# 4 Assessment of Human Factors and Non-technical Skills

## 4.1 Considerations

Most professional air crew would be aware that human behaviour and performance are cited as causal factors in the majority of aircraft accidents. While the aviation industry has benefited from increasing technology, with hardware and software becoming more reliable, human operators still continue to make errors. We know that human error cannot be eliminated, however efforts can be made to minimise and catch or mitigate errors before their consequences become unacceptable.

One of the best ways to ensure errors within aviation are managed is to ensure that applicants under flight examination display a sound knowledge of human factors (HF) and demonstrate adequate non-technical skills (NTS).

**Human factors** is a field of scientific knowledge that involves the minimisation of human error by optimising the relationship within systems, between people, activities, equipment and the environment.

**Non-technical skills** are specific skills such as critical decision making, teamwork, communication, situational awareness and workload management that complement the technical skills required in a given role. For example, applying the correct technique to land or hover an aircraft is a technical skill for a pilot. However, maintaining situational awareness (attention to the surrounding environment) to prevent a potential runway incursion, is a non-technical skill.

### 4.1.1 Airmanship

Traditionally, such skills as the consistent use of good judgement and flight discipline, as well as a high state of situational awareness, have been associated with good airmanship. Often, it was considered that knowledge of airmanship was gained through experience and a process of ‘infusion’. However, experience has shown that airmanship was difficult to measure accurately because identifiable performance criteria were not available. Assessment of airmanship was, therefore, largely subjective.

Linking airmanship to HF and NTS is, in effect, bringing science to the often-nebulous concept of airmanship. By linking airmanship to the performance criteria in the HF and NTS units of the Part 61 MOS schedules, it is possible to evaluate an applicant’s competency more accurately.

For example, it is considered good airmanship for a pilot on a navigation exercise to continually identify potential forced landing areas along the route. But how can this be measured objectively? If an examiner observed the applicant maintaining an adequate lookout, identifying potential forced landing areas along the route, demonstrating that they are maintaining situational awareness by keeping track of (e.g. surface wind direction and strength, visibility, aircraft performance) and applying relevant information for realistic contingency planning for a simulated engine failure, then the examiner could assess the applicant’s competency on these observable skills.

The purpose of linking HF and NTS to airmanship is not to diminish the importance of airmanship, but to make the measurement of it valid and reliable.

Pass or fail judgements based solely on airmanship issues must be carefully determined since they may be entirely subjective. It is not practical to give a comprehensive list of airmanship considerations, however the main principle is to look for signs that the applicant is effectively dealing with present or evolving flight conditions.

### 4.1.2 Human factors and non-technical skills

It is important for all pilots to recognise and appreciate the importance of HF and NTS knowledge, and the need to integrate these skills into their normal flight operations. Accordingly, examiners must not only incorporate sound HF and NTS principles into their flight tests and proficiency checks, but also develop effective assessment strategies. This requires the development and preparation of comprehensive assessment scenarios by examiners.

The requirement for NTS training and assessment is addressed through the elements in Schedule 2 of the Part 61 MOS:

- NTS1.1 – Maintain effective lookout
- NTS1.2 – Maintain situational awareness
- NTS1.3 – Assess situations and make decisions
- NTS1.4 – Set priorities and manage tasks
- NTS1.5 – Maintain effective communications and interpersonal relationships
- NTS2.1 – Recognise and manage threats
- NTS2.2 – Recognise and manage errors
- NTS2.3 – Recognise and manage undesired aircraft state.

A pilot would be expected to demonstrate knowledge of human performance limitations in these elements, including physiological, psychological and ergonomic aspects. For example, some knowledge aspects that underpin the application of NTS include:

- fatigue
- illusions
- general health
- drug and alcohol management
- knowledge of the functions of the eyes and ears.

# 4.2 Non-technical skills 1 – Manage safe flight

## 4.2.1 Examples of proficiency in unit NTS 1

**Table 10. Examples of proficiency in unit of competency NTS 1**

| NTS 1 elements | Examples of proficiency |
|---|---|
| Maintain effective lookout | Maintains effective lookout at most times during flight. |
| Maintain situational awareness | Generally aware of developing situations, able to effectively anticipate future situations to maintain adequate flight safety and efficiency goals. |
| Assess situations and make decisions | Sound ability demonstrated to assess situations, consider available options and predict likely outcomes. |
| Set priorities and manage tasks | Generally demonstrates adequate planning and prioritisation of tasks to achieve safe and efficient flight operations. |
| Maintain effective communications and interpersonal relationships | Generally communicates clearly, concisely and consults with others. |

## 4.2.2 NTS1.1 – Maintain effective lookout

An effective lookout concerns seeing what is ‘out there’ and assessing the information that is received before making an appropriate decision.

Vision is the primary source of information for a pilot. The aircraft attitude, position, physical hazards and other traffic seen by the pilot are processed by the brain and used to build up situational awareness. Therefore, it is important for an examiner to effectively assess the ability of a pilot to best use vision to maintain safety.

Inside an aircraft, vision is used to interpret flight instruments, flight controls and aircraft systems. Externally, vision is used to observe and interpret weather, terrain, aircraft attitude and position.

