FORKLIFTCENTER

KALMAR

Kalmar DRF400-450C
Reachstackers 40 – 45 tonnes



Technical information, Stage IIIB/Tier 4i

Powerful intermodal handling

Fast and efficient Intermodal handling requires a machine that can manage several tasks with power, speed, and precision.

Intermodal handling is characterised by several modes of transportation meeting in one geographical point such as the transfer of containers and trailers between rail, road and water. A reachstacker is perfectly suited for all kinds of handling that can occur on an Intermodal site with high demands on efficiency and low operational cost.

The Reachstacker machine type is well adapted to all kinds of diversified Intermodal handling, from one-unit operations to medium sized transfer terminals with high demands of versatility and flexibility.

A reachstacker can also be a perfect supplement to the terminals existing fleet of other machines. It can be put in operation at short notice to reduce bottlenecks because it masters most of the occurring tasks in the terminal.

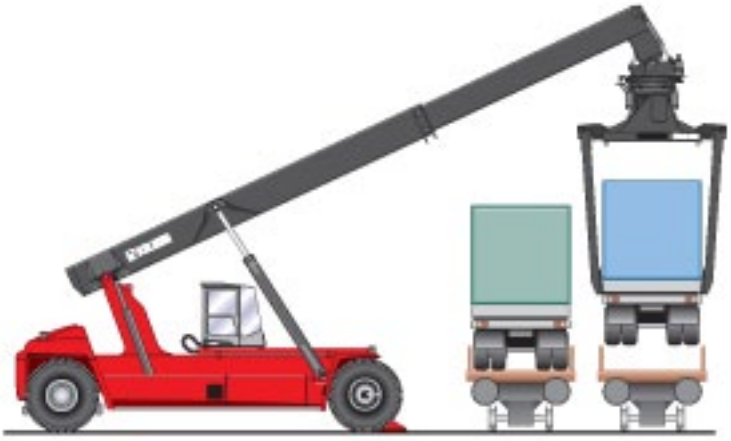
With it's advanced lifting equipment, boom and attachment, this type of machine manages to handle both containers and trailers so there won't be any loss in production due to conversion.

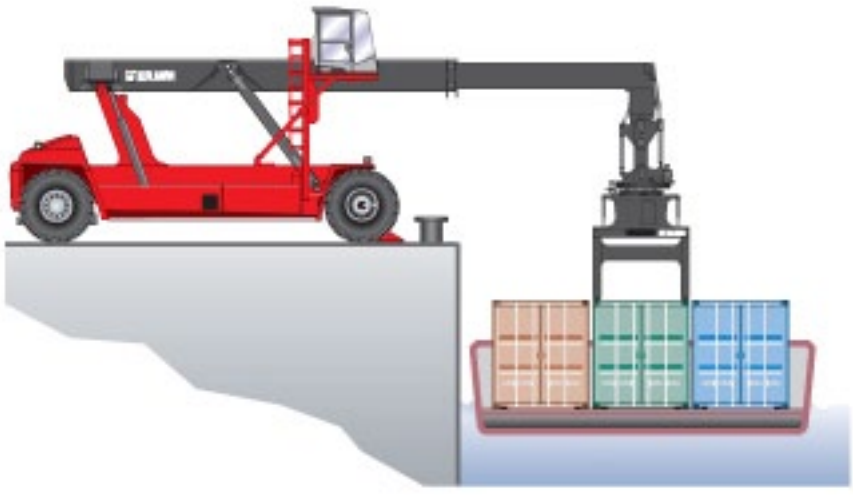
When handling containers the top lift function will be used and the unit will be operated as a reachstacker dedicated for top lift container handling. Apart from that the unit can handle a trailer in first and second rail by using the lifting legs for bottom lift.

Container transport on canals and rivers by barge is an environmental-friendly and growing transport mode. The considerable capacity at long load centres and the option to get an extended boom nose facilitates handling of containers when loading/unloading a barge. The extended nose makes it possible to pick containers below ground level when the machine is placed on the quay-edge. The unit can reach up to three containers deep from its position.

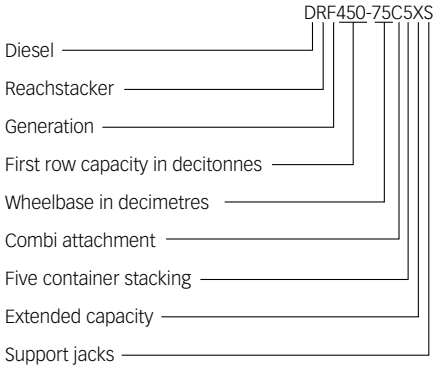
Small external dimensions in proportion to capacity, good manoeuvrability combined with an extensive degree of freedom allowed by the lifting equipment make few operations too heavy or too complicated. By using the lifting equipment to get in position instead of adjusting the position of the machine, the wear on the unit and the ground surface will be minimal. This will also improve the work efficiancy.

Any driver with the ability to take advantage of the machines versatility and power will find a flexible tool for Intermodal handling at lowest possible operating and maintenance costs.





