Kalmar DCE280-330RoRo
Roro lift trucks 28 – 33 tonnes

Technical Information

Introduction

Efficient RoRo handling

Handling unitised cargo and containers inside vessels put special demands on machine versatility, manoeuvrability and lifting capacity.

Kalmar was the pioneer manufacturer of lift trucks especially designed for operations onboard vessels. Like today the machines travel around the globe and are used during transhipments of cargo and containers on different sites.

RoRo operations are one of the most demanding challenges for handling equipment. The machine has to cope with all kinds of cargo and containers, operate fast and gentle in confined spaces and often on slippery and leaning driving surfaces. Versatility, manoeuvrability and user friendliness is therefore key factors in efficient handling.

This RoRo machine is very simple to operate and it has impressive capacity in proportion to its limited dimensions and tight turning radius. Our aim is letting the driver focus on the handling task at hand instead of the machine. We strongly believe that good communication between man and machine is vital for efficiency and safety. This is the reason why we have put so much work in developing the driver environment, cabin climate and the sensation of driving.

Kalmar helps you finish your task in time. With the Kalmar DCE RoRo you will do more with less effort.

Model designation

DCE330RoRo

- Diesel
- Counter-balance truck
- Generation
- Lifting capacity in deciton
- Roll on – Roll off

The best machine for RoRo handling is a machine that can combine high demands on capacity and manoeuvrability at the same time. A RoRo machine must be capable of handling different type of goods and containers without any limitations in manoeuvrability.

Chassi

The chassis forms the basis of the machine's lifting and manoeuvring characteristics. The beam construction makes the machine stable, torsion resistant and service-friendly. The chassis is built of fully welded steel profiles that provide a rigid design with extremely strong mounting points for the drive axle and the lifting equipment. Stress concentrations has been eliminated for optimum tensile strength.

The machine is available in two wheelbases to fulfil different demands on lifting capacity in relation to manoeuvrability and operating economy.

Improved lifting hydraulics

One of the main goals has been to design a simple but sophisticated hydraulic system. Therefore, the new system has only one main valve, fed by one single and one double vane pump. The main valve feed the lifting and tilt functions as well as the carriage functions. The single vane pump feed the main valve via a priority valve, which serves the steering function. When the steering function not is used the hydraulic pressure generated by this pump may be used to increase the lifting performance.

The hydraulic system has its own cooler, which ensures that the working temperature of the system is kept within the optimum values. Oil from the main valve is led back to the hydraulic oil tank through a cooler.

Mast

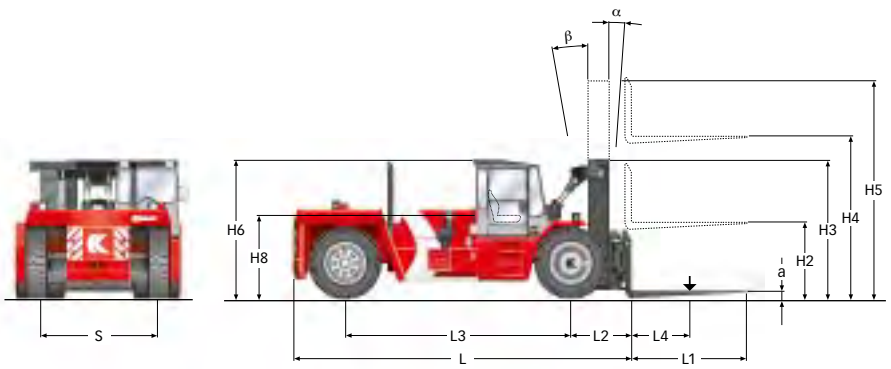
The machine is equipped with a compact free lift mast in high tensile steel. This successful concept allows efficient stuffing up to the decks' full height, which is an demand on many RoRo vessels. The free lift eliminates the lifting height limitations caused by a standard mast solution.

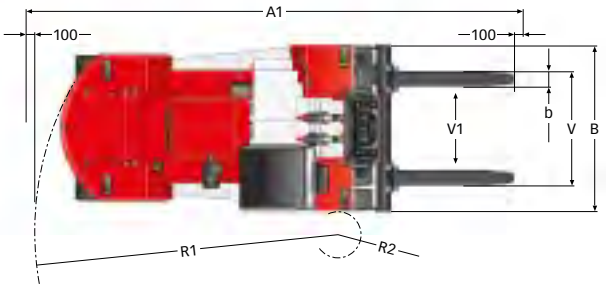
Carriage

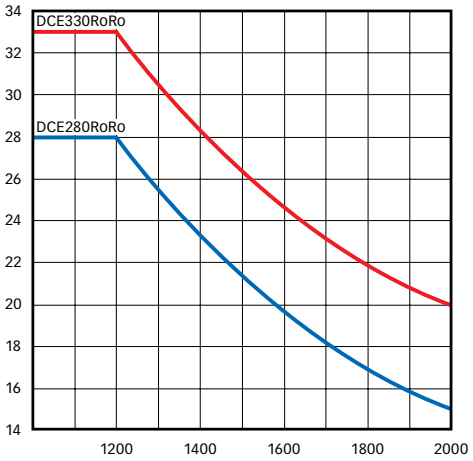
The carriage has all necessary functions for efficient RoRo-handling. The design and functions are developed to meet the extreme demands on reliability and versatility in this kind of operations.

Forks

The forks are suitable for handling wood and general cargo and fit into the lifting pockets of a container. The forks are designed for optimum stability and flexibility when handling different types of goods and containers.







Capacity and dimensions					DCE280RoRo	DCE330RoRo
Lifting	Lift capacity	Rated		kg	28000	33000
		Load centre	L4	mm	1200	1200
Dimensions	Truck	Truck length without forks	L	mm	6550	7065
		Truck width	B	mm	3410	3410
		Truck height	H6	mm	2830	2830
		Seat height	H8	mm	1850	1850
		Distance between centre of front axle – front face of fork arm	L2	mm	1245	1245
		Wheelbase	L3	mm	4250	4750
		Track (c-c) front – rear	S	mm	2440 – 2540	2440 – 2540
		Turning radius, outer	R1	mm	5900	6400
		Turning radius, inner	R2	mm	450	450
		Ground clearance, min.		mm	200	200
	Min. aisle width for 90° stacking with forks		A1	mm	9600	10100
	Standard duplex mast	Lifting height	H4	mm	3200	3200
		Freelift	H2	mm	1550	1550
		Mast height, min.	H3	mm	2840	2840
		Mast height, max.	H5	mm	4490	4490
		Mast tilting, forwards – backwards	α – ß	°	4 – 10	4 – 10
		Ground clearance, min.		mm	200	200
	Forks	Width	b	mm	300	300
		Thickness	a	mm	110	110
		Length of fork arm	l	mm	2400	2400
		Width across fork arms, max.	V	mm	3150	3150
		Width across fork arms, min.	V	mm	1650	1650
		Sideshift ± at width across fork arms	V1 – V	mm	400 – 2350	400 – 2350
Weight	Service weight			kg	38700	40950
	Axle load front	Unloaded		kg	17500	18500
		At rated load		kg	61600	69200
	Axle load back	Unloaded		kg	21200	22300
		At rated load		kg	5100	4600
Misc.	Wheels/tyres	Type, front – rear			Pneumatic	Pneumatic
		Dimensions, front – rear		inch	16.00×25 – 16.00×25	16.00×25 – 16.00×25
		Number of wheels, front – rear (*driven)			4* – 2	4* – 2
		Pressure		MPa	1,0	1,0
	Hydraulic pressure	Max.		MPa	20,0	22,0
	Hydraulic fluid volume			l	330	330
	Fuel volume			l	415	415

No machine is better than its driver

Kalmars goal while 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 vibrations. The cabin is fitted with insulation material both inside and outside. The maximum noise level inside the cabin is 70 dB (A) (EN12053, cabin).

Ergonomics

Controls and instruments are intuitively positioned and work the way a driver would expect. Search light buttons and switches are easy to identify and use, even in obscure conditions.

The monitoring display (Kalmar Information Display, KID), located centrally above the steering wheel, shows 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 levers for the lifting functions can be adjusted to match the optimum position for each individual driver.

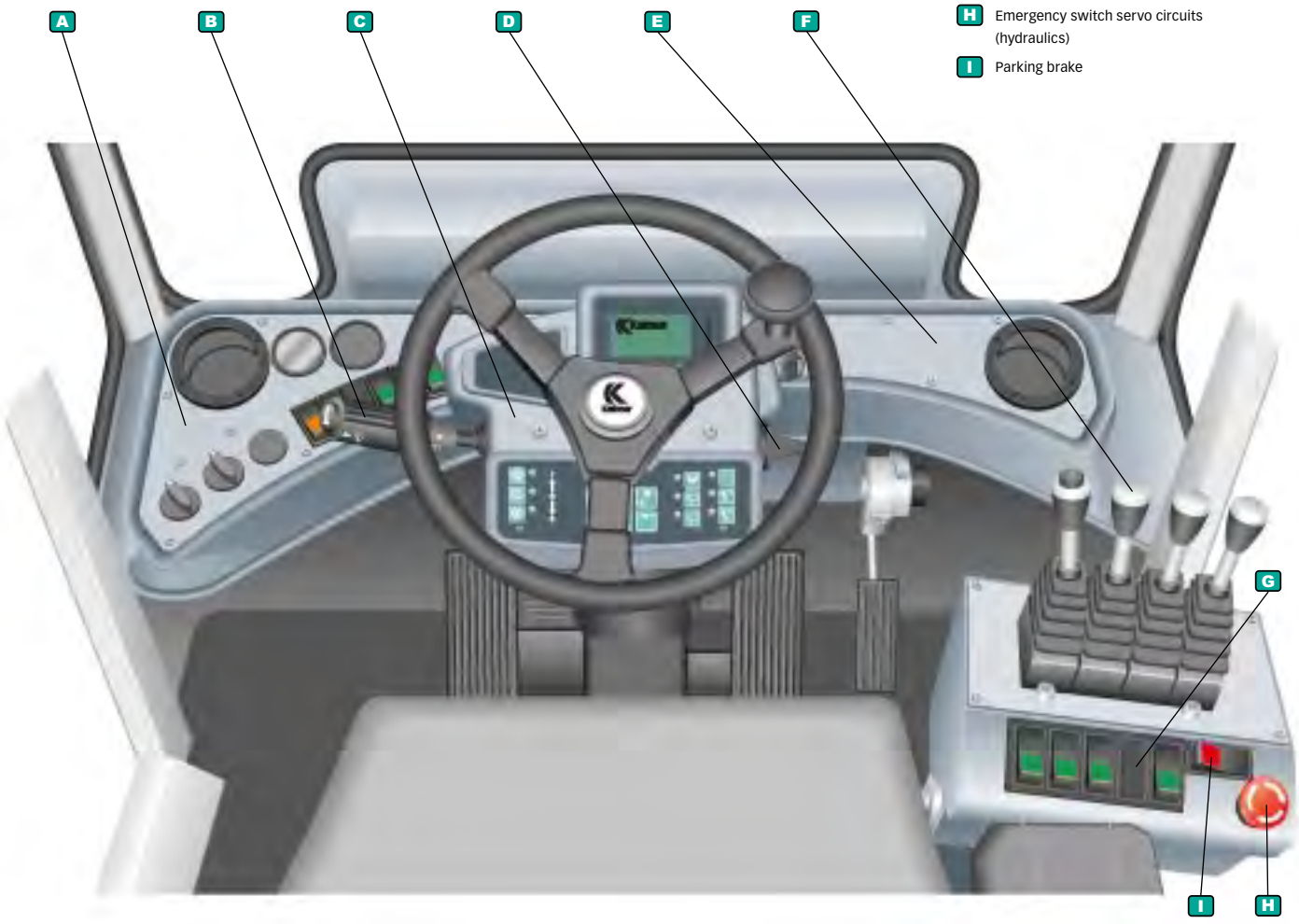
An adjustable steering column and rotateable driver seat is available as an option.

The pedals are designed for high comfort, with a suspended accelerator. The internal dimensions of the cabin are generous, offering an open floor space.

Climate

An electrical controlled heating and ventilation system comes as standard, as do filters for fresh air and re-circulation. Air conditioning is available as an option, it provides a good cooling effect even at high outside temperatures. A pollen filter is available as an optional extra.

- 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 servo circuits (hydraulics)
- I Parking brake



Technical performance is the result of how well the machine's functions interact.

The efficiency of the machine is determined by how well all functions work together in real settings. Lifting speed, capacity, visibility and user-friendliness in handling are all key ingredients. Prior to the machine gets in position to load or unload, the demands are instead concentrated on precise control with tight turning radius, high speed, effective brakes and high pulling power. And of course, all the functions must still perform optimally even after heavy use.

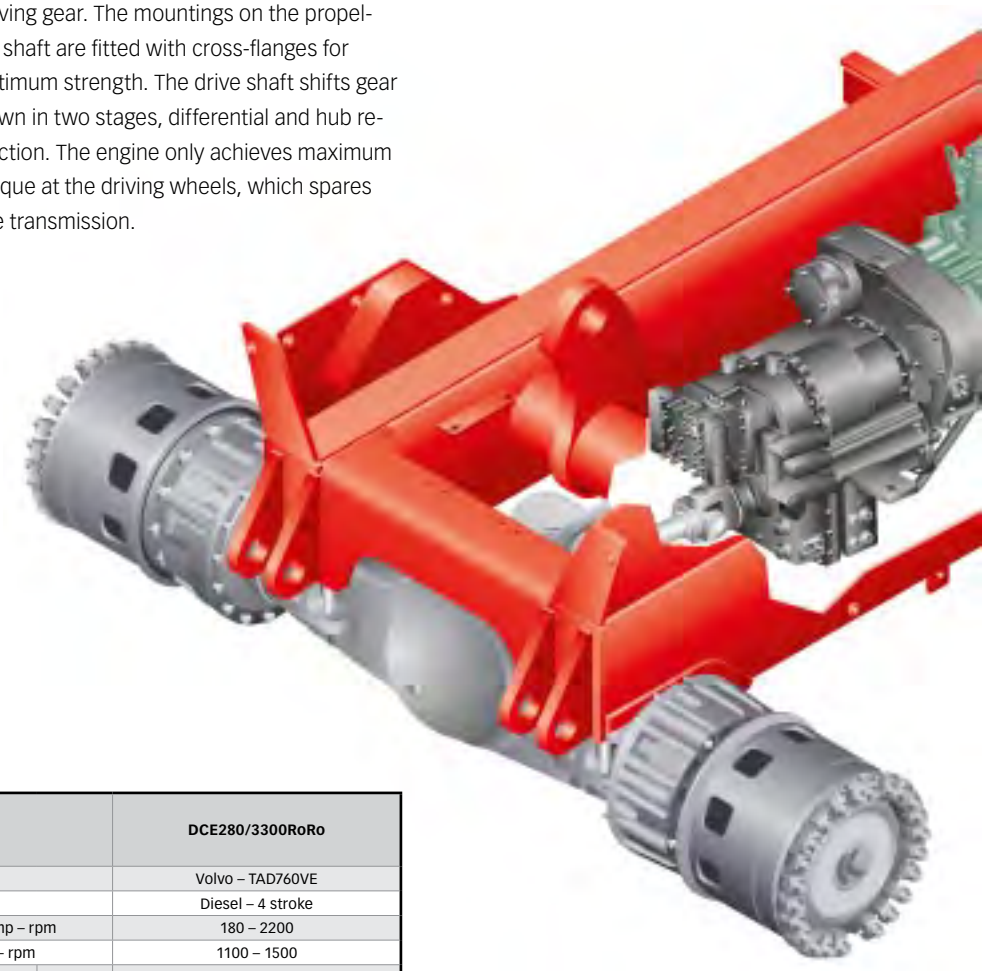
Transmission

The transmission transfers power from the engine to the hydraulic pumps and the drive line. The engine and gearbox have a completely new joint control system which makes them work together as one integrated unit. This new technology makes it possible to reach the optimal balance between power and fuel economy at any given point. This spares both the engine and transmission and also results in better and smoother performance.

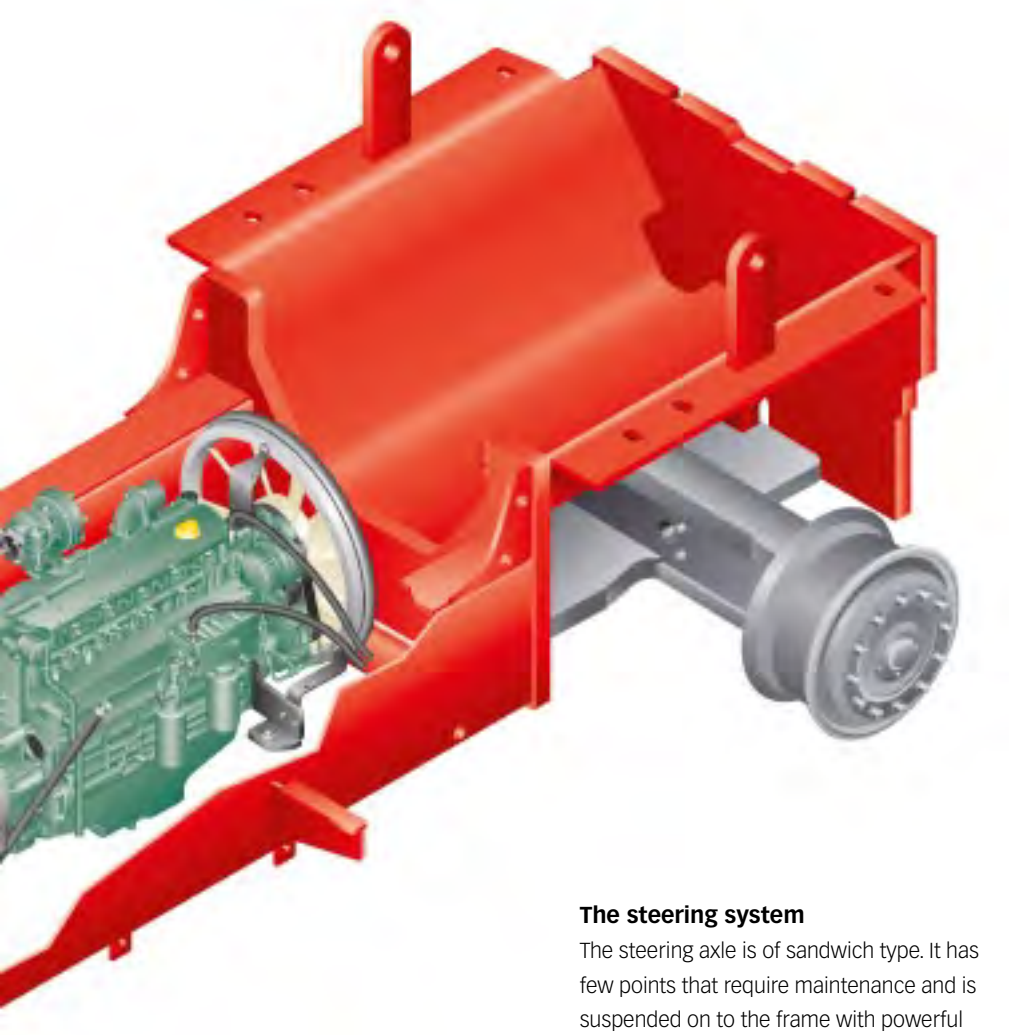
The transmission system consists of a torque converter and a gearbox. The gearbox is automatic, but can partly be shifted manually. The torque converter is a hydraulic coupling positioned between the engine and gearbox. The gearbox and torque converter work together via a joint hydraulic system.

The drive line

The propeller shaft and drive shaft transfer the power from the transmission to the driving gear. The mountings on the propeller shaft are fitted with cross-flanges for optimum strength. The drive shaft shifts gear down in two stages, differential and hub reduction. The engine only achieves maximum torque at the driving wheels, which spares the transmission.



Drive train				DCE280/3300RoRo
Drive train	Engine	Manufacturer – type designation		Volvo – TAD760VE
		Fuel – type of engine		Diesel – 4 stroke
		Rating ISO 3046 – at revs	kW/hp – rpm	180 – 2200
		Peak torque ISO 3046 – at revs	Nm – rpm	1100 – 1500
		Number of cylinders – displacement	cm^3	6 – 7150
		Fuel consumption, normal driving	l/h	16
	Transmission	Manufacturer – type designation		Clark TE17000
		Clutch, type		Torque converter
		Gearbox, type		Powershift
		Numbers of gears, forward – reverse		3 – 3
	Alternator	Type – power	W	AC – 2240
	Starting battery	Voltage – capacity	V – Ah	2×12 – 140
	Driving axle	Type		Differential and hub reduction



The engine

The new Volvo engine provides power for driving and the working hydraulics. The engine is a low-emission turbo diesel with electronical controlled injector regulation and intercooler.

In every situation, the new engine is more powerful than the previous one, especially at low revolutions. The design of the combustion vessels, along with the precise fuel injection control, ensures more efficient combustion. All these characteristics reduce the environmental impact. The engine complies with the stringent legal requirements of Tier 3.

The engine and transmission cooler is built as a single unit and uses the same fan. The engine cooler's separate expansion vessel is fitted with a gauge that indicates low coolant level.

The steering system

The steering axle is of sandwich type. It has few points that require maintenance and is suspended on to the frame with powerful rubber bearings. The hydraulics that feed oil to the steering cylinder are optimised for enhanced driving sensation. Together, the orbitrol and the priority valve provide gentle yet precise steering movements.

The brakes

The wet disc brakes can cope with heavy use without fading or ware and requires a minimum of maintenance. A fixed vane pump feeds the brake system. The brake valve that feeds the disc brakes is sensitive enough to secure an optimum balance between maximum braking power and gentle handling.

The parking brake will be activated automatically when the engine is turned off. Pushing a button can also activate the parking brake.

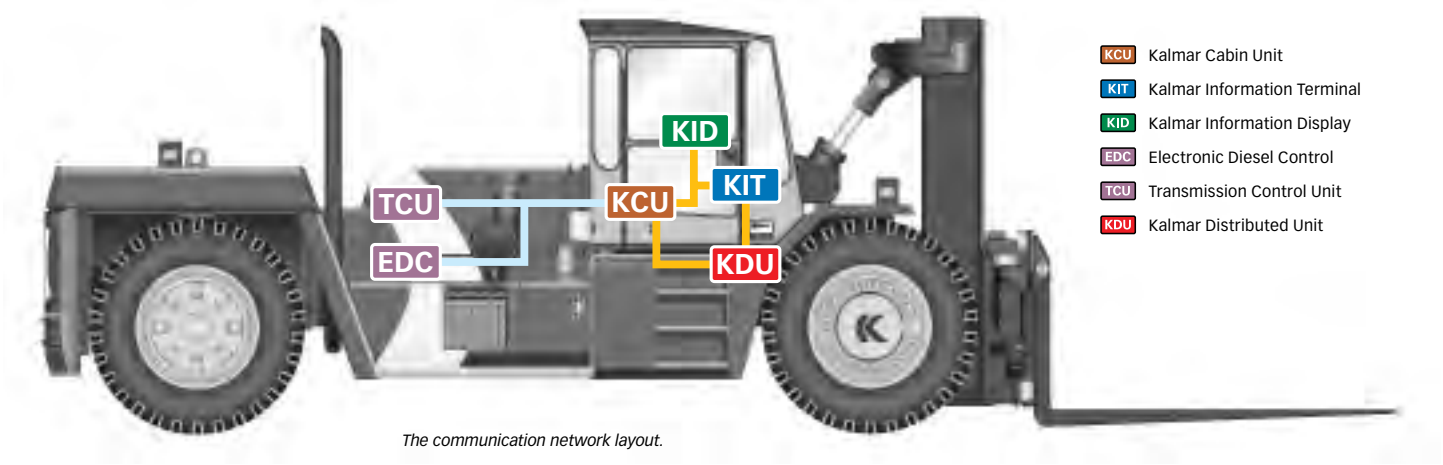
Performance					DCE280RoRo	DCE330RoRo
Performance	Lifting speed	Unloaded		m/s	0,25	0,20
		At rated load		m/s	0,20	0,13
	Lowering speed	Unloaded		m/s	0,20	0,17
		At rated load		m/s	0,30	0,30
	Travelling speed, f/r	Unloaded		km/h	25/25	25/25
		At rated load		km/h	23/23	22/22
	Gradeability	Max	unloaded	%	58	53
			at rated load	%	32	28
		At 2 km/h	unloaded	%	39	36
			at rated load	%	22	19
	Drawbar pull	Max		kN	212	212

Intelligence

The distributed control systems.

The machine works perfectly through a robust communication network along with a system providing the functions electrical power.

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



The communication network layout.

Communication

The communication network and the distributed voltage-feed consists of electrical components and a microcomputer-based system for controlling and monitoring the machine.

The most important components in the network are the control units (nodes). 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; nodes in the network listen to each other.

CAN-bus is a two-wire transfer of data.
We have chosen the CAN-bus technology because it provides a reliable, robust transfer of data and is difficult to disrupt. The network loop for both the CAN-bus and the nodes' processor voltage-feed are redundant. CAN-bus have been used in Kalmar machines since 1995.

One of the great benefits of using CAN-bus technology is that the amount of cabling can be reduced. All that is needed to establish communication are two data-bearing leads and two leads for feeding the nodes' processors.

The Kalmar Cab Unit (KCU) is the control node for the network. The Kalmar Distribution Units (KDU) deals with all functions on the machine that is not related to the engine and transmission.

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

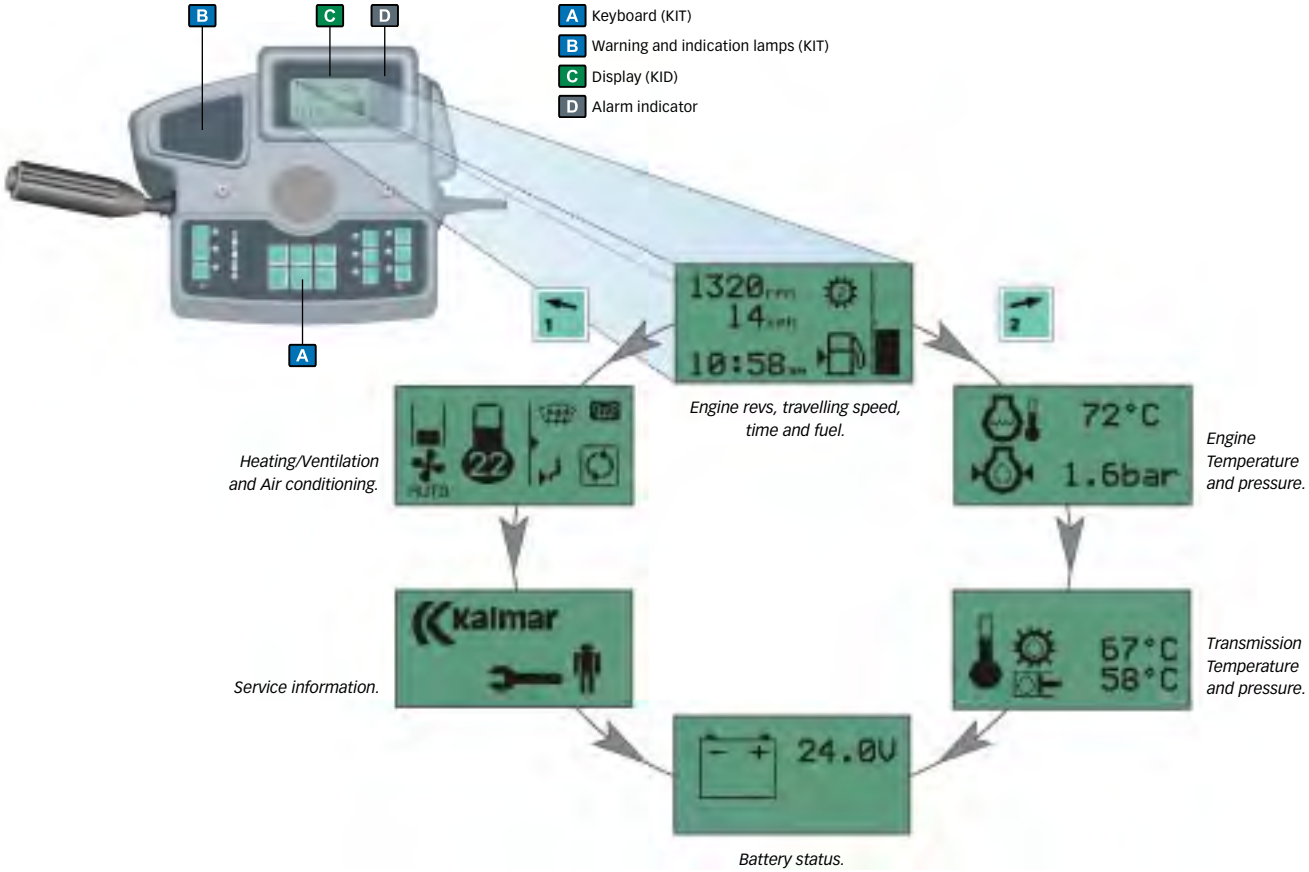
Voltage

Voltage-feed for the functions differs from the feed required for communication and feeding of the node processors.
Each distribution unit (node) in the distributed network is fed voltage from the power distribution boxes. 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 that handles all incoming signals from the controls in the cabin, and sends messages out on to the communication network.

The system also distributes information to the driver such as alarm warnings, operating details and action-guided information. The KID and KIT show information from the control units (KCU, KDU, TCU and EDC) in messages, status, fault indication etc.



Availability

High reliability achieved by individual component quality.

In Kalmar DCE RoRo, we have minimised 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 and a long experience of this type of operation.

The machine's structure

Kalmar has been making machines dedicated for RoRo operations since the 1960s. This has helped to build our unique experience of this type of machine.

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.

Redundant communication network

The control and monitoring system is newly developed (see the distributed control system). A network of distributed control units (nodes) contains less cabling and fewer couplings, which means increases the reliability.

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

Hydraulic components and couplings

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

The steering cylinder is fitted with double gaskets. Moreover, the machine is fitted with extremely reliable, well-sealed ORFS couplings in all the hydraulic hoses as standard.

All hydraulic hoses are fitted with ORFS-couplings.

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. A cooler fitted on the return line from the main valve. The return filters are fitted into the hydraulic tank easy accessible from ground level.

Few, short intermissions for service maximises up-time.

In the longer term, the machine's reliability is a crucial parameter in the overall handling economy. Each machine must be service-friendly to facilitate and minimize the time for daily inspection, maintenance and repairs, thereby assuring high reliability.

The Kalmar products have always been very service-friendly as we continuously strive to:

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

Service accessibility

Service points are grouped and easy accessible for daily inspections. Top covers on the instep to the cabin can be removed quickly and easily. From this position all main hydraulic components are accessible for service or maintenance operations.

Fault identification

The control and monitoring system offers completely new opportunities for fault identification. The overall aim is to make intermissions 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 RoRo lifttruck.

The air filter is easily accessible.

Daily inspection is simple and can be performed from ground level.

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

Cargotec *improves the efficiency of cargo flows on land and at sea – wherever cargo is on the move. Cargotec's daughter brands Hiab, Kalmar and MacGregor are recognised leaders in cargo and load handling solutions around the world. Cargotec's global network is positioned close to customers and offers extensive services that ensure the continuous, reliable and sustainable performance of equipment. Cargotec's class B shares are quoted on the NASDAQ OMX Helsinki. www.cargotec.com*

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