In this context, lookout must not be thought of as just ‘scanning the skies’ to locate other traffic; it also involves looking at the internal and external environment of the aircraft and maintaining a radio listening watch and interpreting transmissions to determine traffic location and intentions.

## Assessing effective lookout

Lookout is a critical facet of safe flight operations, and assessment of this skill will be ongoing throughout a pilot’s flying career.

The examiner should be looking for competency in 2 main elements of effective lookout:

- see an object
- react appropriately to what has been seen.

In reacting appropriately, the applicant should be able to determine if the object is a threat and take mitigating (avoiding) action.

The examiner should ensure that the applicant covers the field of view from the cockpit, and varies the scan rate to accommodate the threats.

## Congested airspace

Airspace congestion is usually encountered during busy stages of a flight, such as departure and approach. These high workload periods often focus an applicant’s attention inside the cockpit.

The applicant should pay extra attention to other traffic when operating in congested airspace. Examiners should watch the applicant during these phases of flight to ensure that tasks are prioritised and managed to ensure a good lookout is maintained. This can be achieved by monitoring head and eye movement when possible and questioning the applicant about what they see.

Additionally, the examiner must monitor the applicant for an appropriate reaction to any traffic information received by radio transmissions, TCAD or TCAS. Questions such as ‘where do you think other traffic will be coming from?’ will assist in making this determination.

## Hazardous terrain

When operating close to or in hazardous terrain or during periods of reduced visibility, greater effort must be directed outside the aircraft. The examiner should monitor the applicant’s performance and assess any decisions they make to avoid collision with terrain or other aircraft.

Questioning should be used to determine if the applicant is aware of the current threats and whether a plan has been made to address them. The examiner should ask the applicant what they are seeing and whether they have recognised the possible associated hazards. These assessments must occur throughout the flight; however, the examiner must ensure that questions do not adversely impact the safe management of the flight.

## Clearing procedure

Pilots must always clear the airspace around them before manoeuvring the aircraft. This ‘clearing procedure’ must be used to locate other aircraft as well as any terrain, weather or other hazards that may compromise safety.

Examiners should observe whether the applicant always uses an acceptable procedure and whether threats are seen and identified.

Given the physiological limitations of ‘see and avoid’, it may be appropriate to supplement continued lookout with other actions (e.g. establish vertical separation). To achieve this, examiners themselves must closely monitor the airspace and maintain a good lookout so that they can identify any threats that are missed by the applicant.

Pilots of slow-flying aircraft must also demonstrate awareness of the fact that undetected faster aircraft approaching from the rear quarter are a constant risk to flight safety.

### Limitations of vision

Examiners should ensure that applicants are aware of, and take into account, the limitations of vision. These limitations include aspects such as blind spots, threshold of acuity, accommodation (focusing on an object), empty field myopia, focal traps, visual field narrowing and cockpit workload. Notwithstanding the applicant's awareness of visual limitations, the examiner should determine that the applicant sights any threats to safety and takes appropriate mitigating action.

The same 'maintain effective lookout' (NTS 1.1) items can also be applied during the conduct of an Examiner Proficiency Check (EPC) in an FSTD (approved for the purpose). The EPC applicant should satisfactorily perform the published Part 61 MOS Schedule 2 NTS 1.1 competency within the context of the FSTD instructor operating station.

## 4.2.3 NTS1.2 – Maintain situational awareness

In the aviation context, situational awareness (SA) is defined by Endsley[1] as:

> *'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of the status in the near future.'*

This definition is often assigned 3 levels:

- level 1 – perception of the current environment
- level 2 – interpretation of the immediate situation
- level 3 – anticipation of the future environment.

**Level 1 SA** is achieved through monitoring and gathering information from both within the cockpit and the environment outside the aircraft (perception).

**Level 2 SA** requires the pilot to process the information gathered and interpret the situation (interpretation).

**Level 3 SA** occurs when the pilot recognises the situation and predicts what is likely to occur (anticipation).

In the context of the Part 61 MOS and assessment of SA, it is important to understand that this is the scope of SA. Decision making is assessed as a separate activity.

### Assessing situational awareness

The most important aspect of assessing SA is to confirm that the applicant's mental model (or perception) of the environment is accurate.

The next step is to find out what options the applicant has identified and assess whether they are realistic. In other words, the examiner must see if the 'what ifs' complement the mental model and provide a basis for an accurate and timely decision (if one is required).

Depending on the applicant's perception and options, there may be no need to proceed to the next step of making a decision, as SA is a dynamic process—further action only needs to be taken if a perceived situation compromises flight safety.

For example, if there are thunderstorms in the area but they do not conflict with the intended track, and the adverse effects of the storm will not affect the flight, no decision or action would be needed. However, it would indicate a lack of SA if the applicant did not consider the storms and the associated hazards in their planning.

[1] Endsley MR. Toward a theory of situation awareness in dynamic systems. *Human Factors* 1995;37(1):32–64.

## Objective and responsive assessment

Observation and questioning are the primary means used by an examiner to make a formative assessment of SA. Questions such as ‘what do you think could happen if….?’ or ‘what would you do if…?’ can be used to assess an applicant’s SA.

