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LF™160 DRILL RIG AND FREEDOM™ LOADER

V4 | 4/12/2017

 **BOART LONGYEAR™**

LFTM160 DRILL RIG

Boart Longyear has combined proven technology from its most popular surface coring drill rigs to create the powerful LFTM160. When paired with the FREEDOMTM Loader, the LF160 combination is ideal for contractors who want to target sophisticated surface drilling exploration contracts that stipulate some of the highest safety standards, without compromising on productivity.

Totally hands free rod handling

The LF160 and FREEDOM Loader combination is one of the industry's first 100% hands-free rod handling solutions. No intervention from the driller's assistant is required to align and cycle the rods or connect the hoist plugs when operating the loader. All operations happen behind the control panel at the touch of a finger.

Optimal safety without compromising productivity

The FREEDOM Loader can cycle 6 meter rods in same amount of time as a manual cycle which means enhanced safety is achieved without compromising productivity.

Designed to today's rigorous CE standards

The LF160 and FREEDOM Loader combination adheres to all of today's rigorous CE standards.

Depth capacity

With up to 1,800 meters of NQTM capacity, the LF160 can meet the demands of most diamond coring projects. The LF160 is efficient and economical on shallow hole drilling and can handle the majority of diamond coring needs.





INTRODUCING THE FREEDOM™ SERIES

Introducing Boart Longyear's FREEDOM™ series of rod loaders, handlers and presenters. Our cutting-edge range has been engineered with drillers' safety and productivity front-of-mind.

FREEDOM TO DRILL

The FREEDOM series is your best option for reducing the risk of hand and back injuries while handling rods.

FREEDOM TO MOVE

Using the FREEDOM Loader remote control enables you to work from a safer location, away from the risks of moving rods.

FREEDOM TO BID

Only the FREEDOM series complies with today's rigorous CE standards, so you will have the freedom to bid on jobs with some of the most stringent health and safety standards.

LF™160 DRILL RIG & FREEDOM™ LOADER

1. 100% HANDS-FREE ROD HANDLING

No intervention from the driller's assistant is required to trip and align the rods or connect to the top drive head when operating the Freedom™ Rod Loader. All operations happen behind the control panel at the touch of a finger.

2. TILTING TOP DRIVE HEAD

The forward tilting head design simplifies the rod handling process and reduces the need for operator intervention and maintenance.

3. CLAMPING AND BREAKING DEVICE

A hydraulic breaking device means no wrench under power. Rod alignment device and centralizer included.

4. CE CERTIFIED

The LF™160 is CE certified according to the latest EN16228 safety standards.

5. VISUAL WIRELINE

The wireline winch and sheaves are located in the front of the mast, inside the rotation barrier, for improved visibility.

6. DEPTH CAPACITY

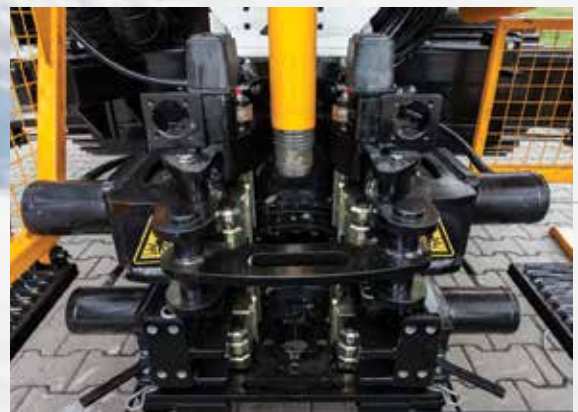
With up to 1,800 meters of NQ™ capability, the LF160 can cover the majority of diamond coring needs.

7. ENVIRONMENTALLY CONSCIOUS TIER 3 OR 4 ENGINE

Offered with either a Tier 3 or 4 final engine to comply with emissions requirements in every country.

8. VERSATILITY OF CARRIERS

The LF160 can be ordered in either a crawler or truck mount configuration. The truck mounting is compatible with International 6x4 and Mercedes 8x8 or 6x6 trucks.



