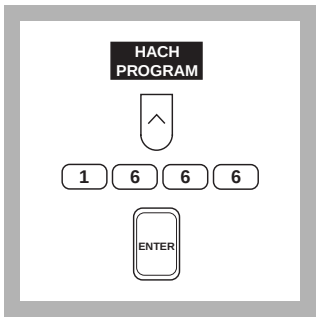
COLOR, Tristimulus Values and Chromaticity Coordinates

Method 10103 **ASTM Method E 308-95***

* This method uses, as defaults, CIE Illuminant C, and the CIE 1931 Standard 2° Observer. However, CIE Illuminants A, C, D50, D55, D65, D75, F2, F7, and F11 can be used, as well as the CIE 1964 Supplementary Standard 10° Observer.
To select other Illuminants, press the soft key under ***OPTIONS, MORE*** and then ***ILLUM***. Scroll the ***ILLUM*** soft key to select one of the Illuminants. The tristimulus values will be calculated using the Illuminant selected.
To select the 10° Observer, press the soft key under ***OPTIONS, MORE*** and then ***STD OBS***. The tristimulus values will be calculated using the 10° Observer.



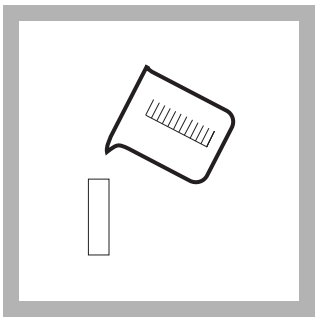
1. Press the soft key under ***HACH PROGRAM***. Select the stored program number for tristimulus values by pressing **1666** with the numeric keys.

Press **ENTER**.

2. The display will show:

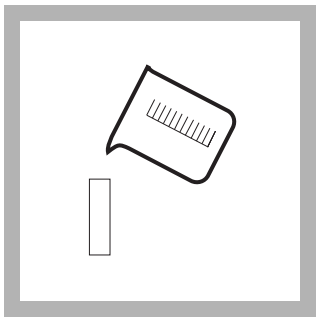
HACH PROGRAM: 1666
Color, Tristimulus

The starting wavelength (λ), 780 nm, is automatically selected.



3. Fill a 1-cm sample cell with the sample to be measured.

Note: *Other cell sizes may be used for very light-colored samples. Insert the appropriate cell holder and press the soft keys under* ***OPTIONS*** *and then* ***PATH****. Enter the path length of choice and press* **ENTER**. *The display will indicate the selected cell path length in cm. The displayed results will be normalized to a 1-cm path length.*

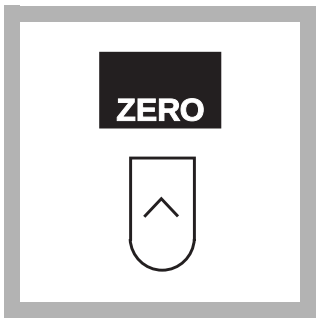


4. Fill another sample cell with the blank solution, if available.

Note: *The blank solution should match the sample in composition, but without any colored components.*

5. Insert a 1-cm cell adapter into the cell compartment. Place the blank into the 1-cm adapter. Close the light shield.

Note: *If a colorless blank solution is not available, leave the cell holder empty and close the light shield.*



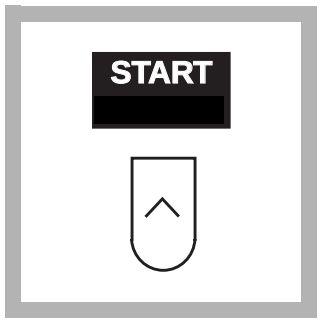
6. Press the soft key under ***ZERO***.

Starting at 780 nm, the instrument will establish 100% transmittance values for the blank at 5 nm intervals until it reaches 380 nm.

The display will show:

X:	Y:	Z:
0.0	0.0	0.0

7. When prompted, place the sample in the cell holder and close the light shield.



8. Press the soft key under ***START***.

Starting at 780 nm, the instrument will read the percent transmittance (%T) at 5 nm intervals until it reaches 380 nm. Once finished, the instrument will display the tristimulus values of the sample.

Note: *To view chromaticity coordinates, press the soft key under* ***OPTIONS****, then press* ***VIEW*** *repeatedly until* **CHROM** *is displayed.*

Interferences

Turbidity interferes directly and must be removed by filtration. Samples containing fluorescent components may interfere. Temperature and pH should be controlled for consistent results. Bubbles will interfere and should be removed.

The solution used for zeroing the instrument can directly affect the results. For accurate absolute results, the zeroing solution should resemble the sample as closely as possible but be absent of any color. When air is used for zeroing, the results are best used comparatively.

Sample Handling

The preparation of samples can significantly affect measured results. For increased accuracy, collect the sample in such a way that it is representative of the source, and prepare it using a standard method for the material being measured.

Accuracy Check

Perform the wavelength accuracy and absorbance checks described in the *DR/4000 Spectrophotometer Instrument Manual*. The wavelength and absorbance accuracy of the instrument affect the bias and precision of the method. (See ASTM Method E 308-95.)

Summary of Method

Tristimulus values are a set of three numbers obtained from a spectrophotometer or colorimeter that, when combined in various ways, describe how the human eye perceives a given color. Calculations using the three tristimulus values are typically used to define the color of a specimen for color matching specifications or quality control. In this program, transmittance is measured from 780 to 380 nm in 5-nm increments. These transmittance values are then used to calculate tristimulus values X, Y, and Z using ASTM Method E 308-95. The bandpass of the DR/4000 spectrophotometer matches the 5-nm measurement interval; therefore no bandpass correction is necessary.

Options exist for obtaining the tristimulus values under different viewing conditions, illuminants, and path lengths. Samples which are to be compared should be similar in appearance.

The CIE colorimetric systems are meant to provide numerical specifications to indicate whether pairs of color stimuli match when viewed by a CIE standard observer. The CIE color systems are not intended to describe visual color appearances or to provide visually uniform scales of color difference.

Safety

Good safety habits and laboratory techniques should be used throughout the procedure. Consult the *Material Safety Data Sheet* for information specific to the reagents used. For additional information, refer to Section *1*.

Pollution Prevention and Waste Management

For information on pollution prevention and waste management, refer to Section *1*.

REQUIRED EQUIPMENT AND SUPPLIES

Description	Quantity required per test	Unit	Cat. No.
DR/4000 1-cm Cell Adapter	1	each	48584-00
Sample cells, 1-cm, glass	2	each	20951-00

OPTIONAL EQUIPMENT AND SUPPLIES

Aspirator, vacuum	each	2131-00
Filter Holder, 47-mm, 300-mL graduated	each	13529-00
Filter, membrane, 47-mm, 0.45-microns	each	13530-00
Flask, filtering, 500-mL	each	546-49
Sample cell, 1-cm, quartz, w/ stopper (for volatile samples)	each	27401-01
Sample cells, 5-cm, quartz, w/ stopper (for volatile samples)	each	27401-05
Sample cells, 10-cm, quartz, w/ stopper (for volatile samples)	each	27401-10
Sample cells, microcell, 1-cm, 1.5-mL, disposable	100/pkg	26295-00
Sample cell adapter, 5-cm	each	48186-00
Sample cell adapter, 10-cm	each	48118-00
Sample cell adapter, microcell, 1-cm	each	48588-00
Stopper, No. 7, one hole	each	2119-07
Temperature Control Module, 15 to 50 °C, 1-cm cell holder	each	48070-08
Tubing, rubber	12 ft	560-19

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