Since their introduction in 1989 the current H165-360XL2 & H330-360XL2-EC products have been well accepted in the market place. Our customers have appreciated the Hyster product because of it's minimal service needs, however we have seen the global competitiveness of this product begin to deteriorate due to the relatively unchanged platform since the 1989 introduction. Realizing the needs of industry through customer surveys and research our objective was to design and introduce a customer focused upgrade to replace the current model offerings.

When the project was started Hyster Company wanted to ensure that we sustained global competitiveness of this product family and quickly realized that the industries where these machines operate require a truck that complies with the expectations of a customer in relation to:

Comfort = Ergonomics

Durability= Reliability

Performance=Productivity

Maintenance = Serviceability

The new Hyster H170-360HD easily meet these customer needs in all aspects. With this series we not only have a competitive edge, but we also provide our dealer organization with the products to keep Hyster one large step ahead of the competition.

Central to the upgrade in design is a new operator compartment as well as updates to the styling, hydraulics and electrical systems will make the product offering competitive and " BEST IN CLASS" in the areas of operator ergonomics and comfort.

Improved serviceability has been achieved within the upgrade, with gull wing hoods facilitating easy daily checks and the introduction of a hydraulic powered tilting cab, giving unrivalled access to major components.

Product Line

Model	Capacity – lb Std Crg – 24 in W/ integral sideshift	Wheelbase
H170HD	17,000	106.3 in.
H190HD	19,000	106.3 in.
H210HD	21,000	106.3 in.
H230HD	23,000	114.2 in.
H250HD	25,000	114.2 in.
H280HD	28,000	114.2 in.
H300HD	30,000	129.9 in.
H330HD	33,000	129.9 in.
H360HD	36,000	129.9 in.
H360HD- EC	15,500 @ 48 in	129.9 in.

•The wheelbase for the H170-210HD has been increased by 6”. This is a result of the new larger cab. The new design maintains the hood arrangement and provides superior service access.

Product Line

Top SIC's

- Truck Rental / Dealers
- Saw / Paper / Planing Mills
- Steel Works
- Lumber Building Material Dealers
- Wood Preserving
- Transported Freight
- Lumber / Plywood / Mill Work

Features To Be Covered

- NEW! Body Styling
- NEW! Operator Compartment
- Improved Service Access
- Improved Hydraulic Systems
- Engines
- Masts & Carriages
- Transmission
- Electrical Systems

New Body Styling

- **New Rounded Form**
  - **Operator Compartment**
  - **Hood**
  - **Fenders**
  - **Counterweight**

Completely new styling incorporating rounded form on the operator compartment, hood, fenders and counterweight. This improves rearward visibility.

New rear fenders include the rear light clusters that enhance styling and improve component durability.

New rear counterweight has dual air intakes and wide central rib to merge smoothly into the fender styling.

New graphics style placed on the mast, hood and counterweight.

Counterweights are new and unique to this model series. Each model in the series is fitted with a specific combination of fender / center section to achieve the required truck rating.

A single center section counterweight is secured to the truck frame via ‘hang-on mounting’ with a single lower cap screw. This method provides for easy installation. A wide horizontal center rib provides excellent protection for the radiator.

Fender counterweights are secured to the truck frame with two cap screws and incorporate provision for taillights, which are deeply recessed to protect them from accidental damage. Shims are used to achieve alignment with the center section counterweight.

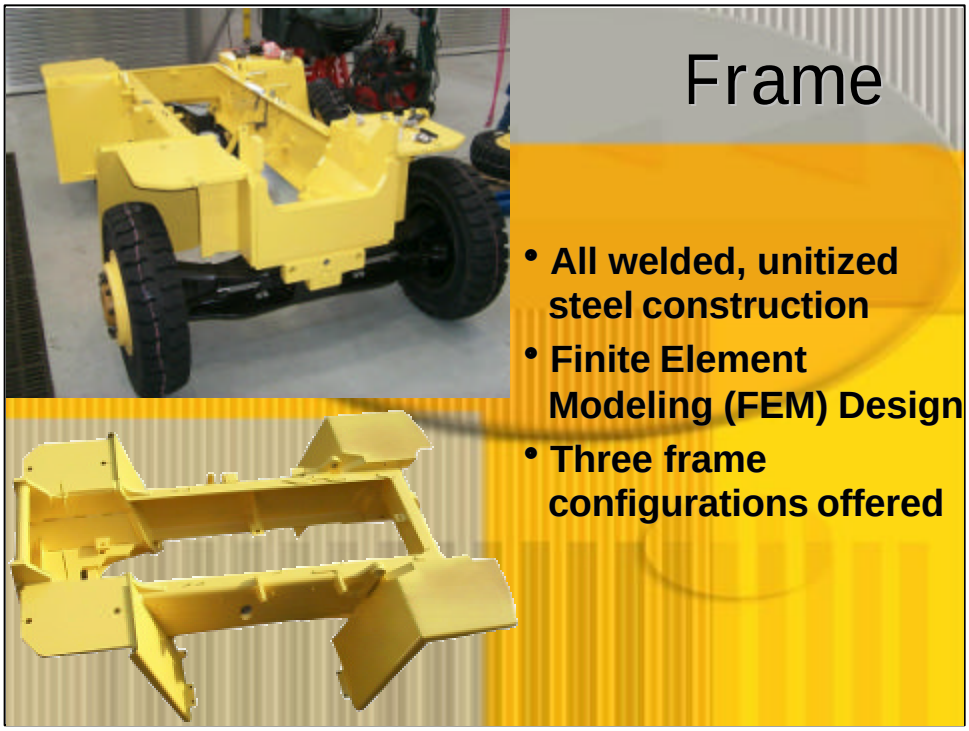
The counterweights have been contoured to give best visibility and modern styling.

Additional counterweight slabs are fitted on some models. These are bolted in place.

Large area ducts spaced to provide a clear flow path for cooling air to the radiator.

Lifting provisions are incorporated to make the counterweight easily removable.

A 40 mm diameter tow pin is provided for towing functions and is held captive by the counterweight center rib. It lifts up but does not come completely out.



The frame is a one piece welded steel fabrication, developed for long term durability. In addition to mounting the major components such as axles, power train, counterweights, fuel/hydraulic tanks, the frame incorporates the brackets and hydraulic cylinder mounting components required for the operator cab tilt mechanism.

The frame is designed in FEM and pro "E": two computer programs that simulate stresses and pressures applied to major components of the truck.

Side members are manufactured from 10mm high strength steel for long-term durability.

Non-integral fuel and hydraulic tanks cleaned to ISO 19-17-14 to reduce risk of contamination on initial machine start up.

Bolt-on longitudinal slabs for additional stability are fitted to certain models.

Three frame configurations are offered to meet the various capacities.

H170-H210	Wheelbase 106.3"
H230-H280	Wheelbase 114.17"
H300-H360	Wheelbase 129.9"

Frame

- **Full-length running boards**
- **Low profile frame**

The frame is designed with serviceability in mind. Long running boards give service technicians ample area to stand while accessing the service compartments. The low-profile frame gives technicians free and easy access to major components.

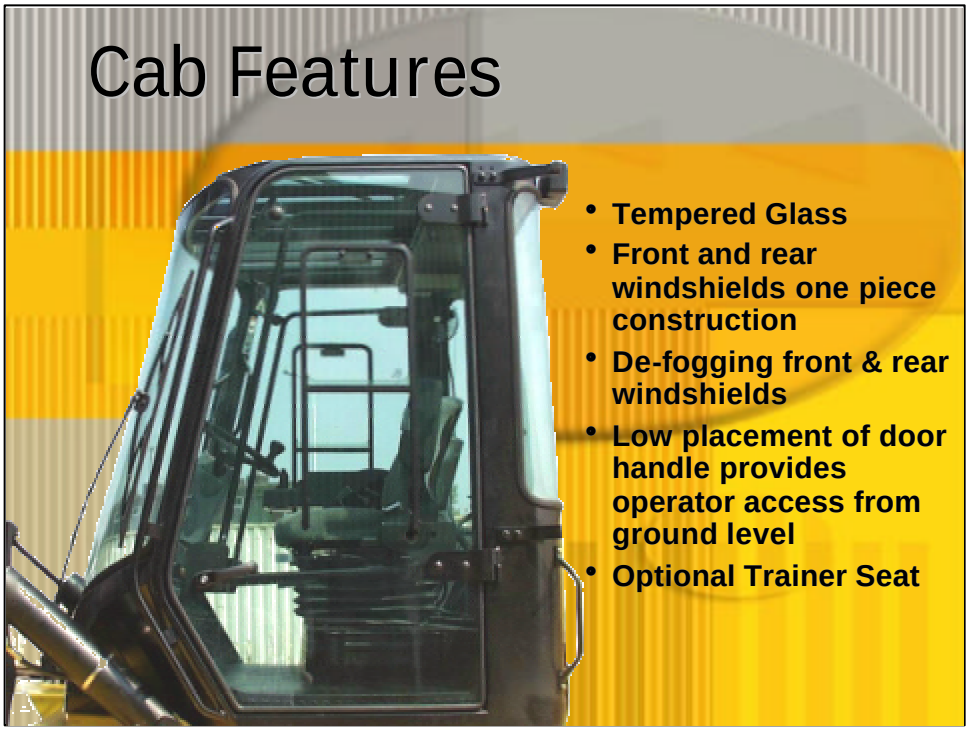
The operator compartment is mounted on four rubber isolators to minimize noise and vibration. The floor plate is an integral part of the cab, which also reduces noise. Noise reduction measures have been applied throughout the design process. By careful attention to basic principles and the selection of components it has been possible to achieve 77 and 78 dBa with minimum acoustic treatment for both the Perkins and Cummins engines This represents approx. 3-6dBa less than the current XL, depending on truck configuration. *A low noise option will be developed at 72dBa for those applications that will require this level. This will be accomplished with additional sound barrier materials.*

To permit the operator compartment to tilt, the cab is mounted to a sub-frame that is mechanically locked to the frame. The fully side tilting cabin improves serviceability of components below the cab. *An optional electric powered tilt system is also available.*

Lights are available for both cab and non-cab units.

Visibility

- **Video illustrating visibility**



Doors are tempered glass. The door handle is mounted low to allow the operator to open the door from ground level.

Handrails are provided to assist the operator in mounting and dismounting the truck.

A steel framed door is available as an aftermarket option.

A door catch mechanism is fitted to permit the operator to work with the doors open.

A trainer seat is available as an option.

Curved glass panels provide excellent visibility. The front windshield is tempered glass and is one-piece construction mounted on a molded rubber seal. Laminated glass is available as an aftermarket option.

The rear windshield is also a one piece construction of molded tempered glass. Both windshields are equipped with wiper/ washers. The rear windshield wraps around the corners to give good visibility.

Defogging for both windshields is through ducting that is integral with the cab structure, which connect to the front and rear plastic molding.

Wide angle rear view mirrors are provided in the top left and right front corners of the cab.