Tilting Top Drive Head and Clamping Device





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TOP FIVE FEATURES OF THE LF™160

1. Tilting Top Head Drive

The tilting top drive head simplifies rod handling with built-in tools and functionality.

The rod clamp attached to the head carriage is used to make and break joints at the drive sub with power from the head. You don't have to worry about inadvertently breaking a joint elsewhere in the string.

The floating spindle is spring loaded to provide just the right amount of tension or compression when threading rods. This will reduce thread wear and other issues associated with making rod joints.

The tilting function of the head allows for all joints to be made low to the ground where the driller has a clear and comfortable view of the joint. Tripping rods at a near horizontal angle is ideal for auxiliary equipment such as the FREEDOM™ Loader.

Other benefits of the tilting top drive head include the elimination of the mainline hoist, hoisting plug and water swivel management.

2. Foot Clamping and Breaking Device

The foot clamp and breaking device is four tools built into one.

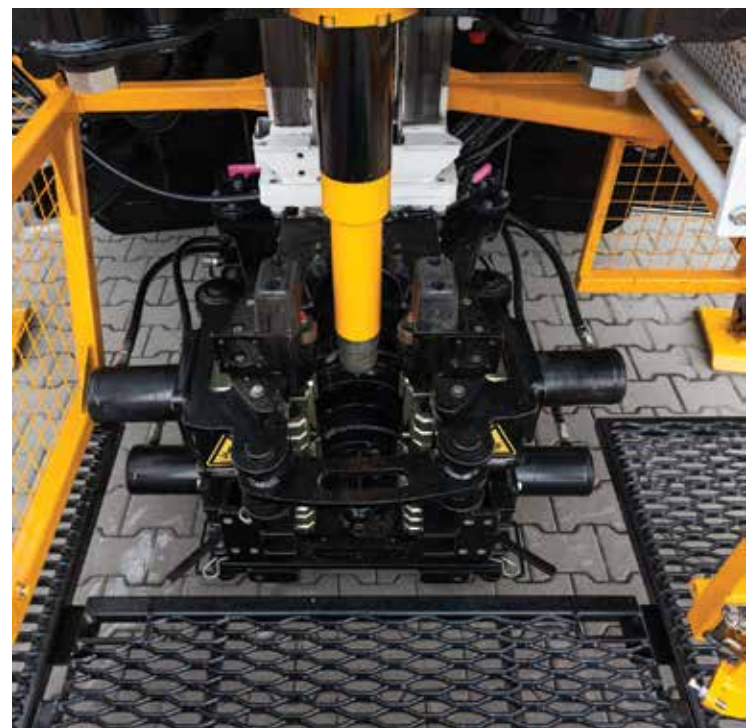
The lower rod clamp is a fixed clamp that is used to hold the rod string in a traditional manner.

The upper rod clamp performs the same job but also rotates, and is intended to break joints positioned between the two clamps.

A rod making alignment device is located above the top clamp. This alignment device is critical to facilitate hands free rod handling. When adding a new rod, this alignment device will center the top rod with the rod already in the hole, ensuring a clean stab and thread start.

The rod centralizer, mounted under the bottom clamp, keeps the rod string centered in the drill line.

All four of these tools can be opened in the front allowing flexibility of tools to pass through as needed in special drilling conditions.





3. Visual Wireline

The wireline winch is located in front of the mast, inside the rotation barrier for improved visibility. The driller can monitor the wireline spooling from the control panel, avoiding tangling of wire rope typically experienced while lowering the overshot. The wireline sheaves are also easily seen from the driller's platform, keeping the entire wireline system within view.

4. Versatility of Carriers

The LF™160 can be ordered as either a crawler or truck mount configuration. Truck mounting is compatible with International 6x4 and Mercedes 8x8 or 6x6 trucks.

5. Driller Safety Features

The LF160 is CE certified (Machinery Directive 2006/42/EC) according to the latest EN16228 drill rig safety standards available.

