For more information or to give feedback on this document, please contact M&T Risk and Assurance
Tel: +27 11 638 2815

AFRG 2 – SURFACE MOBILE EQUIPMENT GUIDELINE

1 AIM

To eliminate or minimise the risk of fatalities, injuries and incidents arising from the use of surface mobile equipment.

This guideline refers to the implementation of the Anglo Fatal Risk Standard: Surface Mobile Equipment and should be read in conjunction with that Standard.

The guidelines contained in this document are considered as "highly recommended" and deviations are to be documented and justified. Full adherence to these guidelines will not be a factor in determining compliance with the Standards, since alternative methods can be available if justified on a risk basis.

In case of conflict with requirements of any other Anglo document or guideline, the following hierarchy will apply:

a) Anglo Safety Way - ASW

b) Anglo Fatal Risk Standards - AFRS

c) Anglo Fatal Risk Guidelines - AFRG

It is important that when implementing Standards the organization takes cognizance of, and comply with the relevant legal requirements in the country of application.

2 APPLICATION

This Standard applies to surface mobile equipment such as rear dump, belly dump and water trucks, graders, dozers, loaders and pressurised road and rail tankers. Where surface mobile equipment falls outside these groups (e.g. draglines, shovels, excavators, forklifts, mobile cranes, buses, backhoes, bobcats and other trucks larger than light vehicles), the application of some requirements of this Standard may not be practicable. In these cases, a risk-based approach shall be used to determine the level of compliance needed for each of the specific requirements.

This Standard applies to all Anglo American Group managed businesses and operations, including contractors and visitors when involved in controlled activities.

The purpose of this Guideline is to provide guidance and clarification on the requirements of the Anglo Fatal Risk Standard: SURFACE MOBILE EQUIPMENT, which describes the minimum acceptable requirements for operating surface mobile equipment for controlled activities within Anglo American.

This guideline has been developed to provide more detail and clarification to the implementations of the requirements of the Standard. This should enable sites to be more aligned with each other on what the boundaries are with regards to meeting the requirements.

This guideline is by no means exhaustive and will be updated periodically and supported by good practice sharing. It is not intended as a template for achieving compliance.

This document is structured using exactly the same numbering sequence as the Fatal Risk Standard document. Each requirement is repeated in a box, followed by a statement of intent. This is followed by discussion and clarification of that particular requirement with reference to other related requirements, Appendices, and other relevant documents. Appendices are used to reduce the size of this document, and allow more efficient continuous improvement.

There are two questions to be asked in determining the application of the Surface Mobile Equipment Standard;

Does this specific equipment classify as Surface Mobile Equipment for the purpose of this Standard?

Is any of the equipment subject to the Surface Mobile Equipment Standard also subject to compliance with the requirements of another Fatal Risk Standard?

These questions will be addressed in the following paragraphs.

Recommended approach

It would be advisable to start with a list of all the Surface Mobile Equipment as specified in section 2.2 of the Standard and to have this in a matrix format. Then check all the safety requirements as specified in section 1, 2, 3, 6 and 8 for each one of listed equipment. Consult the technical guideline for clarity and applicability (risk based) on each of these safety requirements as stipulated in section 2.2. Once this has been done is to assess whether natural replacement process of these equipment over the next three years will enable full compliance by 4 October 2010.

It is recommend early interaction with the various OEM's should commence to enable timeouts equipment conversions as required in the AFRS for all new (to site) selection and acceptance processes to enable compliance to section 10 of the AFRS. This process will normally be done on a Divisional basis to ensure governance and coordination and enable cost effective outcomes.

If identified that full compliance through natural turnover for some of the equipment is not achievable, a conversion program will have to be put in place with the OEM's or on site with the approval of an engineer, using the Guideline specifications.

Once this process is underway a match need to be found between the listed equipment and their operating environments which include the requirements of sections 4, 5, 7, 14, 17, 18 and 20. This process will have to be vigorously subjected to the change management process requirements as per Standard 2 of ASW and section 4, 11 and 21 of the AFRS.

The following task will be used to identify the inspection and maintenance requirements as described in the FRS. It is recommend to use FMECA risk assessment technique to determine the maintenance requirements – this might have already been done and should possibly only be revised considering that some of the equipment will be required to be modified to comply.

3 DEFINITIONS

Controlled Activities or Controlled sites	:	Those where the Anglo American Group Company has the authority to determine how to manage the operation. It does not include monitored or uncontrolled activities.
Monitored Activities	:	Those where Anglo American can exercise some influence but cannot set Policies and/or comprehensive Control Standards and/or directly supervise and enforce their application (i.e. contractor and supplier transporting their goods and/or personnel to or from "controlled sites").
Uncontrolled Activities	:	Those where Anglo American does not set Policies or influence Control Standards and does not supervise safety performance. These include services provided by public Companies, activities performed at supplier or manufacturer shops, etc. Where there is uncertainty over whether the activity is controlled, monitored or uncontrolled, the matter should be referred to the Safety function for determination.
AFRS	:	Anglo Fatal Risk Standards
Cab	:	The occupant structure for SME
Earth Moving Equipment	:	large heavy mining equipment such as rear dump, belly dump, and water trucks, graders, dozers and loaders
Ergonomics	:	The design of equipment and process to allow the task and activities to be carried out by a person/s with the minimum of detrimental effect on their health and physical capabilities.
FOPS	:	Falling object protective structure
Impracticable	:	Not viable, unfeasible, unworkable, impossible, impractical
OEM	:	Original Equipment Manufacturer
Maintainability	:	A measure of the ease or risk of accessing or maintaining/servicing equipment
ROPS	:	Roll-over protective structure
SOP	:	Standard Operating Practice
COP	:	Standard Operating Practice

Definition of Surface Mobile Equipment (SME)

SME examples are included in Reference Document 1.

a) Surface Mobile Equipment (SME) – Inclusions

This Standard applies to surface mobile equipment such as rear dump, belly dump and water trucks, graders, dozers, loaders, pressurized road and rail tankers.

The above mentioned list includes the following categories:

- Anglo American owned or leased surface mobile equipment,
- Hire surface mobile equipment,
- Contractor or Supplier surface mobile equipment operating at controlled sites.

b) Surface Mobile Equipment - Exclusions

Pertinent section in the Standard: Where surface mobile equipment falls "outside" these groups, for example but not confined to, draglines, shovels, excavators, forklifts, mobile cranes, buses, backhoes, bobcats, and other trucks larger than light vehicles, there may be some requirements of this standard that are not practicable. In these cases a risk-based approach shall be used to determine the level of compliance required with each of the specific requirements."

The following equipment is not considered Surface Mobile Equipment for the purpose of this Standard:

- Aeronautical,
- Rail and marine equipment,
- Elevated work platforms,
- Mobile lifts,
- Scissor lifts and equipment whose prime activity is underground related.
- A crane is considered Surface Mobile Equipment when it is in motion over the ground, but the Lifting Operations Standards applies once that crane commences a lift.

c) Risk Management / Risk-based approach

In accordance with the "HIERARCHY OF CONTROLS" the significant risks identified in the risk assessments should be dealt with as follows:

- ELIMINATE - The complete elimination of the hazard.
- SUBSTITUTE - Replacing the material or process with a less hazardous one.
- REDESIGN - Redesign the equipment or work process
- SEPARATE - Isolating the hazard by guarding or enclosing it
- ADMINISTRATE - Providing control such as training, procedures etc.
- PERSONAL PROTECTIVE EQUIPMENT (PPE) - Use appropriate and properly fitted PPE where other controls are not practical.

It is recommended that operations do not only rely on "procedures". Fatal accidents continue to occur where robust procedures were thought to exist.

The risk assessments should cover the designed application, operation and maintenance of SME and their associated equipment and tools, in the various mining environments in AA plc.

The risk assessment documents should lists the identified hazards, their associated risks with its significance rating and the detailed controls.

The relevant information where applicable such as accident statistics, ergonomic studies, research reports, manufacturers specifications, approvals, design criteria and performance, must be used to assess the risks.

In the selection process of every SME the following issues should be considered and should be available for use in the hazard identification process.

The detail information of every SME should include the following where applicable:

- The make and type of machine or equipment
- The mass and payload
- The physical dimensions of the equipment
- The purpose and prime use of the equipment
- The power required and the brakes including braking force
- The speed and turning circle of the equipment
- Operator visibility, vision and blind spots
- The safety devices required and the signalling / communications arrangement
- The limitations of the equipment
- The required illumination and ergonomics of the equipment
- The operation and maintenance requirements
- Training and emergency procedures

The risk assessments should be reviewed after every serious incident/accident involving an SME or when significant changes are made to the procedures, mine layouts, mining methods, plant or equipment and or audits conducted.

A Risk Register should be available on the mine that indicates the Potential Hazards and Controls identified.

4 PLANT AND EQUIPMENT REQUIREMENTS

1. Minimum Safety Specifications

Surface mobile equipment shall have the following minimum safety specifications:

- seat belts for all occupants
- adequate lighting (e.g. headlights, tail, turn, brake, strobe, flashing lights)
- identified isolation/lockout point in accordance with the Isolation Standard
- adequate walkways, railing, steps/grab handle combinations and boarding facilities, including an alternative path of disembarking in case of emergency
- collision-avoidance technology and/or procedures
- reversing alarms
- chock blocks for rubber-tyred surface mobile equipment
- horn
- effective windscreen wipers
- effective guarding on accessible moving parts (consistent with the Equipment Safeguarding Standard)
- signage on the equipment that allows clear and easy identification from a distance
- security systems to prevent unauthorised operation.