Windshield testing

- **A 16.5 lb. weight was dropped from a height of thirty-six feet on both laminated glass (left) and tempered glass (right) to simulate a live application scenario.**

Drop test on laminated glass. August 2nd 2001
Weight 16.5 lbs.
Height 36 feet

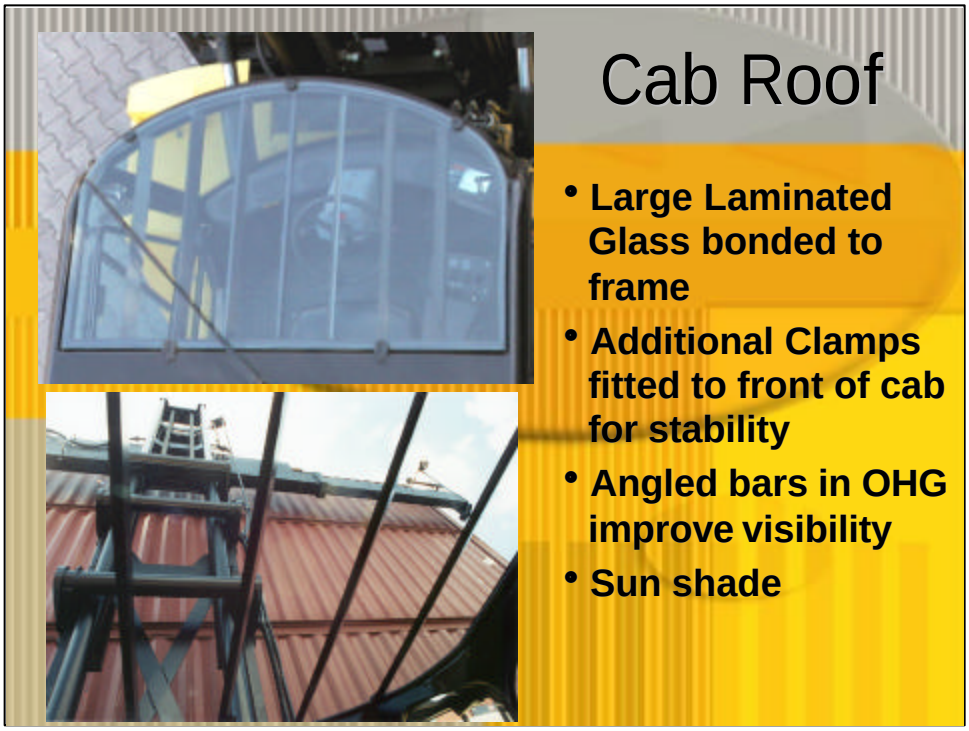
Droptest on tempered glass.
Date :
August 2nd 2001
Length rope 11meter
Weight cornerpocket:
7.5 Kg

Windshield testing

- **A 110 lb. cube was swung into the glass on a ten foot arc on both laminated glass (left) and tempered glass (right) to simulate a live application scenario.**

Laminated Glass

Tempered Glass



The top (roof) screen utilizes a large laminated glass panel bonded to the frame. Additional clamps are fitted at the front of the cab to ensure a positive seal when the truck is being transported at high speed.

Top bars in the overhead guard are set at angles to provide excellent visibility.

An internally mounted roller type sun shade mounted in the roof is standard with air–conditioning but is also available as an option.

Roll-out Sun shade

Wide Angle Rear-view Mirrors

How do you spell productivity? O-p-e-r-a-t-o-r C-o-m-f-o-r-t! The operator compartment is designed with comfort in mind.

A full suspension seat is standard. It features a durable vinyl covered cushion that is contoured for operator comfort. The angle of the backrest is adjustable, as are the armrests. The seat spring rate is adjustable to accommodate most operators regardless of weight. The seat has a front/rear adjustment range of almost eight inches.

A cloth –covered version is available for enclosed cab models and is picture above.

An air suspension seat is available as an option(cloth or vinyl covered).

All seat options are equipped with retractable seat belts.

All seats are equipped with an electrical switch that is wired to the warning buzzer system. If the operator leaves the seat without applying the parking brake, an alarm will sound.

The floorboard is flat, open and unobstructed allowing plenty of room for the operator's feet. The floor plate is an integral part of the compartment and is equipped with easy-to-clean molded rubber , easy-to-clean floormats. Both these features help to reduce noise in the operator compartment.

The steering column has a wide range of adjustment as we will see in the next slide.

Steering Column Adjustment

Video

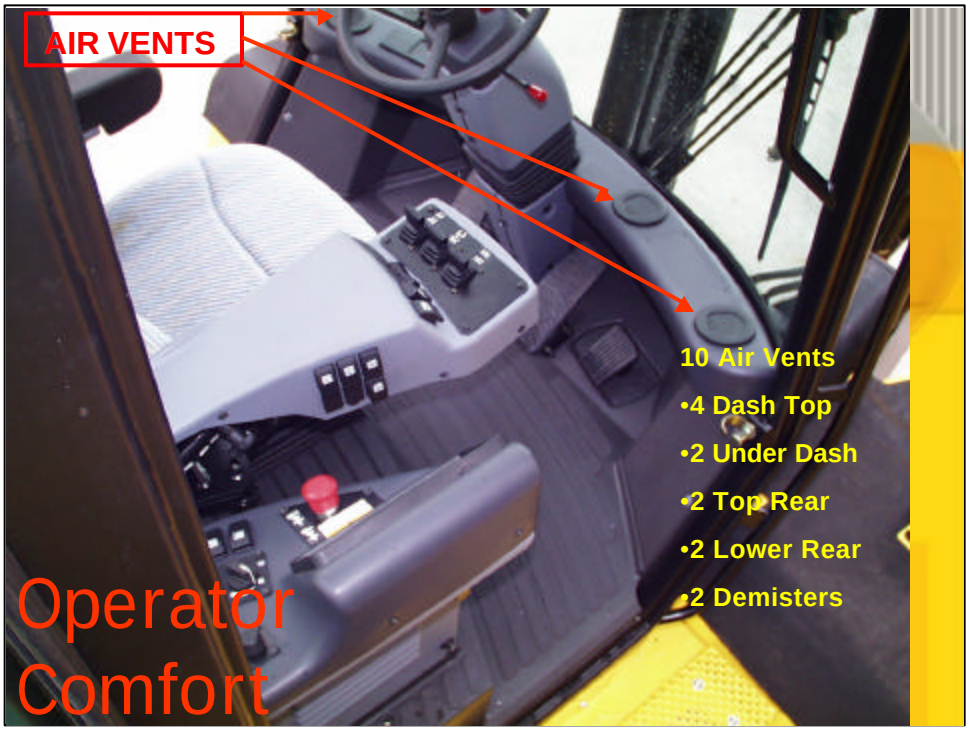
- **Steering column offers wide range of inclination and height adjustments to accommodate most operators.**

The steer column has a stepless wide adjustment range for both rake angle and height, and includes lever controls as appropriate i.e. transmission shift, turn signal lever and central warning light.

Seat Adjustments

Video

- **Seat adjustments accommodate most operators**

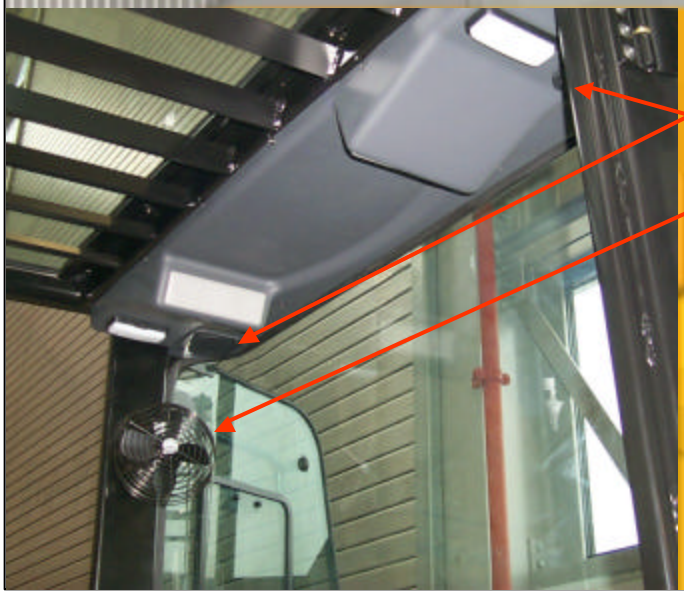


While only three are visible in the image above, the operator cab has ten air vents to provide outstanding heating and cooling from all sides. A replaceable paper element filters air from outside. Re-circulation and fresh air positions can be manually selected. The three-speed fan and variable heat output controls are located on the right side operator console.

Air conditioning is optionally available. The system has a 6 kW cooling capacity. Two-speed electric condenser fans insure constant performance at low engine speed. The condenser is mounted to the hood spine.

A circulation fan is also available as an option to provide additional air circulation.

Operator Comfort



- Additional air vents
- Optional Circulation Fan

Operator Controls

- **Standard Levers or Optional Joystick Controls Available on New Right-Side Armrest**
- **Brake Pedal, Inch-Brake Pedal, Monotrol or Accelerator**
- **All operator controls located within easy reach**

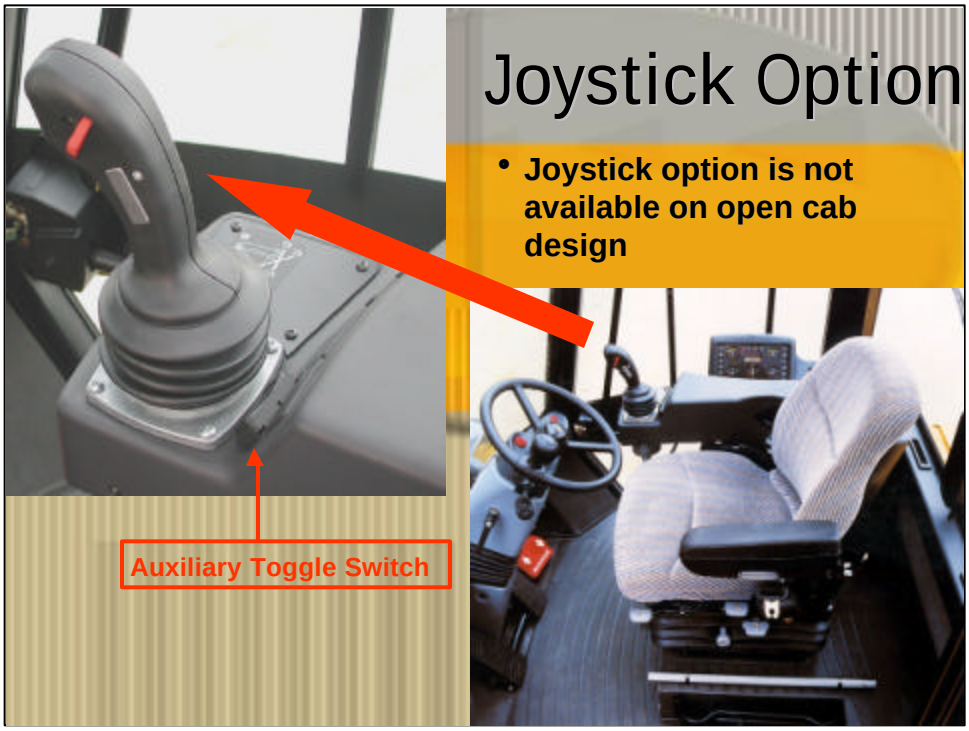
Operation of the hydraulic control valve is provided by standard levers or optional joystick, which are mounted on the right hand armrest.

