

# COLOURED GEMSTONE GRADING (PART ONE) COLOUR



In Part One, we look at colour, including hue, tone (or value), and saturation, how light sources affect colour perception, how gemstones absorb light, the classification of gemstones based on the origin of their colour, and the grading systems that aim to standardise the evaluation of gemstones.





# GRADE SCHOOL

## Coloured Gemstone Grading (Part One) Colour

Imagine you are a jeweller in New York looking for a blue sapphire for a client. You contact one of your wholesale gem dealers and he says, 'I have two 2-carat sapphires, one is a G2B colour and the other is a P1B'. What would you do? What if he added that the G2B sapphire had a 40 zone and a 30% mask and the P1B had a similar zone but no colour mask? Would you know what he meant? Would you feel comfortable buying the stones?

In this four-part series on Coloured Gemstone Grading, we are going to 'deep dive' into the four factors that affect the value of a coloured gemstone, namely colour, clarity, cut and carat weight.

We will also look at four grading systems (G.I.A / Gemwizzard, GemDialogue, World of Color and ColourWise) currently used in the gem trade and see how they approach what many consider to be the most challenging area of the gem industry.

Since colour is an integral part of all our lives and by far the most important factor, it seems to be the logical place to start.

### WHAT IS COLOUR?

Colour is the visual perception based on the electromagnetic spectrum. Though colour is not an inherent property of matter, colour perception is related to an object's light absorption, reflection, emission spectra, and interference. For most humans, colours are perceived in the visible light spectrum (380 to 760 nanometers) with three types of cone cells (trichromacy). These three cone cells are short-wavelength (S-cones), medium-wavelength (M-cones), and long-wavelength (L-cones).

Colours have perceived properties such as hue, saturation, and luminance. Some of the most well-known colour models and colour spaces are RGB, CMYK, HSL/HSV, CIE Lab, and YCbCr/YUV.

The study of colours in general is called colour science and includes the colour complements; colour balance; and classification of primary colours (traditionally red,

yellow, blue), secondary colours (traditionally orange, green, purple), and tertiary colours.

### LIGHT SOURCES

When you buy a light bulb, you will see the terms 'Cold' and 'Warm'. This refers to the colour temperature. Colour temperature is measured in 'Kelvins'.

A 'warm' colour on the Kelvin scale is typically considered to be within the range of 2000K to 3000K; with lower Kelvin values producing a yellowish or orange-tinged light.

A 'cool' colour on the Kelvin scale is typically above 4000K; with higher Kelvin values producing a more bluish light.

Therefore, if we view an object under different light sources and colour temperatures, our perception of the colour will be different.

For example, if we use a light source in the 2800 to 3000K range, reds will lose some of their purplish cast, oranges will appear more reddish-orange, yellows will appear more orangy-yellow and greens, blues and purples will appear darker.

If, on the other hand, we use a light source of 6200K, reds will appear more purple, oranges will appear less warm, yellows will appear greener, greens and purples will appear more bluish, and blues will appear stronger.

We can immediately see how the temperature of light can have either a positive or negative impact on the appearance of a gemstone and why it is important to standardize the light source used to view and grade coloured gemstones. If we do not, it will simply be impossible to properly assess the colour and communicate this to others with any degree of accuracy.

The 'ideal' light temperature is generally considered to be between 5000 and 5500K. Under this light, all colours will appear at their best allowing for slight variances in hue and/or saturation to be detected.

## ELECTROMAGNETIC SPECTRUM

The electromagnetic spectrum is represented by a wide range of frequencies of electromagnetic radiations including radio waves, infrared rays, visible white light, ultra-violet light, x-rays, and gamma rays.

For the grading of gemstones, we are only concerned with visible white light, which falls between 380 and 760 nanometers.

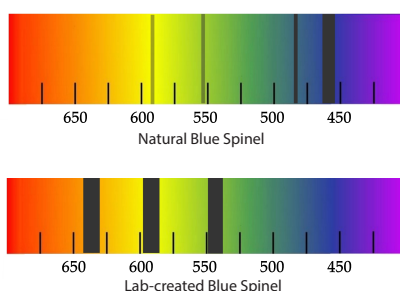
White light is composed of seven different colours, (wavelengths) namely violet (400 to 425 nanometers), indigo (425 to 450 nanometers), blue (450 to 500 nanometers), green (500 to 570 nanometers), yellow (570 to 590 nanometers), orange (590 to 610 nanometers) and red (610 to 750 nanometers).

