

CHAPTER 1 - GENERAL

THE CONCEPT OF AEROMEDICAL FITNESS

What constitutes medical fitness for flying is not as simple as mere absence of disease. Good health does not always mean fitness for flying, nor does bad health necessarily mean unfitness. Sometimes a healthy person may be less fit for flying than a chronically ill person, and in some circumstances even a quite severe disease in an airman may not preclude him from being assessed as fit for flying. When interpreting the Requirements as they are laid down in JAR–FCL []3 (Medical) it is important to bear in mind the purpose of having a set of established standards and of performing aeromedical examinations to ensure that these requirements are met, namely to maintain flight safety at a level acceptable to society.

From the point of view of the certificatory authority, an airman is fit for flying if:

- 1 he is mentally and physically capable of performing his flying duties at or above the level required for safe flying under all conditions; and
- 2 if it is safe to assume that he will remain so for the period of validity of his certificate.

At the aeromedical examination it is to be considered good practice for the [Aeromedical] Examiner (AME) to assess whether the airman is likely to remain fit for the following two year period. If an AME is in doubt about whether a pilot's health condition will allow him to continue flying for the following two years, usually a serious underlying pathology is suspected or has already been diagnosed. In such a case the final decision should be left to the Authority Aeromedical Section (AMS) which may decide to continue the [aeromedical assessment] under certain provisos (as for example shorter intervals between aeromedical [revalidation or] renewal examinations).

Thus, an airman may be assessed as fit for flying if:

- 1 he is physically and mentally capable of performing his duties on board in a safe manner. This includes having full use of his faculties, i.e. his visual ability, his hearing and his colour perception shall meet the requirements as stated in JAR–FCL []3 (Medical);
- 2 he is free of disease which may suddenly render him incapable of performing his duties on board in a safe manner during on-going flight (acute incapacitation);
- 3 he is free of disease which may slowly, but within the period of validity of his certificate, reduce his capacity for performing his duties on board to below the acceptable level.

As all aeromedical assessments are based on medical opinion, which to some degree [is] subjective and may be imprecise and sometimes even incorrect, the final decision – the aeromedical disposition – should lean towards the side of safety. If error cannot be completely avoided it is important to err in favour of flight safety, even if this may sometimes seem (and perhaps also be) unjust to the individual airman.

If an airman falls ill during the period of validity of his certificate, he [shall] notify the Aeromedical Section of the Authority (JAR–FCL 3.040). Some medical conditions, though quite unacceptable in an airman, may go unnoticed by the airman himself and thus []develop into a threat to flight safety. An example could be a borderline blood pressure becoming manifest hypertension or a slight myopia deteriorating into substandard vision. For this reason it is vitally important that the authorised medical examiner is particularly attentive to the first signs and symptoms of disease or malfunction, even if the condition does not necessitate sick leave or warrant medication or hospitalisation.

Any acutely incapacitating condition forms a major threat to flight safety. A disease like urolithiasis which may strike without warning and which may place the airman in a state of [severe] pain within minutes from onset, must clearly [disqualifies] him from all kinds of single seat flying duty, even if at the time of examination the airman may be totally asymptomatic. Classical migraine is another such condition. Although an attack may be preceded by certain warning symptoms, usually lasting 10–30 minutes, these

The concept of aeromedical fitness (continued)

are sometimes, per se, disqualifying and the fully developed attack with headache, nausea, photophobia etc. is clearly incapacitating and must entail unfitness for flying. Particularly dangerous, even in a multi-crew setting, are conditions which may develop slowly and insidiously and thus go unnoticed by the other flight crew members (subtle incapacitation). Some neurological disease (e.g. global amnesia, narcolepsy) could be mentioned here. Also psychiatric disease may be very dangerous. An airman in a hypomanic state may appear normal and energetic to his colleagues but may make a series of marginal decisions which are still acceptable to the other members of the crew but, when put together, may spell disaster.

To help avoid such situations and thus enhance flight safety is the ultimate goal of clinical aviation medicine as practised by AMEs and AMCs.