Electro-proportional hydraulic control valve sections provide operator control of hydraulic functions and fine-tuned metering of hydraulic functions.

Control levers provide easy fingertip control of raise/lower, sideshift and tilt. Individual toggle switches provide control of auxiliary hydraulic functions.

The horn is located below the cab and can be actuated in a number of ways depending on the machine specification. These are:

- Pressing the horn button in the center of the steering wheel;
- Pressing the trigger switch on the joy-stick;
- Pressing the horn switch on the right hand side arm rest.



Moving the joystick to the right or left controls tilt functions.

Moving the joystick in forward or reverse raises or lowers the forks.

A thumbwheel is provided on the left side of the joystick for actuation of sideshift.

A trigger switch located on the underside of the joystick actuates the horn.

Individual toggle switches are provided for auxiliary hydraulic functions.

The foot controls consist of an accelerator pedal, an inch-brake pedal and a brake pedal.

The accelerator pedal is located on the right hand side of the cab floor, and is connected via a high quality flexible cable to the engine injection pump.

On Monotrol equipped trucks, the Monotrol pedal controls acceleration and the forward/reverse transmission shifting in addition to controlling the diesel injection pump. Stepping on the right or left side of the Monotrol pedal controls the position of the transmission directional control spool through electrical switches and wires.

The inch-brake pedal is located on the left-hand side of the cab floor, and provides inching and braking on the same pedal. When this pedal is depressed part way, the transmission clutch packs are partially disengaged. This is the inching mode, and it permits the truck to inch forward or back in a slow controlled manner. This is helpful in placing or accessing loads.

When this pedal is depressed further, the transmission clutch packs become fully disengaged, and the vehicle brakes are applied. This is the braking mode, and it permits the vehicle to brake and hoist loads at high engine speed with the transmission disengaged.

The brake pedal is located just to the right of the steering column. This pedal applies the vehicle brakes without affecting the transmission clutch pack engagement

Hand & Foot Controls

- ✓ **Compact 14” Steer Wheel**
- ✓ **Directional Control for units without Monotrol**
- ✓ **Optional Auto-shift**
- ✓ **Red warning light alerts operator to check gauges and warning lights on operator console**
- ✓ **Turn Signals (Optional)**
- ✓ **Horn button**
- ✓ **Optional Spinner Knob**

A compact 14” diameter steering wheel with centrally mounted horn button is fitted.

For trucks that do not have Monotrol directional shifting, a direction control lever with forward, neutral and reverse detents is located at the left side of the steering pod with integrated roll shift type range control.

The optional auto-shift is controlled by a new Hyster designed electronic transmission controller located within the cab console. The controller receives signals from a speed sensor on the transmission case and a load sensor in the torque converter. Shift selection is automatic and dependant on the speed of the truck and the traction power requirements. The system works in both forward and reverse direction. With the selection lever the operator can select three driving conditions.

Position 1 to drive in first speed only

Position 2 for automatic selection of first or second speed depending on operating conditions.

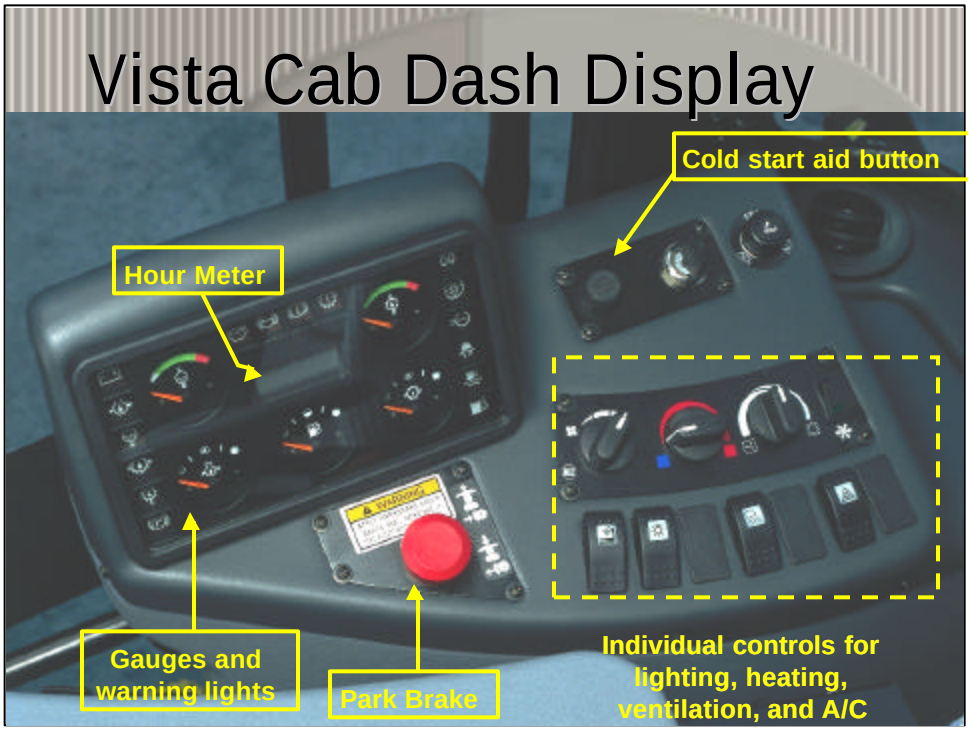
Position “D” allowing the truck to automatically select one of the three speeds available.

When the operator selects to change the driving direction,either through operating the direction control lever or the Monotrol pedal, the system automatically senses travel speed and tractive load and will prevent the direction change to occur until a predetermined maximum speed is achieved.

To assist engine starting in cold weather a cold start aid button is mounted on the right hand console, next to the key switch.

To start the engine on units equipped with Monotrol directional shifting, the park brake must be applied or the inch/brake pedal must be depressed. To start the engine on units equipped with control lever directional shifting, the directional control lever must be in the neutral detent position.

Engine Stopping - The engine is equipped with an electric shut-off that is actuated by turning off the ignition key.



The Multi-function display console positioned on the right hand side of the driver has been designed to house the instrumentation and electronics. The display provides the operator with error code message facility for the optional auto-shift transmission. The display has 16 warning lights, 5 gauges and 1 LCD that provide the operator with machine status. Gauges are provided for transmission temperature and pressure, Engine temperature and pressure and fuel level. The LCD is dual function in that it displays both machine hours and auto-shift transmission fault codes.

Backlit Gauges are provided for:

Transmission – pressure

Transmission – temperature

Engine – pressure

Engine – temperature

Fuel level

Five-digit LCD hour meter and autoshift transmission error codes

Individual controls provided for lighting, heating, ventilation, and air condition configured to a variety of options.

To assist engine starting in cold weather a cold start aid button is mounted on the right hand console, next to the key switch.

To start the engine on units equipped with Monotrol directional shifting, the park brake must be applied or the inch/brake pedal must be depressed. To start the engine on units equipped with control lever directional shifting, the directional control lever must be in the neutral detent position.

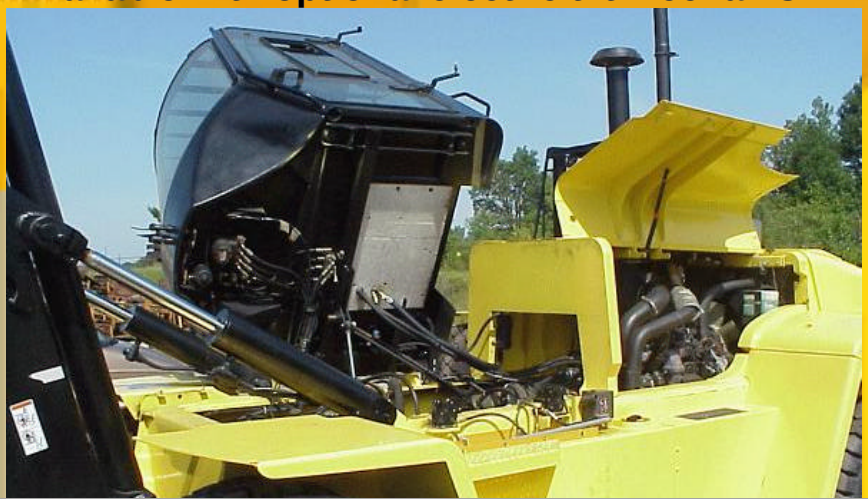
Vista Cab Dash Display

	Service Indicator Lights	Console Dash Gauges	Steering Warning Red Light	Audible Alarm Sounds	Automatic Engine shut down
Park brake, button actuated	Yes			Yes	
Fasten seat belt	Yes				
Low Fuel level	Yes	Yes	Yes		
Water Separator, fuel system	Yes				
Engine, low oil pressure	Yes	Yes	Yes	Yes	Yes
Engine, low coolant level	Yes		Yes		
Engine, High Coolant Temperature	Yes	Yes	Yes	Yes	Yes
Engine Air filter, High Restriction	Yes				
Engine, Hour Meter)	Yes	Yes / LCD			
Engine, Shut Down Warning	--		Yes	Yes	Yes
Glowplug On, Cylinder Heaters	--				
Battery Charge - Alternator	Yes				
Air Brake System, Low Pressure	Yes		Yes		
Hydraulic brake system, low pressure	Yes**		Yes**		
Hydraulic brake high oil temperature	Yes**		Yes**		
Transmission low oil pressure	Yes	Yes	Yes		
Transmission high oil temperature	Yes	Yes	Yes		
Transmission autoshift error	Yes**	Yes /LCD	Yes**		

** = warning functions for optional feature

Service Access

- **Cab Tilts for improved service access of components below cab**
- **Available with optional electric tilt mechanism**



Service Access

- **Video illustrating standard manual tilt cab and optional electric tilt.**

Electric Cab Tilt

Manual Cab Tilt

All models have a common gull wing hood design. The hood panels are formed steel fabrications

A gas spring assists in opening of the hood and provides a positive means of maintaining it open.

Exhaust system is mounted to the hood spine to prevent noise and vibrations being transmitted to the operator compartment.

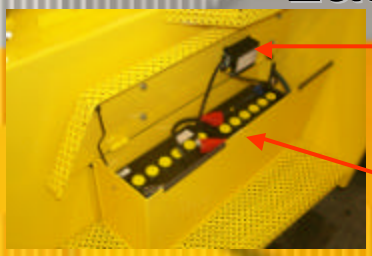
The hood and spine assembly is designed to pivot sideways to permit access for radiator removal or major overhaul activity.

The hood and cover arrangements have been designed to maximize service access, achieve maximum component commonality across the model range, and to permit ease of assembly.