## ABSORPTION OF LIGHT & GEMSTONES

When we view a gemstone in white light, the actual colour we see is a result of the colours or wavelengths that have not been absorbed by the gemstone.

In the case of transparent stones, absorption occurs as the light passes through the stone; while in opaque stones, absorption occurs as the light is reflected from the surface of the stone. If there is no absorption of light, the gemstone will appear white or colourless, if there is total absorption of light, the gemstone will appear black.

In gemmology we can see this using a spectroscope (diffraction or prism-type) with the areas of the spectrum absorbed by the gemstone appearing as dark lines.



Computer generated absorption spectra showing differences between natural and lab-created blue spinel

The suppression of certain wavelengths or colours in white light is called selective absorption and may be caused by chemical elements (in the form of impurities) present in the gemstone lattice (i.e., chromium III in ruby or iron in amethyst) or by elements, which are intrinsic to the stone's chemical composition (i.e., copper in malachite or manganese in rhodonite).

Based on this, all gemstones can be classified as either:

**Allochromatic Gemstones:** gemstones where their colour is caused by impurities.

**Idiochromatic Gemstones:** gemstones that owe their colour to elements present in their chemical composition.

## COLOUR GRADING SYSTEMS.....PAST AND PRESENT

In 1978, C.R. Beasley of American Gemological Laboratory (AGL) created Color/Scan as a means of quantifying the hue and tone of a gemstone. Although no longer commercially available, the Color/Scan system consisted of individual cards, based on gem varieties rather than hue, each containing six foil-like acetate samples to simulate the three-dimensional appearance of a gemstone. In total, 156 colour samples were represented.

In 1979, the Gemological Institute of America introduced their ColorMaster using the Munsell system of colour description. While in theory it was designed to consistently determine colour with ultimate and repeatable standards, it was deemed to be unreliable, difficult to use, cumbersome and beyond the financial realms of most jewellers.

In 1983, Howard Rubin released GemDialogue. This consisted of a portable colour chart manual containing twenty-one transparent colour scale charts painted with inks, each showing ten different saturation levels for a total of 210 colour samples. A black to grey mask and a brown to light brown mask, showing ten different levels from light to dark, were also included. To facilitate the grading of opaque gemstones, an opaque black to grey mask was also included. This allowed the system to create more than 60,000 colour combinations.

In 1991, Ken Roberts invented GemSet. This consisted of 324 round plastic-molded colour samples (resembling round faceted stones). The Gemological Institute of America (G.I.A) subsequently purchased the system and re-configured the colour notations to hue, tone and saturation to be consistent with the terms they used in their courses. While the set provided limited coverage of colours, it was extremely useful as a retail sales tool. Although G.I.A no longer produces GemSet, it is still highly sort after with full-size sets selling at premium prices on Internet sales sites such as eBay.

In 1994 Thomas Tashey Jr. of European Gemological Laboratory (E.G.L) published the World of Color, a pocket-sized book based on the Munsell Color System and arranged by tone rather than hue. Containing more than 1500 colour samples arranged in thirty-one standard colours and using small colour dots

representing tone and saturation, it was copyrighted by the Gem Quality Institute and used by the European Gemological Laboratory (Los Angeles) on their lab reports.

Following eleven years of research, Gemewizard released GemeSquare, a colour communication software application that allows users to describe a gem's colour using standard Gemological Institute of America (G.I.A) terminology (hue, tone, and saturation) and Gemewizard's alphanumeric colour code. Using thirty-one master colour hues, each visible in six tones and six saturation levels, GemeSquare can create 1146 colours. GemePro, their advanced colour definition software system allows approximately 9000 gem colours to be reproduced from their database in sixteen common shapes and cutting styles.

In 2015, Gemworld International and Thomas Tashey Jr. released the new World of Color grading system based on the initial system created by Tashey in 1994. Consisting of forty high quality colour pages representing the Munsell colour hues with transparent overlay pages that provide the corresponding colour names for each Munsell notation, the system also comes with a quartz 'Gem Crown' and fifty grading charts that can be used not only to grade a gemstone based on its colour but can also be used in conjunction with GemGuide, produced by Gemworld International, to determine price.

