



# Charmec Revo LF 600 V(E)

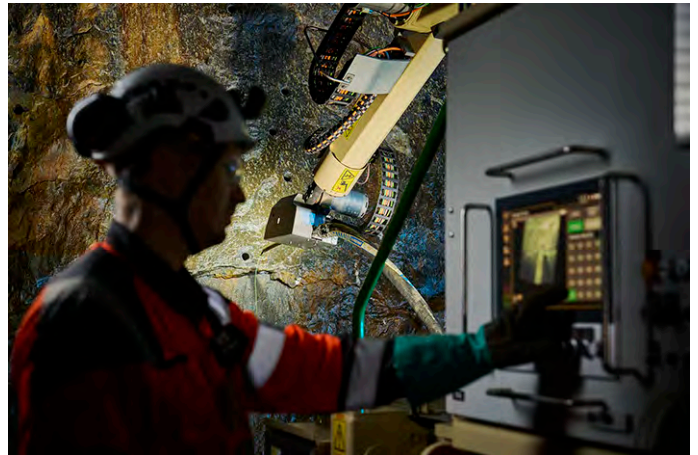


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this specification without further notice

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.

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## 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 with recording support

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 m<sup>3</sup>/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 (Green/Red)
    - Both lights always on
    - Lights follows driving direction
  - 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
          - 210
      - Liquid agent
    - Ansul LVS
      - Manual
      - Automatic, Checkfire
        - 110
        - 210
- 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

Normet is committed to servicing its customers all over the world. We provide service from a single machine to an entire fleet. The Normet service offering consists of many different products from delivery of parts and training to fleet performance agreements.

More information check [normet.com](https://www.normet.com):

<https://www.normet.com/en/products-and-services>

**For any questions about Normet Services contact local Normet.**

<https://www.normet.com/en/contact/>

## SPARE PARTS

As a leading global Original Equipment Manufacturer, we are committed to providing a complete solution to your spare parts needs. All of Normet's spare parts are manufactured to the highest possible standards to help maintain the safety and profitability of your projects. Our spare parts improve efficiency and total cost of ownership throughout your operations.

Start a carefree journey with Normet equipment by having the right selection of parts available from the beginning.

### **Spare part recommendation / Start-up Spare Part package:**

Available for the first 2000h\*: includes periodical service parts, most common wearing parts and other recommended parts. (\*Recommendations are based on average hours that can vary depending on worksite conditions.)

Underground, every part is critical!

More information check <https://www.normet.com>

## SERVICE AGREEMENTS

Service agreements are always customized to meet our customer needs, consisting of various Normet service products. The service solution is created together with the customer and the level of an agreement can vary with different support agreements (including e.g. parts, periodical maintenance, on-call services, and audits) up to guaranteed fleet availability or process performance (including e.g. parts, all maintenance activities, operator trainings and process audits).

Note that we can provide Digital solutions with connected equipment.

More information check [normet.com](https://www.normet.com).

## TRAININGS

Training services can be tailored to your individual needs and range from equipment service training to process application training.

We offer a sustainable training path from the beginning of your operation to the execution stage of your project.

More information check [normet.com](https://www.normet.com).

## COMMISSIONING

Equipment commissioning concerns **equipment familiarization**. This is included as part of Normet vehicle delivery. Safety introduction and operating basics for Normet Equipment. Review of Normet user and spare parts manuals. Hands-on equipment safety device operational training. Ensure product quality and customer satisfaction during handover.

**Commissioning includes machinery handover to customers and safety operating principles** without technical insights or process application training.

## EXTENDED COMMISSIONING

We offer an extended training package on top of standard commissioning. Normet provides extended commissioning services that offer basic insights into maintenance manuals, periodical and daily maintenance, as well as modern operating perspectives to maximize handling efficiency. Safety-oriented training ensures reliable operations for Battery Electric Vehicles and Diesel-Driven based on your vehicle fleet. This cost-effective solution covers the essential aspects of equipment operation, safety, and maintenance schedules.

To ensure continuous and maximized safe operations with your new equipment and to expand your knowledge scale of operations, this option is the most suitable and recommended option for extending your new equipment training. This cost-effective solution covers the essential aspects of equipment operation, safety, and maintenance schedules.

