Hazard - Aircraft undercarriages

Control measure - Establish appropriate cordons: Transport

Control measure - 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 knowledge

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 on 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
- Identify jet engines hazard zones (intake & exhaust), establish and communicate appropriate cordons
• Approach considering the risk of wheel assembly failure and establish a hub disintegration exclusion zone

• Identify any rotating propellers and helicopter blades, establish and communicate avoidance routes

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.

UKRO provides further information on stabilising large goods vehicles (LGVs) and public service vehicles (PSVs).

**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 as part of the incident plan
- 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
- Appoint a safety officer to monitor the effect of operations on the stability of vehicle
- Maintain rescuer egress route in case the vehicle becomes unstable or moves
- Consider securing an unstable vehicle to a suitable anchor point
- Stabilise the vehicle and create initial access to casualties
- Stabilise the vehicle to protect against uncontrolled movement and regularly check effectiveness