



XMOR

HIGH PRODUCTIVITY EQUIPMENT

G&G MINING

A white paper addressing common challenges across all mining operations and commodities – a push for increased safety, increased productivity, automation and ultimately a lower cost per tonne.

XMOR – Off Highway Dump Truck Body





CONTENTS

ABSTRACT	3
MODERN MINING CHALLENGES	3
<i>Safety.....</i>	<i>3</i>
<i>Productivity.....</i>	<i>3</i>
<i>Carryback.....</i>	<i>3</i>
<i>Maintenance Reduction.....</i>	<i>3</i>
<i>Automation.....</i>	<i>4</i>
<i>Environment and Social Licence.....</i>	<i>4</i>
<i>Lower Cost Per Tonne.....</i>	<i>4</i>
G&G BRINGS EXPERTISE TO MINING DUMP BODY MARKET.....	4
DELIVERING THE EDGE ON MOVING PAYLOAD.....	5
<i>Innovation.....</i>	<i>5</i>
<i>Materials come first.....</i>	<i>5</i>
<i>Designed around the load.....</i>	<i>5</i>
<i>Improved dumping / reduced carryback.....</i>	<i>6</i>
<i>Unique cab canopy.....</i>	<i>6</i>
<i>Environment & Sustainability.....</i>	<i>6</i>
XMOR DUMP BODY FEATURES.....	8
CONCLUSION.....	9
REFERENCES	10



Abstract

G&G Mining designs and manufactures the XMOR range of off highway dump truck trays and buckets. XMOR is a revolution in attachment design – offering lighter weight and improved productivity. The unique high strength steel formula delivers the lightest, hardest working dump body in the mining and earth moving industry. Offering larger volumes and reduced weight, XMOR dump bodies can handle larger payloads than their counterparts increasing the productivity of your asset and reducing your cost per tonne whilst extending asset life.

Modern Mining Challenges

Over recent years, G&G has noted several common threads across all mining operations and commodities – a push for increased safety, increased productivity (more tonnes moved for the same energy), a demand for a reduction in on-site maintenance and maintenance costs, automation and ultimately a lower cost per tonne.

Safety

Increased safety can mean many things across mining – but one thing is clear and that is that people need to be removed from harm's way. This is one of the drives for automation – with people removed from the pit. But there is also a push to reduce harder to control maintenance tasks on site – particularly those involving hot work, working at heights, cranes and lifting at site, all of which are involved when performing traditional dump body lining and repair. As such, suppliers need to consider how they reduce or remove the requirement for such maintenance or develop modular repair solutions.

Productivity

After safety, the next goal is productivity. In order to maximise the assets and capital employed, miners are striving for more and more efficient ways to mine. New technology is enabling this – through simulation, live monitoring and visualisation, automation, artificial intelligence and more. But essentially there is a push to move and process more material, using less energy and resources employed, more quickly. In load and haul this can mean a push for lighter attachments leading to increased payloads on existing equipment.

Carryback

There are more mines digging deeper or in more challenging conditions– with below water table operations offering problems of increased carryback in wet and sticky material. Carryback issues can easily negate any productivity development work and any value gained from lightweight dump bodies through the reduction in usable payload, as well as increased downtime through regular cleaning (which can also result in accelerated body wear if the body is scraped out by an excavator).

Maintenance Reduction

On-site maintenance is expensive, causes equipment downtime, and introduces safety hazards. It can also be challenging to ensure the right skills and equipment are available on site in order to perform all required maintenance tasks. As such, industry wide there is a push to reduce or eliminate maintenance; reducing maintenance costs, improving uptime performance and improving on-site safety. To achieve this, miners are looking for equipment that offers a longer life – whether that be the full asset life or to major maintenance and overhaul, as well as being able to operate without the need to regular on-site maintenance and repair. Modular repair options are also an innovative way to manage critical maintenance whilst minimising transport and work on-site.





Automation

As mentioned, automation is being employed to improve safety and productivity. But there are also by-products of automation that need to be considered in the design of dump bodies. Autonomous trucks have many benefits, but these trucks are often subject to higher forces during hauling due to high speed hauling and cornering, as well as increased impact forces during loading now that the safety of the truck operator is not the primary concern.

