Revision 0

The Training and assessment of Human Factors and Crew Resource Management

3 December 2013

General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rule.

Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate AC.

Purpose

This AC describes an acceptable means of compliance relating to the requirements for crew member human factors and crew resource management training in New Zealand. In addition, guidance material is also provided and/or referred to.

Related Rules

This AC relates specifically to Civil Aviation Rule Part 121 Subparts H, I and J.

Change Notice

This is the original issue of AC121-4.

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1. Introduction

The principal mission of the Civil Aviation Authority of New Zealand (CAA) is to promote civil aviation safety and security. Given the extent to which human factors plays a part in accidents and incidents, it is appropriate that importance is placed on the improvement of appropriate human factors skills within the New Zealand civil aviation system. This goal is in keeping with the International Civil Aviation Organization (ICAO) which has also recognised the importance of improving aviation human factors in accident prevention, and has mandated within the standards and recommended practices of the Convention on International Civil Aviation under Annex I Personnel Licensing and Annex 6 Operation of Aircraft that training of the human performance aspects during aircraft operations be undertaken. The ICAO guidance material to design a training programme and to develop knowledge and skills in human performance can be found in the Human Factors Training Manual (ICAO Doc 9683).

Objective of Human Factors/Crew Resource Management Training:

The principal objective of the human factors/crew resource management (HF/CRM) training discussed in this document is to enhance the HF/CRM skills of flight and cabin crew in the New Zealand aviation industry in order to reduce the risk of accidents and to optimise safety performance. This training is intended to reduce the occurrence of breakdowns in CRM, to enhance teamwork and other CRM processes, to improve their HF/CRM knowledge, skills and behaviour, and to outline the need for a full integration of this non-technical training with existing technical training.

While the terms human factors, crew resource management, and non-technical skills are often used interchangeably, they are slightly different. Human factors are generally regarded as the umbrella term for the whole paradigm and include crew resource management, non-technical skills, and other similar applications across the industry. Human factors is generally acknowledged as including other facets such as ergonomics and aircraft design, human physiology, and health related issues; and while they are of interest, are outside the focus and intent of this advisory circular. CAA acknowledges the importance of these subjects but the principal focus of this advisory circular is on those largely cognitive and interpersonal skills. The importance of the broader human factors spectrum is acknowledged and it is encapsulated in other aspects of flight training such as the commercial pilot licence syllabus.

Some national aviation authorities have chosen to use the term non-technical skills to describe this type of training, but they acknowledge that the terms CRM and non-technical skills are loosely interchangeable. The CAA has elected to describe the non-technical side of aviation training as HF/CRM to underscore that these skills are inherent to, and not separate from, overall crew member performance.

Increased scope for HF/CRM Training under Part 121:

A holder of an air operator certificate will note that there is a substantial increase in the scope of HF/CRM training now required under Part 121. This is deliberate. While previous focus on HF/CRM training amongst some certificate holders was through an initial and or recurrent classroom based approach, this has generally targeted awareness or knowledge based level of training, and has not necessarily flowed through to specific skill and attitude training, which are evidenced in behavioural changes and crew performance on the line.

While this advisory circular outlines an acceptable method of compliance for the HF/CRM elements in Part 121 Subparts, H, I and J, the primary intention of this advisory circular is to move operators away from a simple classroom based HF/CRM programme, to a fully integrated training

programme where both the technical and non-technical parts of the job receive equal attention. To achieve this integration, operators will need to employ HF/CRM training in all their training and assessment processes. For some operators this may mean substantial work is required to up-skill their instructional and standards personnel. This is acknowledged as a large, but important task, and the transition to a state where HF/CRM training is an integral part of all airline training processes will take some substantial work and time.

For this reason, a two year transition period has been allowed, commencing from the date the rule was promulgated – 6 September 2012.

Who can conduct HF/CRM Training:

A holder of an air operator certificate may not wish or be able to conduct the required HF/CRM training using the operator's own personnel resources. In accordance with the rules the certificate holder can contract an approved aviation training organisation to conduct this training. They may utilise a suitably qualified person from the contracted organisation to run their courses for them, but they (the operator) will be responsible for the standard of the course and its syllabus as well as the standard of the training given. Any contracted personnel must be thoroughly briefed prior to the commencement of any training in order to promote an understanding of the unique aspects of the operational environment and organisational culture of the operator.

In order to assist a holder of an air operator certificate, this advisory circular is presented in 16 sections and includes examples of training programs, assessment methodologies, instructor/assessor training, implementation and documentation requirements.

2. Applicability

This advisory circular applies to New Zealand Part 119 air operators exercising privileges under Part 121, and is intended for all crew members tasked with flight operations.

3. Definitions

Behavioural marker means a short, precise statement describing a single non-technical skill or competency.

Behavioural marker system means an organised set of competency descriptors, collectively representing the domain of non-technical skills required for successful performance in a specified role.

Crew resource management means the effective use of all the resources available to crew members, including each other, to achieve a safe and efficient flight.

Crew resource management training means an applied form of human factors training using team management concepts and adult learning approach to provide crew members with the understanding and skills required to manage themselves and all available resources safely and effectively.

Flight crew means an appropriately qualified person assigned by the operator for duty in an aircraft.

Flight operational quality assurance (FOQA) means a non-punitive program to improve flight safety by providing more information about, and greater insight into, the total flight operations environment through routine recording and analysis of digital flight data generated during flight operations.

Human factors means the multi-disciplinary science focusing on systematic and comprehensive assessment and improvement of human performance. Human factors involve the study of the human's capabilities, limitations, and behaviours, and the integration of that knowledge into the design of systems to reduce error, enhance safety and improve efficiency.

Line operations means a typical air transport revenue flight involving crew members in a number of flight phases normally commencing from flight planning; through to post flight duties.

Line orientated flight training (LOFT) means scenarios of typical daily operations are presented to flight crew with reasonable and realistic difficulties and emergencies introduced to provide training and evaluation of proper flight deck management techniques. The training is carried out in a flight simulator as part of initial or recurrent flight crew training and includes special emphasis on abnormal situations which involve communications, management and leadership. The abnormalities which will be encountered are not pre-briefed.

Line operations safety audit (LOSA) means a proactive safety data collection programme. LOSA's primary objective is to highlight safety strengths and weaknesses in normal flight operations, during regular scheduled flights.

Line training means the training of crew members conducted during actual line operations under the supervision of a flight instructor in the case of a pilot or flight attendant assessor in the case of a flight attendant.