Model designation



Maximum lifting capacity in confined spaces

The chassis and lifting equipment have been developed to ensure the best possible performance, strength and userfriendliness. The nature of the working environment and capacity requirements at different load centres determine which reachstacker model that is the most suitable.

Lifting boom

The lifting boom carries the weight of the load. The design has been optimised using computer simulations and extensive field tests. The powerful execution in high tensile steel has a minimal number of welds for maximum strength. The boom and the lifting cylinders are fitted on the frame with spherical plane thust bearings. The width of the rear fixture (boom suspension) increases the overall rigidity and the visibility backwards.

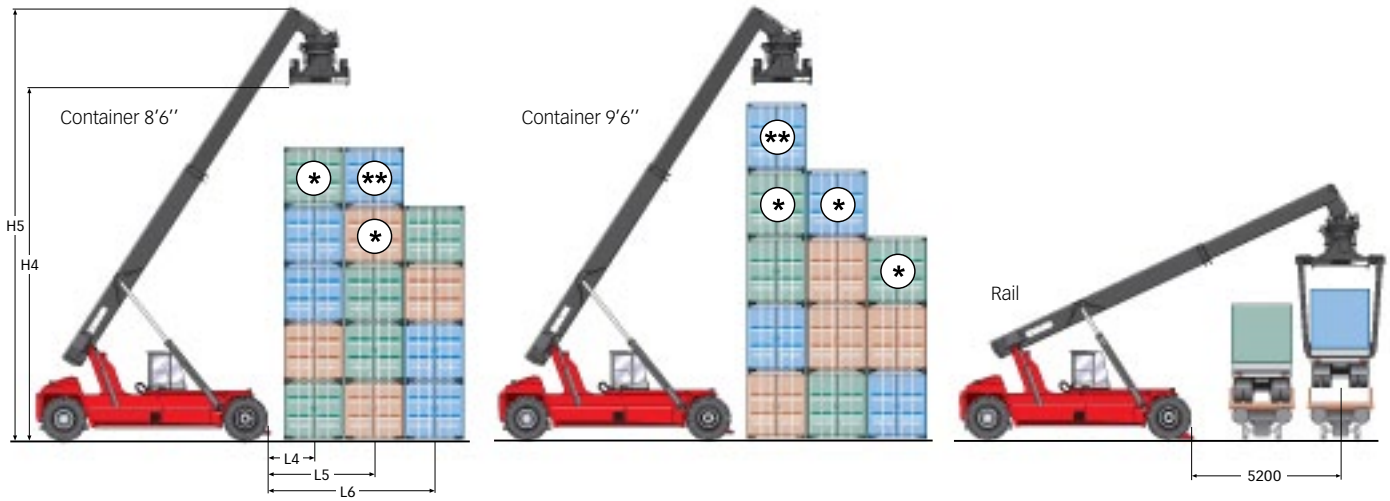
The boom has two sections, the inner and outer boom. The sliding plates between the inner and outer boom don't require lubrication. The cable-chain, which leads hydraulic hoses and cabling to the attachment, is made of maintenance-free plastic.

Lifting boom hydraulics

Oil is fed to the boom functions by load sensing pumps. To reduce pressure drops, wide hydraulic hoses have been used for the boom functions. A wider hose produces a lower flow rate with the same volume, thereby reducing friction and heat development. The blocking valves on the lifting and extension cylinders block the oil flow when the boom functions are not in use, which secures the boom position. The base of the lifting cylinders has a design that produces smooth stopping and starting movements. The boom's lifting and extension motions are damped in the end positions for reduced wear and greater comfort.

Rotator

The rotator is fixed in the inner boom and enables the container to be rotated. The rotator consists of an upper and a lower yoke joined with a powerful bearing. Rotation is enabled by two hydraulic motors, which drive a gear-ring. Two hydraulic dampers help prevent the container from swinging lengthwise. The damping cylinders can also be used to tilt the attachment via hydraulic pressure.



Capacity	Container 8'6"			Container 9'6"			Rail	Lifting height		Load centre		
	1:st row	2:nd row	3:rd row	1:st row	2:nd row	3:rd row	2:nd row	H4 (mm)	H5 (mm)	L4 (mm)	L5 (mm)	L6 (mm)
DRF400-60C5	38*/40	25**	10	37**/40*	25*	10*	15	14900	18100	1965	3815	6315
DRF450-60C5X	42*/45	32**	14	41**/44*/45	32*	14*	20	15000	18200	1865	3815	6315
DRF450-65C5X	42*/45	33**/34*	16	41**/44*/45	34*	16*	22	15000	18200	1865	3815	6315
DRF450-70C5X	45*	36**/38*	20	43**/45*	37*/38	20*	26	14900	18200	1865	3815	6315
DRF450-70C5XS	45*	36**/38*	20	43**/45*	37*/38	20*	26	14900	18200	1865	3815	6315
DRF450-70C5XS (SJD)	45*	36**/38*	27	43**/45*	37*/38	27*	32	14900	18200	1865	3815	6315
DRF450-75C5XS	45*	40**/42*/43	24	45**	41*/43	24	30	15000	18400	1865	3815	6315
DRF450-75C5XS (SJD)	45*	40**/42*/43	32	45**	41*/44	32*	37	15000	18400	1865	3815	6315

(SJD) = Support jacks down
For more detailed information please advice the technical Data Sheet

Combi attachment

With a combined top- and bottom lift attachment the machine can handle both containers and trailers without any adjustments. When handling containers the top lift function is used. The attachment is then firmly attached to the container during lifting. This is done with four twist-locks which rotate, thereby gripping the container's corner fittings. The attachment can easily be adapted to different container standards. A hydraulic motor drives the spreader function via chains.

