A System for Precision Ophthalmic Tinting

Manual for the

Intuitive Colorimeter Mk.3

by

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TABLE OF CONTENTS

1. GENERAL SAFETY REMINDERS

Read this manual carefully before operating the machine for the first time.

Plug the machine into an earthed (grounded) 220-240 volt outlet only. **NOTE.** Grounding reliability can only be achieved when the instrument is connected to an equivalent receptacle marked *Hospital Grade* or *Hospital Only*. Use only a power supply with specifications:- HiTRON Model HES49-15033 All machine covers must be in place when operating the machine. Any alteration, removal, or damage to these parts may cause a safety hazard.

CAUTION  . Where you see this sign, please refer to the manual.

2. INSTRUMENT CLASSIFICATION AND DATA

The instrument is electrically classified as Class 1, Type B, to IP10, and continuous rated.

The type B symbol shown here and marked on the equipment means this equipment complies with UL2601.1 and CSA C22.2 601.1 in providing protection against electric shocks, particularly regarding LEAKAGE CURRENTS.

Supply 100-240vAC; Frequency 50-60Hz; Rated current input for the voltage range 1.0A. Power output 15VDC 3.3A.

The power supply must be connected to an electrical outlet using only a cord set with a hospital grade plug.

The Instrument is not suitable for use in the presence of flammable anaesthetic mixtures with air oxygen or nitrous oxide.

There should be no interference with other equipment. If any is experienced move the instrument further away.

There are no recognized accessories.

The Instrument should only be connected to the electricity supply via a power box HiTRON Model HES49-15033 power unit, as supplied.

Local regulations should be considered when disposing of this product. The product contains a fluorescent lamp. When disposing of fluorescent lamps it is usual to break the tubes, taking care to avoid:

- The risk of cuts from flying glass. The pressure in the lamps is very low and, if broken carelessly can give rise to an implosion.
- The risk of inhalation of the fluorescent powder. The powder itself is not especially toxic but it will be contaminated with mercury and it is not advisable to inhale any type of dust. Those carrying out the work should wear suitable protection for exposed parts of the body especially for the eyes, hands and arms. A suitable mask will guard against unnecessary inhalation of dust. The work should be carried out outdoors or in a well-ventilated area.

Compact fluorescent lamps may be broken, as above, or left intact, in which case they should be returned to their packaging or wrapped in several layers of newspaper.

The markings on the instrument are a guide. The accuracy of the instrument is dependent on the skills of the operator in comparing the instrument colour with appropriate coloured filters.

The user should not touch the patient and the output connector of the power supply at the same time.

Store / Transport in upright position. Temperature Range -10°- +70°C; Operating Temperature Range 0°- +30°C; Humidity Range 20-80%.

3. BACKGROUND

The Intuitive Colorimeter enables an ophthalmic tint to be chosen according to a patient's subjective assessment of its effects on perception and visual comfort. A precise tint can be selected rapidly and efficiently. Precision Tints can reduce visual stress and perceptual distortion (Wilkins *et al.,* 1994).

The Colorimeter has undergone open and double-masked clinical trials (Maclachlan *et al.*, 1994; Wilkins *et al.*, 1994; Wilkins, 1995; Lightstone *et al.*, 1999). This manual describes procedures derived from fifteen years' experience.

Ophthalmic tinting

Most modern spectacle lenses are made from plastic, usually a resin (allyl-diglycol-carbonate, CR39). Lenses made from this resin can be dyed by immersing them in hot organic dyes. Although this technology has been used for cosmetic tinting, there is now evidence that coloured glasses have therapeutic potential. The range of disorders in which tinted glasses may be of value include dyslexia, photosensitive epilepsy, migraine, multiple sclerosis and acquired colour vision deficits. Individuals differ with respect to the tint that they find therapeutic, and the tint needs to be precisely determined if the benefits are to be optimized.

Intuitive Colorimeter Mk. 3

The Intuitive Colorimeter Mk. 3 is a new apparatus for mixing coloured light. Colours exist in three subjective dimensions: hue (colour) ( ), saturation (depth or strength of colour) and brightness . Many shades can be produced by mixing primary colours in various amounts, but it can be difficult and time consuming to mix lights to match a particular shade. Hue, saturation and brightness all change when one of the lights is varied. The way in which the lights interact to produce a given colour is not obvious Similar considerations apply when tinted trial lenses are superimposed.