Non-technical skills means the cognitive, social and personal resource skills that compliment technical skills, and contribute to safe and efficient task performance. They include teamwork, communication, decision making, leadership, managing stress, coping with fatigue and situational awareness (attention to the work environment).

4. Core elements of human factors and crew resource management in aviation

The accepted core elements of HF/CRM training are listed in Appendix 1. Some expansion on the content for each core element is provided in this advisory circular but should not be limited to this, or delivered in isolation.

5. General

Ref: CAR 121.555 – Syllabus for Crew Member Training Programme

A holder of an air operator certificate must ensure that each segment of the training programme for crew members has a syllabus which includes training on HF/CRM. This advisory circular provides a framework for a fully integrated training programme. Operators will need to review their current HF/CRM training programmes and adopt instructional methodologies which promote this integrated approach.

While some initial emphasis in HF/CRM training should be upon knowledge and comprehension of basic human factors, instructors/facilitators must also bear in mind the need to develop appropriate operational behaviour and skills. In other words, to make this academic knowledge useful, flight crew and cabin crew must develop those skills and behaviours necessary to maximise their operational performance. Obviously training activities directed towards the development of suitable behaviours and skills should always be given the highest possible priority.

Historically the core elements of any HF/CRM programme are often taught as stand-alone topics in a classroom environment. In order to achieve integrated training in HF/CRM, operators are encouraged to deliver the training in a realistic and interactive style, incorporating subject matter particular to the operator's flight operations. It must be acknowledged that given the wide and diverse aviation population there will be different learning styles. The classroom environment is static and often this environment only suits the most motivated and interested participants.

Focus on objectives:

Training methods should be focused on objectives rather than be activity driven. The objectives would be to ensure that participants develop the right knowledge, skills and behaviour. Often training programmes have been constructed and assessed largely on their content, but the more recent tendency is to assess programmes on the basis of the stated trainee outcomes and the operator's procedures to assess these outcomes. This focuses the effort and investment in training on objectives which are defined in terms of measurable outcomes. It does not render content obsolete, but recognises that content is only the means, not the end in itself, of training and education. In behavioural training, where behavioural skills development and attitude changes are being encouraged, the interactive process of the actual training is of paramount importance. Knowledge, ability and motivation are all necessary to effect enduring changes in behaviour.

HF/CRM training is long term involving wide range of training resources:

HF/CRM training is a long term development process that encompasses a wide range of training resources and media, which run from the traditional and passive to the highly interactive and experiential, including: self-study; classroom awareness training; modelling, scenario based training, classroom skills training; continual skills practice both classroom and simulator; and practice or coaching during flying operations.

The onus for operators and regulators rests upon specifying HF/CRM training objectives that map onto the competency domains and standards which they require of their crew members. Training content and methods, and trainers themselves, need to accommodate the needs of the trainees in whatever ways, shapes and forms necessary to attain these ends, within the constraints imposed by commercial and other practical considerations.

In summary, training objectives need to encompass the knowledge, skills and behaviours required for optimal individual and team performance. Training must be centred on student learning and be outcome focussed. Assessment of performance must be based on observed behaviours examining the contribution of both technical and HF/CRM elements.

6. Methodology for assessing crew member performance on human factors and crew resource management

The methodology for assessing HF/CRM involves the application of a set of specific principles as part of crew training. It is important to follow the principles in order to enhance objectivity, to achieve coordinated application and to promote consistency.

"Assessment" is preferred instead of "appraisal" or "evaluation," even though the words share a similar meaning — to measure performance against a set of standards.

The principles are set out as follows:

6.1   Principles

Principle 1. *Coupling of 'technical' and 'HF/CRM skills'*

Technical and HF/CRM skills are strongly related, and greatly influence each other. The technical and HF/CRM sides of flight operations are like two sides of a coin, and it would be artificial to consider and assess them separately. Therefore, the first rule of this principle is that technical and HF/CRM skills must be considered together.

Another basic rule under this principle is that HF/CRM skills must be assessed in a flight-operational context that permits the integration of the HF/CRM and technical skills assessment in a realistic setting. Therefore, by definition, the "total assessment" of a crew member's performance combines technical and HF/CRM skills in the flight-operational context.

Principle 2. *Measurement through the technical outcome and its consequences*

Using the outcome of technical exercises as the starting point for assessing HF/CRM skills has been shown to be an effective approach for trainers, instructors and examiners. Under this approach, the assessment of HF/CRM skills initially involves the measurement of the technical outcome of an exercise and its related consequences. Since poorly exercised HF/CRM skills can lead to errors in technical areas, examining the origins of flaws and failures in technical outcomes often highlights deficiencies in HF/CRM skills.

Principle 3. *Observable facts and behaviour as basis*

HF/CRM skills assessments should be based on observable facts and behaviours. Assessment of character traits should not be made since such ratings are subjective and can easily differ greatly among examiners. Assessment of character traits is also largely unproductive since it is difficult for a person to change such traits but fairly easy to change his or her behaviour.

Principle 4. *Define language clearly*

HF/CRM skills are often described by specific words and terms that create a HF/CRM skills jargon. The collection of the words and terms used, together with the description of behaviour components and behaviour categories, can be regarded as a "HF/CRM language." In order to understand what is being said, one has to understand the meaning of the words or terms used. Hence, the HF/CRM skills jargon must be well-defined and familiar to its users.

There have been many special sets of jargon or "languages" developed over the years within specific companies. There are two main advantages for a company to develop its own vocabulary:

- the company can employ terms it prefers to use and that are easily understood by its personnel

- the process of defining the vernacular within the company will involve key personnel and give them "ownership" of the special language. Prescribed word usage is more likely to be implemented when those who must use it have a role in its development.

The fact that the language is explicitly and clearly defined is more important than the specific terms and exact wording included in it. Nevertheless, there are minimum requirements for any HF/CRM skills language, including:

- the language should cover the definitions of all relevant behaviours associated with the cognitive side of human performance

- the language should be clear and unambiguous. No matter who uses the language within the organisation, the interpretations and conclusions should be the same

- behaviour components or elements should be defined and grouped into categories

- components or elements are best described in a neutral manner without either positive or negative performance connotations (Note: performance measurement is best achieved through a behavioural marker system which incorporates word pictures to identify levels of performance)

- the language should be readily available and fully familiar to all parties involved in the training

Principle 5. *Repetitive behaviour observation*

Assessment of crew member performance of each task must be based on observed behaviours, examining the contribution of both technical and HF/CRM elements. Frequently, observations of multiple tasks will indicate common behavioural strengths or weaknesses. By identifying common themes it will provide a basis for future training focus.

