

# SH650 VFD

Roof Support Carrier



**Engine**

Power		
AC	184 kW	247 hp

**Carrying Capacity**

Capacity	45 tonnes	50 tons
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**Dimensions**

Length (with lifting fork)	11.76 m	38 ft 7 in
Width	3.03 m	9 ft 11 in



SH650 VFD Features

Customers’ No. 1 Shield Mover Choice

*Supported by the world-class Cat® dealer network.*

Increase Productivity

*The perfect balance of power, speed, control and maneuverability.*

Flexibility

*Powerful machine with a small roadway presence and the capability to be used for multiple tasks.*

Efficiency

*AC battery power option delivers optimum power to ground at low speed.*

Safety

*Very low noise emissions which allow miners to communicate in confined spaces as they move and place longwall components.*

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# Smooth Mover



Longwall moves represent an enormous challenge to underground transportation logistics. Caterpillar offers a full range of roof support carriers to meet the needs of efficient longwall moves. With an increased lift capacity of 45 tonnes (50 ton), the SH650 can handle almost any piece of longwall equipment in a move. In addition to enhanced traction and maneuverability, the SH650 offers improved range of motion of the lift, allowing easier load engagement.





# Development and Design

## Designed to Excel

## Lift and Carry Capacity Heavy Lifting

### Industry's Highest Rated Lift Capacity

The SH650's 45-tonne (50-ton) lift and carry capacity meets all your longwall handling needs now and for the foreseeable future. The massive 1829 mm × 356 mm (6 ft × 14 in) forks are retained to the lift frame structure by 102 mm (4 in) diameter steel pins. The forks are heat-treated forged steel. The lifting frame is high-strength alloy steel with bushed pivot points.

### Perfect Positioning

The unique lift and tilt mechanism allows the operator to manipulate the lift frame into an infinite number of positions to facilitate placement and handling of the load. The range of motion of the lift has increased by 133% allowing the load to be engaged more easily by reducing the angle between the lift frame and the grade. This reduces the stress on the winch and the drive train.

### Built by the World Leader

As the world's leading supplier of longwall technology, Caterpillar has always striven to design and manufacture the best longwall movers possible. Our outstanding experience in the development and design of rubber-tired vehicles has contributed to the success of our four-wheel roof support carriers.

### Built for the Future

All Cat roof support movers are built to meet both current and future requirements in longwall moving by providing a combination of compact power, capacity, maneuverability, long-term availability, and efficiency.

### Built to Be Best

After studying operations all over the world, we selected the best concepts and designs for the varying conditions and regulations encountered in underground coal mines.

Caterpillar offers a range of roof support carriers designed to provide maximum lift and carrying capacity at dimensions adequate for our customers' different mine layouts and for various transportation tasks.





# Battery

## Packed with Power

### **Clean Air Act**

Cat battery-powered roof support carriers do not burden your mine's ventilation system with emissions or heat. Due to infinitely variable power control, they are the ideal vehicle for the installation or removal of longwall roof supports where heat, emissions and noise would impact work and where a flexible vehicle is needed.

### **Power to the Max**

As the world leader in longwall systems and battery-powered vehicles for underground mining, we take pride in providing the world's most advanced battery-powered roof support carriers. Innovative solutions in power control and transmission contribute to utilizing battery power to the max.

### **Battery Competence**

Caterpillar has developed unparalleled experience and expertise in the design of batteries and battery changing systems. Current 2000 Ah batteries enable maximum performance at peak loads as well as lasting performance throughout the shift. Battery capacities and vehicle designs are field-proven and are adapted to actual work schedules and longwall move experience.

### **High Performance, Low Cost of Ownership**

The Cat East Penn battery is built for the long run, providing the lowest cost of ownership in the industry. Specially formulated premium-grade lead oxide is used in the flat-plate design and each plate is individually formed prior to cell assembly. This ensures uniform performance and maximum capacity. State-of-the-art computerized equipment is utilized in every phase of the production process and stringent quality checks are made on each battery to ensure the highest level of performance.



