National Operational Guidance Programme

Local Government Association | CFOA Chief Fire Officers Association | in partnership with LFB London Fire Brigade

Title:	Performing rescues
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Synopsis:	The guidance consists of three main areas – searching for casualties, extrication of casualties and casualty care. The search and extrication incorporates incidents in the built environment, open environment and all forms of transport. This includes rescue of casualties from both fire and non-fire incidents.
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National Operational Guidance – Performing rescues first edition version one (ARCHIVED on 23-12-2016)

Introduction

A 'person at risk' is defined as a person involved in any situation that exposes them to a risk of death, injury or illness. Those falling into this category may include bystanders, casualties and those involved in performing rescues. This extends to those involved in scene preservation and post-incident activities being carried out whilst the fire and rescue service is still at the scene.

A person may remain 'at risk' even after being rescued. For example, where somebody has been extricated or has self-extricated from a vehicle following a road traffic collision, but is required to remain at the roadside awaiting an ambulance.

A rescue is defined in the Cabinet Office UK Civil Protection Lexicon as the:

Removal, from a place of danger to a place of relative safety, of persons threatened or directly affected by an incident, emergency, or disaster

This guidance is for incidents where the initial attending fire and rescue service personnel will conduct search and rescue operations. This includes both fire and non-fire incidents. For fire incidents, some elements of this guidance will be supported by the hazards and control measures contained in the Fires and Firefighting guidance.

National Operational Guidance looks to share good practice; an example of this is the recommendation that search techniques may be enhanced by the use of audio or optical equipment and/or the use of canine resources.

The satisfactory identification and management of people at risk requires a combination of incident pre-planning, incident management and incident debrief functions, beginning with a service-wide appreciation of which incidents the organisation can and will respond to.

Fire and rescue services should use all available specialist knowledge to assist with rescue of casualties. This knowledge may be available from within the fire and rescue service either locally or regionally, external agencies or the owner/occupier.

Fire and rescue services should clarify the range of rescue and other functions they will provide and more importantly, which functions they absolutely cannot deliver. This should inform the organisation's risk management plan. Where activities are identified that require the assistance of another fire and rescue service or agency (blue light, private sector, voluntary, etc.), clear, unambiguous agreements should be drawn up. These too should inform and be reflected in the risk management plan.

When drawing up the risk management plan and underpinning agreements, fire and rescue services should consider how information, intelligence and data can and should be shared among and between the command, control and communications elements for planning, co-ordinating, integrating and executing response operations.

Agreements should include:

- The span of activities to be undertaken

- Clarity of what roles and activities are to be performed and by whom
- A defined, clear, understood chain of command
- What resources are required
- The mechanisms for co-ordination of operations
- Suitable controls to cover the span of operations and resources deployed
- How access to the scene of operations (cordoned or not) is to be controlled and by whom
- Which roles, tasks and activities the fire and rescue service will have fulfilled before departing from the scene including:
    - Rescue of trapped persons
    - Provision of initial medical care to casualties
    - Assistance with casualty handling and body recovery
    - Extinguishing fires
    - Dealing with released chemicals, fuels and contaminants
    - Managing health and safety activity
    - Co-ordination with other agencies

Agreements should consider the provisions for co-operation and communication between the responders and agencies involved and/or present. Agreements should identify the measures required to effect formal handover of responsibilities as and where appropriate.

Where possible and appropriate, fire and rescue services should seek to gather Site-Specific Risk Information (SSRI) to inform their response arrangements. This information, together with local arrangements, agreements and memoranda of understanding (MoUs) should be tested and reviewed to ensure suitability and accuracy through a programme of exercises and debriefs involving relevant agencies.

Operational response should be underpinned by prevention and protection initiatives, delivered in partnership with local communities and a wide range of other relevant partners, locally, regionally and nationally.

It may be difficult to determine the point in some incidents when the fire and rescue service's duty to protect people from harm has been fulfilled. Risk management plans should contain appropriate provision for performing rescues, together with strategic and local collaboration with other fire and rescue services, other Category 1 and 2 responders and resilience forums.

Fire control rooms should ensure they employ robust information gathering wherever possible and pass this information on to mobilising crews. This information gathering process supports the Joint Emergency Services Interoperability Principles (JESIP) Joint Doctrine: The Interoperability Framework.

A more accurate picture of the situation can be developed through liaison with other agencies and information gathering from members of the public. This includes information about the number of people involved, their last known position (LKP) or point last seen (PLS). The information gathering process should continue throughout the incident and will inform the nature of operational response.

References

Fire and Rescue Services Act 2004

The Fire and Rescue Services (Emergencies) (England) Order 2007

Civil Contingencies Act 2004

College of Policing – Authorised Professional Practice for Missing Persons

Crime and Disorder Act 1998

Department for Communities & Local Government Fire and Rescue Service Circular 42/2006 – National Mutual Aid Protocol

Joint Emergency Services Interoperability Principles (JESIP) Joint Doctrine: the Interoperability Framework

Hazard and Control Statement

Intraoperability and interoperability

Hazards	Control measures
Fire control room failing to identify and notify appropriate resources	Ensure fire control operators have knowledge of internal and external resources, their availability and the request or mobilisation procedures Have effective and current prompts, action plans and contact details Have mutual aid or memoranda of understanding arrangements in place Understand how to request and mobilise National Resilience assets
The incident commander failing to identify and request appropriate internal and external resources	Identify and record local risks in conjunction with partner agencies and local resilience forums (LRFs) Be aware of internal resources and availability Be aware of external resources and availability Have mutual aid or memoranda of understanding arrangements in place Understand how to request and mobilise National Resilience assets

Search

Hazards	Control measures
Lack of co-ordinated search plan (generic)	Gather information from the public and liaise with other agencies Have a clearly defined area of operations Ensure crews have detailed taskings Have adequate communications Control and co-ordinate search teams Use thermal imaging cameras Provide adequate lighting
Lack of co-ordinated search plan (transport)	Search in hidden voids

Hazards	**Control measures**
	Review passenger/cargo manifests Be aware of seating capacities Look for other indicators
Noise impact from industrial processes, machinery or transport	Isolate industrial processes, machinery or transport Control the numbers of personnel entering premises or transport Reduce exposure by distance, time and crew rotation Wear personal protective equipment (PPE)
Persons at risk	Handle calls efficiently Gather information from the public and liaise with other agencies Deploy appropriate resources in line with operational requirements
Scene of operations or terrain	Isolate industrial processes or machinery Identify and designate access and egress routes (safe routes) Control the numbers of personnel Appoint a safety officer to monitor personnel Hold team briefings
Potential collapse of unstable ground	Establish a hazard zone Appoint safety officers Record personnel within the area of operations Deploy the minimum number of personnel Give specific tasks Employ a safe system of work to recover casualties and rescuers
Contact with animals or insects during search for or extrication of casualties	Isolate animals Establish alternative access/egress routes Consider hygiene Undertake decontamination Carry out post-incident health monitoring

Hazards	Control measures
	Wear personal protective equipment (PPE) or respiratory protective equipment (RPE)

Extrication of a casualty

Hazards	Control measures
Failure to extricate the casualty without deterioration of their condition	Make the inner cordon safer Stabilise the casualty Extricate the casualty

Extrication – generic

Hazards	Control measures
Equipment used by other agencies	Identify equipment and communicate accordingly Isolate and remove the equipment Be oxygen aware Establish an equipment or tool dump
Tools	Use other methods of space creation Identify the most appropriate tool for the task Manage tool operatives and their actions Wear personal protective equipment (PPE) Manage the effects of tool use

Extrication from the built or natural environment

Hazards	Control measures
Primary surface extrication of casualties following collapse of a structure	Give a specific team briefing highlighting avoidance routes Appoint safety officers Provide adequate lighting Use thermal imaging cameras (TIC) Have adequate communications

Hazards	Control measures
Manual handling over terrain	Deploy adequate personnel Rotate crews Use casualty transport equipment Use motorised vehicles
Extrication of casualties from confined spaces	Employ information gathering Isolate machinery, processes and utilities Establish appropriate safe systems of work Appoint safety officers Provide adequate lighting Have adequate communications Undertake decontamination
Restricted or complex layout affecting extrication of casualties	Deploy adequate personnel Rotate crews Use equipment for working at height Use casualty transport equipment Use extrication tools
Entrapment due to failure of internal fixings or exposed cables	Give a specific team briefing highlighting avoidance routes Follow breathing apparatus (BA) procedures Provide adequate lighting Remove or secure internal fixings or cables Use thermal imaging cameras

Extrication from any form of transport

Hazards	Control measures
Objects involved in collision	Identify direction of movement Stabilise Relocate objects in a controlled manner Deploy the minimum number of personnel

Hazards	Control measures
	Consider access for other agencies
Vehicle contents	Identify direction of movement Stabilise Empty vehicle load to a safe place Consider methods of entry Consider access for other agencies
Unstable vehicle containing casualties	Make a safe approach Manage vehicle air systems Stabilise the vehicle Control the numbers of personnel entering or working around the vehicle Maintain access to and egress from the vehicle Appoint safety officers

Extrication from air transport

Hazards	Control measures
Military aircraft	Make a safe approach Establish, monitor and maintain cordons Isolate aircraft armament Gain safe access to the cockpit Make ejection seats safe Extricate the aircrew
Rotary-wing aircraft	Make a safe approach Establish, monitor and maintain cordons Stabilise

Hazards	Control measures
	Apply the rotor brake Avoid deploying the Automatically Deployable Emergency Locator Transmitter (ADELT) unit Avoid activating flotation devices
Aircraft undercarriages	Establish, monitor and maintain cordons Stabilise
Escape slides	Identify slides and access points Establish, monitor and maintain cordons
Aircraft ballistic parachute systems	Identify systems and communicate their positions Isolate on board Manage the deployed parachute
Aircraft electrical systems	Identify and isolate using on-board systems Isolate battery supplies Isolate fuel systems
Man-made mineral fibres (MMMF)	Identify locations and communicate them Establish, monitor and maintain cordons Apply foam Prevent manipulation or damage Wear personal protective equipment (PPE) Undertake decontamination
Metals	Know the capabilities and uses of rescue equipment Wear personal protective equipment (PPE)

Extrication from rail transport

Hazards	Control measures

Hazards	Control measures
Weight / instability	Request specialist knowledge Stabilise
Electrical systems (pantograph, batteries, high voltage (HV) connectors)	Request specialist knowledge
Steam engines	Request specialist knowledge
Air systems	Request specialist knowledge Stabilise
Asbestos (older rolling stock)	Be aware of the Total Operating Processing System (TOPS) Request hazardous materials and environmental protection advice
Man-made mineral fibres (MMMF)	Request specialist knowledge Request hazardous materials and environmental protection advice Apply foam Prevent manipulation or damage
Polychlorinated biphenyls (PCB)	Request hazardous materials and environmental protection advice
Toilets and sewage systems	Establish hygiene controls Undertake decontamination
Detonators	Request specialist knowledge
Delay in accessing driver or passenger compartments	Use designated doors and windows
Air conditioning systems	Request specialist knowledge Request hazardous materials and environmental protection advice

Extrication from road transport

Hazards	Control measures
Alternative fuelled vehicles (AFV)	Identify the vehicle and communicate its type Carry out a scene assessment Control vehicle movement Use appropriate extrication techniques Isolate high voltage systems
New or heavy vehicle construction	Identify the vehicle construction and communicate the information Make the correct tool choice Be aware of the respiration of particles and dermal irritation Be aware of the release of energy from structural vehicle components Manage heavy vehicle considerations
Unconventional and specialist road vehicles	Identify the vehicle Isolate the power supply Establish appropriate distance Contain the vehicle or cargo Use specialist cutting equipment Request specialist knowledge
Vehicle supplementary restraint systems (SRS)	Identify the SRS and communicate the information Establish appropriate distance Isolate the systems Prevent manipulation or damage

Extrication from machinery, lifts and escalators

Hazards	Control measures

Gaining access to machine rooms and shafts	Establish a safe working environment
Noise	Use hearing protection
Power systems	Request specialist knowledge Isolate supplies
Stored energy	Request specialist knowledge Isolate supplies
Moving or displaced machinery parts	Request specialist knowledge Isolate supplies
Hydraulics and lubricants	Request hazardous material and environmental protection advice

Casualty care

Hazards	**Control measures**
Failure to assess, identify and treat life-threatening problems of the casualty	Follow principles of casualty care Carry out structured assessment and treatment using <C> Ac B C D E
Single 'dead' casualty	Use effective Cardiopulmonary Resuscitation (CPR) and use of Automated External Defibrillator (AED) Wear personal protective equipment (PPE)
Failure to hand over vital casualty information	Offer a structured handover to an appropriately trained and competent practitioner
Multiple casualties	Employ METHANE structured update Establish a triage sieve (adult and paediatric)
Bariatric casualty	Make an early identification of the bariatric casualty Use bariatric management equipment Request an early deployment of advanced medical support
Thermal or chemical injury	Treat the burn

Hazards	**Control measures**
	Neutralise the chemical irritant Cover or dress the wound Manage pain and distress
Casualty has body part crushed	Create a safe environment for the casualty and responders Assess the casualty using standard <C> Ac B C D E Request an early deployment of advanced medical support Plan for the casualty deteriorating on release Protect from hypothermia or hyperthermia

Intraoperability and interoperability

Intraoperability

In accordance with the Fire and rescue national framework for England, "Each fire and rescue authority must produce an integrated risk management plan that identifies and assesses all foreseeable fire and rescue related risks that could affect its community, including those of a cross- border, multi-authority and/or national nature. The plan must have regard to the Community Risk Registers produced by Local Resilience Forums and any other risk analyses as appropriate".

This should include the intraoperability of resources and assets within individual and bordering fire and rescue services as well as National Resilience assets available through National Co-ordination and Advisory Framework (NCAF) arrangements.

Interoperability

Interoperability is inextricably linked to the Joint Emergency Services Interoperability Principles (JESIP) doctrine. Fire and rescue services should be aware of the aspects of interoperability that exist when identifying, assessing and preplanning for all incident types and eventualities they may attend.

In addition to the Community Risk Register, firefighters retain a wealth of local knowledge of risks or potential scenarios within station areas that would benefit from a multi-agency response and that may not be captured within the broader Community Risk Register. This information may be contained within Site-Specific Risk Information (SSRI) or similar formats.

It is essential that all components of fire and rescue services, including fire control staff, operational planning departments and incident commanders, identify and liaise with relevant partner agencies. This ensures that in the event that they are required to respond to different incident types, all agencies are fully aware of the assistance available to maximise effectiveness in saving lives and reducing harm.

Joint Emergency Services Interoperability Principles (JESIP)

The Joint Emergency Services Interoperability Principles (JESIP) Joint Doctrine: The Interoperability Framework, advocates the use of the METHANE mnemonic for information gathering by and information sharing between emergency responders, their control rooms and other agencies.

This mnemonic should be used when passing information between emergency responders, their control rooms and other agencies so that shared situational awareness can be established:

- **M**ajor incident declared?
- **E**xact location
- **T**ype of incident e.g. explosion or building collapse
- **H**azards present, potential or suspected
- **A**ccess – routes that are safe to use

- **N**umber, type and severity of casualties
- **E**mergency services now present and those required

The broader principles of intraoperability and interoperability at the pre-incident stage are captured above, and the principles will be augmented by the on-scene interoperability information contained in the JESIP doctrine.

Fire control room failing to identify and notify appropriate resources

Hazard	Control measures
Fire control room failing to identify and notify appropriate resources	Ensure fire control operators have knowledge of internal and external resources, their availability and the request or mobilisation procedures Have effective and current prompts, action plans and contact details Have mutual aid or memoranda of understanding arrangements in place Understand how to request and mobilise National Resilience assets

Hazard knowledge

Search and rescue incidents predominately require a multi-agency response and in many cases may require specialist teams.

The skills required may need to be sourced from internal resources, other fire and rescue services or external agencies.

Fire control rooms will need to identify and notify appropriate resources based on the information received and their subsequent prompts or action plans.

Without access to the required resources it may not be possible to fulfil the statutory duties of the fire and rescue service, resulting in the incident worsening.

Further information about fire control rooms can be found in the Operations guidance.

Control measure – Ensure fire control operators have knowledge of internal and external resources, their availability and the request or mobilisation procedures

Control measure knowledge

Fire and rescue services should ensure that fire control operators are aware of the internal and external resources available to assist in performing rescues from locally identified risks. They should also understand

how to request and mobilise assets, both locally and nationally. Effective arrangements should include an understanding of roles and responsibilities of the relevant agencies.

Control measure actions

- Arrangements should be in place for effective and timely application of relevant procedures
- Any arrangements should ensure that all requests are processed in a timely manner

Control measure – Have effective and current prompts, action plans and contact details

Control measure knowledge

Fire and rescue services should ensure they have relevant and user-friendly procedures and prompts or action plans. Contingency arrangements should be in place to ensure that any interruption is managed effectively and the delivery of service to the public is maintained.

Control measure actions

- Effective arrangements should enable fire control rooms to notify or mobilise appropriate resources
- Arrangements should include a periodic review of prompts, action plans and contact details

Control measure – Have mutual aid or memoranda of understanding arrangements in place

Control measure knowledge

Fire and rescue services should have an awareness and understanding of all relevant protocols. They should be aware of mutual aid arrangements and develop memoranda of understanding (MoUs) to suit the needs of their risk management plan and should ensure that there are appropriate and current procedures for mobilising internal and external resources.

Control measure actions

- Effective arrangements should enable fire control rooms to notify or mobilise appropriate resources
- Any arrangements should ensure that all requests are processed in a timely manner

Control measure – Understand how to request and mobilise National Resilience assets

Control measure knowledge

Fire and rescue services should have an awareness of National Resilience capabilities that should include an understanding of the arrangements contained in the National Co-ordination Advisory Framework (NCAF). They should also ensure that there are appropriate and current procedures to deal with any related requests.

Control measure actions

- Effective arrangements should enable fire control rooms to notify or mobilise appropriate resources

- Any arrangements should ensure that all requests are processed in a timely manner

Incident commander failing to identify and request appropriate internal and external resources

Hazard	Control measures
Incident commander failing to identify and request appropriate internal and external resources	Identify and record local risks in conjunction with partner agencies and local resilience forums (LRFs) Be aware of internal resources and availability Be aware of external resources and availability Have mutual aid or memoranda of understanding arrangements in place Understand how to request and mobilise National Resilience assets

Hazard knowledge

Search and rescue incidents predominately require a multi-agency response and in many cases may require specialist teams. The skills required may need to be sourced from internal resources, other fire and rescue services or external agencies. Without the required resources it may not be possible to fulfil the statutory duties of the fire and rescue service, and result in the incident worsening.

Control measure – Identify and record local risks in conjunction with partner agencies and local resilience forums (LRFs)

Control measure knowledge

Fire and rescue services should understand the requirements of the Civil Contingencies Act 2004 and, in particular, collaborate with the LRF and partner agencies to identify local risks. This collaboration should include an understanding of the contribution to the community risk register from the fire and rescue service and other agencies. Fire and rescue services should understand the relationship between their risk management plan and the community risk register, and understand the arrangements for obtaining Site-Specific Risk Information (SSRI)

Control measure actions

- Fire and rescue services should ensure that arrangements are in place to meet the demands of the locally identified risks
- These arrangements should include a facility for a periodic review of risk registers
- Arrangements should be in place to produce and publish risk management plans, which have due regard to the community risk register

- These arrangements should include an effective relationship with any SSRI process

Control measure – Be aware of internal resources and availability

Control measure knowledge

Fire and rescue services should ensure that fire control operators are aware of the relevant internal resources, their capabilities, roles and responsibilities. Fire control room procedures should include prompts and action plans to enable personnel to notify or mobilise appropriate resources. Contingency arrangements should be in place to ensure that any interruption is managed effectively and the delivery of service to the public is maintained.

Control measure actions

- Effective arrangements should enable fire control rooms to notify or mobilise appropriate resources
- Any arrangements should ensure that all requests are processed in a timely manner

Control measure – Be aware of external resources and availability

Control measure knowledge

Fire and rescue services should be aware of the capabilities and limitations of external assets, including Category 1, Category 2 and non-governmental organisation (NGO) responders. Fire control room procedures should include prompts and action plans to enable them to notify or mobilise appropriate resources, and these prompts and action plans should include contact details for requesting external resources. Effective arrangements should include an understanding of the roles and responsibilities of the relevant agencies, and contingency arrangements should be in place to ensure that any interruption is managed effectively and the delivery of service to the public is maintained.

Control measure actions

- Effective arrangements should enable fire control rooms to notify or mobilise appropriate resources
- Any arrangements should ensure that all requests are processed in a timely manner

Control measure – Have mutual aid or memoranda of understanding arrangements in place

Control measure knowledge

Fire and rescue services should have an awareness and understanding of all relevant protocols, which should include identifying any cross border arrangements with neighbouring fire and rescue services. They should be aware of mutual aid arrangements and develop memoranda of understanding (MoUs) to suit the needs of their risk management plan.

Control measure actions

- Effective arrangements should enable fire control rooms to notify or mobilise appropriate resources

- These arrangements should include a periodic review of any local and national agreements
- Any arrangements should ensure that all requests are processed in a timely manner

Control measure – Understand how to request and mobilise National Resilience assets

Control measure knowledge

Fire and rescue services should be aware of National Resilience capabilities. This should include an understanding of the arrangements contained within the National Co-ordination Advisory Framework (NCAF), which should in turn ensure participation in mutual aid and access to resources, such as tactical advisors

Control measure actions

- Fire and rescue services should test any arrangements as part of their exercise programme with other services
- Effective arrangements should enable fire control rooms to notify or mobilise appropriate resources
- Any arrangements should ensure that all requests are processed in a timely manner

Search

Operating principles

There are four phases in every search and rescue scenario. Depending on the incident, they may be present to a greater or lesser degree. They are known by the 'LAST' acronym:

Locate

Access

Stabilise

Transport

These phases are the basis of a set of principles that may be applied at every incident requiring search and rescue operations. The nature and complexity of the situation should determine the levels of management and control applied to the incident and the scale of the search and rescue operations.

Fire and rescue services should be prepared to deal with this type of operation. Guidance for operational planning may be found in *Section 7, Planning and Implementing operational policy*, of the Fire and Rescue Authorities, Health, safety and welfare framework for the operational environment.

The overall responsibility for search and rescue operations should rest with the appropriate (lead) agency and their representative. A competent person from the lead agency should be nominated as soon as possible in the operations to co-ordinate resources and activity around the search and rescue principles.

The requirement for search and rescue operations will usually fall into one of the following broad categories:

- Operations in the built environment

Such as a fire in a building or a collapsed structure

- Operations in the natural (open) environment

Such as unstable ground or a wide area search on land or water

Please note that an incident involving a confined space may occur in either of these categories.

Locate

- 'Locate' represents the search phase. This may be brief, in the case of a clearly identified casualty, or protracted, when the person is reported to be missing.
- Identify, record and mark the point last seen (PLS) or last known position (LKP) (collectively known as the initial planning point (IPP)).
- Record the casualty details and time at PLS or LKP
- Assess the situation in terms of significant hazards, operational activity and the required resources. Resources include personnel, personal protective equipment (PPE) and work equipment (including firefighting, rescue and communication equipment).
- Allocate tasks and brief operational crews on the working environment, hazards, tasks and communication method – enhance the briefing with visual information, such as suitable plans and annotation
- Take into consideration the resources available and, en route, consider what else may be required
- Establish search management records. Operational crews should landmark any recognisable features to:
    - Provide orientation, and therefore support. for effective briefing of crews
    - Support effective recording of the areas and compartments that have been searched
    - Communicate progress to inform the overall tactical plan
- If the casualty is not immediately located, a number of search phases may be identified and considered: primary phase, secondary phase, tertiary phase and so on
- Identify and employ a safe system of work throughout
- Ensure this information is communicated and included within the overall tactical plan

Access

- Start a dynamic risk assessment (DRA) and communicate the findings when the casualty is located
- Identify the agency with the appropriate capability to access the casualty
- Update search management records using progress and activity reports

Stabilise

- 'Stabilise' should involve stabilising both the situation and any casualties
- Stabilise the situation to reduce the risk to operational crews and prevent further harm to any casualties. Examples may include securing unstable structures or ground, or controlling a fire compartment
- Stabilise the casualty by physically isolating them from any immediate hazard with the potential to cause harm. Ideally, any hazard should be removed from the vicinity of the casualty. If the hazard cannot be removed the casualty should be moved to a place of (relative) safety
- Assess and secure the casualty following the <C> Ac B C D E approach
- Carry out casualty packaging for transport, extrication and rescue using, for example, a vacuum mattress, scoop stretcher or basket stretcher
- Prepare for transport and rescue
- Communicate progress to inform the overall tactical plan

Transport

'Transport' is the final part of the operation. It should provide the removal of any casualties to a place of relative safety and definitive care.

- It is important to remember that the casualty should be protected from any harm during this part of the operation
- Information that may be relevant and important for casualties to be safely and effectively transported should be passed to the responsible agencies. Consider briefing paramedic staff using ATMIST as a handover tool, details of which can be found in the Casualty care section of this guidance. Information transferred in this format should contribute to successful pre-hospital care.
- Operational crews, their personal protective equipment (PPE) and other equipment should be removed to a place of safety

End of the incident

Operational activities should be safely and effectively managed throughout the closing stage of an incident. A debrief should be conducted to identify best practice and lessons learned.

Guidance on incident debrief may be found within *Section 12, Performance review*, of the Fire and Rescue Authorities, Health, safety and welfare framework for the operational environment.

Lack of co-ordinated search plan (generic)

Hazard	Control measures
Lack of co-ordinated search plan (generic)	Gather information from the public and liaise with other agencies Have clearly defined area of operations

	Ensure crews have detailed taskings Have adequate communications Control and co-ordinate search teams Use thermal imaging cameras Provide adequate lighting

Hazard knowledge

In this guidance, the term 'search' refers to the processes used to locate a missing person or object. A missing person is anyone whose whereabouts cannot be established and where the circumstances suggest the person may be at risk of harm to themselves or another. The term 'absent person' is defined by the Association of Chief Police Officers (ACPO) as anyone not at a place where they are expected or required to be.

If a co-ordinated search plan is not carried out in a timely and structured way, the casualty may not be located and their condition could potentially deteriorate.

The working environment, weather conditions and time of day may affect the search, especially with regard to visibility. This may make it more difficult to carry out an effective search, as people and objects may be difficult to distinguish.

Control measure - Gather information from the public and liaise with other agencies

Control measure knowledge

Initial crews will need to gather information from members of the public and liaise with other agencies in attendance.

Control measure actions

Information to be gathered includes:

- Casualty numbers and details
- Location
- Environmental considerations
- Last known position (LKP) or point last seen (PLS) of casualties, including time(s)

Control measure – Have clearly defined area of operations

Control measure knowledge

To carry out a co-ordinated search plan, the best way of defining and subdividing the search area should be considered. Once designated, search teams should confirm this, and provide regular updates to the incident commander.

Control measure actions

Identify clearly defined parameters of the search area and subdivide into appropriate sizes depending on:

- Structure
- Terrain
- Natural features
- Type and size of transport involved
- Available resources

If visibility is reduced, or at night, give additional consideration to using safe routes and landmarks.

Control measure – Ensure crews have detailed taskings

Control measure knowledge

Before tasking personnel, incident commanders should consider all available sources of information. Team briefings should be based on incident needs and a plan should be constructed to achieve them. Continuous evaluation and review throughout the incident will determine whether the current objectives and subsequent plan are appropriate.

Control measure actions

- Crews should be given a brief, including the area to be searched along with information available on casualties, their last known position (LKP) or point last seen (PLS).

Control measure – Have adequate communications

Control measure knowledge

Effective communications should be established with the search co-ordinator and the deployed crews. These are essential for a successful outcome to operations, both within the incident command structure where they are vital to the incident commander in ensuring that the current objectives and subsequent plan are appropriate, but also between safety officers and crews. If distances are adequate, verbal communications may be more appropriate during the dynamic stages of the incident. Refer to the Operations guidance for further information.

Control measure actions

- Co-ordinate hand-held radio use, with clearly defined channel allocation. This is important in ensuring an incident command structure is established and maintained correctly throughout the incident
- Pre-determine the audible signals to be used, either verbal or mechanical
- Carry out communication checks periodically and pre-determine a 'lost communications procedure'

- Give clear briefs on maintaining and minimising communications equipment traffic to ensure only critical information is sent and received
- Confirm the evacuation procedure and signal for critical events

Control measure – Control and co-ordinate search teams

Control measure knowledge

There should be a clearly identified chain of command for updating and reporting back information to the incident commander, who can continually review and amend their tactical plan.

Control measure actions

- Establish a robust and structured incident command structure, with clearly defined roles and confirmed spans of control
- Undertake regular briefings to update incident commanders of the progress of operations

Control measure - Use thermal imaging cameras

Control measure knowledge

Thermal imaging cameras can be used to locate people, especially at night or if visibility is reduced. In these situations, a thermal imaging camera can prove invaluable to search operations.

Control measure actions

- Consider providing thermal imaging cameras to each team entering the area of operations
- The incident commander should enforce the importance of correct search procedures, to reduce reliance on thermal imaging cameras

Control measure - Provide adequate lighting

Control measure knowledge

Many searches will need to be undertaken at night or with reduced visibility. Adequate scene lighting should be used to define safe routes, and scene of operations. Refer to the Operations guidance for further information.

Control measure actions

- Consider how appropriate personal or scene lighting should be used
- Ensure sufficient lighting resources are requested
- Make sure generators are located at an appropriate distance from the scene of operations. This avoids exhaust fumes entering the void and can also reduce noise pollution

- Ensure sufficient quantities of fuel for generators are available at the scene to ensure a loss of lighting does not hamper rescue operations

Lack of co-ordinated search plan (transport)

Hazard	Control measures
Lack of co-ordinated search plan (transport)	Search in hidden voids Review passenger/cargo manifests Be aware of seating capacities Look for other indicators

Hazard knowledge

In this guidance, the term 'search' refers to the processes used to locate a missing person or object in incidents involving all forms of transport. A missing person is anyone whose whereabouts cannot be established and where the circumstances suggest the person may be at risk of harm to themselves or another. The term 'absent person' is defined by the Association of Chief Police Officers (ACPO) as anyone not at a place where they are expected or required to be.

If a co-ordinated search plan is not carried out in a timely and structured way, the casualty may not be located and their condition could potentially deteriorate.

On arrival at incidents, the exact location of casualties or numbers involved may not be apparent, even after carrying out a scene assessment including an inner and outer survey.

Surveying the scene

Once the incident commander has assessed the scene and determined the nature of any hazards present, they can decide to task others to carry out a more intensive survey of the scene. This can be achieved by initiating inner and outer surveys.

Performing a circular survey of the incident gives a 360 degree view of the scene and can save valuable time by allowing the rescuers to develop an adequate plan of action.

Inner survey

An inner survey allows closer examination of the vehicles. One or two rescuers walk adjacent to the vehicles, checking the immediate area for casualties and any hazards. During this assessment a look under the vehicles can help identify:

- That there are no further casualties underneath
- Any weak areas of the vehicle due to accident damage that will require additional stabilisation
- The presence of any fuel or oil from the accident

- The presence of supplementary restraint systems (SRS)
- Any other situation requiring attention, e.g. the position of catalytic converters

Outer survey

One or two rescuers walk completely around the vehicle. They look in towards the car and out to the perimeter of the scene, checking for casualties, obstructions, and any potential problems, while remaining two to five metres away from the vehicle. All information gathered should be shared with personnel in attendance.

Incident commanders should consider any areas of vehicles that may have not been thoroughly checked because they lack obvious signs of any casualties.

With larger forms of transport – aircraft and trains that have crashed or derailed, for example – the interior will be unfamiliar. As a result of the damage, disorientation may lead to confusion for the search personnel.

For example, the interior of an aircraft will be unfamiliar to fire and rescue service personnel. It is therefore vital to personnel working inside the aircraft that firefighting, search and rescue operations are methodical. In these situations, fire and rescue services should use the knowledge and expertise of the rescue and firefighting service personnel (from an airport) if in attendance.

Fire and rescue service personnel should be aware of the benefits of a structured and co-ordinated approach to search operations. Six elements should be considered; they will help in performing a well-controlled rescue from various forms of transport. These elements are:

- Scene assessment and safety
- Stabilisation and initial access
- Glass management
- Space creation
- Full access
- Immobilisation and casualty extrication techniques

The involvement of other emergency services, such as specialist USAR teams, or appropriate resources and casualty care should be considered.

Control measure – Search in hidden voids

Control measure knowledge

Before tasking personnel, incident commanders should consider all available sources of information and assess the developing incident. Incident commanders and crews should have an understanding of the layout of various road vehicles, including passenger-carrying vehicles such as cars, minibuses and coaches, commercial light goods vehicles (LGV), trains and aircraft.

Control measure actions

Incident commanders should give crews specific briefings and ensure crews understand the plan. In structuring search plans, a thorough check of hidden voids should be considered. These include:

- Under seats
- Sleeping compartments on coaches, LGV, trains and aircraft
- Luggage compartments
- Toilets
- Cargo or luggage areas

Control measure – Review passenger/cargo manifests

Control measure knowledge

Where possible, incident commanders should review passenger lists to determine the number of persons involved (though this will not apply to certain types of transport such as local buses with a transient and variable amount of passengers). Incident commanders should also check the lists against the number of casualties located, and those who may have been taken to hospital before fire and rescue service resources arrived. Cargo and load manifests should be checked for any potential hazards to casualties and rescuers.

Control measure actions

- If commercial vehicles are involved, contact vehicle operators to obtain employee and passengers numbers and a list of cargo for LGVs, if applicable
- Interview driver or passengers to determine the number of persons involved

Control measure – Be aware of seating capacities

Control measure knowledge

Incident commanders should consider confirming the seating capacities of larger forms of transport. This can indicate the potential number of persons involved, though it should be borne in mind that the vehicle may not have been full at the time of departure and may have had several drop off points. Refer to the control measure *Review passenger/cargo manifests*

Searching in larger forms of transport should be done in a methodical manner and in a way that subsequent teams can assist or re-enter and continue with the search. The use of seat counting and simple laminated charts depicting seat layouts can be useful in identifying casualties and as a reference point for subsequent fire and rescue service rescue teams.

Control measure actions

- Task personnel with an initial count of seating, which they should confirm with the incident commander who can formulate a tactical plan

Control measure – Look for other indicators

Control measure knowledge

Casualties may have fallen or been thrown clear due to the impact. The incident commander should consider other visual indicators to identify this possibility, including the presence of:

- Child seats
- Disabled badges or ramp access

Control measure actions

- Carry out a structured search of the surrounding area, consider an early request for canine search teams and police helicopters to undertake a wider area search
- Hidden voids should be thoroughly searched and a confirmation of the outcome passed to the incident commander
- Use of specialist search equipment, including thermal imaging cameras, may assist in locating casualties, although this does not replace the need for correct, systematic and methodical search procedures

Noise impact from industrial processes, machinery or transport

Hazard	Control measures
Noise impact from industrial processes, machinery or transport	Isolate industrial processes, machinery or transport Control the numbers of personnel entering premises or transport Reduce exposure by distance, time and crew rotation Wear personal protective equipment (PPE)

Hazard knowledge

In this guidance, the term ‘noise’ incorporates any form of sound in a search environment that is due to industrial processes, machinery and transport, and that can affect the ability to communicate effectively or to hear audible warning devices.

In defining this hazard and associated control measures, it is assumed that the appropriate resources (personnel and equipment) are available, and that personnel have the training required to appreciate the potential impact of noise on communication between the incident commander and crews, and between crews directly.

An additional element of this hazard is that the noise generated by machinery or transport, including the equipment being used by the fire and rescue service, may prevent rescuers from hearing the casualty.

Control measure – Isolate industrial processes, machinery or transport

Control measure knowledge

Before committing crews, incident commanders should ensure industrial processes, machinery or transport are isolated. This will have an impact on communications and could potentially affect the search for and extrication of a casualty.

Control measure actions

- Isolate, seeking advice from the owner or occupier, on-site engineers or maintenance engineers if necessary
- If it is not possible to isolate on site, consider asking the electricity supply company to isolate the premises remotely

Control measure – Control the numbers of personnel entering premises or transport

Control measure knowledge

To reduce personnel exposed to risk, numbers of fire and rescue service and other emergency services personnel should be kept to the minimum appropriate to achieve the task.

Control measure actions

- Maintain appropriate communications, taking into account the level of noise
- Ensure crews are regularly updated with information about hazards and their isolation
- Make sure incident commanders are updated regularly, so that plans can be reviewed and updated with personnel requirements

Control measure – Reduce exposure by distance, time and crew rotation

Control measure knowledge

Before tasking personnel, incident commanders should consider all available sources of information and assess the developing incident. Team briefings should be based on the incident with safe access and egress routes highlighted. This should ensure crews are not exposed to potential risks and also that travel distances are kept to a minimum when transporting equipment or casualties. Crews should be monitored continually to reduce potential effects of fatigue.

Control measure actions

- Clearly define access and egress routes to crews and confirm their understanding
- Clearly delineate routes using physical barriers, and clearly illuminate them if there is reduced visibility
- Continually monitor routes, and update crews with any changes

- Ensure routes are appropriate to the task; consider manual handling implications when transporting equipment and casualties

Control measure – Wear personal protective equipment (PPE)

Control measure knowledge

All personnel involved in the stabilising and extrication of casualties, whether fire and rescue personnel or those of other agencies, should wear personal protective equipment (PPE) suitable for the task.

Control measure actions

- Monitor personnel to ensure correct and suitable PPE is both available and used throughout the incident

Persons at risk

Hazard	Control measures
Persons at risk	Handle calls efficiently Gather information from the public and liaise with other agencies Deploy appropriate resources in line with operational requirements

Hazard knowledge

In this guidance, the term 'person at risk' refers to any person in a situation that exposes them to a risk of death, serious injury or serious illness. Therefore 'persons at risk' include the fire and rescue service personnel undertaking the rescue and the individuals who need to be located and/or rescued.

Based on available information and deployed resources, there will be occasions when fire and rescue service personnel are unable to locate and rescue casualties in conjunction with other emergency services and agencies. Fire and rescue service incident commanders need to be aware of the benefits of a structured and co-ordinated approach to search operations.

Requesting and involving fire and rescue service USAR teams and other emergency services or appropriate resources should be considered.

Control measure – Handle calls efficiently

Control measure knowledge

Appropriate information gathering is required to co-ordinate the appropriate resources.

Control measure actions

To mobilise appropriate resources and ensure a timely multi-agency response, fire and rescue control centres should ensure they employ robust information gathering and should notify other appropriate agencies as soon as possible

Control measure – Gather information from the public and liaise with other agencies

Control measure knowledge

Initial crews will need to gather information from members of the public and liaise with any other agencies in attendance.

Control measure actions

Information to be gathered includes:

- Casualty numbers
- Location
- Environmental considerations
- Last known position (LKP) or point last seen (PLS) of casualties

Control measure – Deploy appropriate resources in line with operational requirements

Control measure knowledge

The aim is to ensure personnel are equipped to identify all persons currently at risk or who may potentially be at risk. For further information, refer to the 'Safety Management' section of the Incident Command guidance.

Control measure actions

Incident commanders should continually review and reassess the incident after their initial assessment, including the:

- Status of those directly involved in the situation
- Status of other persons present
- Nature of the incident
- Location and environment in which the events are unfolding
- Underpin this by liaising with others on the scene, including other agencies and members of the public, and gathering information from them. Also consider current site-specific risk information (SSRI)

This information will also inform the nature of operational response and, in particular, appropriate incident command. This should include:

- Clarity of roles and activities to be performed and who will perform them
- Spans of control

- Communicating roles, activities and spans of control and the risks present and controls required or implemented
- Co-operating with and liaising between the responders and agencies involved and/or present
- A clear, understood and observed chain of command
- Co-ordinating operations and having suitable control over the span of operations
- Access to the scene of operations (cordoned or not) and the resources deployed

Scene of operations or terrain

Hazard	Control measures
Scene of operations or terrain	Isolate industrial processes or machinery Identify and designate access and egress routes (safe routes) Control the numbers of personnel Appoint a safety officer to monitor personnel Hold team briefings

Hazard knowledge

In this guidance, the term 'scene of operations or terrain' applies to the conditions underfoot and physical objects, both manmade and natural, that fire and rescue service personnel may have to traverse to the scene of operations, to locate, access, stabilise and transport casualties to a place of safety. This may include open land with underfoot hazards in a rural environment or machinery and plant in a built environment that fire and rescue service personnel need to cross when searching for or extricating a casualty.

Control measure – Isolate industrial processes or machinery

Control measure knowledge

Before committing crews to the search area, incident commanders should ensure that industrial processes or machinery are isolated. If this is not possible, the condition of the utilities present in the structure should be continually monitored. Dynamic risk assessments based on the information received from the monitoring process can dictate additional control measures and will provide personnel with information on the working environment.

Control measure actions

- Request that local electricity supply companies attend to isolate the incoming supply if the Responsible Person (or appointed competent person) cannot confirm isolation

- Consider avoidance routes if crews are still to be committed to carry out a search and/or extrication – there may be a need to stabilise the casualty before isolation and extrication

Control measure - Identify and designate access and egress routes (safe routes)

Control measure knowledge

Before tasking personnel, incident commanders should consider all available sources of information and assess the developing incident. Team briefings should be based on the incident with safe access and egress routes highlighted. This should ensure crews are not exposed to potential risks. Underfoot conditions and prevailing weather conditions should be taken into account, with continuous evaluation and review throughout the incident to determine whether the current tactical plan is effective.

Control measure actions

- Clearly define access and egress routes to crews and confirm their understanding
- Clearly delineate routes using physical barriers and clearly illuminate them if there is reduced visibility
- Continually monitor routes, and update crews with any changes
- Ensure routes are appropriate to the task; consider manual handling implications when transporting equipment and casualties

Control measure – Control the numbers of personnel

Control measure knowledge

To reduce personnel exposed to risk, numbers of fire and rescue service and other emergency services personnel should be kept to the minimum appropriate to achieve the task.

Control measure actions

- Ensure appropriate communications are maintained and that crews are updated regularly with information about hazards and their isolation

Control measure – Appoint a safety officer to monitor personnel

Control measure knowledge

Safety officers should be appointed at various locations to give an overall view of and to control the inner cordon and scene of operations. Additional resources may be required to ensure the number of safety officers in place is sufficient.

Control measure actions

- Establish and maintain adequate communications between safety officers and the incident commander, with clear areas of responsibility defined

Control measure – Hold team briefings

Control measure knowledge

Before commencing search, locate and casualty extrication operations, it is essential that incident commanders brief crews clearly.

Control measure actions

- in the briefing , clearly set out search perimeters and highlight any known or perceived risks
- Establish and maintain adequate lines of communications, including appropriate evacuation signals

Potential collapse of unstable ground

Hazard	Control measures
Potential collapse of unstable ground	Establish a hazard zone Appoint safety officers Record personnel within the area of operations Deploy the minimum number of personnel Give specific tasks Employ a safe system of work to recover casualties and rescuers

Hazard knowledge

In this guidance, sudden collapse or the failure of unstable ground can be attributed to adverse weather conditions or naturally-occurring erosion that has undermined the integrity of the ground, so that it can fail without warning. The presence of unstable ground after a partial building collapse should also be considered.

Through knowledge pooling between various agencies and through information sharing within local resilience forums, fire and rescue service personnel should be aware of specific areas within service boundaries that have potential for failure.

Involving specialist fire and rescue teams (such as USAR and line rescue) and other emergency services or appropriate resources should be considered.

Control measure – Establish a hazard zone

Control measure knowledge

Hazard zones should be adequate and incorporate wide safety margins.

Control measure actions

- Locate vehicles and personnel sufficiently far away from any potential risk area, whether that is a known or perceived risk area

Control measure – Appoint safety officers

Control measure knowledge

Safety officers should be appointed at various locations to give an overall view of and to control the inner cordon and scene of operations. Additional resources may be required to ensure the number of safety officers in place is sufficient. Refer to the Incident Command guidance for further information.

Control measure actions

- Establish and maintain adequate communications between safety officers and the incident commander, with clear areas of responsibility defined

Control measure – Record personnel within the area of operations

Control measure knowledge

Fire and rescue services should employ a robust system to record numbers and locations of crews in the area of operations. This should be able to include non-fire and rescue service personnel who are directly involved with search, locate and rescue operations.

Control measure actions

- Establish inner and outer cordons with suitable cordon distances from the scene of operations
- Monitor and maintain cordons closely. For further information on cordons, refer to the Incident Command guidance.

Control measure – Deploy the minimum number of personnel

Control measure knowledge

Incident commanders should ensure that the minimum numbers of personnel needed to ensure a successful outcome are deployed within the risk area.

Control measure actions

- Continually monitor and review to ensure that adequate fire and rescue service resources, and other agency resources, are both requested and available. For further information, refer to the *Intraoperability and interoperability* section.

Control measure – Give specific tasks

Control measure knowledge

Team briefings should be based on incident needs. Construct a plan to achieve them. Continuous evaluation and review throughout the incident will determine whether the current objectives and subsequent plan are appropriate.

Control measure actions

- Incident commanders should give crews specific tasks and confirm their understanding
- Crews should return directly to control point when their task is concluded, for re-tasking and welfare support

Control measure – Employ a safe system of work to recover casualties and rescuers

Control measure knowledge

Incident commanders should consider implementing a safe system of work which is capable of recovering casualties and their rescuers.

A recoverable system using line equipment is an example, but may not be appropriate in all circumstances.

Control measure actions

- Make adequate resources available on scene before commencing operations, but recognise that this could increase the number of personnel in the hazard area, and potentially delay the start of operations if the attendance of additional resources or specialist teams is delayed

Contact with animals or insects during search for or extrication of casualties

Hazard	Control measures
Contact with animals or insects during search for or extrication of casualties	Isolate animals Establish alternative access/egress routes Consider hygiene Undertake decontamination Carry out post-incident health monitoring Wear personal protective equipment (PPE) or respiratory protective equipment (RPE)

Hazard knowledge

Animals or insects could be encountered in urban, rural, built or natural environments, while searching for or extricating a casualty. Domesticated and non-domesticated animals can be encountered in any type of environment, including private dwellings and farms. Animals or insects may also be encountered in commercial locations like medical research establishments, hospitals and zoos.

Hazards that may arise during or following contact with animals or insects include:

- Crush injuries
- Puncture wounds
- Abrasions, cuts and bruising
- Bites and stings
- Infection

Encountering animals or insects may result in personnel from the fire and rescue service, other emergency services and agencies being unable to carry out the extrication of a casualty effectively. Any resultant delay, and/or the animals or insects themselves, may result in the casualty's condition deteriorating.

Assistance from owners or keepers should be sought if appropriate, or consider other agencies such as the RSPCA. In particular, consider issues arising from the presence of animals or insects such as the risk of infection or disease and their implications on casualty care.

Control measure – Isolate animals

Control measure knowledge

Consider isolating the animals or insects where appropriate and possible to prevent exposure or injury to fire and rescue service personnel, other agencies and the casualty

Control measure actions

- Request advice from owners, keepers, veterinary surgeons, RSPCA, Defra or other specialist resources

Control measure – Establish alternative access/egress routes

Control measure knowledge

Alternative access or egress routes could be used to minimise exposure to animals or insects.

Control measure actions

- Consider alternative routes if access or egress is hampered, or the presence of animals or insects means it is not possible to proceed
- Liaise with owners, keepers or occupiers to determine a safe and uncompromised route

Control measure – Consider hygiene

Control measure knowledge

A full safety brief should highlight any potential risks from the presence of animals or insects.

Control measure actions

- Ensure personnel are aware of hygiene routines, especially before any welfare breaks and when operations conclude

Control measure – Undertake decontamination

Control measure knowledge

Consider decontamination in the event of exposure to animals or insects.

Control measure actions

- Consider initial decontamination if personnel have been contaminated
- Ensure sufficient welfare support is in place

Control measure – Carry out post-incident health monitoring

Control measure knowledge

Following any exposure to animals or insects during the search for or extrication of a casualty, health monitoring should be considered.

Control measure actions

- Establish appropriate reporting for post-incident health monitoring. Health monitoring should highlight the signs and symptoms that should be monitored by individuals exposed to the hazard

Control measure – Wear personal protective equipment (PPE) or respiratory protective equipment (RPE)

Control measure knowledge

All personnel, whether from the fire and rescue services or other agencies, involved in stabilising and extricating casualties, should wear PPE suitable for the task.

Control measure actions

- Ensure appropriate PPE/RPE is worn for safety, and to enable decontamination to be carried out if required
- Request advice from owners, keepers, veterinary surgeons, RSPCA, Defra or other specialist resources to determine the presence of infection or disease

Extrication of a casualty

Introduction

Casualties may need to be extricated from many environments. Further information will be provided within the 'Context' sections (when developed) including:

- Road transport systems (including Highways Agency Managed Motorways)
- Underground rail transport systems
- Overground rail transport systems, including overhead line equipment (OLE)
- Air transport systems
- Maritime environments and waterways (including docks and boatyards)
- Underground structures (including tunnels and mines)
- Areas with restricted access or egress
- Confined spaces

In this section of the guidance the term 'transport' has been used to encompass the three most commonly used forms of transport:

- Air
- Road
- Rail

Each form of transport has its own set of hazards, relating to the materials used in construction, its contents and so on. Information on these hazards can be found in the relevant sections of this guidance.

Extrication of casualties may result in exposure to various hazards, many of which may be encountered at any incident. Therefore the control measures to address these more generic hazards will be found in the Operations guidance including:

- Manual handling
- Slips, trips and falls (on the same level)
- Falls from working at height
- Trauma/psychological stress
- Body fluids from casualties
- Physiological stress from work
- Mechanical hazards
- Environmental hazards
- Animal hazards

Extrication of casualties will take place within the inner cordon of the incident. The Incident Command guidance provides information about establishing cordons.

A casualty can suffer further injury, illness or death from the incident if they do not receive prompt medical aid. By adopting a systematic approach to casualty care, any life-threatening conditions can be rapidly identified and managed.

Failure to extricate the casualty without deterioration of their condition

Hazard	Control measures
Failure to extricate the casualty without deterioration of their condition	Make the inner cordon safer Stabilise the casualty Extricate the casualty

Hazard knowledge

The primary focus should be on the extrication of the casualty. The impact of any secondary hazards that exist because of the location of the casualty should also be managed.

Control measure – Make the inner cordon safer

Control measure knowledge

Depending on the location of the casualty, the inner cordon may contain a number of secondary hazards:

Extrication – generic

- Equipment used by other agencies
- Tools

Extrication from a built or natural environment

- Primary surface extrication of casualties following building collapse
- Manual handling over terrain
- Extrication of casualties from confined spaces
- Restricted or complex layout affecting extrication of casualties
- Entrapment due to a failure of internal fixings or exposed cables

Extrication from any form of transport

- Objects involved in a collision
- Vehicle contents
- Unstable vehicle containing casualties

Extrication from air transport

- Military aircraft
- Rotary-wing aircraft
- Aircraft undercarriages
- Escape slides and access points
- Aircraft ballistic parachute systems
- Aircraft electrical systems
- Man-made mineral fibres (MMMF)
- Metals

Extrication from rail transport

- Weight/instability
- Electrical systems
- Steam engines
- Air systems
- Asbestos
- Man-made mineral fibres (MMMF)
- Polychlorinated biphenyls
- Toilets and sewage systems
- Detonators
- Delay in accessing driver or passenger compartments
- Air conditioning systems

Extrication from road transport

- Alternative fuelled vehicles (AFV)
- New or heavy vehicle construction
- Unconventional and specialist vehicles
- Vehicle supplementary restraint systems (VSRS)

Extrication from machinery, lifts and escalators

- Gaining access to machine rooms and shafts
- Noise
- Power systems

- Stored energy
- Moving or displaced machinery parts
- Hydraulics and lubricants

Control measure actions

Use the control measures detailed in each of the above secondary hazards appropriately to make the inner cordon safer for the benefit of the casualty, fire and rescue service personnel and other emergency responders authorised to work within the inner cordon.

Control measure – Stabilise the casualty

Control measure knowledge

The principles of casualty care listed below apply to all casualties, including trapped and non-trapped casualties:

- Protect the casualty from the hazards associated with the event
- Minimise on-scene time
- Extricate the casualty in the quickest way possible, considering their injuries and the overall threat to their life

Control measure actions

Stabilise the casualty by physically isolating them from any immediate harm. Ideally, any harm should be removed from the casualty unless they are in imminent risk of harm and the danger cannot be moved.

Control measure – Extricate the casualty

Control measure knowledge

A number of control measures may need to be implemented depending on the location of the casualty, their condition and the equipment and resources available and used.

Secondary hazards identified in making the inner cordon safer may previously have been managed, but may need to be considered further where interaction is required to carry out extrication of the casualty as a result of moving, manipulating, cutting or working in closer vicinity of the secondary hazard and so on.

It is also likely that secondary hazards not previously identified will become apparent during an extrication.

Control measure actions

Refer to the control measures detailed in the following sections of this guidance:

- *Extrication – Generic – Equipment used by other agencies*

- *Extrication – Generic – Tools*

Extrication – generic

Equipment used by other agencies

Hazard	Control measures
Equipment used by other agencies	Identify equipment and communicate accordingly Isolate and remove the equipment Be oxygen aware Establish an equipment or tool dump

Hazard knowledge

In this document, the term 'equipment used by other agencies' refers primarily to equipment used by the ambulance service. This will include 'sharps' such as syringes and scalpels, and also drugs and oxygen. Further information can be found in the *Casualty care* section.

The hazards posed by the equipment used by other agencies include:

- Puncture wounds
- Cross-contamination
- Cuts
- Lacerations
- Explosion

It is reasonable to assume that the ambulance service will take responsibility for its own equipment. However, it is also reasonable to assume that when medical interventions on a casualty are taking place inside a vehicle, some equipment may be scattered. Other agencies do not always practise the discipline of creating an ordered equipment or tool dump and this can create issues for maintaining a safe working environment.

It is important to realise that different agencies at the same incident have different ways of working, and may have different priorities to fire and rescue service personnel. This may also include their approach to appropriate levels of personal protective equipment (PPE). Co-operation and communication are important to resolve the incident. Regardless of the agency, or number of agencies, they should be focused on the casualty, making the incident safe and using a casualty centred rescue approach.

Control measure – Identify equipment and communicate accordingly

Control measure knowledge

Identifying the medical processes in place is the first step to controlling the hazard. Letting crews know if needles are in use has a fairly self-explanatory effect. The importance of communicating with other agencies cannot be understated.

Control measure actions

- Liaise with other agencies on site, at incident commander and emergency responder level, to know and understand their activities

Control measure – Isolate and remove the equipment

Control measure knowledge

Medical personnel normally carry sharps cases. In their absence, signposting, removing or covering up sharps in such a way that they do not become a hidden hazard should be considered.

Consider that the casualty could be carrying personal medical equipment required to manage their health condition. Medical alert tags, bracelets or cards may provide an indication of this. Be alert to the potential presence of non-prescription sharps.

Control measure actions

- Avoid crews handling sharps wherever possible.
- Take appropriate precautions if it becomes necessary to handle sharps
- Be aware of the risks posed by contaminants such as body fluids and so on. Refer to the Operations guidance

Control measure – Be oxygen aware

Control measure knowledge

Remember that medical oxygen should not be contaminated with grease or oil; there is an associated hazard of ignition between a fuel and an oxidiser. Refer to the HazMat guidance for further information.

The use of oxygen at an incident scene will pose additional hazards because oxygen supports combustion, making non-combustible items likely to become more flammable. If the oxygen cylinder is damaged in any way during an extrication, and this results in a larger uncontrolled leak, it should be identified and managed immediately.

Control measure actions

- Wear medical gloves when caring for a casualty, including when handling oxygen equipment. Further information can be found in the Casualty care section.
- Prevent cross-contamination between casualties and equipment by changing medical gloves at regularly required intervals

- Consider the hazards posed by oxygen saturation and oxygen supplies in use where tools, equipment or automated external defibrillators (AED) are in use

Control measure – Establish an equipment or tool dump

Control measure knowledge

Fire and rescue service equipment or tool dumps, and good housekeeping within the immediate vicinity of the incident, help facilitate a safer working environment for all personnel.

For example, a screwdriver dropped on the floor in the extrication path of a casualty being removed from a vehicle by emergency responders may seem innocuous. But if an emergency responder slips on the screwdriver and loses their balance while managing the casualty's head and neck, the outcome could be significant.

Control measure actions

- Offer the use of the fire and rescue service equipment or tool dumps to ambulance personnel and other agencies
- Consider establishing a separate equipment or tool dump alongside those of the fire and rescue service – to segregate medical equipment and prevent cross contamination, for example
- Consider identifying a location at the incident, In addition to the equipment or tool dump, designated for waste materials or items from the vehicle being worked on. It may also be necessary to establish a 'personnel dump' – a location for unused personnel from all agencies to congregate away from the immediate scene of operations.

Tools

Hazard	Control measures
Tools	Use other methods of space creation Identify the most appropriate tool for the task Manage tool operatives and their actions Wear personal protective equipment (PPE) Manage the effects of tool use

Hazard knowledge

In this guidance, the term 'tools' relates to different types of specialist rescue equipment such as:

- Cutters
- Rams
- Spreaders

- Combination tools
- Reciprocating saws
- Angle grinders
- Disc cutters
- Chisels

This list is not exhaustive and encompasses tools powered by manual, battery, pneumatic and hydraulic systems.

The hazards posed by tools may occur as a result of a malfunction, misuse or accepted managed use by the operator. These include:

- Projectiles
- Corrosives. Refer to the HazMat guidance
- Toxic materials. Refer to the HazMat guidance
- Irritants. Refer to the HazMat guidance
- Irrespirable tool exhaust gases
- Sparks
- Flammable substances. Refer to the HazMat guidance
- Crush injuries
- Impact injuries
- Amputations
- High pressure liquids/hydraulic injections
- Noise. Refer to the Operations guidance
- Dust – Toxic particles
- Muscular skeletal injuries. Refer to the Operations guidance

It is reasonable to assume that all fire and rescue service equipment will be well-maintained and tested, and only used by trained operators. However, it is also reasonable to assume that a combination of advances in materials, ageing equipment and human error can all contribute towards safety events, which encourages further control measures.

Refer to the *Extrication* sections relating to vehicle construction for further information about MMMFs, metals and other materials.

Although equipment is manufactured with safety features to prevent, mitigate and protect against misuse or malfunctions, operators should still be aware of the varied materials being tackled and the energies involved, whether stored within the structure or as part of the operation of the tool; high pressure liquids and hydraulic injections for example.

Control measure – Use other methods of space creation

Control measure knowledge

Personnel should employ a hierarchical approach to creating space, using the easiest and/or quickest methods as a priority such as creating space through the adjustment of internal features like seats, steering controls and removal of any luggage.

Using larger tools such as hydraulic rescue equipment may not be the most appropriate solution. Opportunities may exist to use spanners, torque wrenches and smaller tools that may support simultaneous activity better.

Alternative extrication paths for the casualty should be identified to ensure they can be safely removed, whilst considering their injuries and the overall threat to their life. The use of tools to create or maintain space should not impede the plan of action and extrication route.

Control measure actions

- Identify space creation techniques in line with casualty extrication needs
- Give priority to rescuer access and consider features such as internal contents, furniture, and reforming or changing the shape of the structure

Tackling high strength components used in construction may introduce high energy dispersal throughout the item. Formulating a space creation plan to suit the needs of the rescuers and casualties should be considered, which involves tackling components that can be displaced and/or removed using low energy strategies. Refer to the *Extrication* sections for new or heavy vehicle construction.

Control measure – Identify the most appropriate tool for the task

Control measure knowledge

Once the need a tool is identified, it is important for the operator to select the most appropriate tool for the task. Most manufacturers offer an extensive range of tools, from small tools designed for use in confined compartments to heavy duty tools designed for use on Large Goods Vehicles (LGV).

Selecting the smallest tool appropriate for the task can help to avoid manual handling injury to the operator and reduce the need to rotate crews, speeding up the extrication while avoiding unnecessary imposition on the casualty. Refer to the Operations guidance for manual handling.

Manufacturers offer guidance on best practice in using their tools, which is cascaded to crews during regular training. This guidance should normally include connecting the equipment, use, possible techniques, advantages, limitations and ongoing maintenance requirements to ensure that the tools are operationally ready.

Control measure actions

- Ensure all tool choices are considered against the needs of the casualty, the extrication strategies and the materials/situation being tackled

- Ensure all materials are visible to aid clear identification of material types including additional, hidden components that could cause harm due to uncontrolled release
- Ensure that the operator is aware of any changes in performance when using the tool. This may indicate the presence of unidentified materials
- Ensure all tools are used within their limitations and in line with the manufacturer's guidance

Control measure – Manage tool operatives and their actions

Control measure knowledge

Poor crew discipline within the inner cordon is a symptom of a badly-run incident. There is an onus on the emergency responders to step outside the inner cordon when their task is complete, and either begin the next phase of the rescue or report to the incident commander for further tasking. At a well-run incident, this has a positive impact on the effectiveness of simultaneous activity. Refer to the Incident Command guidance for further information.

Poor hose management and housekeeping may result in failure and the potential for hydraulic injection.

Working hard for long periods at extrications may lead to tiredness and fatigue, which can lead to mistakes.

The safety officer role involves overseeing the actions of emergency responders using tools and ensuring their safety. This wider view allows improved awareness of the impact of the tool operations, the item being operated on and those directly surrounding it. Unless managed well, emergency responders can become task-focused when operating tools and can lose sight of the impact of their actions.

Control measure actions

- Establish a working area or 'action circle' around the area of tool operation wherever possible. In this area (two to five metres), only essential personnel can undertake roles with only the equipment in use. Any waste or rubbish should be removed to creating a safe working environment. For further information, refer to the control measure *Establish an equipment or tool dump* for the hazard *Equipment used by other agencies*.
- Always warn others when starting to operate any tool. Using the terms "Cutting", "Spreading", "Impact" or something similar before working on materials or sections means casualties can anticipate the noise before it occurs. For further information refer to the *Casualty care* section.
- Use hoses within their limitations
- When using hoses, be aware of contact with debris, entrapment or kinking at all stages of the extrication
- The incident commander should remain aware of the physical condition of personnel. The emergency responder should take personal responsibility for their own physical condition and indicate when they need a rest, but personnel should also be rotated, or rotate themselves, to different tasks at appropriate intervals throughout the incident.
- Position a safety officer to monitor tool operations and the position of emergency responders

Control measure: Wear personal protective equipment (PPE)

Control measure knowledge

All fire and rescue service personnel working in the inner cordon should wear full protective clothing, which includes:

- Full firefighting gear, suitable overalls or similar
- Medical gloves
- Additional debris gloves or heavy duty gloves if handling cables etc.
- Eye protection at all times
- Helmet visors to be worn whilst actually cutting, spreading etc.
- Hi-visibility jackets or markings

Emergency responders who are not protected may take unnecessary risks and can become a liability rather than an asset to the situation.

There has been recent research into the need to use respiratory protective equipment (RPE) when managing glass, particularly in relation to the glass dust or particles produced during cutting operations. This research has been made available for fire and rescue services to make their own assessment of level of RPE they provide to personnel when managing this hazard.

Control measure actions

- Do not remove any protective clothing; very few situations permit this
- Remember there is always the potential for injury when tools are used at the extrication scene
- To improve operational effectiveness, it is sensible to put on this level of PPE before commencing work at the scene

Control measure – Manage the effects of tool use

Control measure knowledge

As mentioned in the hazard knowledge, the hazards posed by using tools can be extensive. The impact or likelihood of hazards resulting in harm are directly related to the type, location of use and the operator's capabilities.

It is important to remember that many of the tools used in extrications will be extremely powerful and can easily lead to uncontrolled movements when not managed correctly and in an appropriate manner.

Continuous familiarisation with the tools intended for use is recommended, including a check before use. This should be done outside a risk area or inner cordon, to re-familiarise operators with the equipment and check that the tool is working correctly before entering a work position.

For example, reciprocating saws create a lot of vibration and noise, which may be transferred on to, or distress the casualty. This may vary with the tool design, the item or material being cut and the operator. A simple test cut, where available and possible, on similar items or materials but without the inherent hazards, will result in improved tool use.

Control measure actions

It is vital that these elements are considered when using tools:

- Look for hidden hazards before you operate. Make sure the operator knows what is being cut, moved and so on
- Think about what the tool will do. How will it react, what direction it will move, etc.
- Think about what the item or material you are manipulating will do. Will it impact on any other item, will it release explosively, will it cause fragments or dust to be liberated?
- Compensate and manage the inevitable hazard of fragments of certain items or materials that are cut, squeezed, manipulated and so on as part of an extrication being liberated, despite the best efforts of tool operators. A combination of hard and soft protection should be placed between the tool and the casualty as a minimum, depending on the actions being undertaken and the item or material being affected.
- Ensure tool operators consider using further protection when required during cutting operations, such as a water spray on laminated glass

Extrication from the built or natural environment

Primary surface extrication of casualties following collapse of a structure

Hazard	Control measures
Primary surface extrication of casualties following collapse of a structure	Give a specific team briefing highlighting avoidance routes Appoint safety officers Provide adequate lighting Use thermal imaging cameras Have adequate communications

Hazard knowledge

Following the partial or full collapse of a structure, initial attending fire and rescue service personnel may have to extricate casualties located on the surface of the debris pile or those entrapped because of fallen masonry and metalwork, before specialist resources such as Urban Search and Rescue (USAR) or canine search teams arrive.

The following details the framework for the CFOA National Resilience *Six Stages of Rescue*. Although initial attending fire and rescue service personnel should be aware of this information, their participation in this type of incident may need to be restricted to non-specialist activities. Refer to the *Intraoperability and interoperability* section for further information about requesting and mobilising National Resilience assets.

To assist in the creation of an operational plan, *Six Stages of Rescue* provides a framework for the organisation of any collapsed structure incident. Whilst it is likely that there will not be a clear delineation between each stage, and there will be times when stages overlap, the incident command structure must ensure that each stage is undertaken and completed. This logical and progressive approach will mean that rescue personnel will maximise effectiveness, particularly in the early stages of an incident.

In simple terms, any operations conducted within a sector will have a defined search phase followed by a defined rescue phase, although these two phases may run concurrently across multiple sectors dependent on the size and scale of the incident.

Progression through the *Six Stages of Rescue* takes a considerable time even at a small, single-dwelling collapse. The tactical plan should take account of this and the resources required to achieve a safe and successful conclusion to the incident.

Rescue operations are conducted under the following six stages:

R Reconnaissance and survey

E Elimination of utilities

P Primary surface search and rescue

E Exploration of voids and spaces

A Access by selected debris removal

T Termination by general debris removal

Stage 1: Reconnaissance and survey

The area is searched for possible victims (surface and/or buried), and the evaluation of the structure's stability and potential danger to rescue personnel is performed. Immediately after a collapse, the debris of the building is very unstable and prone to additional movement. Rescuers must assess the nature of the scene and the pattern of the collapse before entering onto a pile of rubble to ensure their own safety and that of those potentially buried in it. Thermal imaging cameras may assist in this task. Before attempting rescues, shoring may be necessary to prevent movement.

Gather as much information as possible at the onset of the incident. Intelligence regarding the last known locations and activities of those believed to be in the structure will greatly assist in developing a plan for recovery efforts. Preliminary efforts should be concentrated on areas where people were last seen or known to be.

It is suggested that a search co-ordinator be designated to interview those who may have escaped the collapse, were eyewitnesses, or were in the building and rescued early in the effort. A list of the people normally in the building should be obtained if one is available.

Stage 2: Elimination of utilities

During this stage of the incident, all utilities must be evaluated and controlled for safety. If necessary, utility services should be isolated before any rescue work proceeds, and if this is not possible, the condition of the utilities present in the structure should be continually monitored. Dynamic risk assessments and subsequent analytical risk assessments based on the information received from the monitoring process can dictate additional control measures, and will provide personnel with information as to the working environment.

Personnel should be aware that some supplies may not have been located and made safe and, therefore, should not cut the following:

- Water pipes: flooding, or a sudden ingress of water, has been known to drown rescuers and casualties in flooded basements. The sound of flowing water can also interfere with the use of acoustic search equipment.
- Gas pipes: gases leaking into a collapsed building can pool at lower levels such as basements, dependent upon the density of the gas
- Electrical cables or wires: experience has shown that other wiring (e.g. telephone cables) can become live after coming into contact with mains wiring

Stage 3: Primary surface search and rescue

At this point in the incident it may be appropriate for the incident commander to withdraw all personnel and to assess progress made up to that point. It may also be appropriate for the incident commander to review the suitability of the ICS structure in place at that time. Consideration should be given to designating one or more specific search sectors dependent on the size of the incident, each of which should be nominated its own site identification number.

After ensuring rescuer safety and minimal movement of the debris, small organised teams should be deployed to search each sector systematically in specific grids. Canine search teams can be particularly effective in undertaking this task. An agreed marking scheme should be used to demonstrate visually the areas that have been searched, any areas of canine interest, and those areas that could potentially contain victims. Care should be taken when using some methods of marking (e.g. spray paints) as these may interfere with ongoing canine search operations when indoors. The chosen method of marking should also consider the need for discretion where casualty locations are to be noted.

As many as half of all building collapse survivors have historically been rescued near the surface of the debris and early on in the operation. The initial search should be concentrated on those areas that are believed to be the last known locations of people when the collapse occurred. All surface casualties should be removed as quickly and safely as possible.

Extreme care should be taken during this phase to ensure that rescuers do not become victims. Personnel should not be misled by the outward appearance of a structure; what appears to be a settled pile of debris could, in reality, be lacking any genuine support, and a secondary collapse could occur without warning.

Stage 4: Exploration of voids and spaces

All voids and accessible spaces created as a result of the collapse must be searched and explored for live victims. An audible call-out system can be used during this phase. Only trained canine or rescue personnel should be used to search voids and accessible spaces. Voids should be explored visually by canines and with technical search equipment.

Good practice dictates that at approximately every hour on the hour all work on the site be shut down for a few minutes to listen for calls for help. During that period sound detection devices can be used to listen for movement or sounds deep within the debris.

Stage 5: Access by selected debris removal

Selected debris removal using special tools and techniques may be necessary after locating a victim. It may be necessary to remove only certain obstructions that are blocking access to the victim. Information concerning a victim's location prior to the collapse can be helpful during the selected debris removal phase. Information gathering on other possible victim locations can greatly enhance the operation.

Stage 6: Terminate by general debris removal

General debris removal is usually conducted after all known victims have been removed. Exceptions would be:

- When information is obtained that indicates the possibility of other victims not originally accounted for
- When large amounts of debris are impairing or obstructing operations. The decision to use heavy equipment during this phase must be given serious consideration, especially when the possibility exists that there are still live victims in the debris

Involving other emergency services or appropriate resources and casualty care should be considered. Refer to the *Casualty care* section.

The incident commander, while developing their tactical plans, should take the following hazards that may be present following a structural collapse into account, and carry out a Dynamic Risk Assessment (DRA) that considers them:

- Incoming and/or damaged utilities. Refer to Context – Utilities guidance
- Sub-surface voids
- Underfoot conditions, including the unstable nature of surface (rubble). Refer to the Operations guidance
- Manual handling. Refer to the Operations guidance
- Secondary collapse
- Uncontrolled rescue attempts

- Secondary or further collapse as a result of wind, rain, vibration, etc.
- Intimidation or violence from casualties, etc.
- Noise levels. Refer to the Operations guidance
- Dust (airborne, static or caustic). Refer to the HazMat guidance
- Damage to mass storage vessels
- Asbestos. Refer to the HazMat guidance
- Obstructed, hidden or flooded voids
- Glass
- Glass dust. Refer to the *Extrication – Generic – Tools* section
- Falling objects including glass
- Temperature-induced illness. Refer to the Operations guidance
- Arduous working conditions and physiological stress
- Hazardous materials (HazMat); irrespirable/hazardous atmospheres, explosives, flammable, toxic or biological materials/substances etc. Refer to the HazMat guidance
- Environmental conditions such as darkness
- Fire, heat and smoke. Refer to the Fires and Firefighting guidance
- Snagging, e.g. sharp edges from damaged building components, for example reinforcement bars (rebars), etc.
- Falls from height. Refer to the Operations guidance

Control measure – Give a specific team briefing highlighting avoidance routes

Control measure knowledge

Before tasking personnel, incident commanders should consider all available sources of information. Team briefings should be based on incident needs and a plan should be constructed to achieve them. Continuous evaluation and review throughout the incident will determine whether the current objectives and subsequent plan are appropriate.

Consider the following sources of information throughout the incident:

- Building and site plans
- Premises information boxes (PIB)
- Responsible Person (or appointed competent person)
- Observation
- 360 degree external surveys of the building and area

- Reconnaissance of the location reported to be involved
- Information from personnel operating within the building and/or risk area
- Witnesses
- Occupiers
- Other agencies

Control measure actions

- Refer to Site Specific Risk Information (SSRI). Refer to the Operations guidance
- Highlight avoidance routes, due to sub surface voids
- Highlight any potential hazards posed by the presence of live utilities
- Set up clear delineated routes giving crews safe routes to the scene of operations that they should confirm

Control measure – Appoint safety officers

Control measure knowledge

The incident commander should consider the safety of firefighters, other emergency services, other agencies attending (including voluntary agencies) and members of the public. Individual agencies should ensure that personnel arriving at the scene have appropriate personal protective equipment (PPE) and are adequately trained and briefed for the work they are to undertake.

Safety officers should be appointed as soon as reasonably practicable, and any information regarding isolating and managing hazards should be passed to crews immediately and then confirmed. The safety officer should convey the information received to the incident commander to ensure that the current objectives and subsequent plan are appropriate. Refer to the Incident Command guidance for further information.

Control measure actions

- Consider the location of appliances on arrival (rendezvous point (RVP) and marshalling)
- Identify hazards (confirmed or known)
- Establish, monitor and maintain cordons. Refer to the Incident Command guidance
- Effectively manage cordon gateway
- Restrict numbers of personnel in hazard or restricted areas
- Brief all personnel entering the risk area(s) of hazards and restricted areas
- Confirm evacuation procedure and signal for critical events
- Be aware of evacuation strategies and their impact on operations and members of the public

Control measure – Provide adequate lighting

Control measure knowledge

Adequate scene lighting should be used to define safe routes and the scene of operations. Consider using individual lighting. Refer to the Operations guidance for further information.

Control measure actions

- Ensure sufficient lighting resources are requested
- Make sure generators are located at an appropriate distance from the scene of operations. This avoids exhaust fumes entering the void and can also reduce noise pollution
- Ensure sufficient quantities of fuel for generators are available at the scene to ensure a loss of lighting does not hamper rescue operations

Control measure – Use thermal imaging cameras

Control measure knowledge

Thermal imaging cameras will assist in searching for and locating casualties, as casualties may be covered with dust and may not be readily identifiable by the naked eye. If operations are taking place at night a thermal imaging camera may prove invaluable.

Control measure actions

- Consider providing thermal imaging cameras to teams entering the area of operations
- The incident commander should enforce the importance of correct search procedures, such as BA shuffle, to reduce reliance on thermal imaging cameras

Control measure – Have adequate communications

Control measure knowledge

Appropriate communications are essential for a successful outcome to operations, both within the incident command structure where they are vital to the incident commander in ensuring that the current objectives and subsequent plan are appropriate, but also between safety officers and crews. If distances are adequate, verbal communications may be more appropriate during the dynamic stages of the incident. Refer to the Operations guidance for further information.

Control measure actions

- Co-ordinate hand-held radio use, with clearly defined channel allocation. This is paramount in ensuring an incident command structure is established and maintained correctly throughout the incident
- Give clear briefs on maintaining and minimising communications equipment traffic to ensure only critical information is sent and received

- Confirm the evacuation procedure and signal for critical events
- Establish clear and specific timings for regular updates between the crews committed to the risk and the command team

Manual handling over terrain

Hazard	Control measures
Manual handling over terrain	Deploy adequate personnel Rotate crews Use casualty transport equipment Use motorised vehicles

Hazard knowledge

When extricating casualties from the natural environment in rural and urban settings, fire and rescue service personnel may have to use additional equipment and techniques. This may be due to terrain and potential travel distances, or to alleviate any manual handling issues that may arise in transporting equipment to and from the scene of operations, and/or for extricating casualties to a place of relative safety following initial clinical assessment. For further information refer to the *Casualty Care* section.

Teams should have received appropriate manual handling training and should receive briefs on the hazards and risks, both known and perceived, that can be encountered when extricating casualties from the rural natural environment, specifically in relation to manual handling issues due to the terrain and/or travel distances. Through a joint agency approach and initial information gathering, fire and rescue services, will establish a multi-agency response to ensure appropriate resources are mobilised. Refer to the *Intraoperability and interoperability* section for further information.

Consider involving specialist fire and rescue service USAR teams, other emergency services or appropriate resources and casualty care.

Control measure – Deploy adequate personnel

Control measure knowledge

Team size should be appropriate to the task and the team equipped with the necessary resources to undertake specific tasking, subject to fire and rescue service level of training. The incident commander should review all sources of information to ensure timely request for appropriate and additional resources. Subject to the demands of the developing incident, this may include requesting other agency resources.

Control measure actions

- Deploy an appropriate team sized to ensure the task is successfully completed
- The incident commander should make a timely request for additional or specialist teams

Control measure – Rotate crews

Control measure knowledge

Incident commanders should consider committing additional personnel to the scene of operations to ensure adequate rotation of personnel assisting in the extrication of casualties. This should be continually reviewed throughout the incident. Refer to the Operations guidance for further information.

Control measure actions

- Implement welfare arrangements during protracted incidents
- Make timely crew rotations so that personnel can re-hydrate away from the scene of operations
- Safety officers or team leader to continually monitor crews for signs of fatigue

Control measure – Use casualty transport equipment

Control measure knowledge

Subject to their own fire and rescue service provisions, the incident commander should consider the use of suitable spinal stabilisation equipment such as basket stretchers, scoop stretchers or equivalent, to assist crews in extricating casualties, and to reduce any manual handling issues for fire and rescue service personnel, while also reducing possible further deterioration of the casualty condition. Requests for suitable resources or equipment from other agencies should be also considered; refer to the *Intraoperability and Interoperability* section.

Control measure actions

- Consider stabilising casualties until appropriate resources or specialist teams are available to assist or extricate the casualty, subject to availability and/or the developing incident. Refer to the *Casualty care* section for further information.

Control measure – Use motorised vehicles

Control measure knowledge

Subject to their own fire and rescue service provisions, the incident commander should consider the use of suitable motorised vehicles to assist crews in the extrication and transportation of casualties. Consideration should also be given to utilising other agencies or emergency services resources. Refer to the *Intraoperability and interoperability* section.

Control measure actions

- Incident commander to assess and review, if timely request of motorised vehicles is required, based against several factors:
    - Access and egress to scene of operations

- Impact on the ongoing operations of other fire and rescue services or other agencies
- Condition of the casualty
- Welfare of crews due to manual handling issues

Extrication of casualties from confined spaces

Hazard	Control measures
Extrication of casualties from confined spaces	Employ information gathering Isolate machinery, processes and utilities Establish appropriate safe systems of work Appoint safety officers Provide adequate lighting Have adequate communications Undertake decontamination

Hazard knowledge

The hazards in a confined space arise through a combination of the confined nature of the workplace and the possible presence of substances or conditions that could increase the risk to the health and safety of personnel. Fire and rescue services should consider the possibility that a hazard could be introduced to a confined space during an incident, for example, water.

Definitions

The Confined Space Regulations 1997 define a confined space as:

"any place, including any chamber, tank, vat, silo, pit, trench, pipe, sewer, flue, well or other similar space in which, by virtue of its enclosed nature, there arises a reasonably foreseeable specified risk."

A 'specified risk' is further defined as a risk of the:

- Serious injury to any person at work arising from a fire or explosion
- Loss of consciousness of any person at work arising from an increase in body temperature
- Loss of consciousness or asphyxiation of any person at work, arising from gas, fume, vapour or lack of oxygen
- Drowning of any person at work arising from an increase in the level of liquid
- Asphyxiation of any person at work arising from a free flowing solid, or the inability to reach a respirable environment due to the entrapment by a free flowing solid

Under the regulations, a confined space has two defining features:

1. It is a space which is substantially (but not always entirely) enclosed
2. There is a reasonably foreseeable risk of serious injury to personnel from hazardous substances or conditions in the space

Incidents that fire and rescue services may attend, which can be defined as confined spaces, may include:

- Rescues from sewers
- Rescues from silos
- Rescues from trenches and pits

Before committing personnel into any hazard area, incident commanders should take account of the actual information about the incident that is available, to make operational decisions in what are recognised as sometimes dangerous, fast-moving and emotionally charged environments.

A thorough safety brief should be carried out before personnel are deployed within the hazard zone. Areas that the incident commander will have to consider include:

- Working at height. Refer to the Operations guidance
- Falling equipment
- Internal conditions
- Oxygen deficient or flammable atmosphere. Refer to the HazMat guidance
- Excessive noise, Refer to the Operations guidance
- Restricted access/egress
- Stability and condition of the soil in and around trenches and pits
- Reduced visibility
- Heavy and/or moving machinery. Refer to the *Extrication from machinery, lifts and escalators* section
- Electricity supply. Refer to Context – Utilities guidance
- Nature of stored material
- Voids, bridging
- Biohazards. Refer to the Operations guidance

Consideration should be given to the involvement of other emergency services such as USAR teams, rope rescue teams or appropriate resources and casualty care. Refer to the *Casualty care* section for more information.

Control measure – Employ information gathering

Control measure knowledge

Before tasking personnel, incident commanders should consider all available sources of information. Team briefings should be based on incident needs and a plan should be constructed to achieve them. Continuous

evaluation and review throughout the incident will determine whether the current objectives and subsequent plan are appropriate.

The following sources of information should be considered throughout the incident:

- Reconnaissance of the location and numbers of persons involved
- Site plans
- Responsible Person (or appointed competent person)
- Access to local authority engineering departments for schematics of trench or sewer layout. Refer to *Intraoperability and interoperability* section
- Observation
- 360 degree external surveys of the incident ground
- Information from personnel operating within the risk area and/or incident ground
- Witnesses
- Occupiers
- Other agencies
- Weather conditions, both prevailing and expected, and their effects on rescue operations and personnel. Refer to the Operations guidance
- Early request for additional specialist resources. Refer to the *Intraoperability and interoperability* section

Control measure actions

The incident commander should:

- Give crews specific briefings and ensure they understand the plan
- Ensure adequate resources are either available and/or have been requested

Control measure – Isolate machinery, processes and utilities

Control measure knowledge

All machinery, processes and utilities should be isolated and controlled for safety. If full isolation is required within the hazard area, isolating all utility services should be considered before any rescue work proceeds. DRAs based on the information received from the monitoring process can dictate additional control measures and will provide personnel with information on the working environment.

For further information, refer to the *Extrication* section for machinery.

Control measure actions

- Machinery and processes should be isolated before any rescue work proceeds
- Request early attendance of utility supply companies to isolate incoming supplies
- Continually monitor the state of the utilities present in the structure
- Regularly update two-way communication between incident commander and crews in the risk area

Control measure – Establish appropriate safe systems of work

Control measure knowledge

Because of the potential need for rapid evacuation from the confined space, good access and egress should be established as soon as practicable and maintained throughout. Access and egress should be monitored for signs of collapse, water ingress and so on which may affect the safety of personnel within the silo, trench or pit.

Control measure actions

- Keep the number of personnel entering the risk area to the minimum needed to complete the rescue
- Consider travel distances for both equipment and casualty extrication
- Implement full BA procedures if an oxygen deficient atmosphere/flammable atmosphere is suspected, along with the appropriate ventilation of the confined space to reduce or mitigate the flammable atmosphere
- Subject to individual fire and rescue service provisions, incident commanders should consider using line equipment to implement recoverable safe systems of work. If not provided, the incident commander should make a timely request for USAR teams or specialist rope rescue teams.

Control measure – Appoint safety officers

Control measure knowledge

The incident commander should consider the safety of firefighters, other emergency services, other agencies attending (including voluntary agencies) and members of the public. Individual agencies should ensure that personnel arriving at the scene have appropriate personal protective equipment (PPE) and are adequately trained and briefed for the work they are to undertake.

Safety officers should be appointed as soon as reasonably practicable, and information regarding isolating and managing hazards should be passed to crews immediately and then confirmed. The safety officer should convey information received to the incident commander, to ensure that the current objectives and subsequent plan are appropriate. Refer to the Incident Command guidance for further information.

Control measure actions

- Consider the location of appliances on arrival (rendezvous point (RVP) and marshalling)
- Identify hazards (confirmed or known)

- Establish, monitor and maintain cordons. Refer to the Incident Command guidance
- Effectively manage cordon gateway
- Restrict numbers of personnel in hazard or restricted areas
- Brief all personnel entering the risk area(s) of hazards and restricted areas
- Confirm evacuation procedure and signal for critical events
- Be aware of evacuation strategies and their impact on operations and members of the public

Control measure – Provide adequate lighting

Control measure knowledge

Adequate scene lighting should be used to define safe routes and the scene of operations. Consider using individual lighting. Refer to the Operations guidance for further information.

Control measure actions

- Ensure sufficient lighting resources are requested
- Make sure generators are located at an appropriate distance from the scene of operations. This avoids exhaust fumes entering the void and can also reduce noise pollution
- Ensure sufficient quantities of fuel for generators are available at the scene to ensure any loss of lighting does not hamper rescue operations

Control measure – Have adequate communications

Control measure knowledge

Appropriate communications are essential for a successful outcome to operations; both within the incident command structure, where they are vital to the incident commander in ensuring that the current objectives and subsequent plan are appropriate, but also between safety officers and crews. If distances are adequate, verbal communications may be more appropriate during the dynamic stages of the incident. Refer to the Operations guidance for further information.

Control measure actions

- If hand-held communications are to be used, use only intrinsically safe radios. Clearly defined allocation of channels is paramount in ensuring an incident command structure is established and maintained correctly throughout the incident
- Give clear briefs on maintaining and minimising communications equipment traffic to ensure only critical information is sent and received
- Confirm the evacuation procedure and signal for critical events

- Establish clear and specific timings for regular updates between the crews committed to the risk and the command team

Control measure – Undertake decontamination

Control measure knowledge

Decontamination can be carried out on the incident ground using equipment, in a planned and structured manner, to minimise the risk of further harm occurring and to keep cross contamination to as low a level as reasonably practicable.

Depending on the nature and risk posed by hazardous materials, initial or full decontamination may be required. In all cases the incident commander should carry out a risk assessment and remember that initial decontamination is intended as a first-aid measure and is not a substitute for full decontamination.

Further information may be found in the HazMat guidance.

Control measure actions

For information on control measure actions refer to the HazMat guidance.

Restricted or complex layout affecting extrication of casualties

Hazard	Control measures
Restricted or complex layout affecting extrication of casualties	Deploy adequate personnel Rotate crews Use equipment for working at height Use casualty transport equipment Use extrication tools

Hazard knowledge

This hazard relates to the impact of an internal layout of premises or complex access or egress routes on extrication activities. This may be due to the effects on a building from fire, partial collapse or complex layouts such as sewers, trenches and silos. Fire and rescue service personnel may have to use additional equipment and techniques to extricate casualties.

Teams should have a good understanding of the hazards they may encounter when extricating casualties from premises with complex layouts or restricted access/egress routes. They may be required to extricate casualties before fire and rescue service USAR teams or other agencies arrive.

Consideration should be given to involving specialist fire and rescue service USAR teams, other emergency services or appropriate resources and casualty care.

Control measure – Deploy adequate personnel

Control measure knowledge

Team size should be appropriate to the task and the team equipped with the necessary resources to undertake specific tasking, subject to fire and rescue service level of training. The incident commander should review all sources of information to ensure timely request for appropriate and additional resources. Subject to the demands of the developing incident, this may include requesting other agency resources.

Control measure actions

- Deploy an appropriate team size to ensure the task is successfully completed
- The incident commander should make a timely request for additional or specialist teams

Control measure – Rotate crews

Control measure knowledge

Incident commanders should consider committing additional personnel to the scene of operations to ensure adequate rotation of personnel assisting in the extrication of casualties. This should be continually reviewed throughout the incident. Refer to the Operations guidance for further information.

Control measure actions

- Implement welfare arrangements during protracted incidents
- Make timely crew rotations so that personnel can re-hydrate away from the scene of operations
- Safety officers or team leader to continually monitor crews for signs of fatigue

Control measure – Use equipment for working at height

Control measure knowledge

Subject to individual fire and rescue service provisions, incident commanders should consider using line equipment to implement recoverable safe systems of work. Depending on the layout of the access stage of the incident, work restraint or fall arrest equipment may be used to prevent or limit the impact of any fall from height.

Control measure actions

- The incident commander should make a timely request for USAR teams or specialist rope rescue teams
- Consider stabilising casualties, subject to the developing incident, until appropriate resources or specialist teams are available to assist or extricate the casualty

Control measure – Use casualty transport equipment

Control measure knowledge

Subject to their own fire and rescue service provisions, the incident commander should consider the use of suitable spinal stabilisation equipment such as basket stretchers, scoop stretchers or equivalent, to assist crews in the extrication of casualties, and to reduce any manual handling issues for fire and rescue service personnel, while also reducing possible further deterioration of the casualty's condition. Requests for suitable resources or equipment from other agencies should be also considered. Refer to the *Intraoperability and interoperability* section.

Control measure actions

- Consider stabilising casualties, subject to the developing incident, until appropriate resources or specialist teams are available to assist or extricate the casualty

Control measure – Use extrication tools

Control measure knowledge

During the extrication of casualties, the correct choice and application of tools, along with correct methods of extrication based against the initial and ongoing clinical assessment of the casualty will be vital. This should result in a more timely extrication, reduce the risk to fire and rescue service personnel and other rescuers.

Also refer to the *Extrication* section for tools.

Control measure actions

- Identify the need for tools. Once identified it is important for the operator to select the most appropriate tool for the task, subject to individual fire and rescue services provision of equipment. Most manufacturers offer an extensive range of tools, from small tools designed for use in confined compartments to heavy duty tools
- Select the smallest tool appropriate for the task. This can help to avoid manual handling injury to the operator and reduce the need to rotate crews, speeding up the extrication while avoiding unnecessary imposition on the casualty

Entrapment due to failure of internal fixings or exposed cables

Hazard	Control measures
Entrapment due to failure of internal fixings or exposed cables	Give a specific team briefing highlighting avoidance routes Follow breathing apparatus (BA) procedures Provide adequate lighting Remove or secure internal fixings or cables

	Use thermal imaging cameras

Hazard knowledge

Entrapment due to failure of internal fixings or exposed cables applies to the built environment. Incident types may not require the use of breathing apparatus (BA). Potential outcomes could result in death, serious injury due to electrocution, electrical burns and electric shock to fire and rescue service personnel, other agencies and casualties.

Teams should have a good understanding of the hazards posed by electricity. For further information refer to the Context – Electricity guidance.

Control measure – Give a specific team briefing highlighting avoidance routes

Control measure knowledge

Before tasking personnel, incident commanders should consider all available sources of information and assess the developing incident. Team briefings should be based on incident needs and a plan should be constructed to achieve them.

The following sources of information should be considered throughout the incident:

- Building use
- The Responsible Person (or appointed competent person) can highlight potential hazards
- Reconnaissance of location reported to be involved
- Observation and information from personnel operating within the building/risk area

Control measure actions

- Refer to Site Specific Risk Information (SSRI). Refer to the Operations guidance
- Continuously evaluate and review throughout the incident to determine whether the current objectives and subsequent plan are appropriate
- Highlight avoidance routes, to ensure crews are not exposed to the potential risks of entrapment due to cabling or internal fixings, sub-surface voids and any potential hazards posed by live utilities
- Set up clear delineated routes, give and confirm safe routes to the scene of operations

Control measure – Follow breathing apparatus (BA) procedures

Control measure knowledge

If BA is in use teams should be given specific briefings. It is essential that each and every BA team is fully briefed by the appropriate person at the Entry Control Point (ECP), including:

- The nature and layout of the structure to be searched

- The operational search procedures to be employed and equipment to be used

Control measure actions

The incident commander should ensure that BA teams follow all appropriate safe systems of work, search and rescue procedures and personal safety techniques during the extrication of casualties. Refer to the Operational Guidance: Breathing apparatus for further information.

Control measure – Provide adequate lighting

Control measure knowledge

Adequate scene lighting should be used to define safe routes and the scene of operations. Consider using individual lighting. Refer to the Operations guidance for further information.

Control measure actions

- Ensure sufficient lighting resources are requested
- Make sure generators are located at an appropriate distance from the scene of operations. This avoids exhaust fumes entering the void and can also reduce noise pollution
- Ensure sufficient quantities of fuel for generators are available at the scene to ensure a loss of lighting does not hamper rescue operations

Control measure – Remove or secure internal fixings or cables

Control measure knowledge

To maintain access and egress from the scene of operations, crews should remove or secure internal fixings or cables where possible, subject to confirmation by a competent person that services have been isolated.

Control measure actions

- Crews should take in equipment suitable for removing or cutting any cables or internal fixings that have a direct impact on extrication operation. Refer to the *Extrication* section on the use of tools
- Consider providing rated insulated cutters for cutting electrical cables if the isolation of services cannot be confirmed. Avoid exposed cables if unsure of the rating of incoming supplies

Control measure – Use thermal imaging cameras

Control measure knowledge

Thermal imaging cameras (TIC) may assist in identifying internal fixings that have been subjected to heat, either from processes within the premises or after being exposed to fire, as they may not be readily identifiable by the naked eye. If operations are taking place at night a thermal imaging camera may prove invaluable.

Control measure actions

- Consider providing thermal imaging cameras to teams entering the area of operations
- The incident commander should enforce the importance of correct search procedures, such as BA shuffle, to reduce reliance on thermal imaging cameras

Extrication from any form of transport

Objects involved in collision

Hazard	Control measures
Objects involved in collision	Identify direction of movement Stabilise Relocate objects in a controlled manner Deploy the minimum number of personnel Consider access for other agencies

Hazard knowledge

For the purpose of this guidance, the term 'objects involved in collision' refers to street furniture and surroundings that may be involved in an incident. This includes objects that a vehicle may hit or vice versa.

The hazards posed by objects involved in a collision include:

- Instability to the vehicle. Refer to the *Extrication* section for dealing with an unstable vehicle containing casualties
- Impact injury
- Impalement
- Musculoskeletal injury. Refer to the Operations guidance
- Cutting or laceration
- Electricity. Refer to Context – Electricity guidance
- Entrapment

Any object that has come to rest on a vehicle presents a stability hazard in itself, and may in turn affect the stability of the vehicle. It may also increase or cause injury to the casualties and hamper extrication.

Control measure – Identify direction of movement

Control measure knowledge

The weight of the object, and whether it may move, will not always be obvious. It may also be necessary to determine whether the geographical layout may have any impact; for example, a more obvious hill or slope may be a reminder to secure the vehicle, but an insignificant gradient may go unnoticed.

Control measure actions

- Identify information about the weight and movement of an object, along with topography, during the initial 360 degree survey and communicate this to all personnel

Control measure – Stabilise

Control measure knowledge

During the stability phase of the rescue, extra time and care may be needed to fully address this issue. The vehicle may well be secured by collision damage but it should be remembered that ramming, cutting away or pulling during operations can release the vehicle, allowing it to become a 'runaway'.

Refer to the *Extrication* section for dealing with an unstable vehicle containing casualties.

Control measure actions

- Completely stabilise the vehicle before beginning any work on it to prevent further injury to the casualty and to protect the rescuers
- Consider specialist equipment such as ratchet straps or triangulation struts
- Complete this phase of the rescue to the extent that it does not have to be revisited later, apart from standard stability checks that should take place throughout the incident
- Remember that large and extremely heavy objects may actually assist with vehicle stability; make use of them accordingly. It may also be appropriate to carry out a controlled movement of the object, taking it out of the inner cordon to improve access

Control measure – Relocate objects in a controlled manner

Control measure knowledge

It may be possible to relocate street furniture or objects away from the immediate scene of operations without affecting the stability of the vehicles involved. This should be undertaken if possible, to provide greater opportunities of access/egress for emergency responders. If objects are relocated they should be carefully positioned so that they do not compromise future extrication processes.

Control measure actions

- Keep the safety of all persons in mind when moving any objects
- Employ additional stability mechanisms if there is any doubt about vehicle stability; vehicle stability should not be affected during the relocation

Control measure – Deploy the minimum number of personnel

Control measure knowledge

In all extrications it is essential to limit the numbers of personnel working in the inner cordon. This is especially true in the early phases of the incident, before full stability is achieved. This may well include personnel from other agencies working at the incident along with members of the public. They may need to be removed diplomatically or advised on wearing personal protective equipment (PPE).

Control measure actions

- Adopt a disciplined approach when working close proximity to the vehicle
- Use the minimum number of personnel appropriate to the activity

Control measure – Consider access for other agencies

Control measure knowledge

Where a vehicle has come in to contact with street lighting, agencies such as electricity providers may need to be contacted to isolate the power.

If a tree is resting on a vehicle, specialist resources may need to be contacted to aid with the extrication, especially if there is an entrapment.

Control measure actions

- Identify the need for assistance from other agencies early, such as isolating the electricity supply or removing objects, especially where there is a hazard to the emergency services or members of the public. This will assist in reducing any delay to the initial approach.

Vehicle contents

Hazard	Control measures
Vehicle contents	Identify direction of movement Stabilise Empty vehicle load in a safe place Consider methods of entry Consider access for other agencies

Hazard knowledge

The term 'vehicle contents' applies to every possible form of cargo and contents, located anywhere in any vehicle. This will range from the obvious, like the cargos transported by large goods vehicles (LGV), general rubbish accumulated by the public in foot wells and boots of cars, or farm animals.

Hazards posed by vehicle contents include:

- Instability to the vehicle. Refer to the *Extrication* section for unstable vehicles
- Impact injury
- Crush injury
- Impalement
- Muscular skeletal injuries
- Cutting/laceration
- HazMats. Refer to the HazMat guidance
- Animals; zoonoses, bites, kicks, etc. Refer to the Operations guidance and the Context – Animals guidance

In this guidance, hazardous cargo is dealt with in the HazMat guidance, which includes the hazards posed by explosives, ammunition, corrosives and so on.

Any impact has the potential to dislodge vehicle contents. The situation may be worsened if the vehicle has rolled or inverted. Not only will this have potentially caused injury to the occupier of the vehicle, but also it has the potential to cause harm to crews and other agencies attempting to work at the scene.

Control measure – Identify direction of movement

Control measure knowledge

Shifts in loads can potentially influence the vehicle and may cause harm to crews and occupants if they are unaware of any anticipated issues.

Control measure actions

- Undertake an initial 360 degree survey to identify any unstable loads associated with the vehicle contents, such as bulges in the side curtains of LGVs
- Identify the likely direction of travel for any loads that may move.
- Communicate identified hot zones to all personnel operating within or around the vehicle.

Control measure – Stabilise

Control measure knowledge

During the stability phase of the rescue, extra time and care may be needed to fully address identified load movement potential.

Control measure actions

- Consider that specialist equipment such as ratchet straps or triangulation struts may be needed
- Give attention to crew deployment. If it is reasonably foreseeable that a vehicle or its cargo may move into an area, under no circumstances should any personnel be deployed into that area until it is secured from the 'safe side'
- Complete this phase of the rescue to the extent that it does not have to be revisited later, apart from standard stability checks that should take place throughout the incident

Refer to the *Extrication* section for dealing with an unstable vehicle containing casualties.

Control measure – Empty vehicle load in a safe place

Control measure knowledge

Where an unstable load poses a risk to the stability and safety of operations, consideration should be given to removing the load where practicable, and where such removal does not negatively affect the welfare of any occupants.

Control measure actions

- Carry out the necessary Dynamic Risk Assessment (DRA). Following this, the load may need to be removed to a safe area, away from the scene. Refer to the *Extrication* section for manual handling issues over terrain.

Control measure – Consider methods of entry

Control measure knowledge

If it is reasonable to assume that cargo or contents have moved or are no longer secure, take care in selecting the appropriate access point. A typical example of crews getting injured is when opening a boot lid on an inverted car, only to suddenly take the weight of the lid itself, the contents of the boot and a spare wheel. Similarly, curtain sides on LGVs should not be opened if it has been identified that a load has shifted and the curtains are bulging, unless direct access to the unstable load is required as part of a considered incident plan.

Control measure actions

- Maintain stability where it has been established through existing vehicle structures. Consider other methods of entry
- Assess the time spent accessing through other means against the 'risk versus benefit' in terms of casualty welfare

Control measure – Consider access for other agencies

Control measure knowledge

Other agencies may need to attend the incident, such as medics, environment agency, vehicle recovery companies, Highways Agency, police collision investigation team, and so on. They may need access to the incident to perform their respective roles.

Control measure actions

- Liaise with the agencies and ensure they are adequately briefed about dynamic risks and control measures in place, to ensure a safe system of work and that existing safety measures are not compromised by their activities.

Unstable vehicle containing casualties

Hazard	Control measures
Unstable vehicle containing casualties	Make a safe approach Manage vehicle air systems Stabilise the vehicle Control the numbers of personnel entering or working around the vehicle Maintain access to and egress from the vehicle Appoint safety officers

Hazard knowledge

In this guidance, the term 'vehicle' incorporates any form of transport such as rail stock, road vehicle or aircraft that has become unstable due to the incident. The instability may be as a result of damage caused to the vehicle during the incident, as a result of its location or resting position, or a combination of these factors.

At the scene of a vehicle rescue incident, the geographic layout may be less than obvious. An obvious hill or slope may be a reminder to secure the vehicle, but an insignificant gradient may go unnoticed.

The vehicle may well be secured by collision damage but it should be remembered that ramming, cutting away or pulling during operations can release the vehicle, allowing it to become a 'runaway'.

The risk associated with incorrect stabilisation application or poorly managed and maintained stabilisation increases dramatically the larger or heavier the unstable vehicle.

Where the casualty is injured, especially seriously or in a critical, deteriorating condition, the vehicle should be secured and stabilised. This will yield several benefits, some of which may not be obvious to the attending fire and rescue service personnel. Proper stabilisation will prevent the floor pan flexing and the vehicle moving or rocking, particularly when personnel climb into or onto the vehicle.

It is important to note that if a firefighter climbs in to or on to a collision-damaged vehicle before suitable stabilisation, they may be subjecting the casualty to further crushing. The body weight of personnel within the

car may be directly supported by the casualty's trapped legs, particularly where a vehicle component has given way under impact or is cut during the rescue.

Securing the vehicle in a realistic manner will help to avoid rocking when carrying out certain techniques and will suppress jarring when operating equipment, especially where a part may be released under load, such as a forced door removal. It will also ensure that medical attendants have a sound base for their pre-hospital care.

There is seldom any feedback about the person who was trapped, but it is known that post-collision trauma is potentially lethal. Being released from a correctly secured vehicle should be considered less traumatic.

Before beginning any work on the vehicle, it should be completely stabilised to prevent further injury to the casualty and to protect the rescuers.

The properties of a good stabilisation method are:

- It should secure the vehicle safely
- It should completely immobilise the vehicle, preventing it from moving at all and reducing the casualty's chance of further injury
- It should be simple, being able to stabilise a vehicle in the position it was found on arrival of the rescue crew, and not hinder the appropriate extrication of the casualty
- The method should not take a long time to set up
- It should allow for easy checking on a regular basis to ensure the vehicle remains stable

Fire and rescue service personnel should practise and train as a crew to effectively stabilise different vehicles in a variety of locations, such as soft ground or in ditches. Fire and rescue service personnel should also be familiar with differing construction techniques, including the materials used, to ensure that stabilisation techniques make best use of the load bearing parts of a vehicle's structure to support the vehicle, rather than sheet metal, fascia sections etc. Refer to the *Extrication* section for new or heavy vehicle construction.

Everyone should know the speed required to stabilise, be aware of the importance of doing so, and be aware of the ways the objective can be reached.

The vehicle may continue to move or collapse because of instability, resulting in injury to members of the public, fire and rescue service personnel, other agencies and so on. It could cause damage to the environment, other vehicles or surroundings.

Control measure – Make a safe approach

Control measure knowledge

The stabilisation requirements of the vehicle, including its centre of gravity, should be assessed and communicated as part of the initial 360 degree assessment of the scene of any road traffic collision (RTC).

This assessment should take into account any damage that may compromise the vehicle's significant structure where lifting or stabilisation equipment would normally be placed or operated. Any insecure or shifted loads

also need to be considered and managed at this point. Refer to the *Extrication* section for dealing with vehicle contents.

To ensure that excessive numbers of personnel operating on potentially unstable ground or around implemented stability systems do not have a negative impact on vehicle stability, the inner cordon should be managed.

Control measure actions

- Ensure an assessment is undertaken to identify current stability issues. Communicate this information to all personnel within the scene of operations, including those of other agencies
- Keep numbers of personnel working in and around the immediate area to a minimum
- Consider using an inner cordon if the assessment highlights a risk of vehicle movement/drop, until complete stabilisation has been achieved; i.e. implement a safe working area around the vehicle considering the potential area within which the vehicle may move if stability is affected
- Establish a larger inner cordon or increase safe working distances if the incident type dictates that they be larger than a conventional incident

Control measure – Manage vehicle air systems

Control measure knowledge

Vehicle air systems can be broken down into two primary air systems:

1. Pneumatic suspension units. Currently fitted to around 80% of large goods vehicles (LGV) and public service vehicles (PSV) on UK roads. These suspension units can also be found on rail stock
2. Braking systems

It would be reasonable to expect to encounter this air system on all LGVs of 7.5 Tonnes Gross Vehicle Weight (GVW) and above. On PSV vehicles, full air braking systems will be fitted to larger commercial buses and coaches.

The hazard posed by the pneumatic suspension unit may be as a result of normal wear and tear in use, or from damage sustained in a collision, fire or similar potentially catastrophic event. While personnel are working around them, operating these units may cause potential failure unless properly assessed and controlled.

The hazards posed by pneumatic suspension units include:

- Projection or blast
- Impact
- Noise
- Entrapment due to chassis or axle dropping (a lift axle)

There are no mechanical interlocks or built-in safety systems to assist fire and rescue service personnel working in the vicinity of these systems. Any loss of integrity in the unit will result in a chassis or axle lowering and a potential blast hazard from the suddenly released compressed air.

The hazards posed by an air braking system include:

- Unexpected movement of the vehicle
- Stored energy release (spring brake chamber or parking brake)
- Entrapment due to uncontrolled vehicle movement

Control measure actions

- Make an initial assessment of the vehicle's layout, suspension systems and parking brake system. This will help ensure these components are managed. Any damage incurred or subsequent lifting requirements should be taken into account
- Make a quick assessment of the condition of the vehicle's parking or spring brakes if working in or around the air suspension units. If they have been involved in fire, there are significant risks due to the associated damage. Look for significant wear levels, damage including exposed cords or cuts, loss of shape or distortion and so on
- First attending fire and rescue service personnel should ensure the vehicle's parking brake is applied and a set of large vehicle wheel chocks are fitted where applicable; these are often available on the vehicle itself. If possible this should be applied to a non-parking braked axle, taking into account any future potential lifting requirements.
- Consider leaving the vehicle engine running in the early stage of an incident, while the suspension etc. is assessed and/or made safe, thus ensuring that the vehicles ride height is maintained throughout the operations.
- Ensure a safe system of work is employed immediately. This is to stabilise the vehicle chassis to protect any casualties or personnel who need to work beneath the chassis. This should include the insertion of suitable equipment, placed onto the vehicles chassis or significant structure, to take the vehicle's weight and to maintain its chassis height if an air suspension unit fails or a there is a significant leak in the system.
- Lower lifting axles where they exist or, if that is not practical, chain, strap or block them in the raised position.

Control measure – Stabilise the vehicle

Control measure knowledge

Stabilising the vehicle ensures that the risk, to any casualties and emergency responders, associated with vehicle movement is minimised. Any stabilisation measures should take into account the projected extent of operational intervention by emergency responders. This ensures that activities are not affected by any additional stabilisation work required, or by dangers associated with a moving vehicle.

Assessments should be carried out to establish the current and ongoing status of vehicle instability.

Due to vehicle construction, damage and the potential weights involved, any incorrectly assembled and positioned heavy rescue stabilisation equipment may have serious consequences on the outcome of the incident. The manufacturer's familiarisation training may not be sufficient on its own, especially if working simultaneously with other equipment.

Using external companies and partners to assist, if required, should be considered early.

Control measure actions

- Consider using specialist equipment and/or other agencies to help stabilise the vehicle, including winches and airbags. Pre-planning with specialist vehicle recovery, plant or crane companies could provide mutual understanding, with key issues like incident command, terminology and hand or evacuation signals being considered.
- Remember that standard stabilisation equipment carried on the majority of fire and rescue service pumping appliances may not be sufficient for first responders to stabilise a large or heavy vehicle
- Ensure that the planned stabilisation is appropriate for the extent of operations likely to be required. Due to the size of heavy vehicles and/or the nature of the situation, it can be difficult to implement a single stabilisation method to manage the risk appropriately. Fire and rescue service personnel may need to consider initial, primary, secondary and tertiary levels of stabilisation, or more, to effectively stabilise the vehicle.
- Any one stabilisation method should generally be reinforced by another, rather than replaced

Further information on stabilising LGV and PSV can be found at http://www.ukro.org/education/ukro-workshops/lgv-rescues/

Control measure – Control the numbers of personnel entering or working around the vehicle

Control measure knowledge

To ensure that personnel inside the vehicle and their movement do not make any instability worse, the numbers of emergency responders should be controlled, taking fire and rescue service and other emergency service personnel into account, along with any casualties.

Control measure actions

- Consider using sector management. Refer to the Incident Command guidance
- Minimise the required number of personnel operating within the vehicle

Control measure – Maintain access to and egress from the vehicle

Control measure knowledge

Access and egress routes from the vehicle should be maintained, taking into account that an alternative egress route may need to be established if the vehicle becomes more unstable or moves.

Control measure actions

- Ensure all personnel entering the risk area are aware of the identified safe access and egress routes to the vehicle
- Implement additional safe systems of work to assist with access and egress of personnel and casualties if necessary due to the terrain

Control measure – Appoint safety officers

Control measure knowledge

Because of the nature of the incident, appointing safety officers should be considered. The safety officers should be specifically briefed to monitor potential movement of the vehicle, and there should be a pre-arranged evacuation signal.

The supporting terrain on which any vehicle has come to rest should also be considered. Awareness of any movement in the terrain, and its associated effect on stabilisation of the vehicle, should be maintained.

Refer to the Incident Command guidance for further information.

Control measure actions

- Ensure that the role of the safety officer is known and an effective brief has taken place
- Ensure evacuation signals are known to all personnel entering the risk area
- Ensure any words of command to halt operations are known to all personnel operating within the safety officer's designated area of authority
- Consider appointing more than one safety officer if appropriate

Extrication from air transport

Military aircraft

Hazard	Control measures
Military aircraft	Make a safe approach Establish, monitor and maintain cordons Isolate aircraft armament Gain safe access to the cockpit Make ejection seats safe

	Extricate the aircrew

Hazard knowledge

The term 'military aircraft' can be defined as any aircraft used by the military. In the main the hazards associated with military aircraft will be the same as civil aircraft with the addition of hazards arising out of specialist military functions. This section of the guidance highlights only those additional hazards posed by military aircraft and should be read in conjunction with the hazards for aircraft in general.

Due to the hazardous nature of specialist military aircraft, actions should be restricted to life-saving operations. Where the aircrew have already ejected, the aircraft should be cordoned off and left undisturbed. An area around the aircraft with a radius of 300m should be evacuated if the aircraft is armed or if it cannot be confirmed that the aircraft was/is not carrying weapons. Efforts should be redirected to locating the aircrew and the remains of the ejection seats.

Aircraft assisted escape systems (otherwise known as ejection seats) present a significant hazard to responding fire and rescue service personnel attending a military aircraft incident. If the incident is not on an airfield there is a high likelihood that local authority (LA) fire and rescue service personnel will be first on the scene. Ejection seats can also be found in private ex-military aircraft.

Ejection seats can be made safe but, due to the extensive range of seat configurations, general training and familiarisation will be difficult.

Post-accident fire and rescue service operations are potentially subject to a significant number of hazards in relation to military aircraft on or around the scene of the incident. These will include:

- Minor pyrotechnic stores. Refer to the HazMat guidance
- Signal cartridges
- Distress signals
- Engine starter cartridges
- Ejection seats
- Ejector release units
- Cable cutting cartridges
- Major pyrotechnic stores
- Marine markers and floats
- Reconnaissance and target flares
- Photo-flash cartridges
- Aircraft destructors
- Weapons
- Bombs

- Rocket projectiles
- Guided weapons
- Cannon
- Torpedoes
- Mixed loads
- Practice and drill weapons and stores
- Practice weapons contain a small high explosive (HE) burster charge and/or pyrotechnic composition to mark their strikes with smoke, flame, or flash and smoke
- Drill weapons and stores may have working parts for loading drills, fusing drills etc. but they contain no explosive or pyrotechnic filling of any kind
- Additional hazards
- Special fuels. Refer to the HazMat guidance
- Radar
- Arrester hooks
- Explosive canopies
- Lasers for weather or weapon guidance systems
- Liquid oxygen . Refer to the HazMat guidance
- Compressed gas cylinders . Refer to the HazMat guidance

Control measure – Make a safe approach

Control measure knowledge

Fire and rescue service drivers should approach the incident slowly and with great care.

Military aircraft should be approached in the same way as large civil aircraft.

To minimise the risk of personnel being drawn into the engines, personnel should not approach the front of any engine that is running or could possibly be running. With modern aircraft the recommended safety distance will be a minimum of 10m away from the front and sides of any engine.

In addition the exhaust gas hazard area will vary depending upon the size of aircraft.

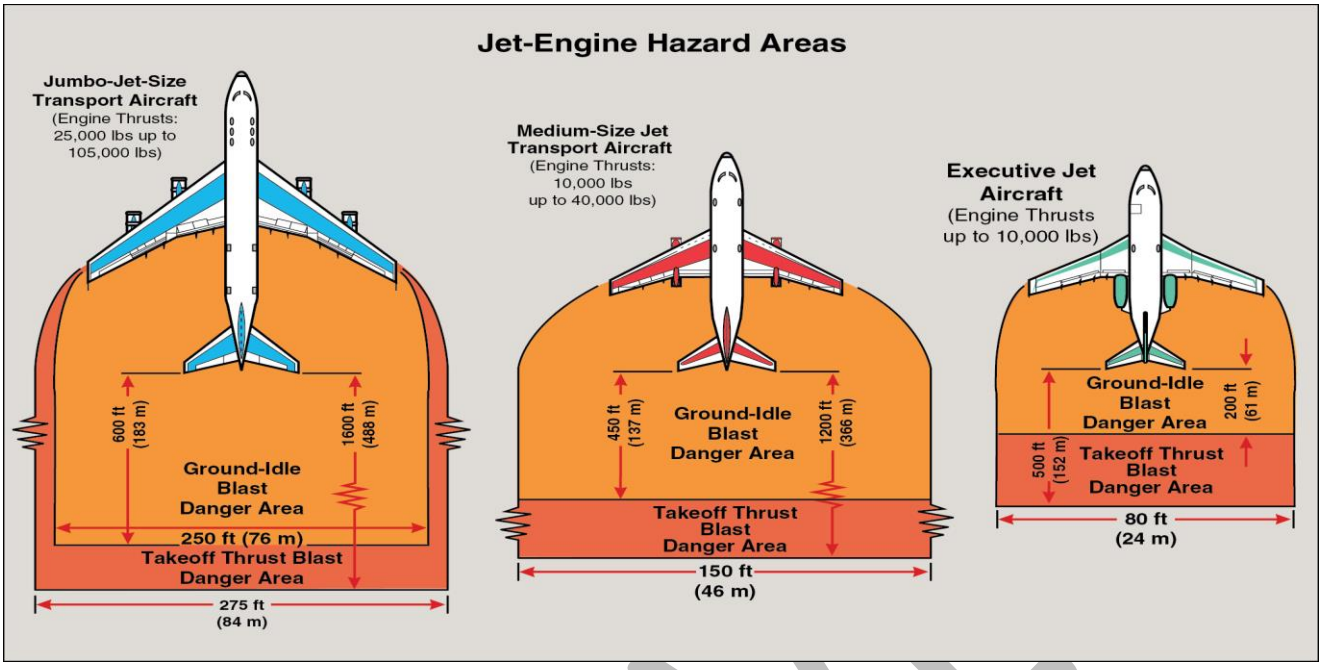


Figure 1: Diagram of the exhaust gas hazard area

Source: Aircraft Rescue and Fire Fighting, 5th edition, International Fire Service Training Association

Control measure actions

- Military aircraft should be approached with caution.
- The best approach is approximately 45° from the front of the aircraft. Avoid positioning appliances or walking directly in front of any weapons that may or may not be being carried.
- Be mindful that even after shutdown, engines retain sufficient heat to ignite flammable materials for up to 20 minutes.

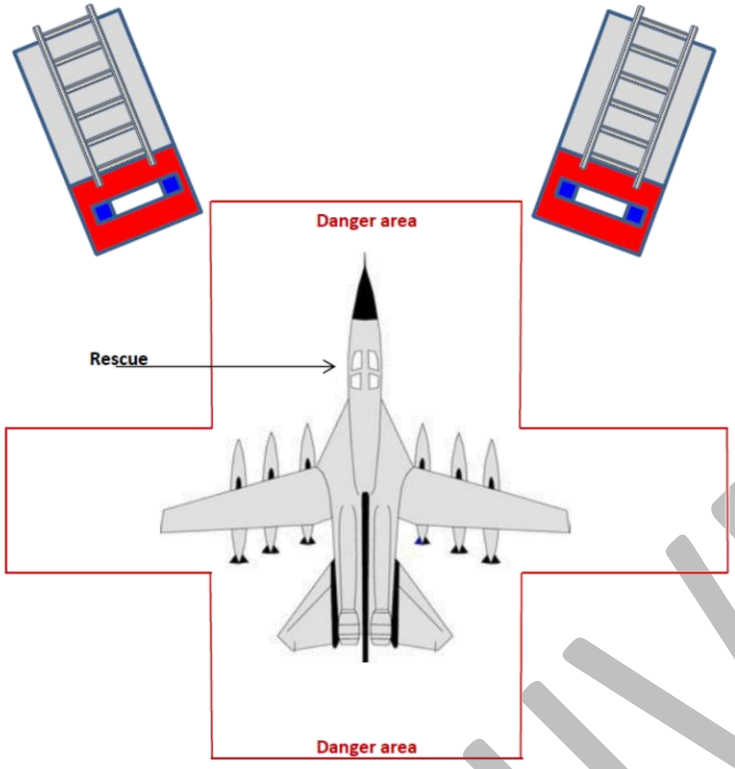


Figure 2: Diagram of the danger areas around military aircraft

Source: London Fire Brigade (using aircraft clipart sourced from PageResource.com)

Control measure – Establish, monitor and maintain cordons

Control measure knowledge

Refer to the Incident Command guidance for information about cordons. Cordons need to be suitable and sufficient and will need to take many factors into consideration, which may include:

- Wind direction and weather conditions. Refer to the Operations guidance
- Topography
- The size of the aircraft involved
- Engine hazard zones
- Escape slide path
- Debris
- Casualties
- HazMats. Refer to the HazMat guidance
- Aircraft armaments
- Post-incident investigations by the police and/or Air Accidents Investigation Branch (AAIB)

Control measure actions

- The incident commander should pay particular attention to the following in assessing the demands of the incident and reaching a decision on applying control measures:
    - Resources available, to include number of appliances/personnel in attendance or en route and resources available from the fire and rescue service or other agencies
    - Manage the safe evacuation of passengers away from the inner cordon
    - Need for rescues to be undertaken and the likely number of people requiring rescue
    - Observation of any hazard information on the aircraft, e.g. hazard warning symbols
- Consider the following when establishing cordons:
    - The first responding emergency service personnel will need to establish the inner and outer cordon as quickly as is reasonably practicable. It will provide a means of facilitating, safeguarding and coordinating the immediate response and adds an element of control to the incident
    - The inner and outer cordon should be flexible and be able to be moved if necessary. The outer cordon may subsequently be identified by police service personnel
- Assess the advised cordon distance of 300m for the incident, and increase or decrease as required
- Be aware that safety distances for military aircraft vary depending on their cargo, etc. for example:
    - Flares: 200m
    - Specific unexploded aircraft ordnance: 400m
    - Guns have a range of 7.5km and rockets 11km, if functioning as intended (The military consider that once an aircraft has crashed ordnance will not function fully, but may partially activate).
- Request specialist advice at the earliest opportunity when assessing cordon distances
- Liaise early on with other services in attendance to ensure a coordinated and safe response. Aircraft incidents are usually attended by more than one emergency service.

Control measure – Isolate aircraft armament

Control measure knowledge

Military aircraft are generally equipped with an array of integral or other safety features to prevent the inadvertent release or operation of explosive stores when on the ground. These features vary between aircraft, and further information should be obtained from an on-site military adviser, the Aeronautical Rescue Co-ordinating Centre (ARCC) or the Ministry of Defence (MoD).

The safety features fall into two categories:

- Master armament safety switch (MASS)

- Weight on wheels switch

Control measure actions

- Always request specialist knowledge before attempting to isolate aircraft armament
- Use the appropriate device:

The MASS is a mechanical device that isolates the electrical supply to the explosive stores fitted to the aircraft, normally situated on the left side of the cockpit or fuselage.

The weight on wheels switch is a device fitted to the main undercarriage of fixed-wing aircraft that isolates the weapon firing and release circuits when the undercarriage is down and locked. Any damage to the undercarriage on these fixed-wing aircraft could result in the weight on wheels switch being ineffective.

Control measure – Gain safe access to the cockpit

Control measure knowledge

A military aircraft cockpit is covered/protected by a canopy; a canopy is usually constructed from a transparent material and is extremely strong and heavy (canopies can weigh in the region of 100kg).

Once a canopy is open it will need to be secured in place to prevent it from slamming shut, which could render serious injury to emergency service personnel and/or aircrew.

Methods of rescuing aircrew from the cockpit will result in one of three entries:

- Normal entry
- Emergency entry
- Forced entry

Control measure actions

- Gaining access to the cockpit initially should be by normal means. Canopies can ordinarily be opened by the pilot using a manual, pneumatic, electronic or hydraulic system.
- Alternatively, canopies can be opened by a release mechanism, on the outside of the aircraft. The method and design of opening mechanisms changes depending on the type of aircraft.
- In the event of an aircraft accident and the pilot being incapacitated, the canopy may need to be opened by responding emergency service personnel. Instructions on how to open the canopy in an emergency will be written on the outside of the aircraft.

Note – This emergency entry only applies to aircraft fitted with a miniature detonating cord/linear cutting cord and requires a cordon at least three metres forward of the cockpit area when activating it.

- Forced entry to the canopy is highly dangerous and is not recommended. It would be extremely difficult to assess the state of any damage to the aircraft canopy on a crash damaged aircraft, which could ultimately activate and ‘fire off’ if the canopy frame is interfered with

Control measure – Make ejection seats safe

Control measure knowledge

In normal conditions only trained and competent technicians from the relevant military services should attempt to make an ejection seat safe. However, emergency service personnel may be faced with undertaking the task in exceptional circumstances, where the risk associated with attempting to work around the hazard impacts upon the ability to save life.

When an aircraft is parked on the ground safety devices, in the form of distinctive safety pins, are fitted to prevent the accidental actuation of the ejection seat.

Modern ejection seats have changed considerably from their earlier equivalents. In most cases they can be made safe for rescue using just one or two sear pins or by the operation of the seat safe lever. The seats vary in aircraft, but they all work in a similar manner. Once initiated, the ejection sequence is fully automatic and cannot be stopped.

All UK aircraft carry a set of sear pins in the cockpit for making the seat safe for rescue. However, some non-UK aircraft no longer carry sear pins and rely solely on the seat safe lever.

Control measure actions

These actions should be carried out in an emergency situation only (exceptional circumstance)

- Look for the seat guide rails projecting out of the canopy area on arrival at the aircraft. If they are visible it can indicate that the seats have fired from the cockpit and the aircrew may be some distance from the airframe. Never assume the seats have gone; a two-seat aircraft may have had only one occupant or a seat may have failed to operate.
- Making an ejection seat safe requires controlling the firing sequence by pinning the ejection handles or the safe seat lever.
- Ejection seats can be made safe at varying levels, usually described as:
    - Safe for rescue: seat firing sequence is inoperable but the seat systems are still active and elements such as the drogue gun can still be fired
        - Safe for servicing: seat totally disabled for maintenance purposes by a competent technician
- To operate the seat safe lever, reach into the cockpit and rotate the lever in an anti-clockwise direction, to turn from armed to safe egress.

Control measure – Extricate the aircrew

Control measure knowledge

This activity will involve operating in a very confined space. Great care should be taken not to accidentally operate any switches or equipment.

Electrical systems are identified by labelled switches marked with black and yellow hatching.

Military aircraft are increasingly fitted with infra-red guidance systems for weapons targeting. These may be both Forward Looking Infra-Red (FLIR) and Sideways Looking Infra-Red (SLIR).

These emissions can be damaging to delicate eye tissues and all emergency service personnel should be aware of the dangers of looking directly into glass panels located on the aircraft nose or elsewhere on the aircraft, until it can be confirmed that all systems have been isolated. Military laser guidance systems, unlike medical lasers, operate at a much higher intensity for targeting purposes and have the potential to cause harm, particularly to the eyes and delicate tissues.

The likelihood of infra-red and laser guidance systems operating post-crash is minimal, due to the aircraft safety system; crash switches, weight on wheels switch, isolating systems and so on. The infra-red guidance systems have to be manually selected by the pilot and therefore it is unlikely these will be activated at a crash site.

Any radar on civilian aircraft is normally restricted to weather indication and is relatively small in size and power output. Radar on military aircraft is primarily for detection and surveillance. These radar units operate on differing wavelengths and at much greater power output when switched on.

The EC3 Sentry AWACS uses an externally mounted dish scanner for airborne early warning and control with a range of over several hundred miles. In normal operating mode the dish rotates and has a large white strip across its surface; however, it should not be assumed that it is switched off if the dish is not rotating. The Nimrod uses fully enclosed nose cone search water radar, of extremely high power, and there is no external indication of its operational status.

Control measure actions

- The aircrew harness arrangement may vary between aircraft but the sequence to be followed is generic. Release should generally start at the head, work downwards at the sides of the body to the feet, and finish at the main harness release
- Be aware of aircrew suffering from possible spinal injury. Await medical assistance if safe to do so, leaving the aircrew in situ
- Ensure all lines and connectors are released before lifting a casualty. Remove the casualty carefully, ensuring sufficient personnel are able to take the weight and that all working surfaces are secure. If ladders are used in the extrication they should be properly secured to avoid slippage
- Any movement of aircraft controls needs to be documented at the earliest opportunity for accident investigation purposes
- Fire and rescue service personnel should be aware of the hazard posed by infra-red and laser systems, and should not look directly at the source when moving around the vehicle during the rescue

Rotary-wing aircraft

Hazard	Control measures

Rotary-wing aircraft	Make a safe approach Establish, monitor and maintain cordons Stabilise Apply the rotor brake Avoid deploying the Automatically Deployable Emergency Locator Transmitter (ADELT) unit Avoid activating flotation devices

Hazard knowledge

Rotary-wing aircraft, which are mostly of the helicopter type, have developed very quickly, both technically and commercially.

It is reasonable to assume that for rotary-wing aircraft lift and thrust are supplied by rotors. This allows the aircraft to take off and land vertically, to hover and to fly forward, backward and laterally. These attributes allow these aircraft to be used in congested or isolated areas where fixed-wing aircraft would usually not be able to take off or land.

The capability to hover efficiently for extended periods allows a rotary-wing aircraft to accomplish tasks that fixed-wing aircraft and other forms of vertical take-off and landing aircraft cannot perform.

Post-accident fire and rescue service operations are potentially subject to a significant number of hazards in relation to helicopters on or around the scene of the incident. These will include:

- Automatically Deployable Emergency Locator Transmitter (ADELT)
- Deployment of flotation devices
- Moving main rotor blade
- Moving tail rotor blade
- Downwash
- Unstable undercarriage
- High pressure systems
- Aviation fuel and oils. Refer to the HazMat guidance
- Entanglement in cables
- MMMF (Composite materials)
- Batteries, potentially including Lithium-ion types. Refer to the HazMat guidance

Control measure – Make a safe approach

Control measure knowledge

The approach to any incident involving rotary-wing aircraft can be extremely hazardous and will need to take many factors into consideration, which may include:

- The position of the aircraft
- The damage sustained to or by the aircraft
- The type of aircraft; military or civil
- Any passengers or aircrew visible on arrival
- The fire situation on arrival. Refer to the Fires and Firefighting guidance
- Whether engines are running
- Whether rotors are turning

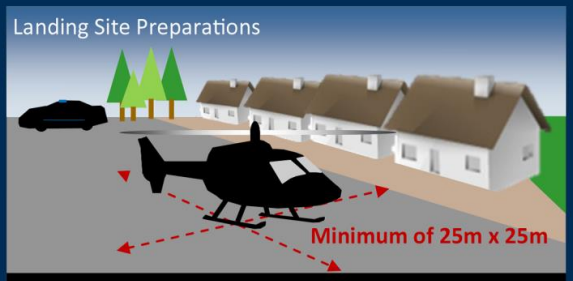
Control measure actions

There may be occasions when fire and rescue service personnel are required to approach, board or disembark from helicopters. The hazards arising from such an activity may be due to any or all of the following:

- Personnel approach from the rear or side of the helicopter, where they cannot be observed by the pilot (**Note –** this is not a hazard with a Chinook aircraft as the standard operating procedure for a Chinook is to approach from the rear in full view of the aircrew loadmaster).
- Personnel approach assuming an upright posture or carrying equipment in an elevated position
- Personnel approach or disembark on the uphill side of a helicopter on sloping ground
- Personnel come into contact with hot exhaust ports
- Personnel approach or disembark during 'engine shutdown' procedures
- Personnel approach the danger area: the area immediately adjacent to the tail rotor

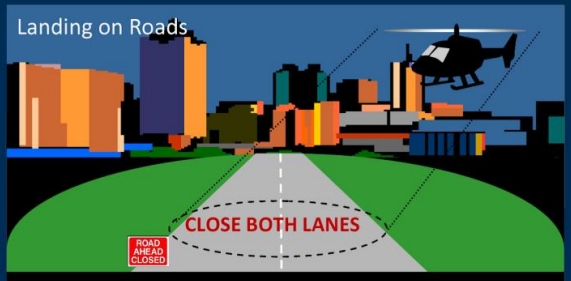
NPAS Helicopter Operations Awareness

Landing Site Preparations



Landing sites need to be free of people, obstacles, trees and overhead wires. Remove as much litter as possible. Do not cordon off with tape.

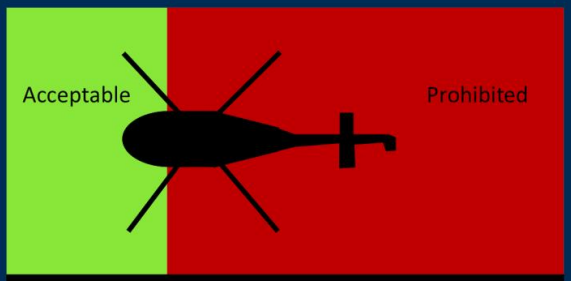
Landing on Roads



Both carriageways MUST be closed to traffic.
Emergency vehicles should not be within 30m of ANY landing site.

Approaching

DO NOT APPROACH without receiving a visual instruction from the pilot. If in doubt do not approach the helicopter until the rotors have fully stopped.



Safety zones for approaching / leaving the helicopter. Stay where the pilot can see you at all times.

Sloping Grounds

On sloping ground, ALWAYS approach/depart the helicopter on the downslope side for maximum rotor clearance.

Departure

IN AN EMERGENCY, THE HELICOPTER MAY NEED TO LAND BACK ON THE REJECT AREA.

KEEP ALL PEOPLE AND VEHICLES CLEAR OF AREA.

Briefing from Crew:

- Do NOT help the crew without direct instructions.
- Do NOT help load/unload the patient without a request from the crew.
- Do NOT help the crew with opening or closing the doors.
- Be prepared to control access to the landing site under direction from the crew in preparation for helicopter departure.

Keep in mind:

- Downwash from the helicopter can be damaging. Remove loose objects and hats. Remove as much litter from the site as possible.
- Do not attempt to attract the crew's attention with bright lights or lasers.
- Keeping the Reject Area clear is vital to your safety.
- When landing on or departing from roads - including dual-carriageways and motorways - BOTH carriage-ways must be closed to ALL vehicles.

This safety aid has been produced with the kind permission of Bond Air Services Ltd

Figure 3: Helicopter operations awareness

Source: National Police Air Service (NPAS)

Considerations for PPE should take into account the need for rescuers to be visible against the operational background, including night working, and for team leaders to be distinguishable within the incident command structure. All personnel should wear appropriate levels of PPE including climatic (for heat, cold, wet and extreme weather) and respiratory protection equipment (RPE), where necessary.

Emergency service personnel working in the vicinity of a helicopter are advised to wear high visibility clothing wherever possible. When rotors are turning, or engines running, ear and eye protection will also be necessary.

Control measure – Establish, monitor and maintain cordons

Control measure knowledge

Refer to the Incident Command guidance for information about cordons. Cordons need to be suitable and sufficient and will need to take many factors into consideration, which may include:

- Wind direction and weather conditions. Refer to the Operations guidance
- Topography
- The size of the aircraft involved
- Engine hazard zones
- Escape slide path
- Debris
- Casualties
- HazMats. Refer to the HazMat guidance
- Aircraft armaments
- Post-incident investigations by the police and/or Air Accidents Investigation Branch (AAIB)

Control measure actions

- The incident commander should pay particular attention to the following in assessing the demands of the incident and reaching a decision on applying control measures:
    - Resources available, to include number of appliances/personnel in attendance or en route and resources available from the fire and rescue service or other agencies
    - Managing the safe evacuation of passengers away from the inner cordon
    - Need for rescues to be undertaken and the likely number of people requiring rescue
    - Observation of any hazard information on the aircraft, e.g. hazard warning symbols
- Consider the following when establishing cordons:

  - The first responding emergency service personnel will need to establish the inner and outer cordon as quickly as is reasonably practicable. It will provide a means of facilitating, safeguarding and coordinating the immediate response and adds an element of control to the incident.
  - The inner and outer cordon should be flexible and be able to be moved if necessary. The outer cordon may subsequently be identified by police service personnel.
- Assess the advised cordon distance of 300m for the incident, and increase or decrease as required
- Be aware that safety distances for military aircraft vary depending on their cargo, for example:
  - Flares: 200m
  - Specific unexploded aircraft ordnance: 400m
  - Guns have a range of 7.5km and rockets 11km if functioning as intended. Note that the military consider that once an aircraft has crashed ordnance will not function fully, but may partially activate
- Request specialist advice at the earliest opportunity when assessing cordon distances
- Liaise with other services in attendance early to ensure a co-ordinated and safe response; aircraft incidents are usually attended by more than one emergency service.

Control measure – Stabilise

Control measure knowledge

Crash-damaged rotary-wing aircraft are particularly susceptible to fuselage rollover and should be fully stabilised to prevent such a situation occurring.

Control measure actions

For control measure actions, refer to the hazard in the *Extrication* section of this guidance, *All forms of Transport – Unstable vehicle containing casualties*.

Control measure – Apply the rotor brake

Control measure knowledge

Many rotary-wing aircraft are fitted with rotor brakes. This device will slow and stop the rotor more quickly than allowing it to stop freely.

The brake should not be used until the rotors have slowed significantly or this will cause further damage, and may make the aircraft become unstable.

Control measure actions

- Emergency service personnel should not apply the rotor brake if not trained to do so. Where suitably trained, the rotor brake should be identified and applied to make the scene safe.

Control measure – Avoid deploying the Automatically Deployable Emergency Locator Transmitter (ADELT) unit

Control measure knowledge

Helicopters that operate over water may be fitted with an Automatically Deployable Emergency Locator Transmitter (ADELT) unit. This unit, when released from the aircraft, transmits a continuous signal to allow responding searching craft to 'home in'.

The ADELT unit may be attached to the fuselage or the tail cone with the deployment being to the rear, in a downward and slightly outwards direction. The unit itself is deployed by a release mechanism squib and subsequent spring pressure to eject the ADELT away from the aircraft.

Accidental activation of any type of ADELT may create hazards to personnel, as release mechanisms or parts of the vehicle such as wheel hubs may be ejected before activation. The ejection speed can equate to 5m/s, with a range of travel of approximately 10m.

Control measure actions

- Personnel should take extreme care when working in the vicinity of ADELT systems, as heavy applications of water (and/or foam) can mimic the aircraft having crashed into a stretch of water and could cause the ADELT to deploy.

Control measure – Avoid activating flotation devices

Control measure knowledge

Rotary-wing aircraft that operate over water may also have emergency devices fitted that allow the aircraft to stay afloat after ditching. The devices are automatically deployed when immersed in water and have the potential to cause a hazard, if they are hit with water and/or foam.

The devices tend to be located on the aircraft sponsons or on the fuselage.

Control measure actions

- Avoid directing water and/or foam at the aircraft flotation devices

Aircraft undercarriages

Hazard	Control measures
Aircraft undercarriages	Establish, monitor and maintain cordons Stabilise

Hazard knowledge

In this guidance, the term undercarriages relates to the area underneath the main fuselage and wing sections of an aircraft or helicopter.

The landing gear, incorporating wheels, legs, struts and shock absorbers, will include the main wheels, nose wheel and, on some older aircraft, a tail wheel. Most undercarriage systems on large aircraft are fully retractable to reduce drag.

The undercarriage legs absorb the shock on landing. A piston moves up a cylinder containing hydraulic fluid or compressed air. The hazards posed by undercarriage incidents may be as a direct result from an accident or fire, or during the rescue phase of emergency service operations.

Many hazards exist when dealing with undercarriage assemblies and it is therefore imperative that emergency service personnel are familiar with the required tactics and techniques needed to manage this type of incident safely, for example:

- Sharps
- Structural collapse
- Impact
- Damage to equipment
- Pressurised systems. Refer to the HazMat guidance

The more familiar personnel are with the underside of an aircraft the less formidable it will look and feel on the day an incident occurs. Joint training and familiarisation visits with airport fire and rescue services are key in achieving greater awareness and understanding of these types of incidents.

Undercarriage problems can occur for many reasons and can result in a number of different problems for responding fire and rescue service personnel, for example:

- Heavy landing
- Aborted take off
- Spot cooling/thermal shock due to incorrect application of firefighting media
- Structural failure
- Mechanical defect e.g. undercarriage not locking in position
- Effects of internal or external fires, affecting the structural strength of airframe
- Tyres bursting as a result of foreign object damage, heat transfer from brake assemblies, etc.
- Hot brake assemblies as a result of heavy braking, defective brake components, etc.
- Full or partial wheels up landing as a result of loss of undercarriage controls, failure of undercarriage assembly etc.

Control measure – Establish, monitor and maintain cordons

Control measure knowledge

Refer to the Incident Command guidance for information about cordons. Cordons need to be suitable and sufficient and will need to take many factors into consideration, which may include:

- Wind direction and weather conditions. Refer to the Operations guidance
- Topography
- The size of the aircraft involved
- Engine hazard zones
- Escape slide path
- Debris
- Casualties
- HazMats. Refer to the HazMat guidance
- Aircraft armaments
- Post-incident investigations by the police and/or Air Accidents Investigation Branch (AAIB)

Control measure actions

The incident commander should pay particular attention to the following in assessing the demands of the incident and reaching a decision on applying control measures:

- Resources available, to include number of appliances/personnel in attendance or en route and resources available from the fire and rescue service or other agencies
- Managing the safe evacuation of passengers away from the inner cordon
- Need for rescues to be undertaken and the likely number of people requiring rescue
- Observation of any hazard information on the aircraft, e.g. hazard warning symbols
- Consider the following when establishing cordons:
    - The first responding emergency service personnel will need to establish the inner and outer cordon as quickly as is reasonably practicable. It will provide a means of facilitating, safeguarding and coordinating the immediate response and adds an element of control to the incident.
    - The inner and outer cordon should be flexible and be able to be moved if necessary. The outer cordon may subsequently be identified by police service personnel.
- Fire and rescue service personnel should be conscious of the particular danger areas at this type of incident, particularly if personnel need to be deployed underneath the aircraft. The main danger areas to be considered are:
    - Engines – Engine propellers, jet engine air intake and exhaust efflux zones

- Ram air turbine (RAT) deployment
- Under the fuselage, mainplane or tail. Should the undercarriage assembly collapse the aircraft will tend to list downwards on the side of the collapse and may also cause the aircraft to swing in one direction. The nature and amount of movement will vary according to the:
  - Point of collapse
  - Aircraft type
  - Weight of the aircraft
- Rim Disintegration Zone; extends outwards at an angle of approximately 45° from the centre of each wheel. The majority of debris caused by wheel/tyre failure will be projected into this area. Debris may also be projected into areas fore (front) and aft (rear) of the undercarriage. In view of the inherent dangers to personnel, the rim disintegration zone should be avoided and personnel operating fore and aft of the assembly should do so with extreme caution

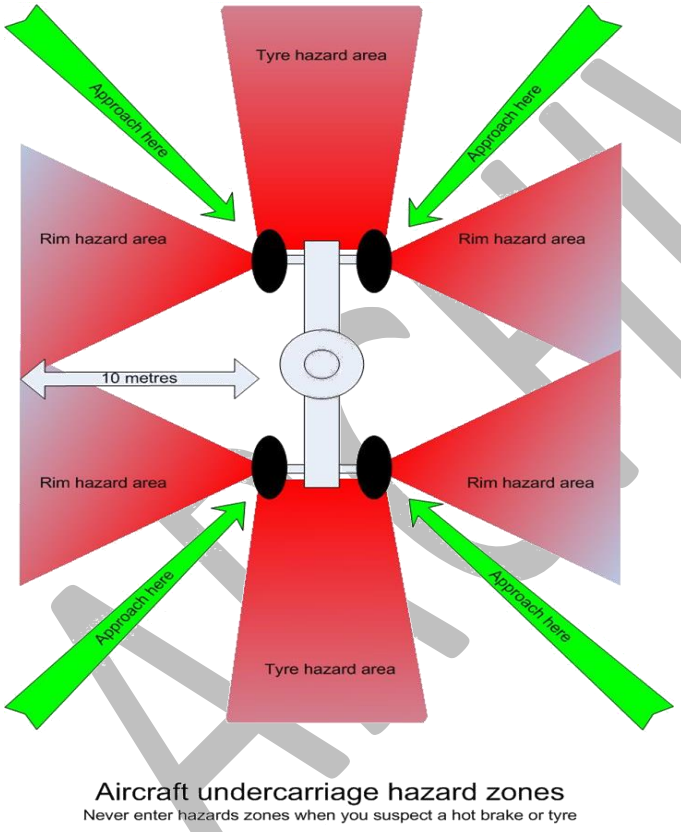


Figure 4: Diagram of the undercarriage and tyre hazard zones around an aircraft

Source: West Sussex Fire and Rescue Service

- Assess the advised cordon distance of 300m for the incident, and increase or decrease as required
- Be aware that safety distances for military aircraft vary depending on their cargo, etc. for example:
  - Flares: 200m
  - Specific unexploded aircraft ordnance: 400m

  - Guns have a range of 7.5km and rockets 11km if functioning as intended.(The military consider that once an aircraft has crashed ordnance will not function fully, but may partially activate)

- Request specialist advice at the earliest opportunity when assessing cordon distances

Liaise with other services in attendance early to ensure a co-ordinated and safe response; aircraft incidents are usually attended by more than one emergency service.

Control measure – Stabilise

Control measure knowledge

Crash-damaged aircraft are very susceptible to leaning and listing. The need to stabilise the aircraft thoroughly is vital, given the structural impact and potential for significant movement should the aircraft be damaged further or be displaced due to emergency service operations.

Control measure actions

Refer to the *Extrication* section for information on dealing with unstable vehicles containing casualties.

Escape slides

Hazard	Control measures
Escape slides	Identify slides and access points Establish, monitor and maintain cordons

Hazard knowledge

In this guidance, the term 'escape slides' relates to deployed and undeployed escape slides. The cabin doors are the primary means of egress from an aircraft, with secondary means consisting of over and/or under wing hatches, tail-cone jettison systems, rear air-stairs or stairs that lower at the rear of the aircraft, with roof hatches and escape windows for the flight deck.

The hazards posed by escape slides and access points include:

- Escape slides deploying when a door is opened
- Their weight
- Their configuration; how to open them
- Efforts to remove a deployed escape slide

It is safe to assume that, due to the manufacturing process, all large passenger aircraft will have escape slides located at each exit.

In addition, it is reasonable to expect that an aircraft with door sills 2m or more above the ground will be fitted with an emergency escape slide.

All aircraft manufacturers provide guidance on the process required to open an aircraft door externally, if required.

Control measure - Identify slides and access points

Control measure knowledge

The immediate priorities are to recognise that the escape slides are active, communicate the fact to all personnel involved and identify emergency break-in points.

Emergency break-in points are areas marked on the fuselage of some aircraft, but more commonly these areas are not indicated at all.

Emergency break-in points are located where there are no internal obstructions such as electrical wiring or pipe work. They are not weak points in the airframe structure but merely areas between frames, meaning only the skin and stringers should require cutting.

The majority of emergency break-in points are located high on the fuselage and well above the aircraft cabin floor. This can cause problems with access and will require suitable working platforms should forced entry be attempted.

The only method of cutting through these areas will be with powered tools; the reality of achieving rescues with this method is very small. All other options in gaining entry into the aircraft should be attempted before resorting to cutting in points.

Two types of escape slides may be encountered:

- Self-supporting; inflated by an inert gas such as nitrogen or carbon dioxide. Refer to the HazMat guidance
- Non-inflatable design made of synthetic materials that require support

Self-supporting escape slides should be automatically deployable and inflate in approximately six seconds. They should also be self-supporting on the ground, regardless of landing gear collapse, and be usable in winds of up to 25 knots with the assistance of only one person.

It should be possible to evacuate an aircraft in approximately 90 seconds. Escape slides can move 70 persons per lane, per minute. In larger aircraft escape slides may have multiple lanes, meaning larger numbers of passengers can evacuate simultaneously.

It is good practice to task emergency service personnel to the bottom of each escape slide in use, to assist passengers and prevent congestion, which may result in injury to passengers.

Control measure actions

- Emergency service personnel tasked to assist with escape slides should keep their visors down, if fitted, to protect from injury that may be sustained by the rapid evacuation of the aircraft

- When the aircraft door is opened from the outside the mechanism should disarm the escape slide actuation system. However, fire and rescue service personnel opening doors from the outside should pay particular attention to the risk of the escape slide deploying due to malfunction of the safety systems, or if the door is damaged in the aircraft accident
- Ladders should be pitched beside the door, on the side opposite to the hinges – that is to the aft (rear) of the door on almost all passenger aircraft with hinged doors
- At the bottom of the escape slide assembly, on the interior of the door, is a metal bar referred to as the girt bar. When the door is armed, this bar is locked into place by two metal fixings on the inside of the door sill
- When opening the door from the outside, the door should be cracked open and a visual check made to ensure that the girt bar is free from the securing clips inside the door frame
- If the girt bar is located within the securing clips the door is still armed. If the door is opened, the escape slide will deploy
- Escape slides deploy a considerable distance away from the fuselage and great care should therefore be taken when parking appliances or moving around the aircraft on foot
- The numbers and length of escape slides will vary dependent on the aircraft – those for an A380 Airbus airliner can be seen in this photograph
- If the escape slide inflates as a consequence of a door being opened from the outside, its design means it will inflate either side of the door frame; there is a high likelihood of the fire and rescue service ladders etc. being destabilised
- Escape slides can be disconnected from the aircraft and used as rafts if the aircraft ditches into water. The top of the escape slide has a lanyard that detaches the escape slide from the aircraft. This facility should also be used when removing the escape slide to carry out firefighting and rescue operations
- To assist access to the aircraft, escape slides can also be cut or deflated by emergency service personnel if necessary
- Familiarisation with this system is best obtained by visiting local airports where escape slides are tested by engineers on a regular basis, i.e. large airports with maintenance facilities

Control measure – Establish, monitor and maintain cordons

Control measure knowledge

Refer to the Incident Command guidance for information about cordons. Cordons need to be suitable and sufficient and will need to take many factors into consideration, which may include:

- Wind direction and weather conditions. Refer to the Operations guidance
- Topography
- The size of the aircraft involved
- Engine hazard zones

- Escape slide path
- Debris
- Casualties
- HazMats. Refer to the HazMat guidance
- Aircraft armaments
- Post-incident investigations by the police and/or Air Accidents Investigation Branch (AAIB)

Control measure actions

The incident commander should pay particular attention to the following in assessing the demands of the incident and reaching a decision on applying control measures:

- Resources available, to include number of appliances/personnel in attendance or en route and resources available from the fire and rescue service or other agencies
- Managing the safe evacuation of passengers away from the inner cordon
- Need for rescues to be undertaken and the likely number of people requiring rescue
- Observation of any hazard information on the aircraft, e.g. hazard warning symbols
- Consider the following when establishing cordons:
    - The first responding emergency service personnel will need to establish the inner and outer cordon as quickly as is reasonably practicable. It will provide a means of facilitating, safeguarding and coordinating the immediate response and adds an element of control to the incident
    - The inner and outer cordon should be flexible and be able to be moved if necessary. The outer cordon may subsequently be identified by police service personnel
- Assess the advised cordon distance of 300m for the incident, and increase or decrease as required
- Be aware that safety distances for military aircraft vary depending on their cargo, for example:
    - Flares: 200m
    - Specific unexploded aircraft ordnance: 400m
    - Guns have a range of 7.5km and rockets 11km if functioning as intended. Note that the military consider that once an aircraft has crashed ordnance will not function fully, but may partially activate.
- Request specialist advice at the earliest opportunity when assessing cordon distances
- Liaise with other services in attendance early to ensure a co-ordinated and safe response – aircraft incidents are usually attended by more than one emergency service.

Aircraft ballistic parachute systems

Hazard	Control measures
Aircraft ballistic parachute systems	Identify systems and communicate their positions Isolate on board Manage the deployed parachute

Hazard knowledge

In this guidance, the term 'aircraft ballistic parachute' will relate to aircraft ballistic recovery systems.

Post-accident fire and rescue service operations are potentially subject to a significant number of hazards relating to ballistic recovery systems on or around the scene of the incident. These include:

- Deploying the rocket and parachute
- Defragmentation of aircraft fuselage during deployment
- The parachute may drag the aircraft and cause destabilisation of the aircraft in the wind
- Electronically fired trigger systems
- The solid fuel rocket
- Entanglement in the parachute and cables

It is reasonable to assume that modern light aircraft will be factory-fitted with a ballistic recovery system. It should also be assumed that older light aircraft may have been retro-fitted with ballistic recovery systems.

The systems may be contained within the fuselage construction (such as the Cirrus airframe parachute system), internally housed in a rigid launch container in the rear compartment, or externally mounted in a rigid or nylon 'soft pack' launch container (such as the Galaxy Recovery System).

Fire and rescue service personnel risk death or serious injury if they move or cut airplane wreckage without determining whether there is a ballistic recovery system or they disregard the positioning of the rocket motor as they work with the wreckage.

Control measure – Identify systems and communicate their position

Control measure knowledge

The first priority is to identify, from the exterior of the aircraft, the location and condition of the ballistic recovery systems on the aircraft by way of signage, known locations etc.

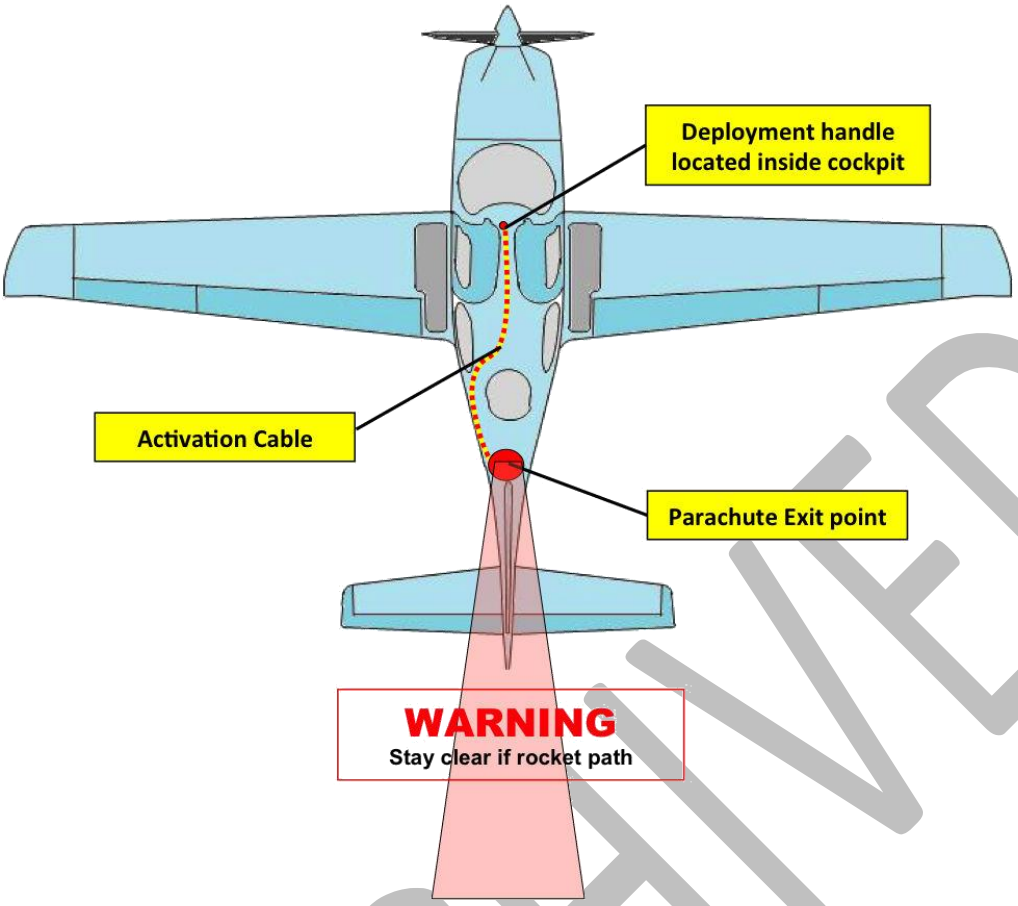


Figure 5: Diagram showing an example of a ballistic recovery system's location and usual trajectory path

Source: Kent Fire and Rescue Service

Control measure actions

- Once the ballistic recovery system has been identified, its presence and state, including any associated cordon/safety area, should be communicated to all emergency service personnel attending the incident
- The usual trajectory taken by a deployed rocket is to the rear of the aircraft. However in some microlight designs the rocket may deploy straight up, or up and slightly forwards

Control measure – Isolate on board

Control measure knowledge

Under normal conditions, the system is well secured and is not prone to accidental firing. The rocket will only fire if the activation handle in the cockpit is pulled with sufficient force. However, the system can be less predictable if an aircraft has been in an accident.

To make the ballistic recovery system safe, the system should be isolated. Only trained personnel should attempt to make safe a ballistic recovery system, using specialist cable cutters that are not generally available to fire and rescue services.

All ballistic recovery systems are self-contained and do not rely on external power sources from the aircraft electrical systems. Therefore isolation of batteries and power supplies will not deactivate these systems.

Situations have also occurred where ballistic recovery systems have become completely detached from the airframe by the forces generated during a crash, resulting in the still live system lying in the middle of the crash site.

A ballistic recovery system unit is made up of four major elements:

- Activation handle
- Activation cable
- Rocket motor assembly
- Parachute container

Control measure actions

- To isolate the ballistic recovery systems the release handle safety pin will need to be inserted and the actuator cable cut. However, this will vary from aircraft to aircraft.
- Approved cable cutters for ballistic recovery systems should be used. Do not use bolt croppers as they may actuate the rocket firing system.

Control measure – Manage the deployed parachute

Control measure knowledge

Once the parachute has deployed there is a risk of the aircraft stability being compromised if the chute canopy suddenly fills with air and drags the wreckage.

Control measure actions

- Consider cutting the parachute cables and wetting the parachute with foam or water spray or placing a heavy object on the parachute canopy to prevent dragging of the aircraft

Aircraft electrical systems

Hazard	Control measures
Aircraft electrical systems	Identify and isolate using on-board systems Isolate battery supplies Isolate fuel systems

Hazard knowledge

The hazard posed by electrical systems may be a direct result of an accident, fire or may occur during emergency service operations.

As aircraft fly higher, faster and grow larger, the services that the power supply has to satisfy also grow more complex. In civil aircraft this means more power to the galley units, environmental control and passenger entertainment systems, while military aircraft require more power sensors and weapon systems. Both have increased power demands for actuators, lighting systems, avionics and heating.

There are several different power sources on aircraft to power the aircraft electrical systems. These power sources include:

- Batteries: lead acid, alkaline and Lithium-ion batteries are used. Refer to the HazMat guidance
- Engine-driven generators: provide the main power for the aircraft systems in flight
- Auxiliary power units (APU): provide essential power for the aircraft systems when the aircraft is on the stand
- Fixed electrical ground power (FEGP): used in lieu of the APU to supply electricity for the essential power requirements of the aircraft whilst on the stand
- Ram air turbines (RAT): used on both civil and military aircraft to supply electrical capacity in flight. RATs are only deployed if the aircraft electrical systems fail. However, if working under the fuselage at an incident, these units could drop down unexpectedly if there is a loss of hydraulic pressure, causing a potential hazard

The primary function of an aircraft electrical system is to generate, regulate and distribute electrical power throughout the aircraft. The aircraft electrical power system is used to operate:

- Aircraft flight instruments
- Essential systems such as anti-icing (essential power is power that the aircraft needs to be able to continue safe operation)
- Passenger services (passenger services power is the power used for cabin lighting, entertainment systems and food preparation)
- Ignition systems in light aircraft

Aircraft electrical components operate on many different voltages, both Alternating Current (AC) and Direct Current (DC). However, most of the aircraft systems use 115 volts (v) AC at 400 hertz (Hz) or 28 volts DC. In some aircraft, 26 volts AC is also used for lighting. Refer to Context – Electricity guidance.

Electrical systems are used throughout the aviation industry on larger commercial and military aircraft. It is reasonable to assume that they will be present at all aviation incidents involving commercial and military aircraft.

Control measure - Identify and isolate using on-board systems

Control measure knowledge

APUs and batteries vary in size and will be located in numerous locations in aircraft. They can be identified via a small exhaust outlet situated close to the APU. This could be located either in the tail section, wing or underneath the aircraft fuselage.

Many modern aircraft are equipped with an APU which is powered by a small turbine engine. It is often found in the tail cone area or to the rear of the aircraft. It is normally used on the ground to run various services when the main engines are shut down. Battery levels are also restored when it operates.

Control measure actions

- Recognise that APUs and batteries are present at the accident scene and communicate this to all personnel involved. Because of their hidden nature and the difficulty in identifying them, this could result in personnel inadvertently causing damage to an APU and associated equipment.
- Isolate using cut-off switches in the aircraft cockpit or emergency shut-offs generally located towards the front of the aircraft, in or near the avionics bay. However, these can be found in different locations depending on the aircraft manufacturer
- The majority of APUs have automatic shutdowns that will activate if a problem is identified

Control measure – Isolate battery supplies

Control measure knowledge

Various types of batteries are used in the aircraft industry; lead acid, alkaline, lithium-ion etc. These are found in various locations depending on the aircraft type and size.

To isolate the power on non-military aircraft look for the electrical master switch on the cockpit panel. This is usually clearly marked with a red switch but in some newer aircraft the switch may be black, but still marked 'Master'.

Control measure actions

When isolating the batteries, the method of disconnecting the supply from aircraft batteries is:

- Most aircraft have a battery isolation switch; this isolates the battery from nearly all electrical circuits. Some emergency services, such as the fire extinguishing systems, may not be isolated.
- Manually disconnecting the terminals from the batteries where possible is recommended

Control measure – Isolate fuel systems

Control measure knowledge

Because of the risk posed by aircraft electrical systems and the volatility of the fuels used in aircraft, fuel isolation switches should be activated.

Aircraft fuel isolation switches are usually found in the cockpit and should be clearly marked.

Control measure actions

- Isolate the fuel via shut-off valves, as identified and where safe to do so
- Document any movement of aircraft controls at the earliest opportunity, for accident investigation purposes

Man-made mineral fibres (MMMF)

Hazard	Control measures
Man-made mineral fibres (MMMF)	Identify locations and communicate them Establish, monitor and maintain cordons Apply foam Prevent manipulation or damage Wear personal protective equipment (PPE) Undertake decontamination

Hazard knowledge

Man-made mineral fibres (MMMF) are a wide range of materials that use the inherent strength and durability of woven fibres bonded together with resins (also known as Polymer Composites or Composite Materials). Some common names to describe these materials are:

- Carbon Fibre Reinforced Plastic (CFRP)
- Aramid Reinforced Plastic (ARP)
- Glass Fibre Reinforced Plastic (GFRP)
- Kevlar

Given the extensive use of MMMFs in the aviation industry, it is reasonable to assume that they will be present at all aviation incidents.

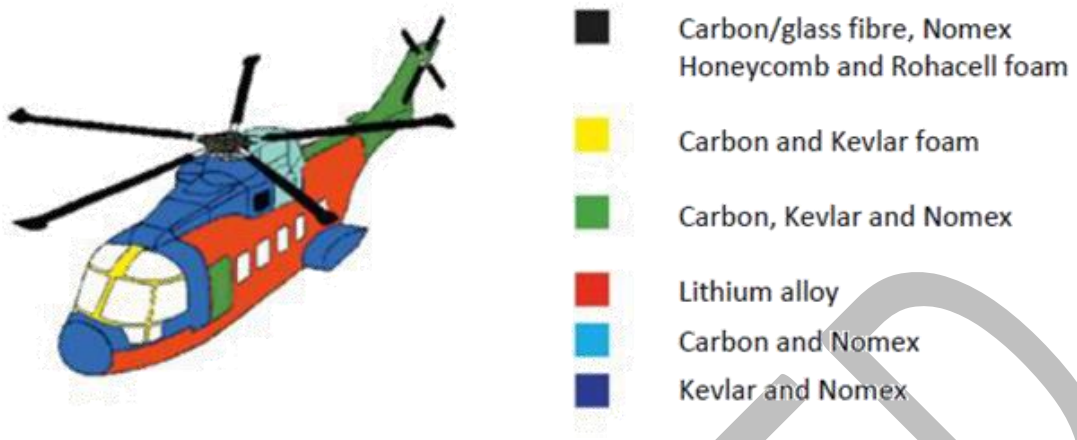


Figure 6: Diagram showing typical location of composite materials used in an aircraft and/or helicopter

Source: MOD Crown Copyright

The principal hazard to emergency service personnel from MMMFs arises from the decomposition of the material both during and after an aircraft fire. The fibres will be left in a fragile condition and may crumble when touched. The fibres are likely to be respirable in size and could easily cause needle stick injuries and traumatic dermatitis, similar to that associated with glass fibre.

Similar hazards exist when cutting MMMFs, whether or not they have been involved in fire. The material may plume following a crash and be carried a considerable distance downwind.

Fibres associated with MMMFs can become contaminated with products of a post-crash incident, such as:

- Fuel and oils
- Biohazards
- Chemicals
- Products of combustion

Consideration should be given to the potential impact on other emergency services, casualties and the environment. If the integrity of the aircraft has been compromised, hazardous materials (HazMat) procedures should be followed.

Control measure – Identify locations and communicate them

Control measure knowledge

MMMFs will be located in numerous individual locations within an aircraft. Although not a metal, the use of composite materials in aircraft construction is common.

Control measure actions

- Recognise that MMMFs are present at the incident as a priority, and communicate this to all personnel involved

Control measure – Establish, monitor and maintain cordons

Control measure knowledge

Refer to the Incident Command guidance for information about cordons.

The incident commander should pay particular attention to the following in assessing the demands of the incident and reaching a decision on applying control measures:

- Resources available, to include number of appliances/personnel in attendance or en route and resources available from the fire and rescue service or other agencies
- Managing the safe evacuation of passengers away from the inner cordon
- Need for rescues to be undertaken and the likely number of people requiring rescue
- Observation of any hazard information on the aircraft, e.g. hazard warning symbols
- Consider the following when establishing cordons:
    - The first responding emergency service personnel will need to establish the inner and outer cordon as quickly as is reasonably practicable. It will provide a means of facilitating, safeguarding and coordinating the immediate response and adds an element of control to the incident
    - The inner and outer cordon should be flexible and be able to be moved if necessary. The outer cordon may subsequently be identified by police service personnel
- Assess the advised cordon distance of 300m for the incident, and increase or decrease as required
- Be aware that safety distances for military aircraft vary depending on their cargo, etc. for example:
    - Flares: 200m
    - Specific unexploded aircraft ordnance: 400m
    - Guns have a range of 7.5km and rockets 11km if functioning as intended. The military consider that once an aircraft has crashed ordnance will not function fully, but may partially activate.
- Request specialist advice at the earliest opportunity when assessing cordon distances
- Liaise with other services in attendance early to ensure a co-ordinated and safe response; aircraft incidents are usually attended by more than one emergency service.

Control measure – Apply foam

Control measure knowledge

Applying firefighting foam will reduce the risk of airborne pollution by MMMFs and the general disturbance of the material in and around the aircraft wreckage.

By reducing airborne MMMF particles, the hazard associated with exposure (inhalation, ingestion or injection) to the material or substance can be reduced significantly.

When using firefighting foam, environmental protection should also be considered. Refer to the Environmental Protection guidance.

Control measure actions

- Firefighting foam will need periodic application to ensure that its effects are maintained. An evenly distributed foam blanket will ensure the best results
- The integrity of any foam blanket should be considered when working within the area where the foam has been applied. This should prevent unnecessary disturbance so exposing the MMMFs. The use of firefighting foam will pose additional hazards that will need to be managed, such as the increased chance of slips, trips and falls because of obscured underfoot conditions. Refer to the Operations guidance for further information.

Control measure – Prevent manipulation or damage

Control measure knowledge

Because MMMFs may be hidden and are difficult to identify, personnel could inadvertently cause damage to materials containing MMMFs.

Control measure actions

- Exercise caution at all times when working with areas of MMMFs that need either to be removed or manipulated to enable access or an extrication; every effort should be made to keep such interaction to a minimum and, wherever possible, to avoid it altogether

Control measure – Wear personal protective equipment (PPE)

Control measure knowledge

Fire and rescue services must ensure that any PPE provided is fit for purpose and meets required safety standards regarding its proposed use/contamination by MMMFs.

Control measure actions

- Take the standard of clothing worn beneath the specialist PPE into account when choosing suitable protective garments, as well as selecting suitable sizes of PPE.
- Consider the need for rescuers to be visible against the operational background, including night working, and for team leaders to be distinguishable within the incident command structure when selecting PPE. All personnel should wear appropriate levels of PPE including climatic (for heat, cold, wet and extreme weather) and respiratory protection equipment (RPE), where necessary.

Control measure – Undertake decontamination

Control measure knowledge

Decontamination can be carried out on the incident ground using equipment, in a planned and structured manner, to minimise the risk of further harm occurring and to keep cross contamination to as low a level as reasonably practicable.

Depending on the nature and risk posed by MMMFs, initial or full decontamination may be required. In all cases the incident commander should carry out a risk assessment and remember that initial decontamination is intended as a first-aid measure and is not a substitute for full decontamination.

Further information may be found in the HazMat guidance.

Control measure actions

For information on control measure actions refer to the HazMat guidance.

Metals

Hazard	Control measures
Metals	Know the capabilities and uses of rescue equipment Wear personal protective equipment (PPE)

Hazard knowledge

In this guidance, the term 'metals' relates to the products used in the construction of light, commercial and military aircraft.

The hazards posed by metals may be as a direct result of an accident, fire or may occur during the rescue phase of fire and rescue service operations, and include:

- Sharps
- Structural collapse
- Impact
- Damage to equipment

Because of the construction of aircraft it should be assumed that various different metals are present at all aircraft related incidents, which will have an impact on the rescue of a casualty, especially where the integrity of the aircraft has been compromised due to instability, access and egress implications and so on.

Aluminium alloys are the most common metals used in airframe structures. The composition of the alloys varies depending on where they are used; skin surfaces, formers, stringers or spars for example. The following broad descriptions are typical:

- Duralumin: an alloy of aluminium with about 4% copper and about 1% each of magnesium, manganese and silicon

- Alclad: duralumin with a surface finish of pure aluminium
- Magnalium: a lighter alloy of aluminium with about 2% copper and about 2-10% magnesium

Refer to the HazMat guidance and/or the Environmental Protection guidance if a water-reactive substance results in corrosive run-off.

Aluminium itself will burn at about 800°C, but the melting point of aluminium alloy used in aircraft construction is around 600°C (refer to the Fires and Firefighting guidance).

Aluminium alloy can be readily cut with an axe, hacksaw or with power operated cutting tools. Practice has shown that stone cutting blades are more resistant to these alloys and will therefore give better cutting results. Care should be taken with sharp jagged edges in a crash situation and personnel should be warned of the danger of the needle sharp 'stalactite' formations from melting and cooling metal. These stalactites can penetrate even the best protective clothing.

Magnesium alloy is a light, strong metal that can be found in undercarriage wheel hub assemblies, engine mounting brackets, crank cases in piston engines, compressor cases in turbine engines and various strengthening brackets throughout the aircraft.

Titanium alloy is used where great strength or resistance to heat is required. Its main use is in engine firewalls, tailpipe casing and turbine engine blades. It may also be used to make major components in high speed aircraft.

Stainless steel is used where greater strength and rigidity is required, such as frames that act as attachments for the mainplane (a principal wing or other supporting surface of an aircraft or beams to support engines) nuts and bolts, parts of the undercarriage and in some cases to reinforce skin surfaces or the mainplane on high speed aircraft and control cables in light aircraft.

Control measure – Know the capabilities and uses of rescue equipment

Control measure knowledge

Aircraft incidents are usually complex and a wide range of materials will have been involved in construction. Working at aircraft incidents will often involve the use of specialist equipment. The type of equipment and the hazards involved will vary but typically may include:

- Manual handling of heavy equipment over difficult terrain and within confined spaces
- Potential injury from failure of equipment causing collapse or sudden movement of loads under pressure
- Cuts, nip, trap or entanglement hazards from the moving parts of equipment
- Excessive noise and/or vibration. Refer to the Operations guidance
- Damage to high-pressure hydraulic or pneumatic systems involved with cutting or spreading tools can cause soft tissue injuries
- Burns from hot and/or cold components

- Accidental ignition of fuels. Refer to the HazMat guidance

Control measure actions

Refer to the *Extrication – Generic – Tools* section, for details of the control measures that apply when considering the capabilities and use of rescue equipment.

Control measure – Wear personal protective equipment (PPE)

Control measure knowledge

Fire and rescue services must ensure that any PPE provided is fit for purpose and meets required safety standards regarding its proposed use/contamination by MMMFs.

Control measure actions

- Take the standard of clothing worn beneath the specialist PPE into account when choosing suitable protective garments, as well as selecting suitable sizes of PPE.
- Consider the need for rescuers to be visible against the operational background, including night working, and for team leaders to be distinguishable within the incident command structure when selecting PPE. All personnel must use appropriate levels of PPE including climatic (for heat, cold, wet and extreme weather) and respiratory protection equipment (RPE) where necessary.

Extrication from rail transport

Introduction

Many types of rail vehicles are used to provide services for passengers and freight. This guidance is not intended to cover any of these types in detail but to highlight the reasonably foreseeable hazards and to detail options for control measures when performing rescues specifically from railway rolling stock.

Refer to the hazards that are generic to all forms of transport. For the purpose of National Operational Guidance (NOG) further information will be provided within the *Context* sections (when developed) including:

- Underground rail transport systems
- Overground rail transport systems, including overhead line equipment (OLE)

This guidance does not cover the hazard of diesel fuel, as this is classified as a hazardous material.

Extrication and evacuation of casualties from rail vehicles can be resource intensive, requiring specialist local and potentially national resources.

Weight/instability

Hazard	Control measures

Weight / instability	Request specialist knowledge Stabilise

Hazard knowledge

The weight of rail vehicles can be significant. A trailer carriage can weigh between 30 and 45 tonnes and fully loaded freight vehicles up to 100 tonnes. It is essential that responders have firstly considered the stability of the vehicle and potential for movement to perform a rescue. Refer to the *Transport – unstable vehicle containing casualties* section.

Control measure – Request specialist knowledge

Control measure knowledge

Incident commanders should use all available specialist knowledge to assist with stabilising the vehicle to allow the evacuation and extrication of casualties. This knowledge may be available from within the fire and rescue service either locally or regionally, depending on local risk assessment. Alternatively, national USAR teams may provide additional capacity and capability at major railway incidents.

The rail industry will also be able to provide a range of specialist equipment and/or teams to support fire and rescue service operations, which may include specialist knowledge such as cutting and lifting equipment, lighting units, welfare and refreshment facilities and command support. This will be available via either the nominated rail incident officer (RIO), or the train operating company (TOC).

Control measure actions

- Establish and request appropriate fire and rescue resources
- Liaise with nominated rail incident officer (RIO) or train operating company (TOC)

Control measure – Stabilise

Control measure knowledge

Stabilising the vehicle ensures that the risk to any casualties and emergency responders associated with vehicle movement is minimised. Any stabilisation measures implemented should take the projected extent of operational intervention by emergency responders into account, to ensure that activities are not affected by the need for additional stabilisation work or the dangers associated with a moving vehicle. Assessments should be carried out to establish the current and ongoing status of the vehicle.

Control measure actions

- Consider using specialist equipment, specialist fire and rescue service teams or other agencies to help stabilise the vehicle, including the use of cranes, winches and airbags
- Ensure that the planned stabilisation is appropriate for the extent of operations likely to be required

Electrical systems (pantograph, batteries, high voltage (HV) connectors)

Hazard	Control measures
Electrical systems (pantograph, batteries, high voltage (HV) connectors)	Request specialist knowledge

Hazard knowledge

Batteries, generators, high voltage connections or pantographs may all be encountered when dealing with train rolling stock. Because of the variety of systems available, specific information gathering should take place at each incident to identify the source and nature of the electrical hazard present.

Electrical sockets are increasingly available to power customer devices, catering facilities and air conditioning units. These all require increased electrical generation, components and cabling.

Traction equipment and batteries are usually housed in the underframe area, the majority of which is encased in a metal skirt. Other electrical equipment and cables may be located in a carriage roof. Creating access points into train bodywork could expose cabling that may range in voltage from 110v – 875v.

Control measure – Request specialist knowledge

Control measure knowledge

The rail industry will be able to provide specialist knowledge. This will be available either via the nominated rail incident officer (RIO), or through the train operating company (TOC).

Control measure actions

- Liaise with the driver, nominated rail incident officer (RIO) or train operating company (TOC) to identify and isolate if appropriate

Steam engines

Hazard	Control measures
Steam engines	Request specialist knowledge

Hazard knowledge

Steam engines can be found on heritage or prestige passenger services. Additional hazards from these vehicles include high fire loadings (including coal fuel), source of ignition, steam and high pressure steam, boiler and boiling water. As part of the incident commander's information gathering process, they should identify if the train is powered by steam.

Control measure – Request specialist knowledge

Control measure knowledge

The rail industry will be able to provide specialist knowledge. This will be available either via the nominated rail incident officer (RIO), or through the train operating company (TOC).

Control measure actions

- Liaise with driver, nominated rail incident officer (RIO) or train operating company (TOC)

Air systems

Hazard	Control measures
Air systems	Request specialist knowledge Stabilise

Hazard knowledge

Except for some heritage railways, trains are air-braked and most passenger vehicles have air suspension. Single or dual brake pipes will connect vehicles and all vehicles will have reservoirs. Locomotives and some multiple unit vehicles will have compressors fitted.

The hazards posed by pneumatic suspension units include:

- Projection or blast
- Impact
- Noise
- Entrapment due to chassis or axle dropping
- Compressed air

The hazards posed by a vehicle air braking system include:

- Unexpected movement
- Stored energy release
- Entrapment due to vehicle movement
- Compressed air

Control measure – Request specialist knowledge

Control measure knowledge

The rail industry will be able to provide specialist knowledge. This will be available either via the nominated rail incident officer (RIO), or through the train operating company (TOC).

Control measure actions

- Liaise with the driver, nominated rail incident officer (RIO) or train operating company (TOC) to identify and if appropriate, isolate

Control measure – Stabilise

Control measure knowledge

Stabilising the vehicle ensures that the risk to any casualties and emergency responders associated with vehicle movement is minimised. Any stabilisation measures implemented should take the projected extent of operational intervention by emergency responders into account, to ensure that activities are not affected by the need for additional stabilisation work or the dangers associated with a moving vehicle. Assessments should be carried out to establish the current and ongoing status of the vehicle.

Control measure actions

- Consider using specialist equipment and or other agencies to help stabilise the vehicle, including cranes, winches and airbags
- Ensure that the planned stabilisation is appropriate for the extent of operations likely to be required

Asbestos (older rolling stock)

Hazard	Control measures
Asbestos (older rolling stock)	Be aware of the Total Operations Processing System (TOPS) Request hazardous materials and environmental protection advice

Hazard knowledge

Most mainline rolling stock post- 1980 is unlikely to contain significant amounts of asbestos, but small quantities may be present in some components. Older rolling stock has been subject to programmed removal from accessible areas but some may be present in enclosed structural areas especially on heritage railways.

Asbestos containing materials (ACMs) that remain in refurbished rail vehicles used on Network Rail's infrastructure have been securely encapsulated. Therefore fibre release and possible exposure will only occur in the event of a catastrophic failure of the vehicle, for example, as a result of a serious collision.

Control measure – Total Operations Processing System (TOPS)

Control measure knowledge

The Total Operations Processing System (TOPS) is a computerised system that contains specific information on rail vehicles on the system. Each carriage or wagon is marked with an individual identification number, which incident commanders can use to obtain information on any vehicle or cargo.

Control measure actions

- Provide the carriage identification number to the fire control room and request TOPS information from National Rail Network

Control measure: Request hazardous materials and environmental protection advice

Control measure knowledge

If the presence of asbestos is identified, incident commanders should request hazardous materials and environmental protection advice on the appropriate cordons, levels of PPE, RPE, decontamination requirements and environmental impact.

Control measure actions

- Request specialist advice
- Refer to http://www.hse.gov.uk/asbestos/

Man-made mineral fibres (MMMF)

Hazard	Control measures
Man-made mineral fibres (MMMF)	Request specialist knowledge Request hazardous materials and environmental protection advice Apply foam Prevent manipulation or damage

Hazard knowledge

Man-made mineral fibres (MMMF) are regularly used in the construction of rail vehicles.

Hazards generated at accident sites from impact damaged composite materials include:

- Particulates (fibres and dust) causing respiratory and skin irritation
- Cuts and abrasions
- Changes in structural strength and contamination

Control measure – Request specialist knowledge

Control measure knowledge

The rail industry will be able to provide specialist knowledge. This will be available either via the nominated rail incident officer (RIO), or through the train operating company (TOC).

Control measure actions

- Liaise with the driver, nominated rail incident officer (RIO) or train operating company (TOC)

Control measure – Request hazardous materials and environmental protection advice

Control measure knowledge

If the presence of MMMFs is identified, incident commanders should request hazardous materials and environmental protection advice on the appropriate cordons, levels of PPE, RPE, decontamination requirements and environmental impact.

Control measure actions

- Request specialist advice

Control measure – Apply foam

Control measure knowledge

Applying firefighting foam will reduce the risk of airborne pollution by MMMFs and the general disturbance of the material in and around the train wreckage.

By reducing airborne MMMF particles, the hazard associated with exposure (inhalation, ingestion or injection) to the material or substance can be reduced significantly.

When using firefighting foam, environmental protection should also be considered (refer to Environmental Protection guidance).

Control measure actions

- Firefighting foam will need periodic application to ensure that its effects are maintained. An evenly distributed foam blanket will ensure the best results
- The integrity of any foam blanket should be considered when working within the area where the foam has been applied. This should prevent unnecessary disturbance so exposing the MMMFs. The use of firefighting foam will pose additional hazards that will need to be managed, such as the increased chance of slips, trips and falls because of obscured underfoot conditions. Refer to the Operations guidance for further information.

Control measure – Prevent manipulation or damage

Control measure knowledge

Because MMMFs may be hidden and are difficult to identify, personnel could inadvertently cause damage to materials containing MMMFs. The principal hazard to personnel from MMMFs arises from the decomposition of the material in the impact and rescue phase. Extrication activities and cutting operations can also create razor sharp edges and cause a release of airborne particulates.

Control measure actions

- Exercise caution at all times when working with areas of MMMFs that need either to be removed or cut to enable access or an extrication. Every effort should be made to keep such interaction to a minimum and, wherever possible, to avoid altogether.

Polychlorinated biphenyls (PCB)

Hazard	Control measure
Polychlorinated biphenyls (PCB)	Request hazardous materials and environmental protection advice

Hazard knowledge

Polychlorinated biphenyls (PCBs) are organic, oil soluble materials of moderate toxicity. The main risk to firefighters is via skin absorption or inhalation, resulting in irritation to skin, eyes, nose and the respiratory tract.

All train operating companies are in the process of replacing components containing PCBs but they may be found in older rolling stock, transformers and capacitors. If present they will be indicated by a label on the vehicle body and equipment.

Control measure – Request hazardous materials and environmental protection advice

Control measure knowledge

If the presence of PCBs is identified, incident commanders should request hazardous materials and environmental protection advice on the appropriate cordons, levels of PPE, RPE, decontamination requirements and environmental impact.

Control measure actions

- Request specialist advice

Toilets and sewage systems

Hazard	Control measures
Toilets and sewage systems	Establish hygiene controls

	Undertake decontamination

Hazard knowledge

All modern trains are designed and constructed with toilet retention systems. These tanks are generally not emptied for four to five days. This means that more than 400 litres of stored human waste could be released if a tank fails.

The tanks may not always be in obvious locations on modern rolling stock; they may be located inside the vehicle due to lack of space on the underframe. Older trains may still deposit human waste along the tracks.

Control measure – Establish hygiene controls

Control measure knowledge

If these systems have been compromised by impact or fire service operations, personnel are likely to come into contact with body fluids. Standards of hygiene should be maintained and all relevant measures to guard against infections should be used.

Control measure actions

- Incident commanders should make washing and hygiene facilities available, if possible
- Wear medical examination gloves and PPE

Control measure – Undertake decontamination

Control measure knowledge

If these systems have been compromised by impact or fire service operations, request hazardous materials and environmental protection advice on appropriate decontamination for personnel and equipment to reduce risk of infection.

Control measure actions

For information on control measure actions refer to the HazMat guidance.

Detonators

Hazard	Control measures
Detonators	Request specialist knowledge

Hazard knowledge

Otherwise known as fog signals, these are small explosive devices used to warn drivers to stop immediately as a major hazard is further up the track. On trains, twelve detonators should be carried in a secure location in the driver's cab. They are a potential explosive and projectile hazard.

Control measure – Request specialist knowledge

Control measure knowledge

Specialist knowledge will be available from the driver or train operating company.

Control measure actions

- Establish the number, type and location of devices carried from initial information gathered from the driver or the train operating company

Delay in accessing driver or passenger compartments

Hazard	Control measures
Delay in accessing driver or passenger compartments	Use designated doors and windows

Hazard knowledge

If there is a delay in gaining access to driver or passenger compartments, either through damage caused or the resting position of the carriage, the condition of casualties could deteriorate.

The design strategy for most modern rail vehicles is for the structure to resist the effects of impact or derailment and to provide adequate protection for passengers, whilst keeping them contained within the vehicle.

Control measure – Use designated doors and windows

Control measure knowledge

The preferred route to gain access to train carriages during emergencies should be through the carriage doors. Most modern rolling stock is fitted with door release mechanisms, which will be labelled and operable from the outside.

Where access via doors in not available, there are three other options:

1) Windows: designated emergency windows will be marked inside and out, and will break more easily to provide access. Whilst windows may be used initially to gain access to casualties, they would not normally provide a long term solution for access and egress due to size constraints and the difficulty manoeuvring stretcher bound casualties
2) Corridor connector: provides a weatherproof connection between two carriages.
3) Create openings in vehicle body

Control measure actions

- Request early identification and use of designated access points. Alternatively:
    - Corridor connector: depending on design it may be feasible to vertically cut through this to access vehicle end doors. **Warning**: some vehicles may contain cables in this area (refer to Context –Electricity guidance).
    - Windows: glazing systems in modern rail stock are designed to survive severe collision impacts. Whilst the outer element can be managed using existing road vehicle techniques, the plastic membrane of the inner laminated element is significantly tougher and will require significant effort to penetrate
    - Create openings in vehicle body

Air conditioning systems

Hazards	Control measures
Air conditioning systems	Request specialist knowledge Request hazardous materials and environmental protection advice

Hazard knowledge

Trains are now regularly fitted with air conditioning units. On the majority of modern vehicles the units are roof mounted and so can be easily identified. The equipment may be underframe mounted on older vehicles. Where windows can be opened on passenger carriages it can be assumed that air conditioning is not fitted.

These units will contain liquid refrigerant, which is hazardous and corrosive if the unit is ruptured or cut. The liquid easily vaporises to gas when exposed to small temperature increases or ambient temperatures.

Control measure – Request specialist knowledge

Control measure knowledge

The rail industry will be able to provide specialist knowledge. This will be available either via the nominated rail incident officer (RIO), or through the train operating company (TOC).

Control measure actions

- Liaise with the driver, nominated rail incident officer (RIO) or train operating company (TOC)

Control measure – Request hazardous materials and environmental protection advice

Control measure knowledge

If the air conditioning systems and refrigerants are involved, incident commanders should request hazardous materials and environmental protection advice on the appropriate cordons, levels of PPE, RPE, decontamination requirements and environmental impact.

Control measure actions

- Request specialist advice

Extrication from road transport

Alternative fuelled vehicles (AFV)

Hazard	Control measures
Alternative fuelled vehicles (AFV)	Identify the vehicle and communicate its type Carry out a scene assessment Control vehicle movement Use appropriate extrication techniques Isolate high voltage systems

Hazard knowledge

In this guidance, the term 'alternative fuelled vehicles' (AFV) relates to those vehicles powered by fuels other than the conventional petrol or diesel, either exclusively or in combination.

AFV styles and types are:

- Cars
- Vans
- Off-road vehicles
- Large goods vehicles (LGV)
- Public service vehicles (PSV)

The fuels used in AFVs include:

- High voltage battery fuel cells in hybrid and electric vehicles
- Compressed natural gas (CNG)
- Liquid natural gas (LNG)
- Bio-fuels
- Hydrogen fuel cells

Where a vehicle uses two or more distinct power sources to move the vehicle, the vehicle is termed a hybrid. The term most commonly refers to hybrid electric vehicles, which combine an internal combustion engine and one or more electric motors.

Except for the control measures described in this document, hybrid vehicles may be approached using standard vehicle extrication principles and techniques.

The hazard posed by the vehicle fuels may be as a result of a collision, fire or submersion, or may be due to the actions of crews during a fire and rescue service operations.

The hazards posed by AFVs include:

- The type of vehicle not being identified
- Uncontrolled vehicle movement
- Inhalation of gases
- Death from electrocution
- Fuel cell explosion during over pressurisation and/or fires
- Residual risks to other agencies post-incident

The majority of vehicles on the roads in the UK use conventional fuels (petrol and diesel) to propel them. But the use of AFVs is increasing and the potential for incidents involving these vehicles will increase with time.

The use of CNG in European AFVs is widely utilised in mainstream manufacturers so their presence in the UK should become an increased consideration.

Where alternative fuels have been compromised and/or released, consideration should be given to the involvement of other emergency services and agencies, the impact on the casualties involved and the environmental impact.

Control measure – Identify the vehicle and communicate its type

Control measure knowledge

The potential for a road traffic collision (RTC) with an AFV will become increasingly likely as they become more popular, so emergency responders should be aware of the need to identify these vehicles. This identification should form part of the initial information gathering, from the time of call and during initial attendance.

With the increased availability and use of AFVs and their associated technology, it is safe to assume that all vehicles are alternatively fuelled, until otherwise confirmed.

Control measure actions

Identify the AFV by:

- Questioning the driver and/or occupants

- Consider the aerodynamic design or recognise the model, for example, the Honda Insight
- Look for vehicle markings, such as the use of the term 'Hybrid Synergy Drive' on the Toyota Prius, or a more subtle 'h' on the rear of the Lexus
- Look for their bright orange cabling
- Make all emergency responders aware at the earliest opportunity if an AFV is identified
- Consider using proprietary IT-based vehicle information systems at the scene to assist with identification. Be mindful that these systems require regular updates to continue providing current information
- Consider placing additional markings on the AFV to identify its type, for oncoming personnel and other agencies, making them aware of the hazards posed by such a vehicle

Control measure – Carry out a scene assessment

Control measure knowledge

If an AFV has been involved in a collision that has led to components such as battery units becoming detached, it is important for the scene assessment to consider the presence of:

- High voltage electricity/systems. Refer to Context – Utilities guidance
- HazMats; due to the leaking of electrolytes from batteries. Refer to the HazMat guidance
- Pressurised systems. Refer to the HazMat guidance

The location of the incident and level of damage experienced by the AFV will dictate the initial actions of emergency responders.

Control measure actions

All AFVs present their own hazards, and combinations of hazards, which will require different actions according to the incident, many involving HazMat related considerations and procedures. Refer to the HazMat guidance for further information.

- Isolate the high voltage electricity/system where possible
- Consider simply cordoning any vehicle components identified as hazards and liberated from the main scene of operations, to reduce the risk of emergency responder interaction
- Consider requesting specialist advice from vehicle manufacturers regarding credible scenarios and methods of managing the various situations in advance of emergency incidents, given the relatively new nature of the AFV technology

Control measure – Control vehicle movement

Control measure knowledge

Where vehicles employ electric motors as part of their propulsion, such motors remain energised when powered but provide no audial (sound) indicators. Some AFVs, particularly electric vehicles, will have different characteristics of drive status when stationary.

Where the vehicle's propulsion has not been identified and the vehicle is engaged in drive, an electric vehicle may remain stationary until such time as the accelerator is depressed or the brake released. Simply pressing the accelerator when the AFV is in either in *Drive* or *Ready* mode may cause the engine to start up.

Control measure actions

- Seek early identification of the vehicle propulsion system, in addition to implementing front and rear wheel chocking
- Establish the vehicle ignition mode, gear lever position, parking brake mode and location of ignition keys (including fobs or cards)
- Power down the AFV using recognised procedures as per manufacturer's guidance, placing the vehicle into *Park* mode and removing the key (or fob or card) to disable the high voltage system

For further information and techniques that should be adopted to stop vehicle movement refer to:

http://www.ukro.org/Education/UKRO-Workshops/Hybrid-Vehicle-Workshops

http://www.ukro.org/Education/Manufacturers-Resources.

Control measure – Use appropriate extrication techniques

Control measure knowledge

Using conventional extrication techniques, in particular hydraulic rams, may cause damage to AFV battery fuel cells. Refer to the *Extrication* section on Tools.

The routing of fuel pipes and high voltage cabling in AFVs has to be considered by manufacturers, and as such they are sited in protected areas under the vehicle or within the vehicle panels. Where a vehicle has been involved in an impact and needs to be stabilised, consider the potential detachment of cables/fuel lines. Refer to the *Extrication* section on unstable vehicle containing casualties.

The resting position of an AFV involved in a RTC may be unconventional, given the location of its internal combustion engine and high voltage systems. This should be considered when attempting to stabilise the AFV to carry out a rescue.

Control measure actions

- Identify the area that will be used in the stabilisation plan and ensure that any stabilisation does not compromise fuel lines or high voltage cables
- Adopt alternative methods for extrication if the fuel cells could be compromised

Control measure – Isolate high voltage systems

Control measure knowledge

Electric Vehicles (EV) and hybrid vehicles typically include high voltage batteries. The presence of high voltage components creates a possible electrocution hazard (static voltage levels range between 36v to 330v with operational voltages up to 600v).

High voltage wiring in EVs uses bright orange cabling as an industry standard, so that they are easily recognised by emergency responders and repair technicians. Battery packs are protected to ensure they are safe during use, and firefighters should identify both their location and the location of any associated high voltage cabling when undertaking their operational plan (they are generally routed centrally, outside and underneath the vehicle).

Toyota hybrid vehicles have G-force sensors in the engine compartment that will automatically isolate the high voltage supply from the rear battery compartment to the front electric motors in the event of a medium or severe frontal collision (using similar criteria to that of airbag safety feature/system deployment).

This high voltage link will also shut down if there is any interruption to the power supply; severing the high voltage cable, water submersion or damage to the vehicle causing a short circuit in any of the high voltage components.

In a severe collision there is a potential risk from high voltage systems due to their potential damage. These systems generally operate between 201-288 Volts. All of the positive and negative supplies on the hybrid electrical system are isolated from the vehicle chassis. The high voltage battery packs are often located either behind or under the second row of seats.

Control measure actions

- Identify the location of any high voltage wiring. Never touch, cut or open any orange cable or components protected by orange shields
- Identify the location of any battery packs in the vehicle
- Establish high voltage battery condition and check for leaks
- Isolate the high voltage system by removing the proximity key from the scene of operations; more than 5m from the AFV
- Consider additional PPE such as appropriately rated electrical gloves, eye protection
- Disconnect the standard 12v vehicle battery
- Consider removing selected fuses
- Activate the battery pack isolator
- Consider the electrical system unsafe for a full 10 minutes after ignition shut down; this should not delay rescue operations

For further information and techniques that should be adopted to isolate high voltage systems refer to http://www.ukro.org/Education/UKRO-Workshops/Hybrid-Vehicle-Workshops

http://www.ukro.org/Education/Manufacturers-Resources.

New or heavy vehicle construction

Hazard	Control measures
New or heavy vehicle construction	Identify the vehicle construction and communicate the information Make the correct tool choice Be aware of the respiration of particles and dermal irritation Be aware of release of energy from structural vehicle components Manage heavy vehicle considerations

Hazard knowledge

To reduce weight, increase corrosion resistance and improve safety in new vehicle design, original equipment manufacturers (OEMs) use conventional lightweight materials such as aluminium, magnesium and polymers, and increasingly use ultra-high strength steels and carbon fibre composites. Such new materials bring with them a range of characteristics that should be understood by fire and rescue service personnel to ensure they can be managed effectively during the extrication process.

With vehicle design often influenced by the styling requirements of consumers, new materials may feature in the aesthetic elements of vehicles, whilst those that are introduced for greater energy management and strength may be hidden to the emergency responder within the construction and shell of the vehicle. The hazard may be made more complex by the combination of materials used in areas of a vehicle's construction, providing a perception of a single material when a number of materials may be present, such as a polycarbonate outer skin with carbon fibre reinforced plastic (CFRP) structural members.

Where alternative fuelled vehicles (AFVs) are being tackled, it is likely that some vehicle structures will be made from modern high strength materials such as boronated steel, CFRP and polycarbonates. This is primarily due to the requirement to make a lightweight strong vehicle shell to offset the considerable weight of associated battery packs.

The overwhelming choice for the majority of volume vehicle designers is still steel for reasons of cost, safety, mass manufacturability and universal repair. However, the following are increasingly found in new vehicles:

- Carbon fibre reinforced plastic (CFRP)
- Glass fibre reinforced plastic (GFRP)
- Boronated or high strength low alloy (HSLA) steels
- Aluminium alloy

- Magnesium alloy
- Glass
- Noryl GTX
- Polycarbonates
- Mild steels
- Plastics

Some material types are recognisable to emergency responders because of their common location, industry standard markings, and through data provided on mobile data terminal (MDT) systems.

The material hazard exposure is either direct, when the vehicle construction has been compromised due to energies involved in a collision, or indirect as personnel undertake operational practices using extrication tooling.

Traditional operational procedures and protocols for using tools may still be relevant when tackling new vehicles but tool operators should be aware of tool reactions when they are dealing with materials on all vehicles. Additionally, where tools are used by emergency responders to remove or displace structural components of the vehicle, the amount of energy delivered into the vehicle by the type of tool selected should be considered.

Materials compromised through impact or through processes introduced by emergency responders can result in the following hazards:

- Stored energy within structural members
- Sharp edges to metal, polymer, composites
- Loose fibres
- Composite dust

The involvement of other emergency services, the impact on the casualties involved and other partner agencies working in the vicinity of the incident should be considered.

Control measure – Identify the vehicle construction and communicate the information

Control measure knowledge

Identifying the materials used in the vehicle construction provides key information to rescuers when they are forming their release strategies. Glass in vehicles is marked up to indicate glass type, but currently no standards exist for marking up other vehicle materials – alternative data sources should be referenced and operational experiences drawn upon to understand the materials being tackled.

Control measure actions

- Use vehicle markings where available

- Use alternative data sources to identify materials utilised within a vehicle

Control measure – Make the correct tool choice

Control measure knowledge

Due to the wide range of materials used by manufacturers in the construction of vehicles, the choice of tool has become increasingly important.

The fundamental goal for using tooling is to achieve the required task while minimising the hazards associated with tackling the vehicle materials. To achieve this, the tool operator should identify the material being tackled as far as possible.

The tool operator should have a thorough knowledge of the tools and their configurations. This is important to ensure that vehicle materials are tackled with awareness of the dust and fibres that may be created, in addition to the energies that can be introduced to the vehicle structure, and potentially to any casualties.

Where the tools required to achieve objectives are likely to introduce additional energy, alternative tools should be considered. Where this is not appropriate, the vehicle should be further stabilised and detailed communications made.

Control measure actions

- Identify vehicle materials before cutting/repositioning, to aid appropriate tool choice.
- Closely monitor the tool when vehicle materials cannot initially be identified
- Reconsider the choice of tools and operational methodologies, if the tools in use do not perform as expected; unknown materials may be present
- Consider alternative tools or introducing additional control measures, like water mist to minimise airborne dust particles, where the activity is producing additional material hazards
- Consider identifying operational plans that involve lower risk materials

Control measure – Be aware of the respiration of particles and dermal irritation

Control measure knowledge

Material deformation due to collision and the cutting of vehicle materials to remove structural elements produces a range of material particulate sizes. Inhaling these particles to the upper and lower respiratory tract poses a significant risk to emergency responders and casualties, both during the extrication phase and during the recovery phase of an incident where clearing up may be undertaken.

Airborne continuous filament particles and their associated health hazards depend on respirability; the potential to enter the lower regions of the lung, where lung disease can be caused.

Where dust or fibres are produced during collision or through the extrication process, itching can also occur when there is direct contact with soft tissues such as the skin and eyes. Such irritation is more prevalent when soft tissue is exposed to resin coated fibrous material, especially GFRP and CFRP

Dust can be found on equipment or PPE and can also be transferred to other personnel and their equipment.

Control measure actions

- Consider damping down any dust on scene or any dust created during the cutting process
- Consider introducing barrier membranes like plastic covers between casualties and any materials being cut
- Consider alternative extrication strategies to reduce the requirement to cut
- Consider alternative tool strategies to reduce any dust produced
- Provide respiratory protective equipment (RPE) to rescuers and casualties when dust is likely, and ensure RPE is disposed of correctly after use
- Consider washing equipment and PPE and ensure that affected PPE is replaced or cleaned

Control measure – Be aware of the release of energy from structural vehicle components

Control measure knowledge

The characteristics of some new vehicle materials such as dual phase and boronated steels mean that where an impact occurs they are less likely to deform. Where deformation occurs it indicates that high energies have existed. Where deformed components need to be repositioned consideration should be given to the sudden release of energy.

Materials such as glass and polycarbonates may fracture when large energy forces are applied. Surface tension across the material can lead to sections being released uncontrollably as projectiles.

Control measure actions

- Use alternative extrication routes to avoid cutting deformed high strength materials
- Consider tool choice to reduce energy input to materials that can fracture
- Ensure stabilisation is effective before releasing high energies from vehicle components

Control measure – Manage heavy vehicle considerations

Control measure knowledge

In this control measure, the term ‘heavy vehicle’ primarily relates to LGVs and PSVs, but will incorporate elements relating to incidents involving any rail stock or large aircraft i.e. working at height.

For further information refer to the *Extrication* sections relating to vehicle construction, including MMMFs and metals.

The enhanced issues presented when carrying out an extrication from a heavy vehicle include:

- Weight and construction of vehicle components with the potential to cause injuries due to manual handling issues
- Sectional thickness or cross-sectional area
- Construction materials
- Reinforcement
- Access
- Tool or equipment damage
- Working at height
- Vehicle systems (including 24 volt systems)
- Sleeper compartment locations and other voids

The size requirements of heavy vehicles, and the significant weight associated with the loads they carry, contribute to the use of high strength, low alloy (HSLA) steels and heavy gauge materials within their construction.

If vehicle structural components need to be displaced or removed there will be significant weight associated with them. This should be managed appropriately. For example, the weight associated with removing LGV components such as doors may be further affected by the height of the components from ground level.

Operating above ground level with rescue equipment introduces a number of significant working difficulties such as:

- Gaining access and egress
- Manual handling of the casualty
- Manual handling of any tools

A clear working area should be established around the vehicle to allow the use of mobile platforms from which crews can work. Such platforms allow same level working between the crews and the casualty location without having to encroach on the minimal space available within a compartment.

Where platforms are used, personnel should be managed to ensure that the limited space is used effectively. Crews should be kept to the minimum required for the extrication.

Where vehicle components are removed or displaced considered the effect on vehicle stability strategies in use.

Control measure actions

- Recheck stability when structural components are to be removed from heavy vehicles
- Use lowering mechanisms for items of significant weight: ‘Tie before you Pry’

- Ensure a safe area of work exists below any vehicle components being removed
- Minimise the size of the component being removed from the vehicle to reduce weight and manual handling issues where appropriate
- Use safe working platforms and ensure a clear working area exists around the platform
- Ensure fall arrest equipment is used where required.

Unconventional or specialist road vehicles

Hazard	Control measures
Unconventional or specialist road vehicles	Identify the vehicle Isolate the power supply Establish appropriate distance Contain the vehicle or cargo Use specialist cutting equipment Request specialist knowledge

Hazard knowledge

Fire and rescue services may encounter unconventional or specialist vehicles that present different hazards to those of common vehicles.

Unconventional or specialist vehicles include:

- Emergency service vehicles, which may contain:
    - Biohazards
    - Compressed gas cylinders
    - Firearms
    - Prisoners or detainees
- Agricultural vehicles, which may contain large quantities of pesticides or chemicals. These may be transported by farm machinery on roads and remote farmland. There may be instances where it is difficult to identify substances because they are pre-mixed or loaded from containers for spreading. Some agricultural vehicles use radioactive monitoring or measuring equipment known as yield meters which may present a hazard if the stainless steel casing has melted – in a fire, for example
- Plant machinery
- Reinforced security or armoured vehicles carrying prisoners or detainees, high value contents or items of an explosive or radioactive nature. These vehicles may have enhanced security features and/or be constructed using strengthened materials, adding to the complexities of an extrication

- Livestock transportation vehicles, where the release of animals could affect the scene of operations and present further hazards to other road users, members of the public and emergency response personnel
- Military vehicles, which may contain munitions and firearms

Control measure – Identify the vehicle

Control measure knowledge

The priority is to recognise that a vehicle involved is of a specialist nature and may require further or specialist resources, balanced with a need to perform rescues at incidents that pose unfamiliar risks.

It is possible that some specialist vehicles will have contents with unique hazards, and as such early identification of the vehicle type and confirmation of its contents is essential.

Control measure action

- Consider the information that can be obtained from observation; hazard identification signs and other labels
- Obtain vehicle information from the Responsible Person (or appointed competent person)
- Ensure that information relating to the vehicle type and its contents is communicated accurately and is confirmed with emergency responders

Control measure – Isolate the power supply

Control measure knowledge

Due to the unique and sometimes bespoke nature of specialist vehicle design, it may prove difficult to locate and gain access to mechanisms that can isolate a vehicle's driven and consumer power sources. Some vehicles may have specialist electrical installations to power devices in the vehicle, and so may have a number of power supply options such as battery or backup generators.

Control measure actions

- Confirm the presence of any isolation mechanisms for high voltage and low voltage systems/installations with the vehicle owner
- Where power sources cannot be isolated, all personnel operating within the inner cordon should be made aware of the potential hazards

Control measure – Establish appropriate distance

Control measure knowledge

Where the vehicle load cannot be managed and is identified as a hazard, operational priorities should take into account the size of any cordons required. Additional distances may be required where specialist vehicles contain livestock, prisoners, firearms or compressed gas cylinders.

Control measure actions

- Implement and manage the required cordons as appropriate to the needs of the vehicle and its cargo

Control measure – Contain the vehicle or cargo

Control measure knowledge

The need to contain specialist vehicle cargos or installations will be determined by the cargos being managed, the priorities of any casualties and the availability of any required specialist agencies.

Where containment cannot be maintained within the vehicle, alternative locations should be identified by the incident commander until such time as support is received from other agencies or responders.

Control measure actions

- Where cargos are not at risk, they should be contained within the original vehicle until replacement vehicles arrive to continue their transportation.
- Where cargos require attention, a secure area should be established to allow for casualty triage.

Control measure – Use specialist cutting equipment

Control measure knowledge

Specialist vehicles may be constructed with additional layers of high strength material. When component relocation is necessary or access to the vehicle is required specialist equipment may be needed.

Control measure actions

- Consider alternative access and extrication routes that can be made using standard pumping appliance equipment, such as security vehicle escape hatches
- Identify the location of any required specialist equipment and consider mobilisation timings to scene
- Seek advice on the equipment required for the vehicle being tackled

Control measure – Request specialist knowledge

Control measure knowledge

Where guidance is required for the type of specialist vehicle being tackled, specialist knowledge should be sought either from the vehicle owner, vehicle manager or vehicle manufacturer.

Control measure actions

- Obtain specialist knowledge of the vehicle being tackled.

Vehicle supplementary restraint systems (SRS)

Hazard	Control measures
Vehicle supplementary restraint systems (SRS)	Identify the SRS and communicate the information Establish appropriate distance Isolate the systems Prevent manipulation or damage

Hazard knowledge

In this guidance, the term 'supplementary restraint systems' relates to passive safety features and systems, designed to alleviate the consequences of an accident. It incorporates all relevant forms of road transport such as cars and large goods vehicles (LGV).

Passive safety features/systems may include:

- Airbags/side impact protection system (SIPS)
- Front and rear crumple zones
- Side impact bars
- Pop-up rollover protection systems (ROPS)
- Seatbelt pre-tensioners/G-force limiters
- Collapsible steering columns
- Laminated glass
- Steering wheel and fascia padding
- Anti-whiplash seats/active headrests

The hazards posed by the vehicle SRS concern the potential of actual uncontrolled deployment during fire and rescue service operations, and include:

- Heat
- Impact
- Noise
- Skin irritation
- Projectile risk

Given the extensive use of vehicle airbags and seatbelt pre-tensioners as a passive safety feature/system, it is reasonable to assume that such SRS will be present in the majority of relevant forms of transport. All SRS safety features/systems are not alike, but they do contain similar components.

Gas restraint bags or airbags are safety devices that have saved many lives and prevented serious injury to the driver or front seat passenger of a vehicle involved in a full frontal or near frontal collision.

Some simple airbag systems, such as the older Volvo SIPS, use a mechanical or pyrotechnic impact sensor. In the event of a side collision, a pressure plate pushes a firing pin and releases the ignition charge. SIPS fall into two groups:

- Door mounted sensor, firing tube, and airbag
- Sill mounted sensor and firing system with a firing tube that leads up to the seat-mounted airbag.

The pyrotechnic sensor systems usually have some sort of disarming interlock. For further information on pyrotechnics refer to the HazMat guidance.

Such systems are treated in a similar way to mechanically-sensed frontal airbags and seatbelt pre-tensioners.

The traditional airbag system has been considered in some depth – it is also important to be familiar with the new (post-2003) generation of SRS systems, as several aspects differ:

- All the latest generation airbag systems are interlinked with the vehicle Electronic Control Unit (ECU). Some are inflated by a stored pressure gas cartridge that may be further energised by using reacting gases, such as hydrogen and oxygen. Refer to the HazMat guidance for further information.
- Front seat sensors determine if the passenger seat is occupied and may also provide information about the driver and passenger weight and proximity to the airbag.
- Multi-stage airbags may deploy as appropriate for the severity of the crash, the weight of the occupants and their proximity to the airbag. If the crash is severe and the occupant heavy, the system will deploy in its most powerful manner. If the crash is minor it is possible that just the pre-tension seat belts will deploy. There is a range of alternative ways in which the system may respond to these variables
- Most vehicles use the ECU to trigger the fuel cut off and a small number also trigger a battery disconnect

Control measure – Identify the SRS and communicate the information

Control measure knowledge

The first priority is to recognise that a vehicle is equipped with a SRS.

If the vehicle is fitted with an airbag, it is usually marked on the windscreen and/or the airbag container itself. It may be marked supplementary restraint system (SRS) or:

- Airbag

- Inflatable tubular system (ITS)
- Side impact protection system (SIPS)
- Head protection system (HPS)
- Inflatable curtain (IC)

Not all systems will be readily identifiable.

A typical airbag restraint system, designed to deploy in the event of a frontal impact, is located on the driver's side in the steering wheel hub or sometimes on the passenger side underneath a plastic bolster on the dashboard. However, they can also be found in the following locations:

- Side of seat (Thorax/side impact airbag)
- Roof lining (Curtain side impact airbag)
- Lower dashboard (Knee airbags)
- Back of front seat (Rear passenger airbag)
- Front and rear seat trim (Side impact airbag)

As technology will continue to develop, the above list is not exhaustive.

Because airbags operate separately, after a collision there may be an inactivated front or side bag in the vehicle.

Seat belt pre-tensioners normally deploy in tandem with airbags. They reduce the slack in the seat belt by up to 6 inches (15cm). These devices, when undeployed, present a finger/hand trap hazard for emergency service personnel and could potentially cause further injury to casualties.

Active rollover devices are found in some convertible vehicles. They can operate with explosive force away from the bodywork of the vehicle. These devices, when undeployed, present a serious risk of injury to emergency service personnel if they are in close proximity on activation. The dangers posed to rescuers cannot be overemphasised. ROPS deploy at very high speeds and with very high forces that can cause serious injury. The direction of deployment is not always apparent from outside the vehicle.

There are two main types in production:

- Rotating bar: these devices protect all the occupants and are generally stored behind and around the rear of the seats. The bar may be mistaken for part of the ‘soft top’ mechanism, such as in the Mercedes SL.
- Pop-up roll hoops: these devices are mounted behind each seat and protect the head of each occupant. They all normally deploy at the same time. Some devices are electric, some spring loaded and some are pyrotechnic. Sometimes the devices are visible as head restraint loops, sometimes not. The BMW 3 Series convertible is an example of the visible type.

Control measure actions

- Recognise that a vehicle is equipped with an SRS as a first priority, and then communicate its presence to all personnel involved
    - Survey the vehicle internally and externally for signs of the hazards
    - Do not enter the passenger cell until the hazards have been assessed (do not delay medical attention unnecessarily)
    - However medical attention is administered, it is highly advisable to remain outside the deployment range of any undeployed airbags
    - Personnel entering the passenger cell should remain outside the deployment range of the undeployed airbags
- Identifying seatbelt pre-tensioner systems and other SRS, including the location of their active charges, will require a level of 'peel and reveal' of vehicle panel fascia

Control measure – Establish appropriate distance

Control measure knowledge

Airbags and other SRS deploy at very high speeds and with very high forces that can cause serious injury. They can also become very hot, reaching temperatures of up to 300°C.

An additional safety concern for emergency personnel that arises when an airbag has activated is direct skin contact with the deflated airbag itself. A chalky white powder will be found on the outside of the bag. This powder is slightly alkaline and, although considered non-toxic, it may cause minor irritation to an individual's skin, nose and eyes. Manufacturers claim that the inflation chemical (sodium azide) will not be present once the bag is deployed.

Control measure actions

- The safest way to manage the risk from an airbag and other SRSs, when required to work around such devices, is to avoid them
- For airbags remember the 5, 10, 15 and 20 rule relating to their deployment range and the distance to remain clear:
    - 5 inches [10cm] clear of side (lumbar) airbags
    - 10 inches [20cm] clear of driver airbags
    - 15 inches [30cm] clear of curtain airbags
    - 20 inches [40cm] clear of passenger airbags

In addition, avoid placing solid objects between casualties and undeployed airbags, within their deployment range.

The specific danger of ROPS devices is to rescuers who may be supporting the head and neck of the casualty from behind, or removing a casualty on a spine board and so on. This is particularly hazardous when the vehicle is on a slope, especially a lateral slope and the vehicle is close to rolling over. Under such circumstances it is

vital that the vehicle is made stable; refer to the *Extrication* section for details of unstable vehicle containing casualties.

Control measure – Isolate the systems

Control measure knowledge

Once an airbag has been identified, the airbag should be disarmed. The undeployed SRS should be made safe if there is to be any cutting or metal displacement and a rescue undertaken.

The airbag is disarmed by disconnecting the negative side of the battery. The airbag will not be immediately disarmed; a capacitor, used to deploy the airbag in case of an electrical failure, can still fire the system. However, this loses its charge within about two minutes on most vehicles.

The method of disarming electronic sensed side airbags of all types is the same as for disarming the frontal airbag system, with the same cautionary points regarding capacitor back-up power.

The SIPS airbag has no integral standby power unit, unlike the steering wheel and passenger airbag, so battery disconnection will eliminate any accidental activation of the airbags. However, due care should still be shown especially if cutting into the upholstery of the front seats.

Control measure actions

- Use purposely designed equipment to mechanically reduce a vehicle airbag's deployment range into the passenger compartment. Refer to the equipment manufacturer's individual guidance regarding its use, advantages and limitations
- Do not delay rescue efforts unnecessarily to wait for the decay of a capacitor's charge once an SRS has been disarmed, but rescuers should remain clear of the immediate area. The chances of inadvertently triggering an airbag operation are not great, but rescuers should never place themselves between the system and the casualty (deployment range), nor place any object near the airbag that could become a projectile until the system is disarmed (Note: earthing both battery terminals may discharge the capacitor immediately)
- Some SRS will have override switches in the vehicle; for example, the front passenger airbag can be isolated to allow a child to be transported in a front passenger seat. In the event of vehicle damage these override systems should not be relied on.

Control measure – Prevent manipulation or damage

Control measure knowledge

Because SRS may be hidden and are difficult to identify, personnel could inadvertently use equipment that can manipulate or damage the features/systems, causing uncontrolled deployment.

Newer vehicles have much thicker posts and pillars, often with strengthened steel inserts and SRS components hidden inside.

Control measure actions

- Always remove or displace internal trim to ascertain the location of such components before attempting to cut pillars
- It is possible to cut away a deployed airbag. The bag should be handled with appropriate PPE, be placed in a plastic bag and disposed of properly. There may be traces of sodium azide or potassium nitrate present, particularly inside the bag. Both are highly flammable and poisonous
- If the SIPS bag has been activated then there is no problem dealing with the hazard, except to cut away the exposed bag if it becomes cumbersome

Extrication from machinery, lifts and escalators

Introduction

If a person is trapped in machinery, the initial focus and actions should be to ensure the safety of fire and rescue service personnel by safely accessing and stabilising the scene and the casualty, to ensure that rescue operations are not compromised.

This guidance will be valid for rescues from all types of machinery, including lifts and escalators.

It is important to remember that when assessing the risks associated with lifts and escalators, temporary lifts such as those on construction sites, whilst used for transporting people and equipment may not meet the same standards as permanent lifts.

Gaining access to machine rooms and shafts

Hazard	Control measures
Gaining access to machine rooms and shafts	Establish a safe working environment

Hazard knowledge

Machine rooms may be situated in remote parts of the premises and under normal circumstances should be locked and secured. These areas may have restricted access or space, which will need to be considered when performing a rescue. Crews should anticipate that unsecure lift rooms in social housing blocks may contain drug paraphernalia, human and animal excrement.

For lifts, these rooms can be either at the top or bottom of the building depending on the type of lift machinery.

In the case of escalators, machine rooms will normally be at the top of the escalator either under a floor trap (for small escalators, such as those in shops) or, in larger premises (such as those used in transport systems) a separate room will be used. On railway premises such as London Underground, access is usually available at both the top and the bottom of the escalator.

Personnel requiring access to machine rooms will generally have to either ascend or descend stairs. They may also have to climb unprotected vertical ladders and pass through access panels. There is a risk of collision with fixed objects when moving around machine rooms.

Machine rooms may have trapdoors and hatches, be on different levels, and will often have displaced lubricants on the floor. This may require implementing additional measures to maintain safe access and egress.

There is a risk of falling from height when ascending or descending unprotected vertical ladders or when working near or inside an open lift shaft. Some machine rooms may require personnel to cross roofs without edge protection, thereby increasing the likelihood of falls from height.

The risks associated with gaining access to a machine room may be increased by the conditions inside; noise, heat and lack of lighting.

Machinery incidents may involve or create working environments where there is minimal headroom and space to manoeuvre. Any available space may be further restricted by the use of fire service equipment or items of machinery that have been left on the floor during maintenance operations.

Control measure – Establish a safe working environment

Control measure knowledge

Before entering a machine room, personnel should recognise and fully assess the risks and hazards associated, as the risk can range from minor cuts and abrasions to being trapped or fatally injured by moving machinery or falling down a lift shaft.

Personnel should be aware of the proximity of other moving parts of the equipment. It is important that the correct equipment is identified so that the corresponding machinery and power systems can be isolated.

Control measure actions

Incident commanders and personnel should:

- Identify hazards and implement appropriate actions to create a safe working area
- Consider using safe equipment for working at height and additional lighting
- Consider controlling access to scene of operations

Noise

Hazard	Control measures
Noise	Use hearing protection

Hazard knowledge

By its nature, machinery can be noisy, especially when confined within a small area. Protracted working in this environment will prolong an individual's exposure to the hazard. Refer to the Operations guidance for further information.

Control measure – Use hearing protection

Control measure knowledge

If it is not possible to eliminate the noise by isolating the machinery, incident commanders will need to consider options to reduce exposure.

Control measure actions

- Consider the possibility of reducing the hazard by minimizing exposure through using enhanced levels of hearing protection and/or by regularly rotating crews, if isolation is not an option

Power systems

Hazard	Control measures
Power systems	Request specialist knowledge Isolate supplies

Hazard knowledge

Personnel should be aware that the risk from electrocution or electric shock will be present until all electrical power supplies have been isolated.

It should be remembered that there may be more than one power source. These may include battery powered standby or emergency generators that activate automatically when the power supply is interrupted. It should be remembered that safety systems may have been circumvented.

It is common for there to be two separate electrical sources within a machine room:

- 230 volt electrical supply for the lighting and any power sockets fitted
- 415 volt electrical supply for the machinery that drives the lift, escalator or machinery

Control measure – Request specialist knowledge

Control measure knowledge

The owner or occupier, on-site engineers or maintenance engineers should be able to provide specialist knowledge.

Control measure actions

- Liaise with the owner or occupier, on-site engineers or maintenance engineers

Control measure – Isolate supplies

Control measure knowledge

Where specialist knowledge is not available, crews may be able to identify instructions either on or in the vicinity of the machinery or locate emergency stop buttons to isolate the machinery.

Control measure actions

- Follow any available instructions or use emergency stop buttons to isolate
- Always use an emergency stop facility if it exists, even if specialist advice is available

Stored energy

Hazard	Control measures
Stored energy	Request specialist knowledge Isolate supplies

Hazard knowledge

The release of stored energy may result in the unexpected movement of machinery.

Machinery may move slowly downwards after personnel have isolated the power supply. It should also be remembered that fluid in the hydraulic systems may leak; this has the same effect on machinery movement. In both cases, it creates a risk of a crush injury.

The braking system should be disengaged to enable manual hand winding of the machinery. Once it has been disengaged, the stored energy within the system is released, creating the potential for rapid uncontrolled movement of the machinery.

Once the power to a lift or escalator has been isolated and the braking system is active, the stored energy will be controlled.

Control measure – Request specialist knowledge

Control measure knowledge

The owner or occupier, on-site engineers or maintenance engineers should be able to provide specialist knowledge.

Control measure actions

- Liaise with the owner or occupier, on-site engineers or maintenance engineers

Control measure – Isolate supplies

Control measure knowledge

Where specialist knowledge is not available, crews may be able to identify instructions either on or in the vicinity of the machinery or locate emergency stop buttons to isolate the machinery.

Control measure actions

- Follow any available instructions or use emergency stop buttons to isolate
- Always use an emergency stop facility if it exists, even if specialist advice is available

Moving or displaced machinery parts

Hazard	Control measures
Moving or displaced machinery parts	Request specialist knowledge Isolate supplies

Hazard knowledge

All personnel working in the vicinity of working machinery should be aware and briefed on the potential of becoming physically trapped in moving parts of machinery such as:

- Gears
- Chain wheels
- Drive shafts/rams
- Sliding doors
- Slack cables
- Moving treads/handrail
- Parts of machinery that open and close or between lift car and shaft wall. This is particularly relevant if the machinery has been exposed by removal of safety guards

It should also be remembered that safety systems may have been circumvented.

Control measure – Request specialist knowledge

Control measure knowledge

The owner or occupier, on-site engineers or maintenance engineers should be able to provide specialist knowledge.

Control measure actions

- Liaise with the owner or occupier, on-site engineers or maintenance engineers

Control measure – Isolate supplies

Control measure knowledge

Where specialist knowledge is not available, crews may be able to identify instructions either on or in the vicinity of the machinery or locate emergency stop buttons to isolate the machinery.

Control measure actions

- Follow any available instructions or use emergency stop buttons to isolate
- Always use an emergency stop facility if it exists, even if specialist advice is available

Hydraulics and lubricants

Hazard	Control measures
Hydraulics and lubricants	Request hazardous material and environmental protection advice

Hazard knowledge

Leaking hydraulic fluid can cause slippery surfaces, leading to slips, trips and falls. Contact with this fluid can also lead to skin irritation and skin disorders. Some fluids may be carcinogenic.

Where hydraulic systems are under pressure there is a risk of hydraulic injection; refer to the *Extrication – Generic – Tools* section.

There is a high likelihood that supplies of lubricants (which can be oil or grease) will be found in machinery rooms.

Lubricant containers may create trip hazards and, if spilled, lubricant will create hazardous surfaces in and around machinery. Lubricants can also have properties that can have detrimental short and long-term health effects. Some lubricants are carcinogenic and others cause an allergic reaction if they come into contact with skin.

Control measure: Request hazardous material and environmental protection advice

Control measure knowledge

If the presence of hydraulics or lubricants beyond normal expectations is identified, incident commanders should request specialist advice on the appropriate levels of PPE, any decontamination requirements and environmental impact.

Control measure actions

- Request hazardous material and environmental protection advice.

Casualty care

Introduction

The guidance within this section has been written with the support of the Faculty of Pre-Hospital Care of the Royal College of Surgeons of Edinburgh. Pre-hospital care is a well-established branch of medicine in the United Kingdom, practised mainly by the ambulance service.

As the face of pre-hospital emergency medicine changes, the Faculty of Pre-Hospital Care aims to set and maintain clinical standards for all practitioners of the evolving specialty.

The principles of casualty care are to:

- Keep the casualty safe
- Identify and control catastrophic external compressible bleeding
- Recognise and assess, manage and/or support airway compromise
- Control the potential or actual injured spine
- Recognise and assess, manage and/or support breathing and ventilatory compromise while treating life threatening chest problems
- Recognise and assess, manage and/or support circulatory compromise and stop and/or identify bleeding
- Assess and manage the patient with reduced level of consciousness
- Expose and assess the casualty and evacuate to definitive care. This should be achieved whilst minimising exposure of the casualty to the cold environment (hypothermia) and putting strategies in place to mitigate the hypothermia hazard (active rewarming with heaters or blankets)

Adopting a systematic approach to casualty care assessment, for example <C> Ac B C D E, allows life-threatening conditions to be rapidly identified and managed. Problems identified in this assessment should be dealt with as they are found. Following the intervention, the casualty is then reassessed. The principle of constantly reassessing of the casualty should be promoted.

The fire and rescue service may be presented with a single casualty or multiple casualties. Both situations will be dealt with in this guidance.

If a casualty is non-responsive, medical alert tags, bracelets or cards may provide information about pre-existing medical conditions.

Failure to assess, identify and treat life-threatening problems of the casualty

Hazard	Control measures

Failure to assess, identify and treat life-threatening problems of the casualty	Follow principles of casualty care Carry out structured assessment and treatment using <C> Ac B C D E

Hazard knowledge

A casualty can suffer further injury, illness or death from the incident if they do not receive prompt medical aid. By adopting a systematic approach to casualty care, for example <C> Ac B C D E, any life-threatening conditions can be rapidly identified and managed.

Identify the need for specialist medical advice or care, according to local protocols.

The handover of the casualty should be presented in the ATMIST format, which will minimise any potential loss of information when being handed over to the next link in the chain of care.

The phrase **ATMIST** is used to structure the handover

- **A**dult or child
- **T**ime that the incident happened and what time the casualty is expected to arrive in the Emergency Department (ED)
- **M**echanism: how the incident occurred and mechanism of injury
- **I**njuries: what injuries have been found – follow a <C> Ac B C D E format
- **S**igns and symptoms: what signs the casualty is showing (respiratory rate, pulse rate, pallor) and what symptoms the casualty is telling you about (pain, feeling sick, cannot feel their legs)
- **T**reatment: what treatment have you given (again follow an <C> Ac B C D E format)

Control measure – Follow principles of casualty care

Control measure knowledge

The principles of casualty care, listed below, apply to all casualties, including trapped and non-trapped casualties:

- Protect the casualty from the hazards associated with the event
- Minimise on-scene time
- Extrication of the casualty should be carried out in the quickest way possible, considering their injuries and the overall threat to their life, to:
    - Allow 360 degree access to the casualty for assessment, treatment and packaging
    - Minimise transit time to definitive care (for example a major or specialist trauma centre)
    - Reduce the casualty's exposure to the elements
    - Reduce pain

- Reduce the psychological impact of the event

Control measure actions

- Have medical equipment pre-packed for treating the casualty
- Ensure formal medical response has been initiated (via 999/112)
- Approach the casualty with safety and maintain a safe environment for all involved
- Speak to the casualty to establish their level of consciousness and reassure them where possible
- Address life or limb threatening injuries or conditions

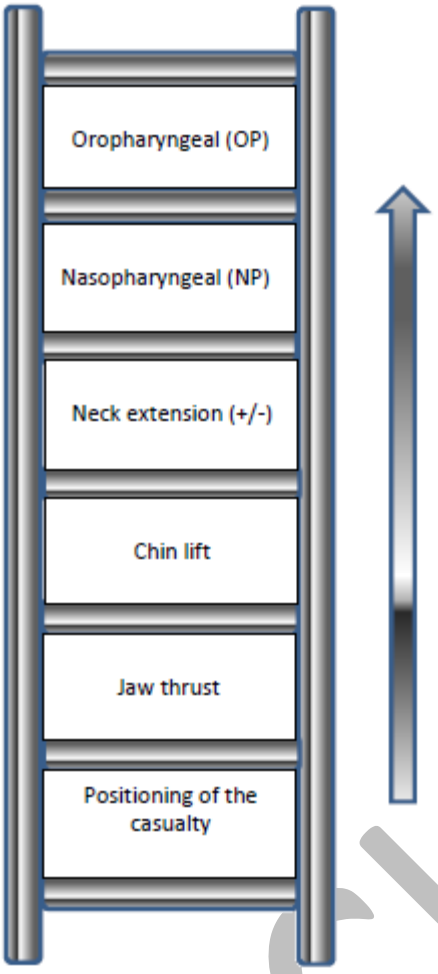
Control measure – Carry out structured assessment and treatment using <C> Ac B C D E

Control measure knowledge

Structured assessment and treatment using <C> Ac B C D E aims to prioritise the needs of the casualty and focus activity towards those injuries or conditions that may do more harm to the casualty, or may cause death.

Control measure actions

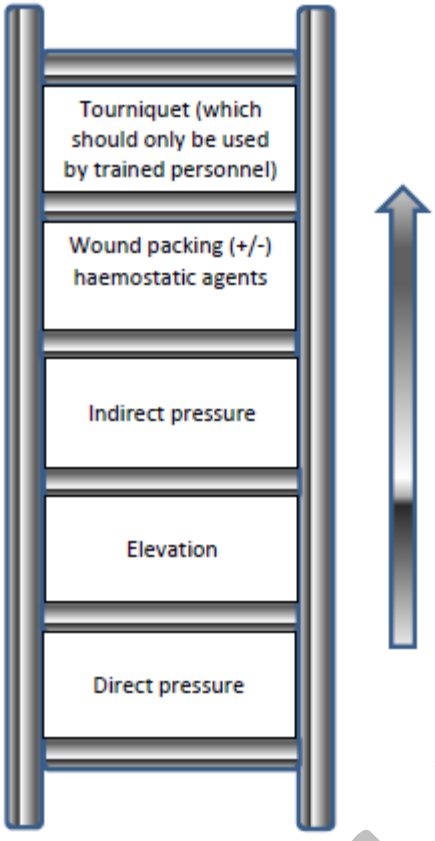
- <C> Control of catastrophic external compressible bleeding
  - The use of tourniquets, by trained personnel, forms part of the Faculty of Pre-Hospital Care (FPHC) consensus statement.
  - If there is a concern that a major bleed may occur on the casualty's release, tourniquet(s) may be applied loose, prior to extrication. These can then be quickly tightened if required – this action should only be undertaken by trained personnel.
- Airway
  - A simple 'airway ladder' approach to airway care should be promoted



  - Assessment and monitoring of the airway should be continuous
  - Suction should be available to clear the airway

- c-spine
  - If possible, self-extrication of the casualty is encouraged, following the guidelines promoted in the Faculty of Pre-Hospital Care (FPHC) spinal consensus statement
  - Manual in-line stabilisation is an acceptable method of stabilising the c-spine
  - A long board is used for extrication only and the casualty is placed onto a spinal stabilising device. Ideally a vacuum mattress or split device (for example a scoop stretcher) should be used to transport the casualty to definitive care
  - If extrication cannot be effected quickly, a request for advanced medical support to deliver advanced medical care (doctor or immediate care practitioner) should be considered at the earliest opportunity
- Breathing
  - Assessment of breathing / ventilation and the chest should be structured
  - Suggest RV-FLAPS WET:

        - **R**ate and **V**olume of breathing
        - **F**eel the chest
        - **L**ook at the chest
        - **A**rmpits clear of injury
        - **P**ress the chest wall
        - **S**earch the back and side/shoulders
        - **W**ounds on the neck
        - **E**mphysema felt in the neck
        - **T**rachea central in the sternal notch
    - Assessment and monitoring of breathing should be continuous
        - Minimum (rate and volume)
        - The means to support a casualty who has stopped breathing should be available – pocket mask and/or bag valve mask (BVM)
    - All live breathing patients will receive high-flow oxygen via a non-rebreathe mask
    - Sucking chest wounds should be covered with either a gloved hand or appropriate chest seal dressing with one-way air release valve
- Circulation
    - All bleeding should be stopped or controlled
    - Stopping bleeding is a priority and should be achieved using the 'bleeding ladder' approach:



  - Pelvic injuries should be treated as per Faculty of Pre-Hospital Care (FPHC) consensus statement
  - A shocked patient is bleeding internally if no external loss can be seen
- Disability
  - The casualty's level of consciousness is measured using **AVPU**:
    - **A**lert
    - **V**oice
    - **P**ain
    - **U**nresponsive
  - AVPU assessment should be recorded every 3 to 5 minutes
  - Casualties should have a pain score recorded
  - The irritable or uncooperative casualty will require early specialist medical assessment and treatment
  - If the casualty is presenting with a psychiatric illness or personality disorder the police should be involved early
- Exposure, Extrication and Evacuation
  - Casualties should be protected from the elements

- Active rewarming is encouraged
- Casualties may require stripping to skin to facilitate assessment
- The dignity of the casualty should be maintained
- If trapped, extrication should be, where possible, swift but controlled
- Casualty handling principles should be adopted as per Faculty of Pre-Hospital Care (FPHC) consensus statement

Single 'dead' casualty

Hazard	Control measures
Single 'dead' casualty	Use effective Cardiopulmonary Resuscitation (CPR) and use automated external defibrillator (AED) Wear personal protective equipment (PPE)

Hazard knowledge

In the event that initial fire and rescue service responding personnel have a single 'dead' casualty to deal with, it may be considered appropriate to act by carrying out the following control measure. For the casualty in cardiorespiratory arrest a systematic approach to care should be adopted, using Safety ABC. Good effective chest compressions and early defibrillation are key.

