Pigeon blood red & Royal blue:

Working towards an international standard

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Background

The colour of corundum is mainly related to the presence of colouring elements (and occasionally so-called colour centres) in its crystal structure.

The colour we see is resulting from the interaction of electrons of these colouring elements (and colour centres) with light photons (energy) when exposed to a light source.

Corundum: the beauty of colours

Colour = selective absorption ± emission (fluorescence)

Background

- Pigeon blood red and royal blue are **trade colour terms**
- not scientifically (colorimetric) defined terms
- so far **no international standard**
- strong demand by the trade for an independent assessment of colour and to mention colour terms on laboratory reports
- new terms emerge (royal red, dragon red, Mekong whisky yellow, etc...)
- historically perceived as **very rare** and **exceptional in quality**
- impact on value

Background

References:

1983

THE RUBIES OF BURMA:
A REVIEW OF THE MOGOK STONE TRACT

By Peter C. Keller

…The Burmese material is chrome-rich, which gives rise to **strong fluorescence** to ultraviolet radiation and a characteristic absorption spectrum, as well as to the **„pigeon‘s blood“ colour** associated with Burmese stones.

Excerpt from page 217:
Keller (1983), Gems & Gemology, Vol. 19, No. 4, 209-219.

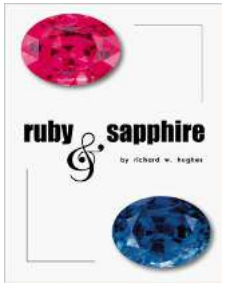
1888

PROCEEDINGS
OF THE
ROYAL GEOGRAPHICAL SOCIETY
AND MONTHLY RECORD OF GEOGRAPHY.

On the Ruby Mines near Mogok, Burma.
By Robert Gordon, C.E.
(Read at the Evening Meeting, February 27th, 1888.)

The ruby ... was generally of carmine, cochineal, or rose-red colour, with a play of violet; **but the most valuable was the colour of pigeon‘s blood**.

Excerpt from page 273:
Gordon (1888). On the Ruby Mines near Mogok, Burma



1997

Traditionally, the Burmese have referred to the **finest hue of ruby** as "pigeon's blood" (*ko-twe*), a term which may be of Chinese or Arab origin.

...It must be stressed that the true **pigeon‘s-blood red is extremely rare**, more a colour of mind than the material world.

"...asking to see the pigeon's blood is like asking to see the face of God.“

Some have compared this color to the center of a live pigeon's eye (Brown & Day, 1955).

…the color most coveted today is that akin to a red traffic signal or stoplight. It is a **glowing red color, due to the strong red fluorescence** of Burmese rubies...

Excerpts from pages 329-330:
Hughes (1997), Ruby & Sapphire. 511 pages.

The harmonised criteria of SSEF and GGL:

Working towards an international standard

Joint Press release of SSEF & GGL 1. Nov 2015

Press release:

Switzerland's SSEF and Gübelin Gem Lab agree to harmonise 'pigeon blood red' and 'royal blue' standards

The Swiss-based **Gübelin Gem Lab** and **Swiss Gemmological Institute SSEF**, recognised as the leading laboratories for coloured stone testing, have agreed to **harmonise their standards** for the colour terms "pigeon blood red" and "royal blue." Their goal is to standardise the usage of these terms for the benefit of the international gemstone trade.

The colour terms *"pigeon blood red"* and *"royal blue"* have been used for centuries by the trade to describe, respectively, only the finest quality rubies and sapphires, which aside from their distinct colours, invariably are stones of superior quality, and hence are among the most coveted gems.

See www.ssef.ch, Press releases

SSEF and Gübelin Gemlab use the terms
pigeon blood red and royal blue only for rubies and sapphires:

- which exhibit **strong** red or blue colour saturation
- which are **untreated**
- which meet **specific** chemical and spectroscopic characteristics
- of **fine quality** in terms of inclusions, transparency, and colour homogeneity

But finally they are colour terms and thus assessed using mastersets of rubies and sapphires according to an internal laboratory protocol.

Levels of criteria ?

Main question: “Pagoda-principle” yes or no ?

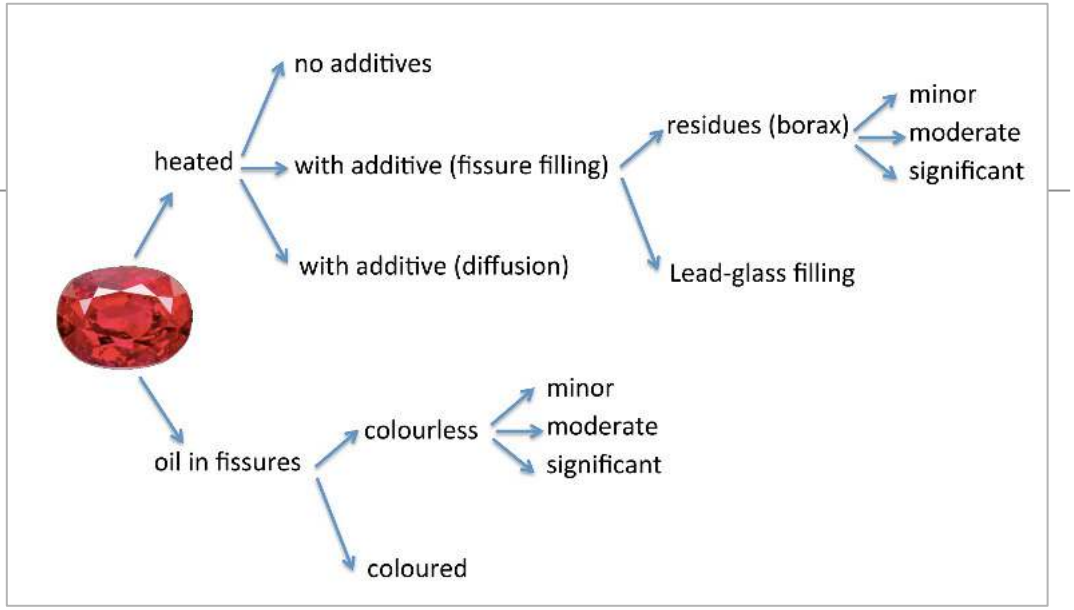
- should these terms just be used as generic colour terms ?