Assessment of an applicant’s SA must be conducted throughout the flight test. The limits of an applicant’s SA can be effectively explored through the creation of different scenarios.

The examiner should be prepared to modify the flight test or proficiency check scenarios as appropriate, to ensure a comprehensive assessment of the applicant’s SA is made. If the examiner determines that an applicant’s SA is deficient, they should provide guidance on how to improve SA in the post flight debriefing.

Examiners may gain an intuitive feeling that an applicant’s SA does not meet the required competency standard; however, feelings cannot be used as a basis for an adverse assessment. Evidence must be obtained to support such an assessment. If an applicant’s SA is below the required standard, there will be a contributing factor or factors and it is up to the examiner to discover and record this deficiency as evidence.

## Assumed level of knowledge

As SA can be adversely affected by a lack of knowledge, examiners must observe the applicant applying appropriate knowledge for any given situation. For example:

- unfamiliarity with air traffic separation rules could result in unsatisfactory descent planning when opposing traffic is present
- deficiencies in aircraft systems knowledge (e.g.fuel system mismanagement) could lead to unsatisfactory outcomes.

If an applicant’s lack of knowledge contributes to poor SA, the examiner should record the problem and provide appropriate feedback to the applicant. In some cases, lack of adequate knowledge (and its potential effect on SA) may be enough reason for an examiner to deem that an applicant has not achieved competency in non-technical skills.

## High workload

During periods of high workload, it is possible that information may be overlooked. Examiners must determine if SA is being maintained, regardless of workload.

For example, if the applicant is busy during an approach into a very active terminal area, radio transmissions may be missed, or instructions forgotten. A possible cause for this reduced SA is failure to recall the information received (i.e. short-term memory breakdown causing faulty perception), which can lead to failure to take appropriate action.

## Low workload

Examiners must also monitor the applicant during periods of low arousal or workload (inactivity) to ensure that an appropriate level of SA is maintained.

During a long navigation leg that is proceeding according to plan, an applicant may relax and stop thinking about what is happening and what could happen. It would be appropriate to confirm that SA is being maintained by the use of questions such as ‘Where would you divert to now if a passenger became seriously ill?’ or ‘If you suffered an engine failure where would you land?’ or ‘What is our endurance now?’

## Specific scenarios

In the normal course of a flight test, it is likely that many opportunities to assess SA will occur. Despite this, if an examiner wants to investigate a specific situation, they may need to develop a scenario to test the applicant’s SA. For example, if the examiner wants to explore the applicant’s ability to maintain SA under a high workload, they could create an artificial workload interspersed with distractions. Such a

scenario may require some time and thought but once developed, the scenario could be refined, adapted and used for other flight tests or proficiency checks.

### 4.2.4 NTS1.3 – Assess situations and make decisions

Although this element is titled ‘Assess situations and make decisions’, the primary area of interest is the decision-making process. By applying SA, a pilot may arrive at a number of options of ‘what could happen’, and the next step is to make a decision that achieves the optimum outcome.

In daily life people are always making decisions—usually sub-consciously. However, in the aviation environment, incorrect or inappropriate decisions can have tragic consequences. Therefore, it is important for pilots to understand and be able to apply the decision-making process and to be aware of the need to make timely and correct decisions.

#### Assessing decision making

Complex decision making may be difficult for an examiner to assess on a flight test or proficiency check because of the limited timeframe and reduced opportunity. Nevertheless, an applicant’s competence to make decisions must be assessed for the grant of a licence, rating or endorsement. It may be necessary to create scenarios to analyse an applicant’s ability to manage complex decision making.

#### Decision making process

The ongoing process of acquiring SA, if working correctly, will provide the applicant with a perspective from which to derive any number of options and ultimately determine the best action to follow. The applicant must recognise that a decision has to be made. Problems must be identified, and the examiner must use effective observation and questioning techniques to determine the facts.

The applicant must analyse problems and propose solutions (options). This will require the applicant to gather and process information. The applicant’s actions must be observable, but some questioning may be required to obtain an accurate assessment.

Based on the options identified, the applicant must make a decision. Examiners must ensure the decision is the optimal one and is implemented effectively in the time available. The applicant then must monitor progress against their plan and re-evaluate the plan as circumstances change, even if it is to confirm the desired outcome has been or will be achieved.

For a decision such as a ‘go around’ after a mishandled landing, the action and results will be very evident. In such cases, the examiner should ensure that the applicant recognised the mishandled landing soon enough and did not delay the recovery action.

More complicated decisions may require greater analysis by both the applicant and examiner. A complex problem may require a decision that does not lead to the optimum result immediately but could be modified at a later time.

It is acceptable for the applicant to make a decision on the basis that it may require revision if the safety of the flight is not compromised, and the applicant continues to re-evaluate and update that initial decision. This situation could occur where a decision is made during flight planning, which may have to be modified after the applicant becomes airborne (e.g. operational requirements, insufficient information available or changed weather conditions).