The transition to autonomous haulage also presents opportunities with design. With the removal of people from the equation it is possible to offer shorter, lighter weight canopies – further reducing the empty vehicle weight and thus increasing the payload capacity. The next generation of trucks are likely to be developed without an operator cab at all – which will present even more opportunities for innovation in design.

Environment and Social Licence

The environment that we live in is becoming more of a concern. Mines have long been conscious of fuel efficiency – as this has a direct cost – but there are broader aspects of emissions, carbon footprint, environmental disturbance and pollution that are coming to the fore. Wherever miners are situated in the world they are coming under more scrutiny – at a local level and in the boardroom. As miners take up the mantle to operate more environmentally sustainable operations with a smaller environmental footprint, as young people entering the workplace make decisions on where they want to work based on companies environmental record, and as savvy customers start to question things like the carbon intensity of the minerals they purchase, the need for lighter, more productive equipment becomes even greater.

Lower Cost Per Tonne

Ultimately most of the trends lead to this. Miners are striving for safe, efficient operations in order to achieve the lowest cost per tonne – and thus maximise the value to their shareholders and stakeholders. This does not mean that they necessarily strive to buy cheap – although everyone in the industry is aware that capital expenditure considerations are always there. What it really does mean is buying smart – ensuring that the money spent goes to solutions that offer a wide range of benefits that can ultimately improve the cost per tonne.

G&G brings expertise to mining dump body market

Located in Perth, a significant global mining capital, G&G has the opportunity to work with a wide range of customers from OEMs, Owner Miners, Contractors and Equipment Rental Companies, operating a wide range of equipment across a wide range of different mining environments, whilst still attempting to address some of the same common challenges.

In recognising this, G&G identified significant opportunity to offer improvement in several areas through the reduction in weight, the increase in capacity, and the improvement in wear performance of large earthmoving attachments – principally haul truck dump bodies and excavator buckets – all resulting in positive outcomes when measured towards the industry focus areas.

Through the construction of a cross functional team, that included design mining equipment & attachment and materials experts, G&G were able to analyse the opportunity and develop new products that utilised the new materials and manufacturing technologies available today in order to solve both the major challenges faced by the mining industry as well as deficiencies in existing dump body designs.





Delivering the edge on moving payload

Innovation

Over several years G&G has been working on developing stronger, lighter, more productive earthmoving attachments – with significant experience gained in the development of “lightweight” mining buckets. This experience combined with expertise in dump body development from around the globe, and the introduction of new materials to the market enabled G&G’s innovative Engineering team to let their creative ideas flow.

From this collaboration, G&G has designed, developed and commercialised a new generation of dump truck body that offers a paradigm shift in the offering for Off Highway rigid rear dump trucks. Whilst the market has been seeking “lighter” offerings in order to increase payload and productivity, many times these offerings are focussed primarily on weight reduction at the cost of other essential features.

Materials come first

The G&G XMOR body is a game changer – utilising the new advanced high strength & wear resistant steel Hardox® 500 Tuf to offer an ultra-lightweight body that also offers a wide range of productivity, maintenance, safety and ultimately cost of ownership benefits.

Through a focus on the best materials available in today’s market in the concept design stage, and a design philosophy to “use the true properties of the steel” – utilising the full hardness, yield strength, toughness and weldability, the XMOR dump body is able to push the boundaries in design and performance.

The XMOR body utilises the inherent high strength of the steel used (using Hardox® as a high strength structural material as well as a wear plate) and a flexible rather than stiff structure; flexible side wall design, strength from overlaps and pressings rather than box beams, omega joints, including thickness only where it is needed (panels), enabling stresses to dissipate rather than build up in welded joints or box beams. The combined high structural strength and high hardness (with added toughness) in the body enables thinner steel to be used throughout the structure – without compromising in the structural performance or wear resistance – and hence result in a super lightweight body that can offer much improved payloads.