Geoffrey Dominy, founder of the World Gem Foundation, released ColourWise, a hybrid digital grading system based on the HSL (Hue, Saturation and Luminosity) colour model in 2021 that consists of thirty-one hues, five levels of saturation and seven levels of luminosity (lightness). The system is fully compatible with the G.I.A, Gemewizard and World of Color grading systems, and GemGuide.

## COLOUR

Colour is defined by three factors; its primary and secondary hues, how light or dark it is and its intensity.

### HUE

Hue refers to the position of a colour on the colour wheel.

While GemDialogue, World of Color, G.I.A /Gemewizard and ColourWise all refer to colour as hue, they differ in how many are included in their systems. Gemewizard and ColourWise use thirty-one, GemDialogue use forty-five and World of Color use forty.

Obviously, the more hues you have, the more accurate you can be in finding a suitable match. However, as the number of options increases, your ability to achieve consistency decreases and in the world of gemstone

grading, consistency is the one thing you do not want to compromise. Ideally, you want to ensure that the hue you assign today will be the same as the hue you assign a year from now. This is the biggest challenge for any grader, grading consistency.

## TONE, VALUE OR COLOR MASK

These terms refer to the degree of lightness or darkness of a colour.

G.I.A / Gemewizard use the term 'tone', World of Color use both 'tone' and 'value', GemDialogue use the term 'color mask' and ColourWise use 'lightness'.

Although Gemewizard have eleven tonal categories, where 0 represents the lightest tone and 10 represents the darkest, only seven are used in the system.

GemDialogue quantifies 'color mask' in percentages.

World of Color uses a tonal scale that is the reverse of G.I.A /Gemewizard with 0 representing the darkest tone/value and 10 representing the lightest tone/value.

ColourWise use seven levels of lightness that like World of Color are in reverse order to G.I.A / Gemewizard and are also quantified in percentages. Like G.I.A / Gemewizard, they do not include levels that are either too light (90% & 100%) or too dark (0% & 10%).

## SATURATION, CHROMA, OR ZONE

These terms refer to the intensity of a colour.

G.I.A / Gemewizard use the term 'saturation' and include six different levels from 1 (greyish or brownish) to 6 (vivid). GemDialogue use the term 'zone' and include ten from 10% to 100%. World of Color use both 'saturation and chroma' on a scale from 0 to 18 while ColourWise use five levels (low to strong) in twenty percent increments.

## FINAL COLOUR GRADES

To accurately describe the colour of a gemstone, all three factors (hue, degree of lightness or darkness and the intensity of colour) must be used.

Therefore, using ColourWise, a stone graded B 100 40 would be described as blue with strong saturation and medium/dark lightness.

## DETERMINING A COLOUR SCORE

The aim of each colour grading system is not only to establish the hue, saturation / chroma / zone, and tone / color mask or lightness but also to determine the value.

While each system differs in their approach, the goal is to create a 'Colour Score' that will form the basis for the



overall score. This is because colour has the greatest impact on the overall value of a coloured gemstone.

With Gemewizard, the calculations are made through the software included in the program.

GIA, GemDialogue, and World of Color use supplementary books that contain colour scores based on the hue, the degree of vividness (saturation / chroma / zone) and tonal level (tone, color mask or lightness), while ColourWise uses a digital interface called ‘Colour Score’.

5PB

9	1	2							
8	2	3	4						
7	1	3	4	5.5					
6		2	4.5	6	7				
5		2	4.5	6	8	8.5			
4		2	5	6.5	9	9.5	10		
3		3	5	7	9				
2		2	4	6					
	2	4	6	8	10	12	14	16	18

Source: The World of Color

A blue sapphire graded 5PB with a tonal level of 4 and a saturation level of 14 would score 10 out of 10 using World of Color.