- or should there be additional criteria (levels) to qualify for these two colour terms ?

Pagoda

*Wikipedia: A **pagoda** is a tiered tower with multiple eaves, built in traditions originating as stupa in historic South Asia.*

Levels of criteria ?



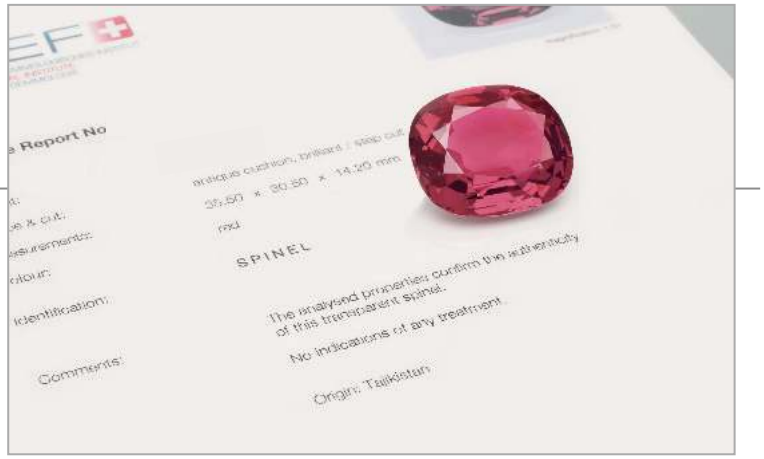
Flow chart of treatment options for ruby. © M.S.Krzemnicki

Should these colour terms be applicable:

- for **imitations** or **other gems** ?
- for **synthetic** ruby or sapphire ?
- for **treated** rubies and sapphires ?
- linked to **quality** requirements (transparency, colour homogeneity etc.) ?
- linked to **chemical/spectral** specifications (influencing colour) ?

If we accept, that further attributes are required, then the only question is where to set the limits.

Creation of an internal standard



Red spinel on SSEF Gemstone Report

Laboratories have to create internal standards to be able to correctly and consistently describe gem materials on their lab reports.

Such an internal standard may become internationally accepted/harmonised (e.g. CIBJO, LMHC, SSEF-Gübelin GGL...).

Example: Fancy coloured diamonds
GIA has de facto created a „standard" terminology which today is globally accepted in the trade.

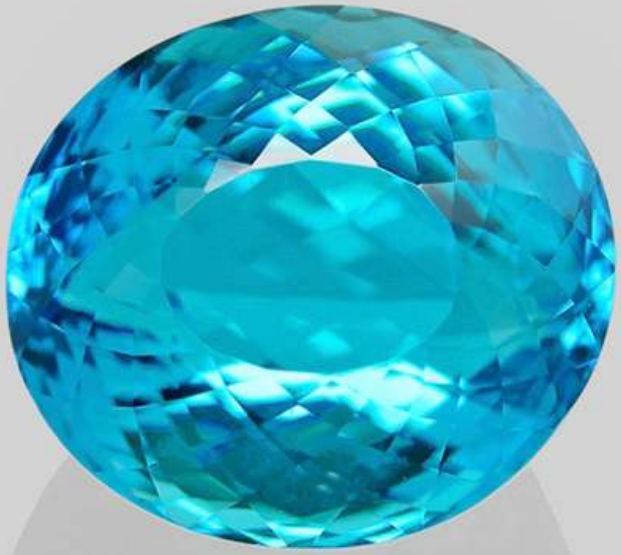
Creation of an internal standard

Padparadscha yes or no ?

Examples:

- Ruby / pink sapphire
- Padparadscha
- Paraiba tourmaline / light blue tourmaline (with Cu traces)
- Emerald / green beryl (with Cr traces)
- Colour change or just slight colour shift under different light sources
- Pearl colours

Creation of an internal standard



Paraiba tourmaline

light blue tourmaline (with Cu traces)

Creation of an internal standard

Colour examples of pink sapphire to ruby

The colour grading of ruby and sapphire is much more complex than for diamonds.

Taking the example of the term **pigeon blood red**, the next slides show our criteria which are required to qualify for this term.

Our criteria for **royal blue** are very similar to the ones of pigeon blood red, only differing in the spectroscopic (chemical) specification.

Harmonised criteria (SSEF & GGL):

Pigeon blood red

Ruby masterset for pigeon blood red of SSEF

The fundamental criterion is colour:

The colour of a ruby is graded by comparison with a masterset of (natural) rubies.

The main parameters hue, saturation and brightness are observed.

Only rubies with a strong saturation and a “vivid” red colour (similar to red traffic light) with no or only slight purplish colour tint are accepted.