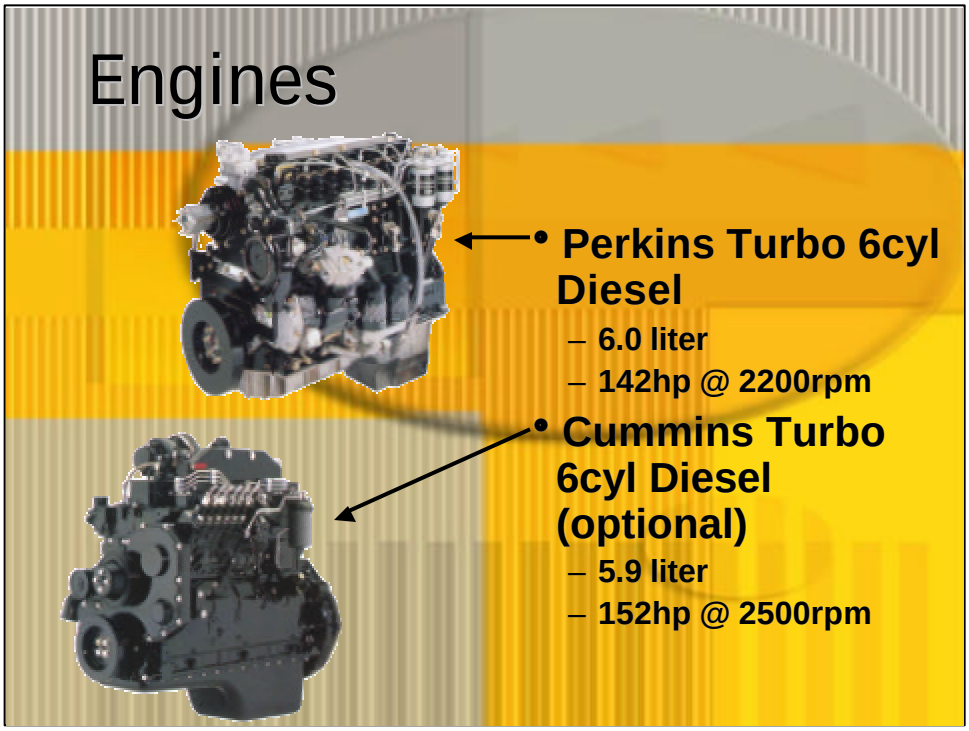
The hood and spine assembly is self-supporting and is totally insulated from the cab. A bulkhead panel that supports the hood assembly is mounted to the frame by 4 bolts and can easily be removed.

The hood panels have adjustable rubber hood stops to achieve good alignment; also a rubber seal is fitted to the rear bulkhead panel to eliminate noise and vibration.

Easy Service Checks



- 12v converter powers accessory plug on operator console
- Easy access to batteries
- Easy access for fluid checks



Perkins Common features

Well proven, Direct Injection

Fully metric

Gear driven water pump

Block and cylinder are cast iron. The block extends below the crankshaft for added strength.

3-ring piston with control expansion, armoured top groove.

High pressure rotary fuel pump

Mechanically governed

No load governed speed is 2450 rpm

Complies with Tier 1 emission legislation.

Thermostart cold start system

500 hour oil and filter change intervals.

Full flow lubricating system

CUMMINS 6BT 5.9 turbocharged diesel engine includes:

4 cycle, 6 cylinders, 359.0 cu. in. (5.88L) displacement

4.02” (102 mm) bore

4.72” (120 mm) stroke

Inline - BOSCH A/RSV Fuel system

NO Cold starting aid on standard configuration

Key-actuated start/stop solenoid

Maximum torque is 414 ft.lbs. (561 Nm) at 1,500 RPM.

Fuel consumption: .358 lb/BHP-HR

152 BHP at 2500 RPM

A Donaldson heavy-duty cyclone type air filter assembly is located inside the engine compartment. This is a new design, avoiding the requirement for a pre-cleaner. A UL approved version is specified for all markets.

An electrical vacuum switch is fitted which provides the operator with early warning of too high air filter element restriction.

An exhaust-aspirated pre-cleaner is available as an option. This extends the filter life and change intervals in severe environments.

A high air intake stack pipe with rain cap insures the cleanest possible intake air. This lengthens the life of the air cleaner.

The exhaust outlet is high so exhaust gases are directed away from the operator and ground personnel. The exhaust stack is offset with respect to the air cleaner stack so that it sits within the shadow of the air cleaner stack and therefore rearward visibility is unaffected.

The exhaust pipe work is routed through the engine compartment to minimize noise to the operator and environment. All connections are designed to prevent exhaust gas leakage.

The engine exhaust gases are connected through a flexible pipe to a large capacity muffler that is secured to the frame. This location provides good noise attenuation, and prevents excessive heat build up underneath the hood.

Metal heat shields are installed to protect the transmission control solenoids from excessive heat.

In very dusty applications, the optional exhaust-aspirated pre-cleaner is recommended.

Cooling System

- ✓ **Closed System (15 psi) - increases overall cooling efficiency**
- ✓ **Std. Puller or Opt. Pusher type fan (20-inch) diameter 6-blade**
- ✓ **High performance tube and fin radiator with electric level switch**
- ✓ **Fin type transmission oil cooler**

The 15-psi (103 kPa) cooling system uses either a puller or pusher type fan and optimised fan shroud to achieve high cooling efficiency and low noise.

A 20-inch diameter 6-blade puller fan will be standard.

A 20-inch diameter 6-blade pusher fan is optional.

The coolant recovery system provides the following benefits to the overall cooling system performance:

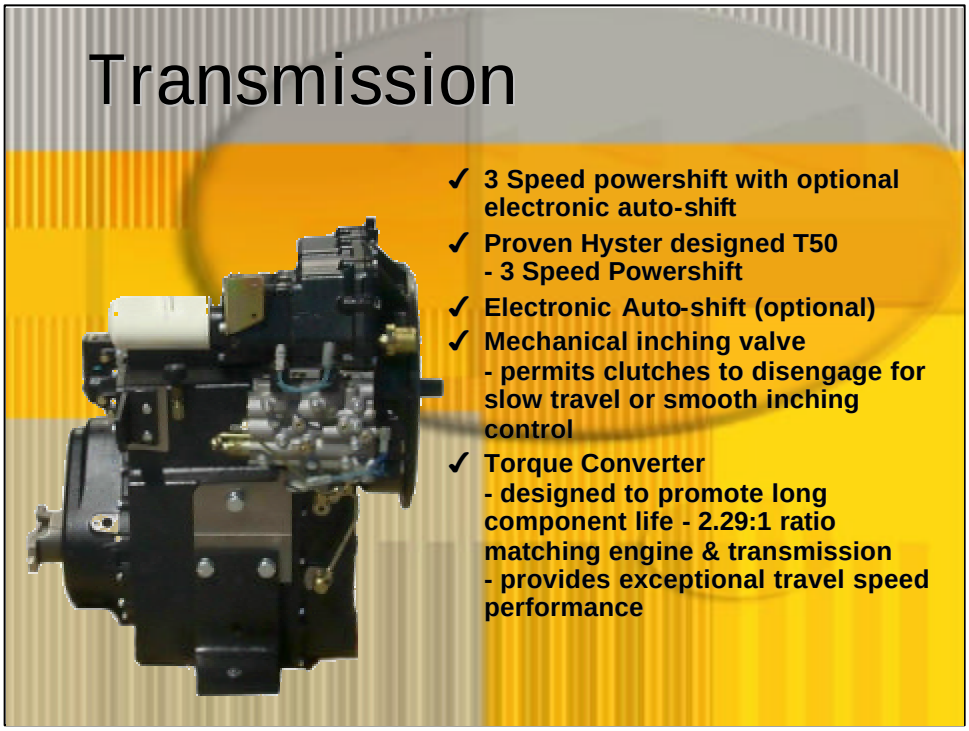
Coolant recovery reservoir provides a convenient fluid level check and the radiator incorporates an electrical level switch, to provide the operator with an early warning of low coolant condition.

The coolant recovery reservoir captures all the coolant as it is discharged from the radiator due to thermal expansion, and returns the coolant to the radiator as the system cools. This by eliminating air entrapment within the coolant.

A Fin type transmission cooler is water- oil and is located in the bottom tank of the radiator to achieve high cooling efficiency.

The overall cooling system efficiency has been optimised by using a high performance tube and fin radiator with a large face area matched to the fan airflow characteristics. The radiator fin density has been selected to minimize plugging due to airborne contaminants. Additionally rubber side skirts prevent recirculation of the hot outlet air; thereby improving cooling performance and reducing noise.

The radiator is fitted with a drain valve used for connecting a hose for ease of collecting the coolant.



¬ The truck series uses the well-proven NMHG designed T50 power shift transmission. This is a 3-speed forward and reverse heavy-duty transmission and is mounted to the engine flywheel housing.

¬ Transmission directional shifts are controlled by 2 electric solenoids mounted externally on the control valve and are actuated by electrical switches in Monotrol pedal or forward/reverse hand lever. The solenoids route oil to spring-loaded forward / reverse spools which route oil to the forward or reverse clutch packs. When neither solenoid is actuated the transmission is in neutral. Gearshifts are controlled by 2 electrical solenoids also externally mounted on the control valve and are actuated automatically by the electronic transmission controller to provide first, second and third speeds.

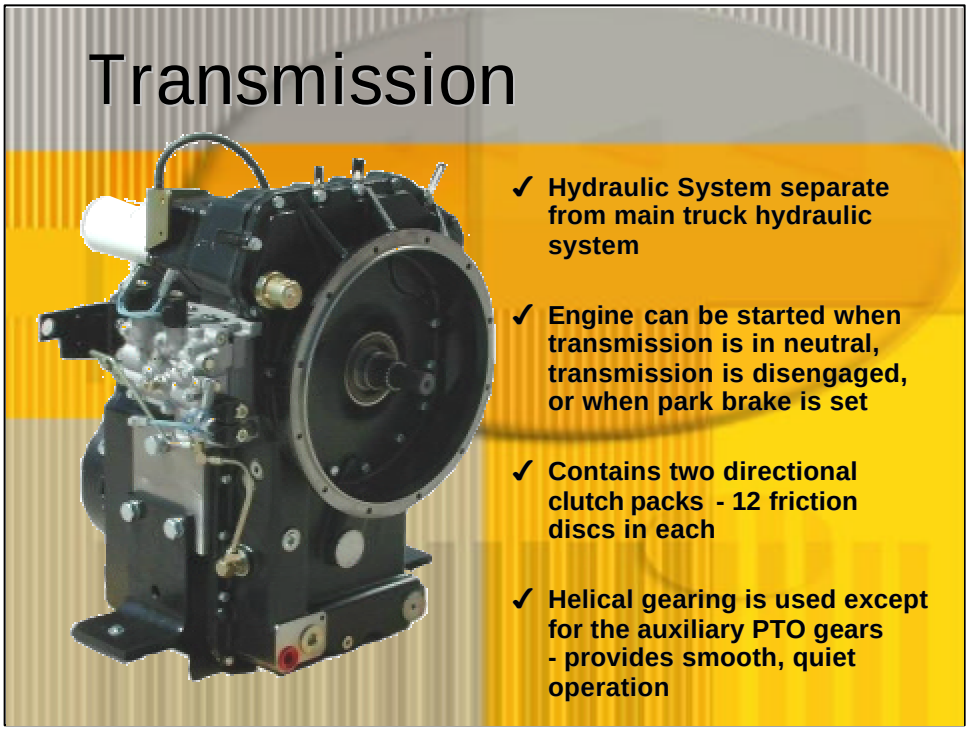
¬ Electric automatic shifting is optional and is controlled by a new electronic transmission controller located within the cab console. The controller receives its signal from a speed sensor on the transmission case. With forward direction selected, the shift from first gear to second gear occurs at 5mph, the shift from second gear to third gear occurs at 10mph. The shift from third gear to second gear occurs at 8mph, and the shift from second gear to first gear at 4mph.

When travelling in reverse and shifting forward, the controller will shift into first gear only when the speed is below 4 mph

A mechanical inching valve is used. This permits the clutches to disengage a small amount for slow travel speed operation or to disengage completely to put the transmission in neutral giving smooth inching control.

A torque converter with a 2.29:1 stall ratio is used to match engine to transmission to give exceptional tractive and travel speed performance.

The torque converter consists of a steel impeller, turbine and cast stator that are designed to promote long component life.



The hydraulic system for the transmission is separate from the main hydraulic system of the truck. The transmission has its own large sump, an externally mounted spin-on filter, charge pump and control valve. Transmission oil temperature is controlled by an oil cooler to reduce wear on the clutches and promote long life. In case of overheating, a sender unit in the oil sump turns on a warning light in the instrument module. There are few potential leak points in the transmission since it is self-contained.

The transmission control valve controls the pressure and the flow of oil to the clutch piston cavities and to the torque converter. It also provides oil flow to cool the clutch discs and lubricate the transmission. A modulating pressure valve is used to cushion directional shifts, reduce shock loads, and provide smooth clutch engagement. The modulator valve is sandwiched between the main control valve and the converter housing.

An inching spool permit the directional clutches to partially disengage by varying degrees or to disengage completely. A high quality cable provides the linkage between the inch brake pedal and the inching spool.

The control valve is mounted to the side of the torque controller housing. Drillings and passages in the control valve permit oil to flow from the valve body to passages in the transmission housing. This limits hydraulic lines and fittings to reduce the possibility of leakage.

The engine can only be started when the transmission is in neutral.

The transmission contains two directional clutch packs that have 12 friction discs in each. The 1st gear range pack contains 10 friction discs, the 2nd gear range pack contains 6 friction discs, and the 3rd gear range pack contains 6 friction discs.

All transmission inching occurs by disengaging either the forward or reverse directional clutch packs.

Torque is transmitted through the transmission by engaging one directional clutch pack, and one range clutch pack.

The hydraulic pistons that actuate the clutch packs feature a stepped hydraulic diameter to provide rapid, but smooth clutch engagement.

The transmission shafts contain oil passages that direct oil to the clutch packs for actuation and cooling. The oil is routed into the shafts through sealing rings located at the ends of the shafts.

Helical gearing is used throughout the transmission.

Transmission

Grip shift gear selector as fitted on trucks with monotrol pedal

Grip shift gear selector combined with forward/reverse lever

Shift selection is automatic and dependent on the speed of the truck and traction power requirements.

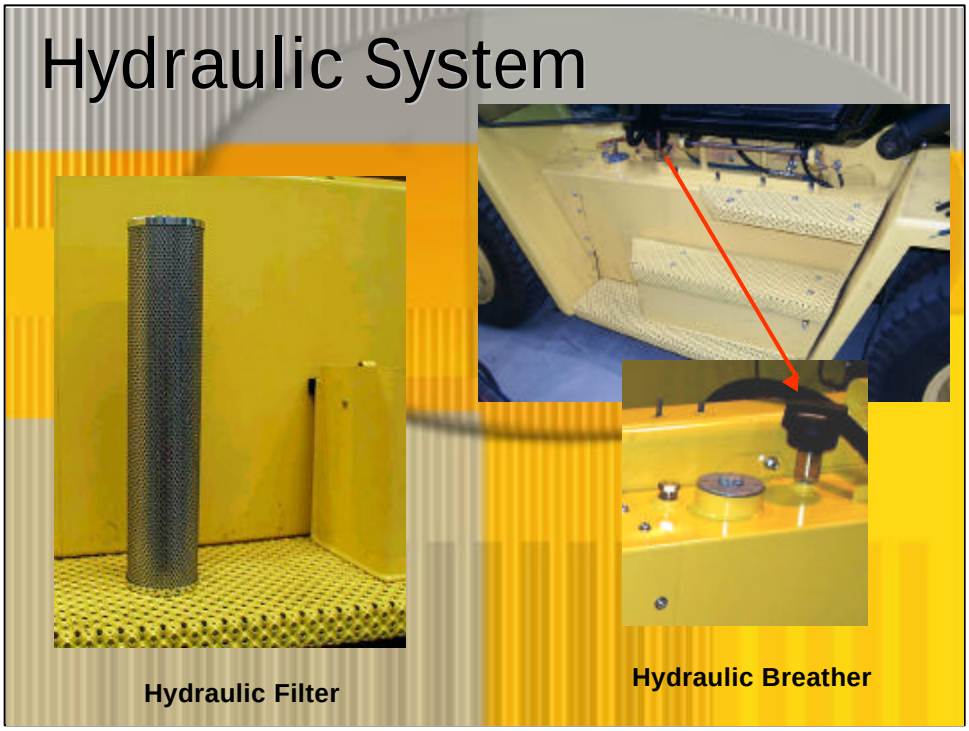
With the selection lever fitted on the steering column the driver can select three driving conditions.

•Position 1 to drive in first speed only.

•Position 2 to drive in second speed only.

•Position 1-2 for automatic selection of first or second speed, depending on operating conditions.

•Position D allowing truck to automatically select one of the three speeds available.



Air Breather

The hydraulic tank air breather now includes a filter and is located outside of the operator compartment to prevent undesirable fumes. The high quality filter protects the hydraulic system from airborne contaminants.

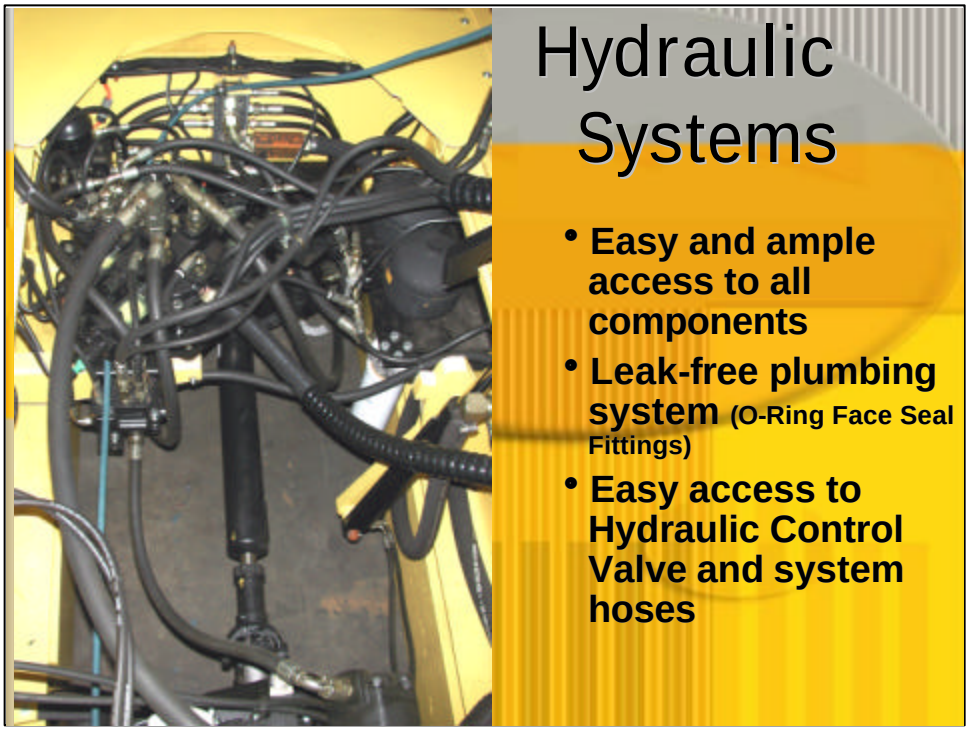
Hydraulic Filter.

A replaceable hydraulic filter is located within the hydraulic tank, and maybe serviced by simply unscrewing the hydraulic filter head. The filter may be replaced without opening the hood.

The filter contains a 20-micron paper element that protects the hydraulic system from contaminants, promotes reliable performance and helps to extend life for all the system components.

The hydraulic filter assembly has a by-pass relief valve to provide oil flow in the event of filter clogging.

Oil added to the hydraulic system must pass through the filter



➘ A 3050-psi (21.0 MPa/210 bar) hoist hydraulic system allows the use of small hydraulic lines and components which increases operating efficiency and improves fuel economy. Tilt and auxiliaries will have 2400-psi (16.5 MPa/165 bar) relief in all valve variations.

Small diameter hoist cylinders provide good visibility.

Small hydraulic lines and components mean excellent maintenance accessibility.

In-tank, full flow, returns filtration for protection of the hydraulic circuit. Both steering and main hydraulic system oil are filtered as the oil returns to the tank.

"O" Ring Face Seal hydraulic fittings are used throughout. Fittings with o-ring bosses are used to connect hoses and tubes to individual hydraulic components and provide leak-free connections.

Flexible wire-braid hoses and conventional steel hydraulic tubing are used to simplify the hydraulic plumbing. These hydraulic lines are carefully routed and clamped. This feature extends service life and simplifies service access.

Hydraulic Systems

- **Tandem Hydraulic Pump**
  - **One pump section for main system**
  - **Second pump section for steer system**

The main hydraulic pump is a tandem pump that contains a pumping section for the lift system, and a pumping section for the steering, tilt and auxiliary system. The pump features high performance gear type pumping sections for high efficiency and long life. The steering section includes an integral flow control to provide flow for the hydrostatic steering system.

It is mounted to the transmission PTO, and is driven by a gear train from the torque converter hub. This mounting location is centrally located within the truck, and provides for an efficient hydraulic system. Hydraulic line lengths are minimized to reduce hydraulic system pressures, thereby lowering power requirements and overall system temperatures.

Electro proportional hydraulic control valve sections provide the means of operator control of hydraulic functions and realize fine tuned metering of hydraulic functions.

One of the major problems with high pressure connections is the possible oil leaks mainly caused at the hydraulic fittings and connections. One of the measures taken by Hyster is to introduce two outstanding improvements on connections:

- 90° flares at the tube collar
- integrated “O” rings are readily commercially available
- Surface to surface fitting

Two double-acting tilt cylinders are mounted in a shielded location above the fenders. The tilt cylinder mounting is widely spaced for upright support and good visibility.

The cylinders are fastened to the upright and frame anchors by hardened steel pins, and pivot through replaceable bushings. Lube fittings are provided at each tilt pin to reduce wear.

Chromed rods and single-lip urethane seals are self-lubricating to offer outstanding cylinder life and low maintenance. Wiper rings are used to help prevent contaminants from entering the cylinders.

The tilt cylinders are easily removed for service.

Heavy duty anti-cavitation control valves are plumbed into each tilt cylinder. They keep the mast from drifting forward when loaded. They prevent tilting when the engine is off. They keep positive hydraulic oil flow preventing vacuums that would lead to erratic tilting.

The existing series of masts is carried over into this new model. The masts have proven to be durable.

Hydraulic connections and hoses are designed using the “O” Ring Face Seal fittings.

Generous channel overlap reduces deflection.

Hang-on style mast mounting makes installation easy.

Mast hanger pins are mounted in replaceable bushings for ease of service.

H165- 280HD

2– Stage No Free Lift (165-210)

147.5”MFH/131.0”OALH

183.0”MFH/149.0”OALH

212.5”MFH/163.5”OALH

2- Stage No Free Lift (230-280)

147.5”MFH/143.0” OALH

183.0”MFH/160.5” OALH

212.5”MFH/175.5” OALH

244.0”MFH/191.0” OALH

H300- 360HD

2-Stage No Free Lift

147.5”MFH/143.5”OALH

183.0”MFH/161.0”OALH

212.5”MFH/176.0”OALH

244.0”MFH/191.5”OALH

484” Top of Attach. (EC-4)

Carriages

Dual function sideshifting fork positioner

- Apron-type sideshift protects load
- Dual function gives greater range of fork positioning

Standard Carriage

Carriages

Side Shifting Fork Positioner

Dual Function Side Shifting Fork Positioner

Attachments are generally application driven. A variety of attachments are available depending upon application and capacity. Hydraulic control valves are a big consideration when specifying a truck that will use a particular attachment. Since there may be many different types of attachments sourced locally rather than supplied by the factory, it is very important for the sales professional to understand which valve, switch and lever combinations are necessary to operate the attachments, so that trucks are specified correctly when orders are placed.

It is essential that the exact combination of the attachments used on the truck ordered is made known to the factory (at time of order), so that the required combination of valves, levers and switches can be fitted. The provisions of correct specifications will avoid the need to make changes in the field and any related costs to your dealership and end users.

Having to retro-fit a truck that has been improperly equipped with a different hydraulic control valve as an aftermarket option could be very costly to your dealership.

Attachments include different configurations of sideshifting fork positioners, pulp bale clamps, and rotators. Empty container handling spreaders are available on the H360HD-EC only. Also available on this model (through SPED only) is a special load backrest extension that enables the trucks to carry two empty containers (double-stacked).

Valve Conversions

HYDRAULIC CONTROL VALVES

Hydraulic Control Levers-

3-Function (3 levers) ***Standard Offering***
3-Function (2 levers, 1 rocker switch)
4-Function (4 levers) - Not for use with Clamping Attachment
4-Function (2 levers, 2 rocker switches) - Not for use with Clamping Attachment
4-Function (3 levers, 1 rocker switch) - Not for use with Clamping Attachment
4-Function (4 levers, 1 for clamp) - For use with Clamping Attachment
5-Function (4 levers, 1 rocker switch) - Not for use with Clamping Attachment
5-Function (4 levers, 1 for clamp, 1 rocker switch - For use with Clamping Attachment
5-Function (3 levers, 2 rocker switches) - For dual function sideshifting fork positioner

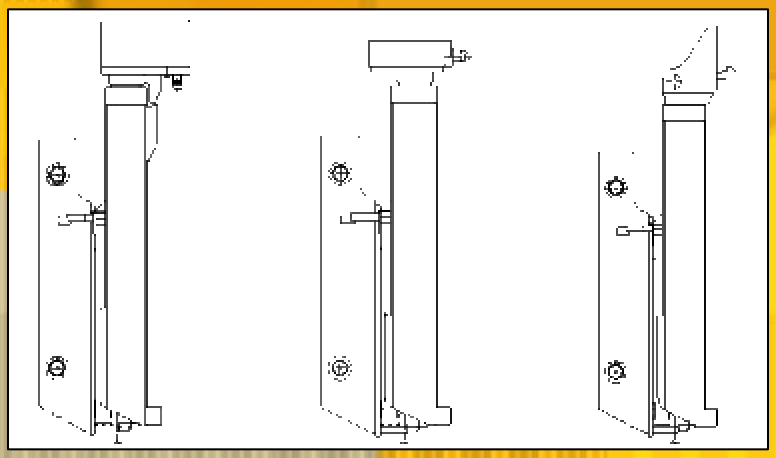
Hydraulic Control Joysticks*** -(Requires Cab 072-03)
3-Function (3rd function on joystick)
3-Function (3rd function on rockerswitch)
4-Function (3rd function on joystick, 4th on rockerswitch)
4-Function (3rd & 4th function by rockerswitches)
5-Function (3rd function on joystick, 4th & 5th by rocker switches)
****** All joystick options not for use with clamping attachment***

•To coincide with the introduction of the upgraded model the H360HD-EC4 Empty Container Handler will be equipped with a new Hyster spreader.

•The new telescoping 20-40 ft. side lift, empty container handling spreader has been developed in partnership with Elme, a company specialising in the design and manufacture of container spreaders. This will ensure that Hyster continues to meet customer needs for increased productivity & reliability.

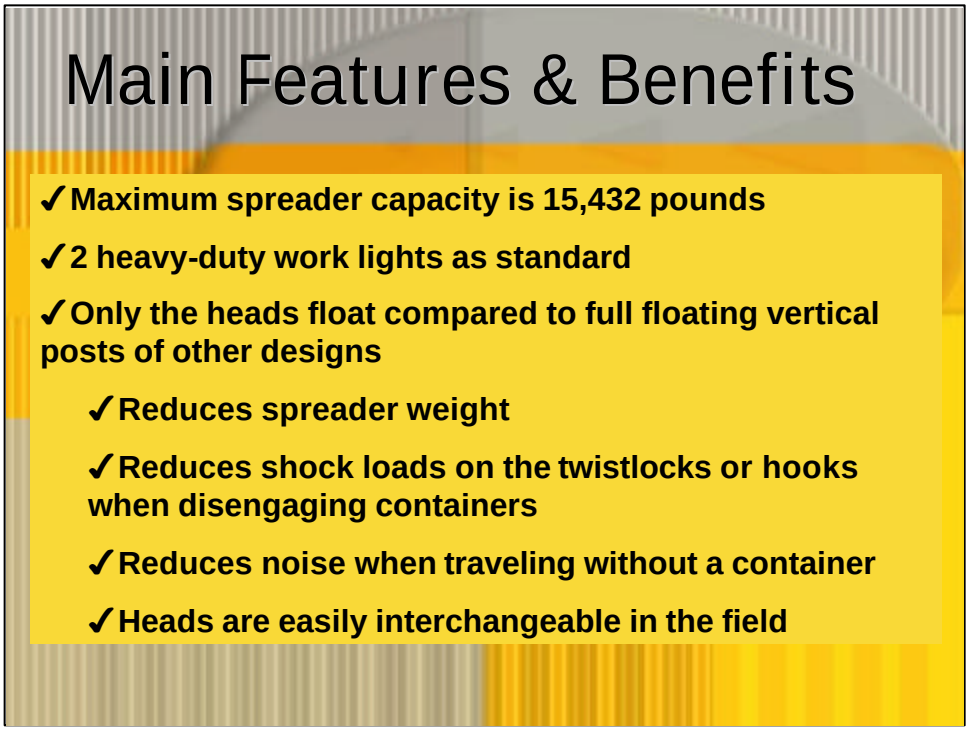
550 Model Spreaders

✓**There are three types of engagement systems available as standard production options:**



Vertical twistlocks **Horizontal twistlocks** **Suspended hooks**

- There are three types of engagement systems available as standard production options:
- Vertical twistlocks
- Horizontal twistlocks (replacement for the current shooting pin system)
- Suspended hooks



The main **features and benefits** are:

Maximum spreader capacity is 15,432 pounds

The spreader features two heavy-duty work lights as standard, one mounted on each extension beam, with the light beam directed at the top head

Leak free O-ring face seal (ORFS) hydraulic connections are featured throughout

Only the heads float compared to full floating vertical posts of other Empty Spreader designs

-Reduces spreader weight

-Reduces shock loads on the twistlocks or hooks when disengaging containers

-Reduces noise when traveling without a container

-Heads are easily interchangeable in the field

Main Features & Benefits

✓Over-lowering interrupt function on All models

✓Blocks lowering once the spreader has connected properly with the container

✓Eliminates slacking of the chains, hoses and wires over the mast

✓Improves chain, hose and wire life

✓Reduces lifting shocks on the spreader

✓Warning light in the cab illuminates when the over-lowering interrupt is activated

•All models incorporate an over-lowering interrupt function. This function blocks any further lowering of the mast once the spreader has connected properly with the container

•This eliminates slacking of the chains, hoses and wires over the mast

•Improves chain, hose and wire life

•Reduces lifting shocks on the spreader

•The warning light panel in the cab includes a blue light which illuminates when the over-lowering interrupt is activated

The steer axle is a casting with a transverse mounted double acting cylinder, 2 non-adjustable tie rods, 2 spindles, tapered roller bearings and 2 wheel hubs. The axle is pin mounted to the frame.

The one-piece axle frame carries the axle loads, and provides the mounting for the spindles and cylinder. The axle frame is designed for high loads and long life.

The axle spindles are supported by tapered roller bearings, and sealed to prevent contaminate entry or loss of grease.

The steer cylinder is secured to the axle by 8 high tensile bolts. By this design, the cylinder does not exert an external force on the frame. This design permits large wheel angles and increased maneuverability.

No steering linkage adjustments are required. The only regular maintenance points are the lubricating fittings on the spindle and tie rod pins.

This axle design, with its large sealed bearings, precision-machined parts, and non-adjustable tie rods, provides a durable and low maintenance system with precise steering control.

Hydrostatic Steering System

Video

- **Hydrostatic Steering System**
  - **Provides precise, reliable control**
- **Load Sensing System**
  - **Prioritizes oil demand to steering**
  - **Steering receives oil before main hydraulic system regardless of engine rpm**

The hydrostatic steering system consists of a steering wheel and tilting column assembly, steering control unit, pump with priority control valve, steer axle, cylinder and wheel hubs and spindles.

The load sensing steering valve prioritizes the oil demand to the steering system. This means that at any revolutions of the engine the steering system receives oil before the main hydraulic system. This reduces the steering effort and increases the steering speed at low engine speeds.

With the engine stopped, the hand pump enables the operator to steer the truck to a controlled stop. A check valve in the steering system is provided to reduce steering wheel kick back.

The wheel hubs rotate on large tapered roller bearings that are lubricated by axle oil. Lip type seals separate the cooling oil from the axle hub oil.

New planetary reduction drive axles are fitted on all models. This axle has been designed and developed for Hyster lift trucks and is specifically tailored for our applications.