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THE AEROMEDICAL HEALTH EXAMINATION

Examining a healthy person may seem an easy task but also a rather futile thing to do, for what can you expect to find where nothing is wrong? In reality the periodic examination of airmen is both difficult and demanding, but may also be quite rewarding when performed with interest, care and thoroughness.

A licence holder is legally obliged to undergo regular health examinations, performed by either an [Aeromedical] Examiner (AME) or an Aeromedical Centre (AMC) – and he may resent the cost or the inconvenience of complying with the regulations. The airman may appear to be in perfect health, and more often than not will he himself believe this to be the case. At the same time he may reasonably fear that if something is wrong after all then this might cost him his medical certificate, i.e. his livelihood. This situation may lead the airman to feel nervous and tense at the examination, but almost invariably he will try to present himself as perfectly healthy. Fortunately most examinations will confirm that he is indeed in good health and fit for flying. But even if he is experiencing a mental or physical problem he may – consciously or subconsciously – repress it and in either case the AME may not receive the usual help from his examinee to guide him towards the site of any problem. To find a sign of early disease or malfunction under these circumstances takes skill, experience and the utmost thoroughness.

It is important that the aeromedical examination is performed in a way that encourages the airman to discuss freely and openly whatever problems – medical or otherwise – he may have, but the situation is not ideal for developing the usual doctor-patient relationship between AME and airman. An airman is not a patient and so has little encouragement to confide more than is required by the regulations. On the other hand, the AME gains little without the airman's confidence as most information of value is voluntary.

There is no specific route for the AME to follow in order to ensure an aeromedical examination of quality, but some important factors are:

- 1 Professional competence – as highly trained technical professionals all airmen appreciate professionalism in others.
- 2 Thoroughness – the airman himself may be unaware of the significance of minor signs and symptoms. It is of vital importance to review all systems at each examination and the airman's statement of 'unchanged since last examination' should only be the start rather than the end of any history. Often the airman will not be aware of anything wrong or that his minor symptoms are significant. In this latter situation only a very careful and thorough examination will reveal the problem. An unknown intestinal cancer may be suspected from a declining haemoglobin, still within normal range, and early diagnosis and intervention will most certainly improve the prognosis. Decreased visual acuity, reduced hearing, reflex anomalies, changes in blood picture or ECG are all signs and symptoms that may go unnoticed by the airman himself but which can be the first indication of serious underlying pathology. Further, there must be ample time to discuss the airman's employment (if professional air crew), or flying interest (if a private pilot) as information thus obtained is frequently as productive as the physical examination itself.

During the health examination [care should be taken] so that minor progressive changes can be noted at the earliest stages, often before symptoms become evident.

- 3 Openness – any abnormality found should be discussed, even if not apparently affecting certification, so that the airman realises that the AME remains primarily a physician throughout. Any such findings should be passed to the airman's family doctor for investigation and action, if appropriate, and full communication maintained with the Authority Aeromedical Section (AMS) concerning such actions.

- 4 Aviation knowledge – every effort should be made to appoint physicians with an aviation interest as the amount of time spent in aeromedical work is often disproportionate to other clinical activities. Sharing the airman's interest in flying is the most direct way to establish a relationship and yet another reason why time spent on the flight deck and in the flying club is an essential experience for the AME.

Although a good relationship between airman and AME is essential, it can occasionally cause the AME difficulty, as a physician he is required to maintain medical confidence and as an AME he is also required to communicate all information regarding the airman's physical and mental fitness for flying to the Authority. At the same time the AME may be the Company Doctor acting on behalf of the airman's employer and thus [pursue] the commercial [interests] of that organisation. Finally, he may be the airman's general practitioner. Despite all conflicting interests the AME must remember that:

- 1 he is appointed by the National Aviation Authority to verify that the individual airman examined by him meets the standards of JAR-FCL []3 (Medical) as required for the issuance or renewal of a medical certificate, and
- 2 the airman consulting him knows that in his role as an AME he is acting as the National Aviation Authority's approved medical examiner.

The individual AME therefore cannot assess []an airman [fit] outside the requirements, nor can he withhold pertinent information from the AMS of the Authority. In either case the AME must realise that he is only an agent for the Authority and cannot act for it without prior consultation and agreement. At all times the AME must protect his professional integrity and remain aware of his responsibility towards flight safety.