The LF160 features a low noise engine and pumps, both of which are located far from drilling area and within an acoustic enclosure. Rotation Barrier with Interlocks, "Restricted Operation Mode" is engaged when barrier is open.

Dead-man buttons prevent unintentional function activation with accidental control lever movement.



LF™160 DRILL RIG TECHNICAL INFORMATION

| Drilling Capacity* | | |
|---|---------|----------|
| | Metric | U.S. |
| Diamond Core BQ™ / BRQ™ (BQ™ rod is rated to 1500 m depth) | 2,100 m | 6,900 ft |
| Diamond Core NQ™ / NRQ™ / NRQ™ V-Wall™ | 1,800 m | 5,900 ft |
| Diamond Core HQ™ / HRQ™ / HRQ™ V-Wall™ | 1,250 m | 4,100 ft |
| Diamond Core PQ™ / PHD / PHD V-Wall™ | 700 m | 2,300 ft |

*The figures in this table have been calculated using torque and pulling capacity of the head with a fluid filled verticle hole and an effective rock tensile strength of 5 Mpa. Actual drilling results may vary and will be affected by in-hole tools, fluid level in the hole, subsurface conditions, drilling techniques, additives and equipment used.

| Safety Design Standards and Highlights | |
|--|---|
| Design Standards | EN ISO 16228 |
| CE Certification | Machinery Directive 2006/42/EC |
| Rod Handling | Hands Free when used with compatable Rod Loader |
| Interlocked Rotation Barrier | Restricted Operation Mode |
| Noise Level | LW(A)=112 dB / Lp(A)=89 dB |
| Other Safety Feature | No uncontrolled movement after a restart or Mode switch, Safety Cage, Deadman Buttons, Mode-switches, Emergency Stops, Head Rod Clamp, Breaking device, Beepers during tramming and more. |

| Prime Mover | | |
|---------------------------------------|---|------------------|
| | Metric | U.S. |
| Engine (option) | Deutz TCD 6.1 L06 Diesel Engine Turbocharged, intercooled, 6.1 L displacement, inline 6 cylinder. | |
| Emmissions compliance | EU Stage IV | EPA Tier 4 Final |
| Fuel | Diesel | |
| Fuel Consumption @ Full Power | 40 L/hr | 10.5 gal/hr |
| Maximum Power @ 2300 RPM | 170 kW | 231 HP |
| Electrical Voltage | 24 V | |
| Recommended max altitude of operation | 2,000 m | 6,560 ft |

| Prime Mover (continued) | | |
|---------------------------------------|---|-------------|
| Engine (option) | DEUTZ TCD 2013 L06 4V Diesel Engine Turbocharged, intercooled, 7.2 L displacement, inline 6 cylinder. | |
| Emmissions compliance | EU Stage IIIA | EPA Tier 3 |
| Fuel | Diesel | |
| Fuel Consumption @ Full Power | 55 L/hr | 14.5 gal/hr |
| Maximum Power @ 2000 RPM | 227 kW | 304 HP |
| Electrical Voltage | 24 V | |
| Recommended max altitude of operation | 4,500 m | 14,760 ft |
| Fuel Tank Capacity | 500 L | 132 gal |

| Prime Mover (continued) | | |
|---------------------------------------|---|------------------|
| Engine (option) | CUMMINS QSB 6.7 Diesel Engine Turbocharged, intercooled, 6.7 L displacement, inline 6 cylinder. | |
| Emmissions compliance | EU Stage IV | EPA Tier 4 Final |
| Fuel | Diesel | |
| Fuel Consumption @ Full Power | 48.5 L/hr | 12.8 gal/hr |
| Maximum Power @ 2000 RPM | 194 kW | 264 HP |
| Electrical Voltage | 24 V | |
| Recommended max altitude of operation | 3,300 m | 10,800 ft |