Principle 6. *Access to training of HF/CRM skills*

Crew members should be trained in HF/CRM during all phases of training. When an assessment reveals a weakness in HF/CRM skills, remedial training should be considered to allow the crew member to increase their skill competency to the required standard.

6.2   HF/CRM as part of overall performance

Technical and HF/CRM skills are strongly related, and greatly influence each other and it is artificial to consider or assess them separately.   Appendix 3 is one example of this combined approach to training and assessment. It is focused on the task (e.g. a missed approach) and recognises that for a safe and successful outcome the combined skills are necessary. From the instructor/examiner perspective, training and assessment requires the same focus and acceptance.

6.3   Grading standards

- assessment employs a grading scale that provides for measurement of good and bad performance

- the grading scale is applied to each task performed during the training exercise or competency assessment

- the measurement of performance is used to determine whether the candidate has met progress targets or competency requirements

- the information is also used by the operator to evaluate the quality of the training programme and to determine additional crew member training requirements

- the grading scale can be as simple as pass/fail, but more developed systems will allow refined assessment of performance, which in turn will provide greater information for the operator

- each task is made up of a number of technical and HF/CRM elements. The grading for the task is based on the lowest performance in any of these areas

- the grading scale should identify the threshold for minimum performance

- each level of performance on the grading scale should be identified with a detailed description (word picture) to allow the assessor to accurately categorise the level of performance and to promote rater reliability

- operators should define a methodology for determining overall assessment based on the performance of individual tasks

6.4 Behavioural marker system

Technical markers

As part of overall crew member performance there is a requirement to assess technical performance and HF/CRM skills. Technical markers include such things as manipulative skills, knowledge of systems and procedures, automation system usage and execution of procedures. These have been the focus of traditional assessment.

HF/CRM markers

These are observable HF/CRM behaviours that contribute to evidence of competent, or not yet competent, performance within a work environment. It includes observable behaviours of teams or individuals and is usually structured into a set of categories. The categories contain sub-components that are labelled differently in various behavioural marker systems.

Appendix 1 contains nine core elements. It must be recognised that it would be unmanageable to assess against all of these in a simulator or line environment – therefore a selection of reduced behavioural markers which can be easily assessed by the instructor/examiner should be utilised.

An acceptable list could include the following key elements; communication, decision making, workload management and situational awareness.

6.5 Assessment form

The assessment form is required in order to document performance covering both technical and HF/CRM aspects. This form should identify the tasks for the associated training exercise or competency assessment. Performance will be graded for each of these tasks using the grading scale, and appropriate markers are rated. The form should also include a comment section to provide further details to support any substandard or exceptional grading. Ideally the form will be in a format which will allow the operator to capture and trend the information.

6.6 Rater reliability

Rater reliability refers to the degree of agreement between people who are assessing student performance according to specific criteria. To determine rater reliability, the agreement between two or more raters must be consistent and dependable. Operators must incorporate a system that promotes this reliability in order to ensure that assessments are accurate and fair.

Any behavioural rating system must be underpinned by adequately trained assessors. The training of raters is quite a complex undertaking. Instruction should develop thorough understanding of the science of rating scales, the characteristics of the actual rating system used, sources of rater bias, the concept of inter-rater reliability, debriefing skills, and procedures to calibrate and optimise the accuracy of observations and ratings.

The first rater reliability session can be part of the initial training mentioned above. Rater reliability sessions typically consist of assessment exercises using paper cases or watching video scenarios. Instructors observe and assess these scenarios and discuss their ratings. The rater reliability process involves reaching a consensus about the assessment following each scenario. The aim is for all instructors to arrive at the same assessments for the scenarios presented. Being

trained to a uniform criterion greatly helps instructors in their future observations and assessments and better guarantees consistent assessments and feedback across instructors. A quality training programme will include annual refresher training in rater reliability for instructors and examiners/assessors.

7. Crew member training programme: Introduction segment

Ref: CAR 121.557

A holder of an air operator certificate must ensure that a pilot or flight attendant who is not qualified and currently serving as a crew member in an air operation completes the introductory segment of the training programme. The introductory segment can be based on the following:

Ground training:

a) Objectives:

- to enhance crew member and operator management awareness of human factors which could cause or exacerbate incidents which affect the safe conduct of air operations

- crew member demonstrates detailed knowledge of the theoretical and practical aspects of HF/CRM

- crew member recognises HF/CRM as an integral component of performance which if employed correctly can prevent the onset of incidents or accidents

- crew member can describe the benefits of co-ordinated team behaviour over individual endeavour

- crew member is able to identify and develop strategies to manage threats

- crew member is able to develop strategies to prevent and manage crew error

b) Competency requirements:

- instructor uses formative assessment techniques to confirm crew member understanding of the course material

- crew member demonstrates correct behaviours and skills during simulator and line assessment. This should utilise a behavioural marker system

c) Elements of training programme:

- All HF/CRM core elements and sub elements covered in depth. Refer to Appendix 1

d) Acceptable training methodologies:

- classroom – including PowerPoint and video presentation

- instructor facilitation

- student participation exercise

- emergency procedures training (EPT)

- computer based training

- (CBT), hand-outs, and self-study (Note: May be used only as a pre-requisite to classroom instruction/facilitation)

An introductory HF/CRM course generally is conducted in a classroom for 2 or 3 days. An example of the material used in the course is a guide to non-technical skills[1].

Simulator training and assessment (where applicable)

   a)   Objectives:

   - the holder of an air operator certificate provides a training environment which recognises the importance of HF/CRM is conducive to learning and promotes a positive safety culture

   - crew member incorporates HF/CRM knowledge, skills and behaviours and fully integrates these techniques to effectively conduct and manage the operation

   - crew member utilises all available resources to achieve optimal performance

   - crew member applies appropriate strategies to manage threats

   - crew member implements strategies to prevent and manage crew error

   b)   Crew member competency requirements:

   - pass competency assessment, which includes assessment of both technical and HF/CRM components for each task. This should utilise a behavioural marker system.