#### Management of factors affecting information processing

An examiner must observe an applicant’s ability to manage factors that can adversely affect information processing and decision-making. An example would be a pilot who is prepared to press on in bad weather or other adverse circumstances, in an attempt to reach a destination.

Examiners should consider developing scenarios where bad weather, operational requirements or fuel shortage would make it impossible to safely proceed to the destination. In such a case the applicant would be obliged to make a decision not to proceed and to take appropriate action that ensures safe flight, demonstrating competency in critical decision making.

While it is a challenge to assess an applicant's decision-making competence on a flight test, if the examiner prepares for the test by creating complex scenarios, the task of evaluating an applicant's decision-making competency will be achievable.

### 4.2.5 NTS1.4 – Set priorities and manage tasks

Task management means completing a job or operation competently in the time available. If the workload is high and many tasks have to be completed, they must be prioritised in a logical and efficient sequence.

The saying 'aviate, navigate, communicate' forms a sound basis for prioritisation and task management. Many people are able to process information in a well organised and logical manner, but some are not able to operate efficiently in a confined and, at times, demanding and busy environment without additional guidance and direction.

#### Assessing prioritisation and task management

The assessment process will require detailed observation, information gathering and questioning by the examiner, because they will need to determine how an applicant's mind is functioning while managing tasks. By obtaining this information and combining it with observations, the examiner will be able to judge an applicant's ability to competently set priorities and manage tasks.

An examiner should observe an applicant's work pattern and task completion to evaluate their competence to set priorities and manage tasks on a flight test. Valid evidence must be obtained to substantiate the assessment. For example, if an applicant is told by ATS to 'expedite take-off' and does so before completing pre-take-off checks, rather than advising ATS that they were not ready for take-off, the examiner could reasonably deem the applicant to be not competent at prioritising tasks. The applicant would not have met the 'take-off aeroplane' standard and could compromise safety.

When assessing task management, the examiner must look for competent completion of a task in the time available. In particular, the examiner should seek confirmation that the applicant can manage multiple tasks (although not an excessive workload) in a logical order. It may be necessary for the examiner to create scenarios to support this evaluation.

Examiners must be aware of factors affecting workload management and look for evidence of how these factors impact applicant conduct.

### 4.2.6 NTS1.5 – Maintain effective communications and interpersonal relationships

Communication is a two-way process. It involves the accurate transmission, receipt and interpretation of information. Communication includes radio, as well as direct verbal and non-verbal exchanges.

A significant and vital component of interpersonal relationships is effective communication. It involves the pilot being able to get a positive or helpful response, rather than negative or obstructive response, from individuals or groups they deal with in order to ensure the effective transfer of information that may be crucial to maintaining SA and safety of flight.

The intent of the NTS1.5 competency unit is to make pilots aware of the need to always foster positive and cooperative relationships with people involved with, or affected by, their flying operations. Affected people may include:

- instructor or examiner
- maintenance engineers
- air traffic controllers
- airport owners and operators
- ground staff, including refuellers.

Examiners are not required to assess an applicant's manners or personality per se; however, they are required to observe the interactions of applicants with other stakeholders and assess their ability to

maintain constructive relationships with others in the operational context, in order to achieve safe flight operations.

### Assessing effective communications and interpersonal relationships

The examiner should evaluate the applicant's ability to 'establish communications', that is, to make the effort to communicate or interact.

The examiner should assess the applicant's:

- tone of voice and demeanour
- ability to use a non-aggressive approach
- willingness to listen, including active listening
- body language (when applicable)
- level of assertiveness.

These traits apply both to communications and interpersonal relationships and should be assessed by observing the reaction of the other person involved.

The examiner must use evidence-based assessment. They should look for brevity and clarity of language, use of standard phraseology and whether the applicant was able to quickly elicit a positive reaction from the person with whom they were dealing.

Examples of feedback on negative communication include:

- *'You did not communicate competently because the air traffic controller had to ask you twice for clarification of your request'*
- *'You got into a shouting match with the engineer when discussing the aircraft's serviceability'.*

The examiner can assess 'define and explain objectives to involved stakeholders' by observing an applicant's cockpit communications and interaction with other flight crew members, or with the examiner.

An applicant who states their intention and explains how they will achieve the desired objectives could be assessed as communicating and interacting well with the examiner. However, assessment of communication and interpersonal skills should not be limited to the cockpit; examiners must make a holistic assessment of this aspect of an applicant's performance.

To assess assertiveness, the examiner must observe the applicant is able to 'demonstrate the required level of assertiveness that ensures the optimum completion of the flight' during the scenarios within the flight test or proficiency check profiles.

For example, if an air traffic clearance is inappropriate or unsafe, an examiner would expect to observe a competent applicant negotiate or suggest alternatives. When faced with a more time critical situation there may be a need to change the normal tone of voice and style of the transmission to maximise the priority and gain the attention necessary to deal with the situation. Accepting the status quo could result in an unsafe outcome, which would be unacceptable.

## 4.3 Non-technical skills 2 – Threat and error management

Threat and error management (TEM) proposes that threats (such as adverse weather), errors (such as using the wrong instrument settings or the incorrect use of automation) and undesired aircraft states (UAS) (such as altitude deviations) are challenges that pilots must recognise and manage to maintain safety. Pilots who successfully manage these issues regardless of their occurrence increase their potential for maintaining adequate safety margins.