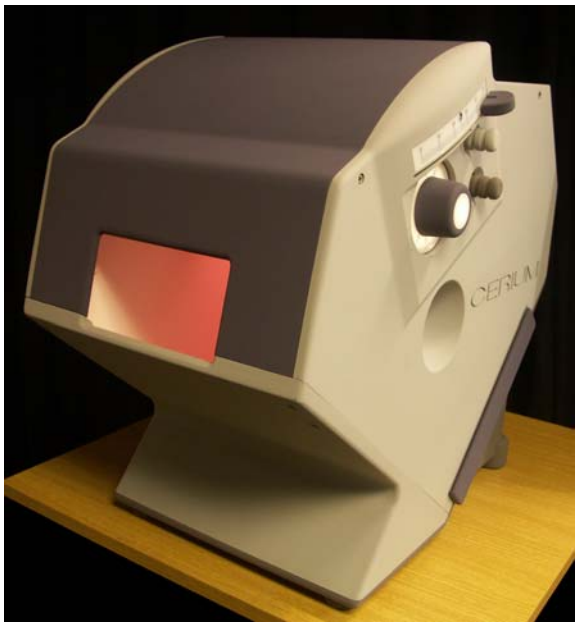


Figure 1. The Intuitive Colorimeter Mk. 3.

The Intuitive Colorimeter overcomes these problems and enables colour and saturation to be varied separately

without an associated change in luminance.

The Intuitive Colorimeter Mk 3 is shown in Figure 1. It is designed to be placed on a table that can be adjusted in height. The examiner sits beside the patient, on the patient's right, operating the controls on the right side of the instrument, see Figure 2.

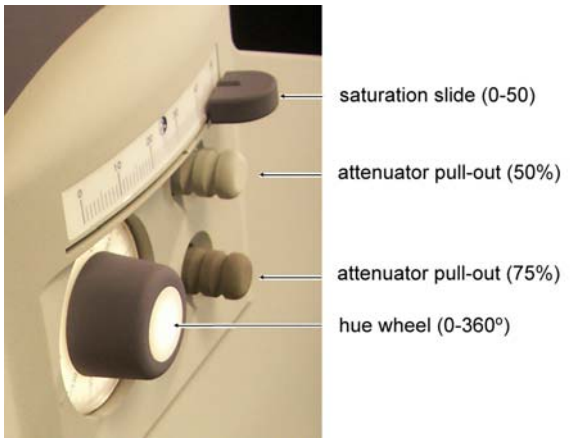


Figure 2. Controls of the Mark 3 Colorimeter.

The controls can also be operated by the patient. A wheel changes the hue, a slider changes the saturation, and two attenuators alter the luminance. The attenuators are operated by fully pulling out one or both of the grey pull-outs. The light grey attenuator reduces the luminance by half, and the dark grey by three quarters, i.e. to one quarter of the unattenuated value. Operating the two together reduces the luminance to one eighth the unattenuated value.

The main viewing window on the front of the instrument reveals an inner surface on which visual material such as the Test Plate or text can be placed. The material can be mounted by pulling out the tray, see Figure 3.

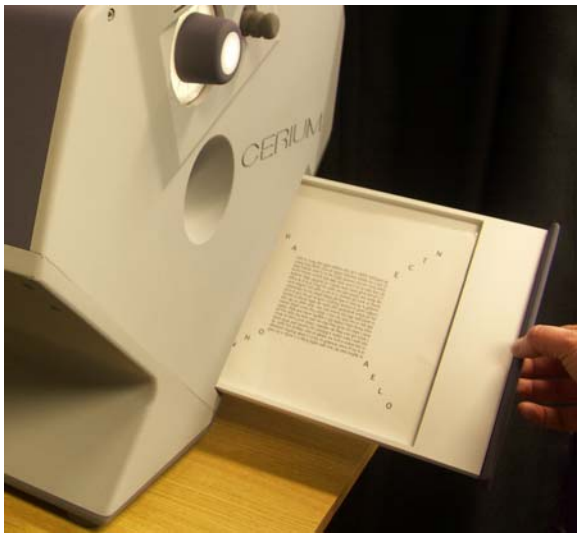


Figure 3. Test plate mounted on the tray.

Suitable visual material is included with the colorimeter (see Test Plate), but practitioners may wish to use readable text as well, such as the patient's school reader or the Wilkins Rate of Reading Test (Wilkins *et al.,* 1996). *Please note that any material used must have a matte surface.*

The examiner and patient select a hue and saturation that provides for the best perception of the text. Details of the appropriate procedure for selecting the hue and saturation are given in the next section.

The standard white comparison port shows the light from a "white" (multiphosphor) fluorescent lamp (Colour temperature 4000K). These lamps have a chromaticity that is yellower than daylight. A fluorescent lamp was chosen because: (i) it is a

light source that is commonly used for lighting offices and schools; (ii) its spectral power distribution is easily controlled; (iii) it has a chromaticity midway between that of daylight and incandescent light.

