# CHSOS Application note # 6 May 2022

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## **Technical Photography of Pigments Checker** "Modern & Contemporary Art"

#### Just published on our website the **Technical Photography**

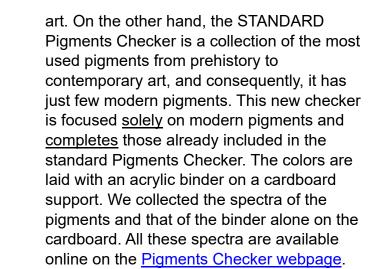
documentation for the new Pigments Checker "Modern & Contemporary Art".

Modern & Contemporary An The images were acquired with our CHSOS Technical Photography KIT that covers the UV-VIS-IR spectral range. This note discusses the images and highlights the most important findings.

Technical Photography (TP) represents a collection of images realized with a modified digital camera sensitive to the spectral range about 360-1000 nm [1-4]. Different lighting sources and filters are used to acquire a selection of technical images, each one providing different information regarding the object under examination. The CHSOS Technical Photography KIT includes all you need to acquire these images.

## **Pigments Checker "Modern** & Contemporary Art"

This is a collection of the most important pigments used in modern & contemporary



-ker

Technical Photography

**Pigments Checker** 

PY 139

PY 184

PO 6

PY 129

irgazin y

PY 159

praseod. PO 48

borary Art

PY 110

PY 154

benz. y. H3G





Figure 1. CHSOS Technical Photography KIT. Mandatory components: lamps, camera, filter set, and the calibration card. Optional components are the laptop with pre-installed software, and pigments checker.

## The Technical Photography documentation

Figure [1] shows the mandatory equipment used for this documentation, <u>CHSOS Technical</u> <u>Photography KIT</u>. The essential components are the <u>ELIO lamps</u>, <u>Alice lamps</u>, <u>Fabrizio lamps</u>, <u>Robertina filters set</u>, TP-MSI card (included in Pigments Checker), and the <u>modified camera for UV-VIS-IR</u>.

Figure [2] shows all the 6 technical images taken for this analysis. The acronyms are: VIS (visible, standard photo), <u>UVF (Ultraviolet</u> <u>Fluorescence)</u>, <u>UVR (Ultraviolet</u> <u>Reflected)</u>, <u>IR (Infrared)</u>, <u>IRF-UV</u>, and IRF-VIS (Infrared

<u>Fluorescence</u>, respectively, made using the UV Lamp Fabrizio, or the VIS lamp ALICE).

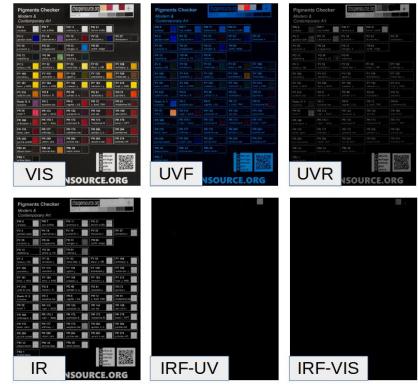


Figure 2. Technical Photography documentation of Pigment Checker "Modern & Contemporary Art".

## **UVF Photography**

Most pigments did not reveal a characterizing fluorescence emission but they absorb most of the UV radiation. PR 90 eosin Y is the one, among these modern pigments, that features the strongest fluorescence emission, with a bright orange color, figure [3].

## **UVR photography**

As for the standard Pigments Checker, the most interesting and useful UVR features are for the white pigments. We took a UVR photo of the 2 pigments checkers, standard and modern, assembled together in order to have the same UV irradiation and postprocessing editing, figure [4]. Titanium white (rutile) and zinc white, in Pigments Checker standard, as well as anatase, absorb UV radiation. This feature is useful to spot their use on paintings as the most common white pigment before the 1920', lead white, reflects the UV and appears bright in UVR photos. Figure [5] shows the reflectance spectra acquired with the FORS GorgiasUV system on these white pigments [5]. Titanium white is the one that absorbs the most UV, then there is

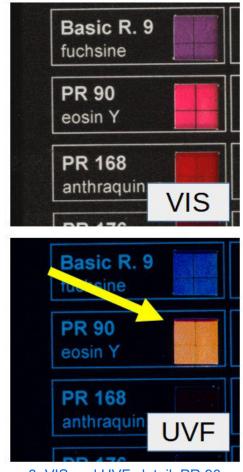


Figure 3. VIS and UVF, detail. PR 90 eosin Y turns from pink to a strong orange.

zinc white and the last is anatase. Lead white keeps reflecting the UV even up at 350 nm. These features are noticeable also in the UVR image.

