Gemology Kit
UV-Vis-NIR

Case Study

Thunder Optics

Science and knowledge for all

www.thunderoptics.fr 09/2025

What it is

A portable, lab-grade kit for nondestructive UV-Vis-NIR spectroscopy of gemstones (≈350–1050 nm). Built around the Thunder Optics O Spectrometer (Hamamatsu S11639 detector) with optimized illumination and sampling accessories, it lets gemologists identify chromophores, assess treatments, and support origin hypotheses in minutes.

What's in the kit

- **O Spectrometer** (350–1050nm) with 25µm slit for higher resolution.
- **Illumination:** Deuterium & Halogen (UV-Vis-NIR) or Halogen (Vis-NIR)
- **Fiber-optic probe** and cosine corrector
- **Custom sampling stand** (stable, repeatable geometry)
- **ThunderView** software (peak picking, overlay/compare, export)
- **Rugged carry case** with power and fiber management

Optional add-ons: reflection probe for opaque/aggregate materials; cuvette holder for dyes/polishants.

Typical workflows

1. **Seat the stone** in the stand (pavilion-to-crown path recommended for faceted transparents; reflection geometry for opaque/cabochon).
2. **Place the probe** at the correct working distance; minimize stray light.
3. **Illuminate** (Halogen for Vis–NIR, add D_2 for deep-UV features when needed).
4. **Record 350–1050nm** absorption/reflectance; average several scans.
5. **Inspect peaks/bands** in ThunderView; overlay with references and prior runs; export the report.

Good practice - Keep geometry consistent between samples; note path length and orientation. - Collect a baseline/dark and a reference spectrum for each session. - Use overlays rather than absolute intensity for band-position comparisons.

What you can do (at a glance)

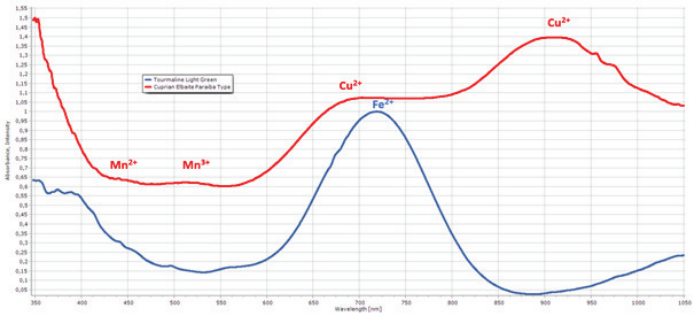
- **Identify chromophores** (Cr^{3+}, V^{3+}, Fe^{2+}/Fe^{3+}, Cu^{2+}, Mn^{3+}, etc.)
- **Differentiate similar colors** (e.g., aquamarine vs blue topaz vs maxixe-type beryl)
- **Support origin hypotheses** (e.g., magmatic vs metamorphic sapphires; iron-poor vs iron-rich emeralds)
- **Screen treatments** (e.g., dyed jadeite/turquoise; some irradiated/annealed features in diamonds)
- **Create documentation** (PDF/CSV spectra for lab files, education, and clients)

UV-Vis-NIR is **confirmatory** *and fastest when you already have a short list of candidates; integrate with* **inclusion microscopy** *and* **FTIR** *for lab-level conclusions.*

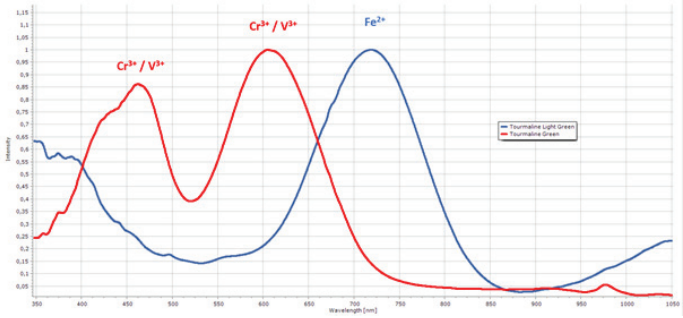
Case highlights (from field use)

Paraíba-type tourmaline (Cu-bearing elbaite)

- Strong Cu^{2+} absorption near ~910–920 nm separates Paraíba/Paraíba-type from visually similar blue tourmalines.
- Corroborative Mn^{3+} bands typically near ~450 nm and ~530 nm; vanadium-rich tourmaline shows Cr^{3+}/V^{3+} features while Fe-colored green tourmaline shows Fe^{2+} only.
- Why it matters: correct identification can change value by orders of magnitude.



