Title:	Transport
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Synopsis:	This guidance deals with the hazards that may be encountered in the specific contexts of air, rail, road and waterways incidents. It replaces over 600 pages of existing guidance, clarifies previous conflicting guidance regarding activity close to live rails and features guidance on SMART and All Lane Running motorways.
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National Operational Guidance – Transport first edition version one (ARCHIVED on 07-11-2016)

Introduction

National Operational Guidance is separated into three main operational activity categories: fires and firefighting, performing rescues and hazardous materials. All of these activities take place in certain contexts, such as on roadways for example. There are hazards that will apply to all activities but that are specific to the context in which the incident occurs.

This section of National Operational Guidance sets out the high level knowledge, hazards and actions that should be considered for incidents occurring in the context of transport. This context is possibly the most common area in which fire and rescue operations can take place and includes road, rail, water and air transport, including networks.

Fire and rescue services can attend numerous incidents, involving a variety of transport types, where the danger to operational crews and the public involved is significant. The objective of this guidance is to promote and develop good practice and support the development of safe systems of work that minimise the dangers within the transport networks that fire and rescue services may face.

This guidance specifically deals with the hazards present at transport incidents, providing a number of potential control measures and links to other National Operational Guidance; fire and rescue services can build on these according to their local risk assessment. This guidance may consider further information that the reader should bear in mind when reviewing the hazard and control statement and the resulting guidance.

The guidance should be read in conjunction with other pieces of National Operational Guidance already published.

When any reference to working with other agencies is indicated in this guidance the Joint Emergency Services Interoperability Principles (JESIP) Joint Doctrine should be applied.

Relevant knowledge

Each fire and rescue service needs a consistent approach that forms the basis for common operational practices that support interoperability between fire and rescue services, other emergency responders and the transport industry and provides an effective response.

Fire and rescue service boundaries may mean that different services may have to attend an incident using this joint approach. Adhering to the hazards and control measures identified will allow an understanding of the typical hazards incident commanders face within these transport networks and lead to improved public and firefighter safety.

Large scale incidents involving any transport network are infrequent. This makes it difficult for fire and rescue services to gain experience and test their procedures, though the fundamental principles of operational response remain the same.

Though certain hazards will be common to all transport incidents, the environment in which they are found can differ hugely. These will be treated as stand-alone hazards and discussed in their separate contexts.

At transport incidents, fire and rescue services may encounter the additional pressures of business continuity from external bodies and other partner agencies, especially when the incident has a large impact and wide disruption is likely. From a fire and rescue service perspective, business continuity should be considered with a view of the impact the incident is having on the community and economy. However, overriding consideration should be given to the safety of emergency services personnel and the public.

It should also be remembered that decisions made at the incident ground may compromise public safety away from it. For example, isolating overhead line equipment can cause a train to become stranded in a tunnel, creating further risk to those on board. Other actions could result in widespread congestion, adversely affecting the ability of essential services to support the community.

At an incident, the highest priority for fire and rescue services will always be the safety of the public involved and emergency responders attending it. Effective and informed action by responders can reduce the hazards posed by the incident and protect the safety of both the public and emergency responders.

At all transport incidents, it is important to consider the need to preserve the scene for investigation purposes, both during and post operations. Fire and rescue services need to be aware that other organisations may have to carry out their own investigations, depending on the transport network involved. The police and British Transport Police, Civil Aviation Authority, Air Accident Investigation Branch, Marine Accident Investigation Branch and the Rail Accident Investigation Branch, as well as local agencies, will all need to be considered when dealing with transport related incidents.

Generally, incidents within the road network are more common, do not normally make the same major demands on fire and rescue services and do not involve the same degree of complexity or the same considerations as those incidents within the air, rail or marine environment. However, the collective impact of road accidents on society is significant, particularly if a 'minor' incident is located at a strategic location such as a junction, tunnel or bridge. The section on road hazards deals with working on roadways and working with vehicles.

Section 8 of the Fire and Rescue Services act 2004 makes reference to the duties of a fire and rescue service when attending road traffic incidents (see also the equivalent Scotland and Northern Ireland acts). See: http://www.legislation.gov.uk/ukpga/2004/21/section/8

Serious air incidents are uncommon, but when they do occur they can cause severe problems and have a significant impact on the community. The degree of severity depends to some extent on the size of the aircraft, the number of passengers and the location of the incident. Serious fires and major risks to life, problems in gaining access and dangers from aircraft components, cargo/freight or the materials used in its construction along with the inherent hazards of working on aerodromes mean they will always be a dangerous place to operate. The section on air transport hazards covers working at aerodromes and the limitations of access, the crash site, both on and away from aerodromes and the hazards of working with aircraft.

Incidents involving marine transport can occur in ports, harbours, docks, in shipyards, on inland waterways and at sea. However, this guidance does not cover offshore incidents. The amount of shipping, its variety, the size and complexity of some vessels, the composition of widely differing numbers of crews and passengers, and the carriage of large and often hazardous cargos can present challenges to attending fire and rescue services. The section on waterways hazards covers the infrastructure of ports, docks and inland marinas, and working in and around vessels.

Incidents within the rail environment can be varied; access to the scene may be difficult, the incident may be spread over a wide area and cause extensive disruption to the rail network. There may be dangers from electrified track and installations, dangerous goods may be present, adjacent lines may still be in use and there may be passengers trapped or injured. Fire and rescue services need knowledge of the construction of trains, tracks and installations, of how the system works and of the special procedures adopted on railways. The section on rail transport hazards covers the rail infrastructure and those associated with rolling stock, both above and under ground.

The Fire and Rescue Services (Emergencies) (England) Order 2007 indicates the provisions for attending incidents involving rescue from aircraft, trams and trains.(see equivalent in Scotland and Norther Ireland acts): http://www.legislation.gov.uk/uksi/2007/735/article/3/made

Fire and rescue service legislation

Fire and Rescue Services Act 2004

Fire (Scotland) Act 2005

Fire and Rescue services (Northern Ireland) Order 2006

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

Civil Contingencies Act 2004

Civil Contingencies Act 2004 (Contingency Planning) (Amendment) Regulations 2011

Dangerous Substances and Explosive Atmospheres Regulations 2002

The Confined Spaces Regulations 1997

The Work at Height Regulations 2005

Police and Criminal Evidence Act 1984

The Environmental Permitting Regulations 2010

The Environmental Damage Regulations 2015

Corporate Manslaughter and Corporate Homicide act 2007

Health and Safety at work Act 1974

Management of Health and Safety at Work Regulations 1999

Safety Representatives and Safety Committees Regulations 1977 (as amended)

Health and Safety (Consultation with Employees) Regulations 1996 (as amended)

Provision and Use of Work Equipment Regulations 1998

Personal Protective Equipment at Work Regulations 1992

Control of Substances Hazardous to Health Regulations 2002

Dangerous Substances and Explosive Atmospheres Regulations 2002

The Work at Height Regulations 2005 (as amended)

Risk management plan

Each fire and rescue authority must develop their strategic direction through their risk management plan. To determine the extent of their firefighting capability, strategic managers will consider their statutory duties and the reasonably foreseeable risk within their area.

The work to identify risk and prepare operational plans should consider all stakeholders, including the local emergency planning groups and the fire and rescue service risk management plan.

Hazard and control statement

Hazards	**Control measures**
All transport hazards	
Transport incidents	Produce Site-Specific Risk Information (SSRI) and emergency response plans Make a safe and controlled approach to the incident Situational awareness Use tactical advisers and responsible person Establish appropriate cordons Ensure effective multi-agency working
Unstable mode of transport	Assess stability Manage pressurised air systems Stabilise the mode of transport
Fuel and electrical systems	Identify and isolate electrical systems Identify and isolate fuel systems
Construction materials	Identify and communicate vehicle or craft construction materials Avoid manipulation or damage to composite materials Apply fine water spray or foam

Large numbers of people	Evacuate affected people to a place of safety
Biological materials	Establish hygiene controls Undertake decontamination
Failure to preserve and secure the scene for investigation	Assist in preservation of evidence and subsequent investigation
Air	
Air transport incidents	Apply all transport incidents control measures
Dealing with incidents within aerodrome perimeters and infrastructure	Understand aerodrome bylaws Be familiar with aerodrome rescue and firefighting service (RFFS) advice and equipment Establish whether vehicles are to be escorted airside
Crash site on and off aerodrome	Apply air transport control measures Control ignition sources
Aircraft undercarriages	Establish appropriate cordons Stabilise the mode of transport
Escape slides	Manage slides and access points
Aircraft ballistic recovery systems	Identify the system and seek specialist advice regarding the isolation of systems Manage the deployed parachute
Aircraft systems and construction	Apply air transport incidents control measures Identify, isolate and control systems
Working around military aircraft	Apply air transport incidents control measures Liaise with specialist military advisers Restrict use of radio transmissions
Working around helicopters	Apply air transport incidents control measures Avoid deploying flotation devices or automatically deployable emergency locator transmitters (ADELT)
Rail	

Rail transport incidents	Apply all transport incidents control measures Establish proportionate control over the railway Appoint safety officers Wear appropriate personal protective equipment (PPE)
Moving rail stock	Apply rail transport incidents control measures Maintain safe working distances (moving rail stock)
Complexity of rail infrastructure	Apply rail transport incidents control measures Identify utilities adjacent to rail infrastructure
Rail power systems	Apply rail transport incidents control measures Identify all present power systems Maintain safe working distance (overhead line equipment)
Access to railway infrastructure	Apply rail transport incidents control measures Identify places of refuge and safety
Track welding powder	Request specialist knowledge from responsible person Establish appropriate cordons
Detonators	Request specialist knowledge from responsible person Establish appropriate cordons
Working within underground rail infrastructure	Apply rail transport incidents control measures Gather knowledge of the infrastructure Identify appropriate tactical plan
On-board train systems	Request specialist knowledge from responsible person
Hazardous materials within the construction of rolling stock	Request hazardous materials and environmental protection advice
Incidents on or near to railway crossings	Apply rail transport incidents control measures
Road	
Road transport incidents	Apply all transport incidents control measures
Moving vehicles	Establish appropriate outer cordon

Operating on SMART and all lane running (ALR) motorways	Use agreed operating procedures
Deformation of crash barriers	Make safe any affected barriers
Objects involved in a collision	Identify the direction of movement of the objects involved in the collision Relocate the object(s) in a controlled manner
Affected vehicle contents	Identify the direction of movement Stabilise vehicle contents Empty the vehicle to a safe place Identify an effective method of entry
Alternative fuelled vehicles (AFV)	Identify and communicate the vehicle type Control the vehicle propulsion system Isolate high voltage systems
Unconventional or specialist road vehicles	Contain the vehicle or cargo
Vehicle supplementary restraint systems (SRS)	Identify the supplementary restraint systems (SRS) and communicate the information Establish an appropriate safe distance for supplementary restraint systems (SRS) Isolate the supplementary restraint systems (SRS) Prevent manipulation or damage to supplementary restraint systems (SRS)
Waterways	
Waterway transport incidents	Apply all transport incidents control measures Seek specialist advice
Working within dock, harbour and marina infrastructure	Apply water transport incidents control measures
Inland waterways	Apply water transport incidents control measures Develop knowledge of operating systems and terminology
Construction of vessels	Be familiar with vessels

	Use ship fire control plans
Stability of the vessel	Appoint a stability officer or tactical adviser Minimise free surface effect

All transport hazards

The following section incorporates the hazards that may be found at all incidents involving the transport networks of road, rail, air and water and where the subsequent control measures can be applied equally to these networks whilst attending incidents.

Transport incidents

Hazard	Control measures
Transport incidents	Produce Site-Specific Risk Information (SSRI) and emergency response plans Make a safe and controlled approach to the incident Situational awareness Use tactical advisers and responsible person Establish appropriate cordons Effective multi-agency working

Control measure – Produce Site-Specific Risk Information (SSRI) and emergency response plans

Control measure knowledge

See National Operational Guidance: Operations – Information gathering

The transport environment should be considered when fire and rescue authorities are identifying local sites for the production of Site-Specific Risk Information (SSRI) and emergency response plans. This risk information gathering process should consider the community risk registers produced by local resilience forums and other appropriate local risk analysis.

Fire and rescue services must ensure that the planned operational response to transport incidents is sufficient to allow relevant safe systems of work to be implemented. A task analysis of various transport scenarios will enable a fire and rescue service to plan an effective response. This, together with any known site-specific information, will provide a risk-based assessment of the pre-determined response. As part of the pre-planning process, the pre-determined response should also include the need for other emergency services, specialist equipment and/or vehicles, other agencies and contractors.

Identifying and managing the potential for transport disruptions in advance can reduce the costs to an organisation in terms of finance and time management. The delay of resources at any transport related incident can cause disruptions to the service and impact the wider community. Pre-planning should include lessons and recommendations from public enquiries into transport incidents.

Air

Fire and rescue services should assist in developing procedures for dealing with emergency situations in which the fire and rescue service will be involved and included in the emergency orders of the aerodrome emergency plan. This should align with fire and rescue service procedures and be very clear on the different roles and responsibilities for the multiple agencies that may attend an incident within the environment of an aerodrome or at an aircraft crash site.

Fire and rescue services should ensure that personnel are aware of the hazards associated with a crashed aircraft and have safe systems of work to deal with an incident on and off an aerodrome site. Air industry partners will have facilities to support any risk information gathering for hazards that may be encountered.

Each aerodrome will have provision for removing and collecting surface water. At larger sites they will have collection or balancing ponds to collect the water before it is put into local water courses. These ponds can be sizeable, holding a vast amount of water, and they present a drowning hazard to personnel working near them.

The purpose of the aerodrome emergency plan is to provide all the required information for their areas of aerodrome responsibility to the agencies and staff involved in an emergency. The document ensures the required information is easily identifiable and covers every aspect of emergency planning and emergency response for the aerodrome.

The aerodrome emergency plan should describe the procedures for co-ordinating the response of different aerodrome agencies, organisations or services (for example, ground handlers, airlines, security services) and those agencies in the surrounding community that could be of assistance in responding to an emergency.

For detailed information on the aerodrome manual see:
https://www.caa.co.uk/docs/1123/srg_asd_Chapter2aerodromemanual.pdf

Rail

Fire and rescue services should have knowledge of the intervention strategies designed for the rail environment and be aware of the environment they will be operating in. Issues associated with problematic communication, confined spaces, travel distances and manual handling can be addressed by pre-planning and determining the appropriate initial response. For complex infrastructure or depots and sidings, pre-planning and tested communication arrangements should be put in place.

Pre-planning will require appropriate liaison with rail operating companies and freight operating companies to establish best practice and a joint understanding of risk and response. This is particularly relevant to rail tracks, rail environment, rail depots and sidings, and rail rolling stock hazards and loads.

Road

For incidents causing disruption to major road networks, fire and rescue services should produce multi-agency plans that detail the emergency and recovery phase roles and responsibilities of each agency.

Fire and rescue services should use all available sources to gain information on the hazard posed by the road infrastructure, for example:

- Road restrictions or maintenance
- Road closures
- Weather updates
- Vehicle type, such as on differences in dealing with vehicle systems

Waterways

The port emergency plan aims to provide fire and rescue services, Category 1 or 2 responders and other agencies involved in an emergency within a harbour, port, dock or marina with the information they need.

This pre-planning and any regular training or exercising will assist fire and rescue services to establish good working relationships and define robust tactical response plans with all port and harbour authorities associated with waterway transport.

Strategic actions

Fire and rescue services should:

- Prepare Site-Specific Risk Information (SSRI) and incident response plans for relevant transport infrastructure and make them available to incident commanders,
- Plan an appropriate pre-determined attendance and initial response to incidents involving transport environments
- Pre-plan with transport network managers and other responding agencies to mitigate the effects of disruption
- Establish processes with relevant authorities for both receiving and disseminating information on transport network changes such as closures or restrictions as they occur
- Establish means to maintain weather forecast information to inform operational planning, decision-making and mobilising
- Provide operational responders with information, instruction and training in relevant Site-Specific Risk Information, emergency response plans and hazards relating to the nature and complexity of the transport environment
- Use multi-agency exercises to test emergency plans and ensure fire and rescue service procedures reflect assumptions and expectations of their role as part of a multi-agency response

Tactical actions

Incident commanders should:

- Access and review Site-Specific Risk Information (SSRI) and/or relevant emergency response plan information at the earliest opportunity to inform a safe and effective incident plan
- Give early consideration to the effect of fire and rescue service operations on the reinstatement of normal operations within the transport infrastructure

Control Measure – Make a safe and controlled approach to the incident

Control measure knowledge

See National Operational Guidance: Operations – Time of alert to time of attendance.

By its very nature, an incident affecting the transport network will present challenges to responding emergency services. Some incident types will enable a degree of pre-planning for the location of access and rendezvous points (RVPs) but more remote incidents may present significant difficulties.

When considering the safest and most effective access to an incident the following should be considered:

- Location: May be given by grid reference, last known location or by a member of the public
- Terrain: Consideration should be given to the type of terrain the appliance is driven over. In some cases the shortest distance may not always be the quickest.
- Wreckage: Must be avoided, as it could be covering casualties, could cause damage to vehicles and will form part of subsequent investigations
- Casualties: May self-evacuate and travel considerable distances from the incident. Drivers must be aware that these people may be injured, disorientated or confused. Others may have collapsed and could be difficult to see, especially in adverse weather conditions.
- Fuel spillages: Fuel spillages may be difficult to detect, especially if the incident occurred at night, during inclement weather or away from areas of hard standing
- Animals: Disruption to the transport network could result in unconfined animals being encountered on roadways or by crews travelling on foot

Larger, more complex incidents may involve multiple resources from many responding agencies. Rendezvous points (RVPs) or strategic holding areas should be identified and communicated, if not pre-planned. Where the evacuation of casualties is likely to be involved, or they require conveyance by the ambulance service, a clear route to and from the incident will be required.

On attendance at incidents, drivers must display appropriate warning beacons in accordance with the Road Vehicles Lighting Regulations 1989 and be aware of the legal requirements of the Road Traffic Regulation Act 1984, Road Vehicles (Construction and Use) Regulations 1986 101 & 105 in addition to other relevant legislation.

Air

Designated rendezvous points (RVPs) for responding emergency services attending the aerodrome will be located around the aerodrome and included in the aerodrome emergency plan. These areas will be designated for emergency services only and should be kept clear at all times.

Depending on the size of the aerodrome the facilities will vary, but may include:

- Immediate access to airside areas via an access gate or equivalent
- Designated parking areas for all emergency services
- Shelter or control room facilities
- Radio communications with the aerodrome fire service and/or air traffic control
- Telephones
- Detailed aerodrome crash maps and additional critical information
- Aircraft hazard sheets and seating configuration for the aircraft that regularly use the aerodrome
- Tabards and associated incident command facilities

See specific control measures relating to military aircraft and helicopters in this guidance.

Rail

Railway incidents are often linear by nature, with limited access points. This can have a significant effect on the provision of equipment and personnel to the scene of operations.

Whatever the source of information about an incident, the relevant fire authority mobilising control centre should establish contact with the appropriate railway traffic control. A considerable problem may be identifying the location of an incident. Members of the public supplying information are likely to be very imprecise, particularly in areas unfamiliar to them or in areas of open countryside where no specific landmark is available.

Assistance in specifying the location of an incident comes from the individual numbers marked on bridges and tunnels, on most signal gantries, and on all overhead line equipment supports. There are also mile-marker posts alongside all lines, and there may also be quarter-mile posts. Network Rail also makes common use of National Grid references to identify locations, and firefighters are recommended to do the same where possible. Adjacent roads, buildings, main rail junctions, level crossings and tunnels will also give a good idea of the whereabouts of an incident.

Access points or emergency response locations are areas that can be used as a means of access for an emergency response. They will also provide integrated facilities for fire and rescue service actions and managed evacuation by the relevant infrastructure manager (incorporating train design, cross passages and rail-managed evacuation trains) and may also incorporate evacuation facilities for members of the public. They can vary greatly from basic access stairs to complex, purpose-built structures. Emergency responders should be aware of the following features:

- Rendezvous points (RVPs)
- Access arrangements

- Plans
- Water supplies
- Communication facilities

The urgency of the situation should be assessed when determining the most appropriate method of accessing the infrastructure. Some fire and rescue services have obtained specialist vehicles for use at rail incidents to mitigate access issues to specific infrastructure.

It is always preferable for fire and rescue service crews to gain access to the infrastructure by means designed for public or fire and rescue service access purposes. This principally involves stations, emergency response locations or access points, and purpose-built walkways.

Fire and rescue service personnel must not move from an area intended for normal public use (e.g. station platforms or the public highway) to an area on or near the railway where there is a hazard from rail vehicles or the infrastructure, without first implementing appropriate control measures. Any signage provided should be considered as part of the risk assessment process.

Roadways

Build-up of traffic caused by drivers being unable to leave the area can present significant difficulties for responding emergency vehicles and fire and rescue services should consider dual approach procedures for incidents involving the road infrastructure.

When approaching any incidents where animals are located on or near to carriageways, or are believed to be involved in the incident (directly or by virtue of being cargo), the warning devices on all emergency responder vehicles will only add to the animals' distress and potentially increase the unpredictability of their actions.

Consideration should be given to turning off all flashing lights and preventing the use of audible warning devices as soon as is practicable. Approach to these incidents should be slow, without any undue noise or visual stimuli. Approaching or passing any vehicles carrying animals should also be carried out with caution to avoid unduly distressing them.

Waterways

The dockside is a high hazard environment and multiple risks are evident; vehicle and plant movements, high tensile mooring lines, falls into water, maintaining safety cordons and controlling the numbers of personnel at the scene.

Strategic actions

Fire and rescue services should:

- Identify pre-determined access and rendezvous points (RVPs) in Site-Specific Risk Information and incident plans
- Identify areas that are unsuitable for vehicular access in Site-Specific Risk Information and incident plans
- Include access and rendezvous points (RVPs) on identified sites in training and multi-agency exercises

- Consider having dual approach procedures for incidents involving severe disruption to transport networks

Tactical actions

Fire control operators should:

- Identify and communicate the best access and rendezvous points (RVPs) based on incident information received

Incident commanders should:

- Access and consider Site-Specific Risk Information and incident plans when considering the most appropriate routes, access and rendezvous points
- Ensure responding vehicles make a safe approach at an appropriate speed and consider associated hazards (e.g. wreckage, casualties, fuel spills, animals)
- Consider the effects of geography on equipment logistics, casualties and crew welfare
- Consider a range of alternative means of access such as using specialist vehicles or cutting through fences
- Consider establishing a rendezvous point or strategic holding area and communicate the location to oncoming resources
- Consider appointing a marshalling officer to manage the logistics of emergency response vehicles at the scene or RVP

Control Measure – Situational awareness

Control measure knowledge

See National Operational Guidance: Incident Command – Situational awareness

At operational incidents in a transport environment there will be supplementary information. Incident commanders should seek to gain an understanding of this supplementary information to identify a safe and effective tactical plan.

Conducting a 360-degree survey of any incident scene allows an incident commander to identify hazards, assess the level of risk and inform safe and effective incident plans. Incidents within the transport environment can present some unique and significant challenges in achieving a thorough 360-degree survey.

Where a 360-degree survey would delay initial response or impede effective command and control the incident commander should consider alternative arrangements such as nominating and briefing a suitably competent person, accessing CCTV or utilising other available resources.

Air

The incident commander should carry out early reconnaissance of the scene to gather information and identify factors such as:

- The size of the aircraft involved

- Engine hazard zones
- Escape slide path
- Debris
- Casualties
- Hazardous materials – See National Operational Guidance: Hazardous materials (to follow)
- Aircraft armaments

Rail

Rail infrastructure incidents can be spread over a wide geographical area, or may involve tunnels or elevated working. Incident commanders should consider a full 360-degree survey of the incident to determine the full extent. This should also highlight alternate means of access, egress and the suitability of a rendezvous point (for example, access points in tunnel sections).

In an underground environment responders will need to gather knowledge of the type of infrastructure. Due to the potential for large numbers of people to be involved in exiting a tunnel (who may be unfamiliar with the location), knowledge of the infrastructure's access and evacuation strategy, pressurised escape areas or intervention shafts will also be needed.

Incident commanders should also consider the following when dealing with railway incidents in tunnels:

- The type of line (i.e. single or multi-directional)
- Whether or not the line is electrified (i.e. overhead line equipment (OLE) or third/forth rail)
- Whether the overhead line equipment (OLE) , or associated equipment, is involved in the incident
- Water supplies
- Emergency lighting
- Access to track level and transport of equipment
- Exhaust fumes from petrol-driven light pumps, generators and positive pressure ventilation fans
- Any structural damage that may affect the structural integrity of the tunnel

Road

Considerations for the incident commander should include vehicle and fuel type, supplementary restraint systems, hazardous materials, number of casualties and type of injury.

The incident commander should identify whether any vehicles involved are of a specialist nature and may require further or specialist resources, balancing this with a need to perform rescues at incidents that pose unfamiliar risks. It is possible that some specialist vehicles will carry contents that present unique hazards, and as such early identification of the vehicle type and confirmation of its load is essential.

Information sources might include:

- The driver
- Witnesses
- Police
- Highways agency

Where guidance is required for the type of vehicle being tackled, specialist knowledge should be sought either from the vehicle owner or vehicle manufacturer, and with suitable information accessible on mobile data terminals.

If an alternative fuelled vehicle 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 or systems
- Hazardous materials (for example, LPG or electrolytes)
- Pressurised systems

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

All alternative fuelled vehicles present their own hazards and combinations of hazards which will require different actions according to the incident, with many involving hazardous material related considerations and procedures. See National Operational Guidance: Hazardous materials (to follow).

Waterways

Awareness of hydrological and meteorological conditions prevailing at the time is vital, so that fire and rescue service personnel can operate safely and effectively at incidents in the waterways environment.

They should develop an appropriate understanding of the design, construction, nature of use and occupancy of all ports, docks, harbours, marinas and inland waterways in their respective areas.

Information sources might include:

- Port/harbour master, dock or port controller
- Maritime Coastguard Agency
- The responsible person for the vessel such as the owner, ship's captain or master
- Crew members and/or passengers
- Shore side operations workers
- Weather mapping and consideration of changing weather and/or environmental conditions
- High and low tide times
- Prevailing weather conditions

- Continual assessment of any tidal range information throughout the incident

For incidents involving vessels, it may not be possible to walk around the incident ground because of its size, location or complexity and the physical or geographical limitations of the site or terrain.

Consider using other vessels in the vicinity, such as tugs or other craft to enable a full assessment of the seaward side of the incident. However, only use craft and crews appropriate to the sea conditions and training.

This may be carried out under local agreement and memoranda of understanding (MoUs) with harbour or port authorities. There may also be a contractual agreement with private salvage or tug companies to provide vessels for firefighting support and/or operations.

Consider using the following:

- A tug or craft and appointing a tug or search officer to provide a situation report of the seaward side of the incident:
  - By fire and rescue service craft
  - By port or harbour craft
  - By an appointed on-scene commander from another vessel
- A fireground camera linked to a monitor on an extended platform, aerial appliance or turntable ladder
- Unmanned aerial vehicle (UAV) if available
- Police or search and rescue helicopters

Strategic actions

Fire and rescue services should:

- Ensure fire and rescue service personnel are aware of the hazards associated with transport incidents and identify safe systems of work to resolve a range of vehicle or craft and infrastructure incidents
- Provide information, instruction and training to incident commanders in the challenges and alternative approaches to carrying out a 360-degree survey at transport incidents
- Consider making arrangements to mobilise unmanned aerial vehicles (UAVs) or drones with infra-red capability to provide an aerial view of the incident and remote, inaccessible sectors
- Have the facilities to identify high and low tide times through weather mapping
- Equip personnel with, and provide access to, up-to-date information on vehicle design and use

Tactical actions

Incident commanders should:

- Gather information from a range of sources to gain accurate situational awareness and understanding of the incident

- Ensure that a full reconnaissance (360-degree) survey is carried out at the earliest opportunity to gain a visual appreciation of the situation and the hazards present
- Consider stability of vehicle or vessels involved and the risk of uncontrolled movement
- Ensure information relating to the type of vehicle/craft, its fuel type and contents is identified, accurately confirmed and communicated to emergency responders

Control measure – Use tactical advisers and responsible person

Control measure knowledge

See National Operational Guidance: Incident Command – Situational awareness

A responsible person may be nominated by the relevant agency and should have the required competence and knowledge of the transport infrastructure hazards and risks to provide timely and accurate information. The responsible person or agency for an incident in the transport environment will vary depending on the type and context of the incident. Identifying a responsible person or agency may give the incident commander access to a range of information sources and expertise that will support in developing a safe and effective tactical plan.

Air

The agencies that should be considered for liaison include:

- The aerodrome fire service
- Aerodrome mangers
- Airlines
- Air Accident Investigation Branch (AAIB)
- Military agencies

Rail

Network Rail will not always appoint a railway incident officer (RIO) to incidents affecting the railway. This will depend on the nature of the incident and if in doubt incident commanders should request their assistance. It is the role of the RIO to liaise with and advise the incident commander on safety issues relating to staff working on or adjacent to the permanent way. For further information on the permanent way see Hazard – Complexity of the rail infrastructure.

The railway incident officer (RIO) will assist with the identification of rail specific hazards and may provide options for removing or reducing hazards. Different rail infrastructures have assigned the responsible person with different titles, such as train operating liaison officer (TOLO) and station incident officer (SIO). An attending Network Rail mobile operations manager (MOM) may be in attendance and assigned the role of a RIO if required.

Rail incident officer (RIO) Network Rail

The railway incident officer (RIO) is the nominated and certified individual responsible for on-site command and control of all rail-related operations. Not normally on-site before the arrival of the fire and rescue services, they will be nominated to attend incidents that are likely to have a serious impact on the rail network.

The railway incident officer will be able to:

- Provide information to the incident commander on rail safety matters
- Arrange for specialist rail workers, engineers, contractors and equipment to be moved to the scene
- Obtain specialist information on the infrastructure
- Arrange for the delivery of extra equipment such as rail trolleys, generators, cranes and welfare facilities
- Liaise with the incident commander to provide options for partial or complete restoration of services
- Assess the suitability of control measures implemented
- Co-ordinate the phased reopening of rail lines

Road

Depending on the type of roadway involved, the responsibility could lie with the local authority, the appropriate highways agency or another body. Where the severity of the incident places a restriction on the normal operation of the roadway or there is damage to the infrastructure, the incident commander should ensure that contact is made with the relevant authority.

Waterway

The responsible person should have intimate and comprehensive knowledge of the vessel and the hazards within the waterways environment. They may also have access to other tactical advisers able to provide additional information that may be useful to the incident commander, such as information on stability, cargo and hazardous materials.

There will be a need to liaise with the port/harbour master if available, as well as the owner or captain of the vessel. Appropriate communications will need to be set up and they should consider vessel size, location and interaction between all attending agencies and port authorities.

Many different types of organisation can operate within port boundaries, including cargo terminal operators, passenger terminal operators, leisure marinas, boat builders and commercial fishing. Under UK legislation, the waterways of many ports are the responsibility of the local port authority, which is managed by a harbour master.

There may be memoranda of understanding (MoUs) between the fire and rescue service and the port authority to ensure the correct information has been collated at the earliest opportunity to improve the service response.

The incident commander should liaise with the port controller, harbour master or ship's master at the earliest opportunity to understand the emergency within the waterways environment. This would include gathering information on the number of passengers and crew involved, the size, type and construction of the vessel and passing this information to fire and rescue service control using the following format:

- Type e.g. ferry, tanker or cargo
- Name
- Tonnage
- Location (quay or berth number)
- Cargo
- Location and extent of any fire hazard
- Summary of resources (what's in use)

Strategic action

Fire and rescue services should:

- Develop arrangements and protocols to identify responsible persons, relevant agencies and/or specialists within the transport environment that can respond and assist at incidents
- Maintain the details of any tactical adviser (Tac Ad) or subject matter expert (SME) relevant to the risk and area and know how to request their attendance

Tactical actions

Incident commanders should:

- Ensure early liaison with the responsible person is carried out to gather appropriate information to inform a safe and effective operational response plan
- Request the timely attendance of a tactical adviser (Tac Ad) or subject matter expert (SME) with relevant competence

Control measure – Establish appropriate cordons

Control measure knowledge

See National Operational Guidance: Incident Command – Structuring an incident

Transport incidents require the implementation and management of effective cordons to protect the public, emergency responders, other agencies and contractors from hazards, prevent escalation of the incident, preserve the scene for investigators, define the safe working area and assist with command and control.

Air

When considering cordons at an incident involving aircraft undercarriage the following should be considered:

- The size of the aircraft involved
- Engine hazard zones

- Escape slide path
- Debris
- Casualties
- Hazardous materials
- Aircraft armaments
- Managing the safe evacuation of passengers away from the inner cordon

See Specific distances relating to military aircraft

Rail

Certain features of the rail infrastructure can be used to good effect to define the extent of the fire and rescue service's working area. This could include stations, platforms, tunnel portals, fences, bridges, signals, tunnel cross passage doors or shafts and marker posts.