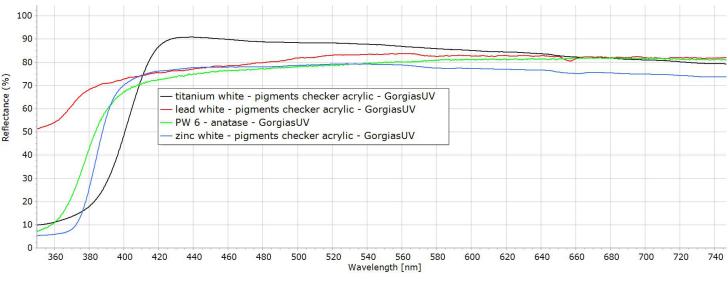


Figure 5. Reflectance Spectra (FORS) acquired with GorgiasUV of the most important historical and modern white pigments.

#### CHSOS - Cultural Heritage Science Open Source - chsopensource.org

Pigments	Checker <sub>v.5</sub>		TP-MSI calibratio	n card		Pigments Modern &	Checker	chsopens	ource.org	
rylic nder	chalk	gypsum	lead white	zinc white		Contempor	ary Art			
opone	titanium white					PW 6 anatase	PW 7 zinc sulfide	PW 11 antimony w.	PW 21 berium sulfat	
np ick	vine black	ivory black	bone black	iron gall ink		PV 3 gentian violet	PV 15 utramarine v.	PV 19 quinacrid. v.	PV 23 dioxazine p.	7
ligo	maya blue	egyptian blue	han blue	azurite		PV 55 quinacrid, p.	PB 24 erioglaucine	PB 33 mangan. b.	PB 66 synth. indigo	1
Itramarine	vivianite	smalt	blue bice	prussian		PG 12 naphthol g.	PG 36 phtha.g. YS	PG 51 victoria g.	7	
cobalt	ultramarine (artificial)	cobalt cerulean b.	cobalt violet	manganese		PY 3 hansa y.10G	PY 32 strontium y.	PY 53 nickel titan. y	PY 83 diaryl, y. HR	1
ohthalo	cobalt chromite b.					DV 109	PY 110 isoindolin. y.	PY 129 irgazin y	PY 139 isoindoline y	
green T	malachite	verdigris	viridian	1		H4G	PY 154 benz. y. H3G	PY 159 praseod, v	PY 184 bismuth v. v.	-
obalt itanate g.	phthalo green	cadmium green		V	IS	zinc	PO 5 hansa o, R	PO 48 quinacr. b. o.	PO 61 isoindole o	
yellow ochre	curcuma	orpiment	massicot			7. 9	PR 3 toluidine red	PR 9 naphth. r. AS	PR 12 p. bord. TRR	
ead tin vellow I	lead tin vellow II	saffron	yellow lake	naples vellow		PR 90 eosin Y	PR 112 naph. r. AS-D	PR 122 quinacrid. m.	PR 144 azo red	
gamboge	cadmium yellow	chrome yellow	cobelt yellow	arylide yellow 5GX		PR 168 anthraquin. s.	PR 170.1	PR 172 erythrosin B	PR 173 rhodamine B	
red ochre	lac dye	red	vermilion (natural)	madder lake		PR 176 benzi carm.	PR 177 anthraqu. r.	PR 179 perylene mar.	PR 206 quinacr. b. s	
realgar	vermilion (artificial)	carmine lake	alizarine	cadmium red		PR 255	PR 259	PR 264	PR 265	
naphthol	- Sul	- Contra	Cultural	392		pyrrole scarlet	PBr 24	pyrrole red r. PBr 25	cerium s.red	
raw	raw umber	taly in 2021	S cience Open	serial #		disazo brown	chrome titan.	benzi brown	C ultur H erita	
sienna	sepia	bitumen	Van dyke brown			aniline black			S cient O pen S ourc	
CH			JRCE.			<b>CH</b> Pigments	SOPE	NSOU chsopenso		
<b>CH</b> Pigments			TP-MSI calibratio	n card		Pigments Modern &	Checker			
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CH Pigments acrylic arder lithopane	Checkerv5 chalk	gypsum	TP-MSI calibratio	n cərd		Pigments Modern & Contemport	Checker ary Art PW 7 zinc suffide	PW 11 antimony w.	UFCE.OFG PW 21 barium sulfat. PV 23	
CH Pigments acylic ander athopone	Checker v.5 chalk titanium whise vine black	gypsum juony black	TP-MSI calibratio	n card		Pigments Modern & Contemport PW 8 anstane PV 3 gentian violet	Checker ary Art PW 7 zinc sullide PV 15 Uttranarine v.	PW 11 antimony w PV 19 quinacrid, v PB 33	Urce.org PW 21 barium sutter PV 23 dioxazine p PB 66	
