

# Kalmar DCF410CSG

## Toplift container handler 90,000 lbs



# Welcome

We'd like to introduce to you the new ultimate top-pick for ports and container terminals – the Kalmar DCFseries.

These heavy-duty container handlers were developed exclusively for the North American market. Built to provide what the most demanding American terminal operators have been asking for.

So what about the impressive benefits?



## The two basic elements in container handling

The decision to develop a "brand new" machine came after getting input from terminal operators around the country for a machine with superior performance characteristics. We then decided to build a toplift that would surpass all existing machines.

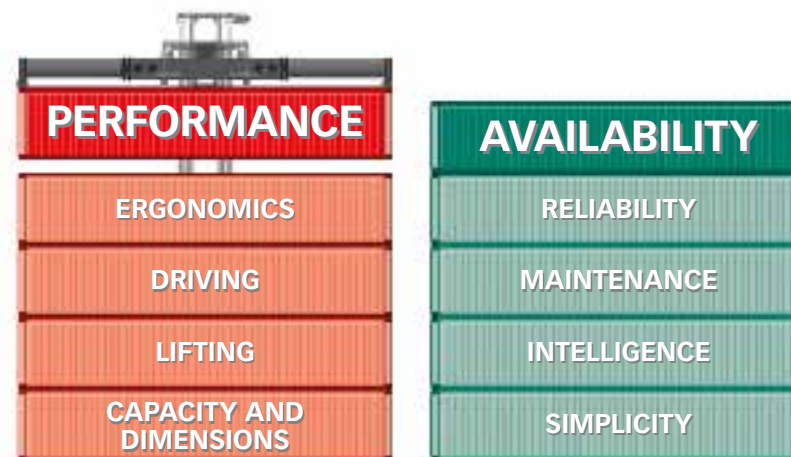
Drawing on our global experience we know that there are two basic elements in container handling that ensure success every day in every port and terminal. Two elements in the mind of operations managers, financial managers, purchasing managers, maintenance managers and so on.

These two elements were our top priority in the design and development of the Kalmar DCF.

### Technical solutions are only the tool. Not the goal.

There is new technology under the skin of the DCF, but it is there to provide the best everyday performance and availability.

We have examined and evaluated every nut, bolt and component to ensure we provided a machine with the highest possible specification.



When appropriate simple technical solutions were available we have applied them, and when the need was for more sophisticated systems we have installed them to boost your uptime and productivity.

The technical optimization of the Kalmar DCF means that you will get the best technology available but still have the feeling of having a reliable, simple, safe and hard working machine.

### Providing the highest possible throughput

This is what it's all about. But of course you have to add "at the lowest lifetime cost possible". To reach such a goal you need to focus on specific critical targets.

# The heart of top performance in top-lift handling

To obtain the maximum out of your investment, you can never underestimate the importance of the drivers' working environment. High throughput demands full driver concentration and efficiency to keep up the container moves, but also to avoid injuries and costly damages.

This is what ergonomics is all about. Being comfortable and aware.

The driver environment in Kalmar DCF is the comfortable Spirit Delta high visibility cabin; appreciated by professional drivers, proven on thousands of Kalmar container handlers all over the world.