Note: Section 2.5 of the Standard is mandatory.

Any exemptions from the Standard must be justified using a risk based approach and be approved by the Divisional CEO.

It would be impracticable, for example, to have windscreen wipers on a forklift that does not have an enclosed cab. Conversely, this provision should not be used to avoid difficult but essential requirements (for example, seatbelts shall be provided for forklift operators, and worn, even though most operators are getting on and off the machine all day, and may find compliance tedious).

Seat belts for all occupants

The intent of this requirement is to avoid serious injury/fatality by constraining the occupants of SME safely in the event of a collision or rollover.

There is documented evidence both within the company and externally, that the chance of serious injury or fatality is significantly reduced if equipment occupants are wearing seatbelts. SME is to be purchased with OEM designed and supplied seatbelts for all seating positions. OEM supplied seatbelts are preferred as these generally meet international standards. Equivalent or superior performance replacements are acceptable provided suitable change management procedures are undertaken to ensure there are no unintended consequences and legislative requirements for the country of use are complied with.

Applicable technical standards are:

- International ISO 6683
- Australian AS2664, ADR4
- Society of Automotive Engineers SAE J386.

Normal practice is lap sash belts with retractable mechanisms. These belts provide superior protection from head/chest injuries in the event of a collision. They are more comfortable, easier and cleaner for the occupants and hence are used more often.

- Fixed belts require manual adjustment (which occupants usually do not bother with) and tend to get dirty and unpleasant to wear because they are left lying on the floor.
- Where a sash is not practical, lap belts shall be used.
- In the case where a trainer must accompany the operator in the SME for training purposes, a fixed seat with a seat belt must be provided for the trainer. The design of the additional seat must be approved by an Engineer.

Purchase of new SME is preferred over retrofitting seatbelts to existing equipment.

- If retrofitting is necessary, reference should be made to the Australian National Code of Practice for Heavy Vehicle Modifications. This document provides practical specifications for seatbelts and seatbelt anchorage strength. A copy of this code is available as Reference Document 2.

Adequate lighting (e.g. headlights, tail, turn, brake, strobe, flashing lights)

The intent of this requirement is to avoid serious injury/fatality as a result of SME accidents where lighting conditions cause the operator to have inadequate vision for safe operation. It is also to ensure that the vehicle is visible to pedestrians, other drivers and operators.

This requirement does not remove the need for general and supplementary lighting in operational areas.

It is expected that each site will have a set SME lighting standard applicable for each category of equipment. A typical example can be found in Reference Document 3.

Inadequate lighting can also have adverse health impacts on operators due to eyestrain and contribute to fatigue.

The risks of slips and falls can be reduced through the provision of suitable lighting over access ways and other service points.

Lighting shall ensure that the width and length of the vehicle are clearly visible.

- It is necessary to indicate the width of the vehicle if the headlights are set away from the extremities of the machine.
- SME shall have headlights turned on whenever the motor is running to enhance

collision avoidance. This is consistent with the requirements in AFRS 1, Light Vehicles Standard.

- Rotating lights for haul trucks should be installed on the roof of the operator cab.

Identified isolation/lockout point in accordance with the Isolation Standard

The intent of this requirement is to avoid serious injury/fatality due to equipment being started or operated whilst people are working on it.

SME shall be fitted with a clearly identified isolation/lockout point (Figures 1 and 2) capable of accepting a personal isolation lock or hasp for multiple users in accordance with AFRS 6, Isolation Standard.

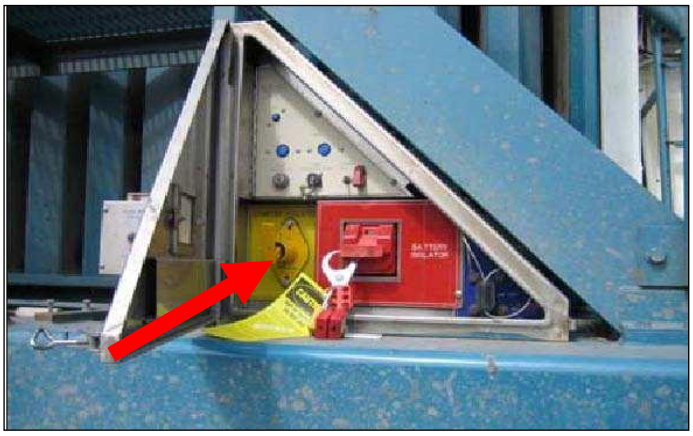

Figure 1: Example of Isolation Point

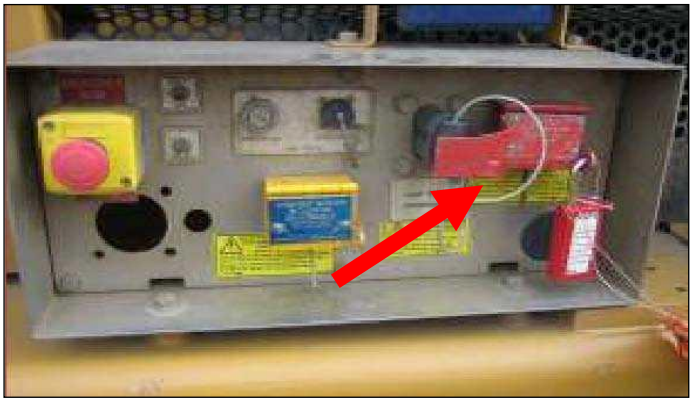

Figure 2: This example protects the jump start terminals. This bracket simply mounts over the top of the original isolation switch to enable the fitment of a lock.

Figure 3: Leading practice identification

Leading practice examples are shown in AA_AFRBP_00000000004: SME Isolation Leading Practice.

Note that some legislative regimes (e.g. MDG15 from New South Wales) require that battery isolation be on both negative and positive poles. This goes one step higher in the control measures than is specifically required by this AFRS Standard.

- Another issue that should be considered is that in some instances use of the jump start terminals may over-ride the battery isolation switch. Note in Figure 2 how a flap has been placed to cover the receptacles when the isolation switch is locked out.
- It should be noted that the Isolation Standard requires that all energy sources are capable of being isolated and not just the main battery terminal lead. A risk based approach should be used to determine if other sources of energy (e.g. Hydraulic) should also be fitted with an isolation/lockout point. Hydraulic isolation manifolds are available.

Figure 4: Isolation point for equipment with air starts

Attempts have been made to modify existing isolation points that are not lockable by placing them in a secure box with a cover that can be locked (Figure 5). This is not acceptable as human error can lead to the box being locked with the switch still turned on.

Figure 5: Unacceptable Isolation

Where isolation switches are located behind covers clear isolation labels should be located both beside the isolation point and on the outside of the cover.

Immobilization procedures shall be developed where there is a need to be within the working footprint of SME whilst it is not fully isolated.

- This procedure shall enable the user to immobilize the machine without isolating it. For example, a truck driver is able to do pre-use inspection with the lights on but with the starter motor immobilized.
- Refer to AA_AFRBP_000005 for an example of an immobilization procedure.

Adequate walkways, railing, steps/grab handle combinations and boarding facilities including an alternative path of disembarking in case of emergency

The intent of this requirement is to avoid serious injury/fatality by ensuring the operator and/or passengers are able to board safely and perform routine inspection/servicing functions without being exposed to the risk of falling from heights.

Standard OEM access systems are generally ladders.

- These will normally comply with this requirement as long as three point contact can be maintained
- The ladder has to be well maintained and free of damage, corrosion or distortion.

Leading practice for access systems is generally based on stairs and not ladders.

- Sites are encouraged to implement leading practice equipment access systems as demonstrated in Reference Document 6 Surface Mobile Equipment Access and Working at Heights Protection as the primary access.
- OEM access systems typically expose the operators to sprain/strain risk, as well as the chance of slipping and falling, particularly in the wet and in reduced lighting conditions.
- Emergency access may still be a ladder, but should be well maintained and reasonably located to provide low risk access to it. Consideration should also be made as to whether the person boarding the machine can maintain three point contact whilst carrying objects such as tool bags. Stairways generally provide this ability to carry an object and board safely. If it is possible to place the item on the walkway from the ground and then climb the ladder (if no stairway is practicable), it may solve this particular issue.

The working at heights requirements of AFRS 7 shall apply to SME.

- OEM supplied walkways and working at heights protection is generally not AFRS compliant. Wherever an operator/serviceman is expected to work (such as cleaning windows, checking fire extinguishers, isolating, fuelling, checking fluid levels, etc.) provision should be made for working at heights protection. In some cases the potential drop is less than the 2 meter requirement of AFRS 7 but the risk of falling is still high.
- For other functions, such as major maintenance, it is recommended that mobile work platforms or lifts would be used rather than fitting this equipment with excessive walkways.

Figure 6: Mobile work platform

AA_AFRBP 6 – Surface Mobile Equipment Access and Working at Heights Protection addresses this issue.

- It is better to eliminate the risk of working at height by bringing the work to the ground and resort to the use of platforms. The AFRS 7 Working at Heights Standard is a useful source of leading practice concerning this issue.

Anglo American is working with OEM's to either improve their standard access and working platforms, or, at least offer option packs that reach compliance with this requirement.

- In the case of track dozers, two generic access ladder options are available. The first is an access ladder which is able to swing into a storage position parallel to the ground as shown on the next page.

Figure 7: Access ladder in vertical position

Figure 8: Ladder being rotated to storage position

Figure 9: Ladder in storage position

- The second option does not have the swinging function and folds upwards into its storage position as shown on the next page. Both designs have been tested at New Vaal Colliery in South Africa and can be contacted for more details.

Figure 10: Access ladder in down position

Figure 11: Access ladder folded up

Collision avoidance technology and/or procedures

The intent of this requirement is to avoid collisions involving SME (including with light vehicles, people and fixed structures) and thus reduce serious injury/fatality.

- Collision avoidance (warning) technology assists the operator to detect and avoid potential collision situations.
- In 2006, Anglo American suffered 14 fatalities (surface and underground combined) due to collisions. This represents 33% of the fatalities in the group and is therefore an area that requires focus and where substantial improvement is demanded. The risk profile of collisions associated with large surface mining haul trucks is high. Operators of these machines are faced with;
    - poor visibility around the machine
    - The need to operate machines at speeds of up to 60km/h for 24 hours a day, seven days a week in terms of continuous operations,

Application of this technology must be seen as providing additional tools to the operator to avoid collisions, rather than as a complete solution or replacement for good operator skills, behaviour and discipline. This requirement calls for collision avoidance and/or procedures.

Before any collision avoidance technology is implemented, each operation needs to conduct a thorough risk assessment. The risk assessment will point out unique site-specific issues that need to be addressed as well as whether slow-speed close range collision warning systems and/or high-speed long range systems will be required.

A detailed Collision Avoidance Systems Technical report is available as AA_AFRBP 7. Note that CAS devices are deemed safety critical devices and therefore the equipment may not be used if the CAS device is defective and must be repaired before operations can continue.

The lowered mechanical bumper system is recommended to be installed on off-highway trucks on surface mines, to prevent light vehicles being driven over by the truck in the event of a frontal collision.

The option of fitting extended front bumpers is to lower the fatal risk due to “ducktail” style collision (Figure 12). Some trucks are not subject to the same level of risk due the relative geometry of the engine protruding out in front of the cab, the cab placed back on the platform, or the truck tray having a short rear overhang.

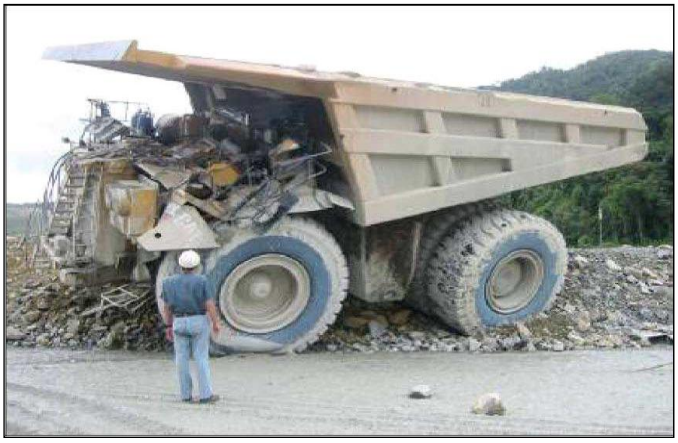

Figure 12: The cab of a truck is crushed by running into the tray of another truck

- Note that this requirement applies to “mine haul trucks” larger than 70 tonnes but should also apply to other trucks with the same cab / chassis configuration such as water trucks or service trucks which would have the same “ducktail” style collision risk.
- The effectiveness of extended front bumpers is critically dependent on their design. The structure should be able to withstand the forces induced during a low speed rear-ending accident, whilst being as light as possible so as not to impact negatively on the weight distribution on the axles and tyres.
- Some operations have also fitted extended front bumpers to avoid a haul truck running over a light vehicle, by pushing the light vehicle away. The heights of a bumper required to avoid a ducktail collision and that required to avoid a light vehicle overrun are different, although a dual purpose design is possible.
- The “ducktail” style collisions almost always involve operator fatigue and the 2.7-30 requirement of this Standard is highly relevant to this risk issue. The required procedures should include Fatigue Management, Reference Document 19
- Anglo Technical Division can assist in providing a design for a specific vehicle, or auditing the suitability of existing designs.

Examples of existing practice in extended bumpers are shown in Reference Document 8, Extended Front Bumpers for Rear Dump Trucks.

The procedures mentioned in this requirement should include those such as the Parking Standards (2.6-18), the Traffic Management plan (2.6-20) (equipment separation distances, notification of intention to move), pre-start checks, truck queuing, fatigue management, speed control, emergency breakdown, lighting for visibility, wet weather and wet road controls.

Reversing alarms

The intent of this requirement is to avoid serious injury/fatality by providing an audible alarm which indicates to pedestrians and drivers of other equipment that the SME is in reverse gear.

- Certain sites have environmental/community issues from the noise created by these alarms. In these cases alternative controls can be applied by following the "Approval for Alternative Controls" procedure explained in the AFRS. As a potential solution to this issue there are directional reverse alarms available which use technology to only transmit loud noise in the narrow field where collision would be likely. Another available technology adjusts the volume of the alarm to the ambient noise level.
- Reversing alarm checks should be an element of the pre-operation inspections outlined in 2.6 -12 of this Standard.

Chock blocks for rubber-tyred surface mobile equipment

The intent of this requirement is to avoid serious injury/fatality and equipment/facility damage by stopping SME from rolling away when parked.

- Chock blocks are to be carried on all SME and available for use if required by the site developed Parking Standard.
- The chocks should be of the correct size and specification for the weight and tyre size of the SME as prescribed by the chock block manufacturers. In some cases the chock manufacturers recommend use of multiple chocks to cope with the mass of the equipment.
- In case of loaded equipment or parking on severe slopes, chocks may not be effective and other forms of control should be used. Their use should be as defined in the site Parking Standard developed for compliance with 2.6-18 of this Standard.
- Reference Document 9 shows various methods of attaching chock blocks to equipment for ease of handling, and some recommended leading practices.

Figure 13: Correct placement of chocks

- Chocks are available in lighter weight alternatives and there are innovative systems (such as placing below the hydraulic access ladder) that sites have devised to carry them to reduce the risk of sprain strain injuries.

- For workshop situations chock trolleys have been developed to avoid bending and lifting for maintenance personnel.

Figure 14: Chock trolley

Horn

The intent of this requirement is to avoid serious injury/fatality by providing audible warning of the presence of an SME in order to avoid a collision.

- The horn should be capable of being heard over the ambient noise level including other machine noise.
- The horn button should be located in a position that is readily accessible by the operator during normal operation and in the event of an emergency.

Effective windscreen wipers

The intent of this requirement is to avoid serious injury/fatality by providing clear vision to the operator for safe operation.

- The wiper blades should be part of the maintenance program to ensure they are effective and not capable of damaging the windscreen.
- Associated windscreen washers should also be available to help clear the screen of accumulated mud or dust.

Effective guarding on accessible moving parts (consistent with the Equipment Safeguarding Standard)

The intent of this requirement is to avoid serious injury/fatality by protecting people from entanglement in moving equipment such as rotating shafts, pulleys, belts.

The guarding should be in compliance with the requirements of AFRS 5 Equipment Safeguarding Standard.

Signage on the equipment that allows clear and easy identification from a distance.

The intent of this requirement is to avoid serious injury/fatality by enabling quick and easy identification of a specific piece of SME from a distance in an emergency situation and/or to ensure positive communication between SME and other vehicles.

Figure 15: Example of vehicle identification

- It is also useful for behaviour observations and incident investigations. Sites should establish their own site standard for equipment identification.
- Iridescent yellow font on a black background (or the reverse) has generally found to be most effective.
- Identification painted directly onto the equipment colour (as a background) is not leading practice as it becomes confused with the OEM model numbers and does not stand out.
- Identification should be visible from all sides of the SME, if practicable.
- Consideration should be given to magnetic identification signage where:
    - it may be impractical to apply permanent adhesive identification signage to SME (e.g. short term operation of a vehicle on site), or
    - local sensitivities exist which may cause concern regarding display of signage when SME travels off site.

Leading practice equipment identification can be found in Reference Document 10.

Security Systems to prevent unauthorized operation.

The intent of this requirement is to avoid serious injury/fatality that could be caused by the operation of surface mobile equipment by unauthorized personnel.

Details of machinery access management systems are included in Reference Document 11.

2. Minimum Safety Specifications, Unless Exempted by Risk Assessment

Surface mobile equipment should have the following minimum safety specifications, unless exempted by risk assessment:

- approved or certified roll-over protection (ROP)
- fail-to-safe brakes
- a fire-detection and suppression system capable of being activated from both ground and cabin levels
- non handheld two-way radio or other forms of communication
- falling object protection (FOP)
- enclosed and tightly-sealed air-conditioned cabins, with consideration of requirements for noise and dust suppression systems and suitable protective glass (e.g. toughened, laminated, shatterproof)
- a method for transporting supplies and personal items to and from the operator cabin (e.g. a back pack or shoulder strap bag) to enable drivers to maintain three points of contact continuously while mounting and disembarking from the equipment
- safety checks, supports, interlocks, etc. to be used when working on the machine.

Note these requirements are “should” and the primary intent is to comply with the full requirements as if they were mandatory.

- However, there will be circumstances where local conditions may demonstrate that the requirement is either not applicable or an alternative approach is necessary. For example, it may not be necessary to have an enclosed and air conditioned cab on a forklift that is used for short periods at a time in a workshop situation.
- In these cases variation must be approved by the most senior manager of the operation based on an evaluation of the risk. A copy of this shall be sent to the Group Sustainable Development unit.

Approved or certified roll-over protection (ROP)

The intent of this requirement is to avoid serious injury/fatality by protecting the operator and other occupants of SME in the event of roll over accident with an appropriate Roll-Over Protection Structure (ROPS).

- Note that these requirements apply to all SME on Anglo sites. This includes

contractor vehicles.

- There are various international and national standards for ROPS on Earth Moving Equipment:
  - International ISO3471
  - Australian AS 2294.2
  - NSW MDG1
  - Society of Automotive Engineers SAEJ1040
  - European Standard BS EN 13510
  - South African SABS 3471

Some early versions of these standards did not provide adequate protection and care must be taken to ensure that old vehicles have acceptable ROPS.

In the case of medium and heavy buses, those sold since 1993 in Australia comply with ADR 59/00 which is a minimum standard for Omnibus rollover strength. This fact can be used as part of the risk assessment to determine if ROPS should be fitted. Compliance to ADR59/00, or the international equivalent, (e.g. United Nations ECE R 66/00) equates to a strong control in its own sense. The compliance nameplate of the bus should be carefully checked for the ADR or equivalent.

Most recently manufactured road going trucks generally have compliance to an international cab strength standard. (European Commission for Europe (ECE); Structural Standards (Regulation 29). The compliance plate of the truck should be checked for this to determine if this control exists and can be used as part of the risk assessment for the fitting of a ROPS or not

- AA_SPEC_264073: Specification for Roll-over Protective Structures and Falling-object Protective Structures for Trackless Vehicles is intended to provide reasonable protection to operators and passengers of vehicles during roll-over accidents. The specification is intended to cover all trackless vehicles, including Light Vehicles and Busses. The specification does not define where Protective Structures shall be required for specific vehicles. This will be established by the operations through Risk Assessments.

Figure 16: Roll-over accident

Most Earth Moving Equipment is delivered directly from the factory with ROPS as

standard or as an OEM option.

- If the ROPS is certified there will be a certification label on the unit.
- Any repair or unauthorized modification made to a ROPS voids the certification unless specifically approved by the manufacturer or a registered professional engineer familiar with ROPS.
- No work can be performed on ROPS that weakens the structure's ability to perform its intended function. Examples include welding, drilling, cutting or grinding.
- Bent deformed or broken ROPS components, including mounting brackets, cannot be repaired and must be replaced.

Any ROPS fitted to SME other than by the OEM shall be designed, manufactured and fitted by a suitably qualified and authorized person.

Any newly determined ROPS design should be appropriately risk assessed.

- In some cases there may be local government or legislative requirements in respect of the design and fitment of a ROPS to SME and it is important that these requirements be determined at local level.
- The design and fitment of a ROPS should take the following items into consideration:
    - Configuration: review of the ROPS overall design:
        - Should the ROPS be "internal" or "external"?
        - Does the ROPS design provide adequate protection for all SME occupants?
        - Does the ROPS design incorporate sufficient bracing to ensure the ROPS is able to withstand a roll over impact?
    - Mountings:
        - Are the ROPS mounting plates (including the fittings) acceptable in type, size and design to withstand the significant forces applied to the structure during a roll over event?
        - Do the mountings interfere with the vehicles structural integrity?
        - Drilling or welding to the vehicle chassis should not be undertaken as this may cause potential concern regarding the overall vehicle crashworthiness.
        - It is recommended that the mounting plates consist of both an "upper" and a "lower" mounting plate to provide a sandwich effect to the primary structure it is being attached to.
    - Passenger space: does the ROPS design create other risks or disruptions to SME occupants? For example:
        - Difficulties associated with operator or passenger vehicle ingress/egress;
        - Interruption of operator visibility;
        - Difficulties associated with opening or closing the doors;
        - Risks associated with the operator or passengers impacting

against the ROPS in a crash event.

- Tubing: is the type and diameter size sufficient to withstand a roll over impact?
- Padding: is there adequate padding applied to an internal ROPS to provide adequate occupant protection in a crash event?
- Seat belt anchorages: it is important that the ROPS is designed and installed in such a way that it does not affix to or interrupt the vehicle seat belt anchorage points.
- Workmanship: shall comply with the requirements of ISO 9001.
- Labelling: the ROPS shall be labelled in accordance with the relevant design standard.

Examples of how sites have achieved compliance with this requirement for non-earth moving equipment can be found in Reference Document 12.

Fail-to-safe brakes

The intent of this requirement is to avoid serious injury/fatality by stopping the SME in the event of brake system failure.

- The fail-safe braking function will cause automatic application of the foundation brakes upon a loss of energy in the braking system.

Further details are available in AA_SPEC_236001: Brake systems for trackless mobile mining machines.

A fire-detection and suppression system capable of being activated from both ground and cabin levels

The intent of this requirement is to enhance the SME occupant's ability to escape to ground without serious injury/fatality in the event of equipment fire.

- The fire suppression system should be capable of being activated from both the ground and cabin levels to cover a variety of emergency scenarios.
- A hand held fire extinguisher is not considered a fire suppression system for the purposes of this requirement. This does not remove the need to equip SME with hand held fire extinguishers in line with the normal site requirements.
- A task based risk technique shall be applied to determine suitable fire suppression arrangements. An example where fire suppression may not be required would be a machine such as a forklift or light truck where the operator can normally exit to the ground through either side with ease in the event of fire.
- The fire suppression system is considered a safety critical component as mentioned in 2.6-19 of this Standard and as such, should be included in a maintenance and inspection program to ensure its effective operation.

Non-handheld two-way radio or other forms of communication

The intent of this requirement is to avoid serious injury/fatality by providing suitable means of communication between SME, people, other vehicles and emergency

response personnel.

- Any communication is inherently dangerous as it distracts the driver/operator. Task base risk assessment is required for any communication system used on SME.
- A subject based risk technique shall be used to determine where 2 way radio communications are required.
- "Non-handheld" radios:
    - Must be audible without operator activation
    - Must allow the operator to respond with minimal distraction and effort
- Operators and drivers of SME shall only use hand-held radios when the vehicle is stationary in a safe location.
- Non-handheld radios are more acceptable than mobile telephones because of the limited duration and scope of conversation.

Falling Object Protection (FOP)

The intent of this requirement is to avoid serious injury/fatality by providing protection to the occupants of SME against falling objects.

International and National Standards exist for Falling Object Protection Structures.

- International ISO 3449
- Australian AS 2294.3
- Society of Automotive Engineers SAE J1040
- European Standard BS EN 13627
- South African SANS 3449
- AA_SPEC_264073: Specification for Roll-over Protective Structures and Falling-object Protective Structures for Trackless Vehicles is intended to provide reasonable protection to operators and passengers of vehicles during accidents involving falling objects. The specification is intended to cover all trackless vehicles, including Light Vehicles and Busses. The specification does not define where Protective Structures shall be required for specific vehicles. This will be established by the operations through Risk Assessments.
- The same general principles of design, fabrication and maintenance outlined for ROPS in the section above should be applied where relevant for FOPS.

Anglo American SHE Bulletin "Design guidelines for slope stability in open pits" is included as Reference Document 22 which deals with the applicable standards relating to slope and wall stability design within operations using strip mining methods.

Enclosed and tightly sealed air-conditioned cabins, with consideration of requirements for noise and dust suppression systems and suitable protective glass (e.g. toughened, laminated, shatterproof)

The intent of this requirement is to avoid serious injury/fatality/serious health issues by protecting the occupants of SME from dust and other severe environmental conditions

and impact from falling or projected objects such as rocks.

- A subject based risk technique shall be used to determine when a managed environment is required for the cab. Issues to be considered include temperature, dust, gases, weather, UV, noise, projectiles.
- Specific consideration should be given to the choice of different types of cab glass.
    - Generally, pressure resistant glass is required on dozers working on live stockpiles with bottom feeders (in case of inundation).
    - Shatter resistant glass is required when working in a mining situation including high risk situations such as adjacent to high walls and falling objects.
    - Heatproof glass is required at times in smelter operations.
    - If tinted or solar radiation reduction cab glass or film is specified, consideration should be made for safe night time operation and the effects of scratching on the film due to dust. There are some reflective films available that make it almost impossible to operate at night due to the in-cab instrument and screen monitor light reflecting back from this film.
- Cab maintenance issues are often overlooked but these are part of Section 19 of this Standard and should include:
    - The inspection and replacement of cab glass that is cracked or broken to maintain visibility, protection and dust sealing.
    - It is essential that the integrity of the environment be maintained by replacing rubber seals that are damaged, flattened or worn.
    - Doors, windows and catches should be maintained to ensure they close securely.
    - Care should be taken when installing wiring and leads for lights, radios, and other devices, that they are not routed over or under the rubber seal in such a way as to restrict its ability to seal.
    - Holes drilled through the cab should be sealed by using appropriate means.
    - Periodic monitoring of dust, vibration and noise levels inside the cab should be performed.
- In-cab occupational noise levels are usually legislated, but consideration should also be given to reducing these if necessary to prevent permanent hearing loss to equipment operators.

A method for transporting supplies and personal items to and from the operator cabin to enable drivers to continuously maintain three points of contact while mounting and disembarking from the equipment (e.g. a back pack or shoulder strap bag).

The intent of this requirement is to avoid serious injury/fatality by making provision for people to maintain three points of contact whilst accessing SME.

- Task based risk management techniques shall be applied to issues regarding access to SME.

- Risks associated with carrying items will be low where the item can be placed on the floor of the cab from the ground, or where stairways are provided and as such a method may not be required.
- Sites have implemented various solutions such as the use of backpacks. This should be coupled with behaviour-based observations to assure the use of these backpacks is as expected.

Figure 17: Operator using a shoulder bag

Safety checks, supports, interlocks etc. to be used when working on the machine

The intent of this requirement is to avoid serious injury/fatality by ensuring that appropriate safety checks, supports and interlocks are employed when performing maintenance or breakdown work.

- All possible crush and nip hazards must be assessed for all types of motion of the machine i.e. not only articulation. Hazards shall guarded and clearly identified with permanent signage.
- Controls must be isolated to prevent accidental or uncontrolled operation of the machine. This can be achieved by either installing appropriate guarding around the controls or additional interlocks such that the activation of the controls can be isolated.
- Guarding should not adversely affect maintenance personnel ergonomics.
- The location of the ignition/starting controls should be such that the machine cannot be started from outside the operator cabin. A dangerous practice is to start the machine from outside the cabin whilst standing in the articulation area which is a crush zone.
- All forms of stored energy on the machine should be clearly identified and appropriate systems must be in place to allow the energy to be controlled or safely released.
- Review the elements that form part of stored energy systems and where possible separate items from parts of the system that contains stored energy. OEMs must approve any such changes.
- Accumulators shall be permanently labelled to identify the charging pressure and charging gas.

- Emergency stop devices shall be located at appropriate and readily accessible locations on the machine.
- Safety pins or sprags for booms shall be permanently attached to the equipment such that the device is always kept on the machine and is therefore always available.
- Adjustable canopies shall have a gap of not less than 250mm at the lowest position. Physical mechanical stops must prevent the canopy from being lowered any further. Consider any under-hung lights that may reduce this canopy clearance.

3. New Technology

Advances in technology for collision avoidance safety management systems fleet management and visibility improvement shall be monitored and appropriate engineering reviews should be conducted to determine whether new technology should be implemented or used.

The intent of this requirement is to avoid serious injury/fatality by enhancing SME safety though the application of new technology that assists operators and their supervisors to complete their functions more effectively.

- Technology that should be monitored includes:
  - Cameras
  - Radar
  - Radio frequency identification
  - GPS
  - Fatigue detection and management devices
  - Equipment operation control systems
  - Systems to monitor separations, position, speed, access, seatbelts and other operating behaviours,
  - Radio and other remote signalling for equipment condition, condition alarms, tyre operating parameters, etc.
  - Fleet dispatch and emergency operations
- Review of new technology should feed into Group Specifications, Standards and Guidelines so that knowledge sharing is effective across operations.
- AskAnglo is a useful medium for collaboration.

4. Design, Inspection and Maintenance of Roadways

Design inspection and maintenance requirements should be in place for all roadways including collision protection of hazardous and critical plant and equipment. Risk assessments should be carried out prior to any changes to traffic movements.

The intent of this requirement is to avoid serious injury/fatality by having safe roads, ramps, intersections and parking areas.

- Roadways shall be designed to appropriate standards (minimum width, turn radius and super elevation, camber, crown, clear vision distance, maximum grade, and surface material, drainage, demarcation and signage etc.).
- Inspection and maintenance shall ensure that relevant standards are being applied.
- Changes in traffic movement are proven to incur higher potential risk and consideration shall be made to ensure appropriate controls are in place. As part of this requirement subject based risk techniques shall be used prior to any changes in traffic movement. Additional controls include:

  - Signs
  - Restricted traffic direction
  - Flagman
  - Lighting
  - Barriers and other road demarcation structures
  - Witches hats
  - Reduce speed limits & speed monitoring technology
  - Dust control
  - Guide posts
  - Stop lights
  - Notification to operators of changes to traffic flow, road closures/changes etc.

Figure 18: Demarcation of construction site

Additional information is provided in Reference Document 13: Haul Road Design Guideline.

5. Dangerous Areas

Systems (such as safety berms) shall be in place along roadways excavations and dump areas to prevent vehicles from entering dangerous areas as determined by risk assessment.

The intent of this requirement is to avoid serious injury/fatality by preventing SME from leaving the roadway when there is a significant change in elevation.

- The normal method for preventing this is placement of safety berms in high risk areas as determined by risk assessment. This usually means protecting the tops of excavations, bridges, dump areas, cuttings, and other roads and road structures where there is a steep drop off.
- Sites should establish standards for these safety berms appropriate to:
  - the size of the SME operating in that area.
  - the material of construction of the safety berm.

The generally accepted standard is half the wheel diameter of the largest SME. This may have to be increased if the properties of the berm construction material are too yielding.

An example of a safety berm standard can be found in Reference Document 13: Haul Road Design Guideline.

Figure 19: Berm construction material too yielding

6. Layout of Cabins

Layout of cabins should take into consideration the ergonomics of seating operator controls and retrofitted devices.

The intent of this requirement is to avoid serious injury/fatality/health impacts by providing an ergonomically sound and comfortable operating environment for the operator and occupants of SME.

- Seating shall be provided that meets appropriate International and National Standards including:
  - Adequate strength and comfort
  - Correctly dimensioned and adjustable
  - The risks of equipment vibration are controlled
- Operator Controls
  - Controls shall be intuitive i.e. the movement of the control shall match the movement of the equipment. Care must be taken when controls are multi-functional.
  - Controls shall be designed and ergonomically located to avoid injuries such as repetitive strain injury and not increase the onset of fatigue. The controls shall be readily accessible for emergency situations.
  - Placement of controls shall not lead the operator or other SME

occupant to human error though inconsistent placement of controls (stereotypic error).

- Displays shall be clear and easily understood. Multiple displays shall take into account the operators inability to cope with too much information.
- Warning signals shall be distinct, audible to the operator and easily understood.

- Retrofitted devices

  - Retrofitted devices shall be subject to a change management process. Their fitment shall not add additional risk or compromise the effectiveness of other controls or safety devices. E.g. a two way radio installed in an overhead position that leaves the operator prone to hitting his/her head is an undesirable situation.

7. Fleet and Control consistency

Fleet and control consistency should be considered where possible to minimize operator error when changing machines.

The intent of this requirement is to avoid serious injury/fatality by providing consistent controls (and their position) between similar types of equipment to minimise accidents due to operator error.

- Control consistency across a fleet should be considered where possible to minimize operator stereotypic error when changing machines.
- An example of a stereotypic error is when a person changes cars and turns on the windscreen wipers instead of the turn signals because they are on different sides.
- Controls of existing equipment should not be rashly changed to reach compliance. In some cases this is impractical, cost prohibitive and may lead to unintended and undesirable consequences. Some modification of existing equipment controls to afford fleet control consistency may be appropriate where those changes are cost effective and change management processes are followed. An example of this would be relocating the position of the fire suppression system button to be the same location for all equipment of the same type.
- When considering equipment purchase, the consistency of controls of the equipment shall be considered as an important factor.

8. Pressurised Road and Rail Tankers

All pressurized road and rail tankers shall be subject to a biannual inspection in accordance with Anglo American specifications and local health and safety regulations. The manufacturing certificate and inspection records shall be submitted to the access control point prior to entering an Anglo American site.

The intent of this requirement is to avoid serious injury/fatality due to catastrophic failure of pressurized tankers.

- The Anglo American specification is still being developed and will be made

available as a reference document when approved. The document will recommend that a risk-based inspection programme be adopted rather than adhering to the biannual requirement.

5 SYSTEM AND PROCEDURAL REQUIREMENTS

9. Seat Belts

Seat belts shall be used in all cases by all occupants.

The intent of this requirement is to avoid serious injury/fatality by having all occupants of SME wearing their seat belts at all times when the vehicle is in motion.

- There are some SME operations where the operator is required to stand e.g. tramming of certain drill rigs. In these cases a risk based approach shall be applied to ensure the risk to the operator is as low as reasonably practical.
- Adherence to this requirement is perhaps the biggest single step an individual can make to increase their chance of survival from a SME accident. For that reason compliance should be an important consideration in behaviour based observations. Some sites have implemented initiatives to assist with compliance such as orange coloured seatbelts, seatbelt reflective shields, seatbelt detector lights and alarms, seatbelt – ignition interlocks.

Figure 20: Orange coloured seatbelt

10. Risk Based Selection

A formal risk based selection and acceptance process shall be in place for all new (to site) and modified surface mobile equipment prior to commencement of work on site.

The intent of this requirement is to prevent serious injury/fatality due to new-to-site and modified equipment having risk issues that have not been detected or controlled.

- Suppliers of equipment have a duty to ensure that their products are without risk to health and safety when used properly. Operations shall ensure that they are provided with suitable documentation including risk assessments and manuals to confirm this prior to placing orders.
- The Operation shall consider the specific equipment and its interaction with people, other equipment and systems on site.

- Where SME does not fully comply with AFRS and modifications are required then these shall be agreed during pre-award negotiations. This would eliminate delays and extra costs caused if a machine arrived at site and was then required to be extensively modified.
- The site acceptance procedure shall be a confirmation that the modifications and options agreed are delivered as specified. The use of formal check sheets is recommended for receiving inspection.

11. Change of Management Process

Selection of equipment and any modification to equipment shall be subject to a rigorous change management process.

The intent of this requirement is to prevent serious injury/fatality caused by changes to equipment.

- Change always affects the risk profile for an operation because physical conditions change and people take time to adapt.
- Changes should not be implemented before new controls identified by risk assessment are in place.
- Risks to be considered include:
  - Traffic density
  - SME performance and characteristics
  - Usage patterns.

12. Pre-operation Inspection

A procedure and checklist system, including a brake functionality test, shall be in place for pre operation inspection by the operator. Log books shall be maintained on the machine and audited.

The intent of this requirement is to avoid serious injury/fatality caused by operating a defective SME.

- A pre-operation checklist system shall be in place that requires operators and drivers to perform an inspection of the machine for:
  - Visible damage and defects
  - Brake functionality test that is capable of being conducted by a competent operator
- Defects shall be classified as those which:
  - Require that the machine be shut down and not operated until they are repaired
  - Would allow safe operation and let the repairs be completed as part of planned maintenance activity
  - If the machine should not be operated, the operator shall ensure that the fault is clearly identified (out of service tag) and responsible maintenance and

production staff are informed.

- The results of the inspections shall be recorded as soon as they are completed and kept on the machine. It is not satisfactory for them to be completed throughout the shift, although there may be situations, such as hot seat changeovers, where it may be more appropriate to conduct the inspection a short time into the shift (after the load has been dumped, or when the machine can be stopped in a safe location for the inspection to be carried out).
- Some sites have utilised functions within their on-board fleet management systems to electronically register the pre-operational checks by the operator. This would generally satisfy this requirement.

An example of a pre-operation check sheet is shown in Reference Document 14.

13. Overloading of Vehicles

Procedures shall be in place to ensure that vehicles are not overloaded.

The intent of this requirement is to avoid serious injury/fatality caused by hazards associated with SME being overloaded e.g. increased braking distance, loss of stability, ineffective steering, under power, reduced visibility and increased spillage.

- Issues to be considered include:
  - Load distribution
  - Take-on of rain water
  - Volume of ore that can be loaded may result in overload
  - Effective load measurement system
  - History of related repairs

14. Stable Surface and Gradients

Procedures shall be in place to ensure surface mobile equipment only operates on sufficiently stable surfaces and on gradients that are within the limits of safe operation.

The intent of this requirement is to avoid serious injury/fatality by preventing roll-over, runaways and collisions.

- This requirement is aimed at preventing the situations such as:
  - Equipment operating, parking, descending, ascending, or travelling across slopes that are too steep
  - Equipment operating on surfaces that are prone to slip, slump, failure, submersion, or bogging
- Consideration should be made for how operators judge the slope on which they are operating the equipment. Some equipment is equipped with inclinometers to assist with this judgment.

Figure 21: Inclinometer

Anglo American SHE Bulletin "Design guidelines for slope stability in open pits" is included as Reference Document 22 which deals with the applicable standards relating to slope and wall stability design within open pit operations.

15. Post Maintenance Machine Testing

A post maintenance machine test (scheduled or breakdown) shall be conducted.

The intent of this requirement is to prevent serious injury/fatality by ensuring that equipment that has undergone repair is not returned to service until it is tested for safe operation.

- Following any work on equipment, the maintenance person must ensure that tests are carried out and documented to confirm that the equipment is safe to operate.
- Attention should also be given to other components or functions that have been interfered with in order to complete the original work. E.g. if the original job was to replace a wheel bearing, and this required the brake discs to be removed, the post-machine test should not only confirm that the wheel bearing is functioning correctly, it should also confirm that the brakes are functioning as well.
- If the required test falls outside the scope of testing or operation that the maintenance person is permitted to perform, they shall arrange for a suitably qualified operator to test it.
- The maintenance person shall ensure that the operator is notified of what work has been completed and that the equipment is safe to operate. This may be documented in the log book.

16. On the Job Risk Assessments

On the job risk assessments shall be conducted as part of the planning process for surface mobile equipment operations, including maintenance and other activities.

The intent of this requirement is to avoid serious injury/fatality by ensuring the task based risks of SME operation, maintenance and other activities are identified and controlled before commencement of the operation or activity.

- The work team shall be involved in this process. It would be considered unsatisfactory to have the on-the-job risk assessment completed by a supervisor in isolation from the work team.
- Additional risks introduced by simultaneous operations should also be taken into consideration.
- If conditions change once an operation commences, the on-the-job risk assessment process would need to be reviewed. This requirement shall not limit the application of other site semi-formal risk assessment processes.

17. Dust Control and Water Management

Adequate road maintenance, dust control and water management plans for roads, mining and haulage operations shall be in place. Consideration shall be given to extreme wet weather and the issue of over watering roads.

The intent of this requirement is to avoid serious injury/fatality by controlling the risk of SME accidents due to dust interfering with vision and visibility, loss of control due to wet or over watered roads.

Figure 22: Dust Hazard for Vision

- Dust control methods may include road pavement sealing, road sweeping/vacuuming, watering, and chemical treatment or application.
- Water management may include road and other drainage structures to effectively clear the operating surface of water that can create unsafe conditions such as road damage and loss of grip.
- Over-watering is a contributing factor to a high number of SME safety critical incidents.
- It is important that operations be aware that the role of the water truck driver is important to the safety of all road users and the training and competency of this person must be carefully undertaken.
- The design of the sprays and control systems are also important in achieving the careful balance of dust control and good traction on the road surface.
- In the case of flooding careful consideration must be given to additional hazards such as hidden pot holes and obstacles.

18. Parking standards

Parking standards shall include requirements for the immobilization of surface mobile equipment (e.g. chocking or ditches/trenches) and consideration for breakdown maintenance activities.

The intent of this requirement is to prevent serious injury/fatality due to unattended equipment rolling away, or collisions due to inappropriate parking.

- Operations shall produce a parking standard which includes a specification of the preferred methods of parking, including when the equipment chock blocks should be applied.
- Leading practice is to have defined SME parking areas, segregated from pedestrians and light vehicles.
- These parking areas should be constructed for drive through parking where practicable to avoid reversing and minimize the risk of collision.
- Parking ditches or berms which allow the SME to be driven over them without causing damage should be provided to avoid the use of chock blocks.
- Chock blocks should be used in all other cases to avoid equipment rollaway.
- Consideration should be made for a segregated walkway for the operators to exit the parking area safely.

Figure 23: Example of Parking Berm

Figure 24: Double Berm

- Provision shall be made for temporary parking outside of the defined parking area if

required. This location shall not hinder the flow of traffic or vision of other road users.

- Maintenance vehicles may need to be parked outside normal areas in the event of breakdown or field service. There are many recent SME related incidents caused by a lack of competent procedures and discipline in this area. Figure 25 demonstrates the potential risks involve at such times.
- Finally the parking standard should also address emergency situations and procedures should be in place to guide the operator in emergency lockout parking procedures.

Figure 25: Parked maintenance vehicles in close proximity to SME

A typical parking standard is shown in Reference Document 15.

19. Inspection and maintenance program

An inspection and maintenance program shall be in place for surface mobile equipment including critical equipment and components.

The intent of this requirement is to avoid serious injury/fatality caused by equipment failure or malfunction due to maintenance issues.

- A maintenance and inspection program based on OEM recommendations should be in place to minimise the likelihood of equipment failure or malfunction.
- The basic elements of a maintenance and inspection program are:

Health & Safety	Environment	Policy
Employee Development	Organisation	Equipment Strategy
Work Origin	Planning	Scheduling
Work Allocation	Work Completion	Shutdown
Contracts	Materials	Budget & Cost
Performance Measures	CI Management	Failure Analysis
MIS Management (IT)	Facilities & Equipment	Drawings & Documents
Plant Acquisition		

20. Site-based traffic management

A site-based traffic management plan should be in place including, but not limited to:

- segregation of pedestrians, light vehicles and heavy mobile equipment, where possible
- clear instructions about where pedestrians must give way to vehicles
- systems to alert mobile equipment operators of the presence of pedestrians
- setting of appropriate speed limits and the installation and maintenance of road signage
- right-of-way rules (including overtaking restrictions)
- access planning in areas identified as hazardous and having significant associated risks
- systems to control movement of mobile equipment in areas accessible to pedestrians, into and out of workshops, and for controls on pedestrian and light vehicle movement around mobile equipment
- designated parking areas for heavy vehicles and light vehicles, including around maintenance areas
- systems to control approaching, refuelling, parking, boarding, disembarking and isolation by production and maintenance crews and other pedestrians
- clear instructions that equipment operators or drivers shall be out of the cabin and dismounted to ground level when their direct involvement with maintenance or servicing is not required
- guidelines for abnormal road conditions (e.g. rain, high winds) giving “go/no go” criteria and stating the responsible person for this decision
- clear communication procedures for interactions between all vehicles
- truck loading/unloading procedures to avoid material or objects falling from the vehicle
- guidelines for wide or abnormal loads, including off-site transport
- systems to control equipment use within the vicinity of overhead power lines.

The intent of this requirement is to avoid serious injury/fatality by ensuring site road networks are designed, constructed and developed to minimise the risk of SME collisions with people, other equipment and structures.

- Completed Vehicle Management Plans provide a framework for the effective management of vehicle interaction to minimize any harm to person, property or the environment. Copies of sample Vehicle Management Plans can be obtained from the Head of Safety, Sustainable Development Division.
- This requirement, constructed of the 15 elements listed in the points below, figures prominently in the identified deficiencies found with recent serious incident reports.

It should therefore be treated with due attention.

Segregation of pedestrians, light vehicles and heavy mobile equipment where possible

- There are many good tools available to assist with the design of traffic segregation. Specialised consultants are also available to conduct a site review and issue a recommended action plan for improvement.
- Full segregation is not necessary, or even sometimes possible, but attention should be focused on high risk areas.
- Segregation, in decreasing order of effectiveness, includes:
  - Physical barriers such as gates, barriers, and fencing should be erected to segregate significant hazards.
  - Demarcation, such as line marking and painting of walkways can be used but it should be recognized that individual discipline must be maintained if they are to be effective.
- Separate road networks for Light Vehicles and SME are sometimes utilised. It is desirable that this be done without significantly adding to the number of intersections - as intersections add risk. Consideration should also be made to the additional road maintenance resources required by the additional road network.
- Segregation of Light Vehicles and SME is essential for parking and other high risk areas such as dump hoppers.

Figure 26: Examples of pedestrian segregation and demarcation

Figure 27: Examples of pedestrian segregation and demarcation

Figure 28: Examples of pedestrian segregation and demarcation

Figure 29: Examples of pedestrian segregation and demarcation

Clear instructions on where pedestrians must give way to vehicles

- Pedestrians can be notified by means of adequate signage and other demarcations.
- All personnel should also be informed about where the driver blind spots for the different machines are and should avoid being in these areas at all times.

Systems to alert mobile equipment operators of the presence of pedestrians

Refer to collision avoidance technology covered in the 5th bullet point of 2.5-1 of the Standard

Setting of appropriate speed limits, and installation and maintenance of road signage

- Maintenance and cleaning of signs should not be forgotten.
- For large scale operations consideration should be made to the size of the signs in comparison to the scale of the roads and equipment.
- Setting the maximum site speed limit too high is a direct contributor to SME and light vehicle (LV) related accidents. Setting it unnecessarily too low will lead to cultural acceptance of violation.
- Site rules and training should make it very clear that the maximum speed limit is the limit providing all environmental factors are normal, and it is the operator's responsibility to lower their speed below this when required for safe operation.
- A vehicle out of control is a sign that the operator has not correctly judged the conditions of the road and lowered the speed appropriately.
- It is implicit in this requirement that regular speed checks, such as radar speed measurement, be conducted.
- Leading practice sites have implemented stronger controls such as continuous speed monitoring linked to positive operator identification.

Right-of-way rules (including overtaking restrictions)

- A better name for this requirement would be “give way” rather than “right of way”. Leading practice right of way rules are usually those that mirror the rules of the road within the community of operation.
- This should be accompanied by give way or stop signs where appropriate. Site training and induction programs should stress the term “right of way” does not remove the responsibility on all drivers and operators to take what ever action necessary to avoid a collision regardless of who has the technical right of way.
- Overtaking on any site is a high risk activity and overtaking rules and permitted areas for overtaking should be carefully defined. Some sites prohibit overtaking absolutely as a very strong control. Where overtaking is permitted it should include a positive form of communication between the parties.
- All personnel should also be informed about where the driver blind spots for the different machines are and should avoid being in these areas at all times.

Access planning in areas identified as hazardous and having significant associated risk

- Ensure that unauthorized SME do not enter areas identified as high risk such as blasting areas, areas where there are flammable, toxic or explosive gasses or other materials stored or conducted, high voltage areas, areas that are deemed unstable from a geotechnical point of view.

Systems to control movement of mobile equipment in areas accessible to pedestrians, into and out of workshops, and for controls on pedestrian and light vehicle movement around mobile equipment

- This may include the use of spotters for tight area manoeuvring. See also the bullet point concerning segregation.

Designated parking areas for heavy vehicles and light vehicles including around maintenance areas

See section 2.6-18 of the Standard regarding Parking standards

Systems to control approaching, refuelling, parking, boarding, disembarking, and isolation by production and maintenance crews and other pedestrians.

Note that many SME incidents involve collisions with maintenance vehicles used to ferry people to the equipment for breakdown. The system must include clear procedures for where such vehicles are parked with respect to the SME and how the maintenance people are to seek permission to board.

Figure 30: Maintenance vehicle in close proximity to SME

There should also be very clear procedures for servicing/fuelling as there is an interaction of equipment and people and a high potential for human error and lack of understanding.

Figure 31: SME LDV accident

Clear instructions that equipment operators or drivers shall be out of the cabin and dismounted onto ground level when their direct involvement with maintenance or servicing is not required

Self explanatory

Guidelines for abnormal road conditions (e.g. rain, high winds) giving "go/no go" criteria and stating the responsible person for this decision

- See section 2.6-17 of the Standard regarding Dust Control and Water Management Plan.
- The site developed guideline must state who is responsible for the decision to suspend operations when conditions make it unsafe to proceed, and for when operations may resume.
- This does not over ride every employee and contractors responsibility to stop the activity if they believe in good faith that it is unsafe to proceed.

Clear communication procedures for interactions between all vehicles

- See 4th element of 2.5-2 of the Standard concerning two way radios or other forms of communication.

Truck loading/unloading procedures - to avoid material or objects falling from the vehicle

- Includes earth moving equipment and other forms of loading (for example the loading of large objects and pallets onto road going trucks). See Reference Document 16: General Principles for Loading and Restraining Items.
- The procedure for loading of haul trucks in mining operations should consider the reduction of spillage to assist with the tyre management systems as described in the 2.6-23 requirement of this Standard.

Guidelines for wide or abnormal loads including off-site transport

- Should include escort requirements as appropriate.
- Off site transport should consider appropriate community permits and licenses and clearance distances and weight restrictions along the intended route.
- See Reference Document 17 for an example

Systems to control equipment use within the vicinity of overhead power lines.

- The system should include controls such as high vehicle movement permits, marking of safe clearance heights of overhead power lines and other structures, marking SME clearance heights inside cabs, “tray up” indicators and speed/travel limiters, and protection of overhead power lines and structures by “jingle bars”.

- “Tray up” indicators should be automatically activated as soon as the tray is lifted. The movement of the SME should then be halted unless an override switch is pressed by the driver in which case the speed of the SME is limited to “crawl” speed only. The distance which the SME can travel with the override switch activated should be limited.
- See Reference Document 18 for an example.

Figure 32: SME in close proximity to overhead power lines

21. Risk assessments

Risk Assessments shall be carried out prior to any changes to traffic movements or road systems.

Covered in 2.5-4 of the Standard

22. Details of maintenance tasks

Procedures should be in place to provide details of the maintenance tasks that an operator is allowed to perform and the operations that maintenance personnel can carry out under testing conditions.

The intent of this requirement is to prevent serious injury/fatality due to operators performing maintenance work that they are not competent to perform, or due to maintenance people operating SME in functions or areas in which they are not competent or permitted.

- Training programs shall be applied that detail the maintenance functions expected to be performed by operators.
- Sites shall train and authorize their maintenance people to be competent to:
  - Safely move SME from the parking areas to the workshop,
  - Testing of functions for fault finding and
  - Post maintenance testing, and return to the ready line.
- Sites shall have systems in place to ensure that staff do not work outside their areas of competency.

23. Tyre management

A tyre management system shall be in place to address issues including fire heating Explosion electrical contact Separations maintenance tyre changes etc.

The intent of this requirement is to prevent serious injury/fatality from fire or explosions of tyres, accidents due to worn, damaged, faulty or poorly fitted or selected tyres, and accidents related to fitting or inflating/deflating tyres.

- Tyre Management goes beyond checking pressures and tread depth. It should also cover such things as:
  - The specification and selection of tyres to suit the duty that the SME will perform (TKPH rating, cut risk, etc.)
  - Safe mounting, fitting, inflation & deflation (including the safe use of tyre handlers and cages)
  - Ongoing maintenance & inspections (tread depth, pressures, cuts and damage)
  - Monitoring of duty (TKPH, speed, load, distance, temperature)
  - Change out and rotation decisions
  - Tyre fire procedures and emergency procedures
  - Rim selection and maintenance
  - Procedures in the event of touching power lines
  - Road maintenance and design to maximise tyre life and minimise tyre damage.

24. Mobile telephones

Mobile telephones whether hands free or not shall be used by the driver of surface mobile equipment only when it is stationary and in a safe location.

The intent of this requirement is to prevent serious injury/fatality as a result of SME accidents caused by distraction to the operator caused by using mobile phones whilst the equipment is in motion.

- There is enough information and evidence to support the need for this requirement.
- Hands free kits are also shown to provide no less a distraction than holding the phone and should not be used.
- This requirement includes prohibition of constructing, sending or reading text messages.
- If operators of SME are permitted by their site rules to use mobile phones they should proceed safely to the nearest safe and approved parking location, and park safely according to the site Parking Procedure before using the mobile phone.

25. Checking and Verification

A procedure shall be in place for the checking and verification of inspection records of

pressurized road and rail tankers prior to such vehicles accessing an Anglo American site.

See 2.5-8 of the Standard.

6 PEOPLE REQUIREMENTS

26. Recruitment and induction

Recruitment and induction processes for surface mobile equipment operators shall encompass past work history site testing and comprehensive medical examinations that confirm fitness for work.

The intent of this requirement is to avoid serious injury/fatality due to SME accidents caused by engaging or selecting operators of SME who are not fit for the task.

- In this case the intent is to avoid injuries / fatalities / accidents such as:
  - Falls from equipment during accessing and working on equipment due to a lack of mobility, strength, agility, etc.
  - Impacts or aggravation to existing health issues from the risks of equipment vibration, dust, noise etc.
  - Collisions due to issues such as vision, depth perception, reaction speed, coordination, hearing, sleep disorders, epilepsy, alcohol or impacting drug dependency, etc.
  - Acute health incidents such as heart attack and strokes
  - Loss of control due to fatigue

27. Site and area induction

Site and area induction of operators shall be performed prior to starting work in a new area.

The intent of this requirement is to reduce the risk of serious injury/fatality caused by SME accidents as a result of the operators not being aware of the risks of a particular work place or environment in which they are operating.

- The site induction shall train the operators on the overall legislative, safety and operating procedures, and expected safe behaviours in order for them to carry out their tasks without injuring themselves or others, or damaging equipment or facilities. It should make them aware of the overall site risks that they would be exposed to.
- The area induction is a more in-depth training and familiarization on the specific risks, operating, safety procedures in the area in which they work. This shall include the traffic system, traffic flow, parking areas, speeds, restricted areas, and so forth.

28. Permits or certification

A permit or certification system shall be in place to ensure drivers are competent to drive on site, including the ability to respond under emergency conditions. In addition, a system shall be in place to verify that operators of Anglo American vehicles have a valid driver's license prior to operating Anglo American vehicles off site.

The intent of this requirement is to reduce serious injury/fatality due to SME accidents caused by operators who are not competent or authorized to operate on site. It also intends to ensure that SME operators do not operate equipment off site without the appropriate community license or permits.

- Sites shall implement appropriate systems to train and formally issue authorization or permits to operate SME.
- Sites may accept community issued certification and endorse that as proof of competency, providing a quality check it is performed.
- If there is no site resource who has the competence to check community issued licenses, it is suggested the site develop systems such as external qualified contractors to conduct this. In some countries the community issued licenses may have such quality control that this is not necessary, but the endorsement for site operation should still be carried out.
- Continuous monitoring of Operator performance should be applied together with a reassessment program to re-evaluate the competence of operators at least once a year.
- If a person does not operate a certain type of SME for a period of six months, the competency shall be deemed to lapse and a reassessment shall be required.
- There shall be a formal process to check that SME operators possess community issued licenses to operate equipment off site. So for example, if a grader was required to be taken into town to complete a project, that there be a formal check to ensure the operator had a current community license to operate that equipment off site. Where off site work is more frequent, such as product haulage to a port, a systematic (for example, annual) checking process should be developed.
- An effective document management system shall be in place for the training and authorization records.
- Leading practice sites have implemented systems which automate the control or access to equipment. Operators are issued a key or token which permits them to only operate equipment for which they are authorized.
- The system may have the capability to alter or suspend the rights of these tokens (for example, if the operator had not passed his regular medical or his time since last operation of that equipment had expired). Some systems also have the capability to monitor and report on driver behaviours such as speed and braking.

Figure 33: Token vehicle access system

29. Fit-for-work policy

A fit for work policy shall be in place, incorporating the clearly defined maximum levels of drugs (including prescribed medication) and alcohol allowed in the system of drivers/operators.

The intent of this requirement is to avoid serious injury/fatality due to accidents caused by operators who are impaired by a fitness for work issue.

- This requirement is intended to control what is historically a high risk
- Control of this risk should not cause a loss of dignity to our staff and employees.

30. Driver fatigue

A system shall be in place to manage driver fatigue.

The intent of this requirement is to avoid serious injury/fatality due to accidents caused by operators who are fatigued.

- This requirement is not only about technology to detect fatigue.
- The fatigue management system should include elements to ensure operators (and families as applicable) are selected, screened for health/medical issues, educated, trained, motivated, monitored, supported, cured, behaviour modified, etc.
- It should also include satisfactory roster structure and arrangements, consideration of travel/commute times, facilities, identification of fatigue by others, processes once fatigue is detected/experienced and so forth.
- Two elements that should not be overlooked are hydration and medical issues. There is evidence that the lack of correct hydration by operators can lead to fatigue. This factor should be catered for in the overall education and training elements. Medical issues such as sleep apnoea and narcolepsy are also common and should be addressed.
- This requirement is intended to control what is historically a high risk.
- Control of this risk should not cause a loss of dignity to our staff and employees

The Anglo Fatigue Management Manual is available as Reference Document 19.

31. Behaviour-based observations

Behaviour based observations shall include the operation of surface mobile equipment. Any need for additional specific retraining shall incorporate the results of these observations.

The intent of this requirement is to avoid serious injury/fatality due to SME operator unsafe behaviour, poor equipment and operating environment conditions (most of which are the result of other unsafe behaviours).

- An example of a safe behaviour observation check list aimed at SME can be found in Reference Document 20.
- Safe behaviour observations are relatively easy to conduct on SME operations and can be done effectively with some simple training. The object is to get the operators and other involved people (including supervisors), to identify good and bad practice in the workplace. Their learning is more effective in this way. They usually can identify more than the observer could identify since they are more familiar with the workplace and its procedures.
- Care should be taken to avoid having the safety observations focus solely on the condition of the equipment or work place. They should be largely directed towards what is being done and what behaviours are being demonstrated.

7 OTHER SME SAFETY ISSUES NOT COVERED IN THE STANDARD

These issues are not currently covered within the Standard but are considered of such importance and relevance to be included within the guideline. They may be considered for inclusion in the next update of the AFRS.

TOWING

Procedures should be in place to ensure that SME towing operations are carried out safely and without damaging equipment.

The intent of this requirement is to avoid serious injury/fatality as the result of towing involving SME.

This activity includes the towing of trailers and other implements using formal towing appliances such as drawbars and tow bars, and towing using EME appliances such as rippers and so forth.

Site procedures should be established that detail the towing process. They should cover factors such as:

- Risk Assessment
- Training and competence
- Supervision
- Use, capacities and inspections of drawbars, tow hitches, safety chains, wire and

fabric slings, shackles, trailer brakes, etc.

- Towed equipment brake release
- Shielding of operators
- Towing capacities and colour coding of tow points and draw bars
- Communications and equipment escort
- Equipment immobilization (chocking etc.) during hook up and release
- Movements of people around equipment during hook up and release
- Towing distances and speeds
- Estimation of weight of towed equipment or object including consideration of whether the SME is fully laden or not
- Unloading of object or SME prior to towing

See Reference Document 21 for a leading practice towing and recovery procedure.

SME RECOVERY

Procedures should be in place to ensure that SME recovery operations are carried out safely and without damaging equipment.

The intent of this requirement is to avoid serious injury/fatality as a result of SME recovery operations.

This includes operations such as towing disabled SME from the haul circuit or back to the workshop, removing equipment from bogs and water bodies, and recovering equipment from rollover situations, or unstable positions on slopes or in excavations.

Site procedures should be established that detail the SME recovery process. They should cover the same factors as listed in the Towing section. Particular attention should be given to shock loading, as occurs when operators attempt to dislodge stuck equipment, and estimation of the weights / loads taking in consideration the additional forces applied by the suction of mud or friction of material bogging the object or equipment.

Where cranes are involved in lifting as part of the SME recovery process the AFRS 8 Lifting Standard should apply.

MAINTAINABILITY

Maintainability should be considered when selecting or modifying SME. The change management process should be applied with respect to maintainability when equipment new to site or modifications are introduced to site.

The intent of this requirement is to avoid serious injury/fatality/health issues caused by SME that incurs significant risk as a result of maintenance and servicing activity.

Maintainability is a measure of the ease of accessing or maintaining/servicing equipment. So for example, if a serviceman had to climb a vertical ladder 4 meters high, and stand at the top of the ladder to swing a 40 kg cover to one side to access a dip stick that required

2 hands to do the job, that would be considered poor maintainability. The same would apply if a transmission overhaul needed to be completed every 10,000 hours that required complete removal of the engine and operator cab.

APPENDIX A: REFERENCED DOCUMENTS

AA GTG 28, AFRG 2 - Surface Mobile Equipment Guideline

AA_GTS_28	:	AFRS2 Surface Mobile Equipment Standard
AA_AFRBP_1	:	Distinction of Surface Mobile Equipment
AA_AFRBP_2	:	Australian National Code of Practice for Heavy Equipment Modification
AA_AFRBP_3	:	Example of Lighting Standard
AA_AFRBP_4	:	Surface Mobile Equipment – Isolation Leading Practice
AA_AFRBP_5	:	Example of Immobilization Procedure
AA_AFRBP_6	:	Surface Mobile Equipment Access and Working at Heights Protection
AA_AFRBP_7	:	Collision Avoidance Technology
AA_AFRBP_8	:	Extended Front Bumpers for Rear Dump Trucks
AA_AFRBP_9	:	Chock Blocks
AA_AFRBP_10	:	Equipment Identification
AA_AFRBP_11	:	Machinery Access Management Systems
AA_AFRBP_12	:	Roll Over Protective Structures (ROPS) for Non-Earthmoving Equipment: Examples
AA_AFRBP_13	:	Haul Road Design Guideline
AA_AFRBP_14	:	Example of a Pre-Operation Checklist
AA_AFRBP_15	:	Example of a Parking Standard
AA_AFRBP_16	:	General Principles of Loading and Restraining Items
AA_AFRBP_17	:	Example of a Wide or Abnormal Load Procedure
AA_AFRBP_18	:	Example of Overhead Power Line Procedure
AA_AFRBP_19	:	Fatigue Management Manual
AA_AFRBP_20	:	Example of SME Safe Behaviour Checklist
AA_AFRBP_21	:	Example of Towing and Recovery Procedure
AA_AFRBP_22	:	Design guidelines for slope stability in open pits
AA_SPEC_236001	:	Brake systems for trackless mobile mining machines
AA_SPEC_264073	:	Roll-over Protective Structures and Falling-object Protective Structures for Trackless Vehicles

APPENDIX B: RECORD OF AMENDMENTS

Issue 0	:	New document (R. Diering; December 2008)
Issue 0	:	Rebranded document based on AA_AFRG_2 [John Orkney, June 2011]
Version 2	:	Appendix A amended to include hyperlinks (October 2012)