| Hydraulic System | | |
|-----------------------------|--|-----------------------------|
| | Metric | U.S. |
| Primary Pump | Axial Piston Pump with Power Regulator, Load Sensing and Pressure Regulator | |
| Maximum Flow, Q1 | 250 L/min | 66 gal/min |
| Maximum Flow, Q2 | 195 L/min | 51 gal/min |
| Maximum Pressure | 300 bar | 4,300 psi |
| Auxilairy Pumps | 2 x Gear Pumps | |
| Flow Q3 | 43 L/min | 11.3 gal/min |
| Flow Q4 | 36 L/min | 9.5 gal/min |
| Hydraulic Oil Tank Capacity | 600 L | 158 gal |
| PTO1 | 35 L/min @ 200 bar | 9.25 gal/min @ 2,900 psi |

| Rotary Head | | |
|---|---|--|
| | Metric | U.S. |
| Model | Boart Longyear™ LCH20 | |
| Configuration | Top Drive, floating spindle, tilt-out with rod clamps | |
| Number of Gear Speeds | 2 Speeds | |
| Ratio 1st Gear | 13.22:1 | |
| Ratio 2nd Gear | 3.23:1 | |
| Head fine RPM control | Motor displacement adjustment | |
| High Speed Torque @ RPM | 0.92 kNm @ 1,050 RPM 1.63 kNm @ 590 RPM | 678 ft-lbf @ 1,050 RPM 1,202 ft-lbf @ 590 RPM |
| Low Speed Torque @ RPM | 3.75 kNm @ 255 RPM 6.65 kNm @ 145 RPM | 2,183 ft-lbf @ 255 RPM 4,912 ft-lbf @ 145 RPM |
| Head Lubrication Pump | Speed Dependent. Driven by head rotation. | |
| Head Lubrication Flow | 17 L/min @ 1000 rpm | 4.5 gal/min @ 1000 rpm |
| Floating Spindle: Inside Diameter | 25 mm | 1 in |
| Floating Spindle: Floating Distance | 120 mm | 4.7 in |
| Tilt-out head | 90° | 90° |
| Head Mounted Rod Clamp Extension Distance | 840 mm | 33 in |

| Undercarriage Mount | | |
|--|----------------------------|--------------------|
| | Metric | U.S. |
| Type | 20 ton - class | |
| Crawler Width | 500 mm | 19.7 in |
| Crawler Track Type | Steel, 3 rib grouser plate | |
| Max Driving Speed in (Low High) gear | 2 km/h 4 km/h | 1.25 mph 2.5 mph |
| Maximum Grade (without support winch) | 20° | |

| Truck Mount | | |
|--------------------|-------------------------------|--|
| International | 7600 - 6x4 (with Pusher axle) | |
| Mercedes ACTROS | 4143 AK 8x8 | |
| Mercedes ACTROS | 3343 AK 6x6 (6x4) | |

| Rig Controls | |
|-------------------------------|--|
| Drilling Controls | Pilot Hydraulic |
| Drilling Control Panel | 2 point positioning adjustment / height adjustable |
| Crawler Trimming Controls | Radio Remote Control |
| Digital Drilling Data Display | Weight on Bit / Head-rpm / Mud Flow / Wireline Depth |
| Hose Management | Energy Chain |

| Mud Pump | | |
|--------------------|-------------------------------|------------|
| Pump Type (option) | FMC W1122 Triplex Piston Pump | |
| Valve Type | Ball Valves | |
| Flow | 130 L/min | 35 gal/min |
| Pressure | 70 bar | 1,000 psi |

| Mud Pump - continued | | |
|-----------------------------|-------------------------------|------------|
| Pump Type (option) | FMC L1118 Triplex Piston Pump | |
| Valve Type | Ball Valves | |
| Flow | 112 L/min | 30 gal/min |
| Pressure | 83 bar | 1,200 psi |