When a pathological condition has been disclosed, many airmen will seek the advice and opinion of another physician, often a highly esteemed specialist, but usually without training or experience in aviation medicine. Almost invariably such a physician will take a more liberal stand to the importance of the disease or abnormality with regard to continued flying than would an aeromedical specialist or the aeromedical officer of the [][Authority (AMS)]. Especially in cases where no effective treatment is possible and nothing can be done, most clinical practitioners try to comfort their patients with assurances that the condition is not very important or that the outlook is not so bad, etc. And, in fact, a disease may have a good prognosis *quo ad vitam*, but may still entail cessation of a flying career. In such cases as these, as in all situations where the airman's [aeromedical fitness] is in question, it is the AME's responsibility to consult with the AMS on the airman's behalf and, if considered appropriate, assist him in preparing his case for further assessment. The AME may play an important role as medical adviser to the airman and he may by prudent evaluation of the situation at hand, by explaining the specialists' statements, the information obtained from hospitals, the laboratory results etc. and by giving a balanced view of all aspects of the case, ensure that the airman fully and correctly understands his own condition and the aeromedical disposition it entails.

To act in this way while maintaining the confidence of his airman and the Authority is the art of the aeromedical examiner. By mastering this art he will serve flight safety and, at the same time, help keep his airmen flying.

THE CONCEPT OF AEROMEDICAL RISK ASSESSMENT

Professional Pilots

No human activity is totally free from risk. Transportation is such an activity and the risk attached varies widely according to mode. Aviation was initially a high risk, but with the introduction of modern jet passenger aircraft and improved instrument approach and landing systems the fatal accident rate has continuously fallen. The present rate world wide is better than 0.5 per 10^6 flying hours with some countries achieving 0.2 per 10^6 flying hours. The average flight time is approximately one hour and so it would seem reasonable to aim for an accident rate of 0.1 per 10^6 flying hours or 1 per 10^7 hours or 1 per 10^7 flights.

In this overall risk it is considered that no system (airworthiness, air traffic, operations) should contribute more than 1/10 of the total (1 per 10^8) and since the health of the pilot is only a small part of the operational risk, (e.g. 10%), medical cause for fatal accidents should occur no more often than 1 in 10^9 hours (10^{-9}).

If we consider the pilots of a large jet passenger aircraft, it has been proposed that a 1% per annum risk of their incapacitation would meet the target rate above. This proposed rate is roughly equivalent to the best experience following myocardial infarction or coronary artery by-pass surgery. Since cardiovascular disease accounts for about 50% of permanent loss of licence in Western European and North American aircrew, it is one of the most likely causes for sudden, complete incapacitation and therefore a good example of risk assessment. One per cent per annum is one incapacitating event per 100 pilot years or $100 \times 8\,760$ hrs. If 8 760 is approximated to 10 000 then this is 1 event in $100 \times 10\,000$ hours or 10^6 hours.

If a pilot with this risk of incapacitation is flying a large jet passenger aircraft with a qualified co-pilot, the theoretical risk to the flight is that of double incapacitation, less frequent than 1 in 10^{12} hours, or very long odds. Such an assumption is based upon perfect handover. Simulator testing would indicate that handover in such cases is virtually always successful but the real incapacitation is not always recognised and a 99% successful handover is suggested as being more realistic. A further factor is that incapacitation becomes critical only during landing or take-off, approximately 10% of an average one hour flight.

At worst case, a pilot with 1% per annum incapacitation risk, (where handover is not completed at the time of his incapacitation) poses a threat to the aircraft of one in 10^6 flying hr/flts. If only 10% of that flight is critical the odds lengthen by a factor of 10 (one in 10^7) and if only one per cent of handovers fail, the odds lengthen again by a factor of approximately 100 (one in 10^9 flying hr/flts). This is the figure quoted in paragraph 2 as an acceptable target rate for medical cause accidents and so the proposed 1% per annum risk of professional aircrew incapacitation appears justified and should be accepted.