TEM pervades all aspects of flight management, from assessing fitness for duty and pre-flight considerations, to the conduct and completion of a flight. Therefore, TEM must be assessed throughout the flight test. Accordingly, the examiner will need to develop scenarios to ensure adequate assessment opportunities.

The practical flight standards prescribed in the Part 61 MOS unit of competency NTS 2 form the starting point for assessing TEM. The basic concept for TEM is simple:

- identify the threat, error or undesired aircraft state
- manage the threat, error or undesired aircraft state.

All conditions specified in the standard for NTS2 must be met before the applicant can be assessed as competent.

Management in the context of TEM is defined as to 'plan, direct and control an operation or situation'. In practical terms this means the timely detection of and response to threats or errors that may lead to undesired aircraft states.

Specifically, the applicant should demonstrate the ability to:

- recognise, assess and manage potential threats in the performance of the various task elements, in accordance with TEM techniques
- avoid or trap errors which may occur in performing the various task elements, in accordance with TEM techniques
- follow standard operating procedures with evident situational awareness to avoid and trap errors
- apply strategies which will mitigate the effects of any errors which may occur, in accordance with TEM techniques.

Below are examples of proficiency in the NTS2 unit of competency.

**Table 11. Examples of proficiency in unit of competency NTS2**

| NTS 2 Elements | Examples of proficiency |
|---|---|
| Recognise and manage threats | Generally recognises and manages threats appropriately, generally uses effective strategies to minimise and mitigate effects of threats |
| Recognise and manage errors | Generally recognises and manages errors appropriately, generally uses effective strategies to contain and mitigate effects of errors |
| Recognise and manage undesired aircraft states | Generally recognises and takes appropriate steps to manage undesired aircraft states with adequate flight safety goals maintained |

### 4.3.1 Evidence-based NTS 2 assessment

Examiners must obtain evidence to ensure that sound TEM techniques are being practised. Examiners cannot assume that just because an applicant completed a faultless trip, competent TEM skills were used. The examiner should question the applicant and observe their actions to ensure the evidence is valid, authentic, sufficient and current.

It is likely that an examiner will need to create scenarios on a flight test or proficiency check to allow proper assessment of TEM. A competent applicant is less likely to get into an undesired aircraft state or would quickly correct an undesired aircraft state (e.g. low approach speed), and it may be necessary for the examiner to artificially create such a circumstance.

For example:

- on approach to a destination aerodrome, simulate a thunderstorm over the airfield to duplicate both a threat and an undesired aircraft state
- simulate a radio failure approaching a non-controlled aerodrome with a CTAF
- simulate a system malfunction or engine failure
- simulate an instrument or display failure.

### Assessment of threat and error management

Evaluation of competence is difficult for an examiner as the TEM assessment must be determined based on a single flight test or proficiency check. Accordingly, the examiner will need to develop scenarios to ensure adequate assessment opportunities throughout the test or check.

During pre-flight planning, the examiner should observe and question the applicant to gain insight into the countermeasures that they apply to anticipated threats. Scrutiny of flight planning activities will also allow the examiner to monitor some aspects of error management.

Throughout general flying and navigation phases of the test, simulation of systems malfunctions and emergencies will afford the opportunity to evaluate threat, error and undesired state management competencies.

The examiner will evaluate NTS competencies at the same time as appraising TEM competencies. Although a flight test involves assessment of a multitude of competencies, with proper planning and some thought, examiners will be able to successfully assess NTS and TEM.

As a practical example, during a PPL flight test it would be possible to assess a number of elements from the NTS1 and NTS2 standards if the examiner sets a scenario during the navigation phase that requires a precautionary search. Consider the list below:

- **Lookout**: selection of a suitable landing area, weather conditions, traffic and terrain avoidance
- **Situational awareness**: monitoring of aircraft systems, weather, location and flight environment. Collecting information from map, charts and ERSA
- **Decision-making**: identifying and assessing options regarding weather, time of day, endurance and location; deciding to conduct precautionary search and assessment of landing area; deciding to land or re-evaluation, and configuring of aircraft for landing
- **Task prioritisation**: organising and managing a logical descent and arrival, aircraft configuration, appropriate radio calls, field selection and briefing of passengers.
- **Communications**: communicating with ATC, other aircraft, passengers and, if possible, ground personnel
- **Threat management**: monitoring, assessing and managing threats, particularly in relation to weather, terrain, low-level operations and aircraft handling
- **Error management**: identifying any errors and take action before safety is affected, particularly when flying low level. Use of checklists and standard operating procedures applicable to a precautionary search situation
- **Undesired aircraft state**: recognising and correcting any undesired state particularly in relation to power settings, configurations, IAS, and height during the low-level manoeuvres.

## 4.4 Assessment of HF and NTS in multi-crew operations

The units of competency outlined above for NTS 1 and 2 are equally applicable to assessment of HF and NTS in multi-crew operations. In addition, further specific requirements for the assessment of HF and NTS in multi-crew operations (MCO) are also defined. The MCO units of competency, including the specific elements and performance criteria, are outlined in Schedule 2 of the Part 61 MOS.