Designed around the load

At the initial design stage it was identified that one major deficiency with designs available on the market was that although these were designed to offer the required axle loading when full (maximum volume / lower density material), if the dump bodies were loaded with higher density material (and therefore reaching their payload limit at a lower volume), this lower volume meant that the centre of the gravity shifted forwards, increasing the load on the front tyres. This can commonly be seen in increased front tyre temperatures and increased tyre wear and can also affect vehicle stability and handling.

In order to combat this, the XMOR body is actually designed around the ideal shape of the load. The body design consists of a number of interlocking cones / curved shapes that ensure the load is always centred at the approved centre of gravity location for the optimal truck axle loading (33% front, 66% rear) regardless of the material density. In addition, the conical shape also ensures that stresses and loads in the structure are dispersed, carry back is reduced (with no sharp corners at the front wall for this to initiate at), and material flow is improved whilst reducing contact pressure from sliding wear during dumping, which in turn reduces the wear rate.

The patented ability for load centring regardless of material density is a significant step change in dump body design and sets the XMOR body apart from current designs on the market which suffer from the load shifting forward when loading high-density, high-grade material.





Improved dumping / reduced carryback

As noted, the XMOR body offers a design that seeks to eliminate carry back. The bowl shape of the floor and front wall – with no major join between the front wall and floor – mean that the traditional carry back initiation point is removed. The flexibility of the structure also means that material finds it harder to gain a hold.

Furthermore, the harder, higher strength steel, Hardox® 500 Tuf also offers advantages here. The higher strength and harness results in less deformation of the floor under impact, and thus offers less dents for carry back to begin to form in.

The dumping performance is also improved – from a speed, discharge and wear point of view. The splayed sidewalls remove any choking effect when dumping – allowing the load to be dumped rapidly, as well as spreading this load – something that is important when dumping over the windrow or into the crusher to avoid choking or material build up. The bowl-shaped floor actually holds the material against the floor whilst material sheds off the top of the heap at the commencement of dumping. Thus, when the final material does slide out, the contact pressure between the load and the floor is much reduced, reducing wear. The shorter, angled tail both improves clearance from the windrow but helps to “throw” the material being discharged away from the body and over the windrow or into the crusher, once again reducing build up or choking.

Unique cab canopy

Over the years G&G’s Engineering team have noted a number of deficiencies in cab canopy design. Canopies are often heavy, but also are often prone to cracking – both due to their weight being cantilevered off the front of the dump body, but also because the join between the canopy and the front wall is exposed to impacts from falling rocks and wayward loader buckets when loading from the side.

These canopies also are either flat – in which case rocks can end up just sitting on top of them, or bounce forwards over them and fall down in front of the truck or even onto the front deck/radiator; or they are curved to the sides in order to prevent rocks falling forwards, but then these fall sideways and end up on the haul road, damaging tyres and even stopping fleets of autonomous trucks in their tracks.

The XMOR body offers a new one-of-a-kind lightweight, high strength anti-spill canopy design. The canopy is angled upwards in order to “catch” material loaded too far forwards and redirects it back into body rather than letting material remain on canopy or fall onto haul road. The curved canopy to front wall transition also removes the sharp joint that is susceptible to damage and cracking on many existing designs.

A shorter canopy option suitable for Autonomous Operations - where operator safety in the cab and on the front deck is not the primary concern – is also available. This shorter canopy can offer an even greater reduction in body weight – and thus can lead to an even greater improvement in available payload.

Environment & Sustainability

The G&G XMOR dump body is an ultra-lightweight dump body using high strength, high wear resistant steel designed with the intention of minimal to no ongoing maintenance; there is no need for wear liners with the combination of a harder steel for the floor, and a reduction in contact pressure and hence sliding wear through the “load shedding” design.

Such a reduction in on-site maintenance offers improved safety as well reducing the body weight significantly vs those utilising liners (for example a CAT793 OEM haul truck body would often utilise over 9 tons of wear liners – typically 12 or 16mm 400 or 450HB Q&T), on top of the original body weight – with the XMOR body already substantially lighter than OEM or even other current “lightweight” dump body offerings. These liners come at a cost both in direct purchase price, as well as a reduction in payload and the ongoing downtime and maintenance cost to maintain and replace the liners.

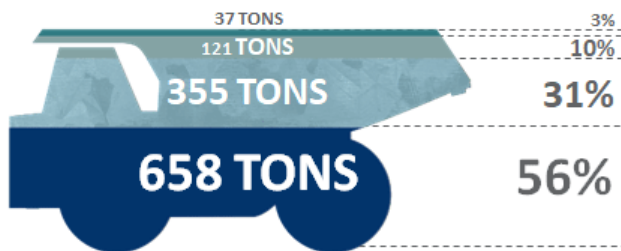


The reduction in wear rates (and hence increased asset life) and the removal of the need for liners, as well as the overall lower weight for the body results in a significant overall reduction in steel consumption as well as a reduced fuel consumption per ton of material hauled as demonstrated by SSAB's EcoUpgraded calculations.

Ultimately this results in a much-reduced Carbon footprint when compared to traditional dump bodies – and even in jurisdictions where carbon pricing is not currently a consideration this may be a consideration for miners with a strong social licence focus. This can also be translated in part as a fuel saving – which clearly can be calculated as an immediate financial benefit.



SSAB EcoUpgraded Calculation based on XMOR Caterpillar 793F Body with Autonomous Canopy vs Caterpillar MSDII OEM Body with Liner Package		CALCULATION DATA
Fuel consumption, fully loaded	200 litres/hour	
Fuel consumption, without load	100 litres/hour	
Machine usage per year	7 500 hours/year	
Distance with maximum load	50 %	
Service lifetime	4 years	
Maximum payload (before upgrading)	234 400 kg	
Gross weight (fully loaded)	405 300 kg	
Weight of original parts	42 400 kg	
Weight of upgraded parts	23 900 kg	
Wear resistant steel saved during lifetime	60 400 kg	



CO₂ SAVINGS
1 171 tons/lifetime



CO₂ PAYBACK TIME
2 months



FUEL REDUCTION
337 800 l/lifetime



Taking **550** cars off the road for a year



LESS STEEL PRODUCED



LONGER SERVICE LIFE



LOWER WEIGHT



HIGHER CAPACITY

For more information visit <https://www.ssab.com/company/sustainability/sustainable-offering/ecoupgraded>

Large mining haul trucks do not work in isolation, and so when introducing the XMOR dump body into a fleet the effects would be multiplied. For example – if a mine were to purchase a fleet of 10 XMOR bodies in place of existing OEM bodies for their CAT793F trucks (a small fleet where these size trucks are concerned) this would achieve a CO₂ reduction equivalent to removing 6130 cars off the road for a year!

Furthermore, SSAB, the manufacturer of Hardox® and Strenx® steels is currently working to be the first commercial steel mill to produce fossil-free iron and steel through the HYBRIT project – a joint project between SSAB, LKAB and Vattenfall. Through the HYBRIT process the Iron Oxide will pass through a process of hydrogen reduction (rather than the current blast furnace process where the Iron Oxide is reduced with Coke which results in Carbon Dioxide and Iron), with the outputs being Iron and Water.

Through this process a number of steps are being taken at the SSAB production facilities – that are already some of the most CO₂ efficient steel mills in the world - that will see Hardox® and Strenx® become the truly green

products with a vastly reduced environmental footprint. This combined with the operational benefits of the XMOR products as detailed in the EcoUpgraded calculations can result in a dramatic improvement in the CO₂ profile of mining load and haul operations.

XMOR Dump Body Features

- **Increased payload with lightest steel Dump Body available today**
 - Super-lightweight structure decreasing body weight by 50% and increasing available truck payload by 9.4% compared to a standard OEM body
 - comparison based on CAT793F using CAT MSDII body with liners vs G&G XMOR AHS body.
 - Options for further weight reduction with AHS short canopy option, as well as customisable floor arrangement dependent upon impact and wear profile of mine site.
- **Certified “Hardox® In My Body” liner-less dump body.**
 - Integrated wear and impact resistant structure constructed from Hardox® 450, Hardox® 500 Tuf and Strenx® 700 advanced high strength steels.
 - Integrated structural & wear design with no requirements for liners, reducing ongoing maintenance costs and downtime whilst improving on-site safety.
 - High strength steel sidewalls with no welded stiffening beams, enabling flexibility and contact with loading machines without significant body damage.
- **Patented Payload Centring Design**
 - Patented design results in automatic load positioning for optimal axle loading and truck stability regardless of density carried.
 - Reduces load on front tyres when hauling high density material vs flat floor dump bodies where the bias is to the front axle as material density increases – reducing tyre temperatures and increasing tyre life whilst offering improved vehicle dynamics and stability.
- **Improved Dumping Performance and Reduced Carry back**
 - Anti-Hang-Up design using curved joints proven to drastically reduce or eliminate carry back.
 - Dove tail design offers increased clearance as well as ability to throw load over windrow – both working to eliminate tail dragging and improve body life.
 - Tapered body and cone shaped floor ensure consistent load shedding – reducing wear rates and eliminating choking at the crusher / dozer clean-up at the dump.
- **Innovative Canopy**
 - New lightweight, high strength canopy design “catches” material loaded too far forwards and feeds back into body rather than letting material remain on canopy or fall onto haul road.
 - Shorter canopy option available for Autonomous Operations where operator safety on front deck not a primary concern.
- **Certified “Australian Made” product**
 - Designed and manufactured by G&G Mining in Perth, WA



Conclusion

G&G Mining has developed and introduced to the market a new generation in rigid mining dump truck body design - the XMOR dump body. Lightweight bodies are not new. But XMOR has gone even lighter, and beyond this additional payload XMOR offers significant additional advantages to reduce cost per tonne, improve safety, enhance site productivity, and all whilst reducing environmental impact.

Through the extensive use of advanced high strength steel in the structure, G&G's XMOR dump bodies are the lightest bodies commercially available for large rigid dump trucks used in mining today, whilst also offering customers significant additional operational benefits.

Through the extensive use of Hardox® 500 Tuf in the structure, G&G were able to develop a design that utilises the full properties of the steel – the 500HB hardness for improved wear life (with most other bodies using 450HB steel as a maximum); the exceptional yield strength of up to 1400MPa to ensure a strong yet light and flexible structure that can withstand significant impacts during loading; and the high toughness level to avoid cracking when encountering impacts due to loading.

G&G offers the XMOR dump body for OEM Off Highway Rigid dump trucks of all sizes and makes.

The XMOR body is designed to be customised for the customer's site-specific application with the design easily modified based on their material densities, rock sizing/blasting, hardness/abrasiveness of the material being loaded, loading equipment and practices used on site etc.

References

- Information contained within this paper is sourced from Engineers, field trials and proven experience as well as commentary on industry challenges and trends from the following sources:
 1. <https://www.mining.com/web/exploring-biggest-maintenance-challenges-mining-industry/>
 2. https://www.ey.com/en_gl/mining-metals/10-business-risks-facing-mining-and-metals
 3. https://www.pwc.com.au/industry/mining/mine_2019.pdf
 4. <https://www.csiro.au/en/Do-business/Futures/Reports/METS-Roadmap>
 5. <https://www.weforum.org/agenda/2019/03/seven-trends-shaping-the-future-of-the-mining-and-metals-sector/>
- SSAB EcoUpgraded is a programme from SSAB to calculate and demonstrate the reduction in CO2 emissions through the use of high-strength steel structures. More information and examples can be found at <https://www.ssab.com/company/sustainability/sustainable-offering/ecoupgraded>
- Hardox® In My Body is a brand programme by SSAB for manufacturers producing hard, tough and cost-efficient products from genuine Hardox® wear plate. Applications are reviewed against quality criteria. More information can be found at <https://www.ssab.com/products/brands/hardox/hardox-in-my-body>
- The Australian Made logo is a mark of Australian authenticity, certifying products as being Australian made, and registered with the not-for-profit Australian Made Campaign Ltd, and which meet the criteria set out in the Australian Consumer Law and the AMAG Logo Code of Practice. More information can be found at <https://www.australianmade.com.au/why-buy-australian-made/about-the-logo/>
- HYBRIT is a joint venture initiative that endeavours to revolutionize steel making between LKAB, SSAB and Vattenfall. More information can be found at <http://www.hybritdevelopment.com/>