## Control System

### Superior Control

#### Maximum Battery Efficiency

The Cat IGBT control makes the most of battery power. It translates to variable speed and tractive effort at the varying intervals. This allows battery power to be controlled with maximum precision and efficiency.

#### Optional VFD

The HiPAC 10 VFD control system is a Caterpillar innovation that drives the traction and hydraulic systems and provides the operator with machine management information.

#### High Efficiency

The HiPAC 10 is a DC-to-AC variable frequency inverter control that drives high-performance AC electric motors, which have superior speed-torque characteristics. It is up to 14% more efficient than traditional DC motors. This means higher loaded tram speeds, more responsive hydraulic functions and more material hauled per battery charge. The HiPAC 10 machine management system speeds fault diagnosis, allowing rapid repairs and maximizing uptime. The new user interface can display information such as drive unit temperatures and distance traveled per battery charge.

#### Intuitive Control

The optional Cat control stick gives the operator intuitive control over steering and other functions. It also gives quick access to monitoring and self-diagnosis of the vehicle's functions.

## Tri-Sectional Chassis

### A Solid Performer

#### Stability, Traction...

One of the key features of the SH650 VFD design is the tri-sectional chassis incorporating the rear drive axle and battery lift into a single oscillating entity. As load motion is independent of the rear frame, this design provides extra load handling stability, especially on uneven ground or when maneuvering and positioning roof supports – even when handling loads equal to the empty vehicle weight. It also improves traction, as wheels remain in contact with the ground with the weight of the battery over them.

#### ...and Maneuverability

The SH650 VFD offers the unique feature of 100 degrees of articulation for maneuvering heavy loads in the confined spaces encountered during longwall moves. The use of through-hardened precision-ground spherical plain steel bearings ensures the smooth transfer of energy through the bearing to the articulation pin and load distribution throughout the contact length.





# Operator Comfort

## Operator-Friendly Control Compartments



### Safe Working Environment

The operator's comfort is paramount for maintaining a safe working environment. Controls are logically placed, and easy to reach from the padded, adjustable seat. Directional control inputs are applied with the left hand which (depending on options chosen) also incorporates a user interface allowing control of many functions.

### Maximum Visibility and Clearance

The frame is contoured with the top sloping from the center to the outside to promote visibility around the vehicle's perimeter. The decks taper from the center upwards to the outside to ensure maximum ground clearance. This combination provides for a machine that has surpassed its predecessor in every way except in growing in sheer size and complexity.

# Sustainability

## Clean Machine



### Ideal for Longwall Moves

Zero emission of noxious gases and low emissions of heat and noise make the carrier range operator-friendly and easy to work with – in short, the ideal utility vehicle for longwall moves.

Heavy lifting and perfect positioning, versatility and maneuverability all combine to make this the world's most advanced battery-powered roof support carrier.

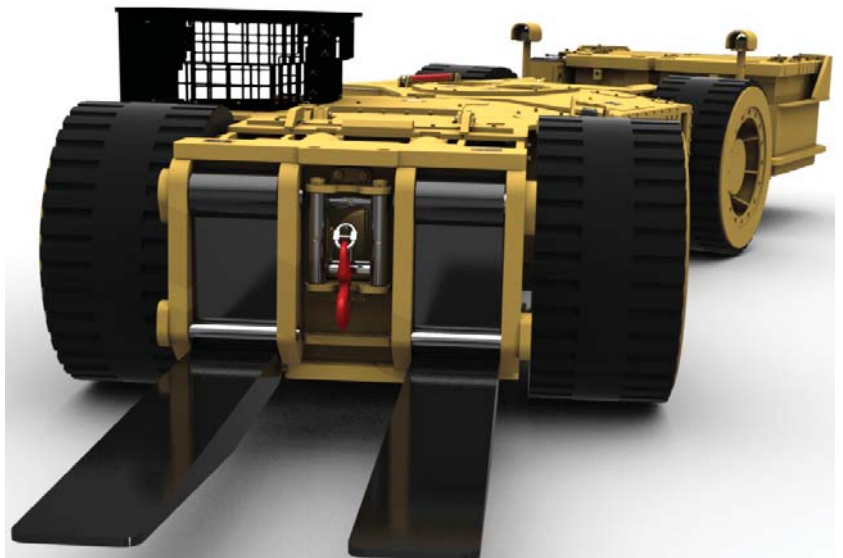
# Safety

## Keep the operators safe while moving longwalls

### Safety Counts

The SH650 VFD offers the following safety features:

- Panic strips in the operator's compartment
- Emergency stop buttons
- Fire suppression (automatic or manual activation) on both sides of the machine
- Steering lockout
- Proximity detection (if requested)
- Spring applied, hydraulic release brakes
- Two key start functions
- Warning gongs
- Start up audible alarms (optional)
- Canopy over operator's compartment





# SH650 VFD Roof Support Carrier Specifications

## Empty Weights

Less Battery	31 751 kg	70,000 lb
240 kW Hour Battery Pack	46 040 kg	101,500 lb

## Tram Speed

Level and Empty on 0% Grade	6.6 km/h	4.1 mph
Level and Loaded on 0% Grade	5.8 km/h	3.6 mph

- Tram Speed (calculated based on 4% rolling resistance)

## Lift and Carry Capacity

Without Ballast	45 tonnes at 1575 mm	50 tons at 62 in
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- Capacities based on 54×26 solid tire (from front of lift plate)

## Drive Train

### Tram Motor

Two proprietary design

Mine traction

Gear motors rated at 74 kW (100 hp)

One-hour rating (111 kW/150 hp total)

VFD driven

140V AC; MSHA totally enclosed, explosion-proof; non-ventilated cooling; foot-mounted. (Motor hp may increase as required for application.)

One motor is front-frame-mounted and drives the front axle and the rear-axle tram motor is middle-frame-mounted.

### Drive Lines

8.5 C Series Shafts with 76 mm (3 in) Slip Joints

### Axles

Front and rear rigid-mounted outboard planetary axles with wet disc, spring applied, hydraulically released brakes and hydraulically actuated Diff-Lock

### Motor Overspeed Protection

Motor overspeed protections are inherent to the AC drive package.

## Brakes

### Service and Emergency/Park

Spring-applied hydraulic release SAHR

4-wheel wet disc

Left-pedal activated

Controlled by reverse modulating valve

## Hydraulics

### Pump Motor

Mine duty

Laminated frame

VFD driven motor rated at 35 kW (47 hp) for one hour

140V AC

MSHA totally enclosed, explosion-proof

Non-ventilated cooling

### Pump

The pump is a splined shaft fit to the pump motor

### Filtration (Standard)

Three pressure filters

One 25-micron filter on the main hydraulic circuit

One 10-micron filter on the accumulator circuit

One 10-micron filter on the pilot valve circuit

One tank-mounted 25-micron return filter

Ten micron fluid port filters on key control circuits

### Reservoir

A 220 L (50 gal) capacity, bolt in reservoir equipped with a spin-on filter/breather

### Reservoir Fill System

Venturi Jet refill system located on opposite side from operator on the middle frame that allows refilling of reservoir through the return-line oil filter.

