

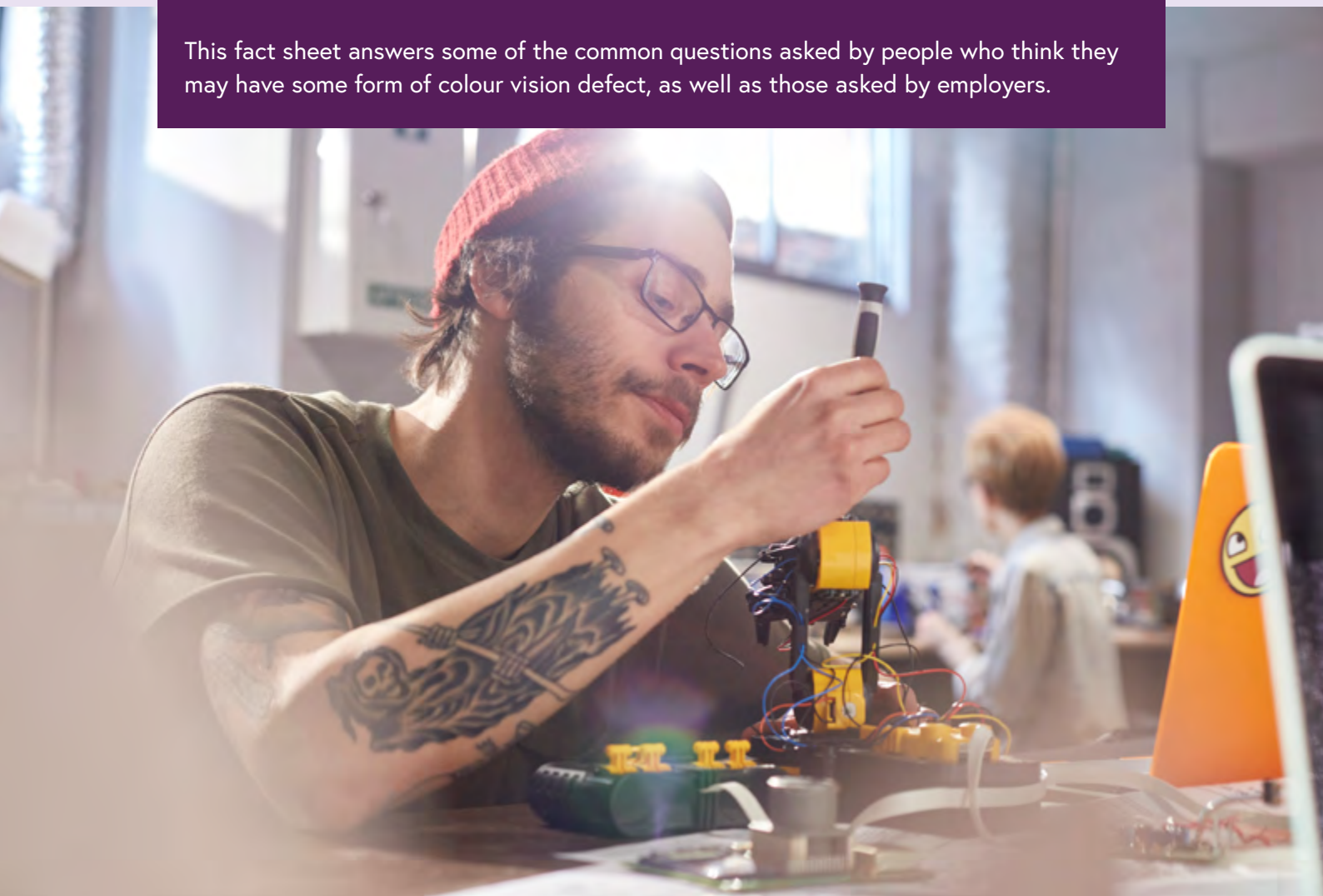
Colour vision in the workplace

What is this factfile about?

Approximately 1 in 12 men and 1 in 200 women suffer from some form of defective colour vision. The degree of disability varies widely, and can even be so severe as to preclude an individual from pursuing certain careers.

Complete colour-blindness (i.e. the perception of the world in monochrome shades of grey), however, is very rare.

This fact sheet answers some of the common questions asked by people who think they may have some form of colour vision defect, as well as those asked by employers.



What is colour?

What we know as "light" is a small part of the electromagnetic spectrum. The electromagnetic spectrum is categorised by the wavelength or frequency of radiation and includes radio waves, microwaves, ultraviolet light and X-rays.

The visible spectrum (light detected by the human eye) encompasses radiation from approx. 400 to 700 nanometres (nm) in wavelength. This gives the familiar rainbow of colours, from violet at around 400nm

through green to red at around 700nm. White light (e.g. sunlight) is a combination of all visible wavelengths of radiation. Most materials absorb some wavelengths of light and reflect or transmit others. An object made of such a material looks coloured when illuminated with white light, because only the reflected/transmitted wavelengths remain. For example an apple looks red because all wavelengths are absorbed by the apple skin except for radiation around 700nm.