Private Pilots

There are no world wide figures for fatal accidents to private pilots. Those North American and European statistics available would indicate a fatal accident rate one hundred times greater than that of large jet passenger aircraft. It would therefore seem reasonable to set a target accident rate for private flying a hundred times greater than that of public transport flights i.e. 1 per $10^7 \times 100$ or 1 per 10^5 flying hours.

If one again considers [that] the pilot is part of the operating system and his health only a part of the risk to that system, then the target for medical cause for accidents in private aviation should be less than 1 per 10^6 flying hours i.e. [the risk] 10^{-6} to 10^{-7} .

In general, private pilots do not fly with another qualified pilot and so acute incapacitation poses an immediate threat to the safety of the flight, throughout its duration. The risk of fatality arising from incapacitation in flight must therefore be that of the incapacitation (10^{-6} to 10^{-7}).

We have previously said that 1% per annum equates to 1 per 10^6 flying hours, therefore it would seem reasonable that a private pilot with a 1% per annum risk of incapacitation would meet the target rate for medical cause accidents in private flying. [This implies that a private pilot should follow the Class 1 assessment procedures. At the discretion of the AMS, a private pilot who has been assessed as meeting

The concept of aeromedical risk assessment (continued)

the requirements for Class 1 OML may be assessed as fit for Class 2 ([without limitation] or OSL / OPL) operations.]

The private pilot with a condition recognised as having a potential risk of 1% per annum or greater must expect the same investigation as would be required for an airline transport rated pilot in multi-crew operations. A lesser degree of investigation may be appropriate for a safety pilot limited certificate as the additional crew member would in some way alleviate any additional perceived risk.

Additional factors

- 1 If more than 10% of the pilot population is assessed as having an incapacitation risk of 1%, then the statistical population []and present assumptions [will be] altered.
- 2 Due to the simple nature of most privately owned aircraft, it may be appropriate to assume a greater proportion of medical cause accidents than 1 in 100, however, even doubling that figure would not grossly disturb the target incapacitation risk.
- 3 Beyond age 65 the cardiovascular incident risk exceeds 1% per annum, therefore it would seem reasonable to request cardiological assessment at a centre acceptable to the AMS.

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[DIFFERENCES FROM PROVISIONS]

Standards

The physical standards outlined by ICAO in Chapter 6 of Annex 1 to the Convention on International Civil Aviation [] were written to outline the minimum physical requirements considered necessary to maintain high standards of flight safety. Each system was considered with respect to its importance in flight whether sensory, physical or related to the possibility of incapacitation. In each case, where measurements could be taken, a norm was set which was varied according to the privileges of licence and operational conditions.

Flexibility and Waivers

Flying requires physical co-ordination, a degree of mental agility and good vision, nonetheless an individual does not need to be physically perfect. As indicated in Note 2 introducing Annex I Chapter 6, 'Standards and Recommended Practices cannot on their own, be sufficiently detailed to cover all possible individual situations.' Accordingly, particular individuals were allowed to exercise the privileges of a licence with or without the imposition of Limitations [] where such activities were considered compatible with the requirements of flight safety [(ICAO Annex 1, Chapter 1, 1.2.4.8 - Flexibility Clause)]. These [differences] from the Standards were proposed under 'accredited medical conclusion' (more than one medical opinion) but generally were empirical, subjective and inconsistent internationally.

[][Review Procedure]

Use of the Annex I '[flexibility]' clause (1.2.4.8) is outlined in the ICAO Manual of Civil Aviation Medicine but many States have developed their own approach[.] with many assessments being completed without any indication of flexibility having been applied [and others with a wide extension of flexibility]. In order to minimise [differences in the outcomes of aeromedical assessments] between JAA Member States, Annex I Chapter 6 was considered inadequate per se. JAR-FCL [] 3 (Medical) was therefore written in a more detailed fashion with Appendices outlining what degree of flexibility could be considered, at what level and after which investigations. The AMS therefore can be flexible in interpreting the requirements but must be seen to have completed what is considered as the minimum investigations necessary to demonstrate that this case falls within flight safety requirements and the parameters described in the JAA Manual of Civil Aviation Medicine.