### MCO unit description

This unit describes the skills, knowledge and behaviours required to plan, direct and control all aspects of flight operations in a multi-crew environment as either pilot in command or a crew member. The unit contains the following elements:

- MCO.1 – Operate effectively as a crew member
- MCO.2 – Demonstrate effective leadership and authority
- MCO.3 – Maintain situational awareness

- MCO.4 – Make effective decisions.

The issue regarding the analysis for assessment of the performance of the individual or the team, in multi-crew operations has been the subject of considerable research. However, it is important to note that while the focus of this unit is on the specific skills required to work in a team, the focus of attention of the examiner is on the performance of the individual operating within the team.

The examiner must assess the performance of the applicant, in the context of the team environment, and how the applicant's behaviour influences the team's performance.

Furthermore, the applicant's performance may vary across scenarios, depending on the demand that each scenario places on the individuals and the team. Therefore, it is important that the examiner considers several scenarios for assessment across the entire flight, in order to make a holistic assessment of the applicant's performance.

It can be considered that teams do not perform per se; it is the performance of individuals that contribute to the effectiveness and performance of the team.

### Assessment of team skills

Assessment of the applicant's ability to operate effectively as a crew member will require the examiner to design appropriate flight test scenarios to provide the applicant with an opportunity to demonstrate proficiency and perform the tasks associated with each of the specific performance criteria included. These scenario events should vary in difficulty and be presented at various points during the flight test or proficiency check.

The examiner should observe the applicant's behaviour and record sufficient evidence to provide constructive feedback regarding the applicant's performance at the end of the flight test.

## 4.4.1 MCO.1 – Operate effectively as a crew member

Considerable research and analysis of safety data has recognised that good teamwork is particularly important to reduce errors and maintain safety in aviation. However, teams are seldom constant, and in larger airlines, the composition of the flight crew may change frequently. However, flight crews must function effectively from the moment they are formed, in order to achieve their task and manage safety effectively.

It can be considered that when an individual crew member commits an error, and that error is not detected or corrected by another crew member, the error becomes a crew error. The general principles of crew resource management (CRM) may support this approach by focusing on the performance of the crew as a whole. However, a core concept of CRM training is not necessarily to strengthen any particular flight crew but rather to make individuals more effective crew members in the flight crew team that they are operating in.

In effective-performing crews, the constant high correlation between behavioural ratings for the captain and first officer indicate that these individuals do not act independently of each other. However, in poorly-performing crews, there are often observable differences in the behaviours that are rated 'poor' for the individual pilots. For example, poor leadership demonstrated by the captain, with no intervention from the first officer, may result in a poor rating for assertiveness for the first officer.

This differentiation is important for the examiner to consider in the context of a flight test for the issue of a flight crew licence, rating or endorsement, which requires individual assessment and feedback for the applicant. The focus of an examiner is not to assess the personality of the applicant, but rather to observe and assess the behaviour of the applicant with respect to proficiency.

The examiner is required to assess the applicant's proficiency in the specific skills needed to operate effectively as a crew member. These skills fall broadly into 2 main categories; communication and cooperation, which can be summarised as:

- sending and receiving information
- identifying barriers to communication
- supporting other crew members
- solving conflict, exchanging information

- coordinating activities.

The MCO.1 element is broken down into 16 specific performance criteria, such as:

- motivate and support other crew members
- apply strategies to manage stress and conflict
- listen critically and request clarification when necessary
- assist other crew members to manage workload.

The main categories, summary and proficiency examples are below.

**Table 12. Element MCO.1 summary and examples of proficiency**

| | MCO.1 summary | Examples of proficiency |
|---|---|---|
| Communication | Sending information clearly and concisely | Generally, communicates clearly and concisely, consults with others |
| | Including context and intent during information exchange | Generally good use of context with adequate meaning and intent during communication |
| | Receiving information by listening | Information effectively received and input sought from others |
| | Identifying and addressing barriers to communication | Identifies and adequately address most barriers |
| Co-operation | Supporting others | Generally, considers needs of others, provides timely support and feedback |
| | Solving conflicts | Generally, focuses on what is right, able to suggest solutions as conflict arises |
| | Exchanging information | Generally, communicates effectively, adequately consults with others |
| | Coordinating activities | Establishes team, creates adequate atmosphere for input and feedback |

### 4.4.2 MCO.2 – Demonstrate effective leadership and authority

Effective leadership is about directing and coordinating the activities of crew members. It includes:

- encouraging crew members to work together
- planning and setting priorities
- assigning tasks
- managing workload
- monitoring and assessing performance
- motivating crew members
- establishing a positive team atmosphere.

The thoughts and behaviour of other members are influenced by the team leader's ideas and actions. Therefore, effective team leadership is essential to team performance and the effectiveness of the team in achieving its objectives.

Summary and proficiency examples for leadership and authority are below.