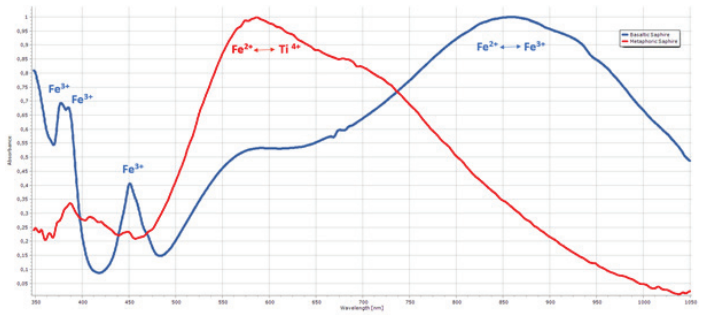
Cuprian Elbaite Paraiba Type - Tourmaline Light Green



Tourmaline Green - Tourmaline Light Green

Blue sapphires (metamorphic vs magmatic)

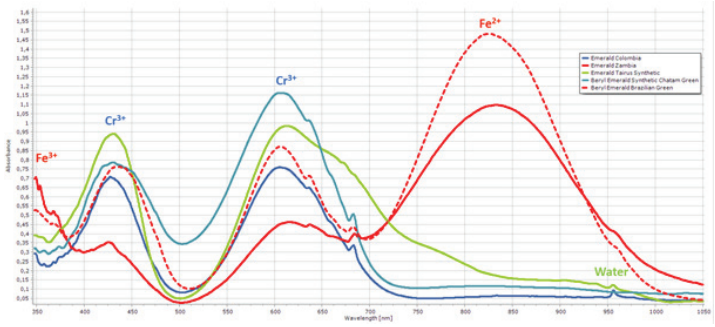
- **Metamorphic:** dominant **Fe^{2+}↔Ti^{4+} IVCT** band; Fe^{3+} absorptions usually subdued.
- **Magmatic:** more distinct **Fe^{3+}** bands plus **Fe^{2+}↔ Fe^{3+} IVCT.**
- Practice tip: pair spectra with inclusion microscopy and **FTIR** when assessing heat treatment/origin.



Basaltic Saphire - Metaphoric Saphire

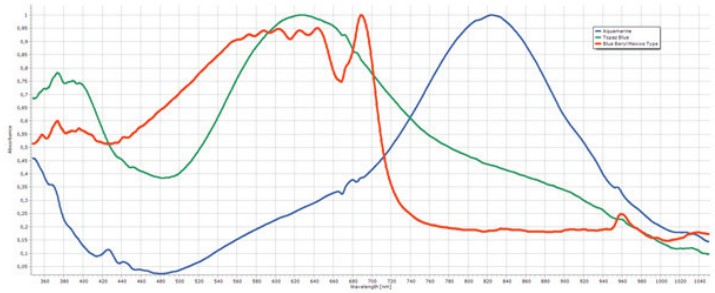
Emeralds (iron-poor vs iron-rich sources)

- Cr^{3+}/V^{3+} visible bands set the color but are not origin-diagnostic.
- **Fe-related** absorptions—when present—in **UV** (Fe^{2+}) and **NIR** (Fe^{3+}) help separate **iron-poor** sources (often Colombian; also Musakashi/Zambia) from **iron-rich** deposits.
- Capture the full **350–1050 nm** range; use overlays for relative comparison.



Diamonds (screening + education)

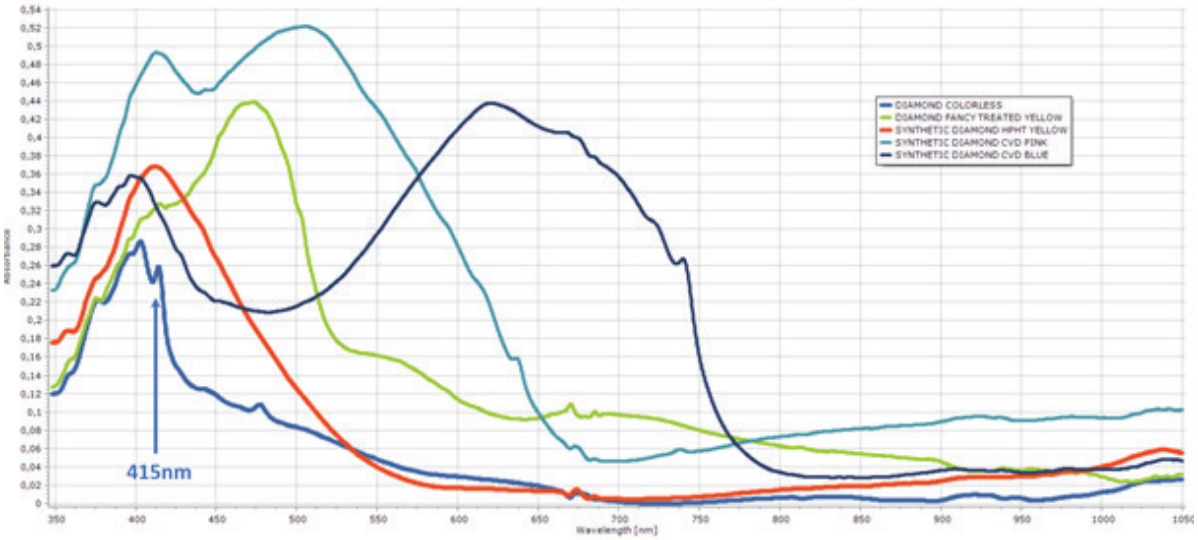
- **TypeI** diamonds: nitrogen-related features support quick screening vs some synthetics/treatments, N3 center at 415nm(ZPL) plus vibronic sidebands; characteristic of nitrogen-aggregated stones.
- For client education, overlay **natural fancy-pink** vs **treated pink** vs **YAG/CZ** to illustrate differences (UV-Vis-NIR patterns).