Assessment

The aeromedical examination is detailed in JAR-FCL [] 3 (Medical) and an authorised examiner (AME) should recognise easily whether an individual meets clearly the requirements. If however, an individual does not meet clearly a requirement, or is marginal under several of them, the AME shall discuss the matter further with the Authority, [i.e. the] Aeromedical Section (AMS), which may provide or have access to further opinion and create 'accredited medical conclusion'. In all cases where an AME has refused or referred an assessment, the relevant data will be forwarded to the AMS in order that such data may be reviewed or made available to Aeromedical Centres (AMCs) and AMEs in other member States, should the individual decide to apply for a certificate elsewhere [(see 'Review Procedures')].

Special Investigations

Not all special investigations allow for specific measurement and in many cases their interpretation is subjective. Under such circumstances it will be necessary for the AMS to request the raw data or 'hard copy' as well as a specialist's report so that a further review can be made by external specialists briefed on aeromedical risk management.

Aeromedical Limitations []

In some cases an applicant will require assistance to meet the requirements, for example using contact lenses or spectacles. Under these circumstances [a respective limitation] should be placed upon the medical certificate and may be transferred to the licence[]. If an applicant is assessed as requiring correction to meet the visual standards at initial assessment {and therefore require a 'VDL' or VNL limitation, it is possible that his vision may improve. An AME should not however add or remove that [limitation] without verifying the position with the AMS and normally a further full refraction will be required before a visual [limitation] can be changed. One exception here should be a normal progression into presbyopia which requires a simple reading addition and only requires spectacles to be available – under these circumstances the AMS should not require consultation.

Some [limitations] are operationally related e.g. 'as or with qualified co-pilot' and if maintained for longer than 6 to 12 months, should be transferred to the licence. If such action is taken the medical certificate should indicate this e.g. 'Refer to limitations on the licence'.

[If an applicant does not fully meet the requirements for a Class 1 medical certificate, but is considered by the AMS to be within the acceptable risk of incapacitation, according to accredited medical conclusion, the AMS may assess him as fit in a multi-pilot environment. The affected pilot can be either pilot or co-pilot. In case of an incapacitation the other pilot can take over. The **multi-pilot (Class 1 'OML') limitation** "valid only as or with qualified co-pilot" has to be added (see JAR-FCL 3.035 (d) and (e), IEM 3.100 (c)). The **safety pilot (Class 2 'OSL') limitation** is a similar limitation applying to Class 2 applicants. The affected applicants have to fly in an aircraft with dual controls. The safety pilot can take over control, if the pilot should become incapacitated (see JAR-FCL 3.035 (f), IEM 3.035). For both limitations the essential element is the availability of a second qualified pilot in the unlikely event of an incapacitation of the one with the limitation.]

Medical Flight Tests

Where a physical deficiency is noted a cockpit check or medical flight test may be required. A cockpit check is appropriate where stature or deformity may be a consideration – for example, obesity can be a problem in smaller aircraft, particularly with floor mounted controls. Where fine movement and strength may be a concern, for example in an amputee, a medical flight test is appropriate and the AMS should brief the examiner concerning the problems that may be expected. In the case of lower leg amputation, toe brake operation may not be possible and with a forearm amputation, it may be necessary to specify which seat may be used. Any arm or hand disability must be carefully considered as the applicant must be able to maintain continuous control of primary flying surfaces at critical flight phases i.e., at landing or take-off. Simulators may be used instead of aircraft when the characteristics and cockpits accurately represent that aircraft and may allow more extensive challenge to the applicant than would be possible in actual flight. If an applicant is considered fit for a medical certificate following medical flight test a report should be made to the AMS and recommendation made by them to the Authority for any appropriate conditions such as 'restricted to demonstrated type'.

Given such procedures, flexibility may be applied to the requirements in a uniform manner and under varied operational conditions. By applying common assessment policies based on aeromedical risk assessment, flight safety should not be compromised and thus maintain the original concept of ICAO Annex I.

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REVIEW [] [PROCEDURES]

The Assessment

As indicated in the section concerning flexibility, JAR–FCL [] 3 (Medical) has been written in a form that is considerably more detailed and specific than ICAO Annex I. In doing so, the JAA FCL Medical Sub-Committee, [later rechristened Licensing Sub-Sectorial Team (Medical) (LSST(M))] has brought together many years of experience in interpreting Annex I with the aim of developing a common systematic approach to the investigation and assessment of cases including those of a marginal nature.