## UPGRADES AND MODIFICATIONS

We build our machines to last. We also understand that your needs on the ground can change - and reacting to that change makes a big difference in your productivity. Normet Upgrades & Modifications provide you with access to product improvements that meet your evolving requirements and let you stay one step ahead of the curve.

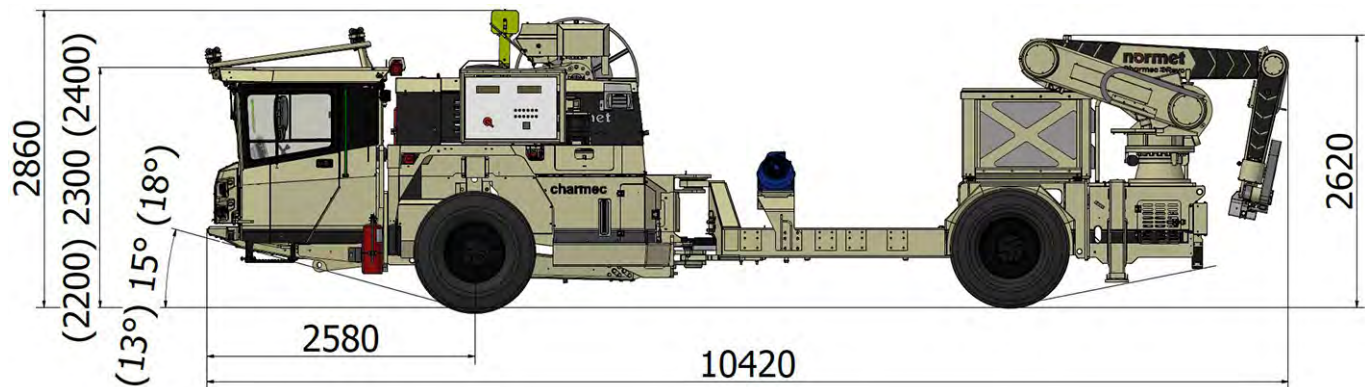
Contact your local Normet office for Upgrade offering to your fleet.

More information check [normet.com](https://www.normet.com).

