Held Instruments (ColorFlex 45/0, ColorQuest 45/0, D25, LabScan, or MiniScan 45/0 LAV)**

Use of a 45°/0° instrument is recommended if one is available. The instrument types require slightly different procedures that are outlined below.

A. ColorFlex 45/0, ColorQuest 45/0, D25A and M, and LabScan

The 2.5-inch glass sample cup (HL#04-7209-00) and its corresponding sample cup port plate (HL#04-6622-00 for ColorFlex, ColorQuest 45/0, and D25, 02-3081-14 for LabScan, A04-1010-020 for LabScan XE), as well as the sample cup opaque cover (HL#A04-1002-177) are required.

1. Configure your software to read using the desired color scale, illuminant, and observer. If your specification does not state conditions to be used, the CIELAB color scale using the D₆₅ illuminant and 10° observer is recommended (C/2° for D25s).
2. Place the instrument in the port-up orientation and install the sample cup port plate at the sample port.
3. Standardize the instrument using the standard port size. For the LabScan, use the 1.75-inch port size and area of view.

4. Fill the glass sample cup with pellets. Position the cup in the sample cup port plate and cover it with the opaque cover.
5. Read the pellets through the glass bottom of the sample cup.
6. Empty the sample cup, refill it, and measure the pellets again.
7. Refill the sample cup and remeasure the sample the desired number of times. Averaging of at least three measurements is recommended (see Section IV).

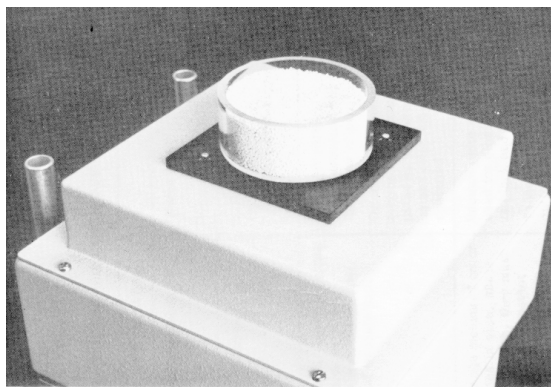


LabScan XE Measuring Pellets

B. ColorQUEST 45/0 Large Area View and D25L

A five-inch glass sample cup (HL#04-7767-00) and large light trap (HL#A02-1002-965) are required. For the D25L, the specimen block, sample dish and sample cover (HL#02-8606-00 for plastic dish and 02-8601-01 for glass dish) may be used instead.

1. Configure your software to read using the desired color scale, illuminant, and observer. If your specification does not state conditions to be used, the CIELAB color scale using the D₆₅ illuminant and 10° observer is recommended for the ColorQuest, C/2° for the D25.
2. Place the instrument in the port-up orientation.
3. Standardize the instrument using the standard port size.
4. Fill the glass sample cup or sample dish with pellets. Position it over the sample port (or in the specimen block) and cover it with the light trap or lid.
5. Read the pellets through the glass bottom of the sample cup or the clear bottom of the sample dish.
6. Empty the sample cup or dish, refill it, and measure the pellets again.
7. Refill the cup or dish and remeasure the sample the desired number of times. Averaging of at least three measurements is recommended (see Section IV).



D25L Measuring Pellets

C. MiniScan 45/0 Large Area View

Measurements on the MiniScan must necessarily be performed slightly differently than those made on the other 45°/0° instruments, since the MiniScan is a hand-held instrument. Measuring pellets using the MiniScan 45/0 SAV is not recommended. Several possible measurement procedures for the LAV model are outlined below.

Procedure #1: A 2.5-inch glass sample cup (HL#04-7209-00) and sample cup opaque cover (HL#A04-1002-177) are required accessories. A MiniScan bench top stand (HL#D01-1007-434) is highly recommended.

1. Configure your software or MiniScan setup to read using the desired color scale, illuminant, and observer. If your specification does not state conditions to be used, the CIELAB color scale using the D₆₅ illuminant and 10° observer is recommended.
2. Mount the MiniScan on the bench top stand and rotate the stand so that the measurement port is facing up. (Make sure you remove the sample clamp from the stand so that it won't be in the way.) Alternately, turn the MiniScan upside down and balance it on its handle as securely as possible.
3. Standardize the instrument.
4. Fill the glass sample cup with pellets. Place it at the measurement port and cover it with the opaque cover. You may use the D02-1009-952 sample cup holder to center the cup over the port, if desired.
5. Read the pellets through the glass bottom of the sample cup.
6. Empty the sample cup, refill it, and measure the pellets again.
7. Refill the cup and remeasure the sample the desired number of times. Averaging of at least three measurements is recommended (see Section IV).

Procedure #2: A white cup, such as a Styrofoam or white plastic drinking cup, and the MiniScan nose cone with cover glass (A02-1002-129) are required.