What is colour vision?

The brain perceives colour from the combination of responses from the three receptor types in the eye, when exposed to light. The receptors are cone shaped cells on the retina of the eye that contain pigments. The pigmentation of a cone type makes it more responsive to light in the red, blue or green part of the visible spectrum. Beyond the retina, the signals are converted from a chemical into an electrical form and transmitted to the brain for interpretation.

Colour is perceived from the combination of responses from the three cone types. Impaired colour vision results from either a lack of one colour receptor or a change in the way that a receptor responds to particular wavelengths (i.e. the peak sensitivity is shifted). The extent to which an individual's colour vision is impaired can vary enormously along a scale from mild deficiency to total lack of colour vision (true colour blindness).

Mildly affected individuals have difficulty with pale colours and with darker hues, but colours will only be confused if they are of exactly the same brightness. If one receptor type is missing and therefore cannot respond to any wavelength,

a severe form of colour vision defect results. Severely affected individuals have difficulty even with bright colours although again, they can differentiate colours if they differ in terms of brightness.

Impaired colour vision is usually inherited, although it can be acquired as a result of eye disease, or as a side effect of medication or toxic poisoning. Acquired colour vision deficiency is very rare. Sufferers are frequently blue/yellow defective, which means that they can't be tested by using some standard procedures such as the Ishihara plates.

Impaired colour vision can have an impact on many everyday activities, dependent upon the type and severity of the defect and the lighting conditions. These include distinguishing the ripeness of fruit, reading maps, and choosing clothes. Sufferers can't distinguish as many different colours, they confuse certain colours (if equal in brightness) and depending on the type and severity of defect, they may have reduced ability to see red (it will look dark), which has implications for driving (stop lights, brake lights) because of increased reaction times.

Terminology

The common term is colour blindness. However, this is misleading due to the wide variation in deficiency experienced.

The medical terminology appears at first sight to be quite complex and is loosely based on Greek.

Table 1: types of colour vision defects

Terminology	RED	BLUE	GREEN
Trichromatism (Normal sight)	Can differentiate all colours		
Anomalous Trichromatism	Can differentiate all colours but one colour has reduced or displaced sensitivity		
Protanomaly	Displaced sensitivity		
Deuteranomaly	Displaced sensitivity – most common colour vision defect		
Tritanomaly	Displaced sensitivity		
Dichromatism:			
Tritanopia	Receptor normal	Receptor missing	Receptor normal
Deuteranopia	Receptor normal	Receptor normal	Receptor missing
Protanope	Receptor missing	Receptor normal	Receptor normal
Monochromatism (Achromatopsia)	Totally unable to differentiate colours of equal brightness		

Most colour defective people in the UK are anomalous trichromats, which can vary in severity from very mild to almost dichromatism. Deuteranomaly, the displacement of green sensitivity, is the most common type. This results in difficulties differentiating between reds and greens and between blues and purples.

Dichromatism is not as common as anomalous trichromatism. Monochromatism, the inability to differentiate any colour, is very rare and is usually accompanied by poor general vision. Further information is included in the HSE publication, Guidance Note MS7 (Third edition) *Colour vision examination – A guide for occupational health providers*.

How do I find out if I have colour vision defects?

If you experience problems in distinguishing colours, in comparison to other people, then you may have impaired colour vision. It is common for people with a mild deficiency not be aware of it. The condition is genetically inherited from your mother, so if someone in your family has defective colour vision (particularly a maternal grandfather or a brother), then there is a possibility that you, and your children, may also be affected. The best advice is to establish first of all if there is a defect. Your doctor or optometrist can test if you have defective colour vision, and arrange for further tests to establish the degree to which

you may be affected. It is particularly important for children to be correctly diagnosed, as they may experience difficulty with colour coded materials used in schools. Early diagnosis is also desirable in terms of choosing a career.

The most common screening test uses Ishihara plates. The Farnsworth D15 test and the City University test are used to establish the type and degree of deficiency. However, these tests only provide some information regarding the type and degree.