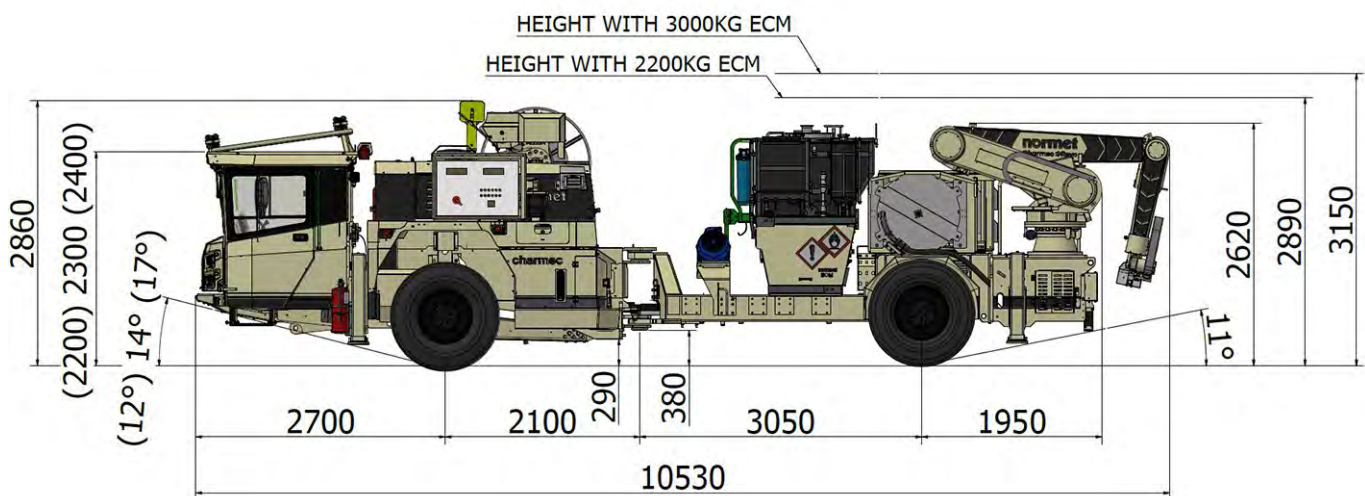
## DIMENSIONS

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		