1. Configure your software or MiniScan setup to read using the desired color scale, illuminant, and observer. If your specification does not state conditions to be used, the CIELAB color scale using the D₆₅ illuminant and 10° observer is recommended.
2. Standardize the instrument.
3. Fill the white cup with plastic pellets.

- Place the nose cone (with cover glass) of the MiniScan into the pellets and read. The cover glass keeps the pellets from entering the measurement port.



- Empty the cup, refill it, and measure the pellets again.
- Refill and remeasure the sample the desired number of times. Averaging of at least three measurements is recommended (see Section IV).

Procedure #3: The MiniScan nose cone with cover glass (A02-1002-129) is required.

- Configure your software or MiniScan setup to read using the desired color scale, illuminant, and observer. If your specification does not state conditions to be used, the CIELAB color scale using the D_{65} illuminant and 10° observer is recommended.
- Standardize the instrument.
- Place the MiniScan into a crate or large box filled with plastic pellets and read. The cover glass keeps the pellets from entering the measurement port.



- After one measurement, lift the MiniScan, replace the instrument in a different spot, and read.
- Remove the instrument, replace, and remeasure the sample the desired number of times. Averaging of at least three measurements is recommended (see Section IV).

II. Diffuse/8° (Sphere) Bench Top Instruments (ColorQuest Sphere or UltraScan)

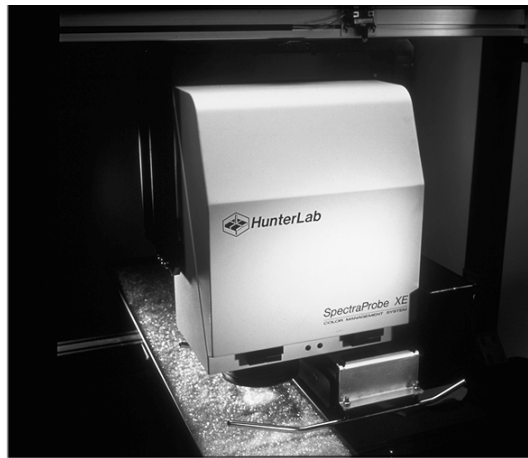
Sphere instruments can be used for measuring plastic pellets, although use of a 45°/0° instrument is recommended if one is available. For measurement on a bench top sphere instrument, a 50-mm glass transmission cell (HL#13-8573-20) and reflectance shelf and light cover (HL#L02-1004-770 for ColorQuest II, B02-1005-172 for UltraScan XE) are required.

1. Configure your software to read using the desired color scale, illuminant, and observer. If your specification does not state conditions to be used, the CIELAB color scale using the D₆₅ illuminant and 10° observer is recommended.
2. Standardize the instrument using the standard (LAV) port size.
3. Install the reflectance shelf at the instrument reflectance port.
4. Fill the transmission cell with plastic pellets.
5. Place the cell on the reflectance shelf with one of the clear sides flat against the reflectance port. Be sure that the port is completely covered by the pellets in the cell. Cover the cell with the light cover.
6. Read the pellets through the glass of the cell.
7. Empty the transmission cell, refill it, and read again.
8. Remove, replace, and remeasure the sample the desired number of times. Averaging of at least three measurements is recommended (see Section IV).

III. On-Line Instruments (SpectraProbe XE LAV)

No instrument accessories are required for measurement of pellets using an on-line instrument, but proper placement of the instrument over the process line is crucial. Use of the large area view instrument is recommended.

1. For this application, the sensor should be located on a shaker or other flat area of the line where finished pellets can be measured. You need to provide as flat, uniform, and level a surface of pellets as possible to the instrument. A constant level of at least 3/4-inch of pellets should be maintained, possibly with the use of a planing device. Mount the instrument over the product line and provide the proper distances to the software as described in the "Proper Positioning of the Sensor Over the Product" section of the SpectraProbe XE Hardware User's Manual.
2. Configure your software (Product Setup) to update measurements every one minute and to perform secondary calibration every thirty minutes. Also choose the color scale, illuminant, and observer. If your specification does not state conditions to be used, the CIELAB color scale using the D₆₅ illuminant and 10° observer is recommended.
3. Begin the run when pellets appear on the line and end the run when the batch is complete.



SpectraProbe XE Measuring Pellets

IV. How to Determine the Number of Measurements to Average (Not applicable to on-line instruments)

It is common practice to take at least three readings (with replacement) for a non-uniform sample such as pellets, and then to average the readings. In order to establish the correct number of readings to average, create one set of averaged readings by reading the same sample three times (with replacement) and averaging the readings. Next, measure the same sample again three times and average. You will now have two averages to compare. If the ΔE between the two averages (either a Hunter ΔE or a ΔE^* will do) is less than or equal to 0.11, then three readings are sufficient to provide repeatable results. If the ΔE is greater than 0.11, then try the same procedure again with a greater number of averaged readings until the repeatability is sufficient. The goal of this procedure is to find the lowest possible number of readings that will provide repeatable results with averaging.

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