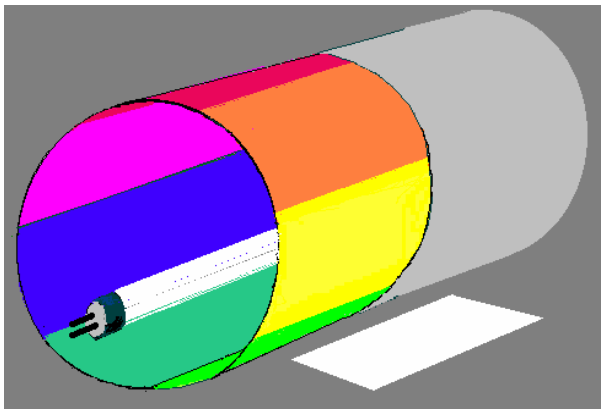


Figure 4 Basic mechanism showing filters on the circumference of a cylinder, coloured filters (left) and uniform grey filter (right). The light shines through the rectangular aperture into the viewing chamber where it is mixed by multiple reflection.

When the attenuators are both in, the luminance of the colorimeter viewing surface is at its maximum: about 25 candelas per square metre. The luminance recommended for office work varies considerably from one country to another but is generally between 60 and 100 candelas per square metre (Mills and Borg, 1993). The colorimeter luminance thus allows for lenses that absorb slightly more than half the light.

How it works

A beam of white light from a fluorescent lamp passes through a cylindrical filter assembly (shown in Figure 2) and into a box with matte white inner surfaces. The filter assembly is divided into seven sectors, each made up of a different filter so as to transmit light of a different colour. Each sector transmits a coloured light equidistant from its neighbour and approximately evenly distributed around a hue circle. The coloured light is mixed as it is reflected and scattered from the inner surfaces of the box. Text is mounted on one surface of this box and viewed through a window in the front.

When the filter cylinder is moved along its axle the proportion of the grey and coloured filters alters, changing the saturation of the colour in the viewing chamber. When the cylinder is rotated the hue changes, at a given saturation. Although the colours obtained result from an additive mixture of light from some combination of one or two coloured filters with or without a neutral filter, the resulting spectral power distribution is remarkably similar to that from Precision Ophthalmic tints when these are worn under conventional fluorescent lighting (Wilkins and Sihra, 2005).

Advantages

The Intuitive Colorimeter Mk. 3 has several advantages for assessing the subjective effects of coloured light: (i)

colour (UCS 1976 hue angle, h_{uv}) and depth of colour (saturation, s_{uv}) can be varied independently and therefore intuitatively; (ii) the variation is continuous rather than discrete; (iii) no coloured surfaces are visible within the colorimeter, so it is unnecessary to consider at this stage the particular spectral power distribution of the illuminating light, and related colour constancy mechanisms; (iv) the perceptual effects of colour can be studied while the patient's eyes are colour-adapted; (v) the assessment is quick and efficient.

4. INSTALLATION OF THE COLORIMETER

The Colorimeter should stand on a table or similar horizontal surface.

The front viewing window should be above the front edge of the table at a level at which a seated patient can see the textual material. The examiner should be able to sit on the right hand side of the patient and reach the controls on the right side panel of the Colorimeter. One end of the power lead should be plugged into the socket at the rear of the Colorimeter and the other end into a grounded electricity outlet. **NOTE.** The Colorimeter should only be connected to the electricity supply via the transformer lead supplied with the instrument.

5. SIDE-EFFECTS OF COLORIMETRY

CAUTION  Clients should be informed that examination with the colorimeter entails a small risk of headache or nausea. Those with photosensitive epilepsy should be examined in the presence of a carer who knows what steps to take in the event of a seizure. The risk of a seizure during colorimetry is, however, small (Wilkins *et al.,* 1999). If any side effects occur, details should be sent to Colorimeter Reports, Visual Perception Unit, University of Essex, Colchester, CO4 3SQ, United Kingdom.

6. EVALUATION OF PRECISION TINTING

The Medical Research Council is evaluating the effectiveness of precision tinting. Patients should be encouraged to send their comments to Colorimeter Reports, Visual Perception Unit, University of Essex, Colchester, CO4 3SQ, United Kingdom.

7. EXAMINATION PROCEDURE

Introduction

There are many potential causes of visual discomfort and perceptual distortions, and tinted lenses will not help everyone with these symptoms. Before using the Colorimeter, patients should undergo a full optometric examination. In particular, the optometrist should look for any binocular vision or accommodative problems. If any clinically significant anomalies are detected, they should be treated, before considering tinted lenses.