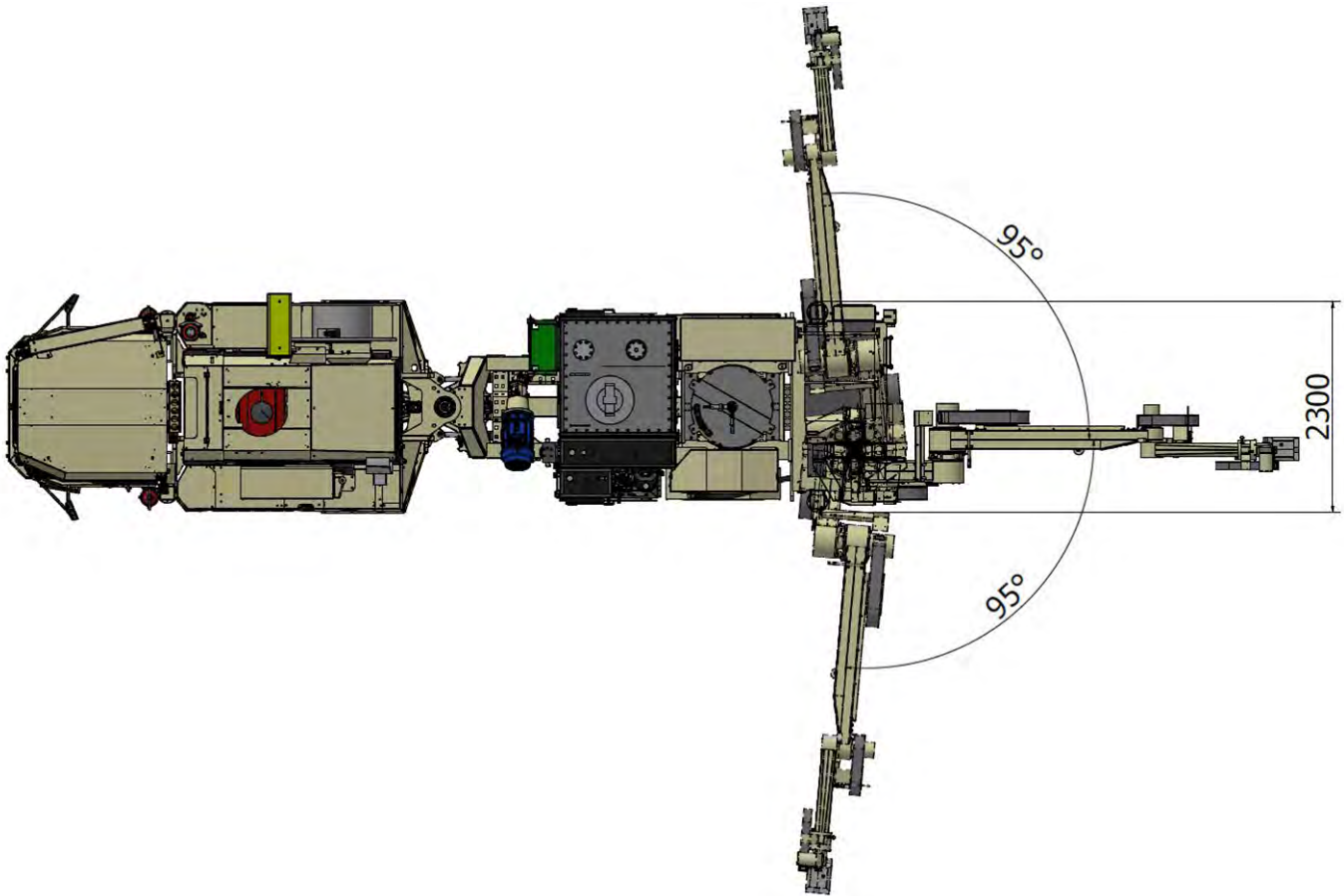
### SIDE VIEW – BASIC MACHINE



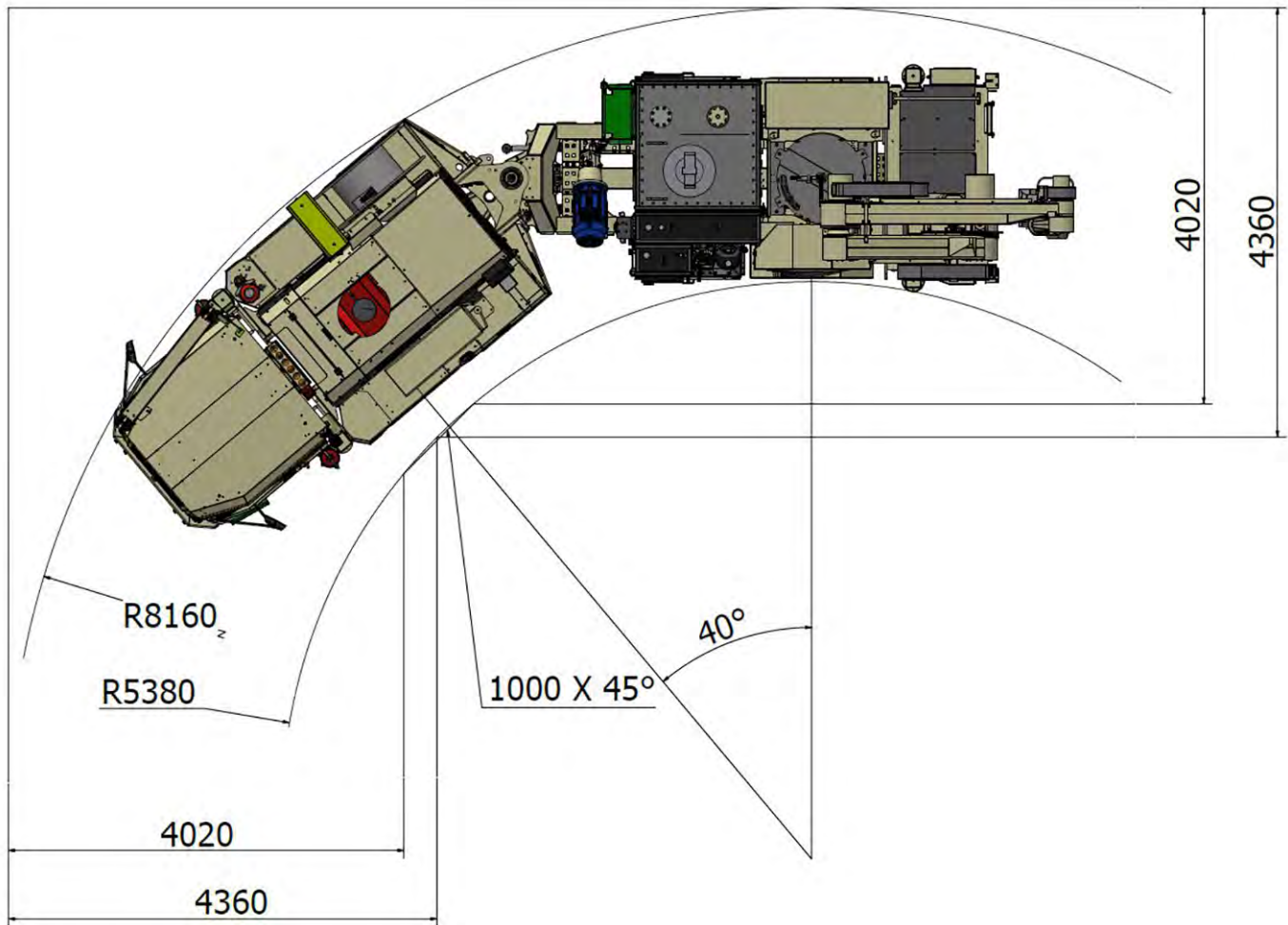
### SIDE VIEW – MACHINE WITH