**Table 13. Element MCO.2 summary and examples of proficiency**

| MCO.2 summary | Examples of proficiency |
|---|---|
| Using authority | Generally, demonstrates appropriate use of authority and assertiveness |
| Maintaining standards | Desired standards generally well maintained, with infrequent lapses |
| Planning and prioritising | Generally, demonstrates adequate planning and prioritisation of tasks to achieve safe and efficient flight operations |
| Managing workload and resources | Generally, demonstrates ability to manage workload and effective use of resources to achieve adequate safety and efficiency goals |

These skills are not only essential for the team leaders or captains, but are also essential for other crew members, including first and second officers.

Effective leadership has been shown to be crucial to maintaining safe performance in aviation. Research has shown that leaders influence the safety behaviours of other team members, such as compliance with rules and procedures, and the outcome of critical incidents and emergencies.

### Assessment of leadership and authority

Assessment of the applicant's leadership and management skills will require the examiner to design appropriate flight test scenarios to provide the applicant with an opportunity to demonstrate proficiency and perform the tasks associated with each of the specific performance criteria included. These scenarios will require the applicant to analyse and assess complex problems and make decisions while directing and monitoring the actions of their support crew member.

Ideally, multiple events should be included for each element and performance criteria against which the applicant's performance is to be assessed. These events should vary in difficulty and be presented at various points during the flight test scenario. These scenarios should be designed such that the applicant is required to consider and manage the consequences of their decisions and review the actions of the crew as the scenario unfolds.

## 4.4.3 MCO.3 – Maintain situational awareness

Situational awareness is the first step in the decision-making process. It relies upon gathering and interpreting information and anticipating the future states, which may require a decision to be made regarding the anticipated outcome or event.

In a multi-crew environment, it is important that crew members working together on cooperative tasks have some degree of shared situational awareness and a 'shared mental model' for the task and the intended outcome, knowing each crew member's roles and responsibilities.

It is well known that both fatigue and stress can adversely affect the quality of situational awareness. Furthermore, research has found that distractions and interruptions occur surprisingly often in safety-critical domains such as aviation. Therefore, knowing when to interrupt other crew members, and what information is essential at critical phases of flight, are important skills in a multi-crew environment. The use of and adherence to standard operating procedures and standard phraseology are important factors in maintaining situational awareness.

Summary and proficiency examples for situational awareness are below.

**Table 14. Element MCO.3 summary and examples of proficiency**

| MCO.3 summary | Examples of proficiency |
|---|---|
| Gathering information | Information effectively gathered from a number of sources |
| Interpreting information | Effectively interprets information to anticipate developing situations |
| Anticipating future states | Generally aware of developing situations, able to effectively anticipate future system states with good level of accuracy and reliability |

### Assessing situational awareness

As situational awareness is largely a cognitive skill, it is impossible to observe directly. Therefore, the examiner must design appropriate scenarios that include specific task actions and communications that

indicate the applicant is gathering and interpreting information to develop an understanding of the situation that is occurring and anticipating what may happen as the scenario unfolds. Observed behaviours and communications must be used to assess the level of situational awareness demonstrated by the applicant.

## 4.4.4 MCO.4 – Make effective decisions

Decision making can be defined as the process of assessing a situation and reaching a judgement or choosing an option to meet the needs of the situation. Decision-making skills are especially important in high-risk environments such as aviation, where the individuals involved may be functioning under time pressures and stress. Different decision-making techniques may be required for different scenarios, depending on the nature of the decision to be made and the time available to make a decision.

In stressful situations, decision making may be particularly vulnerable, especially for complex decisions, where time and mental effort are required to evaluate and compare optional courses of action and potential outcomes. Consequently, there are a number of decision-making models available to aid the process of decision making in complex and often stressful environments.

Summary and proficiency examples for making effective decisions are below.

**Table 15. Element MCO.4 summary and examples of proficiency**

| MCO.4 summary | Examples of proficiency |
|---|---|
| Defining the problem | Sound methodology to define problems, considers most factors, generates appropriate solutions and allows for contingencies |
| Generating and considering options | Sound methodology to consider options and predict likely outcomes |
| Selecting and implementing options | Sound methodology to select and implement satisfactory options, confirms selected course of action to ensure safe outcome |
| Reviewing the outcome | Effective review of plan, and modification of plan when required |

Examiners must be aware that decision making is significantly influenced by technical expertise, level of experience, familiarity of the situation and practice in responding to problem situations. As decision making is a cognitive skill, it is affected by many of the same factors as situational awareness, such as stress, fatigue, noise, distraction and interruption.

### Assessment of decision making

As with situational awareness, decision making is impossible to observe directly. Therefore, the examiner must design appropriate flight test scenarios that include specific events requiring the applicant to make decisions under different conditions. Observed behaviours and communications must be used to assess the effectiveness of decisions being made.

In some cases, the decision-making process may also be observed where the applicant's communications with other crew members follows a structured sequence of steps to evaluate options and choose the appropriate outcome.

## 4.4.5 Threat and error management in multi-crew operations

The examiner will evaluate HF and NTS competencies at the same time as appraising TEM competencies. Although a flight test involves assessment of a multitude of competencies, with proper planning and some thought, examiners will be able to successfully assess all HF and NTS considerations and TEM requirements on flight tests and proficiency checks.