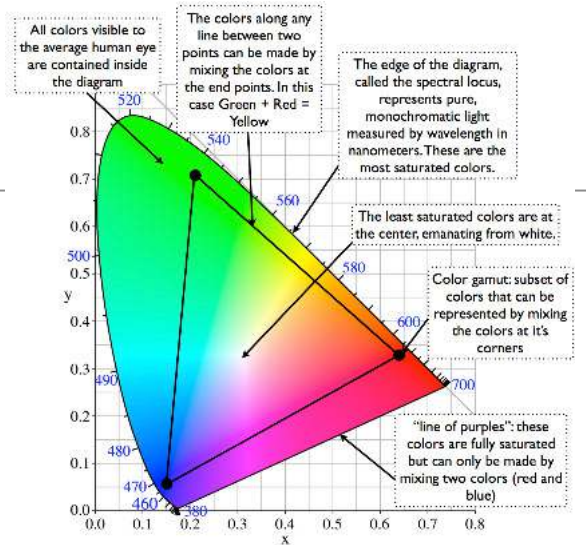
criteria:

Pigeon blood red

Colour observation:

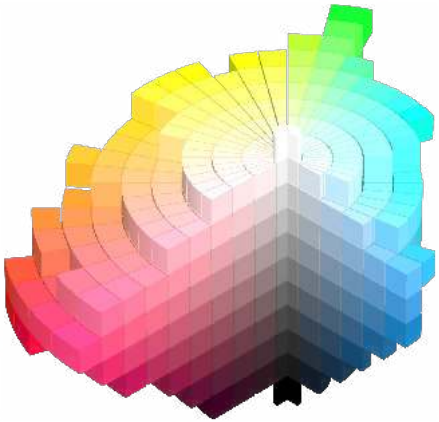
Based on three factors:

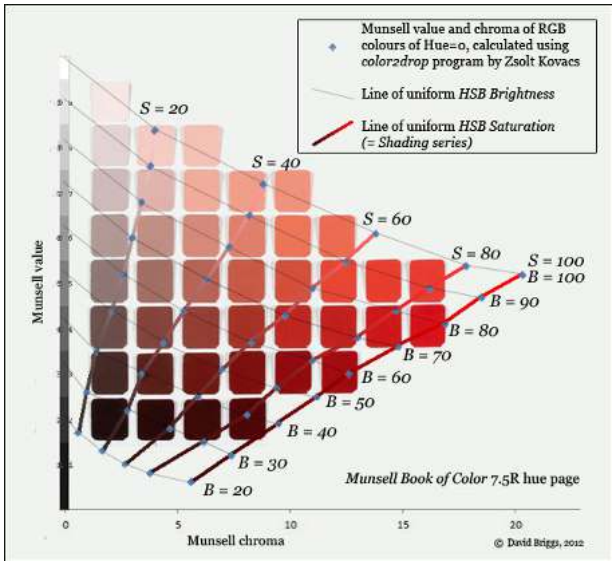
1) Light source (emission characteristics)
2) Observer (protocol and training)
3) Observed item (e.g. ruby or sapphire)



CIE Chromaticity diagram

To grade colour consistently, the first two factors have to be defined and standardised as much as possible.





Munsell colour space and charts

criteria:

Pigeon blood red

Effect of light temperature on colour appearance:

Two rubies showing weak and strong LWUV reaction under different light sources.

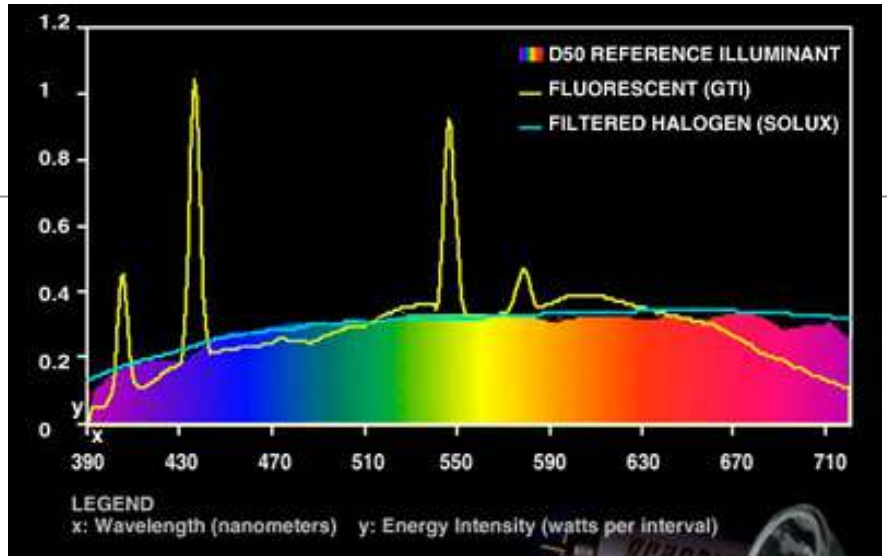
LWUV *D65 (6500 K) daylight* *A (2800 K) incandescent light*

criteria:

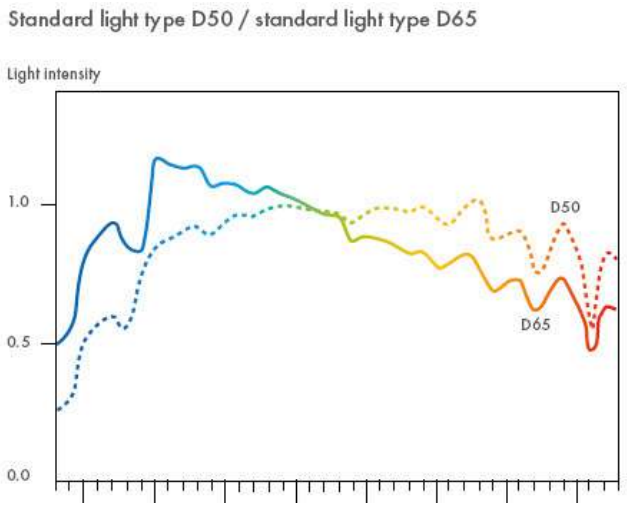
Pigeon blood red

Standardized colour observation:

- Colour observation from the top
- Ruby slightly tilted 20° in all directions
- Standardised light (ideally continuum, e.g. filtered halogen lamp equivalent to CIE D50 illuminant, 99+ colour rendering efficiency).
- The ruby and the masterstones are placed directly below the light source at approx. 20 cm distance. Light intensity at that point approx. 2200 lux (same as for diamonds PAS 1048.2, §5.3.8, page 5).



Spectral distribution of D50 illuminant, compared to halogen and fluorescent light.



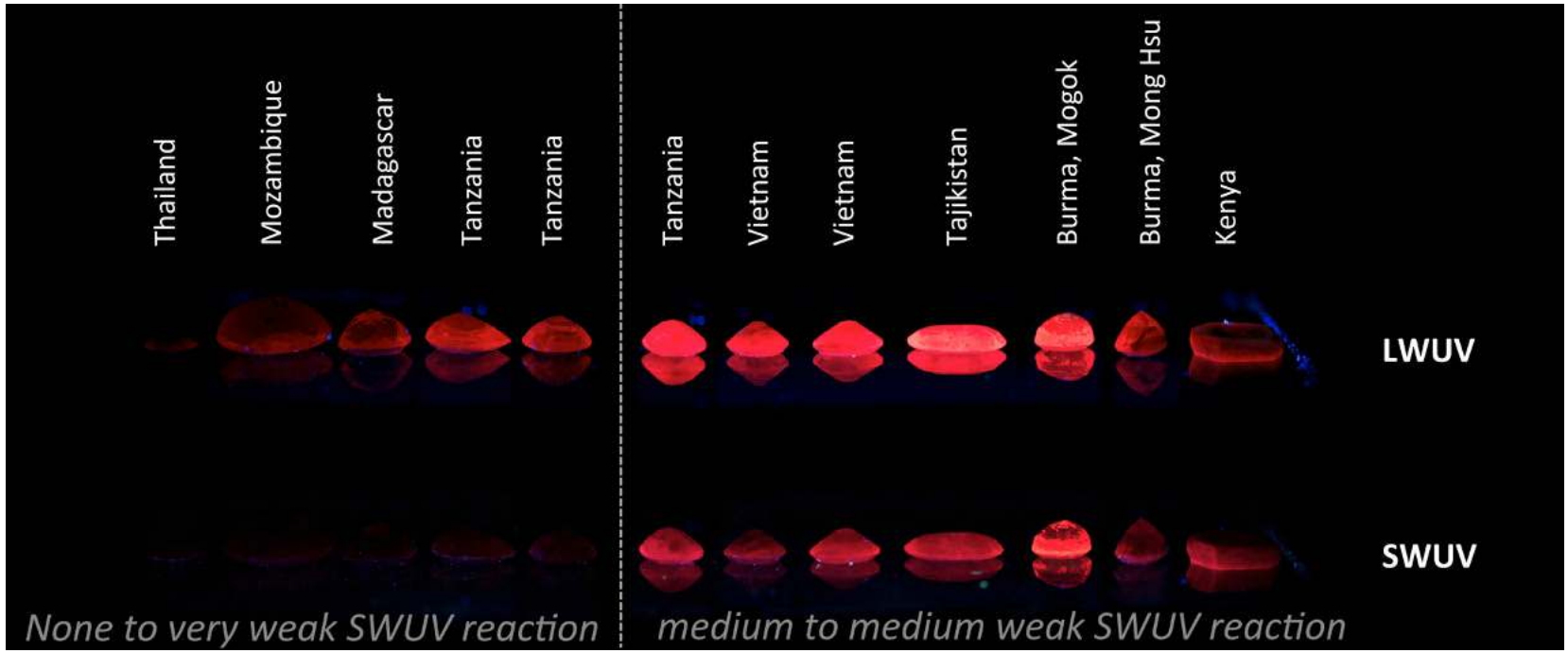
Comparison of D65 (diamond) and D50

criteria:

Pigeon blood red

Fluorescence:

The body colour of pigeon blood red rubies is complemented by a **strong fluorescence** when exposed to ultraviolet light (LWUV: strong, SWUV: medium – medium weak).



criteria:

Pigeon blood red

Inner glow
strong UV reaction

No inner glow
weak UV reaction

Fluorescence:

The fluorescence is caused by high chromium content combined with low iron content. It results in a distinct "inner glow" when exposed to sunlight (which contains UV), an effect which has been coveted in the trade historically.

Rubies with very high chromium content and low iron concentration however show reduced fluorescence and do not qualify.