OPTIONS



## TOP VIEW

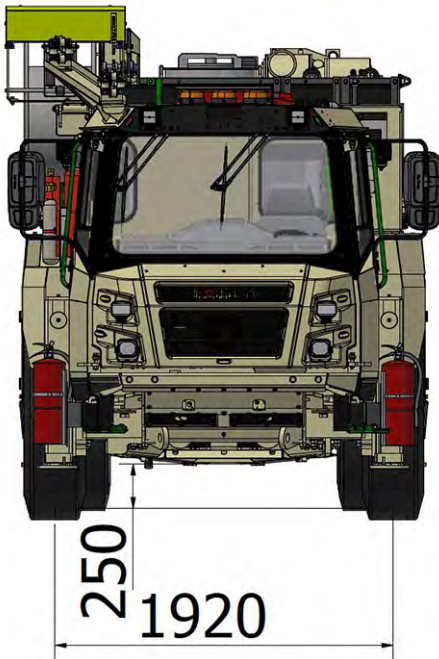


## TURNING RADIUS

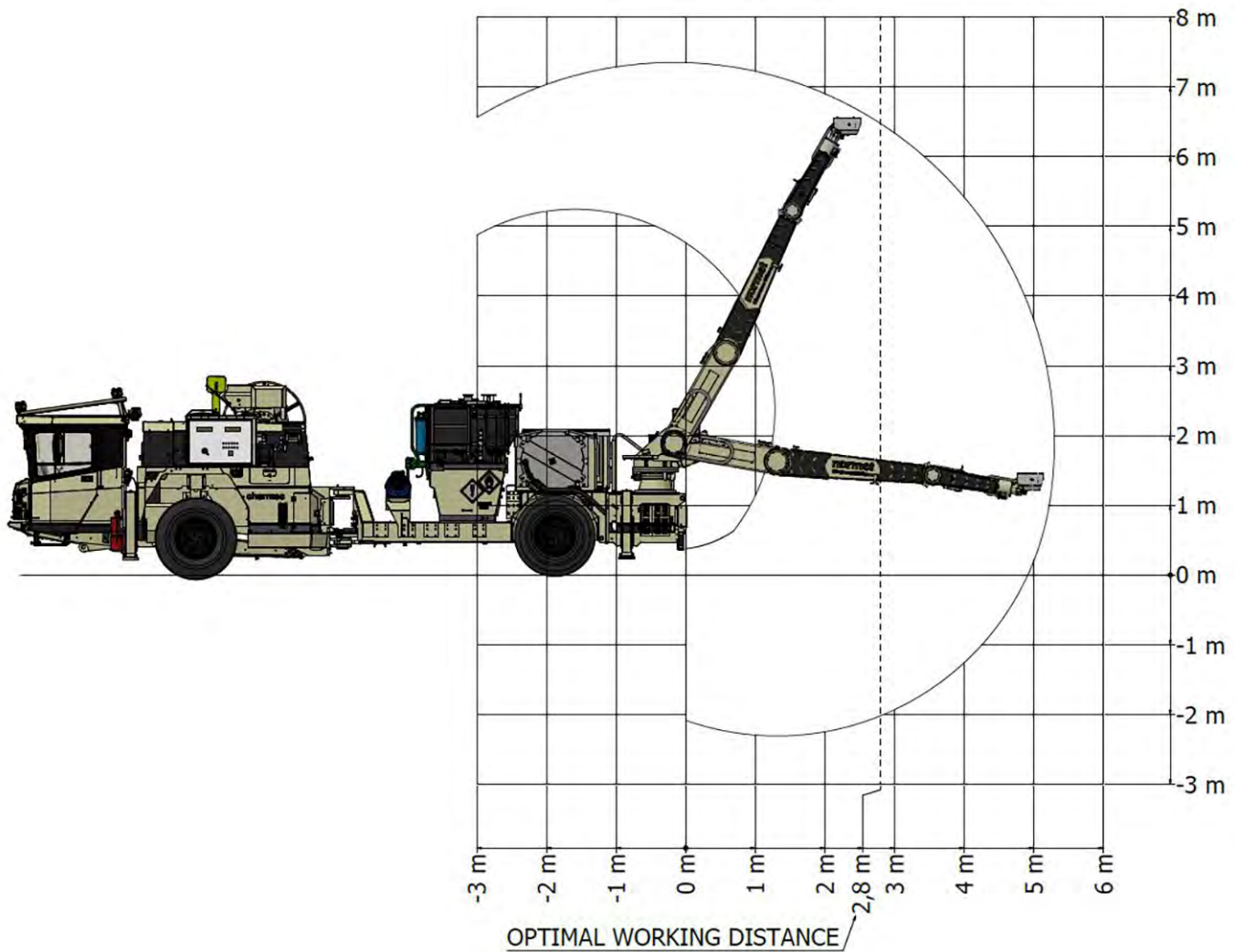