For some patients, there are circumscribed regions of colour space within which perceptual distortions abate, and visual discomfort is reduced (Wilkins *et al.,* 1992a,b; Maclachlan *et al.,* 1993). The procedure described below is aimed at locating these regions without inducing discomfort, and then refining the measurements under conditions of colour adaptation. The measurements are initially made at a constant luminance (V_λ) similar to that which a person might experience under normal conditions of office lighting when wearing tinted glasses that absorb about half the light. In Step 11 the measurements are checked at lower luminance levels.

The absence of coloured surfaces in the colorimeter should ensure that the chromaticity co-ordinates for maximum comfort and clarity are independent of the particular spectral power distribution and related colour constancy mechanisms. The assessment is carried out under binocular viewing conditions unless there are indications that the optimal tint may differ in the two eyes and the patient is prepared to countenance wearing spectacles with differently coloured lenses.

The examination procedure has two parts: (1) Selection of an appropriate chromaticity in the Colorimeter and (2) Selection of a suitable combination of coloured trial lenses.

1. Selecting an appropriate chromaticity

Introduction

The following procedure for the use of the colorimeter is designed to minimise the likelihood of adverse symptoms from exposure to coloured light. Patients who benefit from certain colours can show adverse symptoms when exposed to other colours. In the first part of the procedure the patient is exposed briefly to a wide range of moderately saturated colours under conditions of adaptation to white light. Aversive colours are subsequently avoided during the second stage when measurements are made with more strongly saturated colours under conditions of adaptation to coloured light. The colours are changed in the colorimeter in two ways. First, the practitioner can adjust the instrument, requiring the patient to report which of two successive settings is the best. This is similar to a crossed-cylinder technique.

Adults may prefer to adjust the controls for themselves. Generally speaking, patients can manipulate the saturation control for themselves, but need help in assessing the effects of changes in hue: variation of the hue control is usually best left to the examiner.

When you read these instructions for the first time, it would be helpful to practise with the colorimeter.

1. *Prepare colorimeter.* Sit on the patient's right. Place the Test Plate on the tray, see Figure 3. Ensure both attenuators are off (pushed in). Adjust the hue wheel ( ) until the hue reads 0 degrees on the hue scale. Adjust the saturation control until the saturation ( ) reads 0 on the saturation scale. Turn the colorimeter on at the power switch on the right of the right-hand side panel. **Turn off the room lights.**

2. *Obtain a description* of perceptual distortions and/or visual discomfort. Ask the patient to look at the text on the Test Plate in the colorimeter. Make sure the patient is at a comfortable viewing distance with the eyes close to the viewing aperture so that most of the visual field is exposed to the coloured light. Ask the patient to report any perceptual distortions. For example, do the letters move (e.g. wobble, shimmer); do they distort in any other way; do they blur; do coloured halos appear around the letters; what exactly happens? Use the description given by the patient to refer to the perceptual distortion subsequently. Record this description on the upper left panel on the Colorimeter Record Form. If the patient does not report perceptual distortion, use the subjective feeling of "eye comfort" as a substitute in subsequent testing.

3. *Explain* that you are going to shine different colours on the text. Some may make it better, some worse, and some may have no effect. Ensure that the patient understands that the colours that will be the best ones may not be the same as those of any overlay that they have previously chosen.

4. *Increase then decrease saturation.* Slide the saturation control slowly from 0 to 30 over about 5 seconds. If you keep downward pressure on the control it will stop at 30. Leave the control at this level for about 5 seconds and then slowly return the control to 0 over about 5 seconds. The slow speed enables the patient to compare intermediate degrees of saturation: sometimes these are more beneficial than the higher levels. When the saturation has returned to 0 ask which was better, the coloured or the white. Note the response on the Fan Chart of the Colorimeter Record Form by entering a number in the appropriate position in the fan. Use the response code shown in the attached box. i.e. Enter +1 if perception improves a little, +2 if there is a considerable improvement, -1 if it gets a little worse, -2 if it gets a lot worse, and 0 (not =) if

there is no appreciable change. For example, if at hue=0 the patient reports that the perceptual distortions improve a little at saturation=25, enter +1 half way along the arm that leads to the 0 on the chart. If the perception improves and then gets worse as saturation increases further, make a note. With adults it may be useful to tell them to use a scale of numbers to refer to the perceptual effect of the colour, where +10 is the best possible improvement, 0 is no change and negative numbers are used when the colour makes things worse.

5. *Increase hue angle.* With the saturation at 0, move the hue to 30 degrees. Repeat Step 4. Do so again with the hue at 60 degrees, and so on, advancing hue by 30 degrees until the Fan Chart is complete. Note that you can repeat 0 degrees to check for consistency: 0 degrees was the first trial, and the patient may take a little time to realize what is required.