The drive axle features heavy-duty cast axle housings to ensure durability and have 10% increased rating. These axles are securely mounted to the truck frame with 4 bolts per side.

The axle assembly is a full floating design, which means that the truck weight is carried by the axle housing, not the axle shafts.

The wheel hubs rotate on large tapered roller bearings that are lubricated by axle oil. Lip type seals separate the cooling oil from the axle hub oil.

All these features add up to durability.

Non-asbestos brake linings are used on all trucks.

Three brake options available: Standard air brakes, air brakes with optional air dryer, and wet disc brakes.

Optional wet disc brakes are available for all models. A separate wet brake oil cooler is used with an oil temperature-warning sensor to provide the operator with an early indication of excessive oil temperature

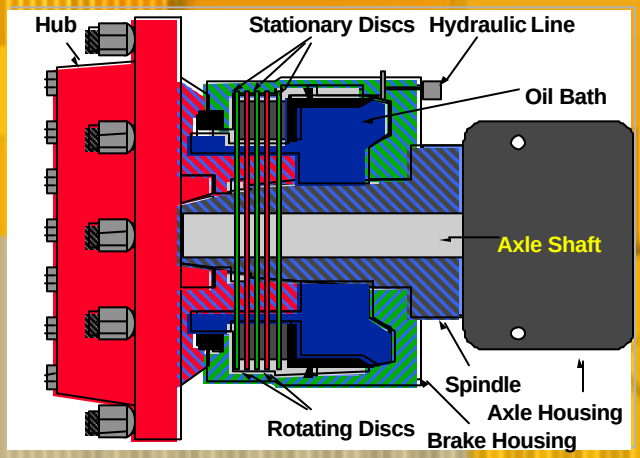
The wet brake system consists of a hydraulic supply and storage section, drive axle wheel speed multi-disc brakes.

Optional wet brake axles include a pinion mounted dry disc park brake.

Large 360mm diameter wet disc brake with 3 or 4 plates ensure braking compliance with ISO and ANSI standards.

For general use air brakes are normally sufficient. In very humid or damp environments, air brakes with the optional air dryer would be more appropriate. Wet disc brakes should be considered in applications that are extremely dusty or in applications that are wet and sloppy, such as concrete manufacturers. They should also be considered in multi-shift heavy duty operations.

Wet disc brakes

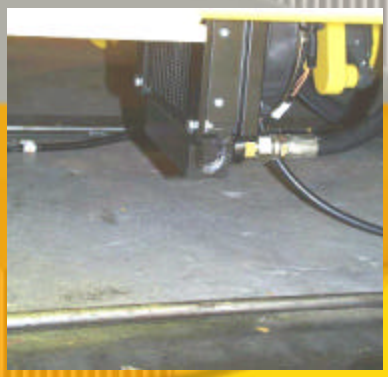


- The wet brake system consists of a hydraulic supply and storage section, drive axle wheel speed multi-disc brakes. Hydraulic oil is supplied to an accumulator system from an engine-driven hydraulic pump. The oil used to actuate and cool the brakes comes from the main hydraulic reservoir. Brake cooling oil is cooled by separate oil to air cooler fitted in the front of the frame. Brake cooling flow is filtered as it returns to the tank.
- The park brake comprises a Knott FSG 90 pinion mounted disc brake with hydraulically released spring applied disk pads and is common to all models.
- A Carlisle brake pedal is used to actuate the brake system with accurate and low effort controlling as a result.

Wet disc brake option should be considered in applications with high air brake shoe wear and brake repair cost.

Other considerations are applications with excessive grade climbs and descents, and applications with abrasive dusty environments.

Brake System



Separate air brake air cleaner

Wet brake oil cooler fitted in the front of the frame

Dry brake axle versions now have increased drum brake lining volume and feature easy brake shoe and lining changes.

Brake cooling oil is cooled by a separate oil to air cooler located below the hydraulic bay area. Brake cooling flow is filtered as it returns to the tank.

Brake System

The brake pedal is located just to the right of the steering column. This pedal applies the vehicle brakes without affecting the transmission clutch pack engagement.

The inch-brake pedal is located on the left-hand side of the cab floor, and provides inching and braking on the same pedal. When this pedal is depressed part way, the transmission clutch packs are partially disengaged. This is the inching mode, and it permits the truck to inch forward or back in a slow controlled manner(i.e. spotting a load).

Fuel System

✓ 32 Gallon Tank common for entire series

- ✓ New large 4” diameter fuel fill port
- ✓ Internal baffles counteract fuel surge

✓ Thermostart system

- ✓ Provides heated intake manifold air for cold weather starting

✓ Combination fuel filter/water separator

- ✓ Two main fuel filters
- ✓ Ensures that the diesel injection pump receives clean fuel for long life

•The basic fuel system includes a fuel tank with fuel cap, a combination fuel filler/water separator, a lift pump, a secondary fuel filler, engine injection pump/injectors and a cold start system.

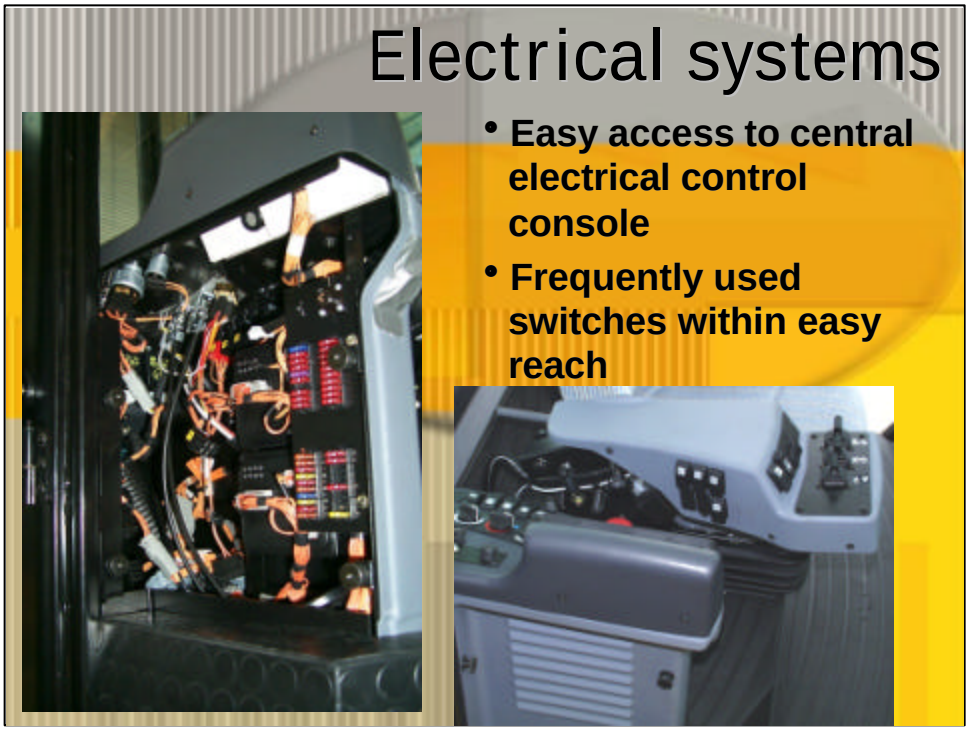
•The fuel tank is now a common part throughout the model series. A bolt-on extension piece is fitted to accommodate differences in wheelbase.

•A 32 gallon fuel tank is mounted to the outside of the left-hand frame channel by 7 bolts. Within the fuel tank a float type level sender is mounted at the top of the tank which can be easily removed for repair or replacement.

•A new large 4” inch-diameter fuel fill port is located at the top of the tank and has an additional external dam to prevent fuel spill from reaching the access steps or outside of tank. Internal baffles with the tank counteract fuel surge and prevent direct impingement of fuel onto the filler cap.

•On the Perkins and Cummins engines, a thermostart system provides heated intake manifold air for cold weather starting.

•A combination fuel filter/water separator, two main fuel filters ensure that the diesel injection pump receives clean fuel for long life.



Truck reliability is emphasized with a major upgrade in the connector technology and harness routing. Significant improvements in the level and quality of information available to the operator by a new ‘state of the art’ instrumentation cluster have been introduced. Diagnostics for both Hydraulics and Transmission electronic systems to assist the service engineer are introduced.

A 24-volt electrical system is used for maximum reliability.

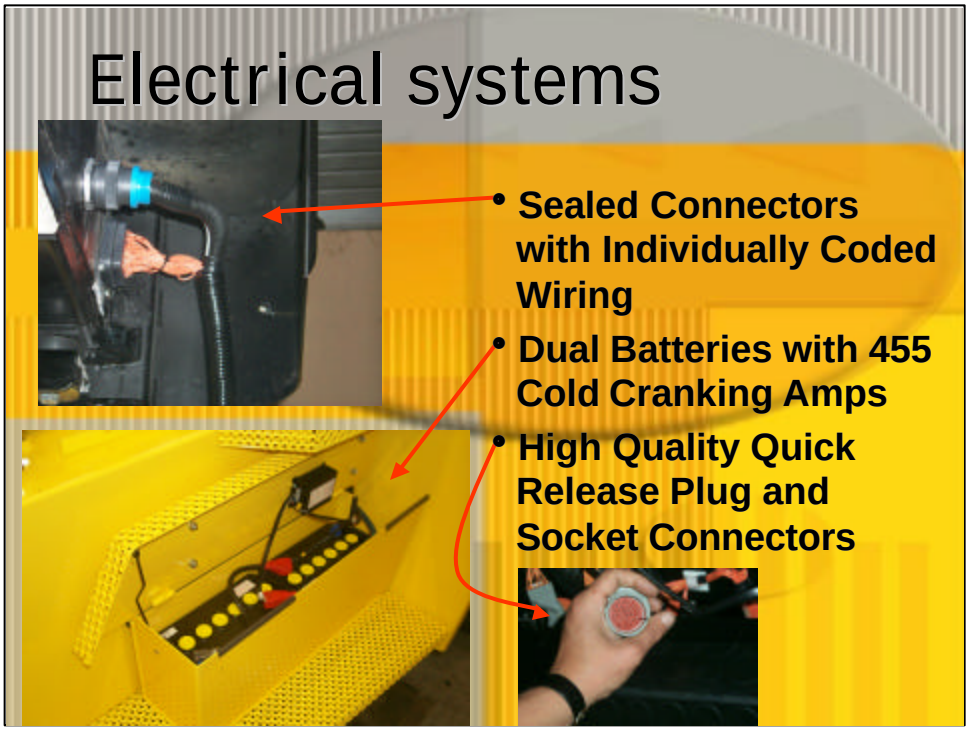
A multi-function display panel provides the operator with all information on the machine status. The instrument module is mounted on the right hand side console. 16 warning lights, 5 gauges and 1 LCD, provide clearly to the operator the machine status. The LCD is dual function in that it displays both machine hours and Transmission fault codes.

Switches are mounted on the right hand armrest and console. Provision is made available for 12 switches on the armrest and a further 7 are available on the console.

The fuse and relay panels are located in the right hand side console. They are grouped together and are easy to access. Depending on the machine specification there is provision for 40 fuses and 8 relays.