## FRONT VIEW

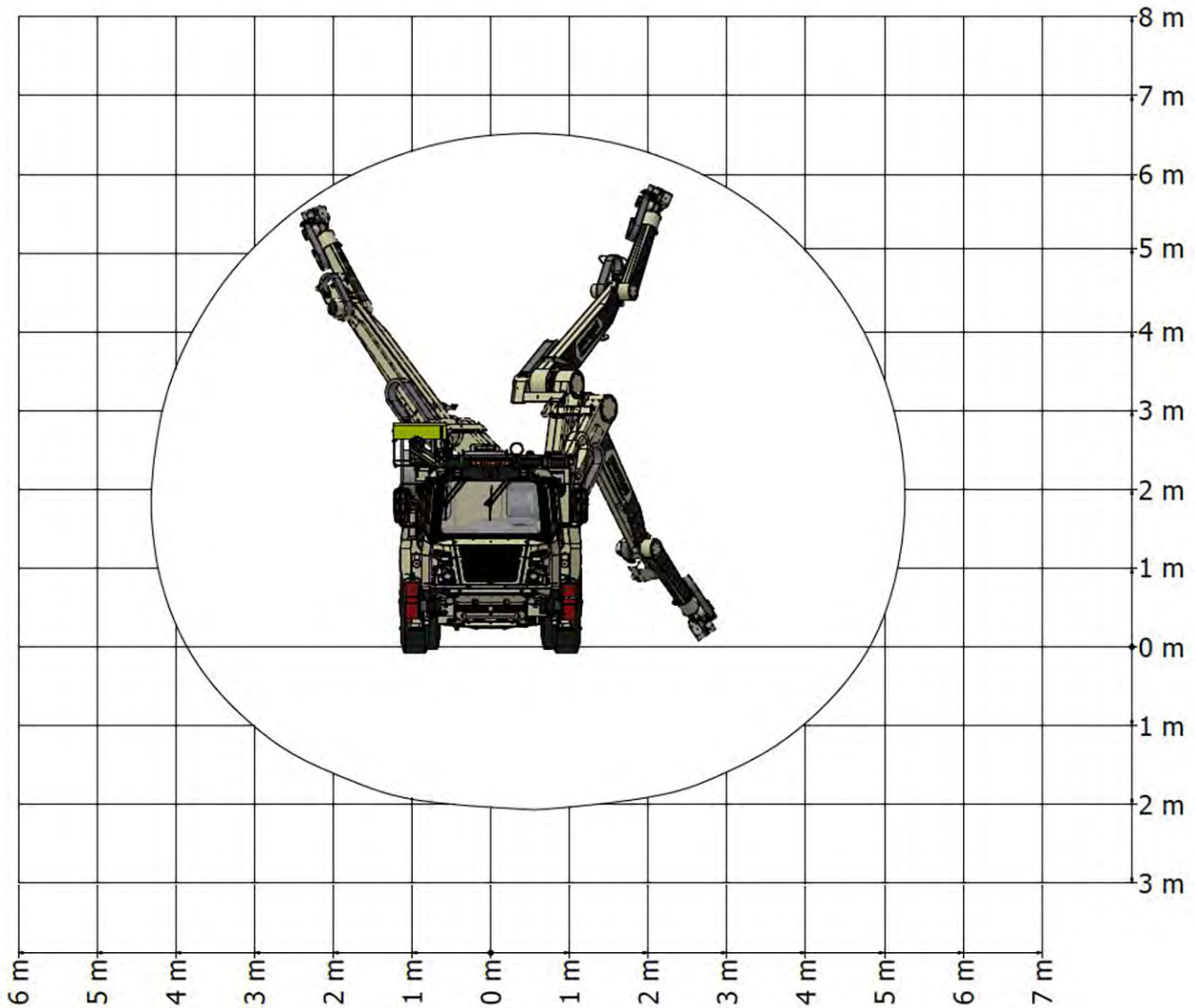


## BOOM REACH

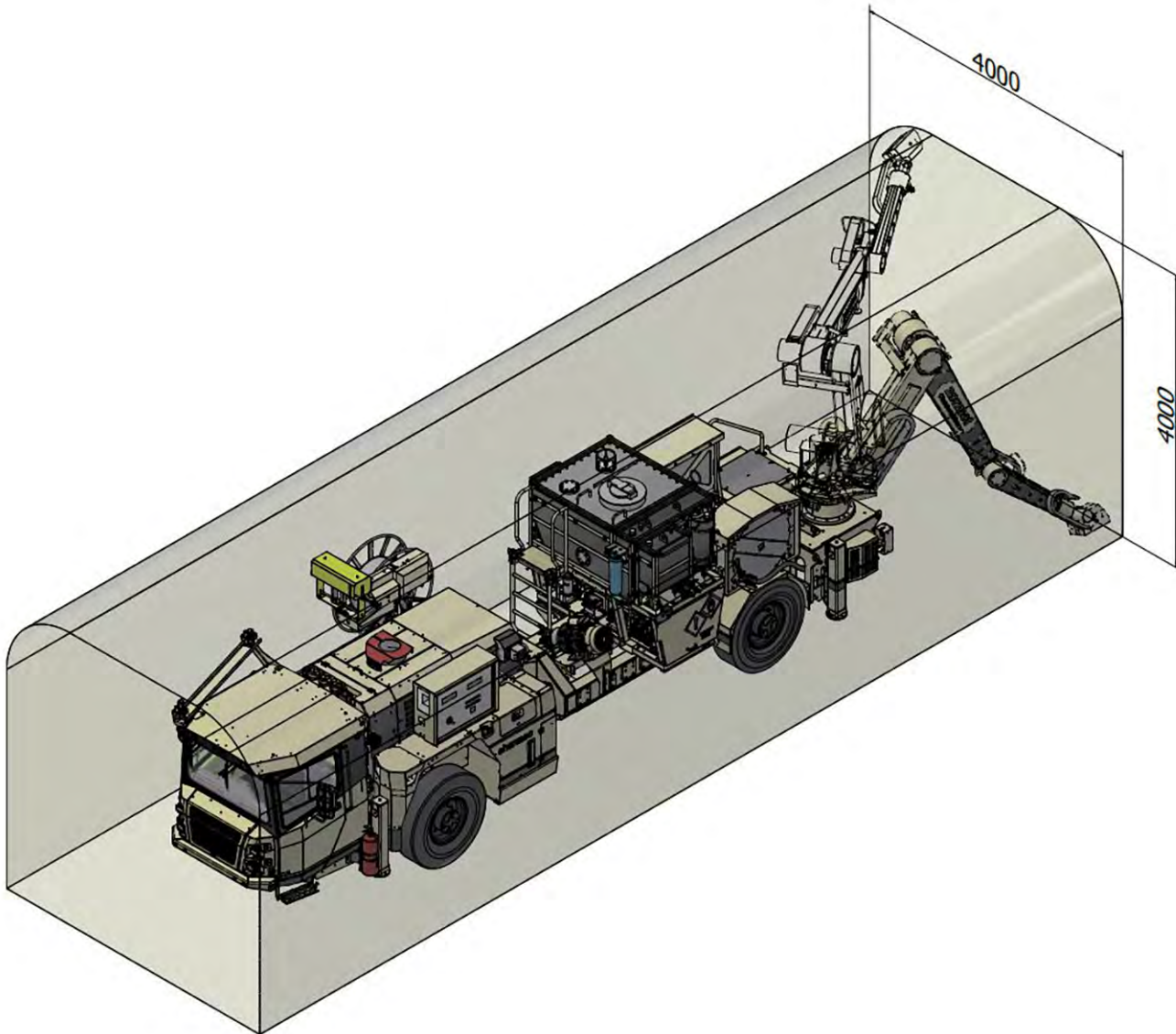