The lifting legs mounted on the attachment are especially adapted for bottom lift of trailers, with dimensional positions, according to international standards. The legs can easily be lowered down when needed. Front and rear legs can be lowered independently of each other when loading. Its strike plates fit into the bottom lift pockets of the trailer. For safe trailer handling sensors are fitted on the strike plates, and a indication lamp panel tells the operator when the load is secured.

Independently if you handle containers or trailers the load can be shifted sideways to facilitate loading and unloading or to balanced uneven loads. The hydraulic levelling ensures that twist-locks or strike plates find their right locations if the load is leaning. Four hydraulic cylinders perform the hydraulic levelling.

Attachment and rotator hydraulics

The functions are fed with a constant pressure, which means there is no pumping of hydraulic oil when the functions are not in use. One valve serves all the hydraulic functions on the attachment. The valve ensures that each hydraulic function is fed the exact amount of oil needed to optimise the speed of the functions' movements. The top lift functions are damped in its end positions.

The trailer legs´ hydraulic cylinders are fed from the single valve that controls all functions of the attachment via two additional directional valves. The directional valves controls one pair of legs each, left respectively right side. Hydraulic cylinders performs the lowering and clamping functions.

Chassis

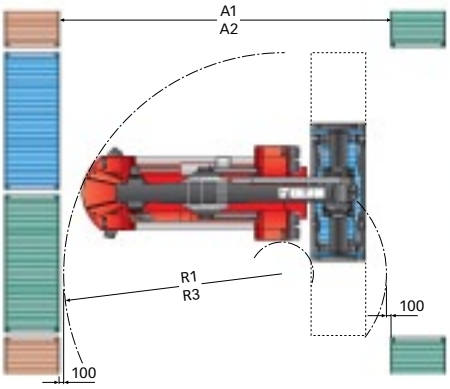
The frame forms the basis of the machine's lifting and manoeuvring characteristics. The frame's beam construction, along with its width, makes the reachstacker stable, torsion resistant and service-friendly.

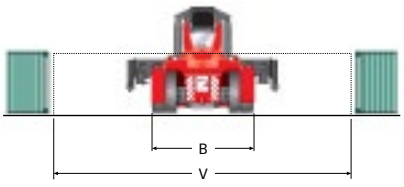
Firstly, a large number of computer simulations have been run in order to eliminate critical tensions under various kinds of strain. The simulations were characterised by uncompromising demands on the fundamental principles of stability, manoeuvrability and visibility. Secondly, the machine has been tested extensively in the field to fully ensure its dynamic strength.

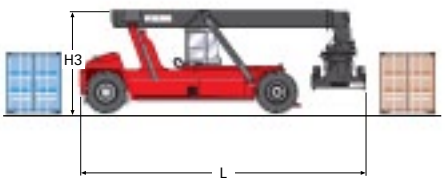
The reachstacker is available with a variety of wheelbases to fulfil demands on lifting capacity in relation to manoeuvrability and operating economy in the best way.

Increased capacity

In some cases, high capacity requirements in the second and third container row, or on the far rail track, call for the benefit of support jacks. In other cases, it may be the restricted handling space that determines the most suitable model.







Capacity	Aisle width (mm)		Turning radius (mm)		Main dimesions (mm)						Service weight (kg)
	A1 - 20 ft	A2 - 40 ft	R1 - 20 ft	R3 - 40 ft	B	V	L	H3	Clearance	Wheels	
DRF400-60C5	11200	13600	8100	9400	4150	6055-12185	11200	4500	250	18.00x25/40	72700
DRF450-60C5X	11200	13600	8100	9400	4150	6055-12185	11200	4600	300	18.00x33/36	81100
DRF450-65C5X	11600	13600	8500	9400	4150	6055-12185	11700	4600	300	18.00x33/36	80500
DRF450-70C5X	12100	13600	9000	9400	4150	6055-12185	12200	4700	300	18.00x33/36	82800
DRF450-70C5XS	12100	13600	9000	9400	4150	6055-12185	12200	4700	300	18.00x33/36	84200
DRF450-75C5XS	12500	13600	9400	9400	4150	6055-12185	12700	4750	300	18.00x33/36	88100

No machine is better than its driver

The goal when developing the cabin has been to assure the driver the best conceivable safety, ergonomics and visibility.

Sound and vibration

The cabin is separately suspended and isolated from the frame with powerful rubber dampers. Effective shock absorption minimises vibration. The cabin is fitted with insulation material both inside and out. The maximum noise level inside the cabin is 72 dB (A) measured according to EN12053.

Ergonomics

Controls and instruments are intuitively positioned and work the way a driver would expect. Search lights in the buttons and switches make them easy to identify and use, even in darkness.

In the centre above the steering wheel is a display showing operating information, warning messages, fault codes etc. To the left of the display is the panel for warning and indication lamps.

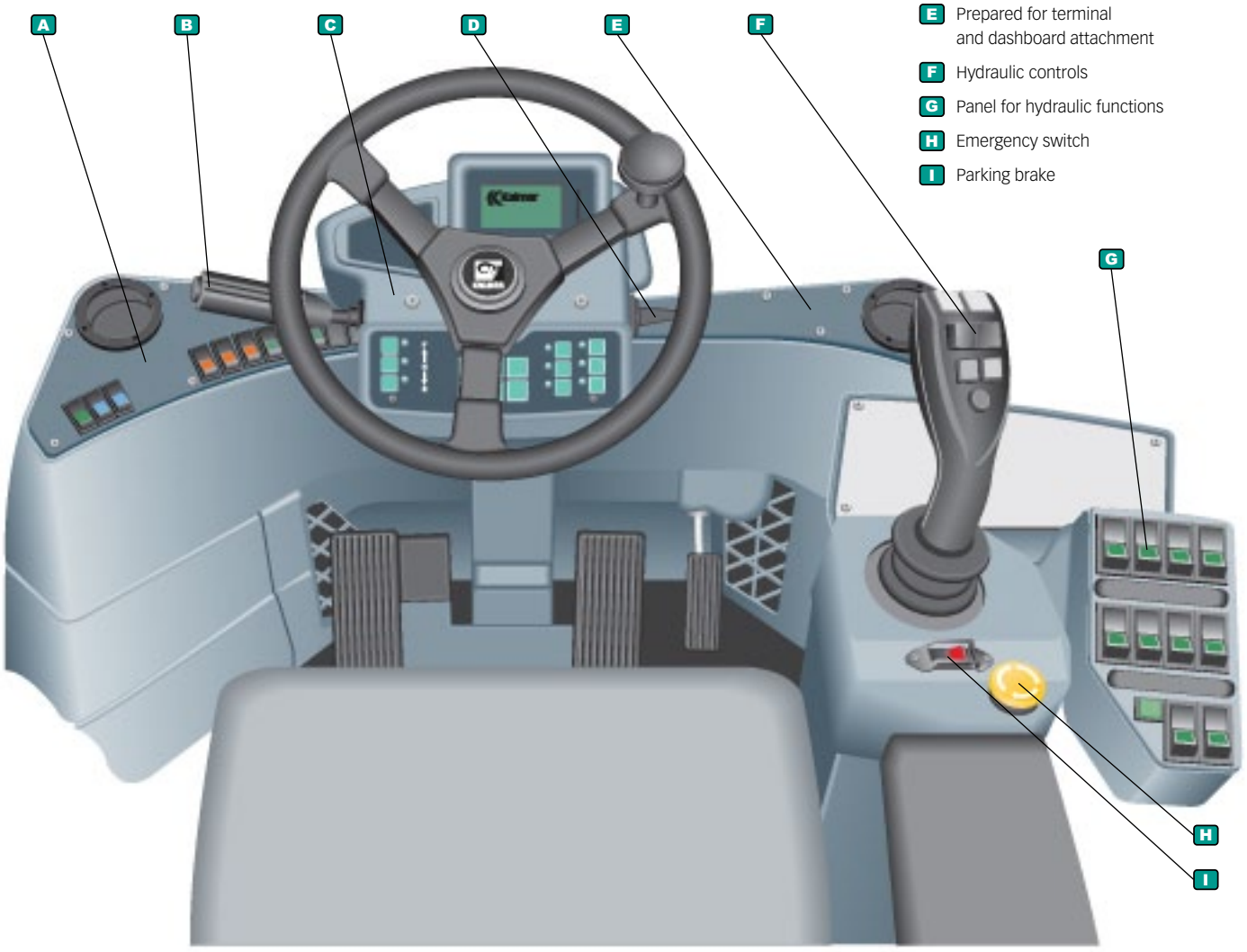
The driver's seat and control lever for the lifting functions can be adjusted to the optimum individual driving position. The pedals are designed for high comfort, with a hanging accelerator. The internal dimensions are otherwise generous, offering an open floor space.

Climate

An electronic climate control system comes as standard, as do filters for fresh air and re-circulation. An air cooling system comes as an standard. The cooling system provides a good cooling effect, even in extremely high temperatures. A pollen filter is available as an optional extra.

Hydraulically movable cabin

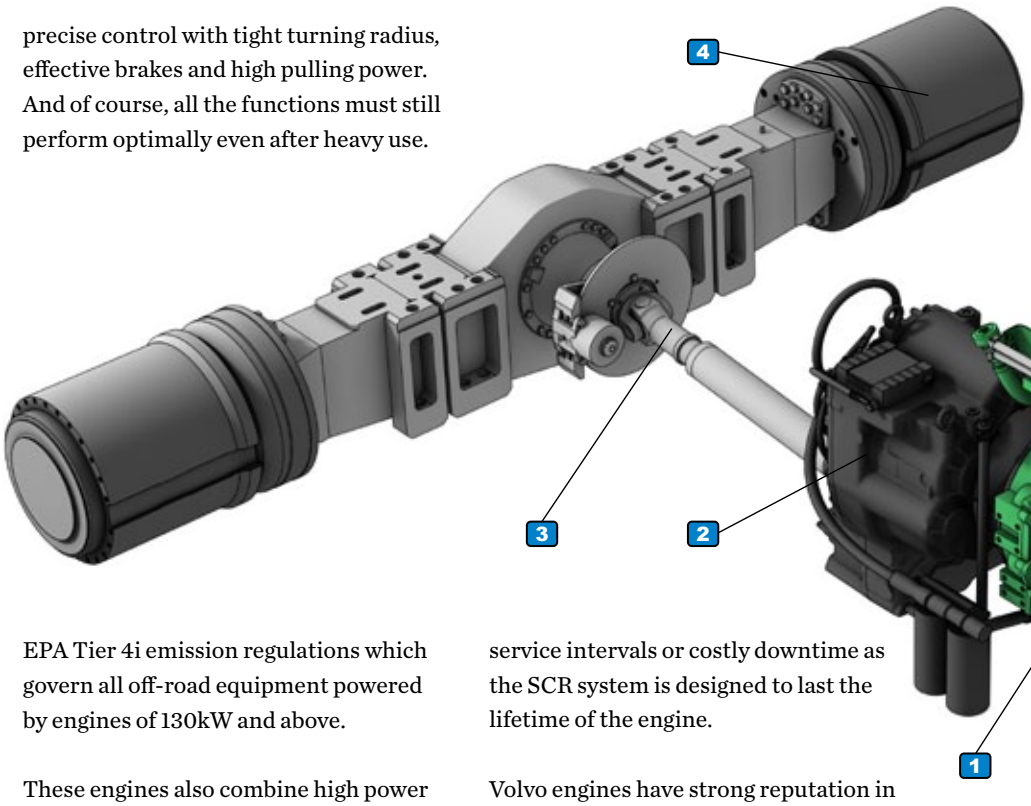
To enhance the overall visibility a movable cabin can be fitted as optional extra. Either hydraulically sliding or elevating cabin can be chosen. The cabin movements are controlled from the panel for hydraulic functions.



- A Left instrument panel
- B Gear selector and multi-function lever
- C Steering wheel panel
- D Direction indicators
- E Prepared for terminal and dashboard attachment
- F Hydraulic controls
- G Panel for hydraulic functions
- H Emergency switch
- I Parking brake

Performance is the result of how well the machines's functions work together

The efficacy of the lifting equipment is determined by a combination of lifting speed, capacity, visibility and user-friendliness. Lifting places heavy demands on the engine and working hydraulics, but lifting is only part of the operating cycle. Before the machine is in position to load or unload, the demands are instead on precise control with tight turning radius, effective brakes and high pulling power. And of course, all the functions must still perform optimally even after heavy use.



1 Engine

Kalmar products are fitted with the latest Volvo diesel engines which use Selective Catalytic Reduction (SCR) technology to deliver near-zero NO^x and harmful particulate emissions. This achieves compliance with the 2011 EU Stage IIIB and EPA Tier 4i emission regulations which govern all off-road equipment powered by engines of 130kW and above.

These engines also combine high power output and efficient fuel consumption. Furthermore, there is no increase in service intervals or costly downtime as the SCR system is designed to last the lifetime of the engine.

Volvo engines have strong reputation in container and industrial handling applications for delivering reliability and low running costs and the latest SCR system is well proven, having been used across the Volvo Group since 2006.

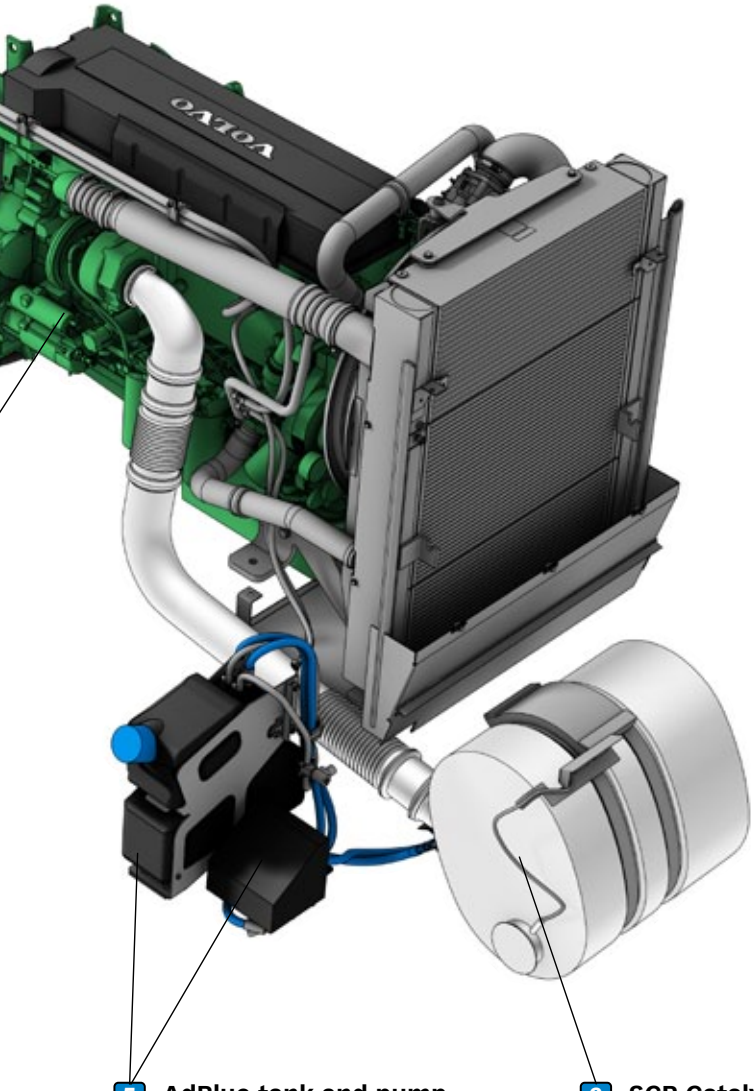
Drive train		**Standard**
Engine	Manufacturer, type designation	Volvo TAD1360VE
	Fuel – type of engine	Diesel – 4-stroke
	Rating ISO 3046 – at revs (kW – rpm)	256 – 1800
	Peak torque ISO 3046 – at revs (Nm – rpm)	1740 – 1400
	Number of cylinders – displacement (cm^3)	6 – 18.1:1
	Fuel consumption, normal driving (l/h)	20
	AdBlue consumption, normal driving (l/h)	0,7
Gearbox	Manufacturer, type designation	ZF – 5WG261
	Clutch, type	Torque converter
	Gearbox, type	Powershift
	Number of gears, forward – reverse	5 – 3
Alternator	Type – power (W)	AC – 3600
Starting battery	Voltage – capacity (V – Ah)	2×12 – 140
Driving axle	Type	Kalmar – WDB
Noise level, inside	LpAZ *according to EN12053*, Spirit Delta (dB(A))	70

Capacity	**Lifting speed (m/s)**		**Lowering speed (m/s)**		**Driving speed (km/h)**		**Gradeability (%)**			**Draw pull (kN)**
	unloaded	**at 70% of rated load**	**unloaded**	**at rated load**	**unloaded (F/R)**	**at rated load (F/R)**	**at 2 km/h, unloaded**	**at 2 km/h, at rated load**	**max, unloaded**	**max**
DRF400-60C5	0,42	0,25	0,36	0,36	25/18	21/16	39	21	39	362
DRF450-60C5X	0,42	0,25	0,36	0,36	27/20	21/16	31	18	40	312
DRF450-65C5X	0,42	0,25	0,36	0,36	27/20	21/16	31	18	40	312
DRF450-70C5X	0,42	0,25	0,36	0,36	26/19	19/15	30	17	39	312
DRF450-70C5XS	0,42	0,25	0,36	0,36	26/19	20/15	30	17	39	312
DRF450-75C5XS	0,41	0,24	0,35	0,35	25/18	19/14	28	15	35	312

2 Transmission

The transmission transfers power from the engine to the hydraulic pumps and drive line. The engine and gearbox control systems work together to find the optimum balance between power and fuel economy at any given point.

The transmission system consists of a torque converter and a gearbox. The gearbox is automatic, but can partly be shifted manually. The torque converter is a hydraulic coupling positioned between the engine and gearbox. The gearbox and torque converter work together via a joint hydraulic system.



5 AdBlue tank and pump

The AdBlue tank has a volume of 20 L and is equipped with a level sensor which notifies the driver when its time to fill up the tank. The filling of AdBlue is usually done together with the filling of diesel. The AdBlue tank is heated by engine coolant and the AdBlue hoses are heated by electricity to prevent freezing in cold climates. (Freezing point of AdBlue -11C).

6 SCR Catalyst

The SCR engines are optimised for efficient combustion, which provides the fuel efficiency and low particulate emission benefits. To combat the resultant NOx emissions, AdBlue is injected into the exhaust gas. The exhaust gas and AdBlue then enter a catalytic converter, which turns the NOx into harmless nitrogen gas and water vapour. The cleaning process of the catalyst is done automatically by the system during normal driving.

3 Drive line

The propeller shaft and drive axle transfer the power from the transmission to the driving wheels. The mountings on the propeller shaft are fitted with cross-flanges for optimum strength.

The drive axle multiplies torque in two stages, differential and hub reduction. The drive line only achieves maximum torque at the drive wheels, which spares the transmission.

4 Brakes

The brake circuit is separated from the hydraulic system and has its own tank, cooler and high-pressure filter. A temperature transmitter in the separate tank regulates the cooler fan.

The foot-brake valve, which controls the oil feed to the brakes, is sensitive enough so that the driver can brake optimally yet still gently. The parking brake is activated automatically when the ignition is turned off.

Steering system

The steering axle has been cut from a single piece of robust steel, which means as few maintenance-requiring parts as possible and high structural strength.

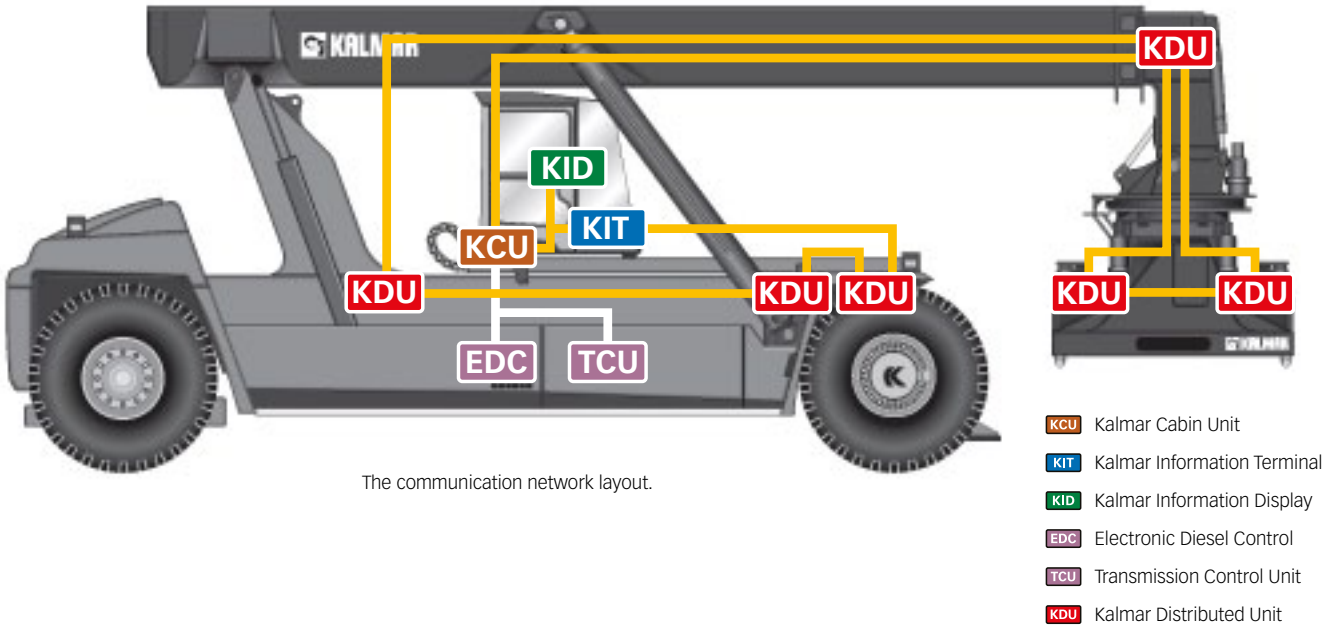
The hydraulics that feed oil to the steering cylinder is optimised for enhanced driving sensation. Orbitrol and the priority valve jointly provide gentle yet precise steering movements.

No machine is better than its driver

For the reachstacker to work perfectly a robust communication network is needed, along with a system that gives the functions power.

Two things are needed for a command initiated by the driver to result in a particular function, or for several functions to work together: power-feed and communication.

The power-feed supplies the machine's electrical and electrohydraulic functions with voltage, while the communication system controls and checks that the functions have been activated, waits in standby mode or indicates a fault.



The communication network layout.

Communication

The distributed power-feed and communication network consists of electrical components and a microcomputer-based system for controlling and monitoring the reachstacker's functions.

The most important components in the network are the control units (nodes). They distribute control of the machine's functions. Each node has its own processor. The nodes integrate with each other and all communication; control signals and signal information are sent via data buses.

The nodes transmit their signals in messages on the network. Each message contains several signals and has its own address. Any units that need to know the status of a signal listen out for the address of the signal's message. All the nodes in the network listen to each other.

CAN-bus is a two-wire transfer of data and a definition of a bus type. CAN-bus technology has been chosen because it provides a reliable, robust transfer of data and is difficult to disrupt. CAN-bus loops have been used in Kalmar machines since 1995.

The greatest benefit of using CAN-bus technology is that the amount of cabinling can be reduced. All that is needed to establish communication are two data-bearing leads and two leads for feeding the nodes' processors. The network loop for both the CAN-bus and the nodes' processor feed are redundant.

The Kalmar Cabin Unit (KCU) is the control node for the entire network. There are several nodes, called KDUs (Kalmar Distribution Units), in the network. Each node is positioned near to the functions it is designed to deal with. With certain optional equipment, further nodes (KDUs) are connected to the existing network near to where the specific functions are located.

The Transmission Control Unit (TCU), which is the gearbox node, deals with the gearbox. The unit is connected in a separate CAN-bus loop with the EDC engine node (Engine Diesel Control) and KCU. The engine node controls the fuel injection and receives its control signals from its own transmitters on the engine.

Power supply

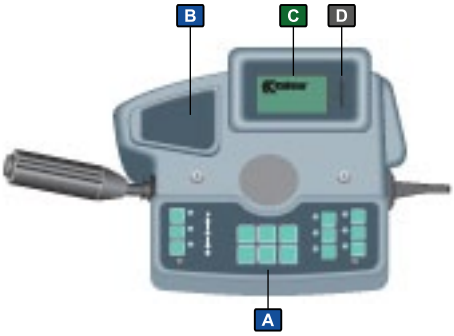
Power-feed for the functions differ from the feed required for communication and feeding of the nodes' processors.

Each distribution unit (node) in the distributed network is fed voltage from one of the power distribution boxes. The distribution boxes are located inside the cabin and on one side of the frame. The distribution units (nodes) guide power from the distribution box to the required functions based on the instructions in the messages from the communication network.

Control functions

The driver and machine communicate via the Kalmar Information Terminal (KIT) and the Kalmar Information Display (KID). Control signals initiated by the driver are transferred to the KCU, which handles all incoming signals from the controls in the cab, and sends messages out into the communication network.

The system also distributes information to the driver such as alarm warnings, operating details and action-guided information. In these cases, messages are sent from one of the nodes in the network, captured by the KCU, and then presented in the KID or the panel for warning and indication lamps. The KID shows information from the control units in the form of messages, status, fault indication etc.



A Keyboard (KIT)
B Warning and indication lamps (KIT)
C Display (KID)
D Alarm indicator

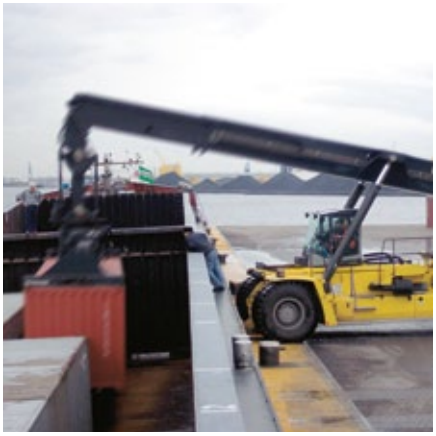
Reliability

High reliability is achieved by reducing the number of components and ensuring each individual component maintains a consistent high quality.

One of our guiding principles in designing the reachstacker was to minimise the number of potential sources of error. Therefore, the machine consists of as few components and moving parts as possible. The functionality and operational reliability of each component is assured by extensive testing.

The machine's structure

Kalmar has been making reachstackers since the mid-1980s. There are a lot of Kalmar machines around the world, used in all kinds of climates. Overall, this has helped build our completely unique experience of this machine type. The machine's lifting equipment, frame and structure has been fine-tuned over the years, and today we can offer the best balance of performance and operational reliability in the machine's mechanical components and structure.



Hydraulic components and couplings

The number of hydraulic components and hydraulic couplings has been minimised. The main valve has an integrated servo, which helps increase control of the oil flow and keep the number of components to a minimum.

The boom's lifting and extension cylinders are fitted with double gaskets. Moreover, the machine is fitted with extremely reliable, well-sealed ORFS (O-Ring Face Seal) couplings in all the hydraulic hoses as standard.

Temperature control and hydraulic cleanliness

In order to maintain optimum functionality in the hydraulic system even under extreme operating conditions, cleaning and cooling of the hydraulic oil is highly efficient. The brake circuit is separated from the rest of the hydraulic system and is fitted with its own cleaning process and cooling system.

Redundant communication network

A network of distributed control units (nodes) using limited cabling and fewer couplings, meaning fewer sources of error.

The power-feed for each node is independent of the other nodes, which help prevent other nodes from being disrupted, should one stop working. The same applies to the transfer of control signals. Both the power-feed and control signal transfer are redundant, so that power or signals always have two paths to choose for maintaining communication, thus offering extra safety and reliability.

Service friendly

Few, short stoppages for service and maintenance minimise loss of production time.

In the longer term, the reachstacker's reliability is a crucial parameter in the overall handling economy. At the same time, each machine must be service-friendly so it can be maintained and repaired quickly and easily, thereby maintaining high reliability.

Kalmar machines have have always been very service friendly as we continuously strive:

- to minimise the number of components
- to choose the highest quality components throughout
- to use lubrication-free options wherever possible
- to optimise accessibility for service and maintenance

Service accessibility

The top covers on the frame can be removed quickly and easily. Most of the main components are easily accessible from above in the broad frame when inspection and maintenance need to be carried out. The cabin can also be moved lengthwise thus further increasing ease of access.



The boom requires a minimum of mainenance due to lubriaction free sliding plates.



Filters are easy accessible.



The new engines have long sevice intervals.



The wide frame gives easy access for maintenace.



The control and monitoring system will minimise downtime due to fast fault identification. Information regarding malfunctions and need of maintenance wil be presented directly in the informaiton display.

Fault identification

The control and monitoring system offers completely new opportunities for fault identification. There are over 400 fault codes and 140 diagnostics menus built into the system.

The overall aim is to make stoppages as few and as short as possible. With this machine, Kalmar has created the best possible balance between performance and operating economy – in other words, a low cost over the entire life cycle of the reachstacker.

Notes

Global presence and local service bring
our products and solutions closer to our customer.





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