Control measure – Use effective Cardiopulmonary Resuscitation (CPR) and use of Automated External Defibrillator (AED)

Control measure knowledge

- Effective external cardiac massage (ECM), known as chest compressions, is achieved with a single person delivering ECM for two minutes then swapping with another rescuer
- 30 compressions to two rescue breaths is recommended for adults as per current guidelines
- 15 compressions to two rescue breaths is recommended for children as per current guidelines
- Chest compression-only resuscitation is acceptable in the witnessed cardiac arrest until the Automated External Defibrillator (AED) is applied
- Defibrillation within three minutes gives the casualty around a 70% chance of survival (RCUK, 2010).
- Move to the appropriate number of compressions to rescue breaths once the AED has delivered the first shock, and oxygen with a delivery system is available

Control measure actions

- Identify or confirm cardiac arrest with a rapid assessment of the casualty

- The casualty who is identified by the fire and rescue service as in cardiac arrest requires prompt resuscitation following the Resuscitation Council guidelines 2010 (RCUK, 2010).
- Extricate a casualty who is trapped and in cardiac arrest by the quickest means possible
- Apply an AED as soon as practicable

Control measure – Wear personal protective equipment (PPE)

Control measure knowledge

The rescuer or responder needs to be protected from any potential or actual bodily fluid contamination. Refer to the Operations guidance for further information.

Control measure actions

Consider using:

- Nitrile gloves
- Eye protection
- Face mask

Also refer to *the Extrication – Generic – Equipment used by other agencies* section.

Failure to hand over vital casualty information

Hazard	Control measures
Failure to hand over vital casualty information	Offer a structured handover to an appropriately trained and competent practitioner

Hazard knowledge

Failure to hand over information relating to the casualty's injuries (or condition) may result in further harm or death and compromises accepted standards in record keeping.

Control measure – Offer a structured handover to an appropriately trained and competent practitioner

Control measure knowledge

The phrase **ATMIST** is used to structure the handover

- **A**dult or child
- **T**ime that the incident happened and what time the casualty is expected to arrive in the Emergency Department (ED)

- **M**echanism: how the incident occurred and mechanism of injury
- **I**njuries: what injuries have been found – follow a <C> Ac B C D E format
- **S**igns and symptoms: what signs the casualty is showing (respiratory rate, pulse rate, pallor) and what symptoms the casualty is telling you about (pain, feeling sick, cannot feel their legs)
- **T**reatment: what treatment have you given (again follow an <C> Ac B C D E format)

Control measure actions

- Keep the ATMIST handover brief; aim for 30 seconds to get the information across
- Do not rush the handover
- Use written notes for reference
- Identify the team leader (or the next link in the chain of care) and introduce yourself
- Let the team know if the casualty is awake or not
- Tell them the name of the casualty
- Present ATMIST information
- Ask for any questions or points of clarification before handing over the casualty

Example of an ATMIST handover

A	ADULT/PAED		40 year old male
T	TIME OF INCIDENT		The accident happened at 13.40 – he was trapped for 40 minutes
M	MECHANISM OF INJURY		Driver, high speed frontal impact into a wall. One metre deformation of the engine compartment seen.
I	INJURIES FOUND	A	Airway is clear and self-maintained, jaw line intact
		B	There is a flail segment on the right side of the chest, his armpits and back are clear
		C	He has an open fracture of his right femur which was oozing blood
		D	He has a bruise to his forehead and a laceration to his right ear
S	SIGNS AND SYMPTOMS	A	Talking
		B	Resp rate 35 and stable, complaining of pain over his right chest wall on breathing
		C	He has a radial pulse but he is pale and sweaty. His heart rate is 95 b/min.
		D	He has a bruise to his forehead and a laceration to his right ear. A – AVPU.
T	TREATMENTS GIVEN	A	Clear, manual in-line stabilisation of his neck
		B	Oxygen at 15 l/min, splinted his chest with his hands
		C	Applied a tourniquet to the right femur, manual traction has been applied
		D	Sterile pad and gauze applied to laceration on his right ear

Multiple casualties

Hazard	Control measures
Multiple casualties	Employ METHANE structured update Establish a triage sieve (adult and paediatric)

Hazard knowledge

During a multiple casualty situation, it is important to notify control of the event in a structured manner. Adults and children may need to be triaged.

Where a number of patients are involved in an incident and not enough personnel are available to treat them, it is important that a system of triage is used before ANY casualty care is undertaken.

Control measure – Employ METHANE structured update

Control measure knowledge

On arrival at the scene, the fire and rescue service will be required to update fire and rescue service control using a METHANE structure.

Control measure actions

METHANE

- **M**ajor incident declared
- **E**xact location
- **T**ype of incident
- **H**azards
- **A**ccess and egress
- **N**umber and severity of casualties, number of dead
- **E**mergency services present and required

Control measure – Establish a triage sieve (adult and paediatric)

Control measure knowledge

The core principle of triage is to do the most for the most. The initial triage method in a multiple casualty situation is the triage sieve.

The triage sieve will identify immediately life-threatening problems based on the C < A B C > system and correctly prioritise the patients for treatment. Not doing this will potentially risk lives.

All fire and rescue services should be aware of this system and be prepared to employ it in a multiple casualty situation or at a major incident.

As a principle, in a poorly resourced scene, minimal casualty care is carried out in a multiple casualty situation. The following list provides guidance on what could be achieved without breaching the core principle of triage:

- Quickly turn a patient to protect an airway
- Encourage self help
- Encourage a bystander to apply direct pressure

Control measure actions

With the publication of the 2013 Ambulance Clinical Practice Guidelines (JRCALC) it was acknowledged that now ambulance services are all practicing C < A B C > in their initial patient assessment, the standard triage sieve needed to be updated to take account of the importance of initial assessment and treatment of catastrophic haemorrhage.

The diagram below is the new National Ambulance Service Medical Directors Group (NASMeD) Triage Sieve, which was published in 2013 for use by all ambulance staff at a major incident (NARU, 2013).

The priorities are described as:

- P1 or red tags (immediate) are used to label those who cannot survive without immediate treatment but who have a chance of survival
- P2 or yellow tags (observation) are for those who require observation (and possible later re-triage). Their condition is stable for the moment and they are not in immediate danger of death. These victims will still need hospital care and would be treated immediately under normal circumstances.
- P3 or green tags (wait) are reserved for the 'walking wounded' who will need medical care at some point, after more critical injuries have been treated.

The JESIP casualty triage has an additional priority:

- P4 or P1E (expectant) is used for those whose injuries are so extensive that they will not be able to survive given the care/resource that is available. This is only to be used under authorisation of the Medical Incident Officer. They alone have the responsibility to match these patients' injuries with the number and type of the other casualties and the remaining resources available to the hospitals.

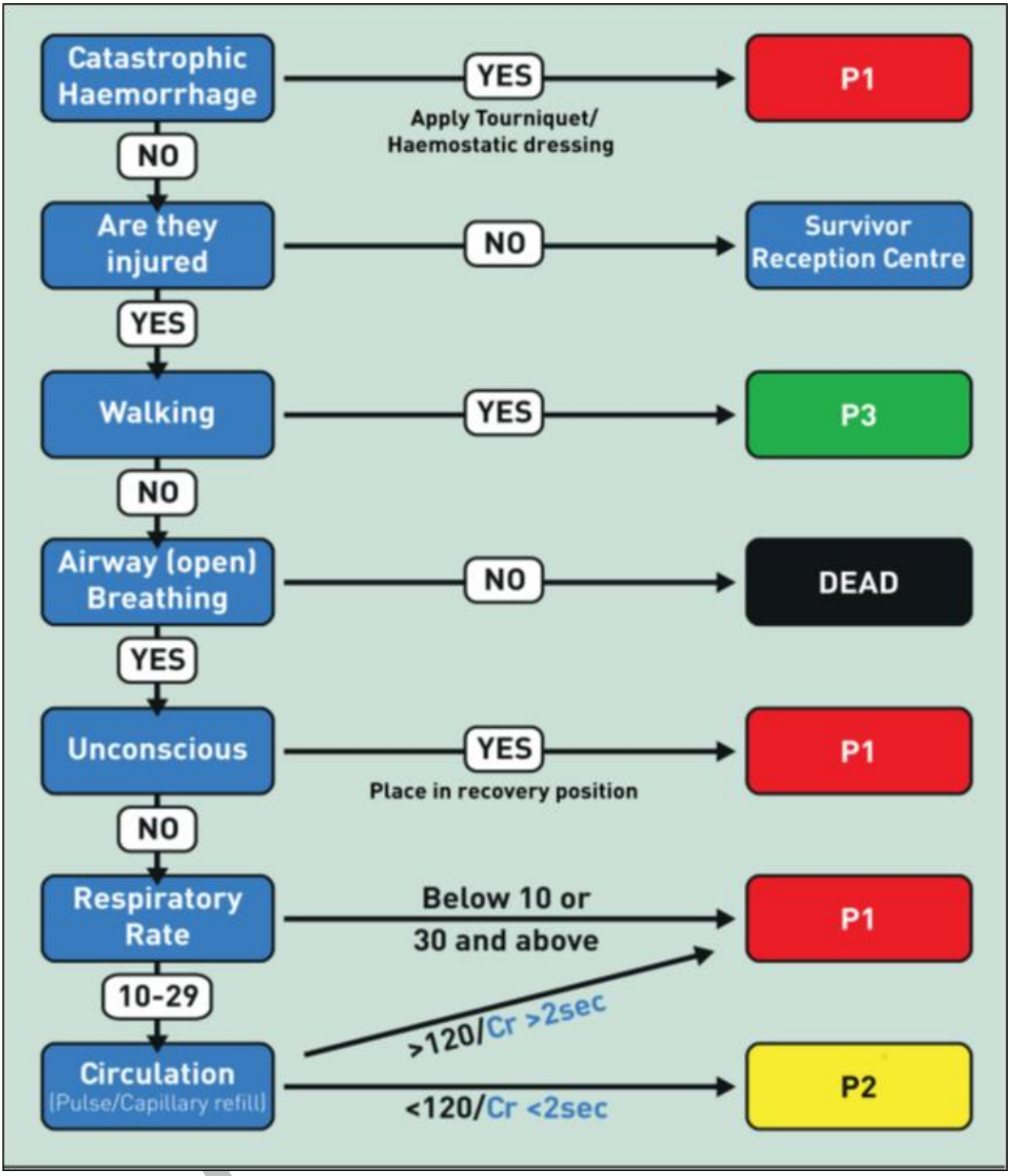


Figure 7: Triage Sieve

Source: National Ambulance Service Medical Directors Group (NASMeD)

The same triage principles apply to children. Paediatric triage tape is available, which groups children by length, weight and age and provides normal physiological values for respiratory rate and pulse within each of the groups to carry out the triage process.

Having labelled the casualty with their priority, casualties are handed over to an appropriately trained and competent practitioner. A record or log of the numbers of each priority should be kept.

When referring to casualties and the above categories at the scene of an incident, everyone should be sensitive to those who may be nearby, which could include relatives and other members of the public.

Bariatric casualty

Hazard	Control measures
Bariatric casualty	Make an early identification of the bariatric casualty Use bariatric management equipment Request an early deployment of advanced medical support

Hazard knowledge

A bariatric casualty presents a range of amplified hazards for fire and rescue service personnel, and for the casualty (HSE, 2007):

- Manual handling
- Difficult access, weight, size, shape or mobility of casualty
- Slips and trips
- Cluttered environment, loose carpeting, uneven floor surfaces etc.
- Crushing
- Hands or limbs pinned between person and hard surface
- Fatigue
- Lifting aids unavailable, limited space, distance carried
- Biohazards
- Blood or other bodily fluids. Refer to the Operations guidance
- Altered physiological states
- Difficult to maintain an airway
- Respiratory reserve is small
- Cardiac function is compromised
- Often the casualty has multiple medical conditions associated with obesity

Control measure – Make an early identification of the bariatric casualty

Control measure knowledge

Making an early identification of a bariatric casualty allows for an appropriate response by the fire and rescue service, initiating a response for advanced medical support and appropriate bariatric management equipment.

Control measure actions

- Make an early identification of the bariatric casualty
- Make an early **TILE** risk assessment:
    - **T**ask
    - **I**ndividual capability
    - **L**oad
    - **E**nvironment
- Use the principles of safer moving and handling:
    - Avoid
    - Assess
    - Reduce
- Consider access and egress considerations or complications in getting to and from the casualty

Control measure – Use bariatric management equipment

Control measure knowledge

Bariatric management or lifting equipment may reduce hazards, and it is important to understand what equipment is available from the fire and rescue service and emergency medical service. Appropriate personal protective equipment (PPE) for the situation should be worn.

Control measure actions

- Consider the early mobilisation of bariatric management equipment, as for some organisations this may not be readily available out of normal office hours
- Consider using hazardous area response teams (HART)
- Consider using specialist fire and rescue service technical rescue teams
- Consider the availability and use of specialist bariatric ambulances

Control measure – Request an early deployment of advanced medical support

Control measure knowledge

Understanding the clinical issues associated with bariatric casualties for both trauma and medical situations is helpful. Shift resources should be managed as availability may be limited outside of normal working hours

Control measure actions

- Request an early deployment of advanced medical support because of an increased risk of complications to:
    - Airway management
    - Respiratory or ventilatory support
    - Cardiovascular compromise
    - Management of pre-existing medical conditions and co-morbidities

Thermal or chemical injury

Hazard	Control measures
Thermal or chemical injury	Treat the burn Neutralise the chemical irritant Cover or dress the wound Manage pain and distress

Hazard knowledge

The priorities and treatment of casualties who are involved in thermal or chemical events are the same as for any other trauma situation. Casualties with thermal injury may have other coexisting injuries.

Having extinguished the fire or carried out decontamination, a full primary survey should be carried out using <C> Ac B C D E. If spinal injury is suspected or cannot be excluded, manual in-line stabilisation should be applied.

The burning process should be stopped as quickly as possible. Any fires should be extinguished if safe to do so and the patient removed from the source of thermal injury. Burnt clothing should be removed from the patient, along with any jewellery, unless either are adherent to the skin.

Patients with chemical burns may need irrigation with large amounts of water to clear the contaminant and specialist advice should be sought if a chemical is involved.

Irrigation for more than 10 minutes may cause hypothermia in the casualty. Be aware of the risk of hypothermia, especially in children and the elderly (NICE, 2012).

Thermal or chemical injuries should be assessed as per British Burns Association guidelines (BBA, 2002).

Control measure – Treat the burn

Control measure knowledge

- Early recognition and intervention
- Early cooling of the affected area
- **SAFE** approach:
    - **S**hout/call for help
    - **A**ssess the scene
    - **F**ree from danger
    - **E**valuate the casualty

Control measure actions

- Approach the casualty with care using the 'SAFE approach'
- Stop the burning process with irrigation (tap water)
- Cool the burn but warm the patient
- Request specialist advice, which should be available
- Identify the thermal or chemical agent through a live database, which should be available

Control measure – Neutralise the chemical irritant

Control measure knowledge

- Early recognition and intervention
- Early specialist advice on chemical involved
- Early irrigation and cooling of the affected area
- **SAFE** approach:
    - **S**hout/call for help
    - **A**ssess the scene
    - **F**ree from danger
    - **E**valuate the casualty

Control measure actions

- Approach the casualty with care using the 'SAFE approach'
- Patients with chemical burns may need irrigation with large amounts of water to clear the contaminant
- Cool the burn but warm the patient
- Request specialist advice, which should be available

- Identify the thermal or chemical agent through a live database, which should be available

Control measure – Cover or dress the wound

Control measure knowledge

- Evaluating the affected area
- Minimise the potential for infection

Control measure actions

- Dress the wound with cling film (layered)

Control measure – Manage pain and distress

Control measure knowledge

- Recognise the casualty's condition and the need for pain relief.

Control measure actions

- Cool the affected area
- Dress the affected area
- Obtain the appropriate level of medical support

Casualty has body part crushed

Hazard	Control measures
Casualty has body part crushed	Create a safe environment for the casualty and responders Assess the casualty using standard <C> Ac B C D E Request an early deployment of advanced medical support Plan for the casualty deteriorating on release Protect from hypothermia or hyperthermia

Hazard knowledge

Casualties that have body parts trapped or crushed pose serious problems for the responding fire and rescue service and medical support.

Early release is always the goal. Emergency amputation is a very rare event and is seen as a last resort for extrication by medical responders.

In the context of a crushed limb, the application of a tourniquet by trained personnel is appropriate to stop bleeding. Crush syndrome is not reduced by the application of tourniquets.

Advanced medical support may be required for surgical release – this should be mobilised early (*Greaves et al, 2003*).

Control measure – Create a safe environment for the casualty and responders

Control measure knowledge

There are many inherent hazards present in scenes with entrapment, dependent on the environment within the inner cordon.

Control measure actions

- Minimise the hazards to the casualty and the fire and rescue service. Refer to the *Extrication of a casualty* section for information on making the inner cordon safer.

Control measure - Assess the casualty using standard <C> Ac B C D E

Control measure knowledge

A structured assessment reduces the chance of missing other injuries/conditions

Control measure actions

- Follow the <C> Ac B C D E approach

Control measure – Request an early deployment of advanced medical support

Control measure knowledge

It will take time to mobilise advanced medical support. Calling them early will benefit the casualty as it may reduce delay.

Control measure actions

- Strive for early recognition and call for assistance

Control measure – Plan for the casualty deteriorating on release

Control measure knowledge

The fire and rescue service can assist the medical response in planning for a deterioration in the casualty's condition once released, by forming clearly designated areas for resuscitation and reassessment

Control measure actions

- Provide clearly designated areas for casualty care; clear trip hazards, for example
- Assist medical responders with appropriate casualty care
- Communicate with medical responders on the status of the casualty (ATMIST)

Control measure - Protect from hypothermia or hyperthermia

Control measure knowledge

The casualty that remains trapped is exposed to the environment and is unable to adjust to extremes of heat and cold. Both have a negative effect on the casualty's ability to survive injury.

Control measure actions

- Understand the issues involved with a trapped casualty and hypothermia or hyperthermia
- Provide assistance in protecting the casualty

Glossary

Term	Acronym (if applicable)	Description (for 'hover over' feature)
Actuator		An actuator is a type of motor that is responsible for moving or controlling a mechanism or system. It is operated by a source of energy, typically electric current, hydraulic fluid pressure, or pneumatic pressure, and converts that energy into motion. Actuators are commonly used for aircraft controls.
Airstair		An airstair is a set of steps built into an aircraft so that passengers may get on or off the aircraft
Amputation		The intentional surgical removal of a limb or body part
Armaments		Military weapons fitted to an aircraft, for example missile launchers
Asbestos-containing material	ACM	Materials used in construction that contain asbestos
Audial		Relating to or perceived through the sense of hearing
Automated external defibrillators	AED	An automated external defibrillator (AED) is a portable electronic device that automatically diagnoses the life-threatening cardiac arrhythmias of ventricular fibrillation and ventricular tachycardia in a patient,[1] and is able to treat them through defibrillation, the application of electrical therapy which stops the arrhythmia, allowing the heart to re-establish an effective rhythm.
Avionics		Avionics are the electronic systems used on aircraft, with systems including those for communication and navigation
AVPU		The mnemonic AVPU refers to an assessment of the basic scale of consciousness. It identifies the following levels: A – The patient is awake and alert. This does not necessarily mean that they are orientated to time and place or neurologically responding normally. V – The patient is not fully awake, and will only respond to verbal commands or become roused after verbal stimuli. P – The patient is difficult to rouse and will only respond to painful stimuli, such as nail bed pressure or trapezius pain. U – The patient is completely unconscious and unable to be roused.

Term	Acronym (if applicable)	Description (for 'hover over' feature)
Bag valve mask	BVM	A manual resuscitator or "self-inflating bag" is a hand-held device commonly used to provide positive pressure ventilation to casualties who are not breathing or not breathing adequately
Ballistic recovery system		A parachute system which lowers an entire light aircraft safely to the ground in the event of loss of control, failure of the aircraft structure, or other in-flight emergency
Bariatric		The most commonly accepted and consistent language for identifying and defining bariatric patients has been through the use of the Body Mass Index or BMI. The World Health Organization describes people who have a BMI greater than 30 as obese, and those having a BMI greater than 40 as severely obese.
Breathing apparatus	BA	Self-contained respiratory protective equipment
Canine support		Dogs that are used by the fire and rescue service for a variety of activities including searching for missing or trapped persons and fire investigation
Cardiopulmonary resuscitation	CPR	A first aid technique which combines external cardiac massage with rescue breathing (inflating the lungs by using mouth-to-mouth resuscitation)
Casualty centred rescue approach		This approach has the aim of reducing extrication times through simultaneous activity, with multiple tasks being carried out at the same time
Chest seal dressing		An airtight and watertight dressing for chest wounds
Chin lift		An action to lift a casualty's chin, thereby opening their airway
Co-morbidities		Two or more diseases existing at the same time in the body
Compressible		The ability to apply pressure, especially to control bleeding
Confined space		A confined space is a place which is substantially enclosed (though not always entirely), and where serious injury can occur from hazardous substances or conditions within the space or nearby (e.g. lack of oxygen).
Consciousness		The quality or state of awareness
Control room operator	CRO	Person who takes calls in a fire control room
Crankcase		Usually the largest cavity in an engine which houses the crankshaft

Term	Acronym (if applicable)	Description (for 'hover over' feature)
Crumple zone		A crumple zone is a structural feature mainly used in road vehicles. They are designed to absorb the energy from the impact of a traffic collision by controlled deformation of the vehicle's structure.
Crush syndrome		A medical condition characterised by major shock and renal failure after a crushing injury to skeletal muscle
Definitive care		The completion of recommended medical treatment
Defragmentation		Breaking up
Drag		The aerodynamic force that opposes an aircraft's motion through the air
Drogue gun		A device that fires the initial parachute of an ejection seat in an aircraft
Efflux		Force or wind generated behind a jet engine, particularly on or before take-off when high or full power is set, but also when the aircraft is taxiing
Emergency department		Also known as accident and emergency (A&E), emergency room or casualty department
Emphysema		A disease of the lungs that can make breathing difficult
Entry control point	ECP	The position for the command and control, deployment and monitoring of breathing apparatus wearers in a risk area
Equipment or tool dump		An area created in which to store equipment or tools during an incident
Explosive canopy		In aircraft fitted with ejection seats, the transparent enclosure (or canopy) over the cockpit is blown upwards and rearwards by an explosive charge
External cardiac massage	ECM	A first aid technique using chest compressions to pump the heart and keep the circulation going
Fall arrest system		A personal fall arrest system is a fall-protection system that uses a harness connected to a reliable anchor to arrest and restrict a fall and prevent the user hitting the ground.
Fire control room	FCR	Department or centre that takes emergency calls for the fire service
Firewall		In vehicles or aircraft, a firewall is the part of the bodywork that separates the engine from the driver or pilot and passengers or crew

Term	Acronym (if applicable)	Description (for 'hover over' feature)
Former		The frame of an aircraft fuselage
G-force limiter		Reduces the force of the seat belt above a certain threshold, in conjunction with belt tensioners
Girt bar		Metal bar that connects an emergency slide to the fuselage of an aircraft
Glasgow Coma Scale	GCS	The Glasgow Coma Scale is a more in-depth way than AVPU used to assess a casualty's true level of responsiveness
Governance		This is provided by a medical doctor who is acting as the Medical Director for that organisation and therefore personnel; they will have agreed as to what level they are trained to, and are therefore able to work at, to deliver casualty care.
Haemostatic agents		A variety of chemicals that are designed to stop the flow of blood from open vessels
Hidden voids		A void is an area that has been intentionally left completely empty. In vehicles this could include luggage or sleeping compartments. A hidden void is such an area that cannot be readily seen.
Highways Agency Managed Motorways		A managed motorway entails the permanent conversion of the hard shoulder to a running lane, whilst retaining the ability to dynamically control traffic
Hydraulic injection		Hydraulic injection can be defined as the puncturing of the epidermis by a jet of a fluid under pressure
Hyperthermia		Overheating of the body
Hypothermia		A condition in which the body's core temperature drops below that required for normal metabolism and body functions
Immediate care practitioners		Highly trained doctors who provide their services in support of the ambulance service
Industrial processes		A systematic series of mechanical or chemical operations that produce or manufacture something
Inner cordon		An inner cordon is established to control access to the immediate scene of operations
Insulated cutters		Cutting tools that provide additional protection against electrical shock

Term	Acronym (if applicable)	Description (for 'hover over' feature)
Interoperability		The joint working of emergency services, especially during a major or complex incident.
Intraoperability		The joint working of fire and rescue services, through combined use of resources and assets, sometimes within a cross-border situation. This can also mean the combined involvement of a fire and rescue service with National Resilience assets.
Intrinsically safe radios		An intrinsically safe radio is one that has been designed and tested to not become an ignition source in a flammable atmosphere
Jaw thrust		A professional technique used on a casualty, especially if there is suspected spinal injury, to open their airway
Last known position	LKP	During a search, clues will be gathered about the person. Occasionally, the clue will be solid enough to be reasonably certain the search subject left it. Since the LKP is more recent than the PLS, this provides a new starting point for the search.
Loadmaster		Member of the aircrew (civilian or military) who is in charge of planning and distributing cargo and passengers on an aircraft
Long board		A patient handling device, used primarily in pre-hospital care, to provide rigid support during movement of a patient with suspected spinal or limb injuries
Major incident		A major incident is any incident that requires the implementation of special arrangements by one or more of the emergency services, the NHS or the appropriate Local Authority for: • The rescue and transportation of a large number of casualties • The involvement either directly or indirectly of large numbers of people • The handling of a large number of enquiries likely to be generated from both the public and the news media usually to the police • Any incident that requires the large scale combined resources of the emergency services • The mobilisation and organisation of the emergency services and the supporting services to cater for the threat of death, serious injury or homelessness to a large number of people.

Term	Acronym (if applicable)	Description (for 'hover over' feature)
Man-made mineral fibres	MMMF	A wide range of materials that use the inherent strength and durability of woven fibres bonded together with resins
Manual in-line stabilisation		Maintaining the head and neck of an unconscious casualty in neutral alignment
Memorandum (Memoranda) of Understanding	MoU (MoUs)	An MoU is an agreement that may exist between organisations such as the emergency services. It provides clear guidelines for local implementation of policies, strategies, and tactical and operational practice in accordance with local circumstances.
Miniature detonation cord or linear cutting cord		Many aircraft with ejection seats have systems that destruct the cockpit canopy. If the eject handle is pulled, the miniature detonation cord or linear cutting cord, which are embedded within the acrylic plastic of the canopy, use an explosive charge to shatter the canopy a few milliseconds before the seat is launched.
Mutual aid		Mutual aid is an agreement among emergency responders to lend assistance across jurisdictional or geographical boundaries. This may occur due to an emergency response that exceeds local resources, such as a disaster or major incident.
Nasopharyngeal airway		A method of using a flexible tube to secure a nasal airway when the casualty does not have, or may lose their ability to keep their own airway open
National Resilience	NR	The national capability to deal with the consequences that are common to most types of emergency, regardless of whether those emergencies are caused by accidents, natural hazards or man-made threats.
Natural		Not man-made
Neck extension		The positioning of the casualty's head and neck to assist with their breathing or resuscitation
Non-breathe mask		A device used in medical emergencies for a casualty that requires oxygen therapy
Ordnance		Military weapons, for example missiles
Oropharyngeal airway		A hard "J" shaped plastic device that secures an oral airway, and can also be used to keep the teeth open for a more permanent airway. It also prevents the tongue from obstructing the airway.
Overhead line	OLE	High-voltage power lines to provide electric current to trains, trams or

Term	Acronym (if applicable)	Description (for 'hover over' feature)
equipment		trolleybuses
Paediatric		Specialist medical care provided to babies, children and young people (under 18 years of age)
Pain score		A numerical rating scale enabling the casualty to rate their pain score, usually from zero (absence of pain) to ten (the most intense pain possible)
Pallor		Pale colour of the skin which can be caused by illness, emotional shock or stress
Pantograph		A pantograph is an apparatus mounted on the roof of an electric train or tram to collect power through contact with overhead line equipment
Peel and reveal		The method of making an initial inspection by peeling back the inner trim of a panel or post of a vehicle. Once the inside of the panel or post is revealed and any components identified that should be avoided, the cut or other action can be carried out.
Personal protective equipment	PPE	Personal protective equipment includes items such as fire tunics, over-trousers, helmets, fire hoods, gloves and boots. Specialist personal protective equipment may be used for certain types of incident.
Plastic bolster		The plastic cover over a deployable airbag, for example a knee airbag
Pocket mask		A hygiene device used to more safely deliver rescue breaths during a cardiac arrest or respiratory arrest
Point last seen	PLS	This is the point on the map or plans where the person was last spotted by a witness who provides a positive identification. If it is known for certain that the person was seen standing in a certain place just two hours ago, this provides a place to begin the search. By calculating how far the person might be able to travel in two hours and/or their likely exit route from within a premises helps to limit the search area.
Premises information box	PIB	Premises information boxes are contain key information that will be needed by fire and rescue crews at the time of an incident. The information should be simple and useable with the following being the essential items: • Operational contingency plans • Simple plans and or schematic representations of the building and information about equipment or fixed installations, such as the design and functions provided for means of escape or firefighting

Term	Acronym (if applicable)	Description (for 'hover over' feature)
		operations • Basic operating instructions for fire protection and fixed firefighting equipment
Pyrotechnic		Materials capable of undergoing self-contained and self-sustained chemical reactions for the production of heat, light, gas, smoke and/or sound
Ram air turbine	RAT	A small turbine that is connected to a hydraulic pump, or electrical generator, installed in an aircraft and used as a power source
Rendezvous point	RVP	After initial response, emergency services personnel attending an emergency or major incident should be directed to a designated rendezvous point.
Rescue		Removal, from a place of danger to a place of relative safety, of persons threatened or directly affected by an incident, emergency or disaster
Respiratory protective equipment	RPE	Respiratory protective equipment includes breathing apparatus, particle masks and respirators.
Responsible Person		The Fire Safety Order details the duties of a Responsible Person for carrying out a fire risk assessment and ensuring the building is suitably safe for all relevant persons
Road traffic collision	RTC	The law defines a reportable road traffic collision as an accident involving a mechanically-propelled vehicle on a road or other public area
Rollover		A rollover is a type of vehicle accident in which a vehicle tips over onto its side or roof
Rural environment		The rural environment often refers to areas in the country which are less densely populated. There are different types of rural areas, depending on how accessible they are from urban areas ranging from the rural urban fringe to the extreme or remote rural areas.
Safety officer		Safety officers are appointed by the incident commander prior to commencement of operations. They will be located at point which provides them with overall view and control of the inner cordon and scene of operations.
Scoop stretcher		A scoop stretcher has a structure that can be split vertically into two parts, with shaped 'blades' that can be brought together and secured underneath

Term	Acronym (if applicable)	Description (for 'hover over' feature)
		a patient
Scope of practice		This is the level at which an individual is trained to deliver casualty care at within their area of work, under their clinical governance. They should NOT go outside their scope of practice under their clinical governance.
Sear pin		A pin used to make an ejection seat in an aircraft safe for performing a rescue
Skin		The outer surface of an aircraft
Space creation		To enable extrication of a casualty, sufficient space and room for the medics to work on the casualty needs to be created. This can include removing the roof of a vehicle involved in a road traffic collision.
Spar		A major component of an aircraft wing framework
Sponson		Any of several structures that project from the side of a boat or ship, especially a gun platform
Spot cooling		Effect of using a water jet, for example on hot metal such as the undercarriage of an aircraft after a crash landing
Squib		A miniature explosive device used to generate mechanical force, for example ejection of aircraft components
Stalactite		Icicle-shaped formation
Sternal notch		The sternal notch is a well-defined, triangular depression in the lower front of the human throat
Stringer		A thin strip of material to which the skin of the aircraft is fastened
Structural		A building or other object constructed from several parts
Tail-cone jettison system		A means to deploy the tail-cone to gain access to an evacuation slide of an aircraft
Tailpipe		An outlet by which engine exhaust gases are expelled from a vehicle or jet aircraft
Thermal imaging camera	TIC	A thermal imaging camera is a type of camera used in firefighting. By rendering infrared radiation as visible light, such cameras allow firefighters to see areas of heat through smoke, darkness, or heat-permeable barriers.

Term	Acronym (if applicable)	Description (for 'hover over' feature)
Thermal shock		Thermal shock is the term for metal failure, which can occur if spot cooling is carried out too rapidly on already hot metal
Time critical		Term used to describe a casualty who needs immediate treatment or intervention of a life-saving manner
Tourniquet		A constricting or compressing device, usually a bandage, used to control venous and arterial circulation to an extremity for a period of time
Trachea		Also known as the windpipe, this is the tube that connects the mouth and nose to the lungs. It goes divides into two airways that supply air to each lung
Triage		The assignment of degrees of urgency to wounds or illnesses, to decide the order of treatment for multiple casualties
Urban environment		The urban environment is characterised by higher population density and vast human features in comparison to the areas surrounding it. Urban areas may be cities, towns or conurbations.
Urban Search and Rescue	USAR	Urban search and rescue locate, extricate and provide initial medical stabilisation of casualties trapped due to structural collapse, natural disasters, mines or collapsed trenches.
Vacuum mattress		A medical device used for the immobilisation of patients, especially in case of a vertebra, pelvis or limb trauma, in particular for femur trauma. It is also used for manual transportation of patients for short distances as an alternative to a stretcher.
Ventilatory		Relating to or serving for the provision of air to the lungs or respiratory system
Witnessed cardiac arrest		A cardiac arrest that is seen or heard by another person or an arrest that is monitored
Work restraint system		A work restraint system is a fall-prevention system, which relies upon personal protective equipment, consisting of a harness and a lanyard, which is adjusted or set to a fixed length that physically prevents the person from getting to the place where they could fall.
Working at height		Working at height means working in any place where, if there were no precautions in place, a person could fall a distance liable to cause personal injury

Term	Acronym (if applicable)	Description (for 'hover over' feature)
Zoonoses		Infections or diseases that can be passed from animals to humans

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