## BOOM REACH AREA AT OPTIMAL 2,8 M WORKING DISTANCE

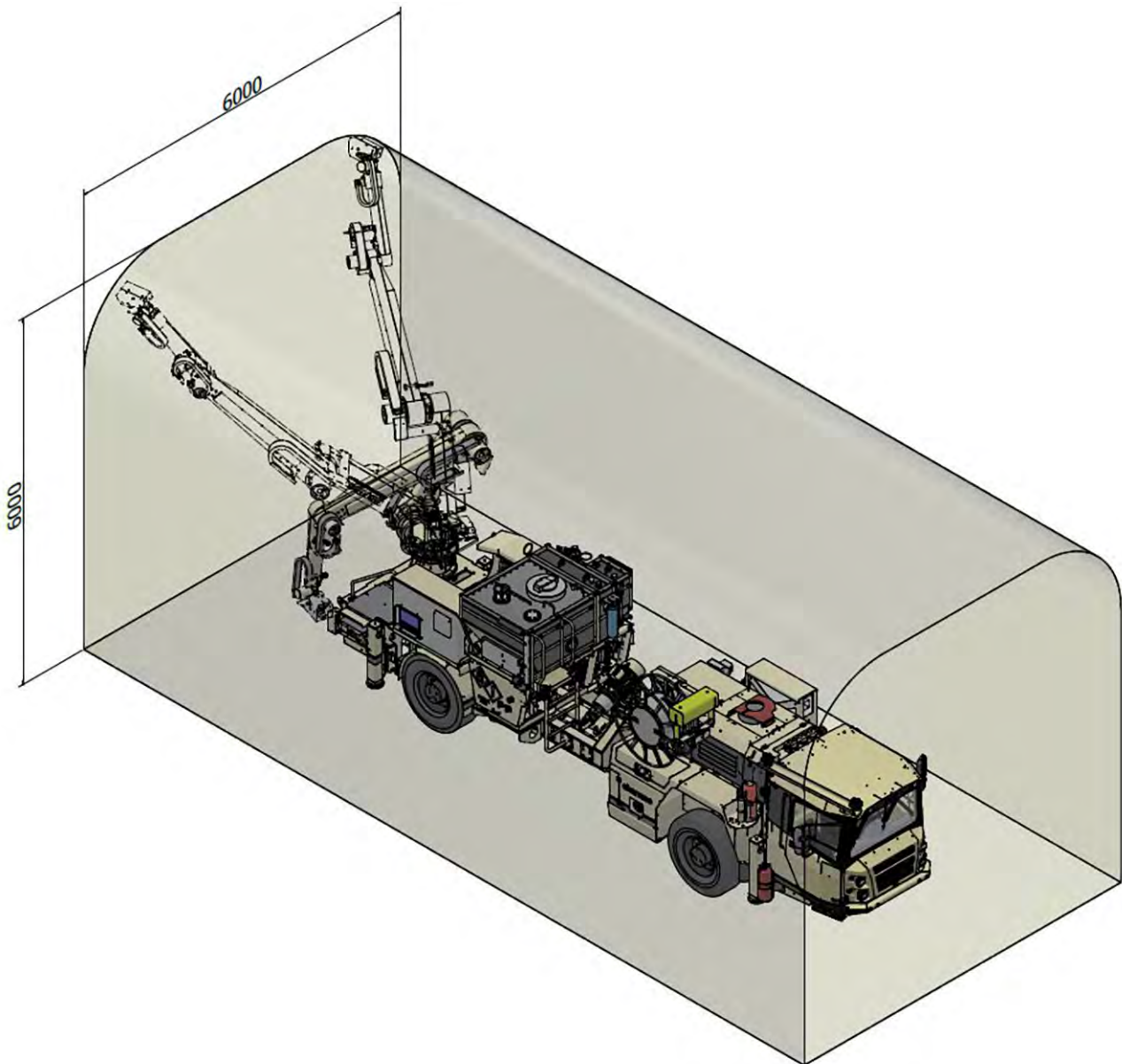
BOOM REACH AREA AT OPTIMAL 2,8M WORKING DISTANCE



## MINIMUM CHARGING AREA





**MAXIMUM CHARGING AREA**

## 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