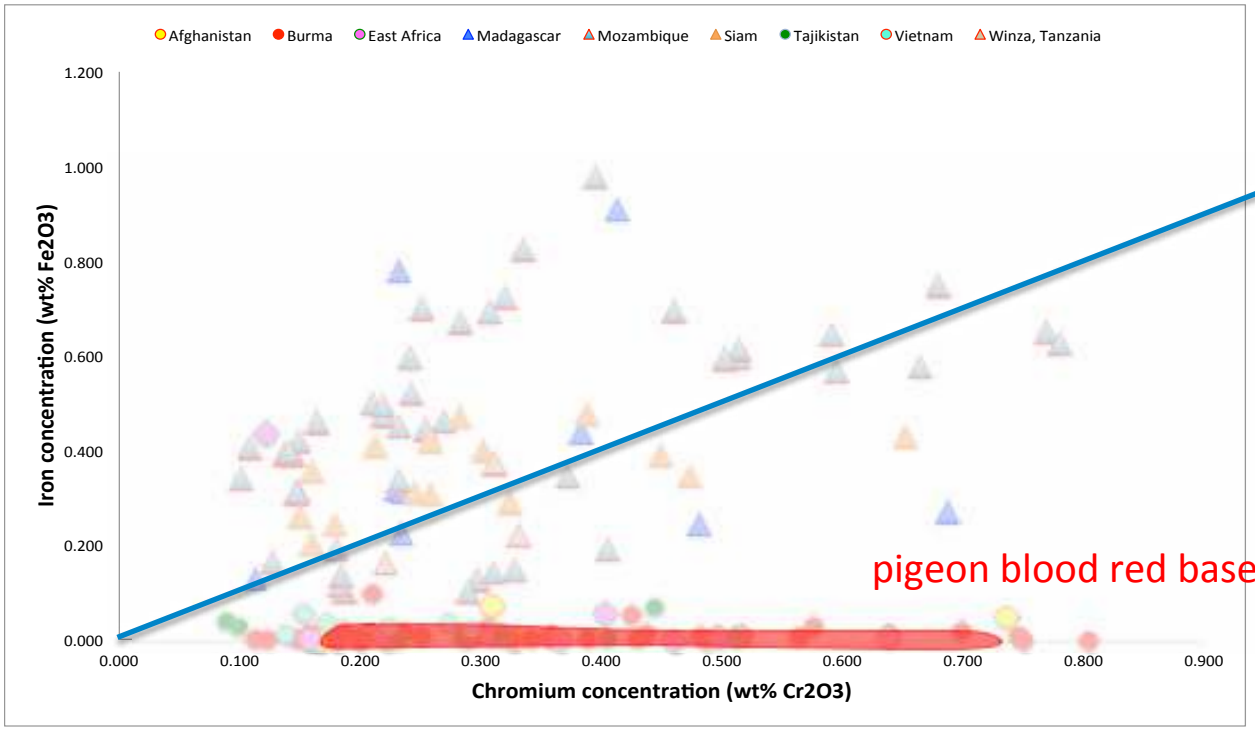
criteria:

Pigeon blood red

Chemical composition:

Generally only rubies with very low amount of iron (compared to chromium) show fluorescence intensity which meets our criterion for pigeon blood red.

The chemical criterion commonly is met for rubies which formed in marble deposits, such as in Myanmar, Vietnam, Tajikistan, Afghanistan, Tanzania (e.g. Morogoro), Kenya, etc.



criteria:

Royal blue

Sapphire masterset for royal blue of SSEF.

The fundamental criterion is colour:

The colour of a sapphire is graded by comparison with a masterset of (natural) sapphires.

The main parameters hue, saturation and brightness are observed.

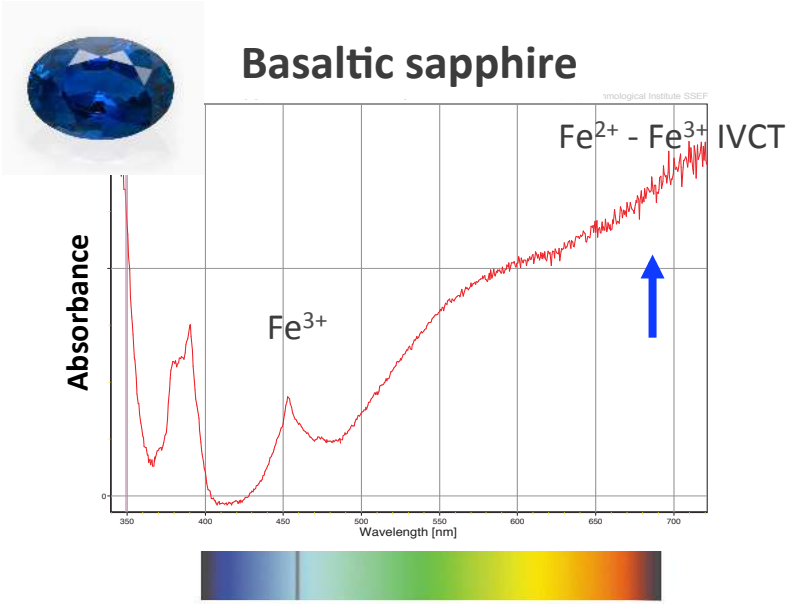
Only sapphires with a strong saturation and a “vivid” blue colour but **no** additional colour tint (greenish, greyish or purple) are accepted.