| Rod Clamping/Breaking Systems | | |
|--------------------------------------|--|---------------|
| | Metric | U.S. |
| Maximum Clamp Diameter | 178 mm | 7 in |
| Clamping Range | 60 mm - 178 mm | 2.4 in - 7 in |
| Type | Hydraulically Closed / Hydraulically Opened | |
| Power Failure Protection | Valved Accumulators | |
| Maximum Holding Force (adjustable) | 196 kN | 44,000 lbf |
| Maximum Break Out Torque | 20 kNm | 14,750 ft-lbf |
| Centralizer Sizes | BQ™, NQ™, HQ™, PQ™, PW (other size available) | |
| Clamp Jaw Style | Floating 2.5 mm - Coring Jaws | |
| Rod Making Alignment Device | 60 mm - 178 mm | 2.4 in - 7 in |

| Drill Mast and Feed System | | |
|---------------------------------------|------------------------------|-------------|
| | Metric | U.S. |
| Drill Mast Feed Method | Chain and Hydraulic Cylinder | |
| Drill Mast Length | 9 m | 29 ft 6 in |
| Feed Stroke Length | 6.7 m | 22 ft |
| Super Fast Feed Up (up to 80 kN load) | 76 m/min | 249 ft/min |
| Fast Feed Up (over 80 kN load) | 43 m/min | 141 ft/min |
| Fast Feed Down | 80 m/min | 262 ft/min |
| Max Pull Down Force | 90 kN | 20,230 lbf |
| Max Pull Back Force | 170 kN | 38,200 lbf |
| Mast Dump | 1.8 m | 5 ft 11 in |
| Maximum rod pull length | 6 m | 20 ft |
| Drilling Inclination | 45°- 90° (vertical down) | |

| Pressure Washer / Mist Pump | | |
|------------------------------------|----------------|-------------|
| | Metric | U.S. |
| Pump Model | Dynaset HPW200 | |
| Flow | 30 L/min | 8 gpm |
| Pressure | 200 bar | 2,900 psi |

| Wireline | | |
|---|--------------------|------------------------|
| | Metric | U.S. |
| Maximum pull on inner layer | 9.7 kN @ 205 m/min | 2,180 lbf @ 672 ft/min |
| Line Speed | up to 340 m/min | up to 1,115 ft/min |
| Cable Diameter | 6 mm | 0.24 in |
| Cable Capacity (6mm) | 2,200 m | 7,200 ft |
| Spooling device | Standard | |
| Max Lifting Capacity (for auxilliary use) | 550 kg | 1,200 lbs |

| Wireline Cleaner (air knife) | | |
|-------------------------------------|-----------------------------|----------------------|
| | Metric | U.S. |
| Air Compressor Model | Dynaset HK 1000/12-35 | |
| Compressor Type | Hydraulic Piston Compressor | |
| Max Flow | 1,000 l/min @ 6 bar | 264 gal/min @ 87 psi |
| Max Pressure | 12 bar | 174 psi |

| Rod Loader Power Supply | | |
|--------------------------------|--|---|
| | Metric | U.S. |
| Hydraulic PTO2 - Load Sensing | 95 L/min @ 250 bar (200 L/min @ 120bar) | 25 gal/min @ 3625 psi (53 gal/min @ 1740psi) |
| Electrical Supply | 24 V | |

| Dimensions - Crawler Mount | | |
|-----------------------------------|---------------|-------------|
| | Metric | U.S. |
| Weight (dry) | 21,100 kg | 46,520 lb |
| Width | 2,430 mm | 8 ft |
| Length | 10,900 mm | 35 ft 10 in |
| Height - road transport position | 3,100 mm | 10 ft 2 in |
| Width - container transport | 2,250 mm | 7 ft 5 in |
| Height - container transport | 2,590 mm | 8 ft 6 in |