6. *Note the uncomfortable colours.* There may be hue angles where perception gets worse and the perceptual distortions are uncomfortable. Hereafter make sure the hue control is not brought within 20 degrees of any uncomfortable settings. The patient may experience pain, and the test may have to be stopped.

***Warning*:**  Do not allow the patient to come within 20 degrees of any uncomfortable hue.

7. *Adjust saturation.* Set the hue control to the angle where perception was most improved. If there was more than one setting at which perception/comfort improved, select one of the better settings. If in doubt about an improvement set the hue control to an angle 180 degrees from that at which distortion/discomfort was worst. Adjust or ask the patient to adjust the saturation until the saturation level gives maximum clarity/ comfort. Slide the saturation control keeping upward pressure on the lever so that it can slide the full length of the scale. Tell the patient to imagine they are tuning a radio. To tune a radio you go past the position of strongest signal until reception gets worse; you then come back in the opposite direction, until reception again gets worse. It is the same for the "tuning" of colour. **Stress that it is important to find the least saturated setting (weakest colour) that is comfortable. (Otherwise the lenses will be too dark).** If the patient is young or has difficulty making this adjustment, help by supplying two alternative settings in immediate succession, asking "Which is best, number one, or number two?".

Repeat the above at each of the good settings identified in the Fan Chart Column 1 of the columns headed 2AFC. Note whether the patient adjusted saturation for him/herself (P), or whether the examiner adjusted the

controls (E). Now present each of the 'good' settings in turn and find which is best. Do this by asking the patient to look at a setting for a few seconds. Say "This is setting number 1". Then ask them to close their eyes while you adjust the controls to a second setting. Ask them to open their eyes and say "This is setting number 2". Ask them which setting was best. They may find it helpful if you repeat the first setting. You can note the second setting in Column 2, and then check which of the settings 1 or 2 was preferred.

8. *Adjust hue at best saturation.* Leave the saturation control at the best setting identified in the previous step. Mark this setting on the Target Chart. Compare the hue with a hue 20 degrees above and below. Show the two settings in succession, having the patient close their eyes while the setting is adjusted, as described in Step 7. Ask the patient to choose which is better. Maximize clarity/comfort using steps that are initially 20 degrees in either direction, the size of step being increased to 30 degrees if no differences are apparent, and reduced to 10 degrees if a clear difference is seen.

If, for example, the initial hue setting is 120 degrees, try comparing 120 with 140. If 140 is preferred, next compare 140 with 160. Continue moving the comparison as appropriate so as to "home in" on the best setting. Repeat the measurements to check for consistency. If the patient is consistent on several trials with 20 degrees separation, try 10 degrees separation.

Note the revised setting of hue angle by plotting it in the Target Chart or by recording the two-alternative forced choices in the 2AFC column.

9. *Minimize saturation.* Leave the hue at this setting. Ask the patient to adjust the saturation once again, as for Step 7. **Emphasize that we are trying to find the minimum saturation that is beneficial.**

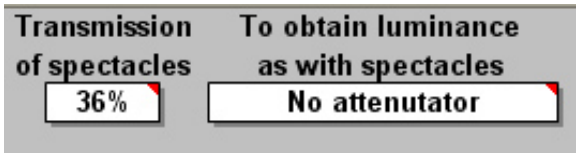
10. *Check for consistency.* Try other neighbouring hues and saturations to check the patient's consistency. Poor consistency may mean that the patient is tiring, or simply that the symptoms are not affected reliably by colour. Check for tiredness by repeating earlier steps after a rest.

11. *Compare lower luminance levels.* When the Colorimeter is used without attenuators, the luminance is that which would occur under normal office lighting when wearing a lens which transmits about 30% of the light. When the light grey attenuator is pulled out, the luminance is that which would occur under normal office lighting when wearing a lens that transmits half as much light, that is about 15%. When the dark grey attenuator is pulled out, the luminance is appropriate for a lens transmitting about 7% light.

If the patient prefers the dimmer light this may be because some discomfort remains despite the colour. Try increasing the saturation slightly to see whether you can decrease the discomfort. Then see if the dimmer light is still preferred.

Enter the hue and saturation settings in the *Lens* spreadsheet. The spreadsheet will indicate whether the lens that supplies the appropriate colour will be (1) light and provide a luminance similar to that obtained with no attenuator, see Figure 5a, or (2) dark and provide a luminance equivalent to that obtained with the light grey attenutator, see Figure 5b.

a



b

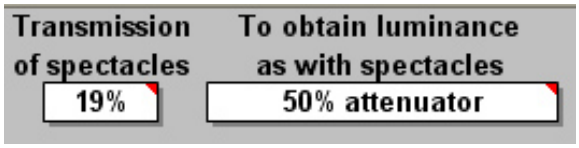


Figure 5. a. A light lens; b. A dark lens

If the lens is dark, point out to the patient the compromise that is necessary between brightness and saturation: stronger colours require darker lenses. Pull out the light grey attenuator slide and ask the patient if the lower brightness is better, worse or about the same. Ideally the reduction in brightness will not make much difference.

