

2.1.1 Overview

Visual cues provide the pilot's most important sensory input. Good visual acuity over all working distances is essential for safe operation of an aircraft. Information should be sought about the range of visual performance required of each pilot so that relevant advice may be given about suitable correction, if required, and about protection against glare.

If there is any doubt whether a pilot meets the required visual standard, referral to a CASA Designated Aviation Ophthalmologist (DAO) or Designated Aviation Eye Examiner (DAEE) for a detailed assessment and report is mandatory. A standard form has been developed for routine ophthalmological examination required for professional aircrew and ATCs (see also [6. Aviation Medicine Forms](#)). Original examinations must be undertaken by a DAO or DAEE.

Visual Requirements Standard – CASR Part 67

[CASR 67](#) The visual requirements standards are found in the following paragraphs of [CASR Part 67](#):

CASR 67.150	For medical standard 1	CASR 67.150 Table 67.150 1.31 – 1.39
CASR 67.155	For medical standard 2	CASR 67.155 Table 67.155 2.31 – 2.39
CASR 67.160	For medical standard 3	CASR 67.160 Table 67.160 3.29 – 3.37

2.1.2 General Visual Requirements

The Medical Standards in the Civil Aviation Safety Regulations (CASRs) stipulate that the functions of the eyes and their adnexae shall be normal. This requirement encompasses more than simply visual acuity. All Designated Aviation Medical Examiners (DAMEs) and Designated Aviation Ophthalmologists (DAOs) and Designated Aviation Eye Examiners (DAEEs) must satisfy themselves that this criterion has been fulfilled before assessing a pilot as meeting the required visual standard.

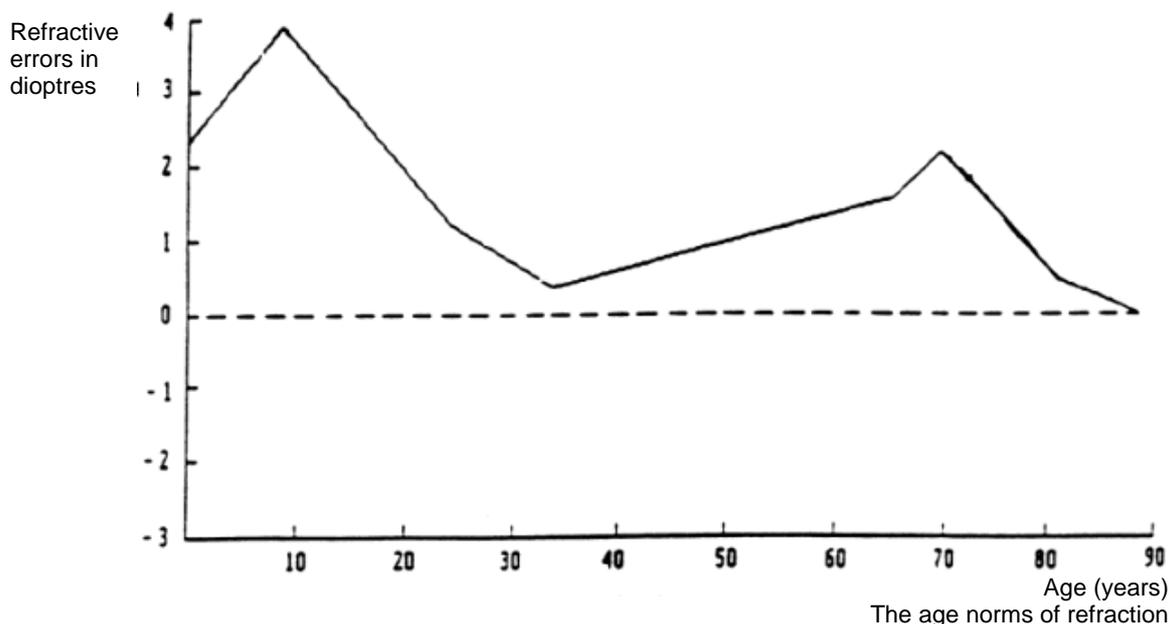
All applicants for initial issue of a Class 1 and/or 3 Certificate must be seen by a DAO or DAEE. All applicants for issue of a Class 1 and/or 3 Certificate must be seen by a DAO or DAEE at the time of first renewal of medical certificate after reaching the age of 60 years and at two-yearly intervals thereafter.

2.1.3 Refractive Error

Some degree of refractive error is found in the majority of eyes. Most of these errors are simple and are due to a slight lack of coordination of development of the various parts of the refractive system. They represent, therefore, a biological variation from the norm and should not be regarded as pathological.