### Valve Bank

Seven-section, pilot-operated, parallel type with internal relief and a dash-mounted, glycerin-filled pressure gauge

### Hydraulic PTO

Two (2) quick coupler connections, 17.58 MPa (2,550 psi) maximum recommended operating pressure

### Tilt Lift Cylinder

Two (2) 241 mm (9.5 in) bore, double-acting cylinders with load-locking valves

### Bell-Crank Lift Cylinder

Two (2) 203 mm (8 in) bore, double-acting cylinders with load-locking valves

### Steering Cylinder

Two (2) 152 mm (6 in) bore, double-acting cylinders with dual-relief setting at 15.9 MPa (2,300 psi)

### Battery Changer Cylinder

Two (2) 152 mm (6 in) bore, double-acting cylinders with load-locking valves

# SH650 VFD Roof Support Carrier Specifications

## Dual Lift System

### Standard Load Lift

A combination bell crank arm and bell crank lifting cylinder for vertical lifting and tilting cylinders for tilt lifting of a universal load lift frame that is provided as standard equipment. Heavy-duty forged alloy steel forks, 152 × 256 × 2134 mm (6 × 14 × 84 in), are standard for 45 tonne (50 ton) lift capability.

### Winch

A fully hydraulic-operated, 31 751 kg (70,000 lb) winch with two-speed pay in/out. Heavy-duty fabricated steel drum.

### Winch Cable Assembly (Options)

The standard winch cable is 7/8-in diameter, 6×36, IWRC, EIPS, class bright cable equipped with a swaged-on thimble, connecting link and swivel hook.

Coated 7/8-in diameter, Samson, Dynema, Samthane rope, connecting link and swivel hook. Attached to drum via U-bolt.

### Tri-Section Frame

The tri-section frame design features multiple-plate, modular construction for maximum strength and structural integrity, and the design produces a maximum of stability while maneuvering with a heavy load. All high-stressed areas are manufactured with T-1 steel.

### Center Section

Center section is designed with hardened 114 mm (4.5 in) diameter pivot pins and spherical bearings to provide maximum load transfer and long component life. Entire center section area manufactured with T-1 steel.

### Oscillation Section

An 813 mm (32 in) diameter bearing with 1 3/4-in diameter rolling elements provides 20 degrees of oscillation.

### Battery Change System

Hydraulically operated, bell-crank, forklift battery charger to pick up battery from grade. The battery/battery tray assembly can be further raised to increase the rear approach clearance up to 508 mm (20 in).

## Operator's Compartment

### Side egress access

Left-hand steering with control stick with the following functions:

Pump motor start/stop

Park brake release/set

Directional headlights

Tram direction

Stop

Panic strip switch that de-energizes the electrical system and applies the automatic park brake.

Dash-mounted, glycerin-filled hydraulic gauges for accumulator, system pressure and emergency brake.

Warning gong

Right hand tilt-lift control lever

Hydraulic PTO control lever

Battery charger control lever

Hydraulic circuit breaker reset control

Emergency/park brake release hand pump

Right-foot accelerator pedal

Left-foot brake pedal

## Manuals

Two Parts Manuals

Two Operation and Preventive Maintenance Manuals

Two Electrical Troubleshooting Guides

Two Battery Maintenance Manuals

Two Battery Maintenance Charts

One CD, which includes all above manuals in electronic format

## Hydraulic Installation (Standard)

JIC fittings with 34.47 MPa (5,000 psi) hosing; MSHA 2G flame-resistant approved

## Electrical Controller

Modular design

Microprocessor-controlled IGBT

Contactless

Variable Frequency Drive (VFD)

140V AC

1,600 amp total

Traction motor controllers with infinitely variable, stepless machine speed control.

Equipped with advanced onboard dashboard display for machine information of battery capacity, battery voltage, motor currents, elapsed time hour meter, distance traveled per battery charge cycle and troubleshooting diagnostics information.



## Circuit Breaker Options

Magnetic, UVR Trip – controller enclosure equipped with UVR trip circuit breaker rated mine duty 800 amp frame, 600 volt.

Standard cab mounted breaker reset using a single, high-capacity, swivel-end style push/pull cable. A manual control handle is mounted within the confines of the operator's compartment.

## Cab Options

Manual Adjustable Cab Assembly – MSHA-certified cab, formed support plate, access handles, completely enclosed grid and dual corner-opening doors.

Hydraulically Adjustable Cab Assembly – MSHA-certified cab, formed support plate, access handles, completely enclosed grid and dual corner-opening doors.

## Tire/Wheels Options

54×26 SETCO solid tires with heavy side wall plate protection

48×25 SETCO solid tires

## Fire Suppression

ANSUL, 8-point fire suppression system with (2) 20# suppressant canisters. NPT (2) wire braid, MSHA 2G hose with NPT fittings. The system is designed within the guidelines published by the manufacturer.

## Lift Attachments

Fork Assembly, 25 603 mm (84 ft) overall length – set of 25 603 mm (84 ft) overall length must be forged forks designed to lift and carry 45 tonnes (50 tons) at 1575 mm (62 in) from the load lift plate mounted to the machine.

Quick-Attach Lift Plate, 25 603 mm (84 in) (fork assembly required) – designed to lift and carry 45 tonnes (50 tons) at 1575 mm (62 in) from the face of the load lift frame. The plate mounts directly to the 25 603 mm (84 in) forks through two parallel pockets and is held in place with two drop pins chained to the lift plate.

## Lighting System

Halogen, 12V DC, 50 watt – two 12-volt quartz halogen front headlights with protective guard, and two rear headlights with protective guard that moves up and down with the battery lift system.

## Battery Plug

Machine is equipped with two J&R 2000, 5-pole brass plugs wired in parallel, each with a captive wrench to install or remove the battery plugs. Each battery plug is rated at 600 amps.

## Machine Accessories (Optional)

Cable guide assembly

Reflector installation – additional reflectors mounted in strategic locations on the machine

Pressure switch kit, intrinsically safe – electric/hydraulic system to shut down the tram motors in the event of low hydraulic system pressure.

Shroeder TestMate with JIC fittings

Power disconnect switch (required in PA)

Tow hook installation – two tow hooks mounted on the front of machine rated at 10.89 tonne (12 tons) each.

Tram and pump motors with RTD monitoring. Temperature data recording provided to aid in motor protections and preventative maintenance. Available with 16-hp pump option.

Automatic fire suppression system.

Battery tray – one required for each battery assembly – heavy-duty welded steel battery trays for use with 2,000 amp-hour battery assemblies.

Park brake/tram inhibit installation kit providing brake system pressure monitoring to limit the potential to tram through parking brakes.

Hydraulic easy-test kit providing for the ability to monitor the hydraulic system.

In-line flow meter monitoring of the tandem hydraulic pump outputs. Provides the addition of two analogue gauges in the hydraulic bay.

Tilt cylinder protection kit consisting of two hinged, heavy-duty steel plates protecting the tilt cylinder rods.

Shield deflector/cage protector consisting of a frame-mounted supported structure, 25.4 mm (1 in) higher than the canopy at maximum height. Allowing protection for the canopy and cage assembly forming the operator's cab.

Ultra heavy-duty fork-mounted ejector bucket with quick-attach pins.

PIT disconnect kit required for PA approval.

## Water Delivery Kits (Optional)

Triple 22 L (5 gal) tanks on the delivery kit store distilled water. The delivery kit is to be used in conjunction with the setup kit to maintain a supply of distilled water to be used in the filling of the battery cells.

## Machine Battery (Dual Tray)

Battery, 120ss-125-17, 1,000 amp/hour with slide latch and clip shrouds – dual-tray battery assembly with slide latch locking devices on the battery lids and clip-on insulating shrouds on the internal cell connections.

## Battery Charger (Dual Connector)

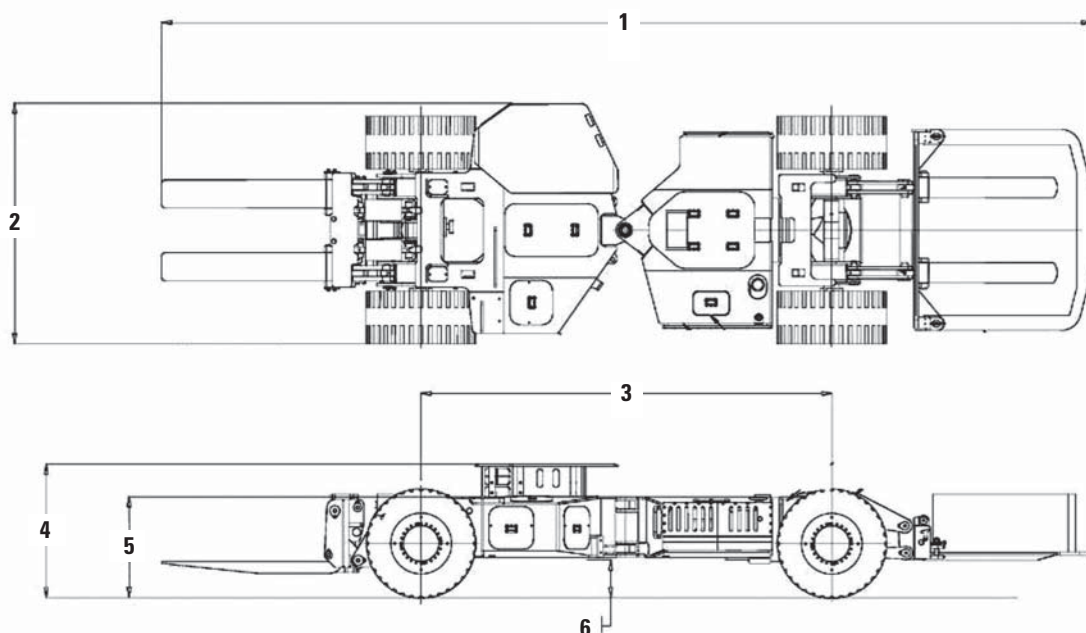
Single-output for one battery

Dual-output for two batteries

# SH650 VFD Roof Support Carrier Specifications

## Dimensions

All dimensions are approximate.



### SH650 VFD

<b>1 Overall Length</b>			
Length Less Load Lifting and Battery Lift Forks	7467 mm	24 ft 6 in	
Length with 2134 mm (84 in) Lifting Fork	11 760 mm	38 ft 7 in	
Length with Lift Plate Attachment	12 039 mm	39 ft 6 in	
<b>2 Overall Width</b>			
With Attachments and 1219 mm (48 in) Tires	2819 mm	9 ft 3 in	
With Attachments and 1372 mm (54 in) Tires	3022 mm	9 ft 11 in	
<b>3 Wheelbase</b>	5232 mm	17 ft 2 in	
<b>4 Cab Height (With 508 mm [20 in] Cab) (Lower cab heights available on request)</b>			
With 1219 mm (48 in) Tires	Std. Cabs adjust from 1448-1702 mm	Std. Cabs adjust from 57-67 in	
With 1372 mm (54 in) Tires	Std. Cabs adjust from 1524-1778 mm	Std. Cabs adjust from 60-70 in	
<b>5 Chassis Height (nominal)</b>			
With 1219 mm (48 in) Tires	1168 mm	46 in	
With 1372 mm (54 in) Tires	1244 mm	49 in	
<b>6 Ground Clearance (Nominal) (Please reference sales drawing for ground clearance profile)</b>			
With 1219 mm (48 in) Tires	406 mm	16 in	
With 1372 mm (54 in) Tires	4883 mm	19 in	
Inside Turn Radius	4140 mm	13 ft 7 in	
Outside Turn Radius	7213 mm	23 ft 8 in	
Steering Articulation – Total	100°	100°	
Frame Oscillation – Total	40°	40°	

Shown with 1372 mm (54 in) tires.

Detailed GA drawings available for specific dimensions and component locations











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