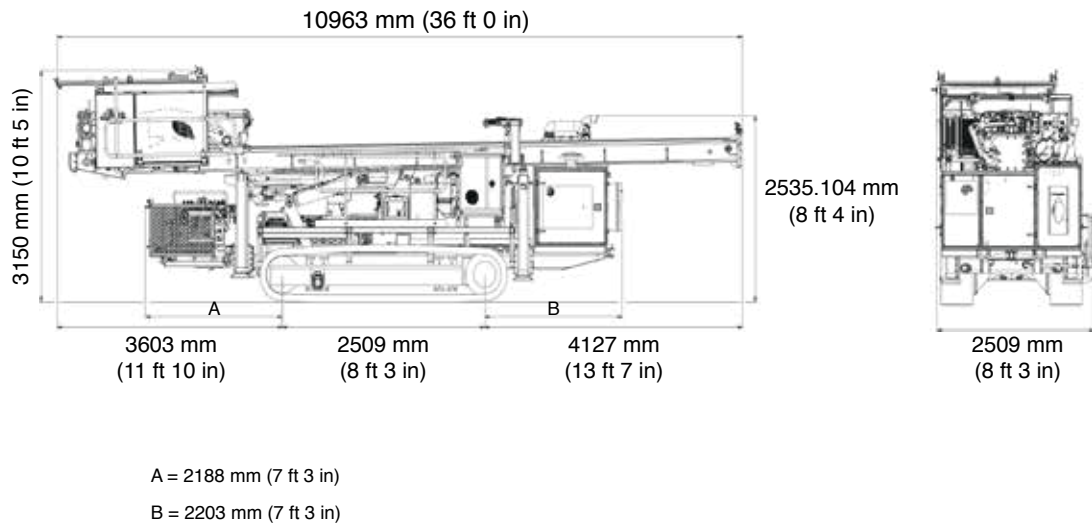
| Dimensions - Truck Mount / Skid | | |
|---|---------------|-------------|
| | Metric | U.S. |
| Weight (dry) | 16,300 kg | 36,000 lb |
| Width - Skid | 2,490 mm | 8 ft 2 in |
| Length - Skid | 10,900 mm | 35 ft 10 in |
| Height - Skid | 3,250 mm | 10 ft 8 in |
| Height - Road Transport (from Truck platform) | 2,700 mm | 8 ft 10 in |
| Length - Base Frame (for Truck Platform connection) | 6,500 mm | 21 ft 4 in |
| Width - Container Transport | 2,250 mm | 7 ft 5 in |
| Height - Container Transport | 2,590 mm | 8 ft 6 in |

| Dimensions - Job Site 90° | | |
|--|---------------|-------------|
| LF™160 Crawler Mount with FREEDOM™ Loader | Metric | U.S. |
| Width | 3,500 mm | 11 ft 6 in |
| Length | 17,000 mm | 55 ft 10 in |

| Dimensions - Job Site 45° | | |
|--|---------------|-------------|
| LF™160 Crawler Mount with FREEDOM™ Loader | Metric | U.S. |
| Width | 3,500 mm | 11 ft 6 in |
| Length | 18,500 mm | 60 ft 9 in |