If the patient does not like the dimmer illumination, then when the trial lenses are offered you may wish to try combinations with reduced saturation.

12. *Replace the test chart with a reading passage from the Wilkins Rate of Reading Test.* Encourage the patient to accept the weakest saturation that will maintain maximum comfort. You can use the speed with which the passage is read to assess the effect of the tint on reading, using alternative passages under different Colorimeter settings, as described in the instructions for the *Wilkins Rate of Reading Test.*

13. *Check final setting.* Ask the patient whether the final setting is at least as good as the best one the patient has thus far observed. It should be, unless untoward adaptation has been taking place. If the patient thinks one of the earlier settings was preferable, try and find it. Bear in mind that the patient may have become tired, and the earlier setting may not now seem as good as it was. The procedure can be quite stressful for some people.

14. *Annotate.* Write in the values of the best setting in the box on the lower right hand side of the record form.

2. Selecting a suitable combination of coloured trial lenses

Introduction

It is possible to match any colorimeter setting with a stack of trial lenses so that the colour appearance is identical, allowing for differences in brightness. This can be done using lenses from only two dyes, and the dyes are always neighbours in the circle of colours shown in Figure 6.

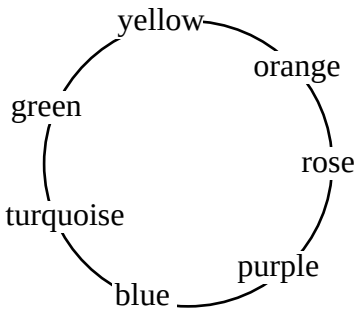


Figure 6. A circle of colours

For example, a yellowy green is produced with a combination of yellow and green trial lenses, and a red with a combination of rose and orange lenses. There are five pairs of lenses of each colour, apart from rose and purple which have six pairs. The pairs are labelled by letter starting with A for the least saturated. The deposition of dye doubles from one pair to the next; for example Trial lens B has half as much dye as Trial lens A and twice as much as trial lens C. This means that the saturation of colour can be increased by very small steps by combining the lenses, placing one lens on top of another. Table 1 shows all the possible combinations of lenses A-E in order of increasing dye deposition.

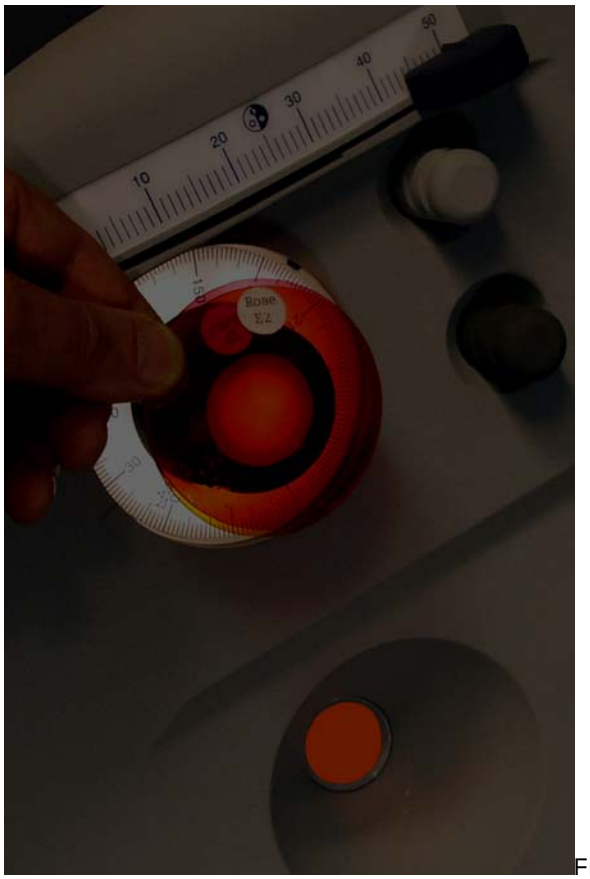
Table 1. Steps of dye deposition achieved with combinations of coloured trial lenses.