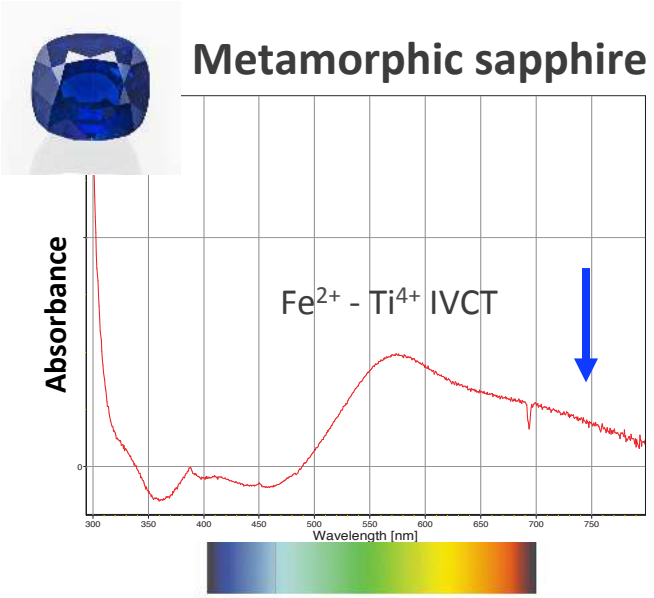
criteria:

Royal blue

Spectral criterion for “Royal blue”:

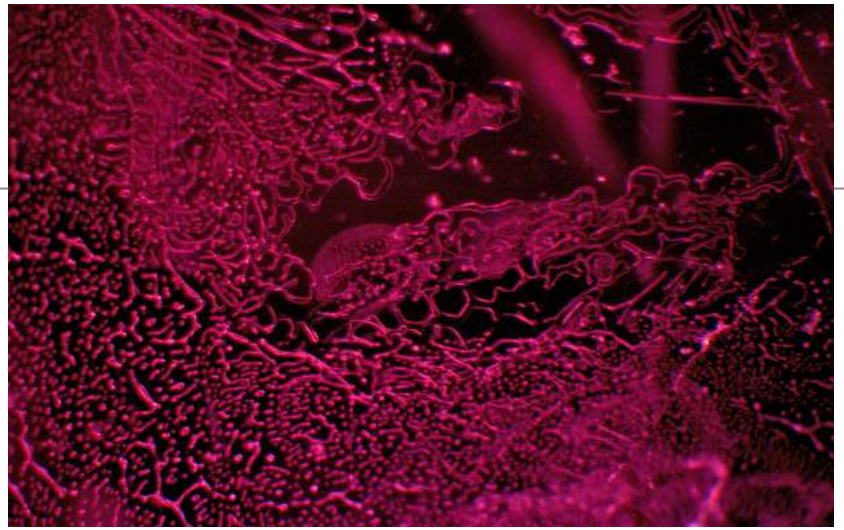
- Blue of strong saturation, either pure or with a very slight purplish tint.
- historically coined for the best quality of sapphires originating from the Mogok area in Burma, it is also applied by SSEF & GGL for sapphires from other **metamorphic** deposits, such as in Madagascar, Sri Lanka, and Kashmir.
- UV-Vis absorption spectrum dominated by Fe^{2+} - Ti^{4+} Intervalence charge transfer.





criteria:

Pigeon blood red



Glassy residues (borax) in healed fissure of heated ruby from Siam.

Treatment:

Only rubies which show no indications of any treatment.

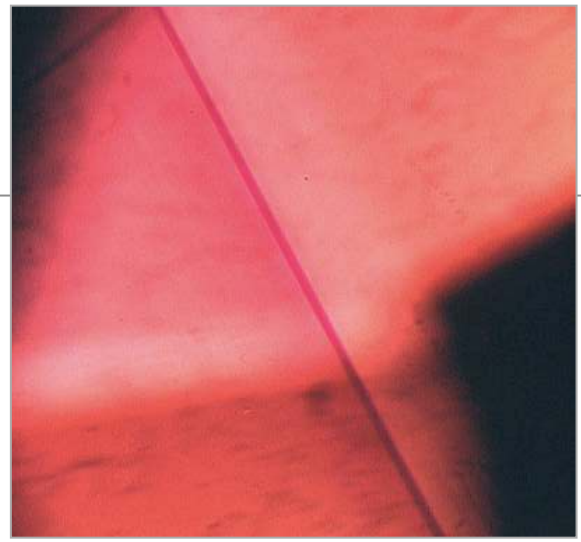
Based on the historical connotation of rarity and exceptional quality.

Photo © Twobadcats, www.etsy.com

Photo © Dreamstime.com

criteria:

Pigeon blood red

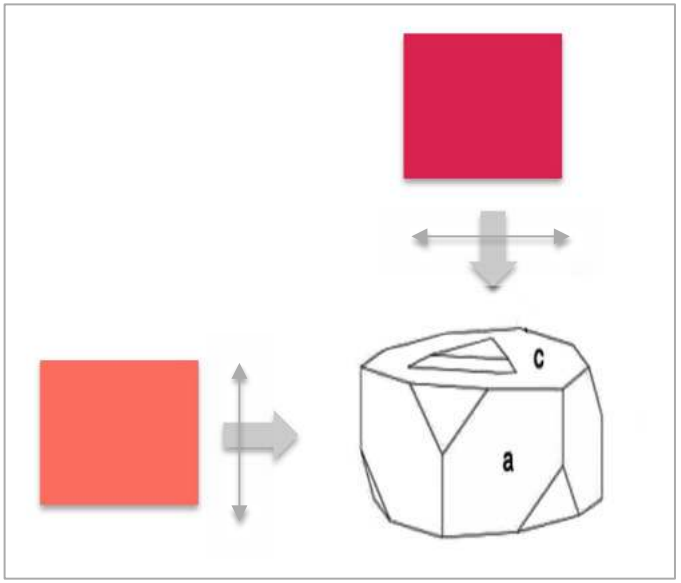


Lamellar twinning revealing the pleochroic colours of ruby. Photo © H.A. Hänni

Pleochroism:

Different to diamond, ruby (and sapphire) is optically anisotropic and shows a distinct pleochroism.