Particular attention has been paid to the routing and clamping of the wire harness to ensure that it is not exposed to heat and oil contamination.

The standard alternator has an output 70 amp. All alternators have internal regulators.



Sealed wiring connectors are employed throughout the truck. The harnesses are pre-wired for ease of option fitment in both factory and field.

A single colour wire with number codes for each wire has been introduced similar to the Laser product.

The truck is wired for light options. Cab and front fenders are pre-drilled to make it easy to install. The tail light assembly is standard and is a cluster of brake/tail, turn and reversing lights positioned into the rear fender counterweights.

The electrical system is designed to meet UL requirements.

Two batteries with 455 cold cranking amps are employed. These are mounted in the battery box located on the right-hand running board.

A warning light is mounted in the steering column directly in line with the operator's eye to provide a warning of any malfunction indicated by the display in the right-hand console. This arrangement provides excellent forward visibility while alerting the operator of any need to check the comprehensive indicator display. Further information on the fault is available on this multi-functional indicator display panel located to the operators right.

The starter motor is a 24-volt heavy duty with integral over-running clutch mechanism and solenoid. The clutch functions to protect the starter armature from over-speeding. A starter lockout mechanism is contained in the key switch to prevent engagement of the starter when the engine is running.

A lockout switch prevents engagement of the starter unless the transmission is in neutral, by placing the direction control in neutral on the lever-shifted trucks, or by applying the park brake on Monotrol trucks. You can start if you apply the brake/inching pedal.

All electrical connections to the operator compartment are via high quality quick release plug and socket connectors.

Performance Specifications

Model		H190HD (Perkins)	H190HD (Cummins)
Capacity, rated	lb. (kg)	19,000 (8 618)	19,000 (8 618)
Load Center	in. (mm)	24.0 (600)	24.0 (600)
Tire type, front / rear		pneumatic	pneumatic
Wheels, front / rear	(X=drive)	4/2	4/2
2-Stg VISTA mast (Top of Forks)	in. (mm)	208.9 (5 306)	208.9 (5 306)
Forks, width / thickness	in. (mm)	8 (203) / 2.5 (64)	8 (203) / 2.5 (64)
Tilt angle, standard mast, forward / rearward	° deg	15 / 12	15 / 12
Length to face of forks	in. (mm)	168.3 (4 275)	168.3 (4 275)
Height, standard mast lowered	in. (mm)	163.4 (4 150)	163.4 (4 150)
Height, standard mast extended, w/o LBE	in. (mm)	271.3 (6 891)	271.3 (6 891)
Turning radius, minimum outside / inside	in. (mm)	154.0 (3 912) / 6.0 (152)	154.0 (3 912) / 6.0 (152)
Aisle width, w/ 48 x 48" load	in. (mm)	238.5 (6 058)	238.5 (6 058)
Travel speed, maximum forward (powershift), NL / RL	mph (km/hr)	20.4 (32.8) / 18.6 (29.9)	22.2 (35.7) / 20.5 (33.0)
Lift speed, standard mast, NL / RL	ft/min. (m/s)	143 (0.73) / 96 (0.49)	155.0 (0.79) / 104.0 (0.53)
Lowering, standard mast, NL / RL	ft/min. (m/s)	98 (0.50) / 114 (0.58)	82 (0.42) / 92 (0.47)
Drawbar pull, powershift xsmn, 1 mph, NL / RL	lbf. (kN)	9,261 (41.2) / 19,300 (85.9)	9,261 (41.2) / 21,379 (95.1)
Gradeability, powershift xsmn, 1 mph NL / RL	Percent	38 / 47	38 / 60
Axle loading, static-RL front / rear	lb. (kg)	41,619 (18 878) / 3,675 (1 667)	41,619 (18 878) / 3,675 (1 667)
Wheelbase, center of steer to center of drive tire	in. (mm)	106.3 (2 700)	106.3 (2 700)
Ground clearance, lowest point - NL	in. (mm)	10.24 (260)	10.24 (260)
Brakes, method of control, service / parking		air / spring	air / spring
Battery, volts / cold cranking amps	V / amps	24 / 227	24 / 277
Engine, make-model		Perkins Turbo 1006-60T	Cummins 6BT5.9-C152
Output per SAE standards	hp (kW)	145 (108)	152 (113)
Governed speed, NL	RPM	2300	2500
Cycle / number of cylinders / displacement	cu.in. (cm3)	4 / 6 / 366 (5 998)	4 / 6 / 359 (5 883)
Clutch type, powershift		Torque Converter	Torque Converter
Number of speeds, forward / reverse		3/3	3/3
Transmission type		Powershift	Powershift
Relief pressure for attachments	psi (kPa)	2,400 (16 547)	2,400 (16 547)

* CERTIFICATION: These Hyster lift trucks meet design specifications of Part II ANSI B56.1-1969, as required by OSHA Section 1910.178 (a) (2) and also comply with Part III ANSI B56.1-revision in effect at time of manufacture. Certification of compliance w

† NOTE: Performance specifications are for truck equipped as described under Standard Equipment on back of this Technical Guide. Performance specifications are affected by the condition of the vehicle and how it is equipped as well as the nature and condi

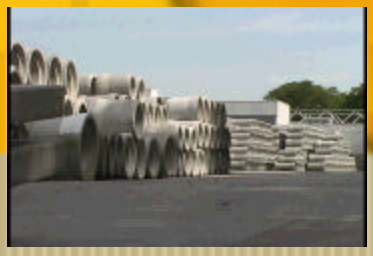
Performance Specifications

Model	H230HD (Perkins)	H230HD (Cummins)
Capacity, rated	23,000 (10 433)	23,000 (10 433)
Load Center	24.0 (600)	24.0 (600)
Tire type, front / rear	pneumatic	pneumatic
Wheels, front / rear	4/2	4/2
2-Stg.VISTA mast (Top of Forks)	209.8 (5 329)	209.8 (5 239)
Forks, width / thickness	8 (203) / 3.0 (76)	8 (203) / 3.0 (76)
Tilt angle, standard mast, forward / rearward	15 / 12	15 / 12
Length to face of forks	177.4 (4 506)	177.4 (4 506)
Height, standard mast lowered	175.2 (4 450)	175.2 (4 450)
Height, standard mast extended, w/o LBE	280.3 (7 120)	280.3 (7 120)
Turning radius, minimum outside / inside	160.6 (4 079) / 10.0 (254)	160.6 (4 079) / 10.0 (254)
Aisle width, w/ 48 x 48" load	246.3 (6 256)	246.3 (6 256)
Travel speed, maximum forward (powershift), NL / RL	19.9 (32.0) / 18.3 (29.5)	21.6 (34.8) / 19.9 (32.0)
Lift speed, standard mast, NL / RL	110 (0.56) / 74 (0.38)	120.0 (0.61) / 80.0 (0.41)
Lowering, standard mast, NL / RL	98 (0.50) / 114 (0.58)	82 (0.42) / 92 (0.47)
Drawbar pull, powershift xsmn, 1 mph, NL / RL	10,609 (47.2) / 19,300 (85.9)	10,609 (47.2) / 21,226 (94.4)
Gradeability, powershift xsmn, 1 mph NL / RL	36 / 38	36 / 43
Axle loading, static-RL front / rear	48,976 (22 215) / 5,202 (2 360)	48,976 (22 215) / 5,202 (2 360)
Wheelbase, center of steer to center of drive tire	114.2 (2 901)	114.2 (2 901)
Ground clearance, lowest point - NL	10.24 (260)	10.24 (260)
Brakes, method of control, service / parking	air / spring	air / spring
Battery, volts / cold cranking amps	24 / 227	24 / 227
Engine, make-model	Perkins Turbo 1006-60T	Cummins 6BT5.9-C152
Output per SAE standards	145 (108)	152 (113)
Governed speed, NL	2300	2500
Cycle / number of cylinders / displacement	4 / 6 / 366 (5 998)	4 / 6 / 359 (5 883)
Clutch type, powershift	Torque Converter	Torque Converter
Number of speeds, forward / reverse	3/3	3/3
Transmission type	Powershift	Powershift
Relief pressure for attachments	2,400 (16 547)	2,400 (16 547)

Performance Specifications

Model	H330HD (Perkins)	H330HD (Cummins)
Capacity, rated	33,000 (14 969)	33,000 (14 969)
Load Center	24.0 (600)	24.0 (600)
Tire type, front / rear	pneumatic	pneumatic
Wheels, front / rear	4/2	4/2
2-Stg.VISTA mast (Top of Forks)	209.1 (5 311)	209.1 (5 311)
Forks, width / thickness	8 (203) / 3.5 (89)	8 (203) / 3.5 (89)
Tilt angle, standard mast, forward / rearward	15 / 12	15 / 12
Length to face of forks	196.6 (4 994)	196.6 (4 994)
Height, standard mast lowered	175.6 (4 460)	175.6 (4 460)
Height, standard mast extended, w/o LBE	280.3 (7 120)	280.3 (7 120)
Turning radius, minimum outside / inside	180.3 (4 580) / 17.5 (445)	180.3 (4 580) / 17.5 (445)
Aisle width, w/ 48 x 48" load	269.5 (6 845)	269.5 (6 845)
Travel speed, maximum forward (powershift), NL / RL	17.8 (28.6) / 16.1 (25.9)	18.5 (29.8) / 16.7 (26.9)
Lift speed, standard mast, NL / RL	87 (0.44) / 58 (0.29)	95.0 (0.48) / 63.0 (0.32)
Lowering, standard mast, NL / RL	87 (0.44) / 98 (0.50)	82 (0.42) / 92 (0.47)
Drawbar pull, powershift xsmn, 1 mph, NL / RL	14,340 (63.8) / 21,160 (94.1)	14,340 (63.8) / 20,121 (89.5)
Gradeability, powershift xsmn, 1 mph NL / RL	39 / 33	39 / 33
Axle loading, static-RL front / rear	67,232 (30 496) / 5,071 (2 300)	67,232 (30 496) / 5,071 (2 300)
Wheelbase, center of steer to center of drive tire	130.0 (3 302)	130.0 (3 302)
Ground clearance, lowest point - NL	10.24 (260)	10.24 (260)
Brakes, method of control, service / parking	air / spring	air / spring
Battery, volts / cold cranking amps	24 / 227	24 / 227
Engine, make-model	Perkins Turbo 1006-60T	Cummins 6BT5.9-C152
Output per SAE standards	145 (108)	152 (113)
Governed speed, NL	2300	2500
Cycle / number of cylinders / displacement	4 / 6 / 366 (5 998)	4 / 6 / 359 (5 883)
Clutch type, powershift	Torque Converter	Torque Converter
Number of speeds, forward / reverse	3/3	3/3
Transmission type	Powershift	Powershift
Relief pressure for attachments	2,400 (16 547)	2,400 (16 547)

Summary



- NEW! Body Styling
- NEW! Operator Compartment
- Improved Service Access
- Improved Hydraulic Systems
- Engines
- Masts & Carriages
- Transmission
- Electrical Systems