Step	Combination	Step	Combination
0	No lens	16	E
1	A	17	A+E
2	B	18	B+E
3	A+B	19	A+B+E
4	C	20	C+E
5	A+C	21	A+C+E
6	B+C	22	B+C+E
7	A+B+C	23	A+B+C+E
8	D	24	D+E
9	A+D	25	A+D+E
10	B+D	26	B+D+E
11	A+B+D	27	A+B+D+E
12	C+D	28	C+D+E
13	A+C+D	29	A+C+D+E
14	B+C+D	30	B+C+D+E
15	A+B+C+D	31	A+B+C+D+E

With the exception of Rose and Purple, there are 32 steps for each colour (numbered 0-31 in Table 1), one for each combination of trial lenses. Rose

and Purple have six lenses and therefore 64 possible combinations, 32 including lens F in addition to those lenses shown in Table 1.

1. *Find the combination of lenses that is nearest to the chosen setting* by entering the combination in the *Lens* spreadsheet. Identify these trial lenses and place them together in a stack.



Fi

Figure 7. Comparison of trial lens colour with that selected in the colorimeter. To be carried out in darkened room.

2. *Compare the colour appearance with the chosen setting*. Dim the room lights so that no light enters the viewing chamber. Close the main viewing window and place the stack of lenses over the circular Standard white comparison port in the centre of the hue control, see Figure 7. When the attenuators are adjusted so that the Colour comparison port has a similar brightness to the Standard white comparison port, the two ports should have a similar colour appearance.

3. *Adjust the stack, if necessary*. Some adjustment may be necessary to make the appearance identical. If the stack consists of lenses from two dyes try increasing the lenses from one dye by one step and decreasing the lenses from the other dye by one step. Use Table 1 to do this. If the stack consists of lenses from only one dye, try adding Lens A from one of the neighbouring dyes.

4. *Ask the patient to verify the match* of the Colour comparison port and the Standard white comparison port when it is covered by the stack of lenses.

5. *Compare the effect of the lenses with that of the Colorimeter*. Decrease the saturation to the maximum extent. Turn on the white light in the viewing chamber. Make up a duplicate stack of trial lenses, one stack for each eye. Mount the lenses in the lens holder and have the patient view the text in the Colorimeter. Ask the patient if the appearance is as good as it was previously. It should be. If it is not, the lenses need adjustment.

6. *Try out the lenses under a range of lighting conditions, and viewing distances*. The patient should be given the

opportunity of comparing the lenses under fluorescent light, light from a tungsten filament lamp, and natural daylight (if at all possible). The lighting should also be made as similar as possible to that which the patient typically has to read under. For example, if the patient has to read music in an orchestra pit, a low wattage filament lamp should be used in a darkened room.

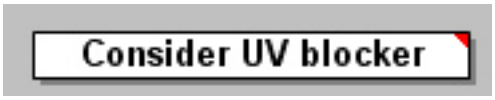


Figure 8. Fragment of the *Lens* spreadsheet

7. If the Lens spreadsheet indicates it is necessary, see Figure 8, *Check the ultraviolet filters*. Add one ultraviolet filter to each stack and then remove them from the stacks to check that these filters do not make matters worse. Provided the filters do not have detrimental effects, leave them in the stack. (The purpose of the ultraviolet filters is to reduce exposure to potentially harmful radiation should the glasses be worn outdoors in strong sun.)

8. *Issue a prescription and order the lenses.* It is most important to enter the specification of the trial lenses clearly and correctly. Enter the name of the main colour. Then follow the name with the letter and number of each lens of that colour (e.g. TURQUOISE: A5 + C3). Then do the same for the subsidiary colour:

TURQUOISE: A5 + C3| BLUE: D2

Strike through the phrase "add" under “UV BLOCKER” only if the ultraviolet filters have detrimental effects on perception. Please note that it is essential that the prescription and ordering details are given in this format. The tinting procedure uses dyes identical to those used for the trial lenses and the spectral transmission of the spectacle lenses is therefore guaranteed. Other dyes should not be used.

9. *Verify the chromaticity of the spectacle lenses.* When the spectacle lenses are received, the chromaticity can be verified by comparing the colour appearance with that of the stack of trial lenses.

The spectacle lenses will be provided with two leaflets. One leaflet, to be retained by the practitioner, gives the spectral transmission, and various numerical indices required under British Standard 2724 for the assessment of sunglasses. The second leaflet gives advice to patients concerning: (i) use of their glasses as sun glasses (based on the degree of ultraviolet and blue light absorption), and (ii) the extent of likely interference with the perception of traffic signals. This advice is offered because many patients find their glasses comfortable to wear for activities other than reading.

The above information is also given in the *Lens* spreadsheet.

Patients need to be given guidance concerning the advisability of wearing their glasses when driving. In general it is inadvisable to wear any filter in front

of the eyes when driving at night. The glasses also come with a small card which can be useful for children to show to their teachers. It explains that the glasses are necessary to correct a medical condition and are not conventional sunglasses.