ruby:	o-ray	purplish red
	e-ray	slightly orange red



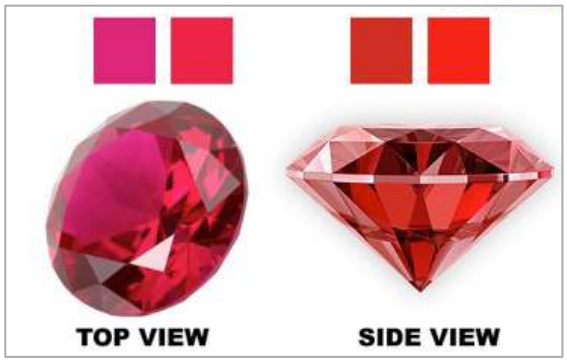
criteria:

Pigeon blood red

Pleochroism:

The perceived colour of a ruby is an interplay of its pleochroic colours.

It is dependent from the orientation in which the gemstone has been cut from the rough crystal and the orientation it is looked at.



© R. Scott, Jewelery-Secrets.com

SSEF & GGL:

- Colour observation from the top
- Ruby slightly tilted 20° in all directions

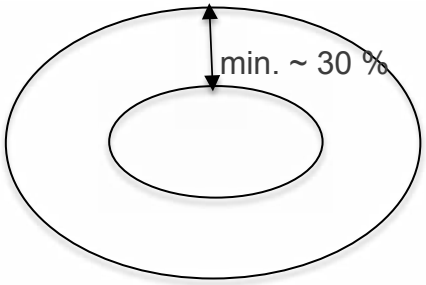
criteria:

Pigeon blood red

Proportions:

Very different to diamonds, rubies (and sapphires) are rarely cut in “ideal” proportions which would maximize the yield of internally reflected light (when viewed through the table).

Their cut is rather reflecting the shape of the rough and weight considerations, often resulting a transmission “window”, which may – in combination with pleochroism – strongly contribute to the visual appearance of the stone.



criteria:

Pigeon blood red

Zoning:

Rubies (and sapphires) often show colour zoning, i.e. variations in colour saturation.

If cut properly, the effect of such zoning might be minimised when viewed from the top.

Pigeon blood red only for rubies with no to insignificant zoning when viewed from the top.

Two examples of rubies with strong colour zoning not fitting for pigeon blood red.

criteria:

Pigeon blood red

Colour modifier:

Rubies often contain fissures or cavities filled with orange substance such as iron hydroxide or even orange oil.

Although only locally present, such colour modifier may shift the colour of a stone considerably.

Pigeon blood red term not applicable for such stones.

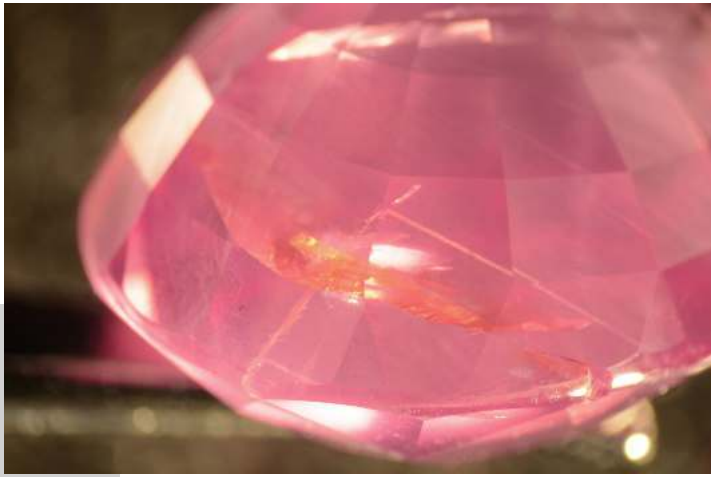
Orange fissure filling in a ruby shifting its originally purplish red body colour into red.

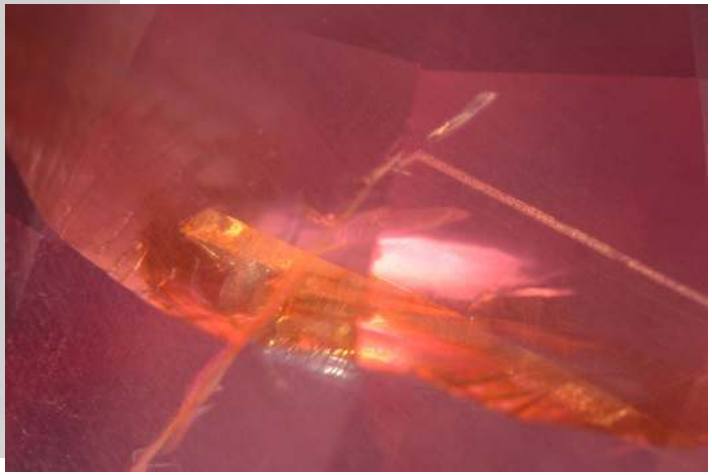
criteria:

Pigeon blood red

Colour modifier:

Similar situation also in case of this pink sapphire which does not qualify for padparadscha.





criteria:

Pigeon blood red

Inclusions:

They must be relatively free of eye-visible or dark inclusions when viewed from the top with approx. 20 cm distance to the ruby.

Inclusions and weak to medium “silk” in zones which do not (or only slightly) affect perceived colour are acceptable.

These colourless inclusions and the weak “silk” in zones do not affect the perceived colour of this ruby.

criteria:

Pigeon blood red

The Star of Kashmir (approx. 20 ct)

Transparency:

Ruby must show vivid internal reflections.