JAR–FCL [] 3 (Medical) Requirements and Appendices provide direction to [Aeromedical] Examiners (AMEs) in assessment and also indicate whether decisions should be referred to their national Authority [, i.e.] Aeromedical Section (AMS) for further consideration. This approach encourages the use of ‘accredited medical conclusion’ as it broadens the basis of what may, in many cases, be rather intangible risk management.

Refusal

The [Aeromedical] Examiner (AME) is therefore primarily responsible for deciding whether an applicant is within the Requirements (initial Class 2) or remains within the Requirements ([revalidation or] renewal Class 1 or Class 2). Any applicant who presents for examination must be examined unless the immediate history (epilepsy, psychosis or insulin dependent diabetes for example) obviously precludes any kind of certification. If full examination indicates that an applicant does not clearly meet the requirements, the AME must advise him of the area of concern and that a report of the refusal/referral will be forwarded to the national AMS without delay (JAR–FCL 3.035(c) and 3.100(e)). Any applicant rejected by an AME or Aeromedical Centre (AMC) will have his data forwarded to the AMS and may then request further review. Such a request will be treated in the same manner as a referral.

[] [Review Procedure]

Any case referred to the AMS nationally must be reconsidered against the Requirements, Appendices and, if necessary, the AMC. If further investigation or opinion is required the applicant should be advised of this need and how it may be achieved. While applicants should be free to choose their physician advisers, it is expected that the AMS will maintain a list of medical specialists with particular aeromedical interest or experience. On occasion it may be necessary for the AMS to direct the applicant to a specific physician (JAR–FCL 3.105(f)) for a further opinion. In all such cases relevant documentation must be provided to the specialist. [The AMS may assess applicants being outside the requirements of Subparts B or C, but within the requirements of the Appendices, as fit. Such fit assessments may be delegated to the AMC or the AME at the discretion of the AMS. In case of such fit assessments the AMS shall be informed of the details of such assessment. The AMS may create a list of conditions (subject to delegation or not). Furthermore, the AMS may revoke such a fit assessment, if it is established that it has not met, or no longer meets, the requirements of JAR-FCL 3 or relevant national law.]

Secondary Review

Upon completion of their review the AMS should make an assessment and advise the applicant in writing of that decision. In most cases the AMS will have sufficient additional expertise and operational experience to make a decision. However, some cases require careful consideration of complex studies, for example coronary angiograms. In such cases it may be advantageous for the AMS to bring together several cardiologists in order to gain consensus concerning interpretation of this data. A national Aeromedical Advisory group of this type will normally be chaired by a senior member of the AMS and may include medical representatives of the airline industry and aircrew associations with further operational expertise available. The assessments can then be demonstrated as having been given full consideration. The AMS does not delegate its authority to such medical advisers but may find their support invaluable. Any certificate issued under the Appendices and AMCs must be annotated as such and carry any appropriate [] Limitations. The AMS shall indicate where and when further examination is required.

Standardisation

All cases which are outside the Requirements and require consideration by the AMS under the Appendices and/or AMCs, are to be reported to the JAA [Licensing SubSectorial Team (Medical) (LSST(M))]. Such a report shall include identification details, age, type of licence held or requested, medical condition, Standard and or Appendix referred to and assessment recommended – including any []Limitations applied. A short narrative indicating the clinical summary is required in order to follow the reasoning applied. Proper compilation of this data should support audit of the Requirements and Appendices and enable continuing review of the AMS' s function. [At least an annual summary of all review procedures should be forwarded to the JAA by each member state, using the table given in the associated procedures, for discussion in the LSST(M)].

Amendment of Common Policy

Some cases may be outside the Requirements and Appendices but may still be considered a reasonable risk by an AMS. Such cases should be presented to the JAA [][Licensing Sub Sectorial Team (Medical)] with all supporting data and if favourably assessed may lead to [an exemption or] amendment of Requirements, Appendices or JAA Manual of Civil Aviation Medicine.

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