8. **REFERENCES**

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Further information and references at

www.essex.ac.uk/psychology/overlays

9. **MAINTENANCE**

Cleaning

CAUTION  Switch off power and disconnect power lead before cleaning. The external surfaces of the colorimeter may be cleaned using a cloth moistened with water and with dilute disinfectant or mild detergent, if necessary.

Lamp Replacement

The lamp has a long life. If replacement is necessary the instrument should be returned to Cerium Visual Technologies.

10. **SUMMARY OF TEST PROCEDURE**

Obtain description of distortions
Explain procedure
Increase/decrease saturation, every 30 degrees, completing Fan Chart.
Optimise saturation of best settings.
Compare these settings by presenting two in succession. (Patient closes eyes when setting is changed.) Record response using 2AFC table.
At best setting optimise hue by comparing two neighbouring hues in succession. Use 2AFC table.
At revised hue, re-optimise saturation. Use Target chart.
Reduce saturation as much as possible.
Compare reduced luminances.
Select stack of matching coloured trial lenses.
Try the stack under various lighting conditions
Revise stack, reducing saturation as much as tolerable. Check ultraviolet blocker.
Order lenses.

Colorimeter Record Form

Name:

Date:

Ref: Examiner's initials:

Address and telephone

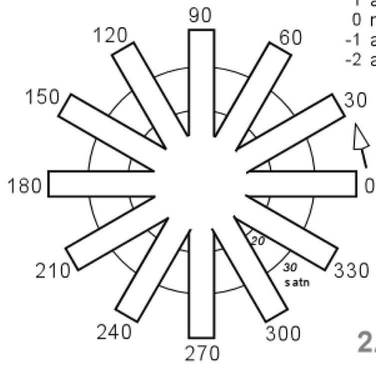
Description of perceptual distortion

Notes

Consistency?
Suitability?

Fan chart

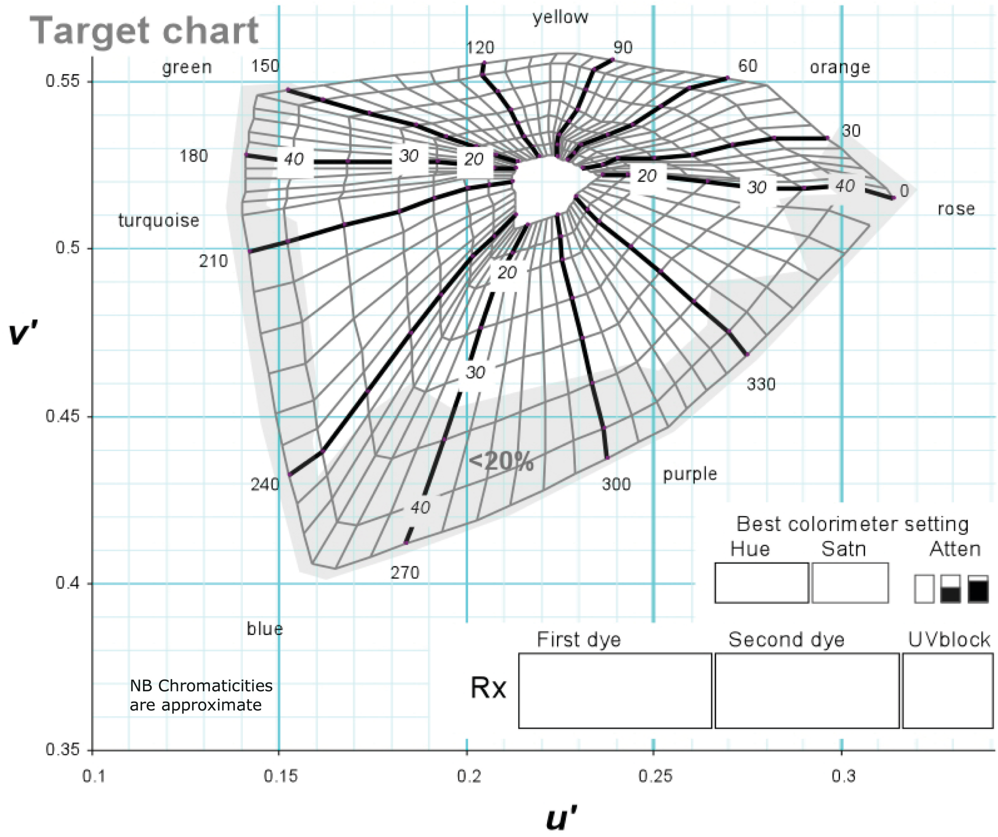
2 a lot better
1 a little better
0 no change
-1 a little worse
-2 a lot worse



2AFC

1		2	
Hue	sat	Hue	sat

Target chart



Best colorimeter setting

Hue	Satn	Atten

	First dye	Second dye	UVblock
Rx			