Conclusions

- The trade terms pigeon blood red and royal blue historically are not used as pure colour terms but linked to **rarity** and **exceptional quality**. This connotation makes these terms so valuable for the trade and consumers.

- SSEF and Gübelin GGL have **harmonised** their **criteria** in 2015. But results may still differ, as colour grading is finally an independent opinion of each laboratory (similar to diamond grading).

- Colour grading is following a internally **standardised protocol**.

- Only for rubies / sapphires fitting all criteria

- Only a restricted number of rubies/sapphires are attributed the colour grades “pigeon blood red” or “royal blue” based on the presented strict criteria.

Conclusions

Summary of our criteria:

- A strong red or blue colour (compared to masterstones)
- Only for rubies and sapphires formed in nature
- Only for untreated rubies and sapphires
- Specific chemical and spectroscopic properties related to colour appearance
  (e.g. fluorescence in rubies, partial transmission in the red for sapphires)
- Not restricted to a single source, but rather to a geological setting
- Homogeneity of colour (orientation of cut, pleochroism)
- Good proportions, avoiding dominant “window situation”
- No apparent colour zoning
- No colour modifier by fissure fillings
- No apparent and disturbing inclusions
- Good transparency, distinct internal reflections

- Colour grading is following a internally standardised protocol.
- We use a 5000K D50 daylight equivalent illumination (continuum)
- Minimum “4-Eyes” principle

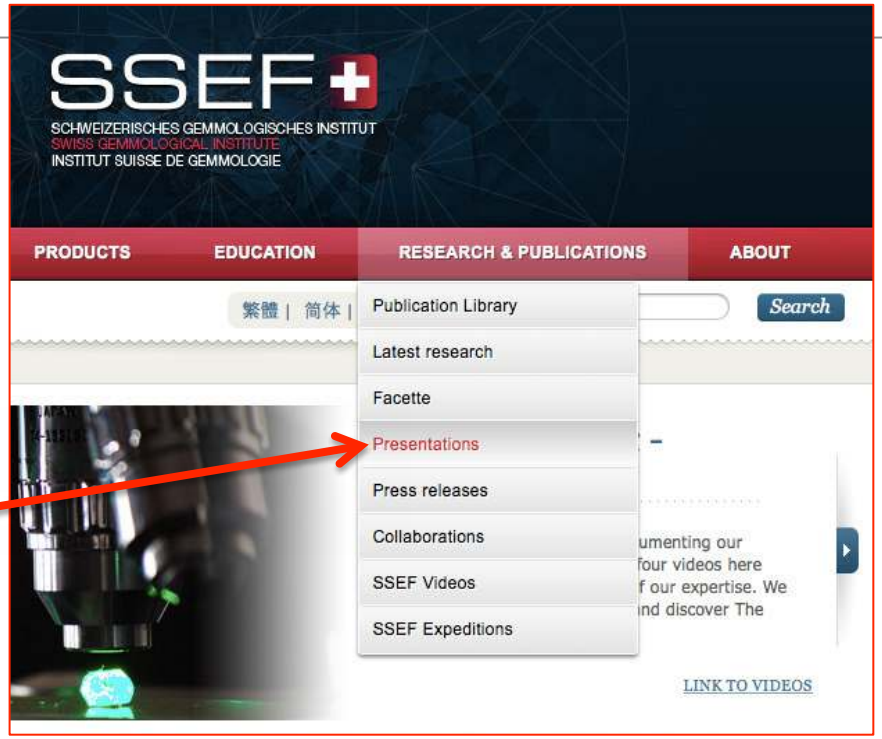
Outlook:

Working towards an international standard

Open access to criteria

Download a slightly modified version of this presentation on our SSEF website.

www.ssef.ch



Direct link for download:
www.ssef.ch/fileadmin/Documents/PDF/650_Presentations/2016_CIBJO_colourterms_SSEF.pdf

Outlook:

Working towards an international standard

CIBJO World Jewellery Federation:

Invited speaker and presentation of criteria at a Special Session of the CIBJO Congress in Yerewan (Armenia), October 2016.

SPECIAL REPORT

Gemmological Commission

cibjo CONGRESS 2016

Yerevan, Armenia
26-28 October 2016

Terminology and standards for describing colours of gemstones to be key focus of Gemmological Commission at CIBJO Congress

By Hanco Zwaan, President
CIBJO Gemmological Commission

During the Gemmological Commission meetings last year in Salvador, Brazil, it became apparent once again that in many areas there is a need for clearer standards. This relates not only to well-defined and non-deceptive terminology that should be used in the trade, but also to the ways in which the results are obtained by laboratories and how these are noted on gem identification reports.

Standardisation at gemmological laboratories and their communication of specific colours, such as "Pigeon's Blood" for rubies and "Royal Blue" and "Cornflower Blue" for sapphires, was

CIBJO SPECIAL REPORT 2016
GEMMOLOGICAL COMMISSION
PAGE 1

Outlook:

Working towards an international standard

- We are convinced that standardising and harmonising the use of these colour terms is important for the trade and laboratories.

- The SSEF & Gübelin GGL harmonisation of criteria may be considered a first step in this direction.

- Any organisation/laboratory which would like to join this harmonisation is welcome.

- We are ready to duplicate our ruby and sapphire mastersets for organisations, laboratories and trade members.

Thank you for your attention!

Highly attractive pinkish red colour !

The „Queen of Burma“ (23 ct)
sold for US$ 6 mio at Christie‘s Geneva, 2014.