Employees with colour vision impairment

Many jobs require the ability to distinguish between colours, either implicitly or explicitly. Whether or not an individual with colour vision defects is capable of doing a particular job depends on the degree of the defect, and the importance of accurate colour distinction to the job function. The following list shows the careers that require non-defective colour vision. The requirement for those involved with transport to have non-defective colour vision is clearly consistent with their job function, in which the ability to distinguish colour coded signals and navigational aids is essential to ensure passenger safety. Careers and occupations known to require non-defective colour vision include:

- Armed Services (some branches)
- Customs and Excise Officer
- Civil Aviation - pilots (depends on severity), engineers, technical and maintenance staff, air traffic controllers
- Railways - drivers, engineers and maintenance staff
- Fire Service Officers (mild deuteranomalous allowed)
- Hospital Laboratory Technicians and Pharmacists

- Workers in paint, paper and textile manufacture, photography and fine art reproduction

In the case of work in relation to electrical wiring, the problem of colour vision impairment may not be as critical as formerly, when single phase electrical wires were coloured green, black and red. Although a new multi coloured (yellow and green) Earth was introduced some 40 years ago, it is only since 2004 that red electrical wiring was phased out completely.

If a worker may have difficulties in colour perception, he or she must make sure that when coming across older coloured wires, either they use appropriate tools or work with a normally sighted colleague to identify the correct colours. Most people with common forms of colour impairment can manage their condition. However, for some people (i.e. those few who can see no colour at all), colour blindness can mean they can't pursue a career as an electrician. Generally, for those who wish to register on an apprenticeship scheme there is a colour blindness test to pass.

Guidance for employers

For employers with employees whose colour vision is important for safety critical purposes then colour vision testing is crucial in deciding on their fitness to work. In organisations where colour vision needs are not associated with safety-critical systems but with product quality, colour vision testing is valuable to avoid costly errors.

Employers should realise the importance of using a risk-assessment-based approach when deciding what the pass/fail criteria is for employing a person, where colour vision is a requirement of employment. This should be decided before starting any colour vision testing procedure. If a colour vision risk assessment is required to evaluate the ability of an individual to perform one or more specific tasks, this is often carried out at the pre-employment stage. For some occupations, annual checks for acquired defects may be desirable.



Is colour blindness classified as a disability?

In relation to employment, it should be noted that case law to date suggests that for most occupations colour impairment is not regarded as a disability. The issue was considered in 2017, by an employment tribunal in the case of *Bessell v Chief Constable of Dorset Police*. Mr Bessell, who had red-green colour blindness as well as difficulties differentiating pink and grey, failed in this attempt to bring a disability discrimination case against his employer. Although he provided a number of examples to explain how his colour perception difficulties caused him difficulties in his daily life and also how he sought to overcome his impairment with coping strategies, the tribunal decided that direct discrimination had not occurred. The tribunal concluded that Mr Bessell's colour blindness did not lead to a "substantial and long-term adverse effect on [his] ability to carry out normal day-to-day activities".

The Bessell case involved employment in an office situation and the issues considered involved matters such as distinguishing between different colours of forms. This verdict may not be replicated in other situations and it is worth remembering that employers have a duty to ensure that 'reasonable adjustments' are made to enable workers to overcome any physical difficulties they may have, in order to carry out daily work tasks.

Employing people: workplace adjustments

Adjustments in the workplace may mean changing the way in which employment is structured, the removal of physical barriers and/or providing extra support for a colour-blind worker. Employers must make reasonable adjustments. This is to make sure that, as far as is reasonable, a worker with colour perception problems has the same access to everything that he or she is involved in doing and that he or she has the same right to a job as a normally sighted person.

Employers must make positive and proactive steps to remove, reduce or prevent the obstacles a colour-blind worker or job applicant faces. Employers, however, must only adjust where they are aware, or should reasonably be aware, that a worker has this impairment. Many of the adjustments employers can make will not be particularly expensive, and they are not required to do more than what is "reasonable". The determination of what is reasonable depends, among other factors, on the size and nature of the organisation.

If, however, an employer does nothing and a colour impaired worker can show that there were barriers that should have been identified or reasonable adjustments that could have been made, then they may have grounds to bring a claim against an employer in an Employment Tribunal. If this claim is upheld, the employer may be ordered to pay compensation as well as make the reasonable adjustments.

Provided the adjustments are reasonable for the employer to make, the need to make adjustments in relation to any individual worker:

- must not be a reason not to promote a worker if they are the best person for the job with the adjustments in place;
- must not be a reason to dismiss a worker; and
- must be considered in relation to every aspect of a worker's job.

Many factors will be involved in deciding what adjustments to make and these will depend on individual circumstances. Different people will need different changes, even if they appear to have similar impairments.

It is advisable for an employer to discuss the adjustments with the colour-blind worker, otherwise the adjustments may not be effective.



Further Information

We would like to thank Dr Catharine Chisholm of the Applied Vision Research Centre, City University for her help in compiling this fact sheet.

More information on colour vision is included in the HSE publication, Guidance Note MS7 (Third edition) **Colour vision examination – a guide for occupational health providers**.

The principles of colour vision testing are set out in the HSE publication:
Colour vision examination – a guide for employers.

The legislation in relation to workplace adjustments is the Equality Act 2010. Further information on workplace adjustments can be accessed by visiting the **Equality and Human Rights Commission website**.

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