Diamond colorless - Diamond Fancy Treated Yellow

Blue gem look-alikes (fast triage)

- Aquamarine vs blue topaz vs maxixe-type beryl: rely on **relative band positions/widths** and **overlays**, not absolute intensity; document geometry and path.



Aquamarine - Blue Topaz - Blue Beryl Maxixe - Type

Quick-reference markers

Material / Question	What to look for	Notes
Paraba-type tourmaline	Cu^{2+} band ~910–920 nm; corroborative Mn^{3+} bands ~450/530 nm	Distinguishes Cu-bearing from visually similar blue elbaites
Vanadium-rich tourmaline	V^{3+} features (±Cr^{3+}); no Cu^{2+} band at ~910–920 nm	Separates V colored greens from Cu bearing Paraíba and Fe only greens
Blue sapphire origin	Metamorphic: strong Fe^{2+}↔Ti^{4+} IVCT; Magmatic: distinct Fe^{3+} + Fe^{2+}↔Fe^{3+} IVCT	Use with inclusion microscopy + FTIR for heat treatment/origin assessment
Emerald origin style	Fe-related bands in UV/NIR present (iron-rich) vs absent (iron-poor)	Colombian/Musakashi often iron-poor; others vary
Jadeite (Type A vs C)	Absence of Cr^{3+}/Fe^{3+} + band near ~670 nm → dyed	Resin (Type B) needs FTIR, not UV-Vis-NIR
Turquoise	~620 & ~670 nm broad bands → likely dyed; lack of ~428 nm Fe^{3+} may indicate imitation	Use reflection geometry and stable contact
Pink diamond vs simulants	Distinct patterns vs YAG/CZ; treated vs natural pink show different bands	Use as screening + documentation

Why Thunder Optics

- **Portable + robust:** field-ready case; quick set-up
- **Repeatable:** fixed geometry stand + cosine corrector
- **Flexible:** transmission or reflection workflows; UV through NIR range
- **Software you'll actually use:** fast overlays, peak tools, and clean reporting
- **Most affordable:** the most affordable gemstone **UV Vis NIR** kit on the world market—complete and ready to measure

Limitations & best-practice notes

- Band positions can shift with path length and orientation; prioritize **relative** positions over absolute absorbance.
- Libraries are helpful, but automated matching can be imperfect due to variable band widths—lean on expert pattern recognition and overlays.
- For treatments/origin, combine **UV-Vis-NIR** with **inclusion microscopy** and **FTIR.**

Included case study conclusions

The kit delivered lab-level sensitivity with clear discrimination of chromophores, treatments, and origin-style indicators, all in a fully nondestructive and highly portable format suitable for professionals, educators, and field labs.

https://thunderoptics.fr/product/uv-vis-nir-spectroscopy-kit/

Included Reference Database (Free)

Access an exclusive **UV-Vis-NIR spectral library** with **200+ high-quality reference samples.** This collection complements your experimental setup, enabling reliable **overlay comparisons** to help **identify and separate similar-looking gemstones** with confidence.

Curation: Gemologist **Marco Longhi**, head and owner of **WPS di Longhi** (Instagram **@wpslonghi,** www.wpslonghi.com).
Use it best: overlay your specimen's spectrum with the closest references; focus on **band positions and shapes** rather than absolute intensity.

Note: Reference spectra are a decision aid, not a sole determinant. For conclusive calls, pair with microscopy and (where needed) FTIR or Raman.

To complete your Gemology Set up for complete identification, we recommend you :

- Gemology Kit UV Fluorescence
- Gemology Dual Kit UV-Vis-NIR & UV-F
- Gem Raman System – 532nm
- Gurzil Raman Microscope