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[1] 'Safety at the Sharp End' – *Flin, O'Connor, Crichton.*

c) Elements of training programme:

HF and CRM are taught as an integral part of the operator's training programme. Refer to Appendix 3 example. Skills that must be trained include:

- threat and error management[2]
- situational awareness strategies
- workload management
- decision making
- leadership
- positive team behaviours
- communication
- automation management
- effective monitoring

d) Acceptable training methodologies:

- instruction in flight training device, flight simulator, cabin trainer
- LOFT briefing prior to exercise
- practice and feedback
- debriefing after exercise
- assessment and constructive analysis
- Self-analysis
- CBT, hand-outs, and self-study (**Note**: *May be used only as a pre-requisite to simulator instruction*)

Line training and assessment

a) Objectives:

- the operator provides a training environment which recognises the importance of HF/CRM, is conducive to learning and promotes a positive safety culture
- crew member incorporates HF/CRM knowledge, skills and behaviours and fully integrates these techniques to safely conduct and manage the operation
- crew member utilises all available resources to achieve optimal performance
- crew member applies appropriate strategies to manage threats
- crew member implements strategies to prevent and manage crew error

b) Crew member competency requirements:

- pass route check assessment which includes assessment of both technical and HF/CRM components for each task. This should utilise a behavioural marker system.

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[2] Guidance on threat and error management (TEM) training can be found in the ICAO Human Factors Training Manual (Doc 9683).

c) <u>Elements of training programme</u>:

HF and CRM are taught as an integral part of the operator's training programme. Skills that must be trained include:

- threat and error management

- situational awareness strategies

- workload management

- decision making

- leadership

- positive team behaviours

- communication

- automation management

- effective monitoring

d) <u>Acceptable training methodologies</u>:

- instruction during line training or line operations

- briefing prior to flight

- practice and feedback

- debriefing after flight

- assessment and constructive analysis

- self-analysis

- training workbooks, hand-outs, and self-study (**Note**: *May be used to support line training, but not in lieu of flight training requirements*)

8. Crew member training programme: Transition segment

Ref: CAR 121.559

A holder of an air operator certificate must ensure that a pilot or flight attendant who is qualified and currently acting as a crew member on an air operation completes the transition segment of the training programme. The transition segment can be based on the following:

Ground Training

a) <u>Objectives</u>:

- crew member demonstrates detailed knowledge of HF/CRM principles and strategies applicable to new aircraft type/variant when transition involves change to aircraft with markedly different size, flight characteristics, procedures, philosophy or operating environment.

b) <u>Competency requirements</u>:

- instructor uses formative assessment techniques to confirm crew member understanding of the course material

- crew member demonstrates correct behaviours and skills during simulator and line assessment. This should utilise a behavioural marker system

c) Elements of training programme:

- elements and sub elements appropriate to transitional differences (refer to objective)

d) Acceptable training methodologies:

- classroom – including power point and video presentation

- instructor facilitation

- student participation exercise

- EPT (type specific)

- use of case studies

- CBT, hand-outs, and self-study (**Note**: *May be used only as a pre-requisite to simulator to classroom instruction/facilitation*)

Simulator training and assessment (where applicable)

a) Objectives:

- the operator provides a training environment which recognises the importance of HF/CRM, is conducive to learning and promotes a positive safety culture

- crew member incorporates HF/CRM knowledge, skills and behaviours and fully integrates these techniques to effectively conduct and manage the operation of the new type/variant

b) Crew member competency requirements:

- pass competency assessment, which includes assessment of both technical and HF/CRM components for each task. This should utilise a behavioural marker system.

c) Elements of training programme:

HF and CRM are taught as an integral part of the operator's training programme. Refer Appendix 3 example. Skills that must be trained include:

- threat & error management

- situational awareness strategies

- workload management

- decision making

- leadership

- positive team behaviours

- communication

- automation management

- Effective monitoring

d) Acceptable training methodologies:

- instruction in flight training device, flight simulator, cabin trainer

- LOFT

- briefing prior to exercise

- practice and feedback

- debriefing after exercise

- assessment and constructive analysis

- self-analysis

- CBT, handouts, and self-study (**Note**: *May be used only as a pre-requisite to similar instruction*)

Line training and assessment

a)   Objectives:

- the operator provides a training environment which recognises the importance of HF/CRM, is conducive to learning and promotes a positive safety culture

- crew member incorporates HF/CRM knowledge, skills and behaviours and fully integrates these techniques to safely conduct and manage the operation of the new type/variant

b)   Crew member competency requirements:

- pass route check/line assessment which includes assessment of both technical and HF/CRM components for each task. This should utilise a behavioural marker system.

c)   Elements of training programme:

HF and CRM are taught as an integral part of the operator's training programme. Skills that must be trained include:

- threat & error management

- situational awareness strategies

- workload management

- decision making

- leadership

- positive team behaviours

- communication

- automation management

- effective monitoring

d)   Acceptable training methodologies:

- instruction during line training or line operations

- briefing prior to flight

- practice and feedback

- debriefing after flight

- assessment and constructive analysis

- self-analysis

- training workbooks, hand-outs, and self-study(**Note**: *May be used to support line training but not in lieu of line training requirements*)

9. Crew member training programme: Upgrade segment

Ref: CAR 121.561

A holder of an air operator certificate must ensure that a pilot or flight attendant who is qualified and currently acting as a crew member on an air operation completes the upgrade segment of the training programme. The upgrade segment can be based on the following:

Ground training

a) Objectives:

- crew member demonstrates comprehensive knowledge of HF/CRM principles and strategies applicable to the different crew position and new responsibilities

- crew member can describe the importance of skilled leadership and decision making considerate of risk in achieving a safe operation

b) Competency requirements:

- instructor uses formative assessment techniques to confirm crew member understanding of the course material

- crew member demonstrates correct behaviours and skills during simulator and line assessment. This should utilise a behavioural marker system

c) Elements of training programme:

Elements and sub elements appropriate to upgrade. Skills that must be trained include:

- decision making

- leadership

- positive team behaviours

- communication

- workload management

d) Acceptable training methodologies:

- classroom

- instructor facilitation

- student participation exercise

- use of case studies

- CBT, hand-outs, and self-study (**Note**: *May be used only as a pre-requisite to similar instruction*)

Simulator training and assessment (where applicable)

a) Objectives:

- the operator provides a training environment which recognises the importance of HF/CRM, is conducive to learning and promotes a positive safety culture

- crew member incorporates HF/CRM knowledge, skills and behaviours and fully integrates these techniques to effectively conduct and manage the operation

- crew member demonstrates good leadership and decision making skills

- crew member utilises all available resources to achieve optimal performance

b) Crew member competency requirements:

- pass competency assessment, which includes assessment of both technical and HF/CRM components for each task. This should utilise a behavioural marker system. Refer Appendix 2. The focus should be on crew member's performance in areas applicable to new responsibilities (e.g. leadership, decision making etc.)

c) Elements of training programme:

HF and CRM are taught as an integral part of the operator's training programme. Training scenarios should provide for the exercise of leadership and decision making skills. Refer Appendix 3 example. Skills that must be trained include:

- threat & error management

- situational awareness strategies

- workload management

- decision making

- leadership

- positive team behaviours

- communication

- automation management

- effective monitoring

d) Acceptable training methodologies:

- instruction in flight training device, flight simulator, cabin trainer

- LOFT

- briefing prior to exercise

- practice and feedback

- debriefing after exercise

- assessment and constructive analysis

- self-analysis

- CBT, hand-outs, and self-study (**Note**: *May be used only as a pre-requisite to similar instruction*)

Line training and assessment

a) Objectives:

- the operator provides a training environment which recognises the importance of HF/CRM, is conducive to learning and promotes a positive safety culture.

- crew member incorporates HF/CRM knowledge, skills and behaviours and fully integrates these techniques to safely conduct and manage the operation in the new role

b) Crew member competency requirements:

- pass route check/line assessment which includes assessment of both technical and HF/CRM components for each task. This should utilise a behavioural marker system

c) Elements of training programme:

HF and CRM are taught as an integral part of the operator's training programme. Focus should be on crew member's performance in areas applicable to new responsibilities. Skills that must be trained include:

- threat & error management
- situational awareness strategies
- workload management
- decision making
- leadership
- positive team behaviours
- communication
- automation management
- effective monitoring

d) Acceptable training methodologies:

- instruction during line training or line operations
- briefing prior to flight
- practice and feedback
- debriefing after flight
- assessment and constructive analysis
- self-analysis
- training workbooks, hand-outs, and self-study (**Note**: *May be used to support line training, but not in lieu of line training requirements*)

10.   Crew member training programme: Recurrent segment

Ref: CAR 121.563

A holder of an air operator certificate must ensure that a pilot or flight attendant of an aeroplane completes the recurrent segment of the training programme in order for the crew member to be current and proficient on the aeroplane type, crew member position, and type of operation in which the crew member serves. The recurrent segment can be based on the following:

Ground training

a) Objectives:

- through training the core elements of HF/CRM over a 36 month[3] period/cycle the crew members demonstrate a detailed knowledge of HF/CRM principles and strategies applicable to the aircraft that they operate

- the operator delivers a training and assessment programme incorporating HF/CRM to effectively address any changes to operating environment or company procedures

b) <u>Competency requirements</u>:

- instructor uses formative assessment techniques to confirm crew member understanding of the course material

- crew member demonstrates correct behaviours and skills during next simulator and line assessment which includes assessment of both technical and HF/CRM components for each task.   This should utilise a behavioural marker system. The focus should be on crew member's performance in areas applicable to the crew member's responsibilities (e.g. leadership, etc.). Refer Appendix 2

c) <u>Elements of training programme</u>:

- annual ground training programme includes training modules on HF/CRM. All core elements and applicable[4] sub elements must be trained over a 36 month[1] period/cycle. The ground training programme should include an interactive training session involving flight crew and cabin crew members

d) <u>Acceptable training methodologies</u>:

- classroom

- instructor facilitation

- student participation exercise

- EPT (type specific)

- use of case studies

- CBT, hand-outs, and self-study (**Note**: *May be used only as a pre-requisite to classroom instruction/facilitation*)

Simulator training and assessment (where applicable)

a) <u>Objectives</u>:

- the operator provides a training environment which recognises the importance of HF/CRM, is conducive to learning and promotes a positive safety culture

- crew member incorporates HF/CRM knowledge, skills and behaviours and fully integrates these techniques to effectively conduct and manage the operation

- the operator delivers a training and assessment programme incorporating HF/CRM to effectively address any changes to operating environment or company procedures

b) <u>Crew Member competency requirements</u>:

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[3] Operator may apply to the Director to conduct recurrent training over a period/cycle of different duration.

[4] Operator may select sub elements based on their operating environment, risk assessment, or safety data.

- pass competency assessment, which includes assessment of both technical and HF/CRM components for each task. This should utilise a behavioural marker system. The focus should be on crew member's performance in areas applicable to new responsibilities (e.g. leadership, decision making etc.). Refer Appendix 2

c) Elements of training programme:

HF and CRM are taught as an integral part of the operator's training programme. Refer Appendix 3 example.

d) Acceptable training methodologies:

- instruction in flight training device, flight simulator, cabin trainer
- LOFT
- briefing prior to exercise
- practice and feedback
- debriefing after exercise
- assessment and constructive analysis
- self-analysis
- CBT, hand-outs, and self-study (**Note**: *May be used only as a pre-requisite to simulator instruction*)

Line assessment

a) Objectives:

- crew member incorporates HF/CRM knowledge, skills and behaviours and fully integrates these techniques to safely conduct and manage the operation

b) Crew member competency requirements:

- pass route check/line assessment which includes assessment of both technical and HF/CRM components for each task. This should utilise a behavioural marker system. The focus should be on crew members performance in areas applicable to new responsibilities (e.g. leadership, decision making etc.) Refer to Appendix 2

c) Elements of assessment:

- HF and CRM must be assessed as an integral part of all aspects of the operation

d) Acceptable Methodologies:

- assessment during line operations[5]
- observations and questioning[6]
- briefing prior to flight

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[5] The crew member is already qualified so the focus is on assessment; however, a debrief should be considered an opportunity for training and the student should use this information as a basis for further self-study.

[6] Safety of the operation is first priority. Questioning should be confined to non-0dynamic and low workload situations.

- practice and feedback

- debriefing after flight

- constructive analysis

- self-analysis

11   Instructor and examiner/assessor training

Ref: CAR 121.517, 121.519, 121.521, 121.523, 121.525, 121.527, 121.529

A holder of an air operator certificate must not designate a person to perform the functions of a line supervisory pilot, pilot instructor, flight examiner, simulator instructor and examiner, flight attendant trainer, flight attendant assessor, and ground instructor unless the person meets the prescribed requirements.

These personnel are collectively referred to as instructors/examiners.

A holder of an air operator certificate must ensure that instructors/examiners have completed a training course in the methods in assessing crew member competency in the technical and HF/CRM aspects of aircraft operation.