At a larger incident the British Transport Police or the police service in attendance will undertake outer cordon control and other police responsibilities. Inside these cordons, the fire and rescue service should define paths for access and egress to the scene of operations.

The cordon at a rail incident is likely to be linear in nature and may cover a considerable distance. It may be necessary for the incident commander to consider positioning staging posts, marshalling areas or command facilities inside or alongside the cordon. It would be beneficial to link cordons with sectorisation, which is likely to be unique for this type of incident.

Cordons may need to be established according to the task, hazards, load or climatic conditions and will vary geographically.

Due to numerous access/egress points, strict cordon and sector control will need to be maintained and managed accordingly.

To manage an incident involving railway crossings carefully and appropriately, full and effective cordons will be needed. Cordons must be established using guidance detailed in National Operational Guidance: Incident command and Railway incident guidance.

Road

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, compressed gas cylinders or other hazardous materials.

See further information regarding outer cordons at road incidents.

Waterway

The dockside is a high hazard environment and multiple risks are evident such as vehicle and plant movements, high tensile mooring lines, falls into water, maintaining safety cordons or controlling the numbers of personnel at the scene. Numbers of personnel boarding the vessel should be covered by a dockside safety sector. The names and locations of personnel who are on the vessel should be recorded at a designated boarding control point as identified by the incident commander. Adequate personal protective equipment (PPE) and welfare facilities should be provided for the decontamination of any people who may enter the water.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance for cordon controls to be implemented at transport incidents
- Provide incident commanders with information, instruction and training on the specific cordon control that should be implemented at transport incidents

Tactical actions

Incident commanders should:

- Ensure that appropriate inner and outer cordons are established and controlled to maintain the safety of crews, other agencies and the public
- Restrict and record access and egress in and out of the inner cordon for fire and rescue service personnel and other agencies

Control measure – Ensure effective multi-agency working

Control measure knowledge

See National Operational Guidance: Incident Command – Interoperability and intraoperability

See Joint Emergency Services Interoperability Principles (JESIP)

Transport related incidents are highly likely to involve a multi-agency response and it is therefore important that the responding fire and rescue service dealing with the incident work closely with other responders and relevant people throughout the incident.

The basic principles of the Joint Emergency Services Interoperability Principles (JESIP) should be embedded in services including the use of the METHANE acronym as a common model for passing information and the use of the joint decision model. The principles of joint working are:

- Co-locate
- Communicate
- Co-ordinate
- Jointly understand risk
- Share situational awareness

Establishing effective communications at the scene will be vital in sharing situational awareness and co-ordinating a safe and effective emergency response plan. The availability of fixed communication systems will vary across the transport infrastructures and be dependent on the location of the incident.

Air

On-aerodrome incidents

The use and compatibility of radio systems and technology is key to effective liaison at incidents. However, fire and rescue service personnel should be aware of the radio traffic demands on the aerodrome incident commander between:

- Aircraft pilots
- Air traffic control (ATC)
- Rescue and firefighting services' appliances and watch room (if staffed)
- Aerodrome ground operation vehicles
- Emergency services rendezvous points (RVPs)
- Aerodrome manager
- Aircraft engineers

Off-aerodrome incidents

The aerodrome emergency plan will contain details of the action to be taken in the case of aerodrome accidents occurring outside of the aerodrome boundaries.

Fire and rescue service incident commanders need to be aware that pressures will be placed on the aerodrome fire manager if resources from the aerodrome rescue and firefighting service (RFFS) are deployed off-site. This is because deployment away from the aerodrome will reduce the site's ability to meet the required rescue and firefighting capability under the terms of the licence. The aerodrome will need to drop its operating category, resulting in flights being cancelled or diverted.

Rail

Incidents involving the rail environment are likely to involve all emergency services including the British Transport Police. Other key responders may include Network Rail, train operating company representatives, freight operating company representatives, Rail Accident Investigation Branch, Office of Rail and Road, local authority liaison officers and specialist rail units.

At the scene of operations

Robust communication must be established and maintained to preserve scene safety. Particular consideration must be given to personnel entering tunnel environments, confined spaces or complex building structures inside stations.

Remote communications

Messages to fire and rescue service control, which may be subsequently relayed to the infrastructure manager, require accuracy in formulation and transmission. To assist the infrastructure manager in implementing safe systems of work, carrying out fire and rescue services operations and reducing risk, it is necessary to include relevant details such as:

- Whether people are on or near the railway

- The location of the incident
- The level of control required, and over which infrastructure
- The geographical area over which controls should be applied
- Nature of the fire and rescue service activity being undertaken

Rail systems usually have a comprehensive telephone network enabling communications between control offices, stations, depots, most level crossings and signal boxes via trackside telephones. These can provide additional communication routes, however, it will be necessary to ensure adequate training is undertaken to ensure understanding of appropriate usage. Therefore, fire and rescue service operations should, whenever possible, communicate with infrastructure managers via the fire control room and arrangements for the methods of effective communication should be identified in preplanning.

Strategic actions

Fire and rescue services should:

- Ensure that all incident commanders are conversant in the principles of the Joint Emergency Services Interoperability Principles (JESIP)
- Identify agencies likely to respond to transport related incidents and ensure that Site-Specific Risk Information (SSRI) and incident response plans identify roles and responsibilities
- Test and exercise planning assumptions on a regular basis and review incident plans in response to the learning outcomes

Tactical actions

Incident commanders should:

- Establish the principles of joint working with other emergency services and relevant people as soon as possible
- Establish effective communications with other emergency services and relevant people as soon as possible

Unstable mode of transport

Hazards	Control measures
Unstable mode of transport	Assess stability Manage pressurised air systems Stabilise the mode of transport

Hazard knowledge

In this guidance, the term 'mode of transport' refers to any form of transport such as aircraft, rail vehicles, road vehicles, vessel or craft and will be referred to as ‘vehicle or craft’.

Instability may result from damage caused to the vehicle or craft during the incident, as a result of its resting position, or a combination of these factors. This section does not cover the stability of any damaged infrastructure, such as buildings and bridges, which may be associated with significant additional hazards including collapse, live electricity or gas leaks.

The risk associated with incorrect stabilisation application, or poorly managed and maintained stabilisation, increases dramatically the larger or heavier the vehicle or craft. Its cargo may be secured by collision damage, but it should be remembered that ramming, cutting away or pulling during extrication operations may release it, allowing it to move in an uncontrolled manner.

Where causalities are injured (especially seriously or in a critical, deteriorating condition) a risk versus benefit assessment should be made regarding stabilisation before carrying out an extrication. Changes in centre of gravity caused by responders climbing on vehicles or craft or by casualty extrication can increase the level of risk to casualties, responders and the environment.

Securing the vehicle or craft in the correct manner will avoid uncontrolled movements when carrying out extrication techniques and will suppress vibration when operating equipment. This will be especially beneficial where a part of the vehicle or craft is released under load, such as a door removal.

At the scene of a transport incident the topography may not be immediately obvious. A noticeable hill or slope may be a prompt to secure the vehicle or craft, but an insignificant gradient may be overlooked, resulting in an uncontrolled movement.

The stability of shipping vessels and craft is a complex subject and the assessment involves complicated calculations. The ship's officers are the experts and the incident commander should liaise closely with them, as they determine the relevant information on the weight of water and the area it is acting upon, including any movement of cargo, ballast, fresh water and fuel oil.

See Hazard – Stability of vessels under waterways for more specific guidance.

Control measure – Assess stability

Control measure knowledge

The stabilisation requirements of the vehicle or craft, including its centre of gravity, should be assessed and communicated as part of the initial 360-degree assessment of the scene of any transport related incident.

This assessment should take into account any damage that may compromise the vehicle or craft'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 together with the impact on any infrastructure.

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

Strategic actions

Fire and rescue services should:

- Provide tactical guidance and support arrangements to ensure appropriate stability procedures can be applied across a range of transport related incidents
- Have arrangements in place for using specialist equipment and/or other agencies to assist with the stabilisation of a range of vehicles/craft

Tactical actions

Incident commanders should:

- Carry out reconnaissance of the incident at the earliest opportunity, to identify and assess the stability of vehicles, craft and infrastructure
- Communicate hazards relating to instability to fire and rescue service personnel, other emergency responders and relevant people at the incident
- Establish appropriate cordon control arrangements to restrict access to areas where there are risks relating to instability

Control measure – Manage pressurised air systems

Control measure knowledge

Pneumatic systems that may impact on stability can be broken down into two primary systems:

- Pneumatic suspension units found mainly in large goods vehicles (LGVs), rail stock and some aircraft
- Pneumatic braking systems found on rail, some aircraft and road vehicles

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:

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

Braking systems on rail vehicles use compressed air as the force to push blocks on to wheels or pads on to discs. The compressed air is transmitted along the train through a brake pipe. Changing the level of air pressure in the pipe causes a change in the state of the brake on each vehicle. It can apply the brake, release it, or hold it 'on' after a partial application.

Pneumatic systems found on aircraft are sometimes used for:

- Brakes
- Opening and closing doors
- Driving hydraulic pumps, alternators, starters, water injection pumps, etc.
- Operating emergency devices
- Suspension systems

Identify any mechanical interlocks or built-in safety systems that can assist fire and rescue service personnel working in the vicinity of these systems. Any loss of integrity in the unit will result in the vehicle 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 or craft
- Stored energy release (especially from spring brake chamber or parking brake)
- Entrapment due to uncontrolled movement

Strategic actions

Fire and rescue services should:

- Provide tactical guidance and support arrangements to ensure personnel are aware of the hazards and procedures associated with pressurised air systems
- Have arrangements for using specialist equipment and/or other agencies to assist with managing pressurised air systems

Tactical actions

Incident commanders should:

- Carry out reconnaissance of the incident at the earliest opportunity, to identify and assess the presence and integrity of pressurised air systems
- Liaise with the driver, operator or responsible person to gain further information regarding the operation and isolation of pressurised air systems
- Communicate hazards relating to pressurised air systems to fire and rescue service personnel, other emergency responders and relevant people at the incident
- Establish appropriate cordon control arrangements to restrict access to areas where there are risks relating to pressurised air systems

Control measure – Stabilise the mode of transport

Control measure knowledge

Stabilising the vehicle or craft seeks to ensure that the risk to any casualties and emergency responders associated with uncontrolled movement of the vehicle or craft is minimised. Any stabilisation measures should take into account the expected level of operational intervention by emergency responders. During the stabilisation phase of the incident, appropriate resources should be allocated to address issues relating to the vehicle or craft and its load or cargo.

Requesting assistance including specialist resources from other services, partner agencies or external contractors should be considered in the early stages due to the potential response times. Urban search and rescue (USAR) teams may provide considerable expert knowledge and resources relating to stability at transport incidents.

The incident commander must make an assessment on the benefit versus the risks regarding the prioritisation of stability over other fire and rescue service priorities at the scene.

The properties of a good stabilisation method are:

- It should secure the vehicle or craft safely
- It should completely immobilise the vehicle or craft
- It should be simple, able to stabilise a mode of transport in the position it was found on arrival of the rescue crew, and not hinder any subsequent actions
- 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 or craft remains stable

Fire and rescue service personnel should practise and train as a crew to effectively stabilise a variety of vehicles or craft in a range of locations based on the risks in that service area. Fire and rescue service personnel should also be familiar with differing construction techniques, including the materials used, so that stabilisation techniques make best use of the load bearing parts of the structure to support the vehicle or craft.

Primary, secondary and tertiary stabilisation methods should be employed and regularly checked throughout the course of the incident.

Large and heavy objects may assist with vehicle or craft stability and these should be considered as part of the plan; it may be appropriate to carry out a controlled movement of the object such as removing it from the inner cordon.

Further information on stabilising large goods vehicles (LGVs) and public service vehicles (PSVs) can be found at http://www.ukro.org/education/ukro-workshops/lgv-rescues/

Strategic actions

Fire and rescue services should:

- Provide crews with information, instruction and training in safe and effective stabilisation of a range of vehicles and craft
- Make arrangements for the provision of specialist equipment to assist in transport related incidents associated with risks identified in their areas

Tactical actions

Incident commanders should:

- Consider the stabilisation of unsecured vehicles and craft as part of a safe and effective tactical operational plan and the likely extent of operational activity
- Identify and request the resources required to implement the identified stabilisation plan, having consideration for response times (including USAR teams)
- Prioritise the use of approved stabilisation techniques and equipment over improvised methods that may be required in some situations
- Regularly assess the effectiveness of the stabilisation techniques employed and review the tactical plan accordingly
- Appoint and brief suitably competent safety officers to monitor the effect of emergency service operations on the continued stability of vehicle or craft

Fuel and electrical systems

Hazard	Control measure
Fuel and electrical systems	Identify and isolate electrical systems Identify and isolate fuel systems

Hazard knowledge

The hazards present at a transport incident due to live vehicle electrical systems and unmanaged fuel may be a direct result of an accident, fire or may occur during emergency service operations.

Throughout the transport networks, various vehicles and craft will feature a range of different power sources. These can include:

- Batteries: lead acid, alkaline and lithium metal batteries. See National Operational Guidance: Hazardous materials (to follow)
- Engine-driven generators that provide the main power
- Auxiliary power units that provide essential power
- Fixed electrical ground power is used in lieu of the auxiliary power units

See also specific Road guidance relating to alternative fuelled vehicles.

Rail

Batteries, generators, high voltage connections or pantographs may all be encountered when dealing with rail vehicles. 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 hazards 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 are encased in metal skirts. 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 to 875v.

Air

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 (The power that the aircraft needs to be able to continue safe operation)
- Passenger services (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.

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

Aircraft fuels fall broadly into two types: gasoline or AVGAS (petrol), and kerosene or AVTUR (jet fuel).

Principal hazards from fuels are that they can be:

- Highly flammable
- Explosive
- Corrosive
- Toxic
- Irritant
- Transported in large volumes

Post accident fire and rescue service operations can pose a significant hazard in relation to fuel spillages on or around the crash site.

When the vapour given off from aviation fuels is mixed with air and then ignited, a flame zone develops above the surface of the fuel. As the temperature rises the rate of vaporisation increases. The development of a flame zone and the rate of vaporisation accelerate each other. Therefore, an aviation fuel fire reaches peak intensity very rapidly as the fuel develops intense heat when burning.

As a result of its high vapour pressure and low flash point, AVGAS vapour can be readily ignited with a spark or flame at ambient temperatures. However, liquid AVGAS must reach a moderately high temperature before it can auto ignite (450ºC).

Liquid AVTUR will not ignite under normal temperature. As a result of its low vapour pressure and moderate flash point, AVTUR vapour cannot be readily ignited by spark or flame at ambient temperature. It will auto ignite at a fairly high temperature (245ºC).

Control measure - Identify and isolate electrical systems

Control measure knowledge

Auxiliary power units and batteries vary in size and will be located in numerous locations in vehicles or craft.

Air

In aircraft, auxiliary power units can be identified by a small exhaust outlet located either in the tail section, wing or underneath the aircraft fuselage. Many modern aircraft are equipped with auxiliary power units that are powered by a small turbine engine. The auxiliary power unit 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.

The majority of auxiliary power units have automatic shutdowns that will activate if a problem is identified.

Entering the aircraft and manually shutting them down can isolate these electrical systems. However, close liaison with the aerodrome rescue and firefighting services (RFFS) and/or aircraft crew will be required for the systems to be shut down and isolated safely, as only trained personnel should attempt it.

Various types of batteries are used in the aircraft industry, including lead acid, alkaline and lithium-ion. They 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. In some newer aircraft the switch may be black, but still marked 'Master'.

Road

Because of 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 within the vehicle, and as such, may have a number of power supply options such as battery or backup generators.

Strategic actions

Fire and rescue services should:

- Provide incident commanders with information, instruction and training in the identification of vehicle electrical systems
- Make arrangements for tactical advisers to provide specialist knowledge to incident commanders at the scene
- Provide responding personnel with access to up-to-date vehicle data information relating to electrical systems and methods of isolation

Tactical actions

Incident commanders should:

- Recognise that auxiliary power units and batteries may be present at the scene and communicate this to all personnel involved
- Liaise with the responsible person to establish the location of isolation points and consider any risks associated with shutting down electrical systems
- Ensure the power is isolated using cut-off switches or emergency shut-offs and consider manually disconnecting the terminals from the batteries where possible
- Document any movement of controls for accident investigation purposes at the earliest opportunity
- Inform crews to exercise caution where sources of electricity cannot be isolated or residual electricity may result in some equipment remaining live

Control measure – Identify and isolate fuel systems

Control measure knowledge

Because of the risk posed by vehicle or craft electrical systems and the volatility of the fuels used in them, fuel isolation switches should be activated where possible.

Air

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.

Strategic actions

Fire and rescue services should:

- Provide incident commanders with information, instruction and training in the identification of vehicle fuel systems
- Make arrangements for tactical advisers to provide specialist knowledge to incident commanders at the scene

Tactical actions

Incident commanders should:

- Identify the presence and type of unburned fuel and assess the risk to casualties and responding personnel
- Ensure fuel is isolated via shut-off valves, as identified and where safe to do so
- Control ignition sources where fuel is not contained
- Document any movement of controls, for accident investigation purposes, at the earliest opportunity.

Construction materials

Hazard	Control measures
Construction materials	Identify and communicate vehicle or craft construction materials Avoid manipulation or damage to composite materials Apply fine water spray or foam

Hazard knowledge

To reduce weight, increase corrosion resistance and improve safety in new vehicle or craft design, manufacturers use conventional lightweight materials such as aluminium, magnesium and polymers, and increasingly use ultra-high strength steels and carbon fibre composites. These materials possess a range of characteristics that fire and rescue service responders need to understand to ensure they can be managed effectively during an incident.

With vehicle design often influenced by the styling requirements of consumers, new materials with high formable factors may feature on the aesthetic elements of vehicles, while those 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 or craft construction, providing a perception of a single material when a number of materials may actually be present, such as a polycarbonate outer skin with carbon fibre reinforced plastic (CFRP) structural members.

It is likely that some vehicle or craft structures will be made from modern high-strength materials such as boronated steel, carbon fibre reinforced plastic (CFRP) and polycarbonates. This is primarily due to the requirement to make a lightweight strong vehicle shell.

The overwhelming choice for the majority of volume vehicle or craft 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

Emergency responders can recognise some material types because of their common location, industry standard markings or through data provided on mobile data terminal (MDT) systems.

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 responders, the impact on the casualties involved and other partner agencies working in the vicinity of the incident should be considered.

Composite materials

Composite materials, also known as man-made mineral fibres (MMMFs), include a wide range of materials that use the inherent strength and durability of woven fibres bonded together with resins (also known as polymer composites). 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 composite materials in the transport industry, it is reasonable to assume that they will be present at a wide range of incidents and transport environments.

The principal hazard to emergency service personnel from composite materials arises from the decomposition of the material, both during and after a severe fire or collision. 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. The material may plume following a crash and be carried a considerable distance downwind.

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

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

The potential impact on emergency services, casualties and the environment should be considered. If the integrity of the vehicles/craft has been compromised, hazardous materials procedures should be followed. See National Operational Guidance: Hazardous materials (to follow).

Material deformation due to collision and cutting 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 and the recovery phase of an incident, where clearing up may be undertaken.

Airborne continuous filament particles and their associated health hazards depend on 'respirability', i.e. 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, mechanical irritation (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 glass fibre reinforced plastic (GFRP) and carbon fibre reinforced plastic (CFRP).

Dust can be found on equipment, personal protective equipment and can also be transferred to other personnel and their equipment.

Metals

Metals may pose a hazard as a direct result of an accident or fire, or the hazards 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 vehicles or craft, it should be assumed that various different metals are present at all transport related incidents. This will have an impact on the rescue of a casualty, especially where the integrity of the vehicle or craft has been compromised due to instability, access and egress implications.

Generally the most common metal materials used in the construction of vehicles or craft include steel, aluminium, magnesium, titanium, other metals and alloys.

See National Operational Guidance: Performing rescues – Tools.

Control measure - Identify and communicate vehicle or craft construction materials

Control measure knowledge

Identifying the materials used in the vehicle or craft construction provides key information to emergency responders when they are making a scene safe and forming their extrication strategies. Glass in vehicles or craft is marked to indicate glass type, but currently no standards exist for marking up other materials; alternative data sources should be referenced and operational experiences drawn on to understand the materials being tackled.

Strategic actions

Fire and rescue services should:

- Carry out a risk assessment of the materials identified in vehicle or craft construction and identify appropriate control measures including appropriate respiratory protective equipment (RPE)
- Provide responding personnel with access to up-to-date information regarding vehicle or craft design and construction

Tactical actions

Incident commanders should:

- Use a range of information sources to identify materials used within a vehicle or craft and communicate to all emergency responders

Control measure – Avoid manipulation or damage to composite materials

Control measure knowledge

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

Strategic actions

Fire and rescue services should:

- Develop operational tactics that minimise the risk of damage to composite materials
- Provide operational crews with information, instruction and training in operational tactics developed to minimise risk of unnecessary damage and manipulation to composite materials

Tactical actions

Incident commanders should:

- Consider a tactical plan that minimises risk to casualties, fire crews and other agencies from vehicle or craft construction materials
- Provide comprehensive safety briefing to crews operating in areas where there is a risk of inhalation, ingestion or injection from composite materials

Control measure – Apply fine water spray or foam

Control measure knowledge

Applying fine sprays or firefighting foam will reduce the risk of airborne pollution by composite materials and the general disturbance of the material in and around the wreckage. An alternative measure, where composite materials are badly fire damaged, is to apply a fine water spray to prevent particulates from becoming airborne.

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

When using firefighting foam or water, environmental protection should also be considered. See National Operational Guidance: Environmental protection.

Strategic actions

Fire and rescue services should:

- Ensure all personnel are aware of appropriate safe systems of work and personal protective equipment (PPE) relevant to the risk associated with vehicle or craft construction materials
- Provide responding appliances or make arrangements to have available appropriate water spray and foam equipment required to implement identified safe systems of work

Tactical actions

Incident commanders should:

- Consider using fine sprays or foam blankets to minimise risk of airborne particulates being inhaled, ingested or injected
- Ensure the continued integrity of an evenly distributed foam blanket throughout the incident and manage hazards obscured by the foam blanket
- Carry out appropriate post-incident decontamination following exposure to vehicle or craft construction materials

Large numbers of people

Hazard	Control measures
Large numbers of people	Evacuate affected people to a place of safety

Hazard knowledge

Fire and rescue services should ensure disruption to transport networks is given appropriate consideration whilst dealing with transport related incidents. Closing highways, runways, railways, ports, docks and so on for any time period, during and after incidents, will have a far reaching effect on the local community and beyond. The detrimental effect of prolonged closures of transport networks is not only disruptive, but can also have widespread financial implications. Periods of closure should be kept to a minimum, limiting the impact of fire and rescue service actions on the wider community whilst dealing with the incident in a safe and calculated manner. The fire and rescue service, along with other emergency services, has a responsibility to achieve normal levels of operation as soon as is practicable, whilst ensuring transport networks aren't unduly affected by operations where possible.

The harm to people delayed in vehicles, trains held in tunnels, overcrowding at stations and transport hubs with critical workers unable to attend work can have a significant effect on public welfare.

Any incident involving significant disruption to transport infrastructure is likely to result in the displacement of large numbers of people, which can impact on attending services as a result of evacuation. Also, the impact of the incident on people away from the incident should be considered and pre-planning should be undertaken to mitigate the potential effects.

In a serious fire, hazardous materials incident or major incident, the evacuation of large numbers of people to a place of relative safety may be an operational imperative and may significantly affect the capacity of the initial responders on scene to conduct other operations.

Where these are not an immediate priority of the fire and rescue service, a failure to ensure the issue is managed can result in a delayed response, extended recovery time and wider community impact.

Air

An on-airfield incident will almost certainly lead to the cancellation of normal aerodrome operations leading to a build up of passengers and traffic at the scene and potentially hampering emergency service response.

Rail

Incident commanders need to be aware that isolating power supplies and stopping trains other than at station platforms can have serious implications away from the immediate scene of operations. There is a duty of care to consider the wider impact on the railway operator and passengers, including:

- Passengers alighting from trains that have stopped outside stations and walking along tracks which may still be in use or live
- Overcrowding of stations and platforms
- Physical and mental distress of passengers on trains in tunnels
- Widespread disruption to train services

Trains are designed to convey large numbers of passengers, and during peak commuting hours they accommodate not only seated but standing passengers (a train operating at full passenger capacity is described as a 'crush load'). Rail stations (particularly termini) can have the capacity to hold many thousands of people.

When there is fire or smoke, stations will have defined evacuation procedures and designated assembly points. Rolling stock, however, may be in areas that are difficult to access and egress from. A fire and rescue service may be requested to attend a stranded rail vehicle to assist in evacuation when no fire situation is present (this is called detrainment).

Due to the lack of power for maintaining air temperature and air quality, the environment in a stranded train will deteriorate, and as a result passengers may self-evacuate. If this happens passengers could be struck by other trains or electrocuted if coming into contact with loose or damaged overhead line equipment (OLE) or the third/fourth rail.

Roadways

Incidents on the roadway, especially on major roads and arterial routes, will inevitably result in large numbers of people being stranded in vehicles that are unable to leave the area due to carriageway closures.

A people management system can range from establishing a designated area where people involved in the incident can report, sometimes referred to as a casualty handling area, through to creating a pathway around a given incident, so that people involved in or separate from incident operations can move around safely.

People straying or walking on the roadway may cause a significant hazard to themselves and other road users. If not managed properly in the early stages, secondary incidents can easily occur.

Waterways

Incident commanders need to be aware that large numbers of people aboard a passenger vessel may need evacuating to a point of definitive safety. This evacuation can have serious implications on the immediate scene of operations. It will also prove a challenging issue for other responders. There is a duty of care to consider the wider impact on the operator and passengers including:

- Large numbers of passengers disembarking from a vessel on foot or by vehicle
- Overcrowding of ports and dockside areas
- Physical and mental distress of passengers on board
- Widespread disruption to operator services
- Border control and possible repatriation of passengers

Some ships are designed to convey large numbers of passengers and during peak seasons some ports and harbours will become very busy. Some ports can have the capacity to hold many thousands of people.

Passengers choosing to leave the vessel in an uncontrolled way present further dangers to themselves and responding agencies. These are in addition to the obvious dangers of slips, trips and falls, and the risks that disembarkation gangways, ladders, platforms and dockside infrastructure present to those unfamiliar with the hazards.

Control measure – Evacuate affected people to a place of safety

Control measure knowledge

Consideration should be given to the evacuation of large numbers of people from incident locations when producing Site-Specific Risk Information (SSRI) and developing incident plans. This should be carried out in conjunction with local resilience partners who may be able to mobilise resources to assist during the emergency phase of an incident and beyond.

Air

Aerodrome emergency orders identify the key groups of people that could be affected by an emergency and outline the structures and processes that are put in place to provide care and assistance to them.

Reception centres provide care and shelter for people affected by an emergency. Establishing a centre also gives the emergency services an opportunity to collate information from the affected people and help communicate with them away from the trauma or danger of the incident area. The earlier the centres are set up and passengers taken away from the incident ground, the easier operations become for responding fire and rescue services.

To assist responding fire and rescue service personnel and other blue light services in controlling passengers evacuating from an aircraft, some aerodromes have introduced passenger emergency management systems (PEMS) to give evacuating passengers and air crew direction and guidance on a safe point to rendezvous having left the aircraft.

Systems will differ from one aerodrome to another, but primarily they are illuminated signs on the back of vehicles or freestanding signs with a loudspeaker giving visual and audible directions. These are erected in a safe location outside the inner cordon and within the outer cordon of the incident, upwind and uphill.

The aerodrome ground operations team normally operate these systems and fire and rescue service personnel simply need to be aware of their existence and, if required, to direct evacuating passengers to them, where immediate medical treatment and triage will be available from responding ambulance teams.

Rail

Fire and rescue services may be involved in detraining passengers from stranded rolling stock due to power failures, damage to overhead line equipment (OLE) or the third/fourth rail. Loose or disconnected parts of OLE and third/forth rail present a serious electrocution hazard.

Refer to information on OLE in Hazard - Rail power systems.

The location of any damaged overhead line equipment and the risk of accidental contact must be considered. While damaged OLE is unlikely to be charged to maximum voltage, a significant residual current may well remain. Assume the OLE is live at all times.

The location of any damaged overhead line equipment must be confirmed before evacuation and routes should always avoid passing them. It should be remembered that the nearest, or most appropriate point of safety to which passengers should be evacuated may be either ahead of or to the rear of the train.

There should be a suitable place away from the operational railway to which evacuees can be directed. The presence of a Network Rail mobile operations manager (MOM) or an appointed rail incident officer (RIO) will assist in agreeing a safe refuge area or egress route from the operational railway.

Ensure confirmation from Network Rail that train movements in the area have been stopped. The presence of the mobile operations manager and/or rail incident officer will ensure a greater degree of safety from train movements and track conditions during evacuation.

A site assessment should also consider the underfoot conditions, proximity of embankments, lighting, tunnels, and other infrastructure hazards, along with the presence of a suitable safe route from the train to the most practicable egress point.

Egress from the train should be conducted using on-train emergency ladders. The evacuation should always be carried out from a vehicle unaffected by damaged overhead line equipment to avoid accidental contact.

Where large numbers of people are evacuated from a station or rolling stock, it is important to provide appropriate, timely information as this will help to prevent potential further incidents occurring.

When dealing with incidents involving large numbers of people, either directly or as observers, their welfare should be considered to protect their dignity. Inclement weather can have an impact on displaced people.

Road

The evacuation of large numbers of people from an incident involving a roadway should be carried out in conjunction with the police, highways agency and other relevant agencies following a sharing of situational awareness.

Waterways

Evacuation should always be carried out in such a way as to minimise the risk to the passengers. It should be remembered that the nearest or most appropriate point of safety for passenger evacuation may be across a busy terminal.

There should be a suitable place away from operations to which evacuees can be directed. The ambulance service, police service and port authorities will assist in agreeing safe refuge and egress from the vessel. It is important to gain confirmation from the port or harbour master or control tower that vehicle movements in the area have been stopped.

A site assessment should consider the underfoot conditions and proximity of infrastructure hazards, along with a suitable safe route from the vessel to the most practicable egress point or safe haven.

Egress from the vessel may be conducted using on board emergency escape chutes, gangways, accommodation ladders or vehicle loading ramps.

Strategic actions

Fire and rescue services should:

- Develop emergency plans and support arrangements in conjunction with local resilience forum partners for evacuating large numbers of affected people at a major transport incident
- Test and exercise plans to ensure assumptions are realistic and achievable

Tactical action

Fire control operators should:

- Attempt to ascertain and communicate to responders the likely numbers of people affected and the impact on responding emergency services accessing the scene of operations

Incident commanders should:

- Consider the evacuation of people at the scene to a relative place of safety as part of the tactical plan
- Make contact with the responsible person to obtain specialist knowledge and advice on evacuation arrangements and progress
- Request appropriate resources and support to evacuate people from the scene in a timely manner
- Communicate the situation and impact on emergency response to fire service control for the information of oncoming appliances and other agencies
- Consider welfare arrangements for people evacuated from the incident

Biological materials

Hazards	Control measures
Biological materials	Establish hygiene controls Undertake decontamination

Hazard knowledge

See National Operational Guidance: Operations – Health, safety and welfare

The risk to emergency responders from exposure to biological hazards should be considered high at incidents involving transport. The potential for large number of casualties, rural locations, hazardous material cargo and the presence of toilet waste retention systems increase the risk to responders.

Most modern modes of transport designed to carry passengers are constructed with toilet retention systems. These tanks may hold a significant amount of human waste which could be released if a tank fails and there is a possibility these tanks may not always be in obvious locations.

Rail

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

The tanks may be located inside the vehicle due to lack of space on the underframe. Older trains may still deposit human waste along the tracks. These vehicles are progressively being phased out by replacement or refurbishment, but will remain in significant numbers until possibly 2030. This can attract rats, and the risk of Weil's disease (leptospirosis) should not be overlooked, nor should other associated diseases or infections.

Control measure – Establish hygiene controls

Control measure knowledge

Where toilet waste retention systems have been compromised by impact or fire service operations, personnel are likely to come into contact with bodily fluids. Standards of hygiene should be maintained and all relevant measures to guard against infections should be used. It is important to request hazardous materials and environmental protection advice on appropriate decontamination for personnel and equipment to reduce risk of infection.