As a practical example, it would be possible to assess a number of elements from the HF, NTS and TEM standards if an examiner sets up an appropriate scenario during the en route navigation phase. Such a scenario requires management of a non-normal event, such as a system failure, resulting in a decision to divert to the nearest suitable airport for landing.

Consider the lists below.

## Operate effectively as a crewmember

- **Use standard operating procedures**: use of normal and non-normal checklists, procedures and phraseology following the first indications of the system failure.
- **Cooperate**: as the consequences of the system failure are assessed, cooperate with other flight crew members; provide timely information, verify receipt of information, encourage input from others, apply assertive strategies.
- **Communicate**: during the immediate and subsequent actions following the system failure, communicate with flight crew, air traffic control, cabin crew, passengers, engineers, company personnel, and other aircraft (as applicable).
- **Monitor and support**: throughout the scenario initiated by the system failure event, consider the ability of other crew members to perform duties, motivate and support other crew, appraise crew performance.
- **Manage**: since stress, conflict and distractions may be heightened during the system malfunction event, manage workload to optimise outcome.

## Demonstrate effective leadership and authority

- **Briefings**: in addition to normal pre-flight briefings, following the system failure event, the applicant should conduct briefings to establish a plan of action, priorities and crew roles.
- **Communication**: the system-failure event allows the applicant excellent opportunities to establish the atmosphere to encourage open communication and input from crew, identify and communicate key issues reinforce roles, and maintain motivation.
- **Management**: one of the prime assessment purposes of the system malfunction event is for the applicant to allocate tasks, establish goals, monitor crew actions and outcomes, manage time and resources to ensure flight is completed safely and effectively.

## Maintain situational awareness

A system-failure event scenario is an ideal opportunity to assess situational awareness. There are a number of competencies that the applicant must demonstrate:

- **Monitor**: flight path, aircraft configuration, system state, flight environment
- **Perceive**: flight environment, aircraft systems, detect non-normal situations
- **Interpret**: identify threats and errors, assess options, modify planned operations
- **Anticipate**: potential hazards, aircraft configuration and performance
- **Cross-check**: cross-check the actions of other crew members.

## Make effective decisions

- **Identification**: once the system failure event occurs, identify problems, consider options and outcomes, generate solutions.
- **Management**: the consequences of the system failure need to be managed by the crew. The applicant must manage the non-normal situation, system performance and the diversion plan.
- **Assessment**: once the immediate actions have been completed, a decision to continue the flight or divert needs to be addressed. The applicant should assess suitable airports, assess risks and analyse solutions and options.
- **Prioritisation**: while working effectively with the other crew members and commencing a diversion, the applicant should prioritise workload management, communication and desired actions.
- **Evaluation**: with the diversion initiated as a result of crew management and decision making, the applicant should monitor progress against the agreed plan and evaluate and review decisions.

### Threat and error management

As the crew divert to the nearest suitable alternate, the decision itself and the ongoing review involves TEM competencies:

- **Threat management**: weather, terrain, aircraft handling and performance
- **Error management**: recognition of errors, countermeasures, checklist use
- **Undesired aircraft state**: management of a non-normal situation, taking appropriate action to prioritise management of an undesired aircraft state.

## 4.4.6 Do poor non-technical skills constitute a fail assessment?

One final consideration is whether an applicant who lacks the necessary NTS skills required for the grant of a flight crew licence, rating or endorsement, or who fails to demonstrate NTS competency during a flight test or proficiency check, should fail on the basis of NTS alone? The answer is yes, but it should be linked to the performance of a technical skill.

Although applicant behaviour is an indicator that the applicant may be having trouble operating in the aviation environment on the day, it is not necessarily diagnostic. Therefore, further information may be required to identify the causal factors for the applicant's poor performance in order to target effective retraining. These causal factors are typically related to less-than-optimal technical skills.

The NTS framework focuses simultaneously on the operational environment and the performance of the applicant operating within that environment. As the NTS framework captures performance in the normal operating context, the resulting description is realistic, dynamic and holistic. Therefore, the results can be highly diagnostic.

Nevertheless, assessment of a pass or fail of a flight test based on NTS should be linked to a technical skill as they do not work in isolation. The assessment of NTS should acknowledge this and it is important for examiners to design flight test scenarios that reflect this interconnection.

For example, a pilot who does not adequately consider the implications of an MEL item on aircraft performance could be potentially assessed as not demonstrating effective skills in the following non-technical skills:

- NTS1.3 – Assess situations and make decisions
- NTS1.4 – Set priorities and manage tasks
- NTS2.1 – Recognise and manage threats.

However, this NTS assessment is probably linked to one or more of the technical skills in the Part 61 MOS such as element C2.1, Perform pre-flight actions and procedures.

In other words, the failure to adequately consider the implications of an MEL item on aircraft performance may stem from inadequate knowledge of specific performance data, or a lack of effort in considering the relevance of the data for the operation being undertaken. The applicant would therefore be assessed as not competent in C2.1 and NTS1.3, NTS1.4 and NTS2.1.