

# DOZER AND GRADER ACCESS SAFETY SYSTEMS

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## SUMMARY

Access Innovations, an Australian owned company, has responded to a need for improved access to earthmoving equipment such as graders and dozers. Numbers of accidents have occurred because operators of these machines have had to endure outdated standards of access. The companies solutions to this problem have been developed based on the philosophy of being guided by operator experience and input. The resulting systems have achieved and exceeded Australian standards of access whilst retaining present levels of operator vision and the full operational capabilities of the machines. The systems employ rugged, off the shelf components, anti-slip stairs, walkways and folding platforms to give access when parked and clear vision when operating. An operating prototype of the grader system has demonstrated production gains through greater haulroad speeds and ease of maintenance whilst achieving a 100% availability rating for the machine. Future developments will include a full range of Caterpillar dozer and grader access systems.

## INTRODUCTION

*"Prevention - Not Reaction" - "Stop Accidents - Before they stop you"*

This is a very challenging statement as unfortunately in the majority of cases, safety related issues are often resolved by quick knee jerk reactions after an incident has occurred. Companies must ensure that safety personnel in conjunction with employees strive to prevent accidents in the framework of the duty of care legislation and obligations within the mining industry.

Mining personnel are constantly exposed to safety risks in operating environments and the ability to recognise and address these risks through operator feedback is often overlooked. By working to raise employee safety awareness, and by tapping in to the wealth of experience and innovative ideas which employees hold, we can make significant progress in creating a safer working environment. This approach is the basis on which the development of the access system has occurred. Research shows that the best safety programs

employ a pro-active approach of prevention measures based on workplace consultation.

Dozer and grader access related injuries are caused by primitive access which doesn't conform to Australian Standards - inadequate step intervals, walkways and handrails continuity, often falling short of the Australian standard. To carry out operations such as checking the water and oil levels, cleaning windows, refueling and maintaining the plant, it is necessary for personnel to clamber over the grader tandem drive trains, dozer push arms and tracks. This involves stepping up at uneven intervals where no external handrails are provided or hanging precariously off the front of these machines. On graders for example, the existing steps flex inwards up to 60 times more than the Australian standard recommends when ascending into the cab. These tasks are made all the more hazardous when operating in damp or muddy environments.

Manufacturers of these machines have not progressed greatly from the 1950's design parameters for access, mainly concentrating instead on improving operator cabs and controls. They state that any additional access would drastically impede the operational functions of the machines and this has resulted in personnel having to comply with sub-standard access. This very poor attempt by manufacturers has led to the employee being responsible for their own safety. This situation has led to many slips and falls off machines resulting in lost time injuries, loss of production and associated costs to employers, insurers, the industry and the community at large. Accidents ranging from relatively minor cuts and abrasions to serious limb, back and debilitating and potentially fatal head injuries have occurred as a result of poor access. Some examples of mining accident statistics involving dozer and grader access resulting in lost time injuries have been extracted from a report provided by the Minerals & Energy Department and details can be seen in Figure 1.

The need existed for an access system that provided safe access for operators and support personnel that does not in any way hinder or limit the performance of the base machine. To achieve this result the successful system must allow the graders and dozers to function through their full operating range. The driver's vision should not be impaired and additional protuberances on the machine should fall within the original foot print of the assembly as safety professionals realise a good safety innovation is one which is readily assimilated in existing work routines and

procedures. The Access Innovations dozer and grader systems meet all of these challenges.

The design parameters to be met by the system in providing safe access were recognised as:

- to meet and surpass all existing Australian design standards and codes, e.g. Emergency exit - already fitted as standard on grader systems ahead of its introduction as a mandatory requirement,
- minimal maintenance,
- access to be provided to the engine compartment, all round the cab (to enable window cleaning) and full Emergency egress,
- a system which must not impede operator vision, and
- a system which must not reduce the operational capabilities of the machine.

## **DEVELOPMENT OF SYSTEMS**

Michael Magnussen, the manager of Access Innovations has designed, developed and patented the dozer and grader access systems which are a world's first. The purpose built access safety systems have been developed for personnel, to enhance safety access on and around dozers and graders.

The initial idea to improve grader access was prompted from an incident he experienced himself, a fall from a grader tyre, whilst operating machinery in a family earthmoving business. He has also witnessed many slips and falls of other operators during his employment as a production operator in coal mines for the past nine years which accelerated the final design of the access systems.

## **GRADER SYSTEM DESIGN**

The new grader access system eliminates hazards and costs by providing a purpose built ergonomically designed access configuration which has anti-slip stairs and walkways coupled with handrails and folding walkway platforms (see Figure 2). This system unlike any other gives access when parked and clear vision when operating. It achieves this by the folding platform system which is controlled by the park brake circuit. The operator gains access to the grader cab via the stairs and platform walkways. Once inside, the operator commences work by releasing the park brake which causes platforms around the cab and the rear stair sections to raise allowing normal operation as on standard dozers and graders. When work is completed before exiting the cab, the park brake is applied causing walkway platforms around the cab and the rear stair sections to be lowered.

## **DOZER SYSTEM DESIGN**

Previously other access systems delivered operators to the cab-level where upon arrival they had to clamber back down onto tracks and perform pre-start checks and then clamber back up the tracks to the cab area again, thus doubling the task time and exposure of potential slips and falls.

Unlike any other, the Access Innovations dozer system features anti-slip stairs and a folding handrail system leading onto a deck adjacent to the engine bay where the operator can now systematically perform his pre-start checks before stepping up to the cab level (see Figure 3). This revolutionary dozer system features, in operating mode, a quick release system allowing it to be folded forward permitting maintenance personnel fast easier access to engine bay components. This saves maintenance time and gains productivity. The system also doubles for an engine side guard which saves additional costs on the purchase of a new machine.

## **PRODUCTION BENEFITS**

*"As often found, safety innovations enhance production - a synergistic effect"*

### **Grader System**

The system generates greater productivity for personnel and reduces operating and maintenance costs due to the time saving benefits of the system. The benefits are produced from the following:-

- level anti-slip walkways and surrounds with a fixed hand-rail system allowing fast, safe access for window cleaning,
- safe systematic access past designated pre-start check areas,
- less time accessing machine, and
- a level platform for servicemen and fitters to position themselves whilst performing their tasks.

Further production benefits have been demonstrated from the rear access platforms which offer a rear mudguard effect where windows are not dirtied in wet haulroad conditions allowing for increased haulroad speeds translating into more time for actual production. In production benefits alone it has been estimated that a return on investment will occur in just over one year. Annual grader production time gained translates to approximately \$37,400 bonus per annum (see Figure 4). This averaged figure has been calculated on normal working conditions and short haulroad cycles and, would increase somewhat if

graders were travelling extensive distances on haulroads at larger mining operations. The average mine with three graders will gain a production equivalent to 3.5 graders. This allows the average mine to extend production beyond three graders without requiring the capital outlay of \$1M for an additional grader and three operators.

#### **Dozer System**

The dozer access system has demonstrated production benefits similar to that of the grader system with additional gains being:-

- quick fold away design for complete engine bay maintenance access, and
- external handrails.

### **GRADER ACCESS SYSTEM PROTOTYPE - 100% AVAILABILITY**

The current 1996 Caterpillar 16G grader prototype has successfully operated at Tarong Coal, an open-cut coal mine north of Brisbane, Queensland meeting all the operational and safety requirements. The grader has operated in earthworks operations and on three shifts in the mining and pre-strip areas of the mine. To date there has been 100% availability. The prototype has been viewed and evaluated at Tarong Coal by BHP and CRA Coal Mining companies, Local Government, Department of Transport and private contractors. An updated 1997 model was fitted to an additional Tarong Coal grader during June, 1997 with two remaining 16G graders to be fitted with systems during the last quarter of 1997. Progress has continued to be made in improving Tarong Coal's Safety Performance through the installation of grader access systems, as the levels

of injuries has continued to fall due to improved access.

### **FURTHER DEVELOPMENTS**

The existing prototype units were developed for the Caterpillar Model 16G grader and D11 dozer and additional systems are being developed for Caterpillar 12H, 13G, 13H, 14G, 14H and 24H graders and D9 and D10 dozers.

### **CONCLUSION**

A clear need has been identified for a high standard of access to be provided to operators of earthmoving machinery. The underlying strategy of Access Innovations products in satisfying this need has been to develop and produce a system for mining companies which facilitates a pro-active approach to operator safety. Safety is enhanced through application of ergonomic principles in the placement of operators and service personnel as well as employing and exceeding relevant Australian Standards for machine access. In conjunction with improved safety a synergistic effect of increased production from existing capital investment has been realised.

It is recommended all mining companies should employ this innovation in access technology to fulfill their "duty of care" towards production operators through the principle of "Prevention - Not Reaction"!

### **REFERENCES**

Minerals & Energy Department, *LTI Statistics - Earthmoving Machinery Access - Sept '96*

<i>Accident Description</i>	<i>Equipment</i>	<i>Injury</i>
Strained back when operator jumped from grader wheel onto ground	Cat 16G Grader	Back Strain
While descending from a grader the operator slipped	Cat 14G Grader	Knee Strain - Surgery
Stepping down from grader, slipped and fell backwards to ground	Cat 14G Grader	Bruised Shoulder/ Ligament Damage
While cleaning the external surface of grader windows, operator slipped off the gooseneck and grabbed handrail to prevent falling	Cat 16G Grader	Strained neck and shoulder
Slipped and fell to ground when climbing onto grader	Cat 16G Grader	Back Strain
Stepping down off grader, foot slipped and right ankle struck the grader blade	Cat 16G Grader	Fracture of Leg
Whilst dismounting from grader, operator slipped and fell onto blade injuring his back	Cat 16G Grader	Back Strain and Head Injuries
Stepping down off blade arm of dozer	D9 Dozer	Ankle Sprain
Slipped and fell when operator lost footing stepping down from dozer - feet first	D10 Dozer	Fractured heel
Whilst dismounting, slipped on shaft	D9 Dozer	Fracture of Leg
Injured left hand and right elbow after falling to ground from dozer	D10 Dozer	Multiple injuries

Figure 1