RED

	1	2	3	4	5	6
2						
3						
4						
5				3	4	8.5
6			3	4	6	10
7			3	4	7	
8			2	4		

Source: GIA

A ruby with a red hue (R), a tonal level of 6 and a saturation level of 6 would score 10 out of 10 using the GIA system

RO/OR/100/50  
Sapphire (10)  
Topaz (9\*)  
Zircon (9\*)



Source: ColourWise

An orange sapphire with a RED/ORANGE / ORANGE/RED hue, a lightness of 50% and a saturation level of 100% would score 10 out of 10 using the ColourWise system





Fluorite (Photo by Tino Hammid)





Yellow Sapphire (92 carats) (Photo by Tino Hammid)





Colour Change Garnet (Daylight) (Photo by Tino Hammid)





Colour Change Garnet (Incandescent Light) (Photo by Tino Hammid)





Colombian Emerald (Photo by Tino Hammid)



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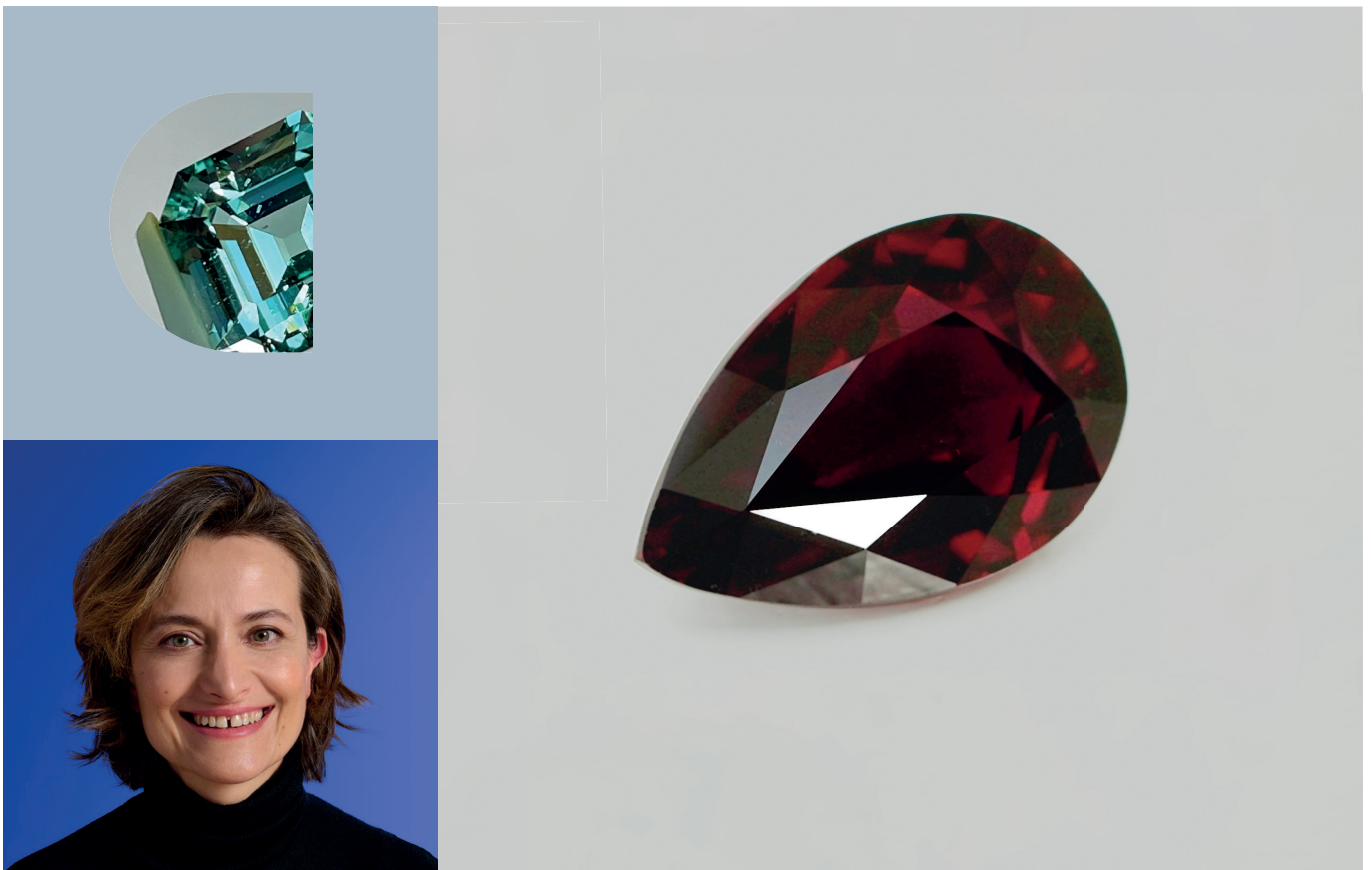
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