### We focus on four important ergonomic areas:

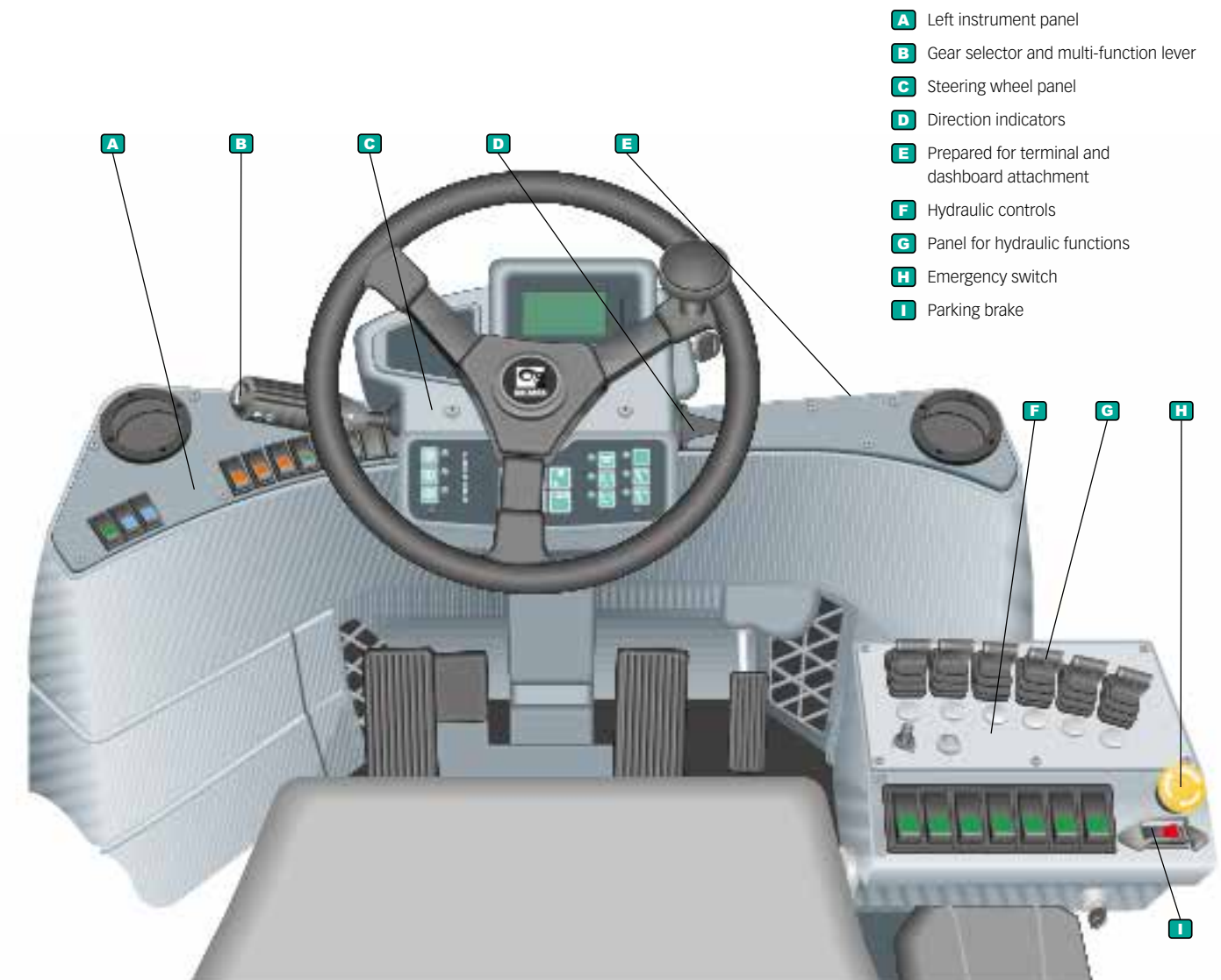
- Operation
- Visibility
- Sound and vibrations
- Climate

The result is a cabin where everything is optimized to improve driver performance.

### Consider this:

- Individually adjustable controls, steering wheel and seat.
- Intuitively positioned instruments.
- Switches and buttons with lights.
- Comfort pedals.
- Electronic accelerator.

- Central operation/warning display.
- Separately suspended and isolated cabin.
- Shock absorption to minimize vibrations.
- Maximum sound level inside is 70 dB (A).
- Generous interior dimensions and floor space.
- Optimized visibility – 360° all around.
- Electronically controlled heating/ventilation.
- Filters for fresh air and recirculation.
- High performance air conditioning system, optional.
- Pollen filter, optional.



- 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

# Matching your handling and throughput needs

The Kalmar DCF top-pick is designed from a clean sheet of paper to provide the pinnacle in customer oriented standards compared to any other machine available.

We analyzed all the main alternatives on the market, and designed a machine which meets or exceeds the specifications of the others – on the spec sheet and in reality.

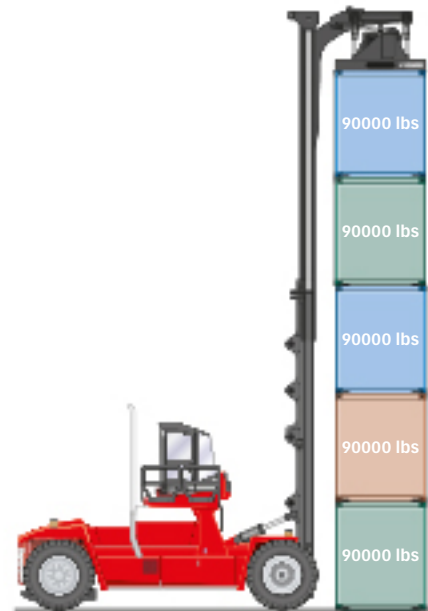
The DCF410CSG is optimized according to lifting capacity – stability – overall dimensions – weight – top-pick speed and driving performance.

The DCF410CSG allows container handling up to 90,000 lbs, 20'-40' containers and up to five high stacking at full capacity.

The design of the chassis, mast, carriage

and spreader has resulted in machines with very good dimensional-, stability- and operational characteristics.

In spite of its size and capacity the Kalmar DCF has a short turning radius. Together with the optimized visibility and good maneuverability it saves terminal space and makes the machine a smooth operator in confined aisles. The counterweight and lifting height requirements have been matched with a modern chassis to keep down the overall weight but with no sacrifice in stability.