Strategic actions

Fire and rescue services should:

- Have available or make arrangements for washing and hygiene facilities to be supplied as part of the response to operational incidents
- Ensure all personnel are aware of the risk of toilet waste retention systems being present at incidents involving modes of transport
- Identify safe systems of work for incidents involving biological hazards including respiratory protective equipment (RPE) and personal protective equipment (PPE) (e.g. medical examination gloves)

Tactical actions

Incident commanders should:

- Identify potential sources of biological contamination as part of their situational awareness and 360-degree survey
- Implement appropriate safe systems of work to protect emergency responders from contamination
- Request sufficient resources to enable washing, hygiene and decontamination procedures to be implemented

Control measure – Undertake decontamination

See National Operational Guidance: Hazardous materials (to follow)

Failure to preserve and secure the scene for investigation

Hazards	Control measures
Failure to preserve and secure the scene for investigation	Assist in preservation of evidence and subsequent investigation

Hazard knowledge

In any incident it is important to consider the need to preserve the scene for post-operations investigation. Fire and rescue services need to be aware that other organisations may have to carry out their own investigations depending on the transport network involved. The police and the British Transport Police, Civil Aviation Authority, Air Accident Investigation Branch, Marine Accident Investigation Branch and Rail Accident Investigation Branch, as well as more local agencies, will all need to be considered when dealing with transport related incidents and any further investigation.

Outside of fire investigation, the need for further fire and rescue service involvement will still be required. Personnel need to be aware that scene preservation will be vital to enable other organisations to investigate fully. Fire and rescue services should ensure that only personnel required to deal with the incident access the site and that any necessary movement of wreckage is minimised.

Due to the complex nature of many transport networks it is even more difficult to ensure the security of the accident scene. Although the security of the site is primarily a police function, it is imperative that all personnel in attendance are aware of the need to maintain, and where possible, contribute to, securing the scene. Transport related incidents can vary in terms of size, geography, number of casualties and the involvement of hazardous materials, adding to the difficulty of maintaining security of the full incident site.

The need to investigate should not affect bringing any incident to a safe and satisfactory conclusion nor interfere with incident objectives and priorities. There may be an opportunity to scale down incidents and allow investigators into safe areas, but this should not affect ongoing operations and scene safety must remain a priority. Nominating safe paths to and from the scene will assist in protecting evidence and health and safety issues.

As part of the investigation process, personnel may be asked for witness statements which should be given as soon as possible. Debriefing of any transport related incident may form part of the investigation and should be recorded.

Further information on conducting fire investigations can be found in National Operational Guidance: Fires and firefighting.

Control measure - Assist in preservation of evidence and subsequent investigation

Control measure knowledge

Although not a control measure in its own right, the following information should be considered throughout the operational response phase of the incident to assist in the investigation.

Once rescue and firefighting operations are complete, the responsibility for the security of an accident site, the wreckage, its contents, personnel and other effects will be that of the police or the statutory investigation team. All personnel should consider how their actions may affect any subsequent investigation and identify and prioritise evidence that may deteriorate. Early liaison to fulfil the requirements of the statutory investigation team is required. However, the control of the scene should not interfere with any life saving activities or fire and rescue service statutory duties.

Although it is primarily a police function to secure an accident site, all emergency personnel need to be aware of the reasons for its implementation. Unauthorised access to the site should be prevented as vital evidence can be destroyed by feet trampling items into the ground. Avoid moving functional switches and levers from their pre-accident position, as this can provide negative and confusing information and every effort should be made to preserve vulnerable evidence. Unauthorised personnel may contaminate the scene or be carrying sources of ignition, unaware of any potential hazards involved.

The positions of fatally injured victims are extremely important for identification purposes and to help establish the cause of an accident. The removal of bodies should only be carried out under the direction of the police or statutory investigation team.

However, removing the bodies before the arrival of investigation teams or medical teams may be necessary to rescue survivors or to prevent the bodies being destroyed by fire or by some other hazard. Where this is the case, the position of the body and its location should be noted, labelled if possible and reported to the investigation team.

Rescuers who have moved bodies should be questioned and a statement should be made as soon as possible after the incident whilst the memory of their actions is relatively fresh and they can recall body positions fairly accurately. Whenever possible, an officer should be appointed to map out as accurately as possible the location and position of bodies, bearing in mind that some incidents, especially high-speed crashes, may result in human remains being distributed over a wide area.

It should also be remembered that bodies that have been badly burnt become brittle and are likely to fall apart if untrained personnel move them; this can destroy vital evidence of identification and cause of death.

It may be useful for photographs or video to be taken of the wreckage, the accident site and the position of the bodies. This can also assist in debriefing purposes.

Most people will carry personal effects and papers, for example, passports, driving licences and reservations. The position of these documents and personal effects of both passengers and crew, along with any documents and papers scattered around the incident site, may help the investigating team. Therefore it is important to leave these articles in place. If they need to be moved, their location and position should be recorded.

It is important to control the number of people allowed on the incident site so that evidence such as personal effects are not disturbed, or are disturbed as little as possible. When the situation permits there should be a careful withdrawal of all non-essential personnel and equipment. Where casualties or bodies are moved, great care should be taken to ensure that any item that is adjacent is recorded or moved with the casualty or body.

Any items that fall from the casualty or body whilst being moved should be collected, recorded and kept with the casualty or body if possible, as it may prove to be a means of identification.

Ideally wreckage should not be moved or disturbed unless for rescue or safety. If wreckage, or any part has to be moved before the investigation is complete, then a record should be made of the location and position of all the parts, taking specific care to preserve any evidence that may be crucial to the investigation such as the position of controls, levers, switches, pressure gauges, air systems and dials.

All serious road traffic collisions are subjected to a thorough police investigation. In more serious road collisions, particularly where fatalities may result, specialist investigation teams try to reconstruct the scene, position, speed and condition of the vehicle(s) involved immediately before the accident. Notwithstanding the primary task required at the incident, it is vital that fire and rescue service crews are aware of, and respect, the needs of the investigating officers completing such investigations.

The position of the vehicles themselves, debris, glass, etc. are vital evidence in any investigation and disturbance should be kept to a minimum. Washing down of any road surface should not be carried out unless authorised by the investigating team.

Wherever practicable, tyre marks should be preserved. Correct positioning on initial attendance would prevent fire appliances having to be re-sited, therefore reducing the confusion of tyre marks at the scene. Depending on fire and rescue service requirements at the incident, parking too close to the vehicles involved in the collision (particularly back up appliances) should be avoided.

The condition and inflation pressure of tyres may give vital clues in the accident investigation. Deflation of tyres by fire and rescue service personnel to achieve ‘flat tyre blocking' must only be carried out in exceptional circumstances when all other methods of vehicle stabilisation are not appropriate. The police should be informed whenever this procedure has been implemented.

In many instances, vehicles involved in serious road accidents are taken for examination to establish their mechanical condition before the accident. In doing so, vehicle batteries need to be re-connected. It is therefore important that, wherever possible, fire and rescue service personnel disconnect battery terminals using spanners rather than cut through battery leads with bolt croppers etc. when making vehicles safe.

When fitted to large goods vehicles (LGVs), tachographs and their associated charts should be left in situ for the investigating officer.

Post-incident, the scene should be handed over to the statutory investigation team, highlighting the hazards and any control measures still in place or required.

Strategic actions

Fire and rescue services should:

- Ensure personnel receive information, instruction and training in a structured approach to the investigation and preservation of an accident scene in transport related incidents

Tactical actions

Incident commanders should:

- Liaise with the police or statutory investigation team to establish a common operating picture
- Where possible, consider preservation of evidence when planning, communicating and implementing tactics, methods and routes of entry and use of equipment
- Make crews aware of known or likely areas of interest, and outline measures taken or required to minimise loss of evidence
- Ensure any dials, valves and controls are, where possible, left as found; if it is necessary to alter their position this should be noted and recorded
- Record tactics used and bear in mind that tools used may be required for forensic inspection
- Minimise the potential for cross-contamination, for example, blood borne pathogens or vehicle fluids contaminating personnel, personal protective equipment (PPE) or the environment
- Attempt to make a record of original location using photographs or a sketch of the site if movement of any wreckage or bodies is required
- Attempt to keep belongings with bodies
- Ensure only authorised personnel enter the scene
- Ensure that any blood injuries are recorded and reported to eliminate potential DNA cross-contamination

Air

The following section incorporates the hazards that may be found at all incidents involving air.

Introduction to working in aerodromes and dealing with aircraft

Large scale incidents involving aircraft are rare. Such incidents place significant demands on local fire and rescue services and often require resources and support from other fire and rescue services and emergency responders.

This guidance aims to provide a consistent approach between fire and rescue services, other emergency responders, the aviation industry and other groups when operating or attending an air transport incidents and identifying the hazards found within this environment.

Civil Aviation Authority (CAA)

The Civil Aviation Authority (CAA) has a statutory duty, imposed by the Secretary of State for Transport, to enforce safety standards at licensed aerodromes and is also designated a competent authority for the regulation of safety standards at European Aviation Safety Agency (EASA) certificated aerodromes within the UK.

An aerodrome is an area where aircraft take off and land, including associated buildings, or where aircraft are stored and maintained. The term airport, heliport and airstrip may also be used to refer to aerodromes. In this guidance the principal term used is aerodrome.

Fire and rescue services should identify the number, type and size of operating military and civil aerodromes (licensed and unlicensed) within their area. This will form part of the fire and rescue service risk management plan and planning will need to be proportionate to the risk identified.

Aerodromes are allocated a rescue and firefighting services category according to the dimensions of the largest aircraft operating at the site. The rescue and firefighting services category will determine the level of rescue and firefighting resources available, Category 10 being the highest category (at aerodromes like Heathrow and Manchester), down to Category 1, which are small aerodromes with limited firefighting provision.

Aerodromes have some flexibility within the regulations depending on the type of operation and the frequency of aircraft movements. The categorisation of aerodromes means that fire and rescue services need to understand the level of rescue and firefighting services provision. This provision may differ depending on the time of day, and the fire and rescue service will need to consider this variation as part of its planning process, procedures and safe systems of work.

There is a requirement for licensed aerodromes to develop an emergency response plan, which must be co-ordinated with local emergency management arrangements. The emergency response plan will be set out in the aerodrome manual and will contain emergency orders, which clearly define roles and responsibilities.

The term aircraft is used to describe all types of flying machines

- Fixed-wing
- Rotary-wing (including helicopters, autogyro, etc.)
- Hot air balloons
- Airships
- Gliders
- Unmanned aircraft
- Microlights

The list above covers both civil and military aircraft. Other agencies may use other more specific definitions for their own requirements, but the definitions above are deemed the most appropriate ones for fire and rescue services to base their risk assessments and planning assumptions on.

Classification of aircraft emergencies differ between those used by the Civil Aviation Authority (CAA) and those used by the military authorities.

Fire and rescue services should be aware of the different airports within their area, or neighbouring areas, which might have differing aircraft incident categories that may have an impact on mobilising and predetermined attendance.

The Civil Aviation Authority (CAA) publication CAP 168 requires that the area adjacent to an airport be assessed, special procedures be developed and specialist equipment be made available. This assessment should be carried out as part of local emergency planning arrangements and the response to incidents adjacent to airports should be set out in the airport emergency orders.

The Air Accident Investigation Branch (AAIB) is part of the Department for Transport and is responsible for investigating civil aircraft accidents and serious incidents within the UK. It focuses its investigation on determining the cause of an air accident or serious incident and then makes recommendations intended to prevent a reoccurrence. It does not apportion blame or liability.

The Ministry of Defence is responsible for investigating accidents involving military aircraft through the Defence Accident Investigation Branch (DAIB), although in certain circumstances the Air Accident Investigation Branch (AAIB) may also investigate accidents involving military aircraft.

For further information refer to Operational Guidance Aircraft incidents 2011 (Dept. of Communities and Local Government) which forms the foundation for this air section.

Air transport incidents

Hazard	Control measure
Air transport incidents	Apply all transport incidents control measures

Hazard knowledge

The control measures for this hazard should be applied when dealing with any incident attended by fire and rescue services within the context of air transport, whatever the size or complexity, including on/off aerodromes and dealing with any type of aircraft.

Control measure – Apply all transport incidents control measures

Control measure knowledge

Refer to Hazard – Transport incidents. Apply all control measures from this section

Dealing with incidents within aerodrome perimeters and infrastructures

Hazard	Control measure
Dealing with incidents within aerodrome perimeters and infrastructure	Understand aerodrome bylaws Be familiar with aerodrome rescue and firefighting service (RFFS) advice and equipment Establish whether vehicles are to be escorted airside

Hazard knowledge

The control measures for this hazard should be applied when attending incidents involving aerodrome infrastructure and within an aerodrome perimeter, whatever the size or complexity of the site.

This guidance has been written to assist fire and rescue service personnel in responding and dealing with incidents at aerodromes because of the wide variety of premises contained within their boundaries. Aerodromes form part of the UK's critical transport infrastructure and are controlled by rules and regulations that set strict controls as to what can, or cannot, happen within the curtilage of an aerodrome's boundaries. Access and egress are strictly controlled, so regular familiarisation and knowledge of local aerodrome plans is essential.

These areas are split into two defined areas, landside and airside:

Airside

Airside is the part of an aerodrome nearest the aircraft, which is controlled by security checks, customs, passport control and so on. Aerodromes will have a number of emergency access gates around the perimeter of the secure airside area. Fire and rescue service appliances and personnel will need clearance and supervision to enter into this restricted and controlled location, where an aerodrome is closed, or has limited security, further arrangements should be made to allow access.

Landside

Landside generally refers to all areas outside the controlled areas of the aerodrome, where members of the public have free movement without passing through a security gate. Some areas around the aerodrome will still have restrictions on access, such as cargo areas.

Types of buildings include:

- Terminal buildings, both high-rise or sub-surface
- Cargo buildings
- Fuel farms
- Maintenance hangers
- Air traffic control towers
- Sub stations
- Administration buildings
- Maintenance workshops
- Multi-storey car parks
- Hotels

The hazards from fighting fires in these buildings are covered in National Operational Guidance: Fires in the built environment. However, special attention should be given to identifying the common specific types of buildings within the aerodrome environment. These can include large aircraft hangars, which due to their size and nature will have their own complexities, or air traffic control towers, which may have sensitive equipment, hazardous radar equipment and may present difficulty in access/egress.

A wide range of risks are often found both landside and airside, so it is critical that attending services understand where to respond and the difference between landside and airside. Rendezvous points (RVPs) are located at all aerodromes and are where responding services should attend. Here they should be met by aerodrome staff that will marshal and escort them to the scene of operations when the incident is within the airside area.

However, it is important to note that buildings located landside will have security measures in place to protect from any hostile attack. This may include such things as automatic bollards for access control.

Although dealing with the types of buildings noted above is no different to attending large buildings or sites with specific risks such as fuel depots, this guidance aims to identify hazards involved in working at aerodromes.

Access and egress are strictly controlled, so regular familiarisation and knowledge of local aerodrome plans are essential to ensure crew safety and avoid unnecessary damage to aerodrome infrastructure which could result in business continuity issues and reputational damage to the fire and rescue service authority and the aerodrome operator.

Types of infrastructure include:

- Runways
- Taxiways
- Aprons
- Critical and sensitive areas
- Radar
- Navigational aids

When responding fire and rescue service crews attend incidents at aerodromes, it is vital they understand that access may involve traversing runways, taxiways, aprons, critical areas and navigational aids, and at no time should this be done without an appropriate escort from the aerodrome authority. Local protocol should always be referred to along with the aerodrome's emergency plan for escort procedures.

Runways and taxiways could still be operating as fire and rescue services attend an incident at an aerodrome and incursions into a live runway or taxiway could have very serious consequences. It is essential that fire and rescue services are familiar with their local aerodromes.

There are sensitive areas on the aerodrome that contain instrument landing systems. These areas are critical to the operation of the aerodrome and for aircraft to land safely. Vehicles driving into a sensitive area can interfere with these systems and trip out the instrument landing systems as this is a failsafe mechanism to avoid sending a faulty signal to approaching aircraft. Therefore these areas should be avoided by responding crews, and they are the reason fire and rescue service vehicles should be escorted by a competent member of staff from the aerodrome authority but without unnecessary delay.

Fire and rescue services should have an awareness of the hazards present due to the wide variety of aircraft, specialist vehicles, baggage transfer systems and rail links at many international and regional aerodromes.

There are a number of unique facilities, systems and equipment around aerodromes that will need to be managed including:

- Aircraft movements
- Specialist vehicles
- Tugs
- Steps
- Fuel tankers
- Airport fire vehicles
- Baggage trollies
- Catering vehicles
- Ground power units
- Water and toilet carts
- De-icing vehicles
- Snow clearing vehicles
- Conveyors
- Baggage transfer systems
- Tunnels
- Rail: Both above and under ground
- Transit systems

When responding crews attend incidents at aerodromes, they should be aware of the many specialist vehicles, equipment, rail links and aircraft that use that particular site. This will provide crews with background knowledge of the risks expected within the aerodrome.

Where incidents involve Rail and Road refer to the respective guidance

Control measure – Understand aerodrome bylaws

Control measure knowledge

Certain bylaws are in place at aerodromes to prevent unauthorised access to the critical parts of the aerodrome. During an incident these bylaws will not take priority because of the overriding powers the enabling fire and rescue acts give fire and rescue services. However, an understanding of these bylaws is still important to minimise health and safety issues. The critical part of the aerodrome is designated a restricted area to protect vital aerodrome infrastructure, such as sensitive instrument landing systems, and to mitigate inadvertent intrusion onto a runway or prevent unlawful damage to aircraft. Fire and rescue services should recognise that it is preferable for any vehicles to be escorted, but aerodrome management are responsible for ensuring there is no unreasonable delay in doing so. Vehicles are escorted to prevent unnecessary damage to, or interference with, landing systems, which may impact on the normal running of the aerodrome.

Strategic actions

Fire and rescue services should:

- Make appropriate arrangements with aerodrome authorities to ensure compliance with relevant local instructions and safety measures

Tactical actions

Incident commanders should:

- Liaise with the aerodrome's responsible person to ascertain any bylaws and their impact on operations. Consult Site-Specific Risk Information (SSRI) for information relating to bylaws

Control measure – Be familiar with aerodrome rescue and firefighting service (RFFS) advice and equipment

Control measure knowledge

Early liaison between the fire and rescue service incident commander and the aerodrome rescue and firefighting service (RFFS) incident commander is essential to gain a full understanding of the incident, ensuring tactical advisers are used and in concluding the incident successfully.

Fire and rescue service statutory responsibility

There is much debate about when a fire and rescue service officer should take over an incident on an aerodrome. This is something that each individual fire and rescue service should decide and agree with the rescue and firefighting service (RFFS) in their respective aerodromes. There should be a clear expectation of initial actions by both the rescue and firefighting service (RFFS) and the fire and rescue service. The agreements should have due regard for incident command procedures and handover protocols. Under the enabling fire and rescue acts, the responsibility of the incident lies with the local authority fire and rescue service even though in practical terms the rescue and firefighting service (RFFS) will have more specialist expertise in fighting aerodrome fires than the fire and rescue service.

Normally, the officer in charge (OIC) of the rescue and firefighting service (RFFS) and fire and rescue service will work in partnership to ensure that the incident is managed safely and efficiently, with due account taken of the specialist advice available from the rescue and firefighting service (RFFS).

Rescue and firefighting services (RFFS) have modern and specialist firefighting vehicles that hold considerable amounts of extinguishing agents and other specialist kit relevant to the size or category including evacuation steps, medical equipment, fuel spill kits, aerial platforms and water rescue equipment or boats.

Strategic actions

Fire and rescue services should:

- Put in place arrangements to ensure specific roles and personnel can be identified at incidents
- Ensure local agreements are in place for transfer of command at an incident
- Participate in regular training and practical exercises, co-ordination and co-operation with aerodrome rescue and firefighting services (RFFS) to gain familiarity with capabilities and equipment

Tactical actions

Incident commanders should:

- Liaise and communicate with the aerodrome rescue and firefighting service (RFFS) to ascertain a common operating picture and establish clear responsibilities and actions
- Ensure competence of crews before operating specialist rescue and firefighting service equipment

Control measure – Establish whether vehicles are to be escorted airside

Control measure knowledge

Normally airside is security-controlled with a number of emergency access gates around the perimeter of the secure area.

Fire and rescue service appliances and personnel will need clearance and supervision to enter into this restricted and controlled location.

In an emergency situation, fire and rescue service appliances and personnel will be escorted to the scene of operations by ‘follow me’ vehicles from airside operations, or by other designated vehicles. However, if the airport is closed, or at a smaller aerodromes with limited security, arrangements should be made to allow fire and rescue vehicles airside to carry out their statutory duties, especially when life is at risk without undue delay.

Strategic actions

Fire and rescue services should:

- Ensure all drivers are aware of the need to be escorted when driving airside on an aerodrome or of the alternative arrangements if an escort is not possible

Tactical actions

Fire and rescue service personnel should:

- Arrive at the security access point and await escort vehicles

- Liaise with aerodrome security and /or management or the aerodrome rescue and firefighting service (RFFS) and request vehicles if necessary
- Brief crews that under normal circumstances they should not drive onto an airside location without an escort
- Use extreme caution even if all aircraft movements have been stopped and air traffic control have given permission to proceed without escort

Crash sites on and off aerodrome

Hazard	Control measure
Crash site on and off aerodrome	Apply air transport control measures Control ignition sources

Hazard knowledge

The control measures for the hazard of air transport incidents should be applied when attending incidents involving aircraft accident crash sites, whatever the size or complexity involved.

Aircraft accidents can vary greatly and result in fires, the need to perform rescues and considerations for scene safety.

Fire and rescue services will be called to aircraft accidents on, or adjacent to, aerodromes, due to the inherent hazards of aircraft taking off or landing. These incidents will have a rapid emergency response from Category 1 and 2 responders. The aerodrome rescue and firefighting service (RFFS) has clear protocols to deal with these types of incidents, therefore fire and rescue service intervention must be fully interoperable with these protocols.

In addition to aerodrome rescue and firefighting service responding to aircraft accidents on, or adjacent to, aerodromes, a number of aerodrome agencies will also attend, providing useful resources. Passenger evacuation management systems (PEMS) assist in evacuating passengers and crew away from the incident to an area of relative safety. These systems are normally deployed on aerodrome operations vehicles and erected in a safe location outside the inner cordon and within the outer cordon, upwind and uphill from the incident.

Passengers should be directed towards these vehicles. Passengers requiring medical treatment should be assisted or carried to this location for triage by the responding ambulance crews.

Rendezvous point (RVP) management will also be controlled at aircraft accidents on or adjacent to aerodromes. Refer to Hazard – Transport incidents, Control Measure – Make a safe and controlled approach to the incident.

Aircraft accidents on or adjacent to aerodromes are likely to be more controlled in comparison with the challenges faced when dealing with an aircraft accident away from aerodromes, where the aerodrome rescue and firefighting service or Ministry of Defence are not in attendance.

It is usually low speed accidents that occur on or around, the aerodrome, as the aircraft is either taking off or landing. However, there will be occasions when the aircraft pilot will be forced to make an emergency landing away from a designated landing area.

In all air incidents, the hazards and subsequent risk will depend largely on the scale and nature of the accident. Accidents on, or adjacent to, the airport, will generally involve lower speeds and lower heights. As a result, aircraft are more likely to be recognisable, significantly intact and accessible for rescue, with survivability relatively high.

High speed accidents often result in complete destruction of the aircraft, with wreckage distributed over wide areas. Fire may occur in several areas, and survivability rates are expected to be low.

Air accidents off-aerodrome may present additional hazards and/or increase the risks to fire and rescue services when responding, including:

- Difficulty of access and egress at accident sites
- Hazardous or exposed ground conditions
- Difficult environments such as water, cliffs, hillside, forest, woodlands or fields
- Damaged utilities networks
- Lack of water supplies
- Wreckage trail
- Multiple casualties, passengers or animals
- Difficult access to aircraft and victims
- Sharps
- Hazardous materials
- Cable entanglement
- Controlling environmental risk
- Preserving evidence

The materials used in aircraft construction are as diverse as the variety of aircraft in existence. These materials, which may be encountered when dealing with an aircraft accident, can produce harmful gases, vapour and particulates when subjected to the extreme effects of a crash.

Some material, such as polymer composites, may plume following a crash and be carried considerable distances downwind, or be contaminated with products of a post-crash incident, such as:

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

Post-accident, fire and rescue service operations pose a significant hazard in relation to fuel spillages on or around the crash site.

Fire and rescue service personnel attending aircraft accidents may have limited experience as this type of incident does not occur frequently. This, and the moral or societal pressures on fire and rescue service personnel to save lives, regardless of resources, training and experience, must be considered.

The nature of aircraft accidents and the possibility of large numbers of casualties mean there is a risk of psychological trauma for responding fire and rescue service personnel, which may cause a stress reaction. See National Operational Guidance: Operations.

Control measure – Apply air transport control measures

Control measure knowledge

Refer to Hazard – Air transport incidents - Apply all control measures from this section

Control measure – Control ignition sources

Control measure knowledge

The accident site should be a 'no-smoking' and 'no naked light' area to eliminate or reduce the possibility of ignition. Other sources of ignition, such as radios, mobile phones, generators or appliance engines should be looked for and eliminated where there is a possibility that they may cause an ignition hazard. It must be remembered that fuel and vapours may travel some distance and gather downwind and downhill of the accident site.

Strategic actions

Fire and rescue services should:

- Ensure incident commanders and personnel understand the hazards, risks and control measures associated with aircraft fuel types

Tactical actions

Incident commanders should:

- Consider using foam blanketing
- Establish a safety jet and portable firefighting equipment strategically around the crash site
- Use safety officers and safety observers if responders are working in the inner cordon

Working with aircraft

The following three sections incorporate the hazards that may be found at all incidents involving working with aircraft.

Aircraft undercarriages

Hazard	Control measure
Aircraft undercarriages	Establish appropriate cordons Stabilise the mode of transport

Hazard knowledge

In this guidance, the term undercarriage 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.

Many hazards exist when dealing with undercarriage assemblies. Therefore it is 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 due to sudden, uncontrolled movement
- Damage to equipment
- Pressurised systems

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 firefighting media being incorrectly applied
- Structural failure
- Mechanical defect, such as the undercarriage not locking in position
- Effects of internal or external fires that affect the structural strength of the airframe
- Tyres bursting as a result of foreign object damage or 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 or failure of undercarriage assembly, etc.

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, main plane 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. This 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 in front of or behind the assembly should do so with extreme caution.

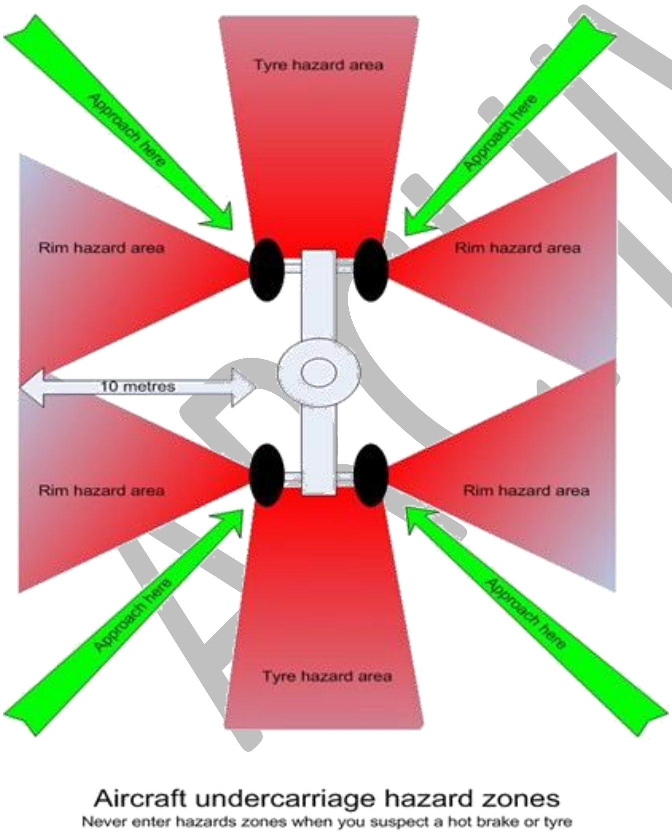

Figure 1: Diagram of the undercarriage and tyre hazard zones around an aircraft
Source: West Sussex Fire and Rescue Service

Control measure – Establish appropriate cordons

See Hazard - Transport incidents, Control measure- Establish appropriate cordons

Control measure – Stabilise the mode of transport

See Hazard – Unstable mode of transport, Control measure- Stabilise the mode of transport

Escape slides

Hazard	Control measure
Escape slides	Manage slides and access points

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 and how to open them
- Efforts to remove a deployed escape slide

It is safe to assume that, as part of 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 two metres or more above the ground will be fitted with an emergency escape slide. All aircraft manufacturers provide guidance on the process to open an aircraft door externally, if required.

Escape slides differ in size depending on the type of aircraft. Multi-lane slides can be found on larger aircraft. If they have not already been deployed, the slides present a significant hazard to responding fire and rescue service personnel attempting to gain access to an aircraft fuselage.

If they have been deployed, the slides still create an obstruction hazard for responding fire and rescue service personnel, and in high wind conditions they can become unstable.

Escape slides inflate rapidly (in approximately six seconds) and are capable of forcibly displacing firefighting ladders placed adjacent to door entries, as well as seriously injuring fire and rescue service personnel or evacuating passengers and crew at ground level.

Crews should gain as much information as possible from the responsible person or from the markings on the door, as not all doors disarm from the outside – some doors can be permanently armed.

Control measure - Manage slides and access points

Control measure knowledge

The immediate priorities are to recognise that the escape slides are active, and to communicate that fact to all personnel involved.

Two types of escape slides may be encountered:

- Self-supporting, inflated by an inert gas such as nitrogen or carbon dioxide. See National Operational Guidance: Hazardous materials (to follow)
- Non-inflatable designs made of synthetic materials, that require support

Strategic actions

Fire and rescue services should:

- Ensure familiarisation with these systems through visits to local aerodromes where escape slides are tested by engineers on a regular basis (i.e. large aerodromes with maintenance facilities)

Tactical actions

Incident commanders should:

- Brief crews on the following safety precautions when working near escape slides, and appoint safety officers to oversee operations:
  - Consider eye protection
  - Be aware of evacuating passengers or any heavy object descending the slide at speed
  - Beware of accidental actuation of the escape slide because the mechanism is damaged (make a visual check to ensure that the girt bar is free from the securing clips inside the door frame)
  - Consider positioning of ladders – pitched beside the door, on the side opposite to the hinges
- Consider the length of the escape slide when setting up inner cordons
- Following advice from a responsible person, consider cutting or deflating escapes slides to assist with access
- Be aware that passengers may throw baggage and other items out of access point before using the escape slides

Aircraft ballistic recovery systems

Hazard	Control measure
Aircraft ballistic recovery systems	Identify the system and seek specialist advice regarding the isolation of systems Manage the deployed parachute

Hazard knowledge

The term 'aircraft ballistic parachute' relates to aircraft ballistic recovery systems.

Post-accident fire and rescue service operations are 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 potentially dragging the aircraft causing 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 serious injury if they move or cut airplane wreckage without determining whether there is a ballistic recovery system, or if they disregard the positioning of the rocket motor as they work with the wreckage.

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. In fixed-wing aircraft the rocket can also be fired sideways.

The cordon distance recommended for an undeployed ballistic recovery system is 100m from the aircraft.

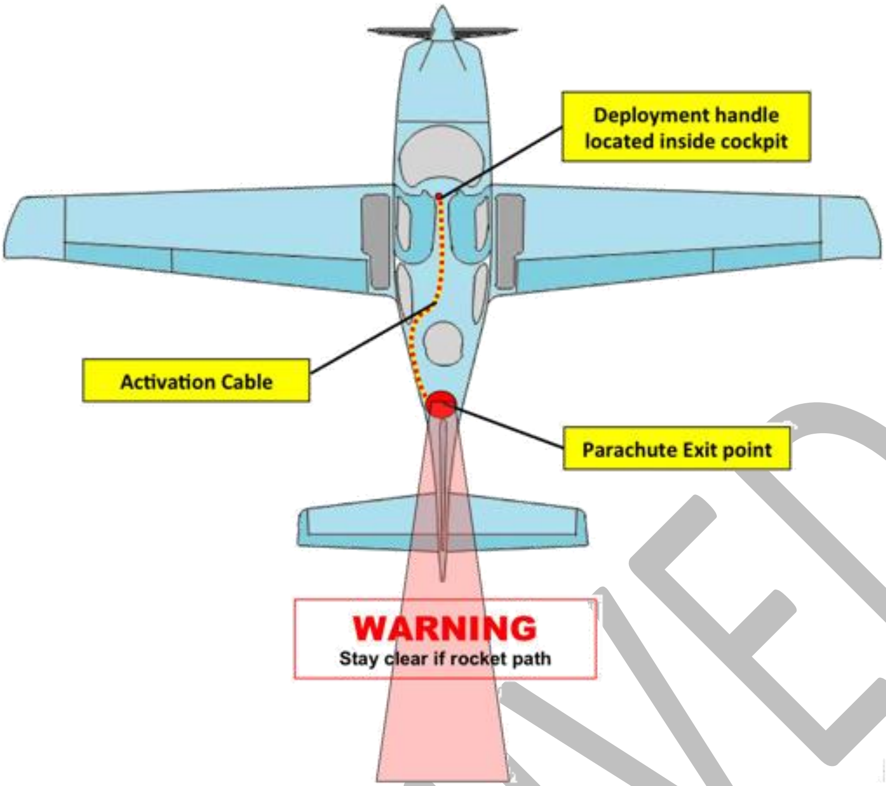

Figure 2: Diagram showing an example of a ballistic recovery system's location and a rear trajectory path
Source: Kent Fire and Rescue Service

Control measure – Identify the system and seek specialist advice regarding the isolation of systems

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, using signage, known locations, etc.

