

**Your partner in
mining and construction**



**ACARP
Ergonomics of Underground
Coal Mining Equipment 2010**

**Environment, Health & Safety
first**

- Sandvik objective: Zero work related injuries or illness
- Conformity with international legislation and standards
- Meet customer requirements for EHS
- Meet clean environment objectives



EHS leadership from all employees
Risk based EHS management systems
Certification to OHSAS 18001 & ISO 14001
Sustainable and continual improvement

**ACARP Seminar 2010
Presentation Overview**

- **The Product Safety Process of SANDVIK**
- **The Ergonomic Evolution for FLP Mechanical Cutting**
- **The Ergonomic Evolution for FLP Load and Haul**
- **Other Improvements in Design to Reduce Injury Risks**

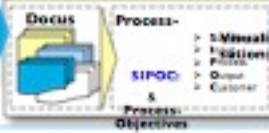
Process Oriented Quality-Management Hierarchy of Processes (3 Levels)



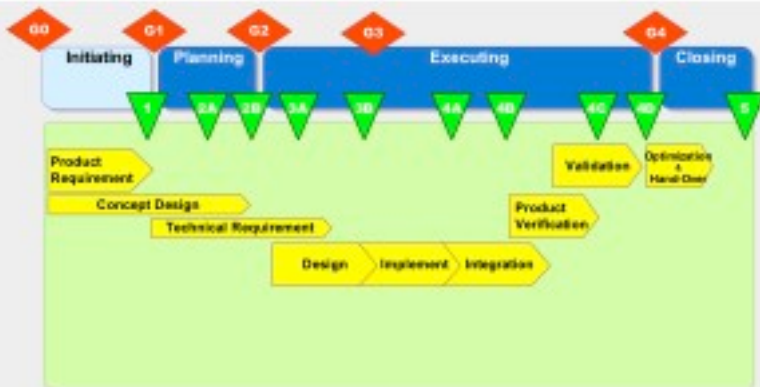
Level 2: Process-Overview



Level 3: Process-Description & Focus of Sub-Processes



SMC Project Model for Product Development Product Safety is fully integrated



Product Safety Process for Product Development Product Safety is fully integrated



Project Safety Plan Content

- Identify - **Directives and legislations**
- Identify - **Standards**
- Identify - **Customer safety requirements**
- Identify - **Product Safety activities** in the project (risk assessment, testing, reviews, system and sub-system analysis etc)
- Identify - **Documentation requirements**: analysis reports, review reports, test plans, test reports, ...
- Identify - **who is responsible** for the activities and preparation of documents / documentation

FLP Mechanical Cutting Ergonomic Evolution

- **Where have we been?**
- **Where are we now?**
- **Ergonomics and Safety Capabilities of SANDVIK Bolter Miners**

Sandvik Bolter Miner MB670 - Introduction

- Designed for rapid entry roadway development
- Integrated rib protection + TRS
- Proven ability to simultaneously cut and bolt
- More than 100 machines produced
- Special Australia packages were designed



Sandvik Bolter Miner Ergonomics

- Old platforms fixed height, rind ladder access
- Adjustable height platforms (200mm) via hydraulic cylinders
- Stair case and handrails



Sandvik Bolter Miner Adjustable Platforms

- Closer to optimal height for accessing material pods
- Adjustment for different height operators
- Adjustment to achieve nominal 2.2m platform to roof distance
- Reduced Neck strain from look up
- Reduced stretching to reach bolts/mesh/vent tube at roof line
- Adjustment for height to drill controls (950-1150mm)
- 3 point access up stairs
- Stairs over rungs for ease of ascent



Sandvik Bolter Miner – Rig & Work area Layout Ongoing improvements

- The Sandvik Bolter Miner is designed to stand on the machine during cutting/bolting



Sandvik Bolter Miner – Rig & Work area Layout Ongoing improvements

- Platforms are larger, level, clear and open
- Non slip and anti vibration floor mats (reduce fatigue/vibration)
- Machine lighting – (to illuminate walkways, ladders, controls, work areas)



Sandvik Bolter Miner – Rig & Work area Layout Ongoing improvements

- Housekeeping (materials/ consumables stored to suit ergonomic & open work area philosophy)
- Customer tailored solutions



Sandvik Bolter Miner – Rig & Work area Layout Push Button Controls

- Consistent bolt set times
- Next step to greater mechanisation
- Less interaction with moving parts
- Reduced operator fatigue