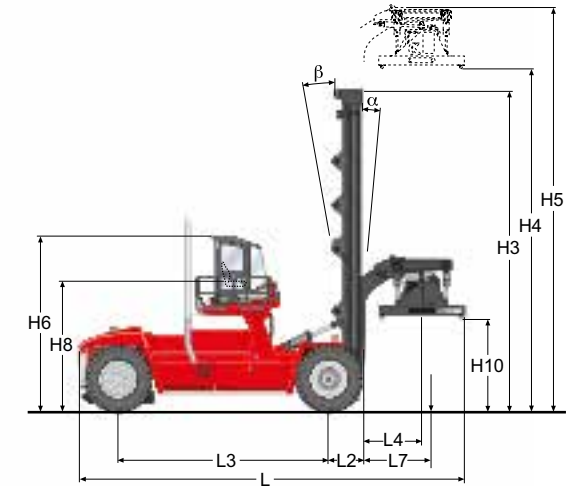
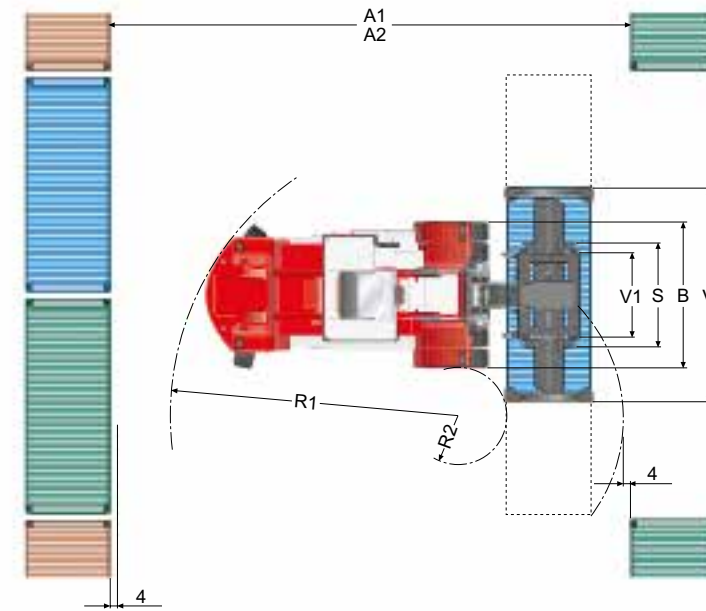


Capacity and weight		DCF410CSG
Lifting capacity	Classification (lb.)	90,000
	Load center, attachment retracted (inch)	L4 69
	Load center, attachment extended (inch)	L7 77
Weight	Service weight (lb.)	154,103
	Weight front axle, unloaded (lb.)	93,696
	Weight front axle, at rated load (lb.)	224,078
	Weight rear axle, unloaded (lb.)	59,883
	Weight rear axle, at rated load (lb.)	17,637

The mast and carriage are computer designed and optimized (FEM and Catia V5) which allowed for a decrease in the front axle weight. This allows us to equip the

DCF with Kalmar's high capacity spreader and fully utilize the capabilities of mast tilt, slewing, extension, sideshift at full lifting height and full capacity. No compromises.

Additionally, we have ensured that every single detail, component and system have been selected and manufactured to provide the highest possible reliability.



Dimensions		DCF410CSG, 5 high	DCF410CSG, 6 high
Truck	Truck length, with attachment (inch)	L 432	432
	Truck width (inch)	B 175	175
Truck height (inch)		H6 183	186
	Seat height (inch)	H8 143	143
Weight	Distance between front axle center – front side of mast (inch)	L2 35	35
	Wheelbase (inch)	L3 236	236
Track (c-c), front – rear (inch)		S 119 – 111	119 – 111
	Turning radius, outer (inch)	R1 341	341
Turning radius, inner (inch)		R2 43	43
	Ground clearance, min. under truck (inch)		11
Min. aisle width for 90° stacking with 20' container (inch)		A1 472	472
	Min. aisle width for 90° stacking with 40' container (inch)	A2 578	578
Standard duplex mast	Height under twistlocks, 5-high mast (inch)	H4 597	-
	Height under twistlocks, 6-high mast (inch)	H4 -	636
Height under twistlocks, min. (inch)		H10 85	85
	Mast height, min. (inch)	H3 362	382
Mast height, max. (inch)		H5 676	715
	Mast tilting, forward – backward (°)	alpha – beta 5 – 10	5 – 10
Attachment	Width, min – max (inch)	V 479 – 239	479 – 239
	Hydraulic slewing (°)		±3
Sideshift, ± either side center (inch)		V1 16	16
	Leveling (°)		±5



# In the palm of your hands

The lifting equipment of Kalmar DCF is an integrated assembly consisting of mast, carriage, spreader, hydraulics and control system. This is to ensure you get a reliable and good running machine with high availability even after long shifts and high load stresses.