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, isolating batteries and power supplies will not deactivate these systems.

Ballistic recovery systems have been known to become completely detached from the airframe by the forces generated during a crash, resulting in the still live system lying in the crash site.

Strategic actions

Fire and rescue services should:

- Carry out joint training with the aerodrome rescue and firefighting service. This should include aircraft familiarisation on aircraft likely to land at that aerodrome.

Tactical actions

Incident commanders should:

- Identify and communicate any ballistic recovery system and its state to all emergency service personnel attending the incident
- Liaise with the aerodrome rescue and firefighting service (RFFS) to ensure sufficiently trained personnel can isolate ballistic recovery systems where an aircraft has been damaged

Control measure – Manage the deployed parachute

Control measure knowledge

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

Strategic actions

Fire and rescue services should:

- Carry out joint training with the aerodrome rescue and firefighting service (RFFS). This should include aircraft familiarisation on aircraft likely to land at that aerodrome.

Tactical actions

Incident commanders should:

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

Working in or around aircraft

The following three sections incorporate the hazards that may be found at all incidents involving working in or around aircraft.

Aircraft systems and construction

Hazard	Control measure
Aircraft systems and construction	Apply air transport incidents control measures Identify, isolate and control systems

Hazard knowledge

Aircraft engines

Engines present many significant hazards to responding fire and rescue services personnel, whether running or isolated. Aircraft engines will contain:

- Fuel pumps and pipelines
- Hydraulic pumps and pipelines
- Oil pumps and pipelines
- Electrical components and high energy ignition systems
- High pressure compressors
- Spinning fans
- Propellers

By their very nature engines create noisy environments (if running), highly heated components and projectile hazards, etc.

Propellers should not be touched. They should be cordoned off and treated as a hazard throughout the incident, as the smallest movement on a propeller can cause fuel to be pumped through the fuel line systems. This may generate ignition sparks, causing the engine to start or turn over.

The hazards posed by exhaust gases and intake air will depend on the size and type of engine involved. Engines that are running should be shut down at the earliest opportunity. Hazard zones in front of engines and to the rear of engines must be established. These hazard areas will differ depending on the aircraft engine size.

Aircraft engines usually come in two types: jet engines or propeller engines. If the engines are running, or have been running, they can present numerous hazards. Engines can generate noise, high temperatures, use oil systems for lubrication, have an electrical supply and have a pressurised fuel system. Aircraft engines are made up of numerous metals, alloys and polymer composites.

If fire and rescue service personnel have to attend an aircraft with engines that are running, the incident commander should ensure that personnel are not put at risk by engine intakes, engine exhausts or propellers that are turning or that have the potential to turn. Intakes are more dangerous than exhausts, as it may be possible for crew members to be ingested through the aircraft engine intake. Safe distances around larger and smaller engines must be considered.

To minimise the risk to personnel of being drawn into engines or being injured as a result of a propeller strike, personnel must not approach the front of any engine that is running or could possibly be running. The recommended safety distance is 10m away from the front and sides of any engine. Engines that are cold and intact should not cause fire and rescue service personnel any problems. Most engines are encased in a cover that has opening cowlings for access to the accessory section; these cowlings have the potential to swing open if disturbed as a result of an accident.

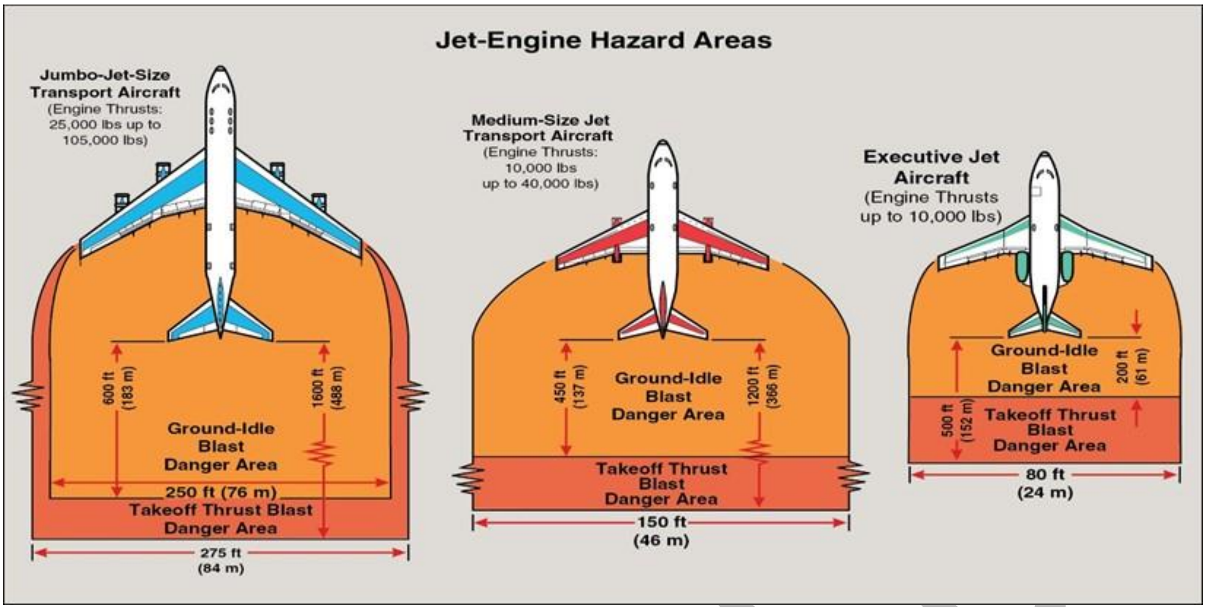

Figure 3: Jet engine hazard areas
Source: International Fire Service Training Association USA

Aircraft fuel systems

All aircraft (with the exception of some gliders) will have a fuel system on board. The size, amount and type of fuel carried will depend on the aircraft, but the hazards will be similar.

One factor related to fuel systems that makes air incidents different from other transport incidents is the volume of fuel that can be involved.

Fuels involved in air transport incidents will range from kerosene, petrol or military fuels, to LPG (in hot air balloons). The principal hazards from fuels in aircrafts are:

- Pressurised fuel lines
- Fuel remaining within the fuselage and aircraft fuel tanks
- Varying degrees of flammability depending on the type of fuel
- Extreme radiated heat
- Escaping fuel creating running fuel fires and pool fires
- Pools of fuel not on fire
- Jettisoned fuel tanks
- Flammable atmospheres surrounding the incident
- Environmental impact

Hydraulic fluid systems

Hydraulic fluid systems will be located on all passenger-carrying aircraft and on some general aviation aircraft. The systems will be pressurised (in excess of 200 bars) and although the fluid itself is generally fire resistant, escaping hydraulic fluid can become atomised with the resultant fine mist spray being easily ignited.

Liquid oxygen systems

Two principal types of pressurised oxygen systems are found on board commercial aircraft:

- Compressed oxygen systems
- Liquid oxygen systems

The systems will be under pressure and present a significant hazard if involved in fire.

RADAR systems

RADAR systems with differing wavelengths and strengths may be fitted to some aircraft. Some systems may have transmitting devices in the nose cone or side pods, and some may have externally mounted dishes or scanners. Following a crash, inbuilt safety systems may have automatically disarmed such devices, although crews should not initially approach aircraft that are suspected to contain RADAR systems, until it has been confirmed that the system has been isolated.

Radioactive materials

Radioactive materials may be used in some elements of aircraft construction and may also be present in electrical and electronic equipment installed on some aircraft. Radioactive substances may also be found in aircraft targeting systems and, if damaged, they can leak very small amounts of radioactive material. The probability of coming into contact with radioactive materials at military aircraft incidents is small and crews undertaking firefighting and rescue operations should be adequately protected by their personal protective equipment (PPE) and respiratory protective equipment (RPE).

Hydraulic/cable systems.

Due to the nature of aircraft construction and the systems required for flight, pressurised systems and cables will be running through the cabin, albeit behind interior furnishings. Crews should be mindful of any damage sustained to either the interior or exterior of the aircraft, as they could be exposed to hydraulics or moving surfaces.

Older aircraft have cables under tension. These cables run from the flight deck to the control surfaces such as the rudder, elevators and flaps. If these surfaces are moved by either the flight deck crew, or possibly through actuation by external personnel, these cables will move internally.

In the majority of aircraft, the auxiliary power unit (APU) is normally situated in the tail of the aircraft, and oil and fuel lines have to pass through the aircraft.

Where the interior of the cabin has been damaged these cables will form a significant hazard from entanglement.

Cargo deck

Access is normally made through large cargo bays situated beneath the passenger deck or at the rear of military cargo aircraft. Conditions can be cramped as most aircraft use unit load devices. These lightweight containers are used to maximise the space in the aircraft hold.

Hazards inside a cargo hold include:

- Operating cargo doors. Seek advice from flight crew, aircraft engineers or ground handling crew
- Heavy luggage or cargo falling or tipping over
- Unidentified cargo in a unit loading device or in the shipper's packaging
- Slips, trip and falls due to the mechanisms used to move unit loading devices on the cargo deck floor
- Access/egress
- On-board fire suppression systems

If the incident occurs on an aerodrome then the incident commander should liaise with the aerodrome rescue and firefighting service (RFFS), and with aircraft engineers or flight deck crew. All of these agencies should be able to assist the incident commander with tactical plans and decision making.

If the incident occurs away from the aerodrome, then the incident commander should liaise with the flight deck crew, if possible, and attempt to gain additional information from specialist advisers if necessary.

Control measure – Apply air transport incidents control measures

Control measure knowledge

Refer to Hazard – Air transport incidents - Apply all control measures from this section

Control measure – Identify, isolate and control systems

Control measure knowledge

Fire and rescue services will need to operate in and around aircraft for various reasons, including:

- Aircraft ground incidents
- Aircraft emergencies
- Fuel spillages

Ordinarily, the pilot or engineers will shut down the aircraft systems. However, in an emergency situation some systems may still be active and will need to be controlled.

Isolation or control of aircraft systems is a task that needs to be carried out by trained personnel and is not ordinarily something that fire and rescue service personnel should be involved with.

Strategic actions

Fire and rescue services should:

- Carry out joint training and familiarisation visits on aerodromes within their area, ensuring the relevant hazards are identified

Tactical actions

Incident commanders should:

- Identify and isolate active aircraft control systems in liaison with aerodrome rescue and firefighting service or specialist advice

Working around military aircraft

Hazard	Control measure
Working around military aircraft	Apply air transport incidents control measures Liaise with specialist military advisers Restrict use of radio transmissions

Hazard knowledge

Fire and rescue services may come into contact with military aircraft of varying types and roles, from a number of different nations. These aircraft operate from military aerodromes around the country, or overseas and in transit through UK air space, but may also operate from civil aerodromes for a variety of reasons.

Military organisations operate many types of aircraft that can vary enormously, from small two-seat trainers, attack helicopters, unmanned aircraft and combat fast jets through to large passenger or cargo aircraft. Large transport aircraft may be similar in appearance to civil airliners, but have unconventional interior configurations. Unmanned aerial vehicles are aircraft that do not carry a human pilot. Instead they are flown remotely by an operator, and can carry a lethal payload.

Most military aircraft are capable of carrying weapon systems and advanced trainers and/or fast jets may be fitted with differing aircraft assisted escape systems (AAES). Apart from the additional hazards associated with explosive stores, weapon and escape systems, the profile of the aircraft types have synergies with civil aircraft.

Due to the hazardous nature of specialist military aircraft, actions should be restricted to life-saving operations. Where it is confirmed by official sources that the aircrew have already ejected, the aircraft should be cordoned off and left undisturbed. An area around the aircraft with a radius of 400m should be evacuated for any incident involving military aircraft and, if the aircraft is armed, this distance should be increased to between 400m and 800m after seeking advice from the responsible military authority. Efforts should be redirected to locating the aircrew and, if requested by the military, the remains of the ejection seats.

Aircraft assisted escape systems

Aircraft assisted escape systems (AAES)means collectively: the ejection seat, the equipment fitted to the ejection seat including emergency escape parachutes, and personal survival packs with systems for clearing the ejection path from the aircraft, including associated mechanisms operated by explosives.

An ejection seat is a system fitted to most military advanced trainer and fast jet aircraft (and can also be found in private ex-military aircraft). It is designed to rescue the pilot or crew from an aircraft in an emergency. In most designs, the seat is propelled from the aircraft by an explosive charge or rocket motor, carrying the occupant with it. Once clear of the aircraft, the system will automatically deploy a parachute. The cockpit canopy will also be jettisoned or fragmented by explosive charges, to provide a clear route for the ejection seat. At aircraft accidents, canopies can be externally jettisoned or fragmented by fire and rescue service personnel separately, to provide emergency access to the cockpit.

The operation of ejection seats will normally be controlled by the pilot or crew. The seat can be operated when the aircraft is in flight or on the ground. If it is suspected that the aircrew are intending to operate aircraft assisted escape systems (AAES), rescue crews should not approach the aircraft and should remain at least 15 metres away from the cockpit until the procedure has been completed, or the aircrew indicates that it is safe to approach.

During immediate operations, fire and rescue service personnel will take whatever precautions are necessary to rescue crew or other personnel. Thereafter, ejection seats and components, survival equipment and flying clothing are to be left undisturbed until the arrival of the aircraft assisted escape systems (AAES) investigation team, who will be responsible for taking all other aircraft assisted escape systems (AAES) safety precautions under the guidance of the Defence Accident Investigation Branch (DAIB).

Aircraft assisted escape systems (AAES) present a significant hazard to fire and rescue service personnel attending a military aircraft incident. If the incident is not on an aerodrome, there is a high likelihood that fire and rescue service personnel will be first on the scene.

It is possible to make ejection seats safe, however this must be carried out under the guidance of the responsible person as (MOD specialist AAES engineers), due to the extensive range of seat configurations, general training and familiarisation will be difficult. For information the Miniature Detonation Cord (MDC) is marked black & yellow.

Explosive armament stores

All missiles, rockets and bombs found on military aircraft will contain varying amounts and types of highly explosive material. Any explosive armament that is in danger of becoming heated by fires should be cooled with water sprays if safe to do so, but on no account should any attempt be made to move or interfere with any potentially explosive devices. Explosive armament does not normally explode on impact of a crashed aircraft, but its condition must be considered as unpredictable, so specialist explosive ordnance disposal advice should be sought. If explosive armament stores, including gun ammunition, have become detached from the aircraft, they should be not disturbed. Their location should be marked, cordoned off and specialist assistance sought for their disposal.

Electro-explosive devices may be accidentally initiated by radio or radar frequency electro-magnetic radiation.

If an aircraft accident involves nuclear weapons or materials, the Defence Nuclear Emergency Organization will assume command of the accident.

Defensive systems

Chaff is used to defend aircraft against hostile missile attack. It consists of a large quantity of reflective material, discharged from the aircraft to 'confuse' the guidance systems of the missile. Chaff is deployed from the aircraft with explosive force, and then distributed through the air by a small explosive device.

Defensive flares are designed to confuse heat-seeking missile systems and will ignite and burn brightly on release. Defensive flares can provide an ignition source, burn at a very high temperature and may produce a light bright enough to cause significant eye damage. These systems are very sensitive and can activate unexpectedly.

Small arms and gun ammunition

Several different types of small arms and gun weapon systems may be found fitted to military aircraft, depending on the aircraft's specification and role. Most of the gun ammunition carried on the aircraft is usually, but not always, stored in 'safe' containers or tanks, but some aircraft fly with a live or dummy round loaded in to the weapon.

Apart from live ammunition, these weapon systems may also discharge pyrotechnics or blank rounds. Gun ammunition may 'burst' unexpectedly if exposed to fire or impact, and weapons may become detached from the aircraft during accidents. The area directly in front of any weapon systems must be avoided, and if possible, the location of any stored ammunition should be recognised and avoided.

Pyrotechnics

Various pyrotechnic devices can be found on military aircraft including: signal cartridges, distress flares and smoke markers. They will commonly incorporate a metal tube containing explosive material that is crimped at one end. When ignited it will emit flame and sparks at the open end.

Pyrotechnic devices can be used to ignite rocket motors, to deploy under-wing weapons, or to jettison external fuel tanks; they may also be located in fire suppression systems around the aircraft. Marine flares and smoke markers may be ejected from the aircraft with some force, manually or automatically, following a crash or on contact with water.

Personal flares may be found within the aircrew survival kit which can be an additional hazard when performing rescues or where bodies have to be recovered.

Liquid oxygen

As military aircraft may sometimes have to operate at high altitudes, a breathable oxygen supply is provided for the pilot and crew to survive. Oxygen will often be stored under pressure in cylinders or automatically generated on demand. If aircraft are involved in fire, the risk of explosion and the effect that the oxygen may have on the fire should be considered.

For more information refer to National Operational Guidance: Hazardous materials (to follow).

Aviation fuel and specialist fuels

Military aircraft generally use the same types of aviation fuels that commercial aircraft use, but with some additional additives. Some aircraft can be fitted with auxiliary external fuel tanks, which can be jettisoned in an emergency

Mono fuels are special fuels that can support combustion without an external air supply, as the chemical make-up of the substance contains its own oxygen. They are usually found in small quantities on aircraft and are used to power emergency power units, or as propellants for missiles.

Infra-red and laser systems

Modern weapons systems used on military aircraft are increasingly fitted with infra-red guidance systems for weapons targeting. The devices are often positioned behind a glass vision panel and are commonly forwards or sideways looking. 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 aircraft safety systems, which automatically isolate weapon firing and release circuits in emergency situations. Fire and rescue service personnel should, however, stay clear of the area in front of these devices and avoid looking into any vision panels.

These systems are a non-ionising form of radiation however, most military aircraft will be carrying some form of ionising radiation on board. Specialist advice should be sought to identify this.

Cordon/evacuation

If the presence of any explosive armament stores is confirmed, the advice and subsequent cordon distances detailed by the Military Aviation Authority and the Defence Safety Authority (DSA) should be followed.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/418983/MPCM_AIDE-MEMOIRE_Issue_3.pdf

Aircraft arresting systems

Two systems may be installed at military aerodromes. These systems are designed to arrest aircraft landing on short runways, temporary runways or in an emergency. They use a cable spanning the runway or a net positioned at the overrun of the runway.

The cable system (generally defined as arrestor gear) consists of a single cable engaged by a hook fitted to many tactical military aircraft. During normal arrestment, the tail hook engages the wire and the aircraft's kinetic energy is transferred to damping systems.

Arresting barrier nets stop an aircraft by absorbing its forward momentum. These nets are raised remotely by air traffic control in an emergency. Both systems involve steel cables, which may be under stress during an aircraft arrest. Fire and rescue service personnel should stay clear of these systems until military advisers have made the area of operations safe.

Control measure – Apply air transport incidents control measures

Control measure knowledge

Refer to Hazard – Air transport incidents - Apply all control measures from this section

Control measure – Liaise with specialist military advisers

Control measure knowledge

The role of the Royal Air Force regional liaison officer (RAFRLO) is to liaise with the civilian emergency services and local authorities, providing a conduit between the military, civilian agencies and other government departments as required. There are nine RAFRLOs in the UK.

The Royal Navy Institute of Naval Medicine duty hazmat and environmental protection officer and RAF Centre of Aviation Medicine duty environmental health officer can provide advice and on-scene support on hazardous materials, occupational and environmental health, and environmental protection. An explosive ordnance disposal team will respond to an aircraft crash, providing specialist safety advice and the capability to locate and identify all items of explosive ordnance, and render them safe. Liaison should be made with the Ministry of Defence aircraft post crash management incident officer (APCMIO), if in attendance.

https://www.gov.uk/government/groups/defence-fire-risk-management-organisation

At an incident involving a foreign plane the Aeronautical Rescue Co-ordination Centre (ARCC) should be contacted.

For further information refer to – Manual of Aircraft Post Crash Management

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/418974/Manual_of_Post_Crash_Management_Internet_Issue_3.pdf

Strategic actions

Fire and rescue services should:

- Develop tactical guidance on the services the military can provide at incidents involving military aircraft in consultation with the Royal Air Force regional liaison officer (RAFRLO)

Tactical actions

Incident commanders should:

- Liaise with Ministry of Defence aircraft post-crash management incident officer (APCMIO), or equivalent specialist military adviser, as the point of contact for military support, at the earliest opportunity

Control measure – Restrict use of radio transmissions

Control measure knowledge

With the increase in the use of electronic communication devices throughout all sections of the community, there is a potential hazard when these items are used in close proximity to an electro explosive device (EED). To a large extent, the sensitivity of electro explosive devices to extraneous radio frequency fields can be minimised by screening, intrinsic design characteristics and specialised packaging. However, there are a number of circumstances, notably when electro explosive devices are unpackaged, when they are particularly vulnerable to inadvertent initiation by radio frequency. This effect is known as RADHAZ, and must be considered at all times when using management radios, mobile phones and so on in the vicinity of electro explosive devices or stores containing electro explosive devices.

Strategic actions

Fire and rescue services, in consultation with military specialists, should:

- Develop tactical guidance on the use of electronic communication devices at incidents involving military aircraft

Tactical actions

Incident commanders should:

- Manage or restrict the use of electronic communication devices until military advisers arrive. Mobile telephones and hand-held radios, including Airwave, are not normally to be taken inside the inner cordon; exceptions to this rule are to be approved by the Military Aircraft Recovery Officer or the Defence Accident Investigation Branch (DAIB)

Working around helicopters

Hazard	Control measure
Working around helicopters	Apply air transport incidents control measures Avoid deploying flotation devices or automatically deployable emergency locator transmitters (ADELT)

Hazard knowledge

References to helicopters within this guidance cover any rotary-wing aircraft.

It is reasonable to assume that for helicopters, lift and thrust are supplied by rotors. This allows the aircraft to take off and land vertically, to hover, to fly forward, backward and laterally. These attributes allow such 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 helicopter to accomplish tasks that fixed-wing aircraft and other forms of vertical take-off and landing aircraft cannot perform.

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

- Automatically Deployable Emergency Locator Transmitter (ADELT)
- Deployment of flotation devices
- Moving main rotor blade including blade sail
- Moving tail rotor blade
- Downwash

- Unstable undercarriage
- High pressure systems
- Aviation fuel and oils – see National Operational Guidance: Hazardous materials (to follow)
- Entanglement in cables
- Composite materials
- Batteries, potentially including lithium metal types – see National Operational Guidance: Hazardous materials (to follow)

Using helicopters in emergency situations is becoming more common. They are often selected because of their ability to gain access to otherwise inaccessible areas, and/or their capability for rapid transport over large distances.

Helicopters may also be deployed to the scene of fire and rescue service operations when requested by other services or organisations such as the police or the media. This may create additional risks for fire and rescue service personnel.

The hazards present when working with helicopters may involve one or more of the following:

Moving rotor blades

Consideration should be given to the hazards presented by moving rotor blades. Stationary helicopters may have rotor blades still in motion (this may not be evident), creating hazards to personnel who are required to perform any or all of the following:

- Approaching the helicopter
- Boarding the helicopter
- Disembarking from the helicopter
- Working in or around the helicopter
- Transporting equipment to or from the helicopter
- Transporting casualties to or from the helicopter.

On some helicopters, as the rotors slow the rotor blades will drop, with the tips becoming significantly lower than the height of the helicopter (known as the blade sail).

Consideration should also be given to helicopters with no tail rotor. Personnel should treat these as they would a helicopter with a tail rotor, because of hot gases from the exhaust and the associated risk of injury.

Suspended loads and static electricity

When working with a helicopter carrying a suspended load (including water carriers), there are additional hazards to consider. Helicopters may use either slings or nets to transport equipment, or alternatively to carry water 'buckets' or containers when 'water bombing' is required. The hazards of personnel receiving impact injuries from these suspended loads may be more likely when personnel and helicopters are required to work in close proximity.

A further potential hazard associated with suspended loads is that of static electrical shock. In cases where a helicopter ground crew is not available, personnel may be required to load or unload equipment from under-slung slings or nets. Helicopters that carry loads will normally have an earthing line to discharge the static build up. Fire and rescue service personnel need to be aware that any load carried under a helicopter has the potential for the build-up of static electricity.

Any load jettisoned by the pilot will become hazardous to those working below**.**

Downwash

Helicopters fly because the rotors accelerate a mass of air downward that is at least equal to the mass of the aircraft. The vertical velocity of this column of air (or downwash) is dependent on a number of factors, which include:

- Surface wind speed
- Main rotor radius
- 'Disc loading' (the weight of the helicopter divided by the 'swept' area of the rotor blades).

Whenever helicopters take off, land or hover close to the surface, the downwash is deflected horizontally. Rotor downwash is invisible unless in conditions of smoke, dust, mist or foliage. However, deflection across the ground may be hazardous for up to 70 metres from the aircraft. Rotor downwash will create considerable ground disturbance, turning any unsecured items into possible projectile hazards.

Other hazards created by rotor downwash include:

- Contaminants blown into eyes, open wounds, sterile dressings etc.
- Dust or sand getting into the air intakes
- Possible re-ignition of dying fires or intensifying an established fire situation
- Spreading contaminants at CBRN(E) incidents
- Stirring up water and reducing sub-surface visibility
- Displacing or blowing over equipment or personnel
- Noise created by the turbulent movement of air
- Loose articles being blown into rotors and possibly engine intakes, affecting flight capability

Approaching, boarding or disembarking helicopters

Fire and rescue service personnel may be required to approach, board or disembark from stationary helicopters. The hazards arising from incorrect approach, boarding, and disembarking to or from helicopters may be due to any or all of the following:

- Personnel approaching 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 military aircraft as the standard operating procedure for a Chinook is to approach from the rear in full view of the aircrew loadmaster)

- Personnel approaching the 'danger area' i.e. the area immediately adjacent to the tail rotor
- Personnel approaching assuming an upright posture, or carrying equipment in an elevated position
- Personnel approaching or disembarking on the uphill side of a helicopter on sloping ground
- Personnel approaching with communications antenna raised
- Personnel coming into contact with hot exhaust ports
- Personnel approaching or disembarking during 'engine shutdown' procedures

Noise

The noise created by the engines, and to some extent the downwash of air, creates additional hazards for personnel working with helicopters. Hazards posed by noise may be twofold:

- If the noise is of such intensity that normal speech cannot be heard, personnel may mishear (or not hear) critical safety information and may expose themselves and/or others to additional hazards
- Prolonged intense noise may result in damage to hearing

Accidental activation of aircraft safety systems

Helicopters have safety systems, some of which may be automatic in operation. These include:

- Water actuated flotation gear – found in wheel hubs or on sponsons (flotation devices to give stability on the water), braced to the fuselage by fixed struts, mounted on skids or located behind fuselage panels (Merlin). They are usually marked with a warning sign.
- Automatically deployable emergency locator transmitters (ADELT) – the ADELT unit is attached to the fuselage on the opposite side of the tail cone from the tail rotor

Accidental activation of any type of vehicle safety system may create hazards for personnel, as release mechanisms, or parts of the vehicle such as wheel hubs, may be ejected before activation.

Aerials

Aerials, particularly high frequency aerials, which are cables slung down the side of the aircraft, pose a significant hazard during high frequency transmissions and can cause burns.

Engine exhaust

The height of the exhaust depends on aircraft type, but personnel should be aware that they exist and should expect a warm or hot blast of air when manoeuvring near the aircraft. Personnel must keep clear of all helicopter tail sections even if they have no tail rotor due to the hot exhaust.

Aviation fuel

Helicopters contain aviation fuel and, as such, this poses a risk should there be an incident involving the helicopter.

Falling from height and objects falling from height

There is a risk of falling from height when embarking or disembarking a helicopter and being transported in a helicopter. There is a risk of objects falling from height if unsecured; also many helicopter landing pads are at height on top of buildings.

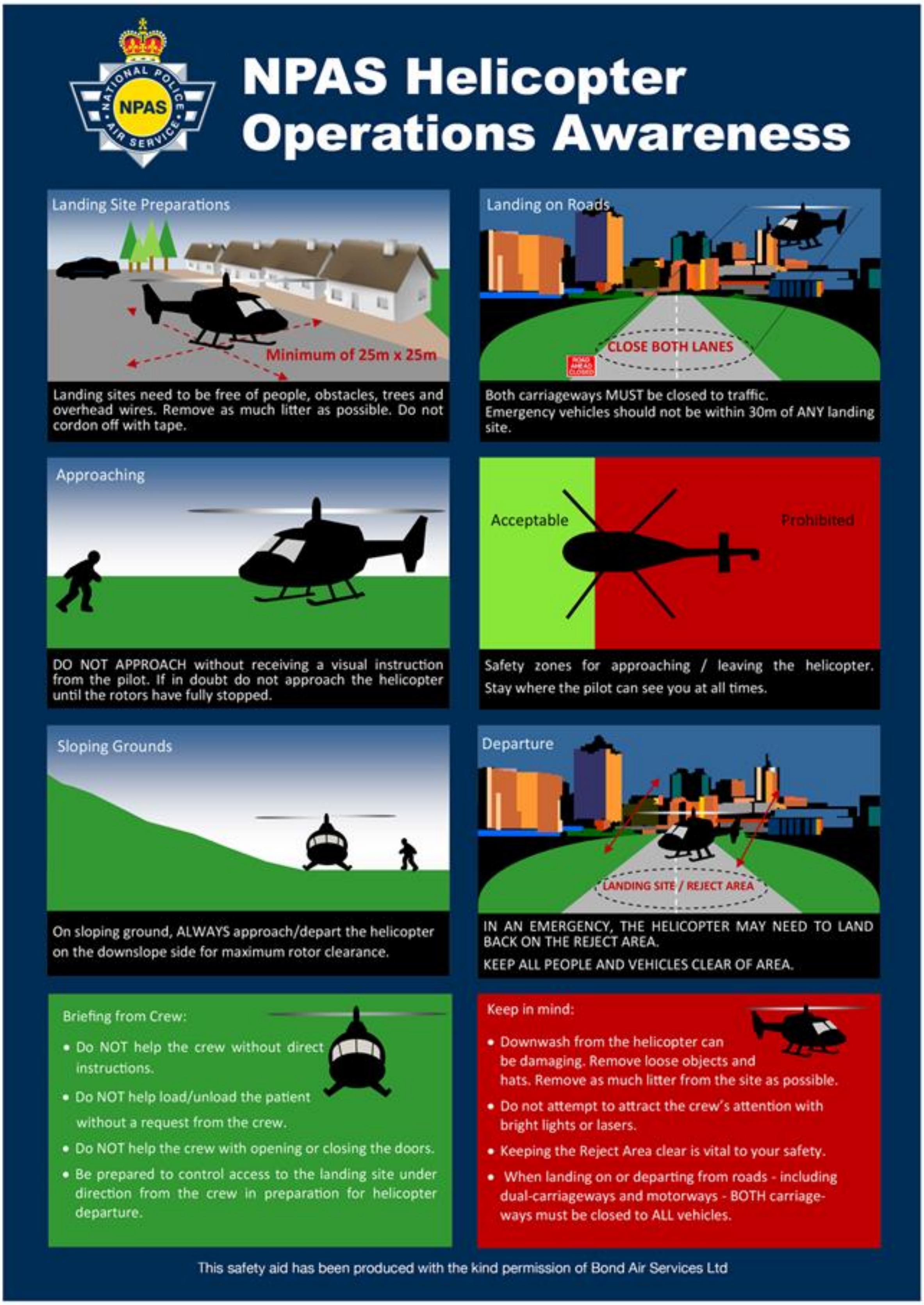

Figure 4: Helicopter operations awareness
Source: National Police Air Service

Control measure – Apply air transport incidents control measures

Control measure knowledge

Refer to Hazard – Air transport incidents - Apply all control measures from this section

Control measure - Avoid deploying flotation devices or automatically deployable emergency locator transmitters (ADELT)

Control measure knowledge

Helicopters that operate over water may be fitted with automatically deployable emergency locator transmitters (ADELT) unit. This unit, when released from the aircraft, transmits a continuous signal to allow responding searching craft to 'home in'.

The automatically deployable emergency locator transmitters (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 automatically deployable emergency locator transmitters away from the aircraft.

Accidentally activating any type of automatically deployable emergency locator transmitters (ADELT) may create hazards for 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.

Helicopters 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 can cause a hazard if they are hit with water and/or foam.