The success of any HF/CRM training program ultimately depends on the skills of the people who administer the training and measure its effects. Instructors/examiners must be skilled in all areas related to the delivery and assessment of HF/CRM. These skills comprise an additional level to those associated with traditional flight instruction and assessment. Gaining proficiency and confidence in HF/CRM instruction, observation, and measurement requires special training for instructors/examiners in many HF/CRM training processes.

Pre-requisites

- have completed a basic instructional technique course acceptable to the director

- have demonstrated that they have the necessary instructional skills

- have experience in the working environment where the subject is to be applied

- have comprehensive knowledge in the subject matter area in which instruction is being provided

- have a comprehensive knowledge of company standard operating procedures

- be motivated to apply HF/CRM knowledge in a practical manner

- have completed initial HF/CRM training.

Training content - general

- the core and sub-elements of the HF/CRM training programme covered in depth

- HF/CRM as part of overall performance

- an in-depth understanding of HF/CRM skills for effective command

- benefits of LOFT

- guidelines for accident analysis

- SHEL and reason models

- importance of HF/CRM in preventing accidents

Training content - Instruction

- briefing the application of HF/CRM to planned task/detail
- delivery of training which promotes the integration of technical and HF/CRM skills
- utilisation of appropriate training resources
- diagnosing and correction of poor performance
- promoting HF/CRM through attitude and example
- debriefing, including constructive facilitation
- formative assessment (classroom)
- operators procedures for recording of crew member performance

Training content - assessment

- grading and a behavioural marker system
- essential and supportive skills
- formative assessment (classroom)
- competency based training and assessment
- operators procedures for recording of crew member performance
- rater reliability including sources of rater bias
- assessment of pilot/flight attendant performance - diagnostic
- crew based versus individual performance assessment
- failure assessment

Training content – operational environment

- use of safety data (occurrences, FOQA, LOSA)
- global incident and accident causal factors
- manufacturer recommendations
- operational threats
- organisational risk factors

The training can be accomplished through interactive classroom based training or a synthetic training device.

Representative training timeframe for HF/CRM instructors/examiners

Training elements	Ground instructor	Line supervisory pilot pilot instructor simulator instructor	Flight examiner	Flight attendant trainer Flight attendant assessor
General	2	2	2	1
Instructional	0.5	1	0.5	0.5
Assessment	not required	0.5	1*	0.25
Operational environment	0.5	0.5	0.5	0.25
Total days	**3**	**4**	**4**	**2**

* Includes rater reliability training

Note: *A holder of an air operator certificate applying to the Director for acceptance of a training programme for instructors/examiners which includes training timeframes less than those indicated above will need to justify this application with a comprehensive implementation plan. See section 13 (Implementation of HF/CRM training) and section 15 (Training programme certification) of this advisory circular.*

Recurrent training requirements for instructors/examiners

Each holder of an air operator certificate exercising privileges under Part 121 must ensure continued competency of their instructors/examiners in the knowledge and delivery of the HF/CRM training component. This must be conducted at least bi-annually. Where this is conducted as part of an internal competency assessment it must be conducted by an evaluator with suitable HF/CRM knowledge and training experience that is acceptable to the operators HF/CRM training manager (holding such a position in the exposition). This assessment should be conducted in their normal training delivery environment (e.g. classroom, simulator, etc.). The requirement for assessment of continued competency applies to any contracted, approved aviation training organisation that the holder of an air operator certificate utilises for training delivery. For examiners only, this could be accomplished in conjunction with the CAA bi-annual flight examiner renewal.

12. Management of HF/CRM training

Traditionally, the holder of an air operator's certificate senior person training and competency assessment has managed HF/CRM training within each organisation. In some cases, these managers have had little exposure to formal HF/CRM training. International guidance and studies have shown that HF/CRM training will not be fully effective unless reinforced by senior managers who understand and promote the benefits. Therefore, it is recommended that the senior person responsible for crew training and competency assessment gain a comprehensive understanding and skills in this area. Alternatively, this senior person can appoint a person within the company who reports to them and is responsible for all aspects of crew member HF/CRM training. This person's responsibilities would include the development of training syllabi which incorporates HF/CRM, and the selection and training of instructors and examiners who can effectively deliver this training.

In either case, a holder of an air operator certificate should be able to demonstrate to the Director that the manager responsible for HF/CRM training has the appropriate experience, qualifications, training, and attitude (demonstrated track record) to be able to carry out this function effectively. Relevant prior experience could be relevant tertiary experience, or equivalent practical experience such as a HF/CRM instructor/facilitator in a Part 121 operation[7].

13.   Implementation of HF/CRM training

It is acknowledged that many certificate holders already have existing training programmes that meet many of the elements identified in this advisory circular, particularly in relation to training for pilots. For certificate holders with well-developed HF/CRM training programmes, implementing the requirements of the new rules (with acceptable compliance with this advisory circular) may involve the expansion of existing programmes to include flight attendants and additional HF/CRM topics within their training programme. For certificate holders with less developed training programmes, this advisory circular provides a framework and practical guidance to support implementation.

Options for smaller operators:

The CAA recognises this advisory circular will apply to operators with widely different capabilities for delivering this training. Some options available to smaller operators include the following:

- negotiating the use of a larger operator's training programmes

- conducting modular training over an extended period to minimise employee downtime and disruption to operations (taking into consideration issues of knowledge erosion over time)

- using a Part 141 certificated organisation to deliver training to instructor/examiners; and/or

- using a Part 141 certificated organisation to deliver crew member training if internal resource in training delivery is limited

Operators should consider the relative merits of each strategy above and decide on the most appropriate training delivery method(s) to meet their particular needs.

Developing a HF/CRM training programme:

The following broad steps are essential in developing a HF/CRM training programme:

- obtain commitment from senior management to support the implementation of this training to enhance safety

- identify the training needs for your organisation by conducting a gap analysis. The gap analysis will compare the current status of the organisation's training programme with requirements contained in the rules and this advisory circular

- develop the training content to reflect the nature and needs of the organisation

- communicate the objectives and scope of the programme to all internal stakeholders

- select and train instructors/examiners. The skills, credibility and attitude of instructors is paramount to effective training

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[7] UKCAA CAP 737 provides additional guidance on managing operator HF/CRM programmes.

- implement HF/CRM training, as an integrated part of crew-member training, using approved training techniques in the classroom, simulator, and aircraft

- assess individual crew member HF/CRM skills

- institute a quality process which evaluates the effectiveness of HF/CRM training and promotes continual improvement

- continually reinforce the importance of HF/CRM in every stage of training and during line operations to promote retention/consolidation of knowledge and skills, and to ensure appropriate HF/CRM behaviours are demonstrated. This should become a part of the organisation's culture.