A major objective in the development process has been to combine optimum functionality for the driver together with high performance in lifting and load handling.

To leverage operational productivity it's essential that the driver has full control over every moment of the picking sequence. This starts with the 360° visibility from the Spirit Delta cabin and is followed by the open design of the mast and gantry. The visual contact with the stack, container corners and spreader is optimized.

Fine-tuning the spreader to handle uneven levels or loads, mast tilt, extension, twist-lock landing is accomplished utilizing a powerful electronic support feedback and control system.



## 1 Mast

The Kalmar DCF has as standard a duplex free visibility mast, made of high strength steel to provide a long life with minimal deflection at high lifting heights. Maximum lifting height is 597", or six containers high under the twist-locks. The mast is equipped with the new Kalmar high speed lifting system, which provides very fast handling of loads up to 48.400 pounds.

The mast is made for high reliability and simple maintenance. It requires only two hoses and one cable passing over the mast roller to feed the hydraulic and electrical functions of the spreader.

## 2 Carriage

The integrated gantry with high-strength roller bearings makes for a secure and durable setup. The benefits of an integrated gantry are increased capacity and a decreased loss of load center. The gantry is a completely new design, made of solid steel instead of welded beams, which improves reliability and see through visibility.

Key functions:

- Leveling – corrects the inclination of the spreader to uneven containers.
- Slewing – compensates when the machine is not positioned 90° to stack.
- Sideshift – compensates when the machine is positioned right or left of the container.
- Extend/Retract – extends the capability when loading/unloading trucks or rail cars.



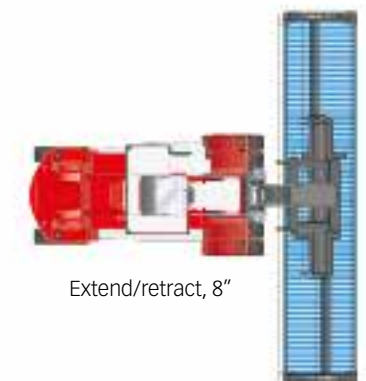
Sideshift ±16"



Leveling 5°



Slewing ±3°



Extend/retract, 8"

## 3 Spreader

The integrated spreader is suspended from four (4) hydraulic cylinders, which compensate for unevenly loaded or stacked containers. Powered pile slope is optional. The spreader is easily adjustable with the touch of a button for 20' or 40' containers and can be side-shifted 16" either side of center. Two additional hydraulic cylinders provide precise control of the slewing function.

The mechanical and electrical safety interlock systems prevent locking or releasing the twistlocks if the spreader is not properly positioned on the container. It also prevents lifting of the spreader when the twistlocks are not fully engaged or fully released.

The lowering interrupt system prevents chain slack once it is landed on the container.

Lights on the instrument panel and spreader indicate proper use of the spreader and locked/unlocked twistlocks.

The Kalmar spreader will handle all ISO standard containers ranging from 20' to 53' long and 8' wide to 8'6" wide. All containers must have the standard ISO 20' or 40' footprint.

## Performance

### DCF410CSG

Lifting speed	Unloaded (ft/min)	82.8
	At rated load (ft/min)	49.2
Lowering speed	Unloaded (ft/min)	61.2
	At rated load (ft/min)	70.8
Traveling speed, F/R	Unloaded (mph)	16/16
	At rated load (mph)	14/14
Gradeability, max.	Unloaded (%)	38
	Unloaded (%)	38
Gradeability, at 2 km/h	Unloaded (%)	38
	At rated load (%)	27
Drawbar pull	Max. (lb.)	84,150

# The basic set up is a key factor for high productivity

Optimized ergonomics. Perfect matching of capacity. Efficient lifting. The fourth key factor for high top-pick productivity is the basic machine set up. Heavy loads and high lifting speed, for example, put critical demands on the engine and hydraulic power support. Fast positioning during the stacking cycle requires precise control with tight turning radius, effective and reliable brakes and high engine torque. Fast transportation requires good stability, reliable brakes and smooth transmission.

Of course, all the working components and systems have to cope with the most demanding stresses during long shifts and heavy operations everyday.

We have put the highest priority on overall technical reliability. Looking at the choice of each component, long running cycle times and how it all comes together. We have incorporated into the DCF several major components and systems from our extremely reliable DRF reachstacker. More than 4000 of these machines have been delivered in the past few years and have proven the durability of the components and systems. Which means expected lower running costs.

## 1 Chassis

The frame forms the basis of the machine's lifting and maneuvering characteristics and was designed exclusively for a top-pick operