



Charmec Revo LF 600 V(E)

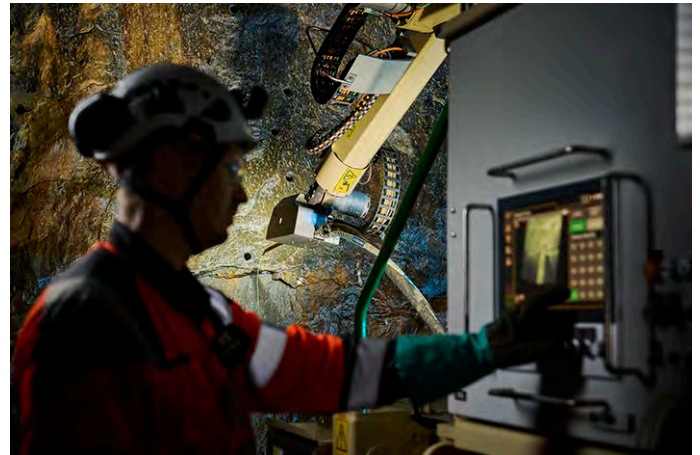


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Pictures may include options and additional equipment.

INTRODUCTION

Charmec Revo LF 600 V(E) is a remote development charger for underground hard rock mining. Its purpose built design covers the special needs of underground development charging, eliminating the need for the operator to be in vicinity of development face wall, where dangers are increasing in shape of rock falls and rock burst accidents. Charmec Revo is built on Normet's robust and proven L-series platform, and it's available with Stage IIIA or Stage V diesel engine, making it globally available. NorSmart 3 electrics and control system are designed for harsh underground environment. Platform electric system consists of self-extinguishing wire harnesses with tinned and watertight conduits. In addition, all exposed components are at least IP65 class.



PRODUCTIVITY

The Charmec Revo's design philosophy was to improve operational safety without loss of productivity. To achieve this, we prioritized the accuracy and speed of the remote charging system in our design, which led us to abandoning traditional hydraulic booms and focusing on robotic solutions. Servo-robotic charging arm is designed to be as fast as possible to optimize operating time and compensate any time loss compared to traditional manual charging. Lifter hole charging is made fast and functional by utilizing lifter pipes, hence eliminating need to clean and remove debris from the lifter holes. Blocked holes are opened and cleaned by using Normet's block hole opening technology.

Revo eliminates the need for redundant face support by removing personnel away from the face. Less rock support such as concrete spraying or roof bolting is required, which frees up time for the actual development work. Productivity is further increased by enabling access to challenging rock strata conditions, when previously unreachable ore assets can be reached.

Normet ECM emulsion charging module is integrated and optimized to work together with Charmec Revo. Free space at the center of Charmec Revo can also be utilized for external emulsion unit, which makes entering remote charging technology as easy as possible. The total payload at the center of Revo is 6 tonnes. Charmec Revo is available and adaptable for all bulk emulsion and initiating systems.

Charmec Revo is designed for safe and efficient charging in underground mines and tunnels from 4 x 4 meters up to 6 x 6 meters, which covers most of the underground mining tunnels.

SAFETY

The Charmec Revo's servo-robotic manipulator boom/arm is designed to "pick-and-deliver" priming unit (detonator-booster package) from ground level's reduced exposure area or the priming magazine and deliver it to the face wall. Pick-and-deliver path between borehole and home position is automatized. This eliminates the need of work in vicinity of face wall enabling operator to work from reduced risk area. The Charmec Revo system provides a technology platform that allows the operator to move even further away from the reduced risk area to a safe work area. This requires among other, priming magazines (detonator-booster), developed and provided by explosives supplier, integrated to Revo platform and sub-technologies to be developed.

Servo-robotic arm control is ultra-accurate, fast, and easy to use, as the operator can focus on controlling the tip of arm, rather than the movements of arm's each axis/joint. The charging arm's ingenious control is based on inverse kinematics, where only the tip of arm is controlled, which enables automatic movements, like the path between borehole and home position. A lot of attention has been given to lowering the learning curve and to make operation of the arm as easy as possible.

INNOVATIONS FOR PERFORMANCE

Innovative tip-controlled servo-robotic boom/arm with automatic movements is the technology to lower learning curve and make remote operation easy as possible.



Machine vision system, fully developed by Normet, supports the operator to find drilled boreholes to shorten the cycle time. In addition, the camera shows plastic lifter pipes and helps in their utilization.

The collision avoidance system of the charging arm is based on volumetric modelling, where tunnel walls and ceiling are taught to the servo-robotic arm's control system, making it slow down and stop the arm movement before contact. Close contact prevention is done by using reliable ultra-sound sensors. Additional safety sensors stop the boom movement if the operator enters the working area.

During operation, Revo's servo-robotic arm creates borehole coordinate data where charging data can be added. Charging data is visualized in Revo's control screen and after charging work, it can be extracted for QA purposes of drill & blast process.



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TECHNICAL SPECIFICATION

REMOTE LOADING SYSTEM

Servo robotic manipulator boom

Redundant 6 degree of freedom servo robotic boom/arm. Light low moment of inertia construction. Minimum work envelope 4 x 4 - meter tunnel, maximum work envelope 6 x 6-meter tunnel. Boom operating modes:

1. Traditional articulated control (each joint controlled separately).
2. A tool mode based on inverse kinematics, where only the tip of boom is controlled.
3. Mode for automatic movements from borehole to home position and back.

Servo motors rated to IP65 class. Servo controls enclosed to ventilated and heated stainless-steel cabinet.

Collision avoidance system

The collision avoidance system of the charging arm is based on volumetric modelling, where tunnel walls and ceiling are taught to the servo-robotic arm's control system, making it slow down and stop the arm movement before contact.

Close contact prevention is done by using reliable ultra-sound sensors. Additional safety sensors stop the boom movement if the operator enters the working area.

Camera assisted boom drive

Camera is mounted on tip of charging boom/arm and automatically stabilizes regardless of the position of boom tip. Boom/arm can be driven parallel to camera / charging hose direction which greatly helps in access to lifter pipes.

Charging hose delivery system

The Charmec Revo has hydraulic power hose pusher for charging and cleaning hose extraction and retraction with cage type hose reel for hose storage. The system has automatic hose stop to primer pick point and mechanized hose swap between charging and hole cleaning hoses.

Block hole opening and cleaning system

A separate hose is used for bore holes opening and cleaning. Normet ECM can pump high pressure water and give pressure air strikes to open and clean blocked boreholes.

CHARGING SYSTEM

Normet ECM Emulsion Charging Module:

- Matrix capacity 1500 kg
 - Matrix capacity 2200 kg
 - Matrix capacity 3000 kg

Matrix delivery rate 20 - 95 kg/min

Radio control for all charging functions

- Installation service for external emulsion charging system
 - CE-marking for installation of external emulsion charging system
- Carrier for external emulsion unit max. load 6000 kg

ELECTRICAL SYSTEM

Main supply voltage

Power supply for the electrical functions

- 50 Hz
 - 380 V (IEC)
 - 400 V (IEC)
 - 415 V (IEC)
 - 525 V (IEC)
 - 690 V (IEC)
 - 1000 V (IEC)
 - 1000 V (AS/NZS)
- 60 Hz
 - 440 V (UL/CSA)
 - 440 V (IEC)
 - 480 V, (460 V) (UL/CSA)
 - 600 V, (575 V) (UL/CSA)
 - 1000 V (UL/CSA)

Robust and abrasion-resistant mains voltage supply cable with PUR outer sheath (excluding plug)

Hydraulically driven cable reel with spooling device

- No cable
 - 100 m cable

Cable in / out reeling function from the cabin and near the reel

- With supply cable (excluding plug)
 - Without supply cable (must be sourced and installed locally)

Pilot circuit

- No
 - Yes

ENGINE AND TRANSMISSION

- **Volvo Penta TAD851VE, 185 kW/2200 rpm, with engine brake, Tier 3 / Stage IIIA approved**

Exhaust system:

- Catalytic exhaust gas purifier and muffler
- Diesel particulate filter (DPF)

Fuel tank capacity: 280 l

Dana T14 series powershift transmission with lock-up

4 speeds forward and 3 reverse

4-wheel drive

Gear selector:

- Manual
- Automatic
- **Volvo Penta TAD881VE, 185 kW/2200 rpm, with engine brake, Stage V approved**

Requires diesel exhaust fluid (DEF) and Ultra-low sulphur diesel (ULSD)

Diesel particulate filter (DPF)

Selective catalytic reduction (SCR)

Fuel tank capacity: 280 l

DEF tank capacity: 25 l

Dana T14 series powershift transmission with lock-up

4 speeds forward and 3 reverse

4-wheel drive

Gear selector:

- Manual
- Automatic

PERFORMANCE

Tramming speed (horizontal) 24 km/h

Lateral gradient for tramming (continuous) 4°

Longitudinal gradient for tramming (continuous) 9°

Depending of machine configuration, lateral and longitudinal tramming gradient can temporarily be higher.

AXLES AND BRAKES

Load end axle:

Dana 113 series fixed

Engine end axle:

Dana 113 series

Hydro-pneumatic suspension and +/- 7° oscillation

Service brake: hydraulically powered dual-circuit oil immersed multidisc brakes in both axles

Safety/Parking brake: spring applied hydraulically released fail-safe -type brake

Brake testing possible from cabin

TYRES AND RIMS

- Nokian Tyres 12.00–20" with NDT inspected rims
- Bridgestone 12.00–20" with NDT inspected rims

STEERING

Orbitrol type hydraulic frame steering

Frame articulation +/- 40°

HYDRAULIC SYSTEM

Variable displacement pump system 190 bar at 2200 rpm:

- Single pump for carrier and process 135 l/min
- Separated pumps for carrier 95 l/min and for process 135 l/min

Hydraulic oil tank capacity 180 l

24 VDC ELECTRICAL SYSTEM

2 x 12 V deep cycle batteries

24 V battery charger (DC/DC converter)

LED driving and indicator lights

LED work lights

LED side lights

Warning LED light:

Color

- Amber
- Blue
- Red
- Green (n/a with rotating light pattern)
- White (n/a with rotating light pattern)

Light pattern

- Strobe
- Rotating

DRIVER'S COMPARTMENT

Enclosed cabin FOPS/ROPS approved

Driver's seat and seat belt:

- Air suspended T-back seat with 3-point seat belt
- Air suspended heavy duty seat with 3-point seat belt

Cabin door interlock switches with safety brake application

Passenger's seat:

- T-back seat with 3-point seat belt
- Heavy duty seat with 3-point seat belt
- 2 seats with retractable lap seat belts

MACHINE CONNECTIVITY

- Machine connectivity hardware (WLAN/3G/4G/LTE)
- Analytics license (includes connectivity hardware)

TECHNICAL DOCUMENTATION

Standard documents:

Instruction manuals, hard copy 2 pcs:

- English
- Russian
- One of destination EU languages

Spare parts manuals, hard copy 2 pcs:

- English
- Russian

PDF manuals on USB-stick 2 pcs, includes instruction and spare parts manuals

Additional documentation:

- Extra hard copies of manuals
- Extra PDF manuals
- LinkOne WebView electronic manuals
- Other than standard language manuals

OTHER

Powder extinguisher:

- 12 kg
- Ansul Sentry

Number of extinguishers:

- 2
- 3

Painting and taping:

- Standard painting and taping
- Painting and taping according to customer specifications

Standard reversing camera system: 5 cameras, 3 displays and reversing radar

- 6 cameras, 3 displays. OACR/VCR system recording device with 72 h memory (4 recorded cameras)

Standard support legs at the load end

Flat cable front and rear grounding straps

Electric pump for brake release

Text labels in:

- En/Ru/One of destination EU languages
- Other language

Measurements:

- Noise
- Vibration

ACCESSORIES

PROCESS PRODUCTIVITY

- Engine end support legs
- Acetic Acid additive dosing system: Improves gassing in low temperature ambient conditions
- Pressure water system for block opening in emulsion line: up to 30 bar adjustable pressure water pumping for emulsion line block opening
- Pressure air for emulsion line cleaning: improves the cleaning of emulsion main line
- 0.4 m³/min compressor with air tank
- Matrix transferring pump: capacity 200 kg/min
- Matrix tank level sensor
- Hydraulically driven pressure washer with hose reel:

Water pressure, max.	180 bar
Water flow, max.	30 l/min
Hose length	20 m

 - Standard pressure washer
 - Stainless steel reel and rod
- Socket supply voltage
 - 220/230/240 V
 - 110/120 V

CARRIER PRODUCTIVITY

- Accessories for enclosed cabin:
 - Two-piece windscreen
 - Sliding rear window
 - Audio system
 - Air conditioning with heating
 - Heated mirrors
- 12 V, 20 A power supply in cabin with socket and connector
- Auto engine shutdown during idling
- Engine shutdown delay
- Inlet plug for jump start
- Block heater with interior heater and battery charger 230 V (Interior heater available with enclosed cabin)
- Block heater with interior heater, battery charger, hydraulic oil and filter heaters 400 V (Interior heater available with enclosed cabin)
- Fuel operated pre-heater
- Fast fuel filling system
- Hand pump for filling of hydraulic tank
- Fluid evacuation panel with sampling points
- Automatic lubrication system
- Spare rim and tyre
- Toolbox and maintenance tools
- Interior cooling fan
- Wax tape for electric connectors

SAFETY

- Cabin door puddle lights
- Extra warning LED light
 - Color
 - Amber
 - Blue
 - Red
 - Green (n/a with rotating light pattern)
 - White (n/a with rotating light pattern)
 - Light pattern
 - Strobe
 - Rotating
- Direction lights (left/right)
 - Green / Red
 - Red / Green
- Extra service warning LED light
 - Color
 - Amber
 - Blue
 - Red
 - Green (n/a with rotating light pattern)
 - White (n/a with rotating light pattern)
 - Light pattern
 - Strobe
 - Rotating
- Seat belt interlock switch applies safety brake
- Fire extinguisher system
 - Dry chemical
 - Ansul A-101
 - Manual
 - Automatic, Checkfire 110
 - Liquid agent
 - Ansul LVS
 - Manual
 - Automatic, Checkfire 110
- Gear lockout:
 - Forward:
 - Highest gear locked out
 - 2 highest gears locked out
 - Reverse:
 - Highest gear locked out
 - 2 highest gears locked out

- Pump for brake release
 - Electric pump
 - Hand pump
- Redundant brake monitoring system
- Methane monitoring system
- Protection guards for tunnel curtains
- Tyre pressure indicators
- Warning triangles
- Flashlight with charger
- Hearing protectors
- Wheel chocks with brackets
- Service isolator for starter

SERVICES

NORMET SERVICES

Our services cover the whole life cycle of your equipment. They include start-up and commissioning, genuine spare parts, upgrades & modifications, and remanufacturing, as well as rental and leasing offerings, and field services. We also offer improvement services such as operator training and process audits.

SPARE PARTS

Genuine parts from Normet Services ensure that you always have the highest quality parts available to keep your equipment up and running. Depending on your needs, we can offer everything from individual parts to complete parts contracts, and our professionals around the world have the experience to ensure that you have the parts you need when you need them.

Initial spare parts package:

Available for 1000h of use*. Includes periodical service, most common wearing parts and most critical safety parts.

Spare parts packages made for customer needs:

Available based on hours of use*. Includes periodical service, most common wearing parts and most critical safety parts.

* Recommendations are based on average hours – can vary a lot depending on work site conditions.

UPGRADES AND MODIFICATIONS

Our Upgrades and Modifications services are designed to ensure the economical, efficient and purposeful performance of your equipment over its entire life cycle. A service provided by a reliable OEM like Normet ensures the safety and performance of your equipment. Normet Upgrades and Modifications save you both time and money, while delivering the high quality you expect from us.

SERVICE CONTRACTS

With a service agreement, Normet manages your fleet with guaranteed availability and agreed costs, giving you transparency for your life cycle costs, annual operational budget and fleet uptime. This lets you focus on your core operations. Each service agreement is built and customized to meet the individual customer's needs from our portfolio of services. Depending on the level of service agreement you need, you can choose anything from basic technical support for an individual machine all the way up to services for your entire fleet, as well as process performance. The service levels we offer are:

- Parts Availability
- Fleet Support
- Fleet Availability
- Process Performance

The content of a service level can be tailored to meet your particular requirements.

TRAINING SERVICE

Our Training Services are available for you and your operators throughout the equipment lifecycle and they include:

	 Operation & Maintenance	 Spraying	 Charging	 Scaling
ADVANCED	Advanced fault diagnostics & troubleshooting	Concrete chemicals, testing and preparing for EFNARC-certificate test		
INTERMEDIATE	Troubleshooting training Foundations of electrics, hydraulics and mechanics NorSmart	Advanced training in concrete spraying Economics of concrete spraying	Advanced training in explosives Economics of charging	Advanced training in scaling Economics of scaling
BASIC	Operation and Maintenance Training Basic Product Training	Basic understanding of concrete spraying	Basic understanding of charging	Basic understanding of scaling
LEVEL	SERVICE	PROCESS KNOWLEDGE		

START-UP AND COMMISSIONING

1. OPERATOR TRAINING

	Start-up training	Commissioning
1.1 Classroom training		
General introduction and operation of machine	Basic	No classroom training included in commissioning
Safety instructions	Basic	
Use of manuals	Basic	
Technical introduction of equipment	Basic	
Hands-on service and pre-operation checks	Basic	
Controls and driving (starting, driving, stopping, parking)	Basic	
1.2 Practical training		
Pre-operation checks	Basic	Introduction
Driving, starting, stopping, parking	Basic	Introduction
Preparing the machine for specific operation conditions	Basic	Not covered
Operation	Basic	Introduction
Washing the machine	Basic	Introduction
Troubleshooting	Basic	Basic

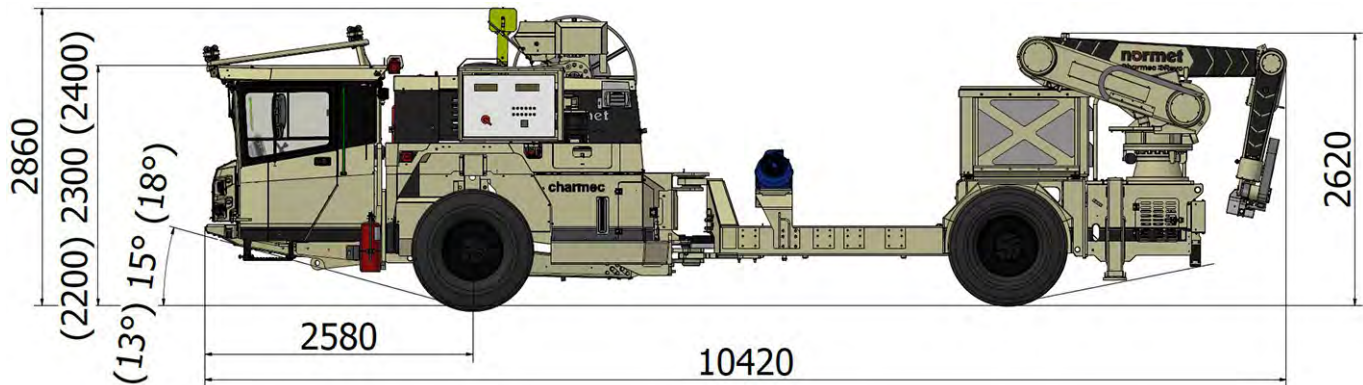
2. MAINTENANCE AND REPAIR TRAINING

General operation of machines	Basic	Introduction
Symbols of drawings and codes	Basic	Not covered
Understanding hydraulic and electric schematics	Basic	Introduction
Control systems	Basic	Introduction
Function of main components (depending on equipment)	Basic	Introduction
Locations of components in the machine	Basic	Not covered
Periodical maintenance	Basic	Introduction
Troubleshooting	Basic	Not covered
Use of manuals	Basic	Introduction
Connection of hydraulic and electrical equipment	Basic	Not covered

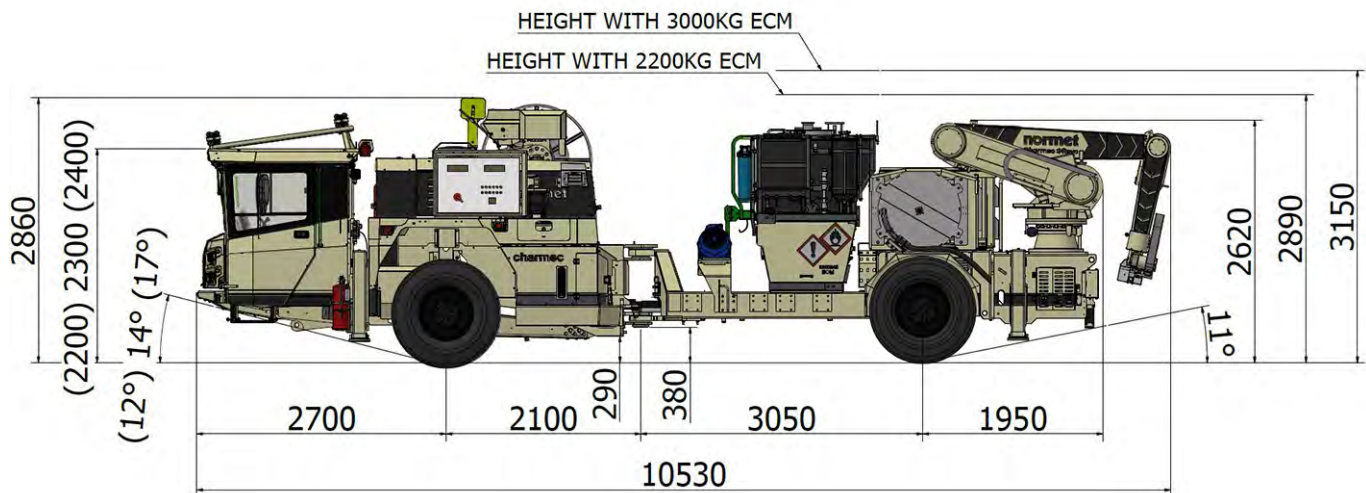
DIMENSIONS

Length	10420 mm	Track	1920 mm
Width	2300 mm	Ground clearance	250 mm
Height	2860 mm	Turning radius outer	8160 mm
Height of cabin	2300 mm	Turning radius inner	5380 mm
Wheel base	5150 mm		

SIDE VIEW – BASIC MACHINE



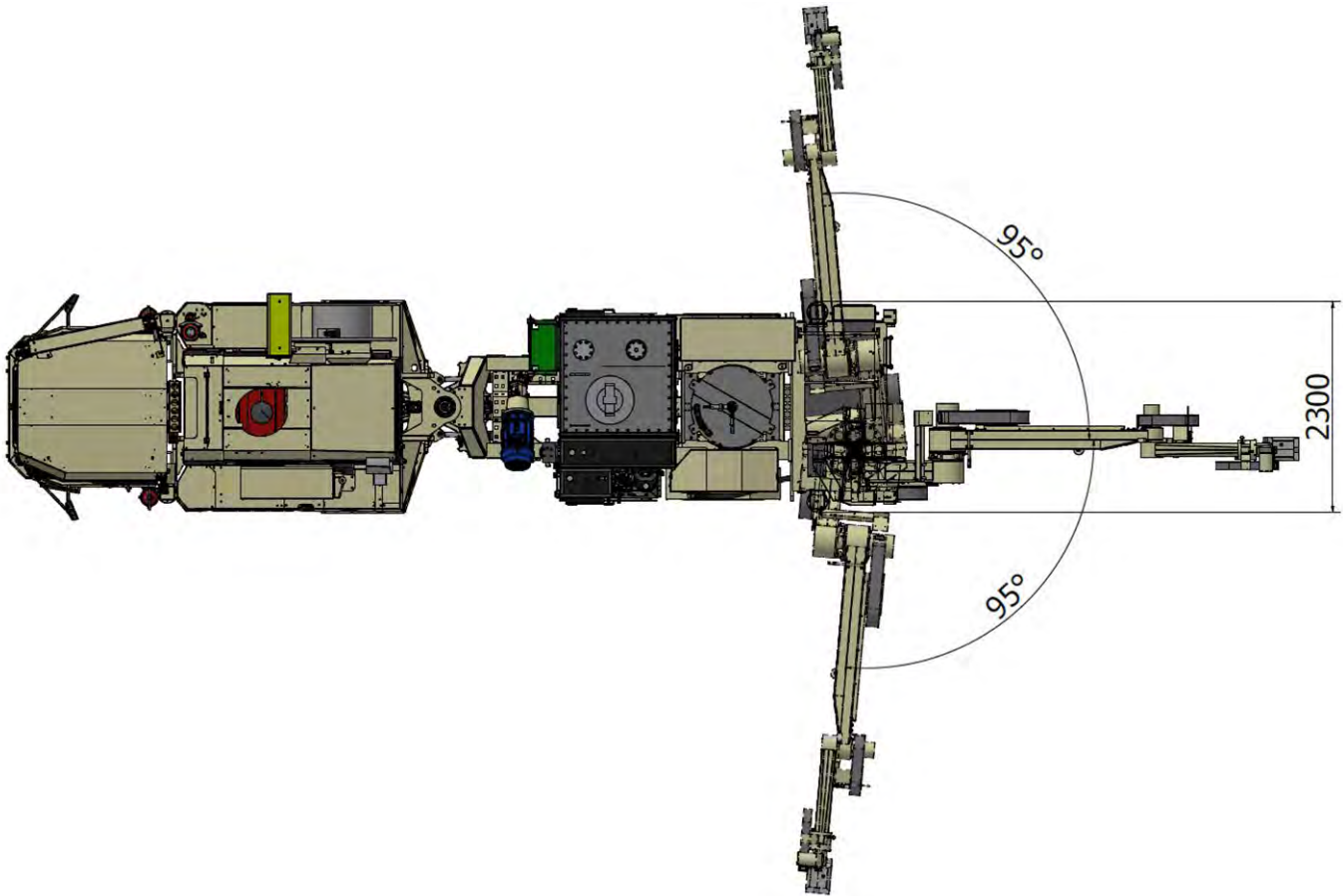
SIDE VIEW – MACHINE WITH OPTIONS



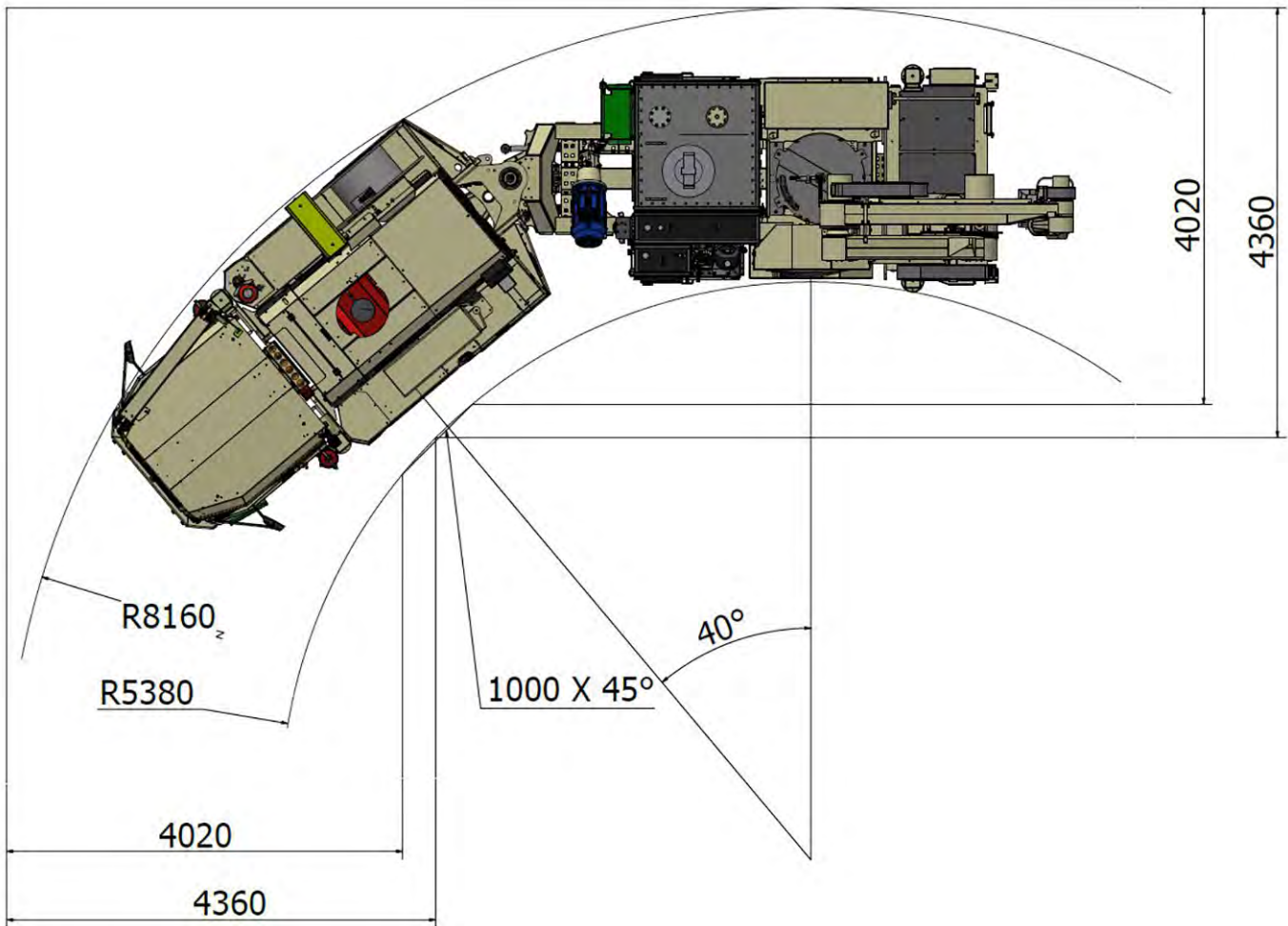
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TOP VIEW



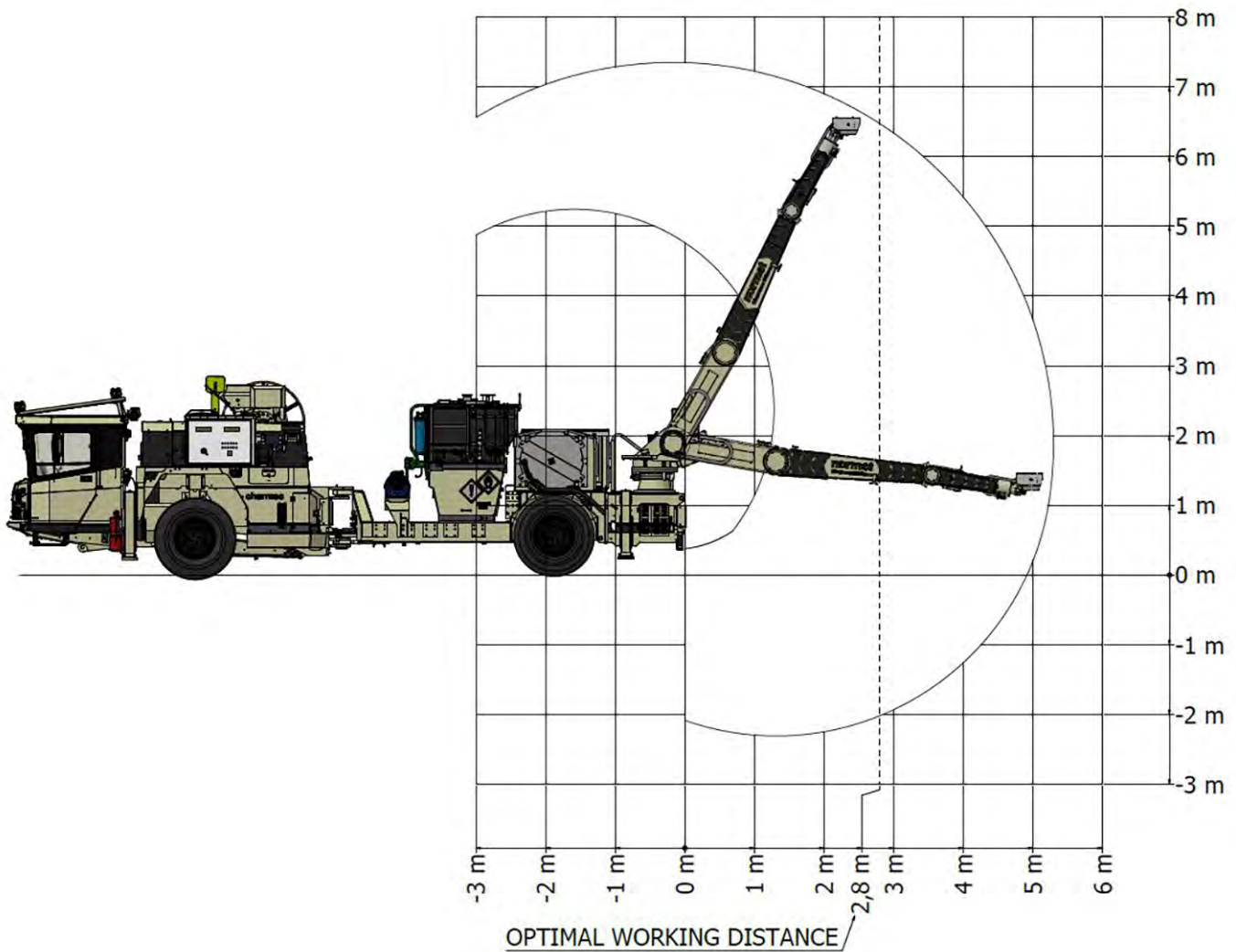
TURNING RADIUS



FRONT VIEW

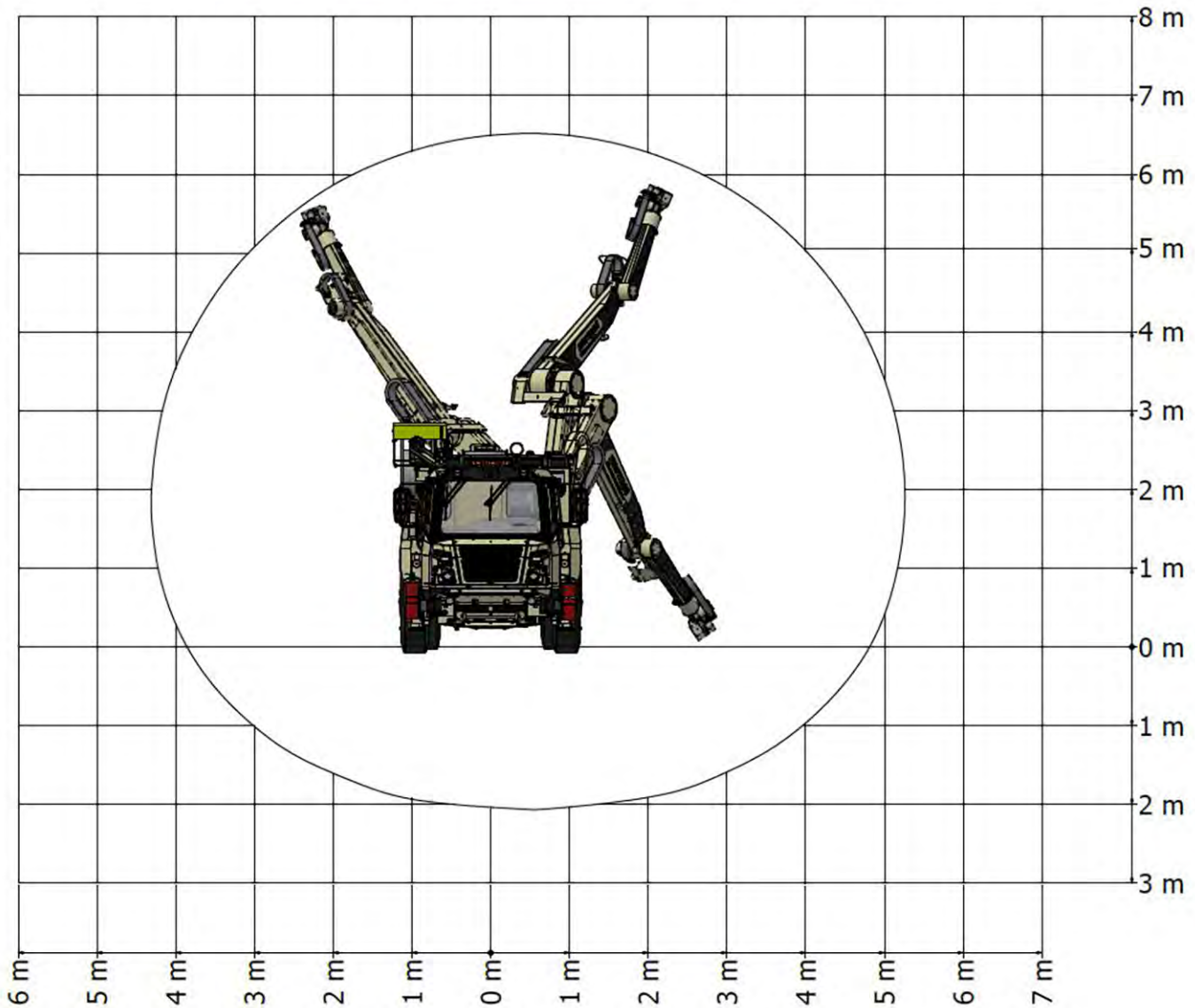


BOOM REACH

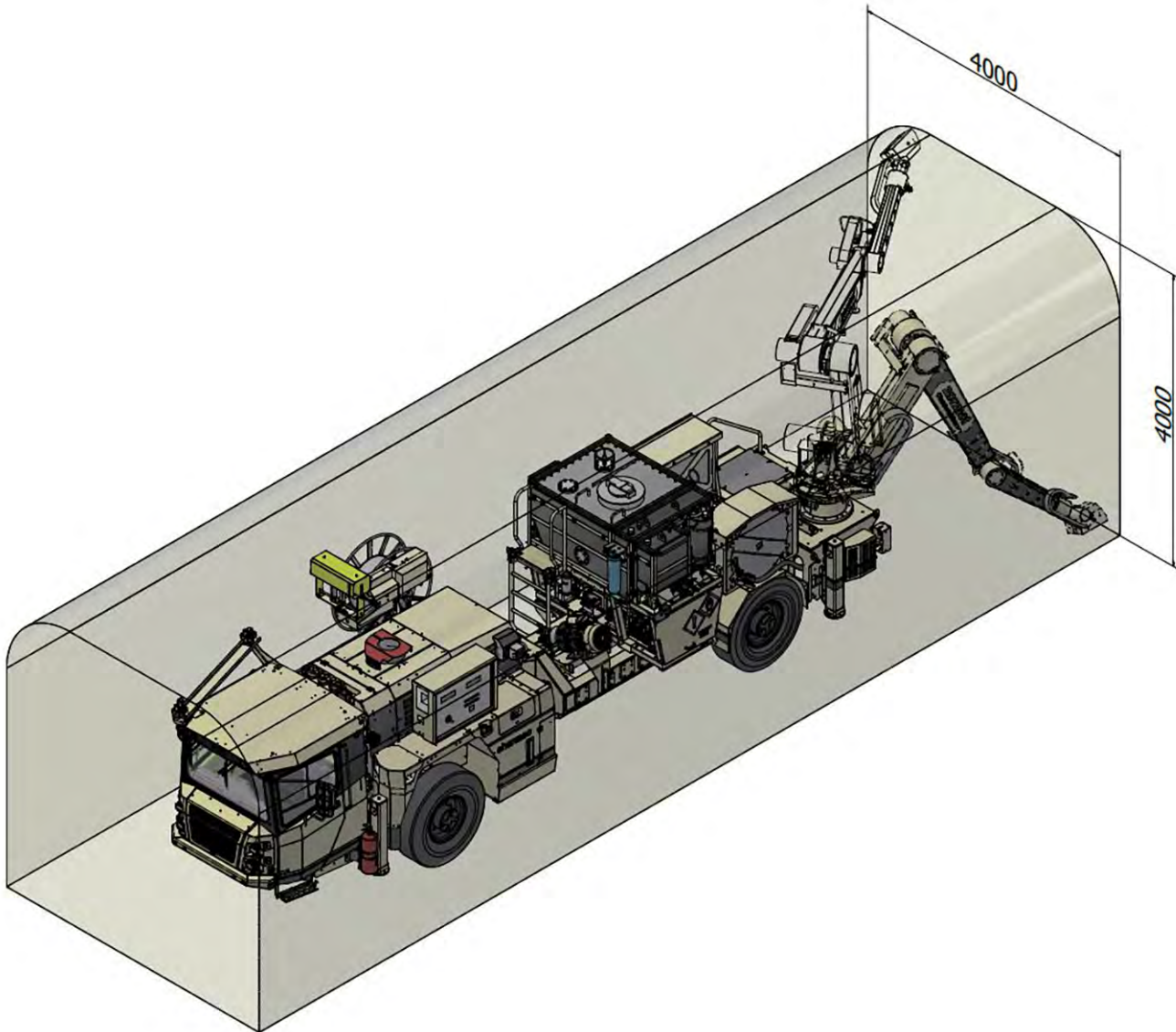


BOOM REACH AREA AT OPTIMAL 2,8 M WORKING DISTANCE

BOOM REACH AREA AT OPTIMAL 2,8M WORKING DISTANCE



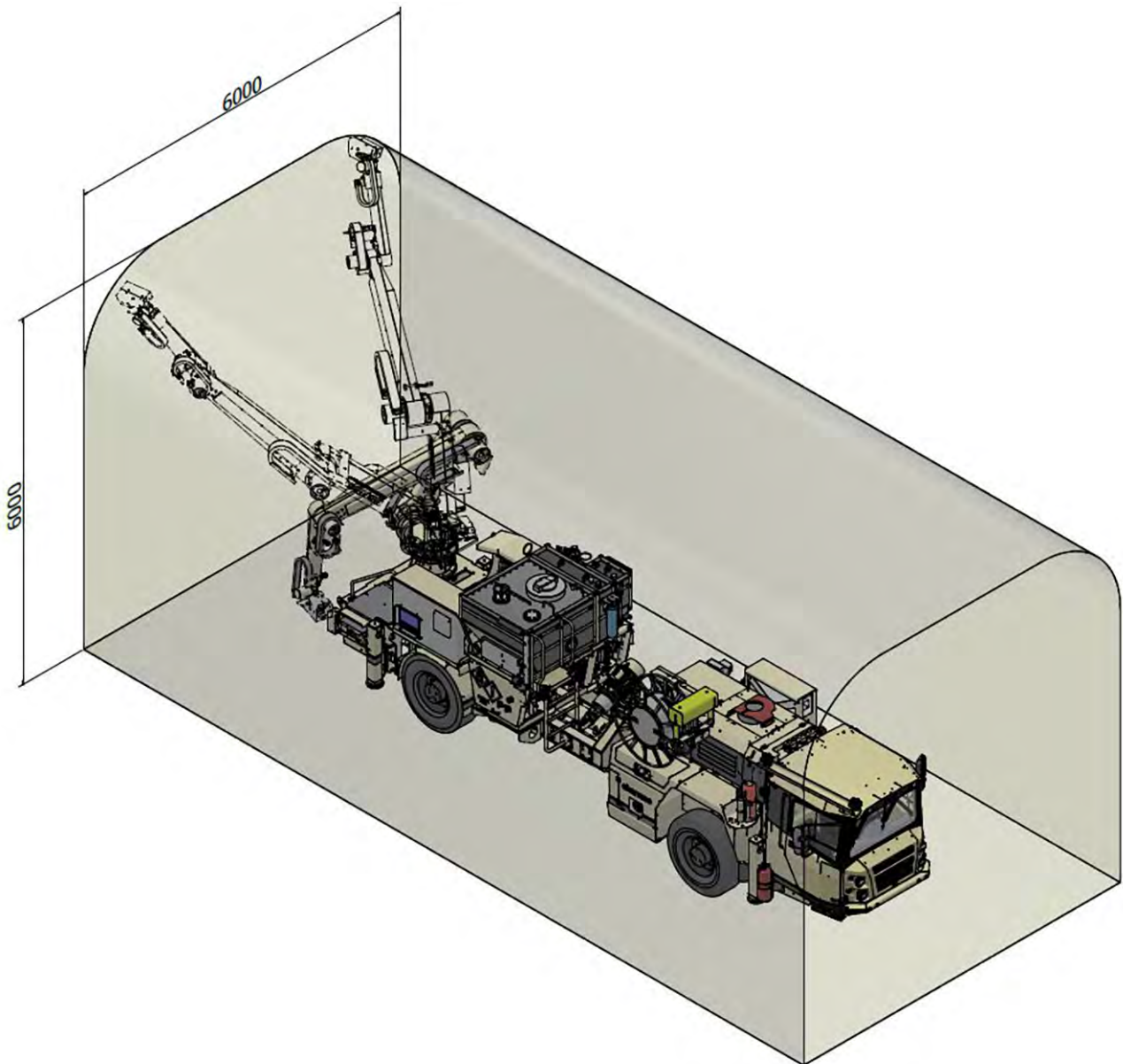
MINIMUM CHARGING AREA



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MAXIMUM CHARGING AREA



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TRACTIVE EFFORTS

OPERATING WEIGHT

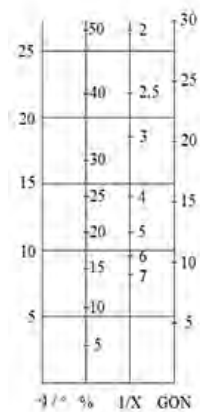
Empty	18 000 kg
Fully loaded	21 000 kg

final machine weight variate in agree with selected options

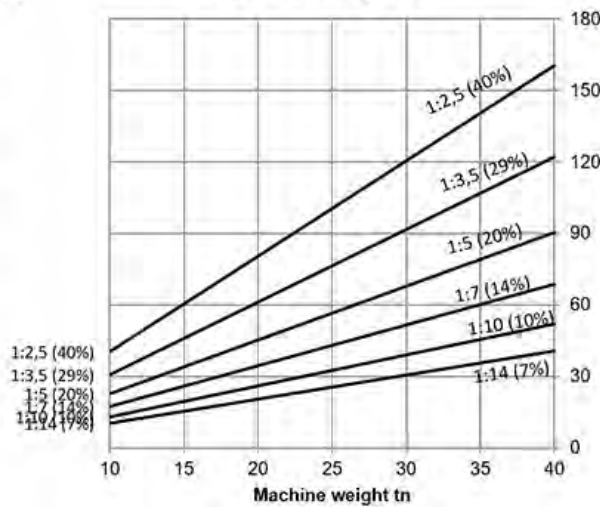
VOLVO PENTA D851/881 185 KW

Performance curve with turbine lock-up DOC059933

Conversion chart



Gradeability kN



Tractive effort kN