Pathological refractive errors are relatively uncommon. They are due to gross developmental abnormality. The degree of error is usually high and the visual acuity is often not fully correctable while, particularly in myopia, the eye may show degenerative changes.

At birth, the majority of eyes are hypermetropic. From then until the age of eight years, this hypermetropia is seen to increase. After age eight, refraction becomes less hypermetropic (or more myopic) until approximately the age of 25 to 30 years, when relative stability is reached.



If, therefore, a young applicant has had less than the average degree of hypermetropia at birth, the natural shift to the more myopic side can result in the development of overt myopia, a development that is likely to progress until the age of 25 to 30 years, when some degree of stability is reached.

It is difficult to give an accurate prognosis of the progress of refractive errors since individuals do not necessarily conform to the population norm, and those who develop frank myopia frequently progress to the myopic side more rapidly than those who remain on the hypermetropic side of the population norm.

CASA has not placed restrictions on applicants who require high levels of correction in order to meet the required visual standards. CASA considers that ability to meet the standard is all that is required, regardless of the power of corrective lenses necessary to achieve this outcome.

2.1.4 Refractive Surgery

Radial Keratotomy (RK)

The role of radial keratotomy in reducing refractive errors is a significant current issue in aviation medicine. Persons who have undergone this procedure are often subject to diurnal fluctuation in visual acuity. If this is significant, (i.e. loss of more than one Snellen line for professional licence applicants and more than two Snellen lines for private licence applicants) **even if an applicant's visual acuity is still within the pass standard**, this fluctuation constitutes failure to meet the visual requirements of the standard(s) concerned.

Applicants who undergo radial keratotomy before their myopia has stabilised are at risk of continuing progression of their myopia.

The long-term consequences of radial keratotomy are not yet well documented, so it is impossible to predict any long-term implications for pilot licensing. Applicants should be reminded of this uncertainty as it may affect their chances of employment in the aviation industry.

Following radial keratotomy, the refraction takes some time to stabilise to its new value. Flying is not permitted while the refraction is still plastic. Evidence of stability requires:

- A variation not exceeding 0.25 dioptres in refraction
- A visual acuity changing by not more than one Snellen line
- Visual acuity, which at least satisfies the minimum standard for the class of licence, at three paired serial measurements.

These three paired serial measurements are to be part of a full ophthalmological examination, are to include measurements early in the morning and late in the day, and must be delayed for at least three months following surgery. Note that some eyes may not have stabilised even as late as a year after surgery.

A second problem associated with radial keratotomy is sensitivity to glare. This can cause considerable difficulty in the healing phase but tends to settle with time. Testing of visual performance with a bright light shining at the applicant should demonstrate any continuing glare sensitivity.

All applicants whose eyes have stabilised following radial keratotomy must thereafter have an ophthalmological assessment every two years for Class 1 and 3 and every five years for Class 2 Medical Certificates.



Photo-ablative Refractive Keratectomy (PRK)

This is a new technique, using a laser, for changing refraction. The long-term implications are as yet unknown. The requirements for assessing stability after radial keratectomy outlined above should be followed after photo-ablative refractive keratectomy.

2.1.5 Monocular Pilots

Monocular pilots may be divided into two categories:

- The monocular condition—the situation in which an applicant has only one functioning eye.
- The functionally monocular condition—the situation in which an applicant has two eyes, but the visual acuity of one cannot be corrected to 6/9 or better.

Provided the visual acuity requirements can be met in the functioning eye, with or without correction, a waiver is granted for Class 2 certification, limited to Australian Airspace, for both the monocular condition and for functionally monocular pilots. Likely Conditions on an applicant's Medical Certificate are:

- Not valid for mustering or agricultural flying.
- Valid in Australian airspace only.
- Special conditions apply.

Functionally monocular pilots who can meet the visual acuity standard with the remaining eye may obtain Class 1 certification. These applicants are required to show that flight safety is not jeopardised by the reduced visual acuity or absence of the other eye. Only the Aviation Medicine Section can issue this waiver. Likely Conditions on the resulting Medical Certificates are as set out above for Class 2 Medical Certificates.

2.1.6 Visual Acuity

Distant Vision

Record the uncorrected distant visual acuity in each eye separately, also binocular acuity. If the applicant wears correcting lenses, record the corrected acuity also for each eye and binocularly. For original examinations, check visual acuity without contact lenses and then with contact lenses. Acceptable values are as follows.

Student and Private Pilots

For students and private pilots, acceptable values are at least 6/12, corrected if necessary, in each eye. An acuity of at least 6/9 (with or without correction) with both eyes open is also required.

If the student or private pilot applicant cannot achieve 6/12 (with or without correction) in each eye, the DAME should inquire about the defective eye and record the cause.

In cases of doubt, referral to a CASA Designated Aviation Ophthalmologist or prescribing optician is indicated. These applicants may be acceptable for non-commercial licences; however, their licences will carry endorsements restricting operations to Australia.

By definition, if an applicant achieves no better than 6/12 in the poorer eye, the applicant is considered to be functionally monocular.

Applicants assessed as suitable for licensing with appropriate endorsements are required to have a stable visual condition to which they have adjusted. This provision affects pilots who have poor foveal static visual acuity but whose peripheral vision is normal (in practice, amblyopia). Those who have completely lost an eye or its vision may be assessed as fit after the Aviation Medicine Section's consideration of such factors as the extent of visual field loss and the duration of the condition.

Professional Flight Crew and ATCs

For all professional flight crew and ATCs: 6/9, corrected if necessary, in each eye separately. Additionally, the acuity must be 6/6 or better when tested with both eyes open.

Applicants with high refractive corrections (i.e. greater than +/-5 dioptres) should be advised of the possible complications, which may affect their vision, and of the implications for their aviation careers, particularly their increased statistical chance of retinal detachment.

Note The equivalent spherical error is taken as the sum of sphere power plus half that of the cylinder, the calculation taking account of arithmetical signs.



The High Myope

CASA prescribes no limit and high myopes who meet the standard after correction are assessed as meeting the standard. The final decision in cases of high myopia depends on the applicant's functional visual ability and on the absence of significant ocular pathology.

Although high-density lens material has enabled the lenses in corrective spectacles for applicants with high myopia to be thinner and so not cause unacceptable peripheral distortion, contact lenses are the preferred method of visual correction for myopes who require more than 5 dioptres of correction.

Near Vision

Near vision at all ages must meet the standards specified in the CAR Schedule (N5 with or without correction at 30-50cm and N14 at one metre without correction). DAMEs must check this function at every periodic medical examination for all applicants for aviation licensing.

Professional flight crew should be advised to have periodic ophthalmological examinations from age 45 to detect early signs of developing ocular pathology.

If an applicant cannot meet the standard, he or she should be referred for an ophthalmological assessment and appropriate spectacles prescription.

Near-vision spectacles have a limited range of clear vision, which depends on the power of the lenses prescribed and on the residual accommodation of the wearer.

It is vitally important that the range of clear vision encompasses all the near objects that need to be seen clearly. Typically this ranges from the reading of maps and operating manuals at ordinary reading distance to reading the more distant parts of the instrument display at a distance of one metre or more.

It is important that the spectacles prescribed are suited to the near working distances imposed on the pilot by the configuration of the flight deck of the aircraft. This becomes increasingly critical as an applicant's presbyopia progresses with age.

The pilot should measure the working distances encountered in all seating positions on the flight deck, and record them prior to having a prescription for near vision determined. A suggested checklist for pilots is as follows.

2.1.7 Working Distances Checklist

Object	Nearest (cm)	Farthest (cm)
Flight instruments		
Engine instruments		
Checklists		
Electronic Flight Instrument Systems (EFIS) and flight management display		
Approach charts		
Radio		
General charts and manuals		
Other		

Overhead Panels

Overhead panels can cause difficulty because of their close proximity to the pilot's eyes. This proximity ensures that the presbyopic pilot has difficulty seeing legends and numerals clearly, yet in order to view through the near segment of bifocals or through look-overs it is necessary to tilt the head back awkwardly. This may present particular difficulty in some aircraft types.

Possible solutions to difficulty in viewing overhead panels:

- The simplest solution is to lift the bifocals (or look-overs) so that the head does not have to be tilted so far back.
- Flip-down spectacles can be provided with an additional lens power to focus the overhead panel clearly when viewing through the upper distance part of the bifocal lens.

However, flip-downs are cumbersome and there is a risk that they may be left down, causing blurring of distance vision. There is also a risk that they may flip down inadvertently as a result of turbulence during some critical phase of flight.

- There are vocational multifocals available which have a near segment in the upper part of the lenses as well as in the lower part. However, the distance portion between the two segments is only 12 or 15mm deep giving a distant vertical field of view of only 21 to 26 degrees. Pilots may find this impedes their visual scanning.
- A special multifocal lens can be constructed to provide a small near viewing segment in one corner of the upper part of the lens.



The more complex solution should usually only be pursued if pilots experience significant and persistent problems with the overhead panel. The overhead panel usually does not demand perfect visual acuity and is not often used in critical phases of flight, so it should not be assumed that it presents serious operational difficulties.



2.1.8 Bifocal Segment Height

The height can be set so that the pilot views the instrument panel through the near segment as well as using it for charts and manuals at an ordinary reading distance.

Alternatively the segment can be set low so that it is used only for charts, manuals and reading. When viewing the instrument panel the pilot will look over the top of the near segment to use the distance part of the bifocal.

This choice will depend on:

- Whether or not the pilot is having any difficulty reading instruments on the forward instrument panel; and
- The pilot's residual accommodation. (At least 2.75 to 3.50D of accommodation is required to see the instrument panel clearly and comfortably through the distance part of the bifocals.)

If the segment is set low, the bifocals may not be suitable for everyday reading outside the aircraft. A separate pair of reading glasses or bifocals for everyday use may then be required.

How to Determine the Correct Segment Height

Optometrists and spectacle dispensers are skilled at setting the segment height correctly, but flying is a demanding occupation and it is worth taking pains to obtain an accurate prescription for the height of the near segment.

It is worth checking segment height on chosen frames or single lens distant vision glasses by stretching adhesive tape across the frame or lens whilst the pilot is seated in the cockpit. The position of the tape can be varied until its upper edge is at the height desired for the top of the near vision segment.

2.1.9 The Need for Trifocals

As presbyopia advances, the power of the near spectacle correction must be increased to compensate for further loss of accommodation power. As a result, the range of clear vision decreases.

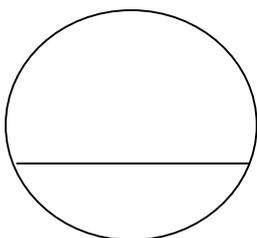
For a pilot aged about 45 with 3.50D of residual accommodation, the power of the near addition typically prescribed is 1.00D. For this person, the range of clear vision is from two metres to 220mm, which should be more than adequate for all flight deck near-vision tasks. However, a pilot aged 50 to 55 with only 1.50D of residual accommodation is typically prescribed a near addition of 1.75D, giving a very much smaller range of clear vision from 800mm to 360mm. This range is suitable for near tasks at ordinary reading distances but does not permit clear vision of those parts of the instrument panel beyond 800mm.

When this occurs, trifocals are required. Trifocals provide an intermediate segment that has approximately half the power of the lower near segment.

2.1.10 Acceptable Forms of Correction

To comply with operational requirements, reading correction must be in the form of 'look-overs', bifocal or trifocal lenses as appropriate. Single vision lenses for near correction are not acceptable. See the diagram below.

Bifocal Lens



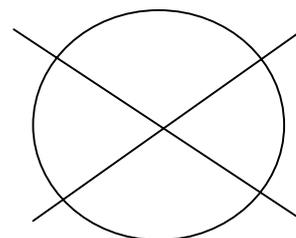
For reading

Look-over Lens



For reading

Single Vision Lens



Whole lens for reading **NOT**
suitable for flying

2.1.11 Progressive Power Lenses

These lenses provide a variable focus depending on which part of the lens is used for viewing. They provide a narrow intermediate visual channel and larger distant and near areas. These lenses may be associated with illusions of movement and distortion in the peripheral field of view. They should only be used for flying after adaptation in flight as a non-critical crewmember.

2.1.12 Contact Lenses

Provided the following criteria are met, contact lenses may be worn for correction of distance vision.

Both hard and soft contact acuity lenses are acceptable. The pilot must be able to wear the lenses throughout an ordinary day without experiencing any discomfort or deterioration of vision.

An acuity of 6/9 in each eye is required with correcting spectacles immediately after removal or displacement of contact lenses.

The pilot and the prescriber are responsible for ensuring that the pilot has adapted to the contact lenses sufficiently to perform his or her aviation duties. The duty period depends on the type of operations in which the pilot is engaged. The length of time that contact lenses can be worn without producing discomfort differs for private/pleasure flying and long haul commercial operations.

The choice of lens depends upon the nature of the correction required and on cabin conditions encountered.

Hard lenses tend to induce more discomfort and can be displaced by propeller wash or strong wind. Should a pilot need to remove the lenses in flight and substitute spectacles, post-wearing blur with decreased visual acuity should be anticipated.

Soft lenses do not cause those problems to the same extent. However, they may not fully correct astigmatism of greater than one dioptre.

For high myopes, soft contact lenses are preferable to spectacles. In the greatest degrees of myopia, the required visual acuity standards may not be able to be met using spectacles.

For initial issue examination, the contact lenses should be removed and the applicant's visual acuity checked while wearing spectacles. The uncorrected vision should also be recorded. At renewal medical examinations it is not necessary for the applicant to remove the contact lenses unless the examiner considers this clinically indicated.

2.1.13 Sunglasses

Glare is often a cause of significant discomfort when flying above cloud or when flying into the sun. Sunglasses may be required in such circumstances.

There are two basic factors to consider when selecting sunglasses, namely the frame and the lenses.

Any spectacle frame reduces the field of vision. Narrow frames that carry large lenses are desirable. The most critical problem with frames arises from the presence of wide side-arms which significantly impair the peripheral visual field.

Sunglass lenses should protect the eyes from glare while not adversely affecting the visual cues necessary for safe flight. Accordingly, lenses should not be too dark, and should transmit at least 15% of incident light. The tint used should be "neutral density" (N.D.), that is, a greyish tint that does not distort colour perception or adversely affect red signal detection and recognition. The recommended tint is N.D.15.

Lenses of polycarbonate are preferred because of their impact-resistance and ability to absorb ultra-violet and infrared rays. However, these lenses can scratch readily and any scratched spectacles should be discarded.

To ensure that sunglasses provide adequate protection from solar radiation that may damage the eyes, only those sunglasses that conform to the current Australian Standard should be worn.

Sunglasses that conform to the current Australian Standard also meet acceptable standards for lens quality, frame strength and lens retention.

For aviation use, those sunglasses marked "Specific Purpose Sunglasses" are recommended, provided their frames are appropriate. The lenses of these sunglasses have been specifically designed for use in conditions of intense glare, such as in flight above cloud. At high altitude, atmospheric absorption of ultra-violet radiation is reduced.

Polarising sunglasses should **not** be used when flying. The polarising filter interacts with the cockpit transparency to produce a distorted and degraded visual field that poses a threat to air safety.

The pilot who already wears prescription spectacles for flying can choose from a number of options for glare protection. Prescription sunglasses with N.D.15 lenses can be obtained, or N.D.15 clip-on or flip-up sunglasses may be worn over prescription spectacles.

Pilots who require correction of their near vision only and who wear "look-overs" are advised to obtain bifocals and a plano upper segment. Clip-on or flip-up sunglasses can then be worn. However, the dangers of flip-ups previously mentioned should be recalled.



Graduated lens tint is another option. This provides glare protection for distant vision outside the aircraft, while near vision inside the aircraft is not impeded by the tint. It is usually considered that the use of a single tinted segment in bifocal glasses should be avoided as the visual effect of a "false horizon" may be disturbing and dangerous.

2.1.14 Photochromics

Spectacles can also be prescribed with photochromic lenses — lenses that change their density depending on the ambient light level. Under bright conditions they are like sunglasses, while in darker conditions they transmit light almost as well as untinted lenses. However, photochromic lenses have disadvantages that render them unsuitable for use by pilots.

Firstly, their transition times are relatively slow. Photochromic lenses take about five minutes to increase their density to the level of sunglasses, but more importantly, the bleaching time from maximum to minimum density can be as long as 30 minutes or more, although there is a rapid lightening of the lens in the first five minutes. This may be too long when there is a sudden variation in light during a descent into or under cloud, or because of a rapid change in cloud cover.

Their second disadvantage is that, even when fully bleached, photochromic lenses still absorb slightly more light than untinted lenses. Since vision is critically dependent on ambient light levels at night or otherwise when light levels are low, even this small decrease of light reaching the eye through photochromic lenses is undesirable. The inherent degradation of these lenses with time effectively prohibits their use in flying or controlling air traffic and applicants should not use them in these circumstances.

2.1.15 Colour Vision

Normal colour perception is becoming increasingly important as colour-coded cathode ray tube displays and colour coded visual approach lights become more prevalent. If any element of doubt exists about a pilot's ability to perceive colour normally, the case should be referred to the Aviation Medicine Section.

Commoner Types of Colour Vision Defects

Type (Incidence)	Essential Characteristics
Protanomaly (1.0%)	Colour matches are different from those made by normals (anomalous colour matching). Reduced sensitivity for red lights.
Extreme protanomaly (0.2%)	Reduced colour discrimination for red, yellow and green. Reduced sensitivity for red lights.
Protanopia (1.0%)	Confusion of red, yellow and green. Reduced sensitivity for red lights.
Deuteranomaly (4.5%)	Colour matches different from those made by normals.
Extreme deuteranomaly (0.5%)	Reduced colour discrimination for red, yellow and green.
Deuteranopia (1.5%)	Confusion of red, yellow and green.

Test Procedure

The DAME is required to conduct a colour perception test, using the Ishihara 24-plate test. This test should be conducted even if the applicant is to be referred to an ophthalmologist. If the applicant should incorrectly identify more than two of the Ishihara plates, a test on a Farnsworth lantern is needed to determine whether or not he or she meets the colour perception standard.

The Ishihara plates test should detect all red/green colour vision defectives. Examiners should be aware, however, that some applicants may have learned the plates, and their presentation in random order is important. Other applicants have been trained to identify numbers on the plates by means of brightness cues or may even attempt to pass the plate tests by wearing an X-chrom or similar lens—a red contact lens worn in one eye which improves the colour defective's performance on the test.



Plate Testing

Reliable colour vision testing using the pseudoisochromatic plates requires that a standardised procedure be followed carefully. The main points are:

Illumination

Only the following are permitted:

- Daylight (but not direct sunlight). This is preferred.
- Fluorescent light from a fluorescent tube of 6,500 degree K colour temperature (normal daylight tubes).

Note Before using fluorescent light, check the maker's label on the end of the tube to ensure the colour temperature is that specified. Tubes labelled "warm white" or "soft white" are not suitable.

- Phillips 'Bleu' incandescent lamp.
- Macbeth Colour Source C.
- Where an applicant is unable to pass the test when it is performed under artificial lighting conditions, it should be repeated in daylight before a failure is recorded. However, this additional test is not required where an applicant makes more than 12 errors or gives a history of known defective colour vision.

Position

The applicant may stand or be seated, but should look squarely at the test plates from about 75cm distance. The applicant's position should be adjusted so that no specular reflection from the glossy surface of the plates is observed. The applicant should not move his or her head while taking the test.

Exposure Time

Each plate is exposed for a maximum of five seconds.

Procedure In Detail

1. Check the applicant's position, illumination, watch or clock with second hand.
2. Open the book at the first (demonstration) plate.



3. Read out at conversational speed, pausing perceptibly where indicated.
"I am going to show you some pages of dots. On some of them you can see a number, but some have no number. I want you to tell me if you can see a number and what it is. (Pause.)
If you can't see a number, say "no number". You have up to five seconds for each page. (Pause)
Is that clear?"
4. Now expose each test plate in random sequence.
5. When the applicant responds, or after five seconds have elapsed, whichever is sooner, turn to the next plate. Most applicants respond almost at once.
6. If more than one response is given to a plate, eg, "It's either three or eight", say "which one are you going to choose?" If the applicant changes his or her response, record the second response.

Marking Standard

Applicants scoring two errors or less on the 24-plate edition of the Ishihara plates meet the required standard. Those making three or more errors need to be tested on the Farnsworth Lantern.

Note: If the DAME suspects that a filter aid is being used, each of the applicant's eyes is to be tested separately and then binocularly. The results are to be notified to the Aviation Medicine Section.

Further Testing

Some applicants with defective colour vision may be safe for aviation duties, e.g. mild deuteranomals. The Farnsworth Lantern passes these while failing all protanopes and deuteranopes and most protanomals and the more severe deuteranomals.

The Australian locations of Farnsworth Lanterns are listed in [5. Colour Vision Testing](#). Farnsworth Lanterns are not transported to outlying areas. Examiners should refer applicants who fail the plate test directly to the nominated centres for Lantern testing. Such referrals should be noted on the examination form. If there is no record of such referral on the form, the Aviation Medicine Section notifies applicants of their right to undergo further testing.

Note: Applicants for original class 3 medical certification must pass the Ishihara Plate Test.



An applicant who fails to meet the colour perception standard (i.e. who fails both the Ishihara Plate Test and the Farnsworth Lantern, but who meets all other standards) is eligible for issue of an operationally restricted student pilot, private pilot or commercial pilot licence. The holder of such a licence is given a dispensation to operate at night in a suitably radio-equipped aircraft. This dispensation applies to Australian airspace only.

Class 1 and class 2 applicants who are unable to pass either the Ishihara Plate Test or Farnsworth Lantern Test may be further assessed by means of Practical Signal Light Test. Details are available from Aviation Medicine Section.

2.1.16 Cataract

Applicants who have undergone cataract extraction(s) and who achieve acceptable visual acuity with lens implant and/or contact lenses may be passed at all licence levels following individual assessment by the Aviation Medicine Section. Full reports are required.

All other cases of cataract should be referred to an ophthalmologist. A report including assessment and prognosis is required. The final decision in these cases is based on the ophthalmology report.

2.1.17 Demyelinating Disease

Multiple Sclerosis (MS) is a central demyelinating disease involving multifocal demyelination of white matter, which initially affects young people under 40 years of age. The diagnosis requires multiple attacks of demyelination separated in time and locations. A thorough neurological history is important at the time of presentation. Nuclear magnetic resonance imaging (MRI) offers some help in diagnosis but should not be substituted for good history taking.

The most common ocular manifestation of MS is optic neuritis. It is the presenting feature in 25% of cases and occurs during the course of established disease in 70%. Between 50% and 70% of patients in the 20 - 40 year age group presenting with optic neuritis subsequently develop systemic demyelination.

Optic neuritis typically presents as sudden unilateral blurred vision progressing over a few days. The vision is often described as being "washed out"; colours appear desaturated and there is often associated retro/peri-ocular pain aggravated by eye movements.

Signs include reduced acuity of variable severity from minimal to "no perception of light"; an afferent pupillary defect (pupil dilates during the "swinging light" test); and dyschromatopsia (poor colour discrimination performance).

The most common visual field defect is a central scotoma. Ophthalmoscopy may reveal a swollen optic disc although the disc is often normal in the retrobulbar type of MS. Optic atrophy (associated with previous attacks) may be found in the ipsi- or contra-lateral eye.

Visual recovery is slower than the initial loss and usually takes between four to six weeks. About 90% of sufferers recover normal visual acuity. Minor defects in colour vision and brightness appreciation may persist. The effects of subsequent attacks are additive. There is no correlation between the degree of visual defect during the attack and the final visual outcome.

All pilots with optic neuritis should be referred to a Designated Aviation Ophthalmologist. Examinations should include visual field plots of both eyes. A typical case may require CT and MRI scanning to rule out compression of optic nerves or chiasma.

Sinister features in applicants with MS include failure of visual recovery after four weeks, persistent periocular pain, proptosis, development of a quadrantic or hemianopic visual field defect, and field defect in the contralateral eye. All cases with severe visual acuity loss (<6/60) should be further investigated.

Flying duties in between infrequent attacks are possible provided there is adequate neurological and visual function monitoring. All cases should be referred to the Aviation Medicine Section for final assessment after adequate work up.

2.1.18 Glaucoma

All applicants for flight crew licensing who have glaucoma, or whom the DAME suspects may have glaucoma, must be assessed by a Designated Aviation Ophthalmologist. The DAME should not revalidate their Medical Certificates.

Primary Glaucoma

Closed Angle Glaucoma

Applicants should not be passed until the condition has been surgically corrected. Once corrected, a pass assessment may be issued after ophthalmological review.

Open Angle Glaucoma

Most open angle glaucoma is controlled by medication. The Aviation Medicine Section may issue a pass assessment only after receipt of a satisfactory ophthalmologist's report, which must include results of perimetry.

Preferred treatment is with beta-blocker drops. However, applicants with glaucoma controlled by other means are assessed individually.

Open angle glaucoma that has been successfully treated by microsurgical or laser techniques may be assessed as meeting the required standard by the Aviation Medicine Section.

Open angle glaucoma controlled with drugs requires annual ophthalmological review, including perimetry.

Secondary Glaucoma

Medical assessment depends on the underlying disease and the effectiveness of control. All cases should be referred to a Designated Aviation Ophthalmologist.

2.1.19 Macular Disease

The symptoms of macular disease include blurring and distortion of vision with micropsia or macropsia, which can be assessed with an Amsler grid. (This consists of a piece of paper showing a 10cm square divided into 5mm squares with a central fixation dot).

The subject is asked to fixate on the central dot, with each eye separately, at one third of a metre and to mark on the chart with a pencil, scotomata or areas of distortion.

When abnormalities are present, immediate referral to a Designated Aviation Ophthalmologist is required.

The commonest conditions affecting the macula are Central Serous Retinopathy and Disciform Macular Degeneration. All cases require final assessment by the Aviation Medicine Section.

Central Serous Retinopathy

The condition affects healthy young men with a hectic lifestyle. Only one eye is usually affected and reduction of acuity is mild (6/12 or 6/18). With a direct ophthalmoscope, dulling of the macular reflex is seen, representing a shallow central retinal detachment.

Vision recovers spontaneously within six weeks in 90% of cases. Stereoacuity is temporarily lost and pilots should not fly until full recovery occurs. Laser treatment has been shown to speed the resolution of symptoms, but does not improve the final visual outcome, and no treatment is usually advised. The condition recurs in 20 to 30% of cases and the second eye is affected in 20%.