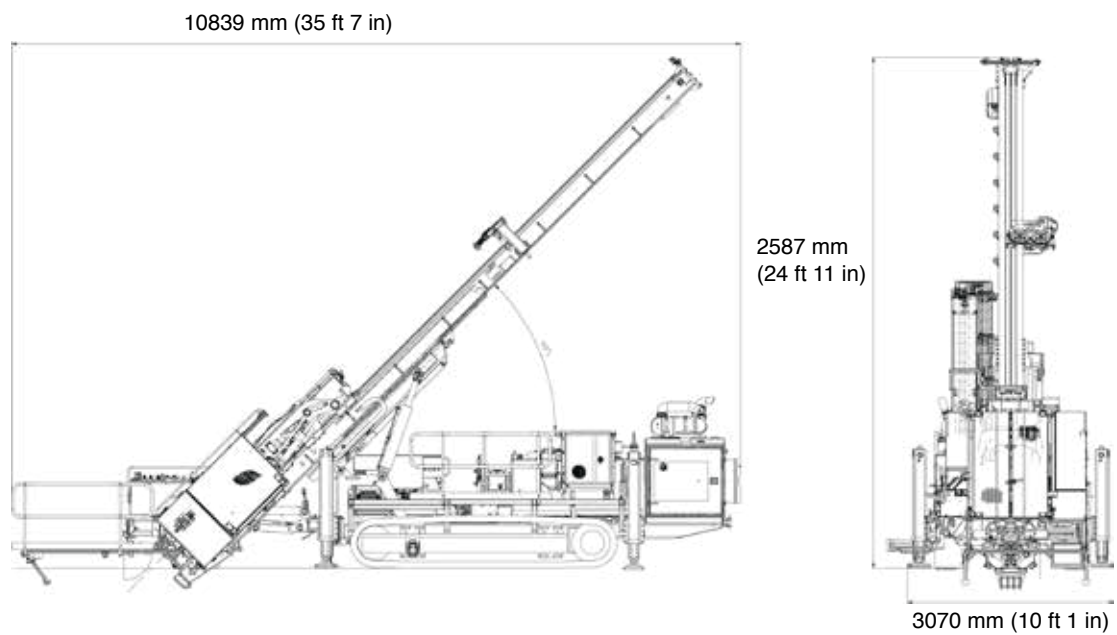
Measurements

Crawler Mount - Street Transportation



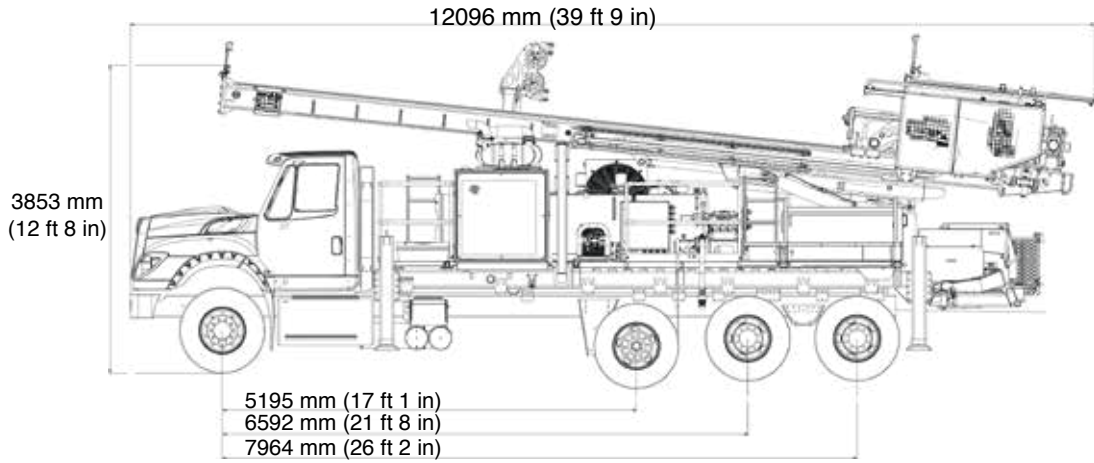
Measurements

Drilling at 45°



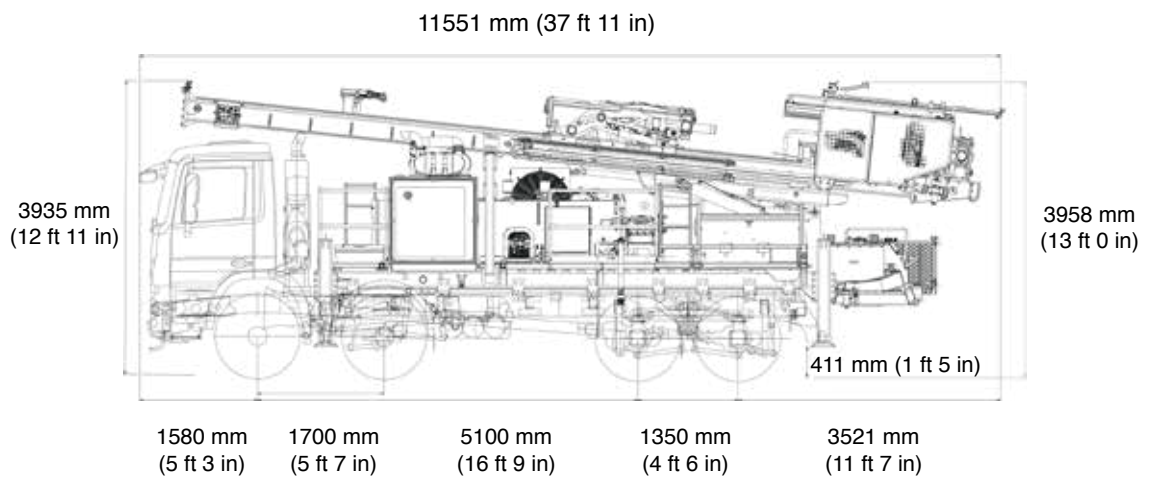
Measurements

Truck Mount - Transport (International)



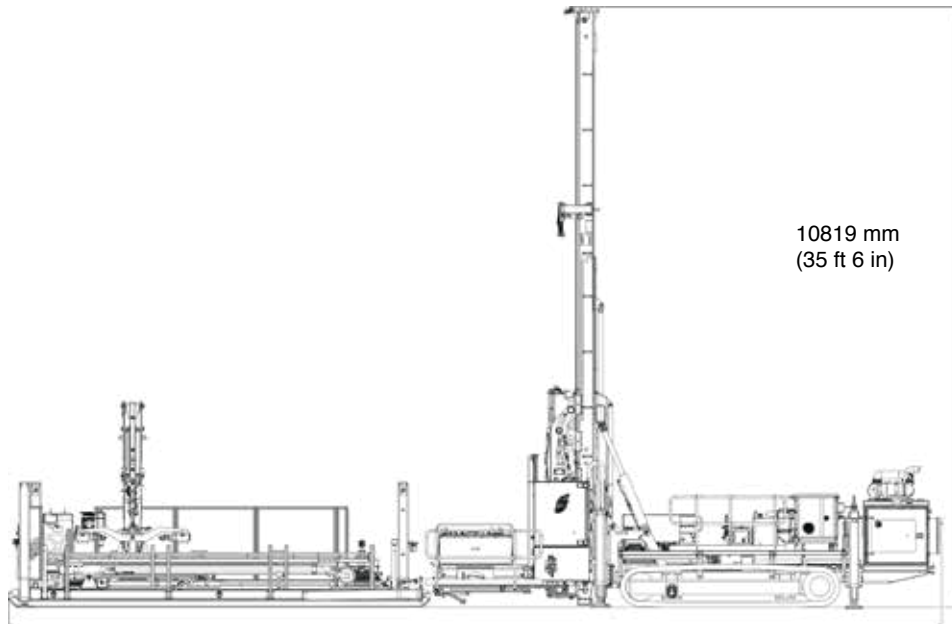
Measurements

Truck Mount - Transport (Mercedes 8X8)



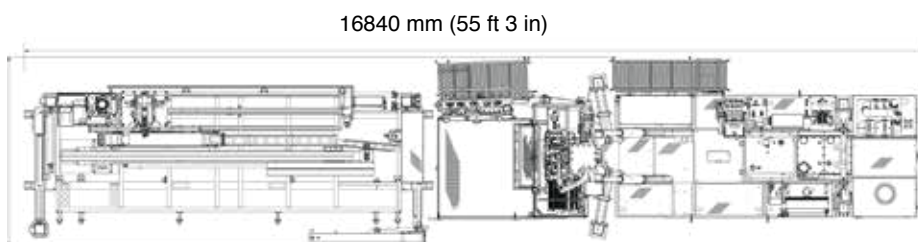
Measurements

Drilling at 90° Mast in on ground with FREEDOM™ Loader



10819 mm
(35 ft 6 in)

16840 mm (55 ft 3 in)



16840 mm (55 ft 3 in)

3512 mm
(11 ft 7 in)

BOART LONGYEAR™ PERFORMANCE TOOLING



DIAMOND PRODUCTS



GENUINE Q™ WIRELINE TOOLING



RODS AND CASINGS



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