Sandvik Bolter Miner – Rig & Work area Layout Current system version



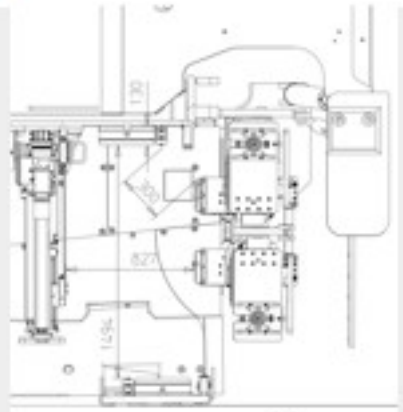
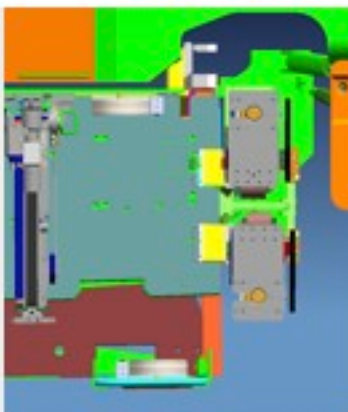
Sandvik Bolter Miner – Rig & Work area Layout Next step forward

- Mast mounted push button station



- More compact design
- Increased operator floor space
- Reduced Hosing (less maintenance)
- Greater flexibility (position controls on mast or off)
- Stand alone system (control software in the display module)

Sandvik Bolter Miner – Rig & Work area Layout Next step forward



Sandvik Bolter Miner Engineering/Maintenance

- Recirculating oil filtration (eliminates high pressure filters)
- Fully load sensed hydraulics (including bolters) = lower operating temperatures (from 60 deg - < 40 deg)



FLP Load & Haul Ergonomic Evolution

- Where have we been?
- Where are we now?
- Ergonomics and Safety Capabilities of SANDVIK Load & Hauling Products.

Sandvik Loaders The Next Generation



LS 151



LS 171



LS 191

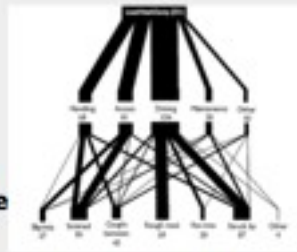
FLP Load & Haul Ergonomic Evolution

- **Loader Design (including Ergonomic) Design is driven by a number of sources**
- **These include standards, safety alerts, customer feedback, industry published statistical info and risk assessments**
- **An example; Ergonomic Design Review by Justin O'Sullivan, ED10 – 2008**
- **These recommendations are mostly addressed in the new models**

FLP Load & Haul Ergonomic Evolution

Break down of ergonomic issues

- > 1. Seats
- > 2. Driver Comforts
- > 3. Cabin Controls
- > 4. Visibility
- > 5. Access
- > 6. Serviceability (Maintenance Ergonomics)



(Burgess – Limerick 2009)

Other Design Outcomes (eg)

- > 1. Stability

ACARP Seminar 2010 Reducing Injury Risks through design

■ Other Improvements in Design to Reduce Injury Risks

- Proximity Detection (Miners, Loaders and Shuttle Cars)
- Noise Reduction Investigations (Miners)
- Dust Suppression and Flame Extinguishing Spray Systems (Miners)
- Dust Extraction and Ventilation System Development (Miners)

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Product and Safety Risk Management



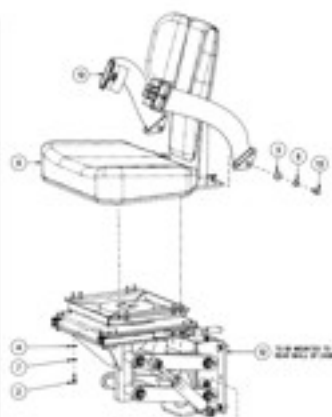
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Thank you for your attention !

Operator Cabin
New Seat offers...

- > Self levelling (+10/-90)
- > Adjusts to weight of operator
- > 150kg rated
- > Adjustable seat belts
- > Swivel Left/Right
- > Slides In/Out
- > Shock absorbing/suspension
- > Design inputs: ISO 3411, ISO 6683, Customer feedback, etc



Operator Cabin Driver Comforts



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Operator Cabin Driver Comforts

- > Upright Seating position (Not layback position)
- > Arm Rests
- > No sharp protruding objects
- > Planned layout (most used functions in front, lesser used to the side)
- > Charcoal Grey dashboard
- > Kick plate – metal enclosed (Reduced heat exposure)
- > Wide door entrance

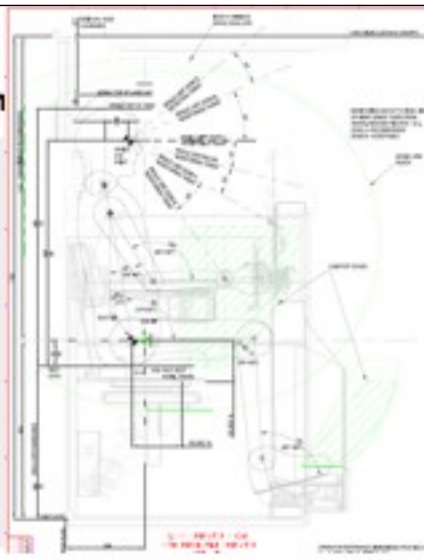


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Operator Cabin Ergonomic Design

- > Spatial Modelling using ISO 3411 95%ile figures
- > Clearances to ROPS/FOPS to ISO3411.
- > Improved steering wheel position
- > Display Unit – All info directly in front of operator.

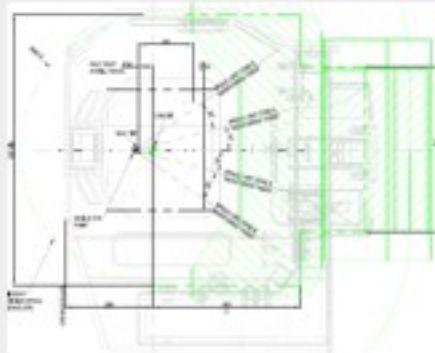


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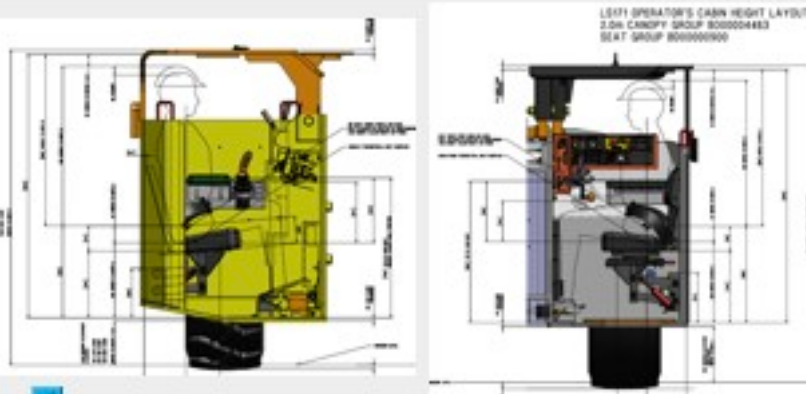
SANDVIK

Operator Cabin Controls

- Throttle, Brake and foot rest repositioned
- More even height distribution (natural)



Operator Cabin Clearance Layouts



Visibility Visibility – LS191 Vs LS190

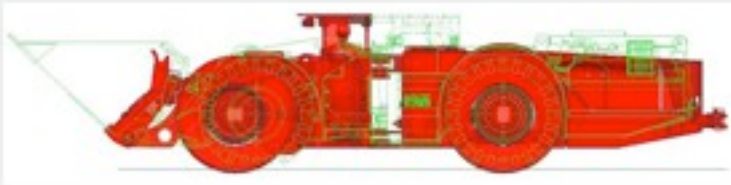
- Reduction of rear frame height of greater than 130mm
- Lower Dashboard (in line with frame)



Visibility

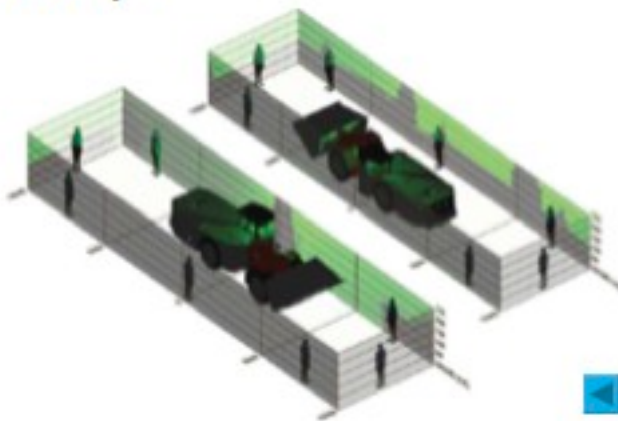
Visibility – LS151 Vs 913

- Tapering of rear engine covers



Visibility

Surveys



Safety of Machines

Access - Permission

- 3 point access
- Non slip footing



Safety of Machines Access - Denied

- > Additional guarding to prevent operators positioning their arms in dangerous locations.



Serviceability



- > Improved Serviceability with ground level access to service points
- > Ground based up to 250hr service
- > EG: Low pressure expansion tank on Cooling System
- > EG: Thermo Hydraulic fan (no more fan belts to adjust/replace)



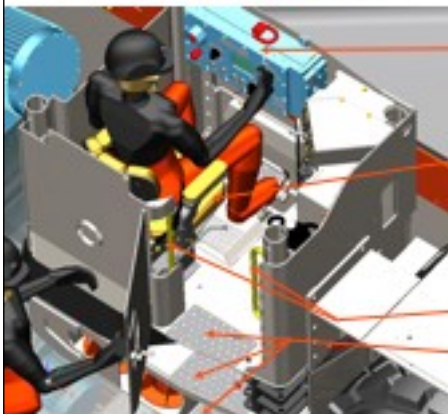
Stability (LS191)



SANDVIK Shuttle Car TC790



TC790 Shuttle Car Operator's Cabin



Master Switch Assy
with integrated display

Seat with suspension,
adjustable, safety belt,
swivel
Clearance in back rest
for self rescuer and
battery pack

Handrails

Anti slip Flooring

TC790 Shuttle Car Independent Suspension

- Improved driving comfort for the operator through suspension design



SANDVIK Shuttle Car TC790