Macular Degeneration

This condition typically affects the elderly but inherited forms may affect younger people. Ophthalmoscopy may show small grey, yellow or white lesions, like small crystals, at the macula. These are called "drusen" (German, druse = nodule).

The visual acuity is usually well preserved, 6/9 or 6/12, until a further complication occurs — the development of a subretinal neovascular membrane that spreads under the macula and reduces vision to 6/60 or less.

To prevent the visual acuity from deteriorating below standard, regular follow-up is essential. In the early stages when the vision is distorted, but the acuity well preserved, the subretinal membrane can be obliterated by argon laser treatment.

2.1.20 Retinal Detachment

This may occur at any age although it is commoner in the elderly. Myopic people, particularly high myopes, are at increased risk. Advice on the long-term prospect of an aviation career should be given to those with high myopic refractive errors.

The most frequent type of retinal detachment follows collapse of the vitreous gel — Posterior Vitreous Detachment. The symptoms are a sudden shower of floaters (caused by vitreous haemorrhage or pigment release) and flashing lights, due to vitreous traction on the retina. Urgent referral to an ophthalmologist is mandatory to exclude the presence of a retinal tear.

At the stage when the retina is torn, but not yet detached, laser treatment may be used to seal the retinal tear before fluid from the vitreous cavity passes through it to detach the retina. Once the retina begins to detach, prompt surgery is necessary. If surgery can be undertaken before the retina detaches from the macula, the prognosis for maintained vision is excellent. Once the macula has been detached for more than a few hours, visual recovery is only partial.

A special form of retinal detachment, retinal dialysis, is the commonest type of detachment seen in young, otherwise healthy people who are not myopic. It may occur after a blunt injury, which causes a tear in the extreme periphery of the retina.

Intraocular gases are often injected into the vitreous cavity during retinal detachment surgery. The most commonly used gases are air, sulphur hexafluoride (SF₆) and perfluoropropane (C₃F₈). Air takes only three or four days to be resorbed whereas the longest acting gas, C₃F₈, persists for up to six weeks. Air travel should be avoided until the gas bubble resorbs. Bearing in mind even in pressurised aircraft cabin altitude can be up to 8,000ft; a dangerous rise in intraocular pressure can occur if this precaution is overlooked.

In all cases of retinal detachment, once the condition is stabilised, a computerised visual field plot is mandatory before considering the applicant for return to pilot duties. The pilot should retain a copy of the plot for future comparison. The Aviation Medicine Section assesses each case individually.

2.1.21 Retinal Injuries

If a severe injury to the eye has occurred, with definite or suspected perforation of the globe, any aerial transport should be conducted at a cabin altitude of 4,000ft or less.

2.1.22 Strabismus

Whereas some degree of heterophoria is the norm, heterotropia (i.e. a manifest deviation of one eye from its normal position which occurs despite both eyes being open and uncovered), requires assessment by a Designated Aviation Ophthalmologist and final assessment, on an individual basis, by the Aviation Medicine Section. An applicant with an acuity (corrected or uncorrected) of worse than 6/12 is unacceptable, and a binocular acuity of worse than 6/9 is also unacceptable.

A majority of squint sufferers who have excellent cosmetic results from surgery and good visual acuity in each eye may still lack normal stereopsis (depth perception). They develop distance judgement by monocular cues and these are usually superior to those available to applicants who have lost an eye. However, their fine distance judgement for near distances is inferior to those with normal binocular vision. The Aviation Medicine Section individually assesses persons lacking binocular vision.

Squint may be latent or manifest. A latent squint is likely to become manifest under the influence of such factors as illness, fatigue, stress, drugs or alcohol. A cover test alternately on each eye unmasks latent squint.

The tests described below are designed to detect those who lack binocular vision.

Cover Test

Test at near (30cm) and at six metres. Use an accommodation fixation target at both distances. (For near an N5-size print and for distance a 6/12 letter). Ask subject to look at the fixation target, cover one eye and observe the other eye for refixation movement. Repeat test procedure for the other eye. Any refixation movement indicates possible squint.

Lang Stereo Test

Test at near (30cm). Hold card still and ask subject to name any pictures seen. Pass is three pictures: cat, star and car. A new Lang stereo test that tests to 200 degrees of arc is available. This may be considered superior to the standard Lang test that tests to 55 degrees of arc.

Worth Four Dot Test

Subject wears red/green goggles. Pass is identifying four lights, one red, two green and one white. Test at six metres only. Those who fail can undergo further tests, for example six-metre vectograph or Bagolini lens test to confirm if they truly lack binocular vision.

Designated Aviation Medical Examiner's Handbook

2. Medical Aspects

2.1 Ophthalmology

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