The devices tend to be located on the side of the aircraft fuselage.

Strategic actions

Fire and rescue services should:

- Ensure personnel are provided with relevant training and information on flotation devices or automatically deployable emergency locator transmitters (ADELT) systems, especially as heavy applications of water (and/or foam) can mimic the aircraft having crashed into a stretch of water and could cause either system to deploy

Tactical actions

Incident commanders should:

- Identify aircraft with flotation devices and/or automatically deployable emergency locator transmitters (ADELT) systems and inform personnel
- Exercise caution when applying water or foam

Rail

The following section incorporates the hazards that may be found at all incidents involving rail.

Introduction to working on railways and dealing with rolling stock

For the purposes of this guidance a rail system is defined as:

'Transport infrastructure managed for the mass transport of people or goods, guided by one or more fixed rail.'

This description is intended to include national metro, tram and heritage rail networks; this may also include temporary rail systems. It will also be useful when dealing with incidents on rail systems that are associated with dockyards, nuclear installations, quarries or other large industrial complex. The system will include:

- Rail vehicles
- Power systems
- All aspects of the built rail environment, such as tracks, stations, terminals, bridges and viaducts

Fire and rescue services may respond to a wide range of incidents involving tunnels and underground structures that have the potential to cause harm and disruption to firefighters and the community.

Network Rail is one of the largest landowners in the UK and there are approximately 7.5million rail vehicle movements over the infrastructure per year. It is the main infrastructure manager in the United Kingdom, but is not the only one. In particular, Northern Ireland Railways are responsible in Northern Ireland and Network Rail (High Speed) Ltd are the owners and operators of High Speed 1 (HS1). There are also individual metro systems and Ministry of Defence facilities, ports and power stations, with rail networks on their own land.

Fire and rescue service actions can have severe implications for the business continuity of the rail industry and wider implications for the economy, especially when implementing excessive measures.

It is important that the rail industry recovers from incidents quickly, but in a planned and co-ordinated way. For the majority of fire events affecting Network Rail operations, recovery is immediate once the circumstances of the event are understood and the appropriate decisions are made.

Safety of the public, rail staff and fire crews is the over-riding priority at rail incidents. However, widespread disruption to train services can lead to long delays and substantial business loss. Therefore, power isolation and train stoppages should only be requested by officers when it is considered essential to protect life and property and the safety of attending crews.

Engagement with rail infrastructure representatives can greatly enhance future performance and operations when attending rail incidents, which can reduce the impact on business continuity for the rail authority and for the responding emergency services.

Multi-agency reviews and exercises should be carried out following rail incidents to ensure that Network Rail, train operating companies (TOCs), freight operating companies (FOCs) and the emergency services have operational procedures, processes and contingency plans that are fit for purpose. Effective interoperability enhances the responses from both Network Rail and the emergency services to manage incidents, and can lead to better outcomes for those affected and a swifter recovery to train services.

While a lot of infrastructure and some major rail stations are owned or managed by Network Rail, a number of train operating companies and freight operating companies operate under franchise. The train operating companies (TOCs) have a variety of rolling stock and stations in their portfolios. It is important for fire and rescue services to understand the hazards that are present within their own, and neighbouring, jurisdiction. There are also rail preservation societies that operate on open and closed sections of track, and a number of freight operators running across the UK rail network. The Rail Accident Investigation Branch (RAIB) is the independent railway accident investigation organisation in the UK. It investigates railway accidents and incidents on mainline railways, metros, tramways and heritage railways to improve safety.

For further information refer to Operational Guidance Railway incidents 2012, (Dept. of Communities and Local Government) which forms the foundation for this rail section.

Rail transport incidents

Hazard	Control measure
Rail transport incidents	Apply all transport incidents control measures Establish proportionate control over the railway Appoint safety officers Wear appropriate personal protective equipment (PPE)

Hazard knowledge

The control measures for this hazard should be applied when dealing with any rail transport incident attended by fire and rescue services, whatever the size or complexity.

Fire and rescue service personnel need to understand the possible hazards associated with all operational incidents and general hazards that are associated with rail transport, rail facilities and its infrastructure. Generally, the movement of rail vehicles and the traction current form the greatest hazards within the rail environment.

There is clear agreement with the infrastructure and train operators that the safety of the public, rail staff and fire crews is the over-riding priority when attending incidents. However, widespread disruption to train services can lead to long delays and substantial business loss. Therefore, power isolation and train stoppages should only be requested when it is considered there is a threat to life and property.

Incident commanders need to be aware that the isolation of power supplies, and the stopping of trains other than at station platforms, can have serious implications away from the immediate scene of operations

Therefore, there may be circumstances where it is better to monitor minor incidents from a point of safety and not take action that may have an impact on the free movement of rail. However, it is still stressed that where there is a genuine threat to the safety of the public, fire crews or infrastructure, these issues become secondary and power isolation and/or train stoppages will be expected to be initiated as quickly as possible.

Control measure - Apply all transport incidents control measures

Control measure knowledge

Refer to Hazard – Transport incidents - Apply all control measures from this section

Control measure - Establish proportionate control over the railway

Control measure knowledge

At any rail incident, it is necessary to establish the level of control to be implemented over traction power supplies and train movements as one of the first rail-specific considerations. Following a risk assessment, there are four levels of control that an incident commander must apply to control rail vehicle movements and traction current:

Inform the infrastructure manager of an incident on or near the railway

These types of incident could include, for example, a small smouldering fire that the incident commander believes may be safely monitored until burnt out. Another example may be a ‘bridge strike’ where a lorry has wedged under a rail bridge, but with no obvious damage to the rail lines. The incident commander may wish for the infrastructure manager to send specialist rail personnel to inspect the rail lines, to see if any misalignment has occurred.

Request rail vehicles are ‘run at caution’

This approach can be used when there is a need to slow rail vehicle movements, by notifying drivers that there are people on or near the rail infrastructure. In these circumstances the driver will adjust their speed to ensure that the vehicle can be brought safely to a halt if required, for example, where crews are extinguishing a trackside fire more than three metres from the nearest running rail. This would not be an appropriate control measure on some systems using driverless rail vehicles.

Request that rail vehicles are stopped

This approach is to be used where there is a risk of people being injured by train movements but not by coming into contact with live electrical traction current. It should be noted that this can take time to implement, as vehicles will have to reach, or receive, a ‘stop’ signal before the fire and rescue services can be provided with a guarantee that rail vehicles have stopped. Rail vehicles could have passed the last set of lights immediately before the incident before a warning could be given to the train, resulting in the vehicle passing through the incident.

Request power off

This approach is used when there is a significant risk of people or resources coming into contact with live electrical traction current.

This will not necessarily stop all rail vehicle movements, for example, diesel vehicles will be unaffected and high speed electric vehicles can coast for some distance. Where fire and rescue service operations need to take place within three metres of any traction power supply, incident commanders should request electrical isolation of the relevant track sections using the term 'emergency switch off'. If the incident involves OLE then there is a risk that residual current may remain, or nearby high voltage power cables may induce an electrical charge into the OLE. Therefore, when operating closer than one metre to OLE, incident commanders must make timely requests for the relevant OLE sections to be earthed, in addition to isolation. This can only be undertaken by rail system personnel and confirmed by infrastructure managers.

For information, the term 'Line Blocked' is a rail term for the line being unsafe for trains to run. This is a stronger term than requesting trains be stopped and indicates that there is a serious risk to the safe running of trains.

When requesting to stop trains or turn off traction power supply, the following information should be provided to the control room:

- Reason for the request
- Nature of the incident
- Location (milepost, signal number, bridge number or other identifying feature)
- Nearest access point

Strategic actions

Fire and rescue services should:

- Provide tactical guidance to ensure the different levels of control over traction power supplies and rail vehicle movements are implemented at rail incidents
- Align their procedures and guidance to that of rail operators, testing these arrangements where appropriate

Tactical actions

Incident commanders should:

- Identify the proportionate level of control over the railway in consultation with the responsible person

Control measure - Appoint safety officers

Control measure knowledge

See National Operational Guidance: Incident command – Clearly defined roles and responsibilities.

At incidents where personnel are working in the vicinity of any infrastructure or track, safety officers should be appointed where there is a risk from rail vehicle movements and carrying out hazardous activities. On bi-directional tracks, two safety officers will be required to warn of the approach of trains from both directions. Safety officers should be equipped with a method to give warning and should position themselves in a safe location to give the maximum warning time. They will relay their warning to a further safety officer at the scene of operations who will alert all personnel. This action should be carried out with the safety officer standing in a place of safety, after giving any previously agreed evacuation signal, and no additional risk is to be taken when making the signal. The proportionate control over the railway must be applied and safety officers are to be used as an additional precaution to these measures. Where personnel have to approach within three metres of any track, rail vehicles should be stopped or, at a very minimum, cautioned, pending the outcome of a dynamic risk assessment (DRA) and the requirements of the incident.

Hand signals to stop trains

When using hand signals, officers should:

- Move along the line to give as much stopping distance as possible
- Stand in a position of safety, facing the train
- Signal the driver (in daylight) by raising both arms above the head
- Signal the driver (at night) by waving a lamp or torch rapidly

N.B. a train may not be able to stop in time and these signals will not apply to driverless rail vehicles.

The delegated responsibilities of the safety officer at the scene will be to ensure:

- Personnel maintain safe distances between themselves and the line when trains are still running
- Trains are stopped or cautioned (as appropriate) where personnel are intending to operate closer than three metres from the nearest running rail
- Operations are conducted safely
- Personnel are evacuated when there is imminent danger

Safety officers should not be stood down until confirmation is received that rail traffic has definitely been stopped, or that safety officers have been replaced by Network Rail lookouts.

Working on or near the track, without stopping or cautioning rail vehicles, will only be implemented in very exceptional circumstances, when the incident commander believes rapid intervention to save life is required and the appropriate control measures have not yet been confirmed as in place. Any equipment taken to the track should be kept to a minimum and should be removed before any train approaches, due to the possibility of causing a derailment.

Considerations when appointing and positioning safety officers to warn for rail vehicle movements, should take account of the following:

- Availability of rail professionals to undertake the role of lookout
- Speed and stopping distances of rail vehicles (see below)
- Distance from the scene
- Complexity of the location
- Weather and lighting conditions

- Whether rail lines are bi-directional
- Communication methods and evacuation signals to be communicated to all fire and rescue service personnel
- Audibility of any message or signal
- Noise level at the scene
- Risk to the safety officer
- Footprint of the incident

Speed (approximately)		Sighting distance in metres to provide maximum warning time						
Mph	Kph	15 sec	20 sec	25 sec	30 sec	35 sec	40 sec	45 sec
140	235	1000	1300	1600	1900	2200	2600	2900
125	200	900	1200	1400	1700	2000	2300	2600
100	160	700	900	1200	1400	1600	1800	2100
90	155	700	900	1100	1300	1500	1700	1900
75	120	600	700	900	1100	1200	1400	1600
60	100	500	600	700	900	1000	1100	1300
40	70	300	400	500	600	700	800	900
20	35	200	—	300	—	400	—	—

Sighting distance and warning times

As can be seen from the table a safety officer will have great difficulty in relaying any safety message to the scene unless the rail vehicle is travelling at slow speeds. Establishing proportionate control over the railway must be a priority when personnel have to go within three metres of any track or electrical traction equipment.

Strategic actions

Fire and rescue services should:

- Ensure relevant staff are familiar with the role of the safety officer and their specific duties at a rail incident

Tactical actions

Incident commanders should:

- Appoint safety officers with a specific brief to warn of rail vehicle movements

Control measure – Wear appropriate personal protective equipment (PPE)

Control measure knowledge

Before committing personnel to the railway, incident commanders must understand the geographical constraints of railway boundaries and ensure that everybody committed to the railway is wearing personal protective equipment (PPE) that is appropriate to the environment and the task required. Where there is any doubt as to the required levels of PPE, the responsible person(s) must be consulted to ensure a safe system of work is employed.

Appropriate high visibility clothing is to be worn in addition to any agreed structural firefighting protective clothing. High visibility tabards must always be worn when working on, or near, moving rail. Agreements or arrangements on the appropriate colour of high visibility clothing in use by fire and rescue service staff should be made with train operating companies (TOCs) within the fire and rescue service area to avoid confusion. Rail operatives wear orange high visibility clothing as a matter of course.

See National Operational Guidance: Operations – Wear personal protective equipment and National Operational Guidance: Incident command for further information.

Working on railways

The following seven sections incorporate the hazards that may be found at all incidents involving working on railways.

Moving rail stock

Hazard	Control measure
Moving rail stock	Apply rail transport incidents control measures Maintain safe working distances (moving rail stock)

Hazard knowledge

People working on, or near, the rail system may be struck by moving rail vehicles. Factors influencing the likelihood of this are:

Rail vehicle speed

Approaching rail vehicles can be very quiet, can appear from either direction on the track, and generally travel up to 200 km/h (125 mph). At these speeds, stopping distances can be up to 1.6 km (1 mile) and may make it impossible to bring the rail vehicle to a stop before reaching the scene of operations. High speed and international services travelling on High Speed 1 (HS1) can operate at speeds of 300 km/h (186 mph) and the stopping distances during emergency braking may be increased to 4.5 km (2.78 miles). In addition, it may be difficult to discern the speed of any approaching rail vehicle and therefore to safely predict the time available to move to a place of safety. This may be further influenced by conditions affecting visibility including weather conditions, time of day, track geometry and topography of the surrounding area.

It should be noted that a commonly experienced visual illusion is that trains seen from a distance are moving slowly, when in fact they may be travelling at over 100mph. This is due to the relatively small change in the apparent size of the front of the train, as experienced by the eye, when it is approaching from a distance. It should be assumed that any approaching train is travelling at line speed.

Air turbulence

When a train is moving it creates air turbulence. This turbulence, in turn, forms an area of low pressure adjacent to the carriages. Personnel standing close to a passing train are in danger of being sucked towards it.

Observation by a safety officer should be from a safe position away from the tracks (three metres away, with back turned towards tracks) and on stable footing, to avoid being drawn into the path of a passing train by turbulence. The majority of station platforms will have lines marked on them. Crews should stand behind these lines to avoid turbulence from passing trains.

Control measure – Apply rail transport incidents control measures

Control measure knowledge

Refer to Hazard – Rail transport incidents - Apply all control measures from this section

Control measure – Maintain safe working distances (moving rail stock)

Control measure knowledge

Personnel should not come within three metres of any moving rail stock. Where circumstances dictate that this limit needs to be reduced, trains must be cautioned or stopped.

See Hazard – Rail transport incidents, Control Measure - Proportionate control over railway.

Strategic action

Fire and rescue services should:

- Provide tactical guidance to ensure crews are aware of safe working distances when working within the rail infrastructure environment

Tactical actions

Incident commanders should:

- Ensure that no personnel work within three metres from the track unless all rail vehicles have been confirmed as 'stopped' by the responsible person
- Consider risk versus benefit of maintaining 3m working distance in life saving circumstances; apply temporary control measures such as safety officers to provide warning of moving rail vehicles

Complexity of rail infrastructure

Hazard	Control measure
Complexity of rail infrastructure	Apply rail transport incidents control measures Identify utilities adjacent to rail infrastructure

Hazard knowledge

The railway's built environment has developed over many decades, with varying facilities to assist fire and rescue service intervention. The construction and topography of the rail system varies widely and will have an effect on fire and rescue service operations and safe systems of work.

Some areas of the rail network present additional risk due to the complexity of the location. These locations can include large rail terminals, junctions, regional stations or places where rail lines are used by more than one rail system. At complex layouts or junctions, rail vehicles may move from one track to another in a short space of time, and may approach from either direction.

At level crossings the railway will interface with road or pedestrian users, which can present an additional complexity.

For complex infrastructure or depots and sidings, pre-planning and tested communication arrangements should be put in place.

To effectively manage a rail incident, it is essential that fire and rescue service responders have a suitable awareness of the nature and complexity of the rail infrastructure they are attending. For the purposes of fire and rescue service intervention, railway infrastructure can be broadly categorised as *managed* and *unmanaged*.

Managed infrastructure is typically within an urban rail system, such as a metro system or rail infrastructure that has holistic emergency response protocols, often managed by a train operating company.

Unmanaged infrastructure is typically remote from urban areas and is likely to be managed by Network Rail. Both types will prompt a certain response from the infrastructure operators, but this will differ according to infrastructure operator capability and the geographical constraints that may affect response and attendance times.

The main infrastructure will include stations, track, depots, sidings, railway arches and overhead line equipment (OLE). All will have their own inherent hazards.

Rail stations

Larger train stations are likely to be complex environments. There may be adjoining properties that may become involved in an emerging incident and neighbouring properties that may need to be considered for evacuation purposes. Larger train stations may have phased evacuation, depending on the nature of the incident or the means of alarm initiation. It is vitally important for responding crews to fully understand the infrastructure risks and the principles of evacuation. See National Operational Guidance: Operations.

A station usually consists of one or more buildings for passengers, and possibly goods, and may be constructed over a number of levels. A 'terminal' or 'terminus' is a station at the end of a railway line.

Large train stations may have a number of rail companies operating in different areas, with varying emergency procedures. Railway stations will have public and non-public areas; the areas for providing public access will generally present limited hazards. Some facilities provided to keep the public safe can present a potential obstruction to a fire and rescue service, for example, platform edge doors or barriers. Methods of opening these facilities should be readily available to station staff.

Non-public areas can present additional hazards to those generally encountered in public areas, such as:

- Fast-moving rail traffic
- High voltage electrical equipment for train stations and infrastructure
- Power supply equipment
- Unusual direct access to the track

In addition to the hazards encountered on other parts of the railway, firefighters and station staff should also be aware of other factors that may have a bearing on incidents located on, or near, a railway station. Many railway premises are historic buildings and are likely to have heritage value.

Railway arches

Railway lines that run though major towns or cities are frequently elevated. To achieve this, arches are constructed and can be adapted for a variety of uses, such as garages, storage, entertainment venues, offices and workshops.

In an incident within the arch, a number of additional hazards can be present. These include:

- Difficult access – the arch may only have one point of entry and the main entrance can span a large opening and be strongly secured
- Lack of openings – making ventilation difficult to achieve.
- Arduous working conditions – caused by the lack of ventilation and heat retention by the structure of the arch, which is generally constructed of thick masonry
- Complicated layout – due to internal modification of the arch
- Contents of the arch – may include highly flammable goods, hazardous materials or gas cylinders
- If involved in a fire, the effects on the rail infrastructure above, including the effect of any smoke on the movement of rail traffic and overhead line equipment (OLE)

See National Operational Guidance: Fires in the built environment

Depots or sidings

Depots or sidings can be described as a short stretch of track, or tracks, that are connected to the main infrastructure. They may be provided for a number of purposes, such as:

- Parking rolling stock
- Storing rail vehicles, including those carrying hazardous materials
- Loading and unloading
- Maintenance facilities particular to the type of vehicle such as fuel, chemicals, gas cylinders and waste
- Allowing rail vehicles to pass
- Parking rail vehicles for servicing, cleaning or maintenance
- Loading or unloading goods
- Storing of track welding powder
- Storing of detonators (used as warnings signals)

Depots or sidings may differ from the main infrastructure in that:

- Sidings are often designed to allow several trains to be spaced closer than usual
- No signal may be provided
- Their control and ownership may be shared between several parties

The shunting of wagons around a depot may take place without warning and personnel should not stand immediately behind, in front of, or adjacent to, rolling stock on a siding or depot. Until a clear assurance has been provided that all train movements have been controlled, fire and rescue service personnel must not:

- Attempt to move between two stationary rail vehicles, or a stationary rail vehicle and a set of stop blocks, unless there is at least a gap of 30 metres between them
- Crawl under, or over, any rolling stock

These locations can present a challenge to the fire and rescue service as various areas presumed to be under their control may be under separate ownership and management control.

Certain locations will require the fire and rescue services to carry out pre-planning to establish the managing party (and its location) and identify the uses and processes that are undertaken at the location. This information should be used to develop appropriate Site-Specific Risk Information (SSRI). These plans should identify areas of ownership and management responsibility such as:

- Who operates in which area?
- Whose responsibility is it to provide safe access for the fire and rescue service?
- Who controls power supplies to which areas?
- Who are vehicles controlled by, and to what extent?

- Who the fire and rescue service should contact to obtain information relating to hazards and risks, including what is stored on rail vehicles?
- What are the arrangements for attendance of the responsible person at tactical command?
- What are the means of identifying the responsible person at tactical command, and what authority they will have over the wider premises?

Railway wagons loaded with hazardous materials are occasionally parked in railway sidings or depots. Military explosives should not be transported with other goods and may be undeclared.

Incident commanders must be aware of the potential for a wide variety of hazardous loads at such locations, and of the importance of liaising with rail staff, where available, to identify loads.

The permanent way

The track on a railway or railroad, also known as the permanent way, is the structure consisting of the rails, fasteners, sleepers, and ballast (or slab track), plus the underlying subgrade. It enables rail vehicles to move by providing a dependable surface on which their wheels can roll.

The term permanent way also refers to line-side structures, such as fences. This can also be referred to as the operational railway and it is normal that the area between the two boundary fences is called the operational railway. The track bed and surrounding infrastructure can cause a potential for slips, trips and falls for personnel entering, or working in, this environment.

The track side has traditionally been used as a temporary store of redundant railway material, as well as undergrowth or waste from fly tipping. This again provides further slip, trip and fall hazards. If a decision is taken to evacuate passengers along the track, then consideration should be given to the speed at which they can safely move, and in dealing with those of limited mobility.

Incident commanders should consider the effect that unusually large volumes of water may have on the rail infrastructure. Such volumes of water, for example, from flooding or high volume pumping, can weaken embankments and misalign running rails. This can have disastrous outcomes even some time after the event. Because of the potential for such damage, the permanent way should not be used as a conduit for removing large volumes of water from nearby flooding incidents.

Railway points

A set of railway points is a mechanical installation enabling rail vehicles to be guided from one track to another. Points can be either mechanically or electrically moved from within a signal box or a control room and may be remotely operated. Remote operation can result in foot entrapment, severe injuries and increased risk of exposure to rail vehicles impact.

Points represent a significant trap hazard to firefighters as they can move rapidly without warning. The points are set automatically when a signaller selects a route for a rail vehicle

A single signalling centre can control many miles of track, so a signaller should not be expected to have an awareness of personnel in the vicinity of points. If entry onto the tracks is required, proportionate control over the railway must be applied and this will usually prevent point movements but the risks from points movements should always be considered.

To avoid railway points becoming frozen and inoperable during cold weather, point heaters that are predominantly powered electrically are used. Traditionally, LPG was used to fuel point heaters. The gas cylinders were normally housed in small wooden cabinets next to the track and the main heating assembly would be supplied with gas via a length of low pressure tubing. Examples of these may still be found on heritage or industrial railways.

Even after traction power has been isolated, points can still move and trap feet as they are powered by a separate electrical system and may still be operated from non-electric or diesel traction rolling stock.

Heritage rail

Heritage railways retain the line-side hazards from that era (some of these can still be found across Network Rail infrastructure). Hazards connected with heritage railways may be:

- Point operating rods – running adjacent to the tracks in the cess and crossing the tracks underneath the running rails, creating entrapment, slips trips and fall hazards
- Semaphore signal operating wires, pulleys and rods – running adjacent to the track in the cess on raised supports, and crossing the tracks underneath the running rails, creating entanglement, trips and falls hazards
- No response from a railway incident officer (RIO) as these networks are not part of the normal National Rail infrastructure
- No immediate engineering support for incidents, derailments, etc.

Bridges and viaducts

A bridge is a structure built to span a gorge, valley, road, railway track, river or any other physical obstacle. The design of a bridge will vary depending on the function of the bridge and the nature of the terrain on which the bridge is constructed. There are a number of additional hazards to consider when dealing with incidents in the vicinity of bridges, such as working at height, restricted safety areas and difficult access. Before any entry into tunnels or viaducts, rail traffic must be stopped.

Bridges that have been struck by moving road or rail traffic should be examined by the infrastructure manager. See network rail bridge strike protocol http://www.networkrail.co.uk/aspx/12824.aspx

Viaducts are used to overcome steep gradients that are caused by geographical features such as gorges and valleys. They are raised sections of track, supported on pillars or on a series of arches.

All bridges and viaducts have unique identifying numbers marked by a metal plaque. These numbers should be relayed to the infrastructure manager, and can be used to establish the exact location of incidents.

Control measure – Apply rail transport incidents control measures

Control measure knowledge

Refer to Hazard – Rail transport incidents - Apply all control measures from this section

Control measure – Identify utilities adjacent to rail infrastructure

Control measure knowledge

Cabling and infrastructure for national grid or local third party electrical supplies are likely to present the most immediate difficulties to firefighters when dealing with railway incidents. Local fire and rescue services should identify the presence of additional electrical supplies when carrying out routine familiarisation visits.

The infrastructure manager responsible for the system has no direct control over these supplies. However, the responsible person may be able to provide information on identification and ownership from their organisational database. The duty for isolating the supply rests with the utilities undertaker and normal local fire and rescue service procedures will apply.

Cable trunking is provided to carry cables through the infrastructure and may appear to provide a suitable pathway for access and egress of firefighters. Generally, most trunking is capped with a thin concrete slab. This has little tensile strength and can be susceptible to vandalism, often leaving it broken up and exposing cables. Trunking covers should not be used as walkways along the trackside as they are not designed for that purpose and may fail. In darkness they can also present significant slip, trip and fall hazards.

Strategic actions

Fire and rescue services should:

- Provide tactical guidance and support arrangements for identifying additional utilities within the rail environment

Tactical actions

Incident commanders should:

- Identify utilities installed adjacent to railway lines and assess the impact on the incident and the safety of personnel working in the vicinity

Rail power systems

Hazard	Control measure
Rail power systems	Apply rail transport incidents control measures Identify all present power systems Maintain safe working distance (overhead line equipment)

Hazard knowledge

Railways can be operated by numerous power supplies including steam, electrification, diesel and batteries.

Steam engines

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 whether the train is powered by steam.

The risks from the pressure systems on these rail vehicles are very severe and the application of water to steam boilers/engine fireboxes could have disastrous results. Advice from the responsible person must be sought.

Electrified railways

These can operate under a number of systems and voltages, using the following traction power supply systems:

- Overhead line equipment
- Third rail supply
- Fourth rail supply

Some rail systems obtain their traction power by 'picking up' electricity from the overhead line, using a roof-mounted pantograph, while third or fourth rail systems use 'collector shoes' mounted close to the bogies.

Overhead line equipment (OLE)

Overhead line equipment (OLE) power can be provided for alternating current or direct current rail vehicles. It consists of a live contact bar, or wire, suspended by a catenary wire, which is supported by a complex system of suspension cables, arms and tension devices. Every OLE structure has a unique number displayed that can be used to identify it. This can be extremely useful to the fire and rescue service and infrastructure managers when determining the location of an incident. The equipment is fed from a railway feeder or sub-feeder station. They operate at up to 25 kilovolts alternating current for 'heavy' vehicles (such as for the National Rail network or large metro systems). Typically 'light' rail vehicles (trams or lighter metro vehicles) operate between 550 and 750 volts direct current, but exceptionally may be up to 1,500 volts direct current.

Due to the close proximity of the overhead line equipment (OLE) to the train line any fire incidents, whether simply in the vicinity or involving rolling stock, should be treated with extreme caution as electricity can be conducted in carbon-induced smoke.

See National Operational Guidance: Fires and Firefighting (to be confirmed)

The rail vehicle will have a 'pantograph' on top to collect traction power. This will make contact with the live bar or wire, and will therefore also be live.

Always assume that the overhead line equipment (OLE), and everything in contact with it, is live and extremely dangerous until formal assurance is provided.

Each overhead line equipment (OLE) structure has a cable connecting it to the running rail. This is known as a bond. Some bonds are coloured red and are dangerous if they become disconnected. They must not be touched, and should be reported to the rail infrastructure manager or railway incident officer (RIO), to ensure control measures are adequate.

Overhead line equipment (OLE)is under tension and therefore, if damaged, it could collapse and recoil with force, remaining electrically charged until safely isolated and earthed.

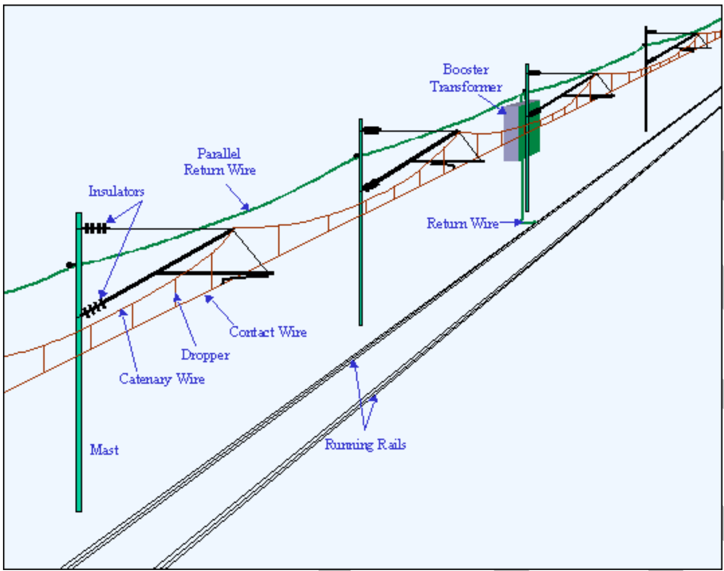

Figure 5: Overhead line equipment (OLE)
Source: railway-technical.com

Overhead line equipment (OLE) warning line (also known as the cant rail warning line)

The overhead line equipment (OLE) warning line is applied to rail vehicles, to be clearly visible when viewed from rail level and from platform height. This is so that personnel working at these levels can see the safe limit for working when a traction and rolling stock vehicle is under OLE equipment.

The warning line is normally painted orange, unless this conflicts with the train operating company's brand colours, in which case it may be either white or black; depending on which gives the greater contrast. Network Rail personnel are prohibited from working on the exterior of rail vehicles above the overhead line equipment (OLE) warning line under live overhead equipment at all times. This can be referred to as the 'cant rail'.

The overhead line equipment (OLE) on national or metro services is divided into sections by means of switch gear at feeder stations and track-sectioning cabins. It operates on sections or circuits that vary in length, but can be 30 miles or longer.

Incident commanders should be mindful that when isolation is requested, it may have a serious impact on all train services within a radius of approximately 20 miles. This could leave station platforms overcrowded and also mean that trains are left stationary on the track or in tunnels, with no power supplies to keep lighting or air conditioning units functioning. However, this must not interfere with the decision to provide a safe working environment for firefighters. These circumstances are likely to raise the stress levels of stranded passengers, which could lead to a further risk of passengers descending from the train onto the track.

Third rail and fourth rail

The third/fourth rail traction system uses a conductor rail operating at a nominal voltage of 750 volts direct current in most areas. A 'pick up shoe' on the train conducts the electrical current from the rail to the motor of the train.

The shoes are interconnected and it should be assumed that if the shoe at one end of a unit is in contact with the third rail, then all shoes on all vehicles in the unit are live. The return circuit is normally provided by the axles and wheels. The control system is similar to that for the overhead line equipment (OLE). Sub-stations convert alternating current to the direct current supplied to the conductor rails, and the overall contact of the circuits is supervised from a control room. Qualified rail infrastructure staff can isolate local sections on-site by, for example, the manual operation of trackside switches. In either case, the individual providing assurance of isolation to the fire and rescue service, and providing details of the safe working area for crews, should have their personal details recorded and the information passed, via fire and rescue service control, for forward transmission to the infrastructure manager.

Anything touching the line, including firefighting media, flood water or parts of the rail vehicle, should always be regarded as live for both third and fourth rail systems, until assurance has been provided by the train operating company.

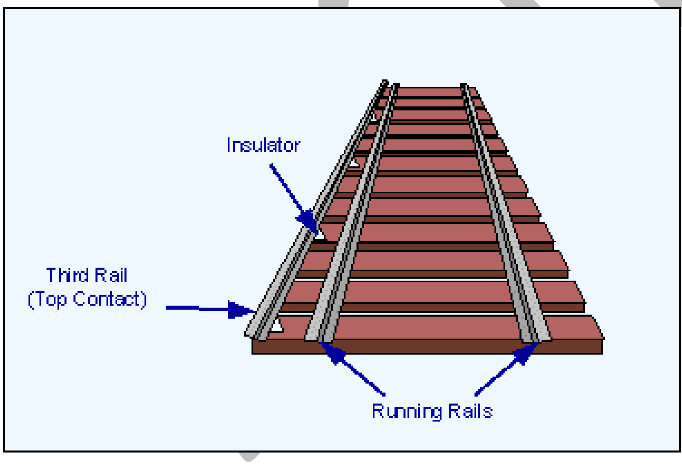

Figure 6: Diagram showing third rail
Source: railway-technical.com

There is a risk that a rail vehicle may bridge an isolated and an energised section which may inadvertently re-energise both sections. The deployment of a short-circuiting device (SCD) by rail professionals, or confirmation of power-off, must be sought.

A relatively new concept to conductor rail – certainly to third rail – is the fitting of conductor rail heating to prevent ice and snow forming on the conductor rail and compromising traction. This is particularly relevant at the exits of stations and on sections of track where low speeds can be encountered. The principle behind heating the conductor rail is to allow the rail vehicle to accelerate under its own traction up to about 30mph, to allow it to get away from the station, or perhaps from a signal location where the rail vehicle may have been required to stop. To achieve this, a section of around 200 metres of conductor rail is heated on the exit track of the station, or where the rail vehicle needs to pull away from the signal. Once speed reaches 30mph the 'pick up shoe' is able to act as its own 'scraper' and take traction. This strip-heating means of supply is generally powered by electricity, and fire and rescue services should familiarise themselves with the means of isolation when required.

Further info can be found here http://www.graybar.co.uk/file/catalogue/48-pdf.pdf

Diesel

In the absence of third and fourth rails and overhead line equipment (OLE) systems, rail vehicles will be self-powered, almost inevitably by diesel traction. Diesel vehicles may operate independently of an electrical power supply to the rail track or overhead catenary. When operating under diesel power, rail vehicles can only be stopped by communication with the driver or when the vehicle reaches a stop signal. Diesel vehicles may carry significant amounts of fuel, lubricants and batteries, and locomotives and some carriages will be fitted with electric alternators and electric traction equipment.

Battery

Batteries are used as the sole traction power source on limited numbers of rail vehicles, including passenger carriages. This type of rail vehicle is typically used for maintenance work on the London Underground and on some industrial and heritage railways. In future however, hybrid battery-diesel vehicles could be encountered, where traction power can be from either source.

The impact of requesting the power off (see Hazard – Rail transport incidents, Control measure – Establish proportionate control over railways) can affect train vehicle movements over a very wide area, covering several fire and rescue services. The size and nature of the incident combined with the complexity of the rail system, or adjacent systems, involved will determine the level of control that should be applied to the incident. More than one level of control could apply to an incident; at larger incidents this may include arrangements for using rail vehicles to assist with the recovery stage.

It must be noted that these controls will only affect the movement of rail vehicles and the traction power supply. Other hazards, such as any third party high voltage electrical systems including the National Grid or infrastructure electrical systems, may remain live. These may be controlled using established procedures for securing electrical safety. At locations where high voltage electrical supplies run adjacent to the area of operations, there is a risk that an electrical current will be induced into any isolated cable. Once the incident commander has determined the extent and level of control required, a message should be formulated and transmitted.

The railway control room can action requests to stop rail vehicles or to turn off the traction power supply. They can also arrange for trains to be cautioned (allowed to proceed at a reduced speed) where necessary. See Hazard –Rail transport incidents, Control measure – Establish proportionate control over railway.

Personnel must always be cautious as the electrical supply to the points is independent of all other power supplies and if isolation is requested for a particular area of the track, this may not include the power supply to the points, and these can still move and trap personnel or equipment.

For further information refer to rail information documents

Control measure – Apply rail transport incidents control measures

Control measure knowledge

Refer to Hazard – Rail transport incidents - Apply all control measures from this section

Control measure - Identify all present power systems

Control measure knowledge

It is vital that the various power supplies within fire and rescue service boundaries are identified, and full training is given to identify their respective hazards and on how to stop moving rail vehicles.

Strategic actions

Fire and rescue services should:

- Be fully aware of the operation of rail vehicles within their boundaries, identifying whether they are electrified, steam or diesel
- Identify the power supplies (i.e. overhead line equipment (OLE) or whether there is a third or fourth rail) where rail networks are powered electrically

Tactical actions

Refer to Hazard – Rail transport incidents, Control measure – Establish proportionate control over railway.

Incident commanders should:

- Request isolation of the power supply, remembering that, unless earthed, DC conductors and AC overhead line equipment (OLE) equipment may hold residual charge
- Establish the line speed and implement appropriate control measures
- Request and establish whether trains are stopped or are running at caution
- Provide crew briefings as to the hazards
- Avoid any contact with live electrical power systems
- Wear high visibility clothing
- Where there is any doubt, always assume the power supply is live
- Reminders to push or pull any casualties clear with non-conductive equipment, for example, a dry line or wooden pole

- Reminders that personnel and equipment should not be allowed within three metres of any overhead line equipment (OLE) unless isolated, and that for the rescue of live person(s) personnel and equipment must not come closer than one metre unless earthed
- Request the use of short-circuiting devices (SCD) – to be used only by qualified personnel
- Consider that rain and flooding can increase the electrification hazard
- Ensure that, where possible, all personnel stand on dry, non-conducting material such as a salvage sheet without metal ringlets

Control measure – Maintain safe working distance (overhead line equipment)

Control measure knowledge

The safe working distance from overhead line equipment (OLE) is three metres. However, if a person is in need of rescue, the safe working distance is no closer than one metre from the OLE, including personnel and any equipment. In this instance, incident commanders should ensure that 'emergency SWITCH OFF' is requested immediately and train vehicle movements are stopped before commencing any operations. Confirmation that the emergency switch off is in place must be received from the rail operator before any person or conductive equipment comes closer than three metres.

When a member of the fire and rescue service, or any conductive material, has to come closer than one metre to overhead line equipment (OLE), a further request for earthing must be made, and there must be confirmation that earthing has been carried out, before crews wearing full personal protective equipment (PPE), including electrical gloves, can remove any casualties from cables or machinery using dry non-conductive equipment. If there is an immediate life-saving opportunity, where waiting for the line to be earthed may lead to loss of life, a rescue can be attempted following confirmation that the power is isolated, and as long as crews remain at least one metre from OLE and use dry, non-conductive material to carry out their actions. Full PPE and electrical gloves must be worn.

For information a rail incident officer (RIO) cannot earth overhead line equipment (OLE) and a specialist team will be dispatched to carry this out, which will result in delays.

Terminology used in the rail industry for emergency isolation is emergency 'switch off'; this term should be understood and used by fire and rescue services. Emergency switch off will normally occur between two neutral-to-neutral sections covering an approximate area of twenty miles; the whole of the track and surrounding utilities will be isolated on receipt of this request. A request to isolate a particular line won't apply on a request of an emergency switch off.

Other factors may require overhead line equipment (OLE) traction current to be shut down, such as:

- A rescue is to be carried out in smoke or high humidity (e.g. following a fire in a tunnel)
- There are signs of damage to, or collapse of, the overhead line equipment (OLE) structures
- It is not possible to assess how far a casualty is from power supplies

Until a section of overhead line equipment (OLE) is both isolated and earthed it is possible that residual current is present. Where high voltage power lines are located close to isolated OLE power cables, it is important to ensure that the cables are isolated and earthed, to avoid introducing additional risks to firefighters through the induction of electrical current. There is also a risk that when a line is isolated, but not earthed, an electrified rail vehicle can still pass into the isolated area and re-energise this section of track.

Rescues involving direct current electric rail (third and fourth rail systems)

When performing a rescue from traction current involving electrified third or fourth rail systems, incident commanders should implement all relevant control measures.

If necessary, a rescue may be attempted before power off is confirmed providing:

- Crews wear full personal protective equipment (PPE) including electrical gloves
- The rescuer is standing on dry, non-conducting material (such as dry salvage sheet without metal ringlets, wood or thick rubber)
- If the above cannot be achieved, then the person should be moved away using dry non-conductive material; metal objects must not be used.

Strategic actions

Fire and rescue services should:

- Include safe working distances from overhead line equipment (OLE) and other electrical systems within the rail environment in their safe systems of work and procedures
- Ensure staff are trained on safe working distances from overhead line equipment (OLE)

Tactical actions

Incident commanders should:

- Ensure staff and equipment are kept at least three metres away from overhead line equipment
- Only allow an approach to within one metre if life is at risk, and then ensure:
  - Power is off and the line is earthed
  - Rescuers use electrical gloves
  - Rescuers stand on dry non-conducting material, if available

Access to railway infrastructure

Hazard	Control Measure
Access to railway infrastructure	Apply rail transport incidents control measures Identify places of safety and refuge

Hazard knowledge

Railway access can be difficult because of tunnels, embankments, viaducts, buildings and security fences. Incidents on the railway can occur in urban and rural environments, on lengthy sections of track, within tunnels, on elevated sections of track, and within multi-use stations involving the built environment.

A significant feature of fire and rescue service operations at railway incidents is access, egress and evacuation of the public. Incident commanders should gather sufficient information to allow an incident's location to be identified, along with an appropriate access point to the infrastructure.

Access to rail infrastructure may be via an embankment or steep slope. Rail infrastructure embankments can be covered by falling leaves, scrub and brambles often thrive, and waste from fly tipping or from the railway, such as discarded rails or clips, can accumulate. Firefighter access may prove difficult due to the amount of scrub present; this is affected seasonally and should be considered when pre-planning. Inclement weather can cause access conditions to deteriorate rapidly. Consideration should be given to ensuring access/egress routes are established and maintained with weather conditions in mind.

Railway incidents are often linear by nature, with limited access points. This can have a significant effect on the provision of equipment and personnel to the scene of operations. Incident commanders should carefully consider the effects of the geography of any incident on logistics, supply chains and crew welfare.

The ability of fire and rescue service personnel to intervene effectively depends on the severity of the incident, the available systems and facilities, intervention strategies, the availability of resources and the limitation of fire and rescue service equipment.

Railway incidents are often spread over large areas with command points remote from operations. Incident commanders should therefore consider the early establishment of effective communications between the key points of the incident management structure.

Incidents occurring at these locations may present additional hazards associated with:

- Delay in reconnaissance to identify the location and type of incident, and subsequent difficulties in estimating resource requirements
- Delay in getting resources to the scene
- Restricted access
- Limited water run-off facilities
- Limited places of safety or refuge
- Ineffective radio communications

Adjacent roads, buildings, main rail junctions, level crossings and tunnels can help to identify the location of an incident. Location indicators include bridge identification plates, markers on overhead line equipment (OLE) supports, signals and trackside marker posts.

Control measure – Apply rail transport incidents control measures

Control measure knowledge

Refer to Hazard – Rail transport incidents - Apply all control measures from this section

Control measure – Identify places of refuge and safety

Control measure knowledge

Some parts of rail infrastructures have designated 'authorised walking routes', providing safe access to or from a place of work. These are normally found near depots, siding or stations. Once control measures are implemented, using these facilities will assist operations. At larger incidents, designating agreed temporary walking routes will assist safety management. These will normally highlight avoidable hazards, such as walking on line-side cable trunking, which is not intended to be used as a pathway. On some parts of the railway, the space between the track and the nearest wall or structure is very narrow. These are areas of limited clearance.

Figure 7

The red signs shown above indicate that there is no position of safety on this side of the railway for the length of structure beyond it.

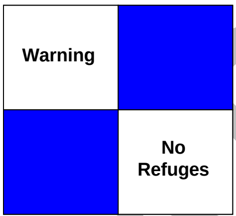

Figure 8

The blue sign above indicates there are no refuges on this side of the railway, but there are on the other side. Again, this example of signage clearly indicates that the area beyond is too dangerous for personnel while rail vehicles are running on the side that does not have refuges.

Figure 9

The sign above indicates there are no refuges and that no positions of safety exist. Personnel should not go past this point when rail vehicles are running.

Strategic actions

Fire and rescue services should:

- Ensure that personnel attending rail incidents understand the signage found along rail routes

Tactical actions

Incident commanders should:

- Identify any signage, and provide information on safety, as part of any operational risk assessment before personnel are committed
- Brief crews that are moving around the rail infrastructure on the following points:
  - Keep to the defined working areas
  - Stay alert – keep watching and listening
  - Do not assume safety because a signal is showing a red light or stop signal
  - Use a designated walking route or pathway
  - Face on-coming trains (remember tracks can be bi-directional)

Track welding powder

Hazard	Control measure
Track welding powder	Request specialist knowledge from responsible person Establish appropriate cordons

Hazard knowledge

Classified under the United Nations ADR (Accord européan relatif au transport international des marchandises Dangereuses par Route) scheme as a Class 4.1 Flammable Solid, track welding powder is used principally for jointing sections of track.

Figure 10: Example of track welding powder on a track
Source: Open source

This granular substance consists of around 70% iron oxide and 30% aluminium filings. Once ignited, it produces a highly exothermic reaction, enabling the pre-heated ends of the rails and the track welding powder to bond and form a very pure iron weld. High carbon additives enable the weld to form steel.

When involved in fire, track welding powder reacts violently to the application of water.

For further detail of specific hazardous materials, refer to DCLG Operational Guidance – Hazardous materials 2012.

Control measure – Request specialist knowledge from responsible person

Control measure knowledge

Track welding powder (thermite) is carefully managed by Network Rail infrastructure managers. Unless being used at a rail worksite it will be stored in depots and marked in accordance with relevant hazardous material signage.

Strategic actions

Refer to Hazard - Transport incidents, Control measure - Use tactical advisers and Responsible Person.

Tactical actions

Incident commanders should:

- Avoid using water
- Liaise with the site responsible person(s) to develop and implement tactical plans

Refer to Hazard – Transport incidents, Control measure – Use tactical advisers and the responsible Person.

Control measure – Establish appropriate cordons

Control measure knowledge

Refer to Hazard – Transport incidents, Control measure – Establish appropriate cordons

Detonators

Hazard	Control measure
Detonators	Request specialist knowledge from responsible person Establish appropriate cordons

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, approximately twelve detonators are usually carried in a secure location in the driver's cab. They have an explosive and projectile hazard, though no projection of fragments of appreciable size or range is expected, and crews should maintain a distance of 30 metres (this distance will need to be increased if the incident involves a large number of detonators)

A railway fog signal is a small metal device containing a limited quantity of explosive. The device is placed on the running surface of a rail so that any rail-mounted vehicle passing over it would cause it to explode, and in so doing, alert the driver of the vehicle to a hazard on the line ahead.

Railway fog signals are painted yellow and they are classified under United Nations ADR (Accord européan relatif au transport international des marchandises Dangereuses par Route) as Class 1.4G (the same class as fireworks used for public sale or possession).

Figure 11: Hazard warning diamond for detonators

Originally stored in trackside cabins, detonators are now held in more secure locations, such as in buildings or in train cabs, to avoid the risk of being stolen and misused.

Figure 12: Example of detonator on a rail
Source: Open source

For further detail of specific hazardous materials, refer to DCLG Operational Guidance – Hazardous materials 2012.

Control measure – Request specialist knowledge from responsible person

Control measure knowledge

Refer to Hazard – Transport incidents, Control measure – Use tactical advisers and the responsible Person.

Strategic actions

Refer to Hazard – Transport incidents, Control measure – Use tactical advisers and the responsible person.

Tactical actions

Incident commanders should:

- Establish the number, type and location of devices carried, from initial information gathered from the driver or from the train operating company
- Assess the manufacturer's instructions, if possible

Refer to Hazard – Transport incidents, Control measure – Use tactical advisers and the responsible person.

Control measure – Establish appropriate cordons

Control measure knowledge

Refer to Hazard – Transport incidents, Control measure- Establish appropriate cordons

Working within underground rail infrastructure

Hazard	Control measure
Working within underground rail infrastructure	Apply rail transport incidents control measures Gather knowledge of the infrastructure Identify appropriate tactical plan

Hazard knowledge

It is estimated that approximately 650 railway tunnels are in regular service, totalling over 200 miles of tunnel in the United Kingdom. Most fire and rescue services will have mainline railway tunnels within their area which will vary in length and complexity.

Underground rail infrastructure can be complex and can present hazardous working environments, requiring that a flexible approach be adopted when planning a tactical response. The extreme conditions that can rapidly develop, and the potential for disorientation, can make operations difficult, tiring and resource intensive. Tunnels that appear straightforward can lead to confusion because of the repetition of features and the lack of way-finder indicators.

When dealing with a railway tunnel incident, operational issues related to tunnels should be considered, in conjunction with design features and operational issues related to railway incidents. Whichever type of system is in use, some of the features specific to railway tunnels might include:

- The characteristics of railway use mean that the tunnels can be longer than other sorts of tunnels
- Often large numbers of the public will be on a rail vehicle, and there may be a lower level of staff supervision at an incident
- Rail vehicles held in tunnels may become hot and uncomfortable, causing passengers to become distressed or unwell

Control measure – Apply rail transport incidents control measures

Control measure knowledge

Refer to Hazard – Rail transport incidents - Apply all control measures from this section

Control measure – Gather knowledge of the infrastructure

Control measure knowledge

Responders will need to gather knowledge of the type of infrastructure. Because large numbers of people may be involved in exiting the tunnel environment (who may be unfamiliar with the location), knowledge of the infrastructure's access and evacuation strategy, pressurised escape areas or intervention shafts will also be needed.

Incident commanders should also give consideration to the following when dealing with railway incidents in tunnels:

- The type of line (i.e. single or multi-directional)
- Whether or not the line is electrified i.e. overhead line equipment (OLE) or third/fourth rail
- Whether the overhead line equipment (OLE), or associated equipment, is involved in the incident
- Water supplies
- Emergency lighting
- Access to track level and transport of equipment
- Exhaust fumes from petrol-driven light pumps, generators and positive pressure ventilation fans
- Any structural damage that may affect the structural integrity of the tunnel

Strategic actions

Fire and rescue services should:

- Ensure personnel are trained and competent in identifying the evacuation and intervention strategy for underground rail structures

Tactical actions

Incident commanders should

- Contact the infrastructure controller by agreed means
- Maintain communication with responsible persons to ensure the accuracy of relevant information

Control measure – Identify appropriate tactical plan

Control measure knowledge

When tackling incidents in underground rail, an understanding of the following is required:

- Fire and smoke behaviour in enclosed spaces
- Rapid smoke or firespread
- Difficult or limited access or egress
- Communication problems
- The effects of high ambient temperatures
- Physiological, psychological and biological hazards

Through pre-planning, liaison and exercising, fire and rescue services should have an understanding of the capability of the infrastructure fixed installations and fire suppression systems, to assist in safe and successful incident resolution. Effective plans should include the role of the responsible person and how this can support the emergency service joint operating plan.

Knowledge of the facilities, network actions at incidents and operating principles of train operating companies that may assist the fire and rescue service includes:

- Plans or plan boxes
- Intervention and evacuation points
- Bridgeheads and firefighting lobbies
- Fire-rated vision panels and spy holes
- Firefighting mains
- Communications systems
- Electrical supplies for fire and rescue service use
- Gas monitoring for pollution or untenable atmosphere indicators
- Fixed firefighting and suppression systems

An awareness of the following should also be considered:

- The effects of deteriorating conditions for those trapped or engaged in rescue, because of high heat, humidity and smoke logging
- Tactics to overcome the difficulty in assessing the extent, nature and likely development of an incident, and difficulty in moving about and applying extinguishing media (because of vehicles, available space of infrastructure or storage arrangements, for example)
- The effects of ventilation, smoke logging/back layering – if there is no ventilation, the tunnels will rapidly become smoke logged; back-layering is a phenomenon encountered in tunnel fires, and occurs when the movement of smoke and hot gasses is reversed counter to the direction of the ventilation flow

Refer to National Operational Guidance: Fires and Firefighting – Piston effect.

Strategic actions

Fire and rescue services should:

- Ensure personnel are trained and competent in identifying the specific hazards, risks and operational techniques required
- Use policies, tactics and equipment that mitigate the risks posed by the tunnel or the underground operating environment
- Ensure established processes are agreed and included in fire and rescue services tactical response plans, and within infrastructure operators' plans

- Ensure that policies and procedures are complementary and understood by all affected parties, through effective liaison with infrastructure managers and other emergency services
- Reinforce procedures through pre-planning, continued liaison and periodic exercising, where appropriate

Tactical actions

Incident commanders should consider:

- Activating local or area-wide automated fire or smoke ventilation and/or suppression systems, normally by the infrastructure manager, on discovery of an incident
- Maintaining contact with the infrastructure controller by agreed means, normally through an on-site responsible person or via fire and rescue service control, so that requests can be made remotely (for example, power isolation)
- Obtaining confirmation from the infrastructure managers on the status and operation of systems used to protect members of the public, staff and firefighters, such as:
    - Ventilation systems
    - Pressurised escape areas or intervention/access shafts
    - Current status of high voltage electricity

Incident commanders should:

- Ensure appropriate measures are employed to reduce hazards within the underground environment – the role of the responsible person and their sector competent knowledge will be critical in ensuring operations are managed safely
- Consider whether products of the incident are being dispersed into the community

Working with rolling stock

The following three sections incorporate the hazards that may be found at all incidents involving working with rolling stock.

On-board train systems

Hazard	Control measure
On-board train systems	Request specialist knowledge from responsible person

Hazard knowledge

Air systems

Except for most 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. Modern electric traction will also have a rheostat brake in which the electric motor is effectively made to turn against itself, acting as a dynamo, and generating an electric current that can be returned to the overhead line equipment (OLE) (this is called regenerative braking), or passed with a large resistor to generate heat.

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

Please note that when there is a loss of air (due to a ruptured brake line, for example) the brakes are automatically applied along the length of the train. This is most common in a freight train.

The length of a large freight train means that there can be a measureable period of time between the brake being applied by the driver and the pressure in the brake line rising sufficiently to apply the brakes.

Air conditioning systems

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

Air conditioning 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.

Other risks

There is an emerging type of rail vehicle which has a raised level of electromagnetic risk and crews should not go under the front driving carriages of these units without the antenna being switched off. This can be achieved by the driver operating a battery off switch. There is no danger when minimum clearance of one meter to the antenna is maintained. Fire and rescue services should identify if this type of rail vehicle is operating within their areas.

Control measure – Request specialist knowledge from responsible person

Control measure knowledge

Refer to Hazard – Transport incidents, Control measure – Use tactical advisers and the responsible Person for control measure knowledge, actions and tactics

Hazardous materials within the construction of rolling stock

Hazard	Control measure
Hazardous materials within the construction of rolling stock	Request hazardous materials and environmental protection advice

Hazard knowledge

For further information refer to rail information documents

Asbestos (older rolling stock)

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 of asbestos 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 should only occur when there is a fire and/or catastrophic failure of the vehicle, such as a result of a serious collision, for example. However identification of the possible existence of asbestos should always be sought and any potential exposure should be controlled, no matter the type of accident.

Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are organic, oil-soluble materials of moderate toxicity. The main risk to firefighters is through 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 polychlorinated biphenyls (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.

For further detail of specific hazardous materials, refer to DCLG Operational Guidance – Hazardous materials 2012.

Control measure – Request hazardous materials and environmental protection advice

Control measure knowledge

See National Operational Guidance: Hazardous materials. (Reference to be confirmed)

Incidents on or near to railway crossings

Hazard	Control measure
Incidents on or near to railway crossings	Apply rail transport incidents control measures

Hazard knowledge

Level crossings are railway lines crossed by a road or right of way without using a tunnel or bridge. Crossings are categorised into two main groups, although the layout, configuration and use of level crossings vary from location to location, so each one is essentially unique:

- Active crossings – these crossings give vehicle users and pedestrians warning of a train's approach by closing gates or barriers, or with warning lights and/or sound
- Passive crossings – these crossings have no warning system to indicate a train's approach and the road user or pedestrian is responsible for ensuring that they can cross safely

Fire and rescue service involvement at these locations includes many instances of road vehicles being struck by rail vehicles. These incidents can require careful assessment in terms of applying appropriate control measures, and local crews should be thoroughly familiar with the level crossings in their area.

Without compromising emergency responder or public safety, the incident commander will need to consider the impact of any request on the wider rail system.

When attending railway incidents, incident commanders must determine and establish proportionate control measures over rail vehicle movements and traction current that take into account local standard operating procedures and relevant national guidance. For any incident on or affecting a level crossing, rail vehicle movements must be stopped and any electrical current present must be isolated.

If implementing control measures such as stopping rail vehicle movements, and where switching off traction current is necessary, it is recommended that confirmation is received from the rail infrastructure manager before committing emergency responders. Any debris on level crossings can have a devastating effect on rail vehicles and this should be reported to the rail authority and trains stopped until cleared.

Control measure – Apply rail transport incidents control measures

Control measure knowledge

Refer to Hazard – Rail transport incidents - Apply all control measures from this section

Road

The following section incorporates the hazards that may be found at all incidents involving road.

Introduction to working on roadways and with road vehicles

United Kingdom road infrastructure takes many forms; each roadway has a varied number and type of users, including various organisations and local bodies responsible for their maintenance. If a road crosses a waterway or a rail level crossing, the risks, and therefore the need for additional skills and control measures, increase.

Given the varied nature of the emergency and non-emergency responders during an incident on the road infrastructure, it is highly recommended that fire and rescue services liaise closely with their partners to ensure that their controls and actions reflect and complement each other, with awareness of their associated documentation, for example:

- Strategic Road Responders Agreement – National Police Chiefs Council (NPCC), Chief Fire Officers Association (CFOA), Association of Ambulance Chief Executives (AACE) and Highways England (HE)
- Guidance for Ambulance Service response to Incidents on the Motorway Network
- College of Policing – Road Policing – linked reference material, including road related legislation
- M25 SMART Motorways All Lane Running (ALR) Regional Operating Agreement (ROA)
- Any associated memoranda of understanding (MoU), for example with any of the UK highways authorities
- Highways Agency Managed Motorways All lane running Concept of Operations
- Safe Use of Roadside Verges in Vehicular Emergencies (SURVIVE) Best Practice Guidelines
- Any other relevant legislation relating to transport and roads.

This should be taken together with acts and regulations defined in the Highway Code, which must also be complied with.

Road transport incidents

Hazard	Control measure
Road transport incidents	Apply all transport incidents control measures

Hazard knowledge

Fire and rescue services are encouraged to develop relationships and combined operating procedures with road infrastructure stakeholders; the hazards posed by undertaking fire and rescue service activities on any roadway is significant and the risks substantial.

For incidents on the road infrastructure, the hazard posed by the environment are:

- The actual roadway environment
- Its location, such as motorways, rural or urban roads
- The other road users, including their varied type and nature

- The nature of the road surface and layout, such as camber and gradient, or debris deposited from vehicle cargo or previous incidents
- The presence of embankments, kerbs, gutters
- Proximity to rivers and canals, bridges and tunnels
- Weather conditions that exacerbate the hazard such as excessive wind, snow, ice, rain and fog

Control measure – Apply all transport incidents control measures

Control measure knowledge

Refer to Hazard – Transport incidents - Apply all control measures from this section

Moving vehicles

Hazard	Control measure
Moving vehicles	Establish appropriate outer cordon

Hazard knowledge

The hazard of moving traffic is present at all incidents on roadways. The class of road involved will affect the type of vehicles encountered and their speed.

The numbers of vehicles on the road will vary depending on the location and the time of day. On quiet roads there is the potential for vehicles to be moving more quickly than expected.

The potential for collision will be influenced by a range of factors, including:

- Visibility – May be affected by weather conditions (e.g. rain) and topographical features (e.g. road bends and undulations).
- Road conditions – May be affected by road type and traffic speed, presence of junctions, weather conditions, substances on the road surface such as oil, the presence of casualties or debris on road and airborne hazards such as smoke
- Failure of other road users to drive with due care – Can cause collisions with fire and rescue service personnel, or cause other road users to take evasive action leading to further collision and/or additional accidents, all of which can impact on the original incident

When dealing with incidents on high-speed roads (motorways or dual carriageways), working across the central reservation will present a significant hazard to fire and rescue service personnel, members of other agencies and the public. The hazard is particularly significant if this results in fire and rescue service vehicles being parked in the outside lane of the unaffected carriageway without appropriate measures being put in place to control traffic on both the affected and unaffected carriageways.

Control measure – Establish appropriate outer cordon

Control measure knowledge

At incidents on roadways crews should wear appropriate high visibility personal protective equipment (PPE), park appliances in position to shield crews at work (fend off), use warning signs, lights and cones to warn oncoming vehicles, close the road where a safe outer cordon cannot be safely established, establish traffic management systems and cordons (safe cell) where required and appoint safety officers to warn crews of any oncoming vehicles.

Personal protective equipment (PPE)

Fire and rescue services should provide responding crews with high-visibility clothing that meets the requirements of relevant British standards for the environment within which they will be working.

Park appliances in position to shield crews at work (fend off)

Appliances should park at a diagonal angle of 45^o across the lane affected. This not only blocks the lane but being parked at this angle makes it more obvious that there is a hazard ahead, encouraging motorists to change lanes and start to slow down. This is known as the 'fend-off position' and is used as a buffer to prevent vehicles from colliding with an existing scene. If a vehicle collides with an appliance parked at the fend-off position, the forces involved in the collision should see that vehicle be deflected away from the scene thereby protecting the emergency workers.

The type of road and lanes affected will dictate the fend-off position of appliances. This procedure will create a 'safe cell' within which firefighters can work safely.

Use warning signs, lights and cones

The vehicle parked in the fend-off position must be well protected by portable warning devices such as lights, warning signs and cones.

Close roads

The enabling Fire Services Acts give fire and rescue service personnel the power to close a highway or stop and regulate traffic at a fire, road traffic accident or other emergency. This action should be considered where crew safety would be impacted by continued traffic movement, ideally in consultation with the police, highways agency or other relevant authority.

Appoint safety officers

In the event that an oncoming vehicle does not pay attention to cones and hazard warning signs a safety officer can alert crews at the scene of an approaching vehicle. The safety officer should have a method of communicating (whistle and a handheld radio) so that if a vehicle drives through the cones, warning can be given to the crews.

Strategic actions

Fire and rescue services should:

- Develop tactical guidance and support arrangements to ensure the safety of crews attending incidents on roadways and ensure they are able to create an outer cordon (safe cell) with the appropriate equipment required

- Provide responding crews with personal protective equipment (PPE) that meets the requirements of BS EN471: 2003

Tactical actions

Incident commanders should:

- Position initial appliance in a fend off position and use signage and cones to warn oncoming traffic
- Ensure appliances in attendance are using warning devices appropriate to their position on the roadway
- Consider positioning a safety officer adjacent to the first cone (off the carriageway), specifically briefed to watch oncoming traffic

Operating on SMART and all lane running (ALR) motorways

Hazard	Control measure
Operating on SMART and all lane running (ALR) motorways	Use agreed operating procedures

Hazard knowledge

For an appreciation of SMART and all lane running (ALR) motorways, refer to:

- www.highways.gov.uk
- www.gov.uk
- The AA
- RAC

SMART and all lane running motorways (ALR) present unique hazards and risks for emergency responders, including:

- A lack of hard shoulder or periodic use of the hard shoulder as a 'live' lane
- Potential difficulties for emergency responders attending the scene of a given incident, who are travelling with the flow of traffic

Motorways using SMART and all lane running (ALR) arrangements are each subject to deliberate and thorough liaison between the agencies that are likely to be required to respond to incidents in these areas. The aim of liaison is to:

- Improve the tactical management of traffic to enable faster access
- Encourage a greater degree of operational co-operation between agencies
- Establish a greater degree of information sharing between agencies

This is in addition to basic improvements such as agreeing common terminology amongst partners, reflecting the Joint Emergency Services Interoperability Principles (JESIP); for example, in relation to carriageways and slip roads identification:

Main carriageways are identified by the letters ‘A’ or ‘B’.

Carriageway ‘A’ = Ascending junction numbers and away from origin of motorway.

Carriageway ‘B’ = Descending junction numbers and back to origin of motorway.

Slip roads off the main carriageways are identified by the letters ‘J’, ‘K’, ‘L’ or ‘M’:

- ‘J’ – Slip road off Carriageway A,
- ‘K’ – Slip road onto Carriageway A,
- ‘L’ – Slip road off Carriageway B, and
- ‘M’ – Slip road onto Carriageway B.

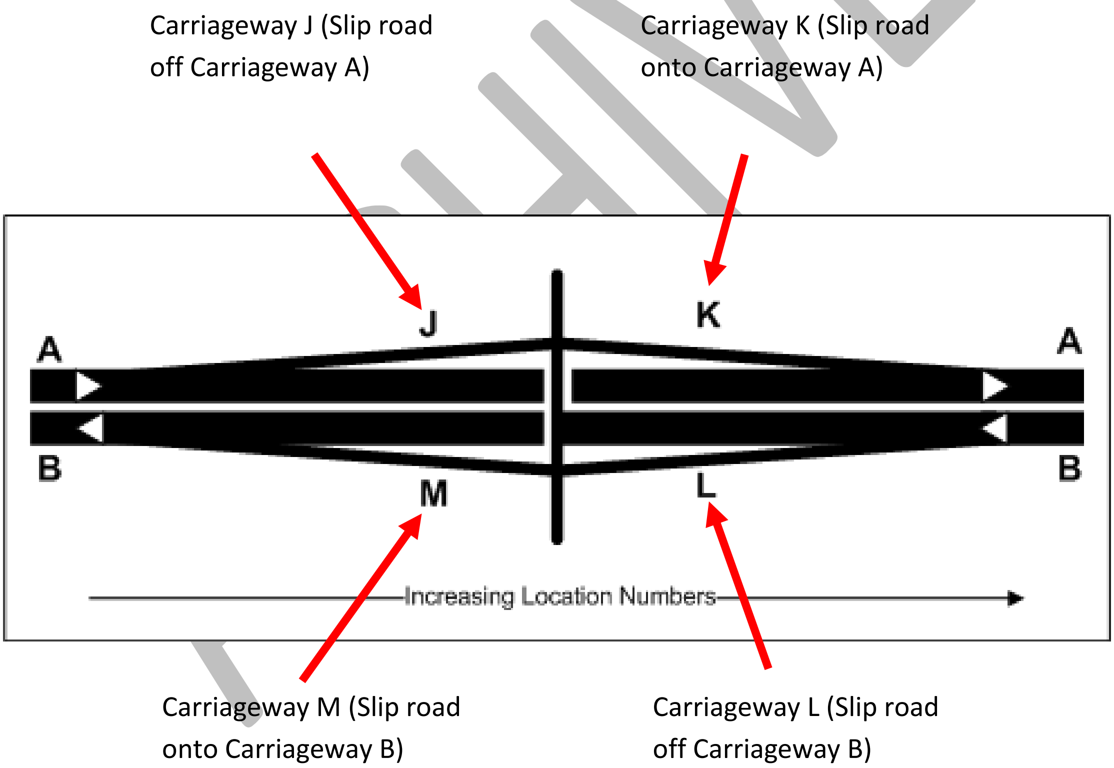

Figure 13: Carriageway and slip road identification
Source: Highways England

Standard lane referencing is used throughout all lane running motorway sections. Within a four-lane section, lane one is closest to the nearside verge and lane four is adjacent to the central reservation. Some small lengths of hard shoulder have been maintained on certain sections of SMART motorways.

On SMART motorways, lanes are referred to as LBS 1, 2, 3 and 4. LBS stands for 'lane below signal', so, for example, LBS1 is the dynamic hard shoulder. This method of identification prevents confusion when the hard shoulder is open or closed.

Most recently, efforts have been made to reflect operating agreements nationally, ensuring those agencies, such as Highways England, who operate beyond fire and rescue service boundaries, are following consistent and uniform procedures.

Control measure – Use agreed operating procedures

Control measure knowledge

The SMART motorways and all lane running (ALR) motorways regional operating agreement (ROA) is a nationally agreed document that provides additional guidance on the preparations that a SMART or all lane running motorway undergoes in terms of infrastructure changes, along with guidance on specific collaboration and the activation of unique operating procedures in certain incidents. Examples are 100% camera coverage and the pre-planned use of reverse access (standard or dynamic).

Emergency response in normal traffic flow will be the initial and preferred approach to incidents. This entails approaching the incident from the rear using the reported carriageway and in the same normal direction of traffic flow.

On an all lane running (ALR) motorway, where traffic flows indicate that access can be achieved by travelling with the normal flow of traffic on the affected carriageway, the highways authority control centre will set red X lane closure signals to provide an access lane to the incident scene (as there is no hard shoulder for access). To encourage compliance, the red X is supplemented by a legend, for example, 'Lane 1-3 closed - slow', 'Lane closure slow down' or 'Emergency vehicles on hard shoulder'. The access lane will be established well in advance of the incident and can be set back as far as the previous junction, or beyond, where necessary.

It should be noted that an incident scene may not specifically be within an all lane running (ALR) motorways section. However, access to the scene could be through an all lane running (ALR) section of motorway; this will require traffic to be managed using variable message signs and signals to provide an incident access lane, for example. This would also help deal with other emergencies in traffic on the all lane running (ALR) section.

If traffic is stationary, emergency responders should ease through the gaps in traffic queues (ideally between the offside lanes where parallel parked large goods vehicles are unlikely to be encountered) or through gaps created by motorists moving their vehicles.

Reverse access is used when it is not possible to approach the scene of the incident from the rear; it allows vehicles to approach from the front of the incident safely and in a structured manner. In essence, the carriageway is turned into a two-way road, allowing emergency responders to get to and from the scene of operations.

There are two types of reverse access:

- Standard reverse access – Commander in place at the head of the incident

- Dynamic reverse access – Commander in place at the head of the incident; access is made from a point after (downstream of) the incident following a dynamic risk assessment (DRA)

To establish a commander at the incident, the police service and fire and rescue service may consider attending via the opposite, unaffected carriageway, using their standard operating procedure for stopping in a 'live' carriageway. This should only be used in extreme circumstances to access the head of the incident, such as a known life risk, or to prevent a catastrophic escalation of events. Each emergency service will advise the highways authority control centre if their resources will be deployed to the unaffected carriageway. The highways authority control centre will use variable message signs and signals to support access to the incident from the unaffected carriageway, as directed by each emergency service.

Fire and rescue services should ensure incident commanders and drivers are aware of the following criteria, to be considered before reverse access is implemented:

- Criteria 1 – A police service, fire and rescue service or highways authority commander has control of head of scene. The most important and over-riding requirement before reverse flow can be implemented is establishing a commander at the incident scene who can verify that no vehicles can pass the scene, and that any vehicles stopped after the scene remain stationary and will not move until instructed to do so. The commander will be responsible for co-ordinating all vehicle movements to and from the incident scene.
- Criteria 2 – It has been confirmed that there are no vehicles after (downstream of) the incident scene to the chosen access point. Before vehicles can enter the carriageway from the access point, it is necessary to check there are no vehicles between the head of the incident scene and the access point. This can be achieved in a number of ways, including using CCTV, line of sight or a vehicle. If there are vehicles in an emergency refuge area the highways authority control centre will try to contact them to advise them not to leave.

Strategic actions

Fire and rescue services must:

- Adhere to the specific criteria stipulated in the SMART motorways all lane running (ALR) motorways regional operating agreement (ROA)

Fire and rescue services should:

- Engage in developing operating agreements with partner agencies, as described above, when SMART and/or all lane running (ALR) motorways are planned or in operation in their respective areas
- Consider applying operating procedures carefully, such as reverse access, which can be challenging for some organisations as it requires a change of culture associated with managing the hazards and risks posed by roadways
- Participate in any associated exercises and post-incident reviews/audits, ideally of a multi-agency nature, to assess the effectiveness and safety afforded by such unique arrangements

Tactical actions

Incident commanders should:

- Consider implementing reverse access, following communication with highways authority, control only if it is not possible to access an incident with the flow of traffic on the affected carriageway
- Advise mobilising control if difficulties accessing the incident are encountered
- Use the affected carriageway essentially as a two-way road, ensuring that all responders adhere to the prescribed procedures for such

Deformation of crash barriers

Hazard	Control measure
Deformation of crash barriers	Make safe any affected barriers

Hazard knowledge

Roadway crash barriers (also known as safety barriers) are designed to prevent vehicles from crossing from one carriageway to the other and to prevent vehicles from impacting or entering roadside hazards, for example bridges, signs, embankments and so on. Crash barriers are also intended to absorb some of the energy from the impact of the vehicle and to redirect the vehicle along the line of the crash barrier so that it does not turn around, turn over or re-enter the stream of traffic; this is termed 'containment'.

In the United Kingdom, several different types of barriers are available, each of which performs differently on impact. Crash barriers can either be flexible, such as a steel wire rope or a steel beam, or rigid, as with concrete barriers.

Control measure – Make safe any affected barriers

Control measure knowledge

The process required to make a crash barrier safe will differ depending on the barrier's design and style, the damage and its 'resting' state. Making any affected barrier safe requires planning and, wherever possible, specialist advice from other agencies such as the highways authorities to ensure associated hazards are managed.

Any emergency responders in proximity to a compromised and under tension steel wire rope crash barrier should be particularly aware of the associated hazards. Personnel must be aware that a vehicle coming to a position of rest on a crash barrier will present additional considerations for fire and rescue service responders in the form of stabilisation. In addition, the barrier itself may also present a stability hazard.

Strategic actions

Fire and rescue services should:

- Provide tactical guidance and establish support arrangements on:
    - Identifying the crash barriers used within their areas

  - Managing incidents involving these barriers
  - Actions that can be undertaken by emergency responders, before the arrival of other Category 1 and/or 2 responders, should incident intervention be required

Tactical actions

Incident commanders should:

- Ensure no emergency responder crosses, straddles or passes over a tensioned crash barrier and use a salvage sheet or tarpaulin to ensure the crash barrier is visible
- Ensure the tension in any wire rope or other crash barrier is removed BEFORE CUTTING to avoid any risk of injury or further damage
- Introduce a secondary method of stabilisation, such as a winch, to reduce the strain on the crash barrier
- Consider de-tensioning steel to any wire rope only if it is required for casualty rescue or if it is deemed that the wire rope is at risk of failure
- Contact appropriate highway authority or local government department for reinstatement/repairs to crash barrier

Objects involved in a collision

Hazard	Control measure
Objects involved in a collision	Identify the direction of movement of the objects involved in the collision Relocate the object(s) in a controlled manner

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.

Street furniture is a collective term for objects and pieces of equipment installed on streets and roads for various purposes. It includes benches, crash barriers, bollards, post boxes, phone boxes, streetlamps, traffic lights, traffic signs, bus stops, tram stops, taxi stands, public lavatories, fountains, watering troughs, memorials, public sculptures and waste receptacles.

In addition, debris deposited from vehicle cargo or previous incidents has been included within this hazard and its associated control measures.

The risks posed by objects involved in a collision include:

- Instability to the vehicle
- Impact injury

- Impalement
- Musculoskeletal injury
- Cutting or laceration
- Electric shock
- 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 activities.

Control measure – Identify the direction of movement of the objects involved in the collision

Control measure knowledge

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

Refer to the Hazard – Unstable mode of transport

Strategic actions

Fire and rescue services should:

- Ensure that responders develop an appreciation of the type, location and potential impact of objects that could be involved in a collision, have the equipment to manage them, and train accordingly

Tactical actions

Incident commanders should:

- Identify and communicate information about the weight and potential movement of an object, along with the incident topography
- Consider using restricted areas to account for anticipated 'slip zones', where full and comprehensive stabilisation techniques cannot be implemented immediately

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 they do not compromise future extrication processes.

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

Strategic actions

Fire and rescue services should:

- Ensure their personnel can manage the movement of objects in a controlled manner, including but not limited to:
    - Providing training in kinetic lifting techniques
    - Providing equipment that could be used to 'lift and move' anticipated objects from the roadway
    - Establishing arrangements with companies equipped to move larger and heavier objects if required during operations

Tactical actions

Incident commanders should:

- Identify the need for, and request the early assistance of, other agencies, such as isolating the electricity supply or removing objects, especially where there is a hazard to the emergency responders or members of the public
- Establish the location any given object will be moved to, before it is moved
- Employ additional stability mechanisms if there is any doubt about vehicle movement; vehicle stability should not be affected during the relocation

Working with road vehicles

The following four sections incorporate the hazards that may be found at all incidents involving working with road vehicles.

Affected vehicle contents

Hazard	Control measure
Affected vehicle contents	Identify the direction of movement Stabilise the vehicle contents Empty the vehicle to a safe place Identify an effective method of entry

Hazard knowledge

The term 'vehicle contents' applies to forms of cargo and contents, located anywhere in or on a vehicle. This will range from the obvious, like cargoes transported by large goods vehicles (LGVs), general items accumulated by the public in footwells and boots of cars, and/or animals .

Hazards posed by vehicle contents include:

- Instability to the vehicle. Refer to the Hazard – Unstable mode of transport
- Impact injury
- Crush injury
- Impalement
- Musculoskeletal injury
- Cutting or laceration
- Electricity
- Entrapment
- Hazardous materials. See National Operational Guidance: Hazardous materials (to follow)
- Animals – Zoonoses, bites, kicks, etc.

Hazardous cargo is dealt with in the DCLG Operational Guidance – Hazardous materials 2012, which includes hazards posed by explosives, ammunition, corrosives, etc.

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 it also has the potential to cause harm to emergency responders attempting to work at the scene.

Control measure – Identify the direction of movement

Control measure knowledge

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

Strategic actions

Refer to the Hazard – Objects Involved in collision, specifically 'Identify direction of movement' for strategic actions

Tactical actions

Incident commanders should:

- Undertake an initial 360-degree survey to identify any unstable loads associated with the vehicle contents, such as bulges in the side curtains of all goods vehicles
- Identify the likely direction of travel for any loads that may move

- Communicate identified 'slip zones' to all emergency responders operating within or around the vehicle
- Consider using restricted areas to account for anticipated 'slip zones', where full and comprehensive stabilisation techniques cannot be implemented immediately

Control measure – Stabilise the vehicle contents

Control measure knowledge

Refer to the Hazard – Unstable mode of transport.

Strategic actions

Refer to the Hazard – Unstable mode of transport.

Control measure – Empty the vehicle to 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.

Strategic actions

Fire and rescue services should:

Refer to the Hazard – Objects involved in collision, Control measure – Relocate objects in a controlled manner for strategic actions.

Tactical actions

Incident commanders should:

- Keep the safety of all people in mind when moving any objects
- Establish the location any given object will be moved to, before it is moved
- Use available equipment in accordance with its design and weight limitations
- Relocate an object minimally, rather than removing it completely from the inner cordon
- Employ additional stability mechanisms if there is any doubt about vehicle stability; vehicle stability should not be affected during the relocation

Control measure – Identify an effective method of entry

Control measure knowledge

If it is reasonable to assume that the cargo or contents have moved or are no longer secure, take care in selecting the appropriate access point. A typical example of injury to emergency responders is 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 large goods vehicles (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.

Other agencies may need to attend the incident, such as the environmental agencies, vehicle recovery companies, highways agencies or police collision investigation team. They may need access to the incident to perform their respective roles at any stage of proceedings.

Strategic actions

Fire and rescue services should:

- Provide adequate training and instruction on the hazards and risks posed by vehicle construction and contents, including the ability to assess these
- Ensure fire and rescue service responders are capable of undertaking a variety of techniques to manage, stabilise and gain access to a vehicle, having considered the vehicle 'load'. These techniques will include limitations such as confined spaces, reduced equipment and specific equipment limitations, i.e. those likely to result in sparks being created in certain environments
- Provide adequate equipment to deal with modern vehicle construction. All of the techniques provided must ensure that the objective of maintaining safety for all emergency responders and saving life is achievable.

See National Operational Guidance: Performing rescues – Tools.

Tactical actions

Incident commanders should:

- Maintain stability where it has been established utilising existing vehicle structures, and consider other methods of entry

Alternative fuelled vehicles (AFV)

Hazard	Control measure
Alternative fuelled vehicles (AFV)	Identify and communicate the vehicle type Control the vehicle propulsion system Isolate high voltage systems

Hazard knowledge

For the purpose of 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.

Alternative fuelled vehicles (AFV) styles and types are:

- Cars

- Vans
- Off-road vehicles
- Large goods vehicles (LGVs)
- Public service vehicles (PSVs)

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. However, this term includes other mechanisms to capture and use energy.

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 emergency responders during operations.

The hazards posed by alternative fuelled vehicles (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 alternative fuelled vehicles (AFVs) is on the rise. The potential for incidents involving these vehicles will increase with time.

The use of compressed natural gas (CNG) in European alternative fuelled vehicles (AFVs) is widespread in mainstream manufacturers, and their presence in the UK will increase.

Where alternative fuels have been compromised and/or released, involving other emergency services and agencies, the impact on the casualties involved and the environmental impact should be considered. See National Operational Guidance: Environmental protection, specifically for hazards, control measures and actions.

Control measure – Identify and communicate the vehicle type

Control measure knowledge

The potential for a road traffic collision with an alternative fuelled vehicle (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 alternative fuelled vehicles (AFVs) and their associated technology, it is safe to assume that all vehicles are alternatively fuelled, until otherwise confirmed.

Information sources that may prove useful in identifying the vehicle type could include:

- Questioning the driver and/or occupants
- Where possible, control room operators questioning the caller of the incident to identify fuel supply if the person is responsible for the vehicle
- Considering the aerodynamic design or recognising the model
- Looking for vehicle markings, such as the use of the term 'hybrid'
- Looking for their bright orange cabling if the vehicle has overturned or is on its side
- Using systems such as mobile data terminals (MDT), where available, to assist with identification

Strategic actions

Fire and rescue services should:

- Equip personnel and provide access to up-to-date information on vehicle design and use

Tactical actions

Incident commanders should:

- Identify the alternative fuelled vehicle (AFV)
- Make all emergency responders aware that an alternative fuelled vehicle (AFV) is identified, at the earliest opportunity
- Consider placing additional markings on the alternative fuelled vehicle (AFV) to identify its type for oncoming personnel and other agencies, making them aware of the hazards posed by such a vehicle

Control measure – Control the vehicle propulsion system

Control measure knowledge

Where vehicles employ electric motors as part of their propulsion, such motors remain energised when powered but provide no audible indicators. Some alternative fuelled vehicles, in particular electric vehicles, will also 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 the accelerator is depressed or the brake released. Simply pressing the accelerator when the alternative fuelled vehicle is in either in 'Drive' or 'Ready' mode may cause the engine to start up.

Strategic actions

Refer to Hazard – Alternative Fuelled Vehicles (AFV), Control measure – Identify the vehicle and communicate its type

Tactical actions

Incident commanders should:

- 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 alternative fuelled vehicle (AFV) using recognised procedures as per manufacturer's guidance, placing the vehicle into 'Park' mode and removing the key to disable the high voltage system

Control measure – Isolate high voltage systems

Control measure knowledge

Electric vehicles and hybrid vehicles typically include high voltage batteries. The presence of high voltage components creates a possible electrocution hazard (voltage levels range from 36v up to 600v). See National Operational Guidance: Operations, – Electricity.

High voltage wiring in electric vehicles 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 the locations of both battery packs and any associated high voltage cabling when undertaking their operational plan (they are generally routed centrally, outside and underneath the vehicle).

Some hybrid vehicles have sensors in the engine compartment that will automatically isolate the high voltage supply from the rear battery compartment to the front electric motors in 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, for example severing the high voltage cable, water submersion or any damage to the vehicle causing a 'short circuit' within any of the high voltage components.

In a severe collision there is a potential risk from high voltage systems due to 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.

Strategic actions

Refer to Hazard – Alternative Fuelled Vehicles (AFV) Control measure – Identify the vehicle and communicate its type.

Tactical actions

Incident commanders should:

- Identify the location of any high voltage wiring, being mindful to 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, if possible, by removing the proximity key from the scene of operations (more than 5m from the alternative fuelled vehicle (AFV)); however, this can lead to dead-locking doors
- Consider additional (personal protective equipment (PPE) such as appropriately rated electrical gloves or eye protection
- Consider removing selected fuses
- Activate the battery pack isolator
- Consider the electrical system unsafe for a full ten minutes after ignition shut down; however, this should not delay rescue operations

Unconventional or specialist road vehicles

Hazard	Control measure
Unconventional or specialist road vehicles	Contain the vehicle or cargo

Hazard knowledge

Fire and rescue services may encounter unconventional or specialist vehicles that present different hazards to those of common vehicles. Unconventional or specialist road 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 vehicles 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 premixed 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 been melted in a fire

- 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 managing such a vehicle
- Livestock transport 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 – Contain the vehicle or cargo

Control measure knowledge

The need to contain specialist vehicle contents 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.

Refer to Hazard – Affected vehicle contents.

Strategic actions

Refer to Hazard – Affected vehicle contents.

Tactical actions

Incident commanders should:

- Contain vehicle contents, where they are not at risk, within the original vehicle until replacement vehicles arrive to continue their transport
- Estalish a secure area to allow for triage where vehicle contents require attention

Vehicle supplementary restraint systems (SRS)

Hazard	Control measure
Vehicle supplementary restraint systems (SRS)	Identify the supplementary restraint systems (SRS) and communicate the information Establish an appropriate safe distance for supplementary restraint systems (SRS)

	Isolate the supplementary restraint systems (SRS) Prevent manipulation or damage to supplementary restraint systems (SRS)

Hazard knowledge

In this guidance, the term 'supplementary restraint systems' (SRS) 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 (LGVs).

Passive safety features/systems may include:

- Airbags/side impact protection system (SIPS)
- Front and rear crumple zones
- Side impact bars
- Pop-up roll over 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 supplementary restraint system (SRS) concern the potential of actual uncontrolled deployment during emergency 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 such supplementary restraint systems (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 supplementary restraint system (SRS), use a mechanical or pyrotechnic impact sensor. In a side collision, a pressure plate pushes a firing pin and releases the ignition charge. SRS 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

Pyrotechnic sensor systems usually have some sort of disarming interlock. For further information on pyrotechnics see National Operational Guidance: Hazardous materials (to follow).

Such systems are treated in a similar way to mechanically-sensed frontal airbags and seatbelt pre-tensioners.

It is also important to be familiar with the new (post-2003) generation of supplementary restraint systems (SRS), which have features that may impact on operational response:

- 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
- Front seat sensors determine whether 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. The system may respond to these variables in a range of alternative ways.
- Most vehicles use the electronic control unit (ECU) to trigger the fuel cut off, and a small number also trigger a battery disconnect

Some vehicles are fitted with dual action frontal airbags. For low speed crashes, only the first detonator is necessary to cushion the impact, for higher speed impacts a second detonator pumps more air into the airbag to withstand the higher impact force. Due to this dual action these airbags may have the capacity for a secondary actuation. Fire and rescue services must be aware of this, and treat all deployed frontal airbags as if deployment can occur again until proven otherwise.

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, may cause minor irritation to skin, nose and eyes. Manufacturers claim that the inflation chemical (sodium azide) will not be present once the bag is deployed.

Active roll over protection systems (ROPS) 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 who 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.

Control measure – Identify the supplementary restraint systems (SRS) and communicate the information

Control measure knowledge

The first priority is to recognise that a vehicle is equipped with supplementary restraint systems (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
- Side impact protection system (SIPS)
- Head protection system
- Inflatable curtain

Not all systems will be readily identifiable.

A typical airbag restraint system, designed to deploy in 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.

Due to the fact that 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 six inches (15cm). These devices, when undeployed, present a finger/hand trap hazard for emergency responders and could potentially cause further injury to casualties.

Two main types of roll over protection systems (ROPS) are 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.
- 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.

Strategic actions

Fire and rescue services should:

- Equip personnel with, and provide access to, up-to-date information regarding vehicle design and identification of any supplementary restraint systems (SRS)

Tactical actions

Incident commanders and tool operators should:

- Survey the vehicle internally and externally for signs that a vehicle is equipped with a supplementary restraint system (SRS) as a first priority, and then communicate its presence to all personnel involved
- Not enter the passenger cell until the hazards have been assessed (however, do not delay medical attention unnecessarily)
- Remember that however medical attention is administered, emergency responders should remain outside the deployment range of any undeployed airbags
- Identify seatbelt pre-tensioner systems and other supplementary restraint systems (SRS), including the location of their active charges, via a 'peel and reveal' of the vehicle panel fascia
- Communicate the appropriate hazards identified and the control measures planned or implemented, when handing the incident over to the responsible person

Control measure – Establish an appropriate safe distance for supplementary restraint systems (SRS)

Control measure knowledge

Airbags and other supplementary restraint systems (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.

The safest way to manage the risk from an airbag and other supplementary restraint systems (SRS), when required to work around such devices, is to avoid them.

Enforce the safety distance rules relating to airbag deployment range and the distance to remain clear:

- 5 inches [15cm] clear of side (lumbar) airbags
- 10 inches [25cm] clear of driver airbags
- 15 inches [40cm] clear of curtain airbags
- 20 inches [50cm] clear of passenger airbags

Strategic actions

Fire and rescue services should:

- Equip personnel with, and provide access to, up-to-date information regarding vehicle design and use

Tactical actions

- Avoid placing solid objects near to undeployed airbags, within their deployment range
- Enforce the safety distance rules relating to airbag deployment range and the distance to remain clear

Refer to Hazard – Unstable mode of transport.

Control measure – Isolate the supplementary restraint systems (SRS)

Control measure knowledge

Once an airbag has been identified, the airbag should be disarmed. The undeployed supplementary restraint system (SRS) should be made safe if there is to be any cutting or metal displacement and a rescue is to be 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 in about two minutes on most vehicles.

The method of disarming electronically 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. A side impact protection system (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.

Incident commanders should not delay rescue efforts unnecessarily to wait for the decay of a capacitor's charge once a supplementary restraint system (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 within the 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 but should only be undertaken following liaison with the specific vehicle/supplementary restraint system (SRS) manufacturers).

Strategic actions

Fire and rescue services should:

- Equip personnel with the latest information regarding vehicle design and associated tool use, through structured training

- Ensure a variety of tools and equipment is made available to fire and rescue service responders to deal with the reasonably foreseeable situations, hazards and implementation of control measures, such as airbag restraint system(s)

See National Operational Guidance: Performing rescues.

Tactical actions

Incident commanders and tool operators should:

- Use approved and specifically designed equipment to mechanically reduce a vehicle airbag's deployment range
- Make use of available over-ride switches in the vehicle and disconnect batteries

Control measure - Prevent manipulation or damage to supplementary restraint systems (SRS)

Control measure knowledge

Because supplementary restraint systems (SRS) may be hidden and are difficult to identify, personnel could inadvertently use equipment that can manipulate or damage the features or systems, causing uncontrolled deployment.

Newer vehicles have much thicker posts and pillars, often with strengthened steel inserts and supplementary restraint system (SRS) components hidden inside.

The bag should be handled with appropriate personal protective equipment (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 side impact protection system (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.

Strategic actions

Refer to Hazard – Vehicle supplementary restraint systems (SRS), Control measure – Isolate the supplementary restraint system (SRS)

Tactical actions

Incident commanders and tool operators should:

- Always remove or displace internal trim ('peel and reveal') to ascertain the location of such components, before attempting to cut pillars
- Consider cutting away a deployed airbag

Waterways

The following section incorporates the hazards that may be found at all incidents involving waterways.

Introduction to working on waterways and working with vessels found in the waterways environment

Incidents on board vessels and in the marine transport environment can be complex to deal with. In ports, firefighters should take into account such factors as passengers and crew, the type of vessel, the location of its berth, whether it is loading/unloading, refitting or under repair, its cargo and the degree of accessibility. They will also have to consider the inherent hazards found at ports, docks, harbours and marine infrastructures.

For the purpose of this section of guidance any ship, boat or craft will be referred to as a vessel.

Incidents, particularly those resulting from collisions, may be complicated by the presence of hazardous materials.

Language difficulties at incidents involving foreign vessels are not uncommon and fire and rescue services should consider having possible arrangements for interpreters to attend. See National Operational Guidance: Operations.

To deal with any incident involving a vessel, fire and rescue services must make themselves familiar with vessel construction and design, any shipboard fire protection and firefighting media, vessel stability and general issues such as liaison with other authorities, emergency plans, the responsibility for the control of operations and safety precautions.

In this context incident commanders must consider the particular features of different vessels and their present condition (e.g. loaded or unloaded) and position, and they must adjust operations accordingly. Appropriate liaison and pre-planning are vital, and fire and rescue services should make every attempt to gain familiarity with, and knowledge of, any specific risks such as naval or commercial dockyards located in their areas, together with regular visits to vessels visiting such docks or ports.

The police are responsible for co-ordinating search and rescue for land-based incidents, and lead the response for incidents in inland waters. Exceptions exist, however, where the incident has been delegated to HM Coastguard. Fire and rescue services should liaise with the responsible authority to determine expectations and requirements at incidents they may be called to attend.

Fire and rescue services have no statutory responsibility for attending incidents at sea as there is no statutory duty for the provision of offshore firefighting. Coastal fire and rescue services do, however, have a statutory duty to fight fires on vessels alongside in ports and down to the mean low water mark (MLWM) at ordinary tide, by virtue of Section 72 of the Local Government Act 1972. Some fire and rescue services voluntarily attend offshore operations; however, these situations will not be covered by this guidance.

This waterways section of guidance should be read in conjunction with National Operational Guidance: Water Rescue and Flooding

HM Coastguard may declare a major maritime incident if:

- There are large numbers of survivors to be rescued and brought ashore

- There are large numbers of people missing and unaccounted for, with the potential for a significant loss of life
- There is large-scale press or public interest
- It is a large-scale rescue and/or counter-pollution and/or salvage incident

Further reading on this expansive topic can be found here:

- International Code of Safety for High-Speed Craft (2000), 2008 Edition
- Maritime and Coastguard Agency Port State Control expanded inspections
- International Convention for the Safety of Life at Sea (SOLAS), 1974
- Health and safety on ships Marine Safety Act 2003
- International Maritime Organisation (IMO)
- Environment Protection Act 1990 & 1995 (in relation to pollution)
- The MARPOL Convention (covering pollution prevention)
- The Water Resources Act 1991
- Vessel classification and certification
- https://www.gov.uk/inland-waterways-and-categorisation-of-waters
- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/443017/Rescue_boat_code_final_rev_5-13_02.07.13-nl.pdf
- A guide to Fishing Vessel Stability, Maritime New Zealand, 2011, https://www.maritimenz.govt.nz/Publications-and-forms/Commercial-operations/Shipping-safety/Vessel-Stability-Guidelines-A4.pdf
- International Maritime Dangerous Goods code https://www.gov.uk/government/publications/international-maritime-dangerous-goods-imdg-code-amendment-2012
- Fire Service Manual Volume 2 Fire Service Operations – Marine incidents

Waterway transport incidents

Hazard	Control measure
Waterway transport incidents	Apply all transport incident control measures Seek specialist advice

Hazard knowledge

The control measures for this hazard should be applied when dealing with any incident attended by fire and rescue services, whatever the size or complexity, in the context of waterways transport.

Fire and rescue service personnel need to understand the hazards associated with waterways transport operational incidents and general hazards that may be associated with dock, harbours and marinas.

Environmental factors

Ports and harbours are influenced by a wide range of natural environmental factors including wind, visibility, channel depth, tidal and sea conditions. These will affect the fire and rescue service response to any incident it attends.

Floating docks and pontoons found in small ports, harbours and boat marinas may pose access and egress hazards when attending incidents affected by tidal ranges. In addition, weather patterns can cause swell and passing craft produce waves, which will affect the stability of these working platforms.

Pollution can occur at any incident involving vessels afloat during loading and/or unloading of cargo operations whilst in dock. Health risks to firefighters from chemical pollution and micro-organisms, including bacteria, will need to be considered. The relevant environmental agencies are responsible for protecting the environment as a whole, namely air, land and water.

There are a number of other references in the Water Industries Act of 1991 and the Salmon and Freshwater Fisheries Act 1975. A memorandum of understanding (MoU) between the Local Government Association and the environmental agencies on fire and rescue service issues is updated periodically to ensure effective co-operation between fire and rescue services and the environmental agencies. The main aim of the memorandum of understanding (MoU) is to minimise the hazard to the environment from fire and rescue service activities, including firefighting and hazardous materials incidents, and to encourage liaison and formulate preventative measures at the planning stage for special risk sites where there is the potential for pollution to occur during an incident.

The Maritime Coastguard Agency (MCA) is in charge of the pollution aspects of incidents. In general, marine pollutants can be jettisoned if necessary for the safety of the ship and its crew, but the Maritime Coastguard Agency must be immediately informed via the nearest coast radio station as outlined in the reporting procedures in the supplement to the International Maritime Dangerous Goods code. Marine pollutants will carry the marine pollutant mark, and the ship and the agents will have a plan showing where they are stowed on board.

See Environment Agency Environmental handbook Appendix 4 and National Operational Guidance: Environmental Protection.

Control measure – Apply all transport incidents control measures

Control measure knowledge

Refer to Hazard – Transport incidents - Apply all control measures from this section

Control measure – Seek specialist advice

Control measure knowledge

Certain sites, such as ports, docks , harbours and marinas, may be identified through local risk management planning as requiring tactical information and/or action plans on special mobilising and operational procedures, so that fire and rescue services can respond effectively. This may require input from local tactical advisers and should be collated in line with fire and rescue service policy and procedure. Mutual aid may also be put in place to assist the affected fire and rescue service and, in turn, their incident commanders, where required.

Some fire and rescue services maintain a declared 'at sea' response via a specialist fire and rescue marine response (FRMR) team. These teams will have a higher degree of training and knowledge in dealing with ship incidents. There may be mutual aid arrangements in place between fire and rescue services, where applicable, to call on these assets as required.

There is also a national group of specialist marine tactical advisers (MTAs) who may be available via fire control to provide the incident commander with additional guidance, information and knowledge.

Strategic actions

Fire and rescue services should:

- Identify declared fire and rescue marine response (FRMR) teams and marine tactical advisers (MTAs) who may be required to assist in tackling incidents within their areas of responsibility.
- Ensure control rooms are updated on the availability of specialist advisers and how they can be contacted
- Where relevant, fire and rescue services should enter into memoranda of understanding (MoUs) with any identified sites and/or other fire and rescue service for mutual aid. They should maintain a list of the contact details of national fire and rescue marine response (FRMR) team declared assets and their location

Tactical actions

Incident commanders should:

- Consider liaising with the specialist marine tactical advisers (MTAs) via appropriate local, regional and national arrangements at the earliest opportunity

Working within dock, harbour and marina infrastructure

Hazard	**Control measure**
Working within dock, harbour and marina infrastructure	Apply water transport incidents control measures

Hazard knowledge

Docks, harbours and marinas are often busy and hazardous places with large vessel movements, heavy machinery, vehicles, cranes, derricks and plant operating on the vessel or on the dockside area. Confined spaces, mooring lines, unprotected edges, sluices with numerous surface and subsurface hazards are also present and should not be overlooked. There are often pressures to load or unload a vessel's cargo quickly to catch a tide or to free up a wharf, which can lead to incidents occurring.

Particular attention should be given to all dockside hazards, and where applicable, safety cordons, nominated safety officers and appropriate measures should be put in place when dealing with an incident on board a vessel. These sites can also be attractive to members of the public and trespassers, particularly during periods of warm weather, including for unauthorised activities such as swimming and fishing.

These factors make docks, ports, harbours and marinas potentially high-risk environments. It may be necessary to liaise with the port or harbour master as well as the owner or captain of a vessel to provide comprehensive support for dealing with incidents.

HM Coastguard is responsible for co-ordinating search and rescue incidents in docks associated with tidal rivers, unless there is specific local agreement with police or harbourmasters.

- Remember that suspension of port, dock, harbour or marina infrastructure operations may affect the incident and crew safety
- Set specific boarding gangways for accesses and egress (ship to shore)
- Implement boarding control
- Consider use of water safety craft

Control measure – Apply water transport incidents control measures

Control measure knowledge

Refer to Hazard – Water transport incidents - Apply all control measures from this section

Inland waterways

Hazard	Control measure
Inland waterways	Apply water transport incidents control measures Develop knowledge of operating systems and terminology

Hazard knowledge

Inland waterways cover a network of more than 2,000 miles of canals and rivers in the UK that are readily accessible to the public for a variety of leisure activities and commercially for shipping goods or for public transport. Incidents may occur in remote locations with limited or no vehicle access. Incidents may occur with people in difficulty in a lock or a vessel that has capsized with a casualty inside.

When operating adjacent to canals and rivers, cordons should be in place to minimise the likelihood of falls into water or from height due to wet, slippery lock edges and trip hazards, and to also keep members of the public away from the scene. Crews need to be aware of hazards associated with cold deep water, contaminated water and underwater hazards from submerged debris, particular to canals and rivers.

Locks can also have weirs, sluices and submerged pumps, and therefore associated water and entrapment hazards.

There is also potential contamination from fuels, biological waste, litter and general commercial debris.

See National Operational Guidance: Water rescues and flooding.

Control measure – Apply water transport incidents control measures

Control measure knowledge

Refer to Hazard – Water transport incidents - Apply all control measures from this section

Control measure - Develop knowledge of operating systems and terminology

Control measure knowledge

Crews should be familiar with the terminology and operating systems associated with canals, rivers, locks and reservoirs, as well as associated structures, such as lift and swing bridges in their area.

Strategic actions

Fire and rescue services should:

- Provide tactical support and guidance to inform personnel of the terminology and associated operating systems and equipment used in and/or on locks and canals, quarries, reservoirs and docks
- Liaise with responsible persons and/or relevant authorities to produce Site-Specific Risk Information (SSRI) for waterways within the area of the fire and rescue service

Tactical actions

Incident commanders should:

- Ensure any dock, harbour and marina operating system controls are secured and/or safe working areas are clearly defined, before commencing operational activities
- Provide effective briefings to all personnel, including information on terminology and associated operating systems

Working with vessels

The following two sections incorporate the hazards that may be found at all incidents involving working with vessels.

Construction of vessels

Hazard	Control measure
Construction of vessels	Be familiar with vessels Use ship fire control plans

Hazard knowledge

Vessels serve various purposes, the most common being to carry different natural and manufactured goods, to carry passengers, to conduct military operations, and for fishing, sport and leisure.

Vessels designed or adapted for each of these purposes vary greatly according to their precise function, the volume of goods or number of passengers carried, the requirements of the individual owners, the practices of different ship-builders, different national legislation, the age of the vessel or the preferences for different materials or techniques.

This guidance attempts to describe some of the more important features of the types firefighters are most likely to encounter. Fire and rescue services should take any opportunity to visit vessels and familiarise crews with construction, layout, controls and provisions for preventing and dealing with hazardous incidents.

Fire and rescue services should be aware that despite the differences outlined above, many vessels do have certain basic common features and personnel should be aware of the terminology used in shipping.

Vessel construction is evolving with the development of increasingly lighter ship building materials, while new flame retardant standards in 'safety of life at sea' (SOLAS) conventions ensure a higher level of fire safety. Certain classifications of ships require fire resisting subdivisions to restrict firespread. Many features in construction pose a hazard to firefighting operations, such as hatches and covers, raking ladders and watertight doors.

See also Safety of Life at Sea (SOLAS).

Control measure – Be familiar with vessels

Control measure knowledge

The main aim of familiarisation visits is to make crews aware of hazards and procedures on the vessels they commonly come into contact with (e.g. roll-on roll-off (Ro-Ro) ferries, container ships, motor cruisers and yachts), including the layout of vessels for emergency situations.

Pertinent areas for familiarisation are:

- Location of access points, gangways, moorings and accommodation ladders
- Location of the bridge
- Location of escape routes

- Different types of alarms on board ship
- Procedure for abandon ship alarm or the evacuation signal
- Basics of fire prevention on ships
- Operation of fire- and water-tight doors fitted on ships
- Hatches and openings
- Classification of bulkheads e.g. A B C
- International ship-to-shore firefighting connections

Strategic actions

Fire and rescue services should:

- Ensure arrangements are in place to enable familiarisation visits to take place on board vessels to identify specific risks within the fire and rescue service area
- Ensure adequate communication with the responsible person at local ports, harbours and marinas, to maintain good relationships and create robust plans

See Hazard – Transport incidents, Control measure – Establish situational awareness

Tactical actions

Incident commanders should:

- When there is a vessel fire, consider using specialist trained crews if available (fire and rescue marine response (FRMR) or marine firefighter trained)
- Consider using specialist ship/vessel firefighting equipment

Control measure – Use ship fire control plans

Control measure knowledge

One of the most important factors in dealing with a fire on board ships is to understand the ship fire control plan, if carried on board. These plans will cover specific areas relating to firefighting such as fixed installations (water mist, CO_2), drencher systems, detection systems, ventilations systems, the location and the type and size of portable firefighting equipment, fire lockers and so on. The plans will also indicate classification of bulkheads, watertight doors, locations of control rooms and other pertinent information to assist the incident commander in developing a plan with the ship's master.

Strategic actions

Fire and rescue services should:

- Provide training in how to interpret ships’ plans through planned training events, exercises and visits

Tactical actions

Incident commanders should:

- Access fire control plans and ascertain if the plans are up to date, taking into account any changes to the vessel layout
- Identify and agree any tactical plan with the ship's master
- Communicate the fire plan to all deployed personnel

Stability of the vessel

Hazard	Control measure
Stability of the vessel	Appoint a stability officer or tactical adviser Minimise free surface effect

Hazard knowledge

Stability is a complex subject and to assess the stability of a vessel precisely at any given time, and the exact effects that actions may have on it, involves complicated calculations. The ship's officers are the experts and the incident commander should liaise closely with them, as they determine the relevant information on the weight of water and the area it is acting in, any movement of cargo, ballast, fresh water and fuel oil.

On a multi-purpose vessel the stability characteristics can affect port working when loading or unloading containers with deck cranes. The responsibility for cargo operations, including loading, unloading, ballasting and/or bunkering operations, normally sits with the ship or vessel's master or captain. However, this is mostly devolved to the chief engineer.

Ship safety management systems identify cargo and bunkering operations as special tasks, and as such, detailed procedures known as a cargo or bunkering plans, are normally available.

Local familiarisation visits should be sought, in conjunction with the port operators and/or harbour master to establish hazards and controls during these operations, as well as any access and egress points, rendezvous points (RVPs), isolation points, etc., for emergency procedures.

Where cargo and bunkering operations are regularly undertaken, the site should have an emergency plan and an agreed spill response plan in the codes of practice that are maintained by the agents or owners, as well as the port or harbour master. Fire and rescue services and other Category 1 or 2 responders, where applicable, should be notified of any such plans.

Where the vessel is in dry dock and the nature of operations may require access by specialist teams, shoring and securing must be considered a high priority. Any stabilisation measures implemented should take into consideration the extent of operational intervention by emergency responders; this is to ensure that protracted activities are not affected by the need for additional stabilisation work or the dangers associated with any subsequent movement of the vessel.

See also Hazard – Unstable mode of transport, specifically – Control measure – Stabilise the mode of transport

As a general principle, it should be assumed that any firefighting and boundary cooling water introduced into a vessel may have an adverse effect on the vessel's stability, and efforts should be made to minimise its use and/or remove such water as soon as possible.

Additionally, water could enter through hatches, doors and scuttles. An incident such as an explosion or collision could have caused structural damage and affected watertight integrity. Therefore, it is very important to check for potential water ingress and check bilge alarms.

If fire and rescue service operations involve lifting or winching from the side of a vessel this could raise the centre of gravity of the vessel and cause instability. Also, if heavy equipment is taken onto a vessel as part of firefighting or rescue this could reduce the vessel's stability.

In smaller vessels the movement of large numbers of passengers to one side of the vessel could have a devastating impact on stability and cause it to capsize.

Most ship classification societies also have their own computer damage control teams. These are office-based teams that may be activated at any time. From information they already hold about the vessel, the team can input data and provide decisive information on stress and stability. Not being involved on the ground, they are able to provide sound solutions quickly.

There may be occasions when there are no ship's officers present, or where communication with them is hindered by language difficulties, and no other qualified people may be available.

The fire and rescue service incident commander of any operations on board vessels must constantly consider stability. This can be affected by various factors, in particular:

- The amount and position of water put on board for firefighting
- The amount and position of cargo or water removed from parts of the vessel
- The movement of cargo or water from one part of the vessel to another also known as the 'free surface effect'; unstable cargo or inadequately secured equipment could move suddenly causing further instability

Control measure - Appoint a stability officer or tactical adviser

Control measure knowledge

Incident commanders attending incidents, particularly vessel fires, should ascertain from the ship's officers the stability of the vessel as soon as possible, preferably before any activities or firefighting begins.

The ship's officers are normally experts in stability and the incident commander should liaise closely with them to determine the relevant information on:

- The weight of the water and where it is acting
- Movement of cargo
- Movement of ballast
- Movement of any other liquid or free flowing solid (e.g. fuel, oil or grain)

Suitably qualified or trained specialists in stability may be available to support the incident commander, and where possible these individuals should be used to provide an assessment of the vessel's stability, as well as ongoing predictions based on firefighting operations.

Most ship classification societies, such as Lloyds Register, Det Norske Veritas (DNV- GL), and American Bureau of Shipping (ABS) also have computer damage control teams available 24 hours a day, seven days a week. They should be used to provide a quick response to any calculations involving stability.

The information they need will be mainly from firefighting operations such as:

- The amount of water being pumped into each compartment
- The amount of water that is accumulating
- The amount of water draining down

Corrective stability measures should preferably be carried out before the vessel gets into a critical stability condition. Advice from the ships' captain or nominated responsible person should normally be taken regarding the ship's stability. However the incident commander will need to be mindful that the ship's captain/ master could be protecting his and others liabilities, though he should normally have an interest to help and holds a great deal of knowledge to assist in incidents.

Strategic actions

Fire and rescue services should:

- Provide tactical guidance during regular training on issues affecting vessel stability
- Make appropriate arrangements with companies and specialist salvage operators who can provide remote advice or assistance on stability calculations to the incident commander
- Liaise with the relevant authorities to maintain knowledge of loading and unloading operations of cargo or other vessels in a working yard at ports, docks, harbours and marina areas within the fire and rescue service area

Tactical actions

Incident commanders should:

- Establish contact with the ship's officers and harbour officials on matters relating to stability
- Obtain regular situation reports from sectors on matters affecting stability from firefighting operations including:
    - How much water is being used, for how long and where
    - Any movement of cargo
    - Any unusual sway, pitch or roll of the vessel
    - Any breaching of bulkheads or watertight doors
- Pass information to the ship's officers on the amount of water that is being used in the sectors, so that calculations and assessments that may affect stability can be made
- Consider use of high volume pumps (HVPs) to assist in water removal

Control measure – Minimise free surface effect

Control measure knowledge

Water on deck is a serious stability hazard. A wave or firefighting water run off on deck can introduce many tonnes of water-weight. A strong rolling force from what are known as 'free-surface effects' could then be added. This combined effect is alarming from a stability standpoint, as the extra weight drastically raises the boat's centre of gravity. The water then shifts and tries to roll the vessel over. This is why it is critical to move water off the deck as quickly as possible.

Knowledge of water volume used for firefighting or other purposes, how long it has been used, and where it is being used on board is vital information. This information is to be passed to the officer in charge of operations and/or the ship's master at the earliest opportunity, to enable the stability of the vessel to be identified through calculations.

Strategic actions

Fire and rescue services should:

- Provide tactical guidance and carry out regular training on issues affecting vessel stability, especially the free surface effect

Fire and rescue services with ship firefighting responsibilities should:

- Have a prepared stability procedure to put into operation when necessary; this also may require a designated officer, usually nominated and introduced by the incident commander. This could be a fire service officer or the responsibility may be devolved to the ship's master or delegated representative.

Tactical actions

Incident commanders should:

- Consider appointing a stability officer and safety observers
- Consider fuel and ballast in tanks can also give rise to free surface effects
- Check that all scuppers or freeing ports are free flowing and not blocked by debris
- Consider topping up low compartments containing liquids
- Consider removing free surface water

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Glossary of terms

All transport

Term	Acronym	Description
360-degree survey		An ongoing process to observe an incident from all available observation points.
Chemical, biological, radiological, nuclear orexplosive	CBRN(E)	An acronym that can be applied to a criminal or terrorist event caused by chemical, biological, radiological, nuclear and explosive materials.
Composite materials		A wide range of materials that use the inherent strength and durability of woven fibres bonded together with resins (often referred to as manmade-mineral fibres (MMMF)).
Inner cordon		An inner cordon is established to control access to the immediate scene of operations. The inner cordon surrounds the area where potentially hazardous activity may be conducted and encompasses both the hot and warm Zones. It is used to control access to the immediate scene of operations. Access to the area controlled by an

Term	Acronym	Description
		inner cordon, which by definition is the hazard zone, should be restricted to the minimum numbers required for work to be undertaken safely and effectively.
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.
Memorandum (Memoranda) of understanding	MoU	A 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.
Mobile data terminal	MDT	Mobile data terminals are usually found on fire service vehicles to provide communications with the mobilising centre.
Mode of transport		Refers to any form of transport such as rail stock, any vehicle, vessel or craft.
Outer cordon		The outer cordon designates the controlled area into which unauthorised access is not permitted. It encompasses the inner cordon and the hot, warm and cold zones. It should be established and maintained by the police.
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.
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 people threatened or directly affected by an incident, emergency or disaster
Respiratory protective equipment	RPE	Respiratory protective equipment includes breathing apparatus (BA), particle masks and respirators.
Responsible person		The person responsible for a site, building or similar. Used

Term	Acronym	Description
		in a legislative context they are known as: • Responsible Person (England, Northern Ireland and Wales) • Duty Holder (Scotland).
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.
Safe system of work	SSoW	A formal procedure resulting from systematic examination of a task to identify all the hazards. Defines safe methods to ensure that hazards are eliminated or risks controlled as far as reasonably practicable.
Safety officer		Safety officers are appointed by the incident commander before start of operations. They will be located at a point that provides them with overall view and control of the inner cordon and scene of operations.
Situational awareness		The perception and understanding of a situation and the anticipation of how the situation may develop in the near future
Tactical adviser	TacAd	Member of a national team identified from within the fire and rescue service and can be called upon to provide advice to the incident commander at a large or serious incident.
Urban search and rescue	USAR	Teams that locate, extricate and provide initial medical stabilisation of casualties trapped due to structural collapse, natural disasters, mines or collapsed trenches.

Air

Term	Acronym	Description
Access point	AP	A gate in the airport perimeter fence that allows access from landside to airside on an airport.
Aerodrome		Means any area of land or water designed, equipped, set apart or commonly used for affording facilities for the landing and departure of aircraft and includes any area or space, whether on the ground, on the roof of a building or elsewhere, for which it is designed.

Term	Acronym	Description
Aeronautical Rescue Co-ordination Centre	ARCC	This is the nominated Royal Air Force centre for military aircraft crash hazard information, offering 24/7 helpline advice.
Air Accidents Investigation Branch	AAIB	An independent organisation embedded within the Department for Transport and responsible for the investigation of civil aircraft accidents and serious incidents within the UK.
Air Traffic Control	ATC	A service provided for the purpose of: a) preventing collisions: i) between aircraft ii) in the maneuvering area between aircraft and obstructions b) expediting and maintaining an orderly flow of air traffic.
Aircraft accident		Occurrence during the operation of an aircraft in which anybody suffers death or serious injury or in which the aircraft receives damage.
Aircraft assisted escape system	AAES	The collective term used to describe the ejection seat and all associated components of the ejection seat system.
Aircraft incident		Occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of the aircraft and its occupants. [N.B. the AAIB definition is: “an incident involving circumstances indicating that an accident nearly occurred”. It is unlikely to involve the police or emergency services other than those based at airports.
Aircraft post-crash management incident officer	APCMIO	The primary police point of contact for liaison on military support requirements associated with the control and cordon of the site
Airport		Means the aggregate of the land, buildings and works comprised in an aerodrome within the meaning of the CAA 1982 Act.
Airport emergency plan	AEP	A document required by the CAA that is prepared by airport operators, to allow the timely and appropriate response to emergencies occurring on or in the immediate vicinity of the airport.
Airside		The controlled area of an airport only accessible through

Term	Acronym	Description
		security gates, that requires all fire and rescue service vehicles to be escorted by leader vehicles unless drivers have the required airside permit to drive license issued by the airport operator.
Armaments		Military weapons fitted to an aircraft, for example, missile launchers.
Automatic deployable emergency locator transmitter	ADELT	An emergency transmitter used on helicopters operating off shore, which gives a continuous signal for search and rescue aircraft to locate.
Auxiliary power units	APU	Usually a small engine carried on board an aircraft to provide an independent power source for such services as electrics, hydraulics, pneumatics, ventilation and air conditioning.
Ballistic recovery system		A system utilising a rocket propelled parachute system that 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. Trade names for this system include Cirrus Air Frame Parachute System (CAPS) and the Galaxy Recovery System (GRS). Also known as ballistic parachute system.
Civil Aviation Authority	CAA	The United Kingdom's specialist aviation regulator. Its activities include economic regulation, airspace policy, safety regulation and consumer protection.
Defence Accident Investigation Branch	DAIB	Conducts impartial and expert no-blame safety investigations across defence organisations to ensure that causal factors are identified and understood as quickly as possible, and recommendations made to prevent recurrence and enhance safety, whilst preserving operational capability. (Formerly known as the Military Air Accident Investigation Branch (MilAAIB)
Defence Safety Authority	DSA	Brings together the Defence Safety and Environment Authority (DSEA), the Military Aviation Authority (MAA) and the newly established Defence Fire Safety Regulator (DFSR) to form an independent authority that provides defence organisations with a single, independent focus for safety and environmental protection.
Drag		The aerodynamic force that opposes an aircraft's motion through the air
Efflux		Force or wind generated behind a jet engine, particularly on

Term	Acronym	Description
		or before take-off when high or full power is set, but also when the aircraft is taxiing
Electro-explosive device	EED	Any device that is initiated electrically to provide an explosive or pyrotechnic effect; such devices may be associated with, or form part of, an explosive armament store or may be an explosive component in an aircraft or equipment system, e.g. an explosive cartridge in a fire extinguisher or a miniature detonating cord (MDC)
European Aviation Safety Agency	EASA	An agency of the European Union with regulatory and executive powers in the field of civilian aviation.
Explosive ordnance disposal	EOD	Military specialist units responsible for counter terrorist bomb disposal, explosive ordnance disposal, the recovery and safe disposal of conventional munitions.
Fire and rescue service	FRS	Local Authority fire and rescue service or Local Authority fire and rescue authority.
Fixed electrical ground power	FEGP	A ground power supply for an aircraft parked at a stand, provided by means of a cable and plug.
Fixed-wing		An aircraft with wings that are attached to the fuselage of the aircraft.
General aviation		A term used to describe all aircraft that weigh below 5700kg without fuel loading.
Girt bar		Metal bar that connects an emergency slide to the fuselage of an aircraft
Ground power unit	GPU	A mobile power unit used by aircraft parked on the stand.
Instrument landing system	ILS	Electronic navigation system that provides guidance information to allow aircraft to approach and land, including during inclement weather conditions.
Landside		This refers to all areas outside the control span of the airport, where members of the public have free movement without passing through a security gate.
Liquid oxygen system	LOX	A system to supply one or more liquid oxygen converters, which supply the aircraft with oxygen whilst in flight.

Term	Acronym	Description
Military Aviation Authority	MAA	Part of the Defence Safety Authority (DSA), the MAA is an independent organisation responsible for the regulation, surveillance, inspection and assurance of the defence air operating and technical domains. It ensures the safe design and use of military air systems.
Miniature detonating cord	MDC	May also be referred to as a linear cutting cord (LCC) or a mild detonating cord. This is an explosive cord around or within military aircraft canopies/escape systems that once operated will explode outwards, shattering the canopy material to allow the seat to pass through easily.
Ordnance		Military weapons, for example, missiles.
Pyrotechnics		A general term to describe smaller explosive devices other than weapons on military aircraft. They include chaff, infra-red flares, signal cartridges, distress flares and large smoke markers. Materials capable of undergoing self-contained and self-sustained chemical reactions for the production of heat, light, gas, smoke and/or sound.
RAF regional liaison officer	RAFRLO	The RAFRLO liaises with the civilian emergency services and local authorities to provide a conduit between the military, civilian agencies and other government departments as required.
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 points	RVP	Pre-planned locations for holding/gathering emergency services when attending incidents on or adjacent to airports
Rescue and firefighting service	RFFS	This is the CAA terminology for the provision of fire and rescue services on airports.
Skin (in the context of aircrafts)		The outer surface of an aircraft
Squib		A miniature explosive device used to generate mechanical force, for example ejection of aircraft components
Undercarriage		The undercarriage or landing gear is the structure (usually wheels, but sometimes skids, floats or other elements) that supports an aircraft on the ground and allows it to taxi,

Term	Acronym	Description
		takeoff and land.
Unmanned aerial vehicle	UAV	Commonly known as a drone, an unmanned aircraft system or an aircraft without a human pilot aboard. The flight of UAVs may be controlled either by remote control from an operator or by onboard computers.

Rail

Term	Acronym	Description
Access points		A location designated for the use of fire and rescue services and network rail and provided with facilities to ease an emergency intervention
Alternating current	AC	Rail vehicle traction current operating at 25KV. Normally found on National rail infrastructure, delivered via overhead line equipment (OLE).
Air turbulence		A moving rail vehicle can create areas of positive and negative pressure. When moving at high speeds these pressures can cause equipment to move and people to fall
Ballast		Crushed stone, nominally 48mm in size and of prescribed angularity, used to support sleepers, timbers or bearers both vertically and laterally
Bogies		The wheeled, supporting structures on which a train runs
British Transport Police	BTP	National police force responsible for policing on the majority of rail networks and some tram systems, including the London Underground network
Cant rail warning line		A line applied to rail vehicles that is clearly visible when viewed from rail level and from platform height so that staff working at these levels can see the safe limit for working when a traction and rolling stock vehicle is under overhead line equipment (OLE).
Catenary		Originally the term used to denote an overhead power line support wire derived from the curve a suspended wire naturally assumes under the force of gravity. Now adopted

Term	Acronym	Description
		to mean the whole overhead line system.
Cess		The part of the track bed outside the ballast shoulder that is deliberately maintained lower than the sleeper bottom. The area immediately outside the ballast shoulder but not between tracks.
Detonator		A small explosive device clipped to a running rail by a railway employee to warn approaching train driver of a hazard ahead.
Earthing		This should be requested where crews need to go within one metre of electrical traction current after the section has been isolated. This will remove the risk of any residual current remaining.
Embankment		A filled area to permit a railway to maintain a safe and functional gradient across low ground without excessive deviation from a straight course.
Emergency switch off		When incident commanders are requesting isolation they should use this term.
Freight operating companies	FOCs	The companies who transport goods, but not passengers, on the national rail network.
Fourth rail		Occasionally a fourth rail between the running rails may be found which acts as a return circuit that may carry a current of up to 250 volts DC.
Isolation		The disconnection of electrical supply from a section of track (see also emergency switch off).
Line blocked		This is a rail term for the line being blocked and is a stronger term than requesting trains to be stopped.
Lookout		A person employed by the infrastructure manager, who has been assessed as competent to watch for, and to give an appropriate warning of, approaching trains when people are working on a railway in operation.
Mobile operations manager	MOM	Generally respond to any incident involving the safe operation of the railway. These people can then be appointed to become the rail incident officer (RIO) at

Term	Acronym	Description
		incidents.
Network Rail	NR	The owner and infrastructure manager of most of the rail network in the UK. Network Rail run, maintain and develop rail tracks, signalling, bridges, tunnels, level crossings and many key stations.
Overhead line equipment	OLE	An assembly of metal conductor wires, insulating devices and support structures used to bring a traction supply current to suitably equipped traction units.
On or near the line		The presence of personnel or equipment within three metres of the track or electrified equipment that has the potential for harm to people or property
Pantograph		Equipment conducting electric current from the overhead line equipment to provide traction current and service power (air conditioning, lighting etc.) to rail vehicles.
Permanent way		The track on a railway consisting of rails, fasteners, sleepers and ballast.
Pick up shoe		Electricity is transmitted to the train by means of a ‘contact’ shoe or sliding ‘pick up shoe’. The shoe is in contact with the third/fourth rail.
Polychlorinated biphenyls	PCB	Used generally as an insulator and coolant in electrical transformers and has toxic properties.
Points		A mechanical device that enables trains to be guided from one track to another.
Rail Accident Investigation Branch	RAIB	Part of the Department for Transport, the independent railway accident investigation organisation for the UK.
Rail incident officer	RIO	A nominated and certificated member of Network Rail staff who may respond to an incident to co-ordinate the railway response. The principal contact point for the emergency services and train operating companies to advise on safe systems of work.
Rail infrastructure		A general term that encompasses, traction systems, signalling equipment, fixed communication systems and all aspects of the built rail environment including stations,

Term	Acronym	Description
		termini, bridges, viaducts, etc.
Rail vehicle		Includes trams, rail carriages, trolleys, service vehicles, regardless of size, length or power supply.
Refuge		A space set back from the trackside where personnel can shelter from trains.
Run at caution		Train drivers are informed that there is an incident on or near the railway. The driver will reduce their speed in the area to ensure stopping safely.
Running rails		The rails that the vehicle's wheels are guided along
Signal box		A signal box or signal cabin is a building from which railway signals and points are controlled.
Sleepers		A beam made of wood, pre- or post-tensioned reinforced concrete or steel placed at regular intervals at right angles to and under the rails.
Third rail		The third rail traction conducts the electrical current from the rail to the motor of the train.
Total operations processing system	TOPS	A National Rail computer system able to identify the location and contents of trains and individual wagons and containers.
Track/track area		The area between the ballast shoulders of a single, double, or multi-running line railway.
Track welding powder		A reacting material used to weld rails (also known as thermite).
Traction current		Term used for electric power supply for electric rail vehicles. Normally supplied by overhead wire or electrified rail and collected by a pantograph on the roof of the train in the former case, or by shoes attached to the bogies in the latter.
Train operating company	TOC	An organisation licensed to operate trains over the rail network.
Trains stopped		No train movement on a given section of track

Road

Term	Acronym	Description
Accord européan relatif au transport international des marchandises **D**angereuses par **R**oute	ADR	European agreements concerning the international carriage of dangerous goods by road.
Alternative fuelled vehicles	AFV	A vehicle that runs on a fuel other than traditional petroleum fuels (petrol or diesel); also refers to any technology powering an engine that does not involve solely petroleum (e.g. electric car, hybrid electric vehicles, solar powered).
All lane running	ALR	The permanent conversion of the hard shoulder to a running lane on a motorway, whilst retaining the ability to dynamically control traffic.
Carbon fibre reinforced plastic	CFRP	Used as a component in vehicle construction.
CLEAR principles		Joint working principles to ensure roads can reopen soonest.
Compressed natural gas	CNG	Compressed natural gas.
Electric vehicles	EV	All-electric vehicles (EVs) run on electricity only. They are propelled by one or more electric motors powered by rechargeable high voltage battery packs.
Electronic control unit	ECU	Controls the safety features in road vehicles.
Fend off		Utilising the fire appliance as a buffer to prevent vehicles from colliding with an existing scene.
Glass fibre reinforced plastic	GFRP	Used as a component in vehicle construction.
Head protection system	HPS	A type of airbag system.
Hybrid vehicles		A hybrid vehicle makes use of both an electric motor and a petrol engine for vehicle propulsion.
Inflatable tubular system	ITS	A type of airbag system.
Large goods vehicle	LGV	Vehicle above 7.5t.

Term	Acronym	Description
Liquid natural gas	LNG	Liquid natural gas.
Public service vehicles	PSV	A vehicle designed to carry the public.
Regional operating agreement	ROA	Mutual co-operation to establish regional operational regimes on road networks.
Roll over protection system	ROPS	Active roll over devices can be found in convertible vehicles to protect motorists from injuries caused by vehicle overturns or rollovers. These can operate with explosive force away from the bodywork of the vehicle
Safe cell		An area established to protect firefighters from external hazards allowing them to operate safely
Side impact protection system	SIPS	A type of airbag system
SMART motorway	SMART	A section of motorway that uses active traffic management techniques to increase capacity by use of variable speed limits and hard shoulder running at busy times.
Supplementary restraint system	SRS	Additional systems in a vehicle used to protect occupants in crash conditions e.g. air bags, seat belt pre-tensioners.

Waterways

Term	Acronym	Description
Ballast		Heavy material used to help keep a ship stable.
Bilge		The space towards the bottom of a ship, at the outer sides of the double bottom tanks, into which water drains from the bottom of the hold and usually, from the tween decks.
Fire and rescue marine response	FRMR	Specially trained fire and rescue marine response teams
Free surface effect		Free surface effect is the change in stability of a vessel caused by liquids moving about freely in a tank or hold. As a vessel rolls, liquids in tanks or breached compartments accentuate the roll by moving freely from side to side of the tank accumulating first on one side and then the other, and may adversely affect the stability of the ship.

Term	Acronym	Description
High tide		When the tide is on the rise, it creates a flood current that moves toward shore. High tide is the peak of the flood current.
International Maritime Dangerous Goods code	IMDG	IMDG code is accepted as an international guideline to the safe transport or shipment of dangerous goods or hazardous materials by vessel on water.
International Maritime Organisation	IMO	United Nations specialised agency that has developed international legislation dealing with the safety of life at sea and the prevention of pollution from ships.
International ship-to-shore firefighting connection		An international shore connection to be used with marine firefighting systems during an emergency when a stricken ship has a system failure. International shore connections are portable universal couplings that permit connection of shipboard fire main systems between one ship and another or between a shore facility and a ship when their respective system threading is mismatched. Both the ship and the facility are expected to have a fitting such that in an emergency can be attached to their respective fire hose and bolted together to permit charging the ship's system.
Marine firefighting	MFF	Personnel trained to carry out marine firefighting.
Maritime and Coastguard Agency	MCA	A section of the Department of Transport to prevent the loss of life on the coast and at sea, responsible for implementing British and international maritime law and safety policy.
Master		The captain of a merchant vessel.
Pontoon		A floating structure that may be used as a buoyant support.
Scuppers		Openings along the sides of a vessel’s main deck to allow water to drain over the sides.
Safety of life at sea	SOLAS	The International Convention for the Safety of Life at Sea (SOLAS) is an international maritime safety treaty. It ensures that ships flagged by signatory states comply with minimum safety standards in construction, equipment and operation. SOLAS in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant vessel.
Tides		Most areas will have two high tides and two low tides in a

Term	Acronym	Description
		lunar day (24 hour and 50 minute period). The weakest tidal currents occur between the flood and ebb currents; this is called slack tide. The strongest currents occur near the time of high and low tides. Tidal range is the height between low and high tide. Tidal effects also are influenced by the shape of the land and how water may be funnelled through an area. Depth of water, wind, and weather (tropical storms and hurricanes) can also have a significant impact on the strength of tides.
Tween deck		On a cargo vessel, any deck between the upper deck and lower hold.