Gathering of operational and safety data:

Systematic HF/CRM training development requires the gathering of operational and safety data to identify significant threats and errors that uniquely occur in the operator's own flight operations system. This information can be derived from audits, occurrence reports, employee surveys, FOQA and LOSA information, crew assessment results, and feedback from instructional and examining personnel. Diagnosis is best achieved through joint operational personnel and management participation, and engaging them in free and open discussions. It is also worthwhile to examine global safety trends, investigation reports, and accident causal factors to identify those which may pose a threat to the operation. The training programme, and in particular the recurrent training segment, should make use of this information to ensure the training is current, risk-based, and relevant to the operation.

14.   Documentation requirements

Training and assessment documents incorporated in the exposition:

HF/CRM training and assessment documentation, including course syllabi, must be incorporated within the operator's exposition, including details of any training/assessment provided by external providers. The exposition must include details of flight crew and cabin crew training programmes, and instructor/examiner training programmes, including required HF/CRM elements. The operator must be able to demonstrate to the Director that the quality of the training programmes, including course content, delivery and assessment, meets the rule requirements.

Retention of records:

The holder of an air operator certificate is required to keep records of all crew member training and assessment in accordance with rules 121.577, 121.613 and 121.553(j)(2). These records must be retained for a minimum period of 3 years as required by rule 119.67. These records should be sufficiently detailed to allow a third party (i.e. someone other than those present) to review what was covered, be able to understand the level of performance or progress including specific areas of weakness (as applicable). The records should record the contributing factors for each task assessment, including technical and/or HF/CRM markers. This level of detail provides for good feedback to the crew member to encourage on-going self-improvement. It also allows the operator to trend the data, in order to improve both crew member and instructor training.

Minimum details for training records:

Training records should include, as a minimum, the following:

- training venue or device (e.g. classroom, CBT, FFS, aircraft, etc.)

- location and date of training

- names of instructor/examiner and crew member(s)

- crew member rank and seat position (where applicable)

- purpose of training/assessment (e.g. B737-800 flight crew recurrent training)

- training/assessment detail or syllabus reference (e.g. B777-TRANSITION-FFS 02)

- list of items/tasks to be completed as part of training/assessment detail (related to syllabus with sufficient elements to provide for a good analysis of performance)

- assessment grading and markers (technical and HF/CRM) for each item above

- overall assessment

    - training = sufficient progress yes/no; or ready for check yes/no

    - assessment = pass/fail

- length of training course or detail

- breakdown of flight crew member time as PF and PNF/PM (as applicable)

- instructor comments (linked to item/task completion; comment required for sub-standard or exceptional performance)

- signatures of instructor/assessor and crew member

- administrative details as required (e.g.; entered into system, referred to manager, etc.)

15.   Training programme certification

HF/CRM training to be reflected in exposition:

An applicant for an air operator certificate will be required to submit an exposition that accommodates the proposed introduction of HF/CRM into Part 121 Subparts H, I and J. Similarly, in the case for continued compliance, an air operator certificate holder will be required to submit an amended exposition that accommodates the proposed introduction of HF/CRM into rule 121 Subparts H, I and J. In either case, this can best be achieved through the use of a completed rule compliance/advisory circular matrix, supplemented with the operators more detailed approach to addressing the requirements. This advisory circular provides the framework for an acceptable means of compliance with the rule but is not intended to be the only means of compliance. Consideration will be given to other methods of compliance that may be presented to the Director. Alternative approaches to this training should be submitted to the Director for review well in advance of the rule effective date to allow sufficient time for assessment and operator revisions (as required).

Rule 119.151(b)(2) requires that the holder of an air operator certificate conform to every procedure and programme detailed in the certificate holder's exposition; and be acceptable to the Director. This includes instructor/examiner and crew member HF/CRM training. These training programmes must be formally documented in the operator's exposition. If an external service provider is used this must also be documented in the exposition, and the operator must ensure that the service provider is listed in the operations specifications consistent with the rule

121.553(h)(2) and (3). Crew member training programmes do not require prior acceptance by the Director; however, given the scale change that these new HF/CRM requirements may represent, operators are encouraged to forward their training programmes to the CAA in advance of implementation. This should contribute to a smoother introduction.

16.   Monitoring

Ref: Rules 119.79(b)(5) and (6), 119.151(b)(2), 121.7

Review and monitoring effectiveness of HF/CRM programmes:

The review and monitoring of the effectiveness of HF/CRM programmes is a key success factor. Operators must monitor their own training programmes consistent with quality assurance and safety management system principles.   As part of its regulatory oversight obligations, the CAA will also monitor the air operator's incorporation of HF/CRM as part of their training programmes and operational procedures. The operator and CAA monitoring aspects are further described below.

Operator

The success or failure of training must be determined by the changes in performance or behaviour which the learning produces. As part of the systems approach to training, the outcomes must be evaluated so that improves can be made – this is a continual process. Operator assessment of their training programmes should include the following:

- surveys to collect feedback from participants in the training

- trending of crew member performance during assessments, including identifying any areas of weak performance that may require further attention

- meetings with instructors and examiners to discuss opportunities to improve the quality   and relevance of training

- monitoring and evaluation of instructors and examiners

- safety data, including FOQA, LOSA, and occurrence reporting to identify areas that might benefit from improved or enhanced HF/CRM training

CAA

The CAA will conduct oversight of operator training programmes consistent with the CAA Surveillance Policy.   This will be achieved through audits of the operators training system, flight examiner renewals, and line observations. The latter will assess how HF/CRM is actually being employed by crew members during operations.