CH Pigments acylic ander lame aback indigo	Checkerv5 chalk	gypsum	TP-MSI calibratio	n card		Pigments Modern & Contemport PW 6 anatase PV 3 gerten violet gunaord p	Checker ary Art PW 7 znc sulfde Uttamarie y PB 24 PB 24 PB 24	PW 11 antmony w PV 19 quinacrid. v. PB 33 PG 51	UTCE.OTG	
Pigments acylic binder   lithopone   black   indige   ultramarine   cobalt	Checker v.5 chalk titanum whole black wine black maya vivienite utramarine (	gypsum ivory block gyptian blue smalt cobat	TP-MSI calibratio	n cərd		Pigments Modern & Contempore PW 6 anstase PY 3 genten violet Quinacrifi p PV 55 quinacrifi p PV 55 quinacrifi p PV 12 p machinol g PY 3	Checker ary Art PW 7 zno suitide PV 15 ultramatine v PB 24 entoglaucine PG 36 y 32	Pw 11 anthrony w.           PV 19 quinacrid. v.           PB 33 mangan. b.           PG 51 victoria g.           PY 53	UrCe.org	
CH Pigments active hithopone lamp black	Checkerv5 chalk thinkm white block	gypsum ivory bigot biue smalt	TP-MSI calibratio	n card		Pigments Modern & Contemport PW 6 anatade gentian violet PV 3 gentian violet guinacid g	Checker ary Art PW 7 znc suifde Utramarie y utramarie y PB 24 PB 24 phiha 0, YS phiha 0, YS ference PY 130 PY 130	PW 11 antonony w PV 19 quinacti v PB 33 wctoria g PY 53 wctoria g PY 129	Urce.org	
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CH Pigments acryle bride hthopone indigo ubzmarine ubzmarine cobalt	Checker v.5 chalk ttanium block vine vine block vine	gypeum ivory bleck blue blue blue blue cerulean b	TP-MSI calibratio	n card	JV	Pigments Modern & Contemport PW 6 anatase PV 3 gertian violet quinacide p PV 59 (12 machinol g PY 19 PY 109	Checker ary Art PW 7 znc sulfde Utramarie v entoglaucine PB 24 PB 24 PB 24 PB 24 PB 24 PB 24 PF 32 strontum y. PY 110 ssindelin y	PW 11 antonory w. PW 11 autonory w. PV 19 guinachi v. PB 33 wctoria g. PY 53 wctoria g. PY 53 maximum f. PY 129 ingazin y. PY 129 ingazin y. PY 199 praseod y. PO 48	UICE.OFG PW 21 banum suitat PV 23 douazne p ordb. hdigo ordb. hdigo PY 83 dangt y. HR PY 139 isolridolina y. PY 144 bismuth y. PO 61	
CH Pigments acrylic birdepone lamp black   indigo   utgamarine (nati cobał   phthalo (pathalo (pathalo (pathalo)   cobał   indigo   utgamarine (nati	Checker v5 chalk ttanium back vine blue viviente utranine cobalt chromite b. melechite chthalo	gypeum ivory blegybian blue conutean b verdigris verdigris	TP-MSI calibratio	n card	JV	Pigments Modern & Contemport PW 6 anatase PV 3 gertian violet quinacide p PV 59 (12 machinol g PY 19 PY 109	Checker ary Art PW 7 Zino suifide Uttamarine v. PB 32 PHTA 2 YS International V PY 116 Detrina 2 YS International V PY 115 Detrina 2 YS International V PY 115 Detrina 2 YS International V PY 115 Detrina 2 YS International V PY 115 Detrina 2 YS International V PY 116 Detrina V PY 11	Chsopenso       PW 11       autonony w       PV 19       quinacrid. vi       PB 33       mangan. b.       PG 51       victoria g.       PY 129       guarased y.       PY 159       prased y.       PY 159       prased y.       PY 189       prased y.       PY 189       prased y.	UrCe.org PW 21 barium suffat PV 23 dioxazine p. PV 23 dioxazine p. PY 33 diaryl, y.HR andradina y. PY 184 bismuth v.y. PY 184 bismuth v.y. PY 184 bismuth v.y. PY 12	
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CHA Pigments acylic tithopone	Checkerv5	gypsum       gypsum       block       gypstan       block       gypstan       smalt       cobat       corulean b.       green b.       content b.       content b.       green b.       content b. <td< td=""><td>TP-MS1 calibratio</td><td>n card</td><td>JV</td><td>Pigments Modern &amp; Contemport Privie gertian violet Privie gertian violet Privie</td><td>Checker ary Art PW 7 znc sulfde PH 2 PB 24 entostaucine PG 36 phtha g YS PY 32 PY 10 solnobit. y PY 110 solnobit. y PR 112 raph. r. AS-D PR 117 solnobit. y PR 117 so</td><td>PV 11         automory w         PV 19         guinacrid v         PB 33         mangan b         PY 59         inskel bban, y         PY 129         ingazin y         PY 139         praseed y         PR 42         quinacrid, n.         PR 122         quinacrid, m.         PR 122         quinacrid, m.         PR 192         eythroan B         PR 199         perigrene mar.         PR 284         Pyrrole red.         PBr 25</td><td>UCCE.OTG PW 21 beham suifat PY 23 dioazane p. PY 83 dargt y. HR PY 139 sorth.indigo PY 139 isolrdoine y. PY 139 isolrdoine y. PY 144 isondoe o. PR 12 boxt TRIR PR 144 sor red PR 206 quitact.b. 5.</td><td></td></td<>	TP-MS1 calibratio	n card	JV	Pigments Modern & Contemport Privie gertian violet Privie gertian violet Privie	Checker ary Art PW 7 znc sulfde PH 2 PB 24 entostaucine PG 36 phtha g YS PY 32 PY 10 solnobit. y PY 110 solnobit. y PR 112 raph. r. AS-D PR 117 solnobit. y PR 117 so	PV 11         automory w         PV 19         guinacrid v         PB 33         mangan b         PY 59         inskel bban, y         PY 129         ingazin y         PY 139         praseed y         PR 42         quinacrid, n.         PR 122         quinacrid, m.         PR 122         quinacrid, m.         PR 192         eythroan B         PR 199         perigrene mar.         PR 284         Pyrrole red.         PBr 25	UCCE.OTG PW 21 beham suifat PY 23 dioazane p. PY 83 dargt y. HR PY 139 sorth.indigo PY 139 isolrdoine y. PY 139 isolrdoine y. PY 144 isondoe o. PR 12 boxt TRIR PR 144 sor red PR 206 quitact.b. 5.	
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Figure 4. VIS and UVR of the 2 Pigments Checkers, "standard" and "modern".

Figure [6] assembles together the white pigments UVR photos. It shows that lead white is the brightest, followed by anatase. Eventually, titanium white (rutile) and zinc white are the darkest. This information is useful to make a preliminary identification of the white pigments. In particular, it is relevant the different UV absorption exhibited by titanium white (rutile) and anatase.

Titanium white is a general name to indicate a white pigment that is made of one (or a mixture) of the two forms of titanium oxide: <u>anatase</u> and <u>rutile</u>. These crystals have the same chemical formula, TiO<sub>2</sub>, but different relative positioning of the 3 atoms (they are 2 polymorphs of titanium oxide).

The standard Pigments Checker v.5 has the <u>rutile</u> titanium white. Nowadays titanium white is all made from rutile. But this was not always the case. From about 1920 titanium white was made mostly of anatase because it was more easy to produce. From about 1940 a cheap production method for rutile was established and it replaced anatase, since it was more lightfast and had a stronger hiding power.

The new "modern and contemporary art" pigments checker has the "anatase" titanium white.

## Case study: Indian Mughal miniature

We did test the CHSOS Technical Photography KIT on a Indian Mughal miniature painting which was supposed to be from the 18th century, likely 1790, figure [7].

We were interested in evaluating the authenticity of the item and, in particular, its dating [6].

The XRF analysis revealed the white paint is made of titanium. As shown in figure [8], the UVR image of the white paint is bright indicating that this is not a modern rutile titanium white which turns black in the UVR photo, but rather the older version, anatase. This type of titanium white was also confirmed with the <u>Raman Spectroscopy system</u> <u>ElviRA</u>.

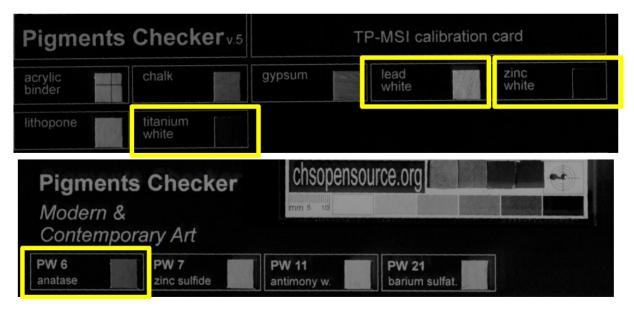


Figure 6. UVR photo. Details from the 2 Pigments Checkers.



Figure 7. Indian Mughal miniature painting tested with the 2 Pigments Checkers, standard and modern.

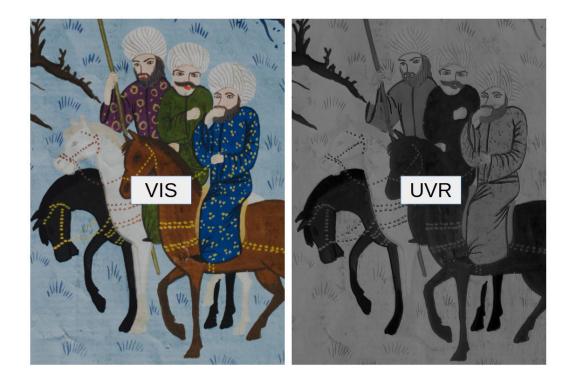


Figure 8. Indian Mughal miniature painting, detail. The white paint turns bright in the UVR photo suggesting anatase, instead of rutile, the modern titanium white.

We know that anatase was in use from roughly 1920'-1940'. For a manuscript supposedly made in the 18<sup>th</sup> century, we were expecting lead white pigment, definitely not anatase. Furthermore, the identification of anatase indicates that the object was created not much later that the 1940', otherwise we should have found more of the rutile titanium white.

## **IR Photography**

As expected most of these modern pigments are transparent in the infrared. There are just few interesting exceptions. PW 6 - anatase reflects infrared and remains opaque, such as rutile.

All the blues and violets are transparent but manganese blue that absorbs infrared. The other pigments, yellows, orange, reds, and browns, all become transparent.

The only black pigment in these collection, PBk1 - aniline black, absorbs infrared and it is totally opaque, such as the carbon-black pigments in the standard Pigments Checker.

### **IRF Photography**

The test of the IRF method, both IRF-UV and IRF-VIS did not reveal any pigments showing infrared fluorescence.

## Conclusions

The analysis of the new set of modern pigments revealed some useful features. In particular, the different behavior in the UVR photo of the titanium oxides and white pigments, anatase and rutile. Also important was the infrared photo of the modern and common PBk1 - aniline black which behaves as the historical carbon-blacks, absorbing all of the infrared and becoming totally opaque.

#### References

[1] A. Cosentino "Identification of pigments by multispectral imaging a flowchart method" Heritage Science, 2:8, 2014.

[2] A. Cosentino "Practical notes on ultraviolet technical photography for art examination" Conservar Património 21, 53-62, 2015.

[3] A. Cosentino "Infrared Technical Photography for Art Examination" e-Preservation Science, 13, 1-6, 2016.

[4] A. Cosentino "<u>Application note 3 -</u> <u>Transmitted Infrared Photography with</u> <u>SALVO</u>" 2021.

[5] A. Cosentino "<u>Application note #5:</u> <u>Reflectance Spectra Database (GorgiasUV</u> <u>Spectrometer) for Pigments Checker - Modern</u> <u>& Contemporary Art</u>" 2022.

[6] A. Cosentino "<u>Application note 4: Gorgias</u> <u>Reflectance Spectra Database for Pigments</u> <u>Checker Modern & Contemporary Art</u>" 2022.





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