Appendix 1

Core Elements	Sub elements
Threats and errors	o definitions of human error o definition of threat o definition of threat and error management o types of threat and errors o threat identification o threat management strategies o error chain o error prevention and detection o error management strategies
Organizational factors	o definition of safety culture o elements of positive safety culture o reporting system as a function of overall safety management o use of safety data to rectify problems and reduce risks o organizational factors, latent risks o organizational risk tolerance o SOPs development based on human factors o company culture re SOPs adherence
Stress and fatigue	o definition of stress, stress management, and fatigue o identify stress o effects of stress o stress management techniques o fatigue and tiredness - causes and symptoms o circadian rhythms, biological clock, jet lag, etc.
Fatigue risk management systems (FRMS)	o management of fatigue at the individual and organizational levels

Information acquisition and processing	- definition of information acquisition, information processing - stages of information processing - attention and perception - types of memory - limitations and failures of memory - techniques for improving/enhancing memory - skill development
Situational awareness and workload management	- definition of situational awareness and workload management - types of situational awareness - components of situational awareness - activities to achieve situational awareness - loss of situational awareness - recognition and recovery - capacity limitations and cognitive overload - workload management strategies - prioritization - managing distractions
Decision making	- definition of decision making - factors affecting decision making - bias - types of decision making (rational, naturalistic, recognition prime based, etc.) - option generation - decision making skills - problem solving techniques - risk management

Communication	o definition of communication
	o modes of communication
	o factors affecting communication / barriers to effective communication
	o standard phraseology
	o listening
	o communication styles and techniques
	o internal and external communication
	o briefings
Leadership and team behaviour	o definition of leadership and authority
	o attributes and qualities of good leaders
	o assertiveness
	o authority gradient
	o identify factors affecting team performance
	o define CRM
	o methods of optimizing CRM
	o group decision making – advantages and disadvantages
	o cooperation and team building
	o concept of management
	o conflict resolution
	o cultural differences
Automation, vigilance and monitoring	o definition of automation, vigilance and monitoring
	o guidelines on use of automation
	o mode awareness/understanding
	o automation complacency
	o redundancy and automation failure detection
	o intervention
	o need for active monitoring
	o techniques for improving monitoring
	o detection of failure
	o factors affecting vigilance

Appendix 2

Behavioural marker system –

There are 2 issues in the specification of performance standards for HF/CRM. The first is to identify and define the categories of behaviour and the second is to define the levels or standards of performance in each category which distinguish competence from non-competence.

The standards are competency based and therefore can be assessed against specific performance criteria. Much work has been done worldwide on these subjects, and although there is not yet an internationally agreed set of reference points, there is obvious overlap among categories and standards defined in the documents referred to in this Appendix.

The following is a selection of behavioural markers and competency standards currently used by various organisations:

- **NOTECHS** - a behavioural marker assessment system developed as a JAA project. It is widely used in Europe as a common standard for the assessment of non-technical skills and is approved by the UKCAA and the JAA.

- **University of Texas behavioural markers** were designed for use in line operations safety audits, non-jeopardy observations of crews conducting normal line flights. Each of the markers is validated as relating to either threat and error avoidance or management. With the exception of two global ratings, specific markers are rated (if observed) during particular phases of flight.

- **LMQ CRM standards**. LMQ (a company specialising in CRM training) produced CRM standards which are being used by several UK airlines. Their standards were developed not only from research but also from accident and incident analysis, as well as experience from exercises undertaken by crews when practising their CRM skills. The standards are founded on observable actions which trainers and examiners should be able to use during their assessments of line crews.

Behavioural markers –

Behavioural makers should cover both technical and HF/CRM markers. Their purpose is to record the assessment of the crew member's performance for each operational task or scenario, and to understand the essential or enabling skill factors which contributed to the associated performance. This diagnosis of performance will help the instructor/assessor and the student to understand the cause of good or bad performance, with the objective of reinforcing good behaviours or identifying areas for improvement and further training.

It is the intent of the CAA that with the introduction of the rule amendments to Part 121, operators will be required to train and assess HF/CRM skills in all crew members and as such may need a modified behavioural markers system which is more appropriate to cabin crew assessment. As yet there are very few international standards available for cabin crew behavioural marker systems; however a paper presented by Qantas at the 25th EAAP Conference in 2002 has some discussion and an example behavioural marker system for cabin crew. That paper is available at:

http://www.leadingedgesafety.com.au/FolioFiles/175/712-Cabin%20Crew%20Warsaw.pdf

It should be noted that each of the behavioural marker systems mentioned below have been designed principally for the assessment of flight crew only.

- Flin, R., & Martin, L. (2001). Behavioural markers for crew resource management: A review of current practice. International Journal of Aviation Psychology, 11, (1), 95-118.

- Flin, R., O'Connor, P., & Crichton, M. (2008). Safety at the sharp end: A guide to non-technical skills. Farnham, UK: Ashgate.

- Civil Aviation Authority UK (2006). CAP 737: Crew resource management training. Retrieved from: http://www.caa.co.uk/docs/33/CAP737.PDF

- Civil Aviation Safety Authority (2009). Civil Aviation Advisory Publication 5.59a-1(0): Competency based training and assessment in the aviation environment. Retrieved from: http://www.casa.gov.au/wcmswr/_assets/main/download/caaps/ops/5_59a_1.pdf

Appendix 3

HF/CRM as part of overall performance

To embrace the integrated approach to training, i.e. technical and HF/CRM no longer in isolation, operators must look at the traditional method of how they train and assess the content. The task which is trained or graded can be broken up into essential and supportive skills and competencies. For example;

Phase of Flight	Key Event	Essential skills	Enabling skills
		Situational awareness **Decision-making** **Aircraft handling (aircraft flown within tolerances)**	**Knowledge:** **Management:** **Communication:**

Appendix 4

Relevant regulations and references

- Civil Aviation Authority (United Kingdom). (2009). Standards Document 29, *Guidance Notes for Accreditation Standards for CRM Instructors and CRM Instructor Examiners*.

- Civil Aviation Authority (United Kingdom). (2006). CAP 737, *Crew Resource Management (CRM) Training: Guidance for Flight Crew, CRM Instructors and CRM Instructor-Examiners*.

   (This CAP is being updated.)

- Civil Aviation Authority (United Kingdom). (2002). CAP 720, *Flight Crew Training: Cockpit Resource Management (CRM) and Line-Oriented Flight Training (LOFT)*.

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- Helmreich, R. L., Kanki, B. G., & Anca, J. M. (Eds.) (2010). *Crew Resource Management* (2nd ed.). Maryland Heights: Academic Press.

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- Joint Aviation Authorities. (2001). JAR-OPS Part 1 NPAOPS- 16: Subpart N - *Flight Crew*.

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- Klampfer, B., Flin, R., Helmreich, R. L., et al. (2001). *Enhancing performance in high risk environments: Recommendations for the use of behavioural markers*. Berlin: Damler Benz Foundation.

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- Reason, J. (2008). *The human contribution*. Aldershot, Hants: Ashgate.

- van Avermaete, J. A. G. (1998). NOTECHS: *Non-technical skill evaluation in JAR-FCL (NLR-TP-98518)*. Hoofddorp: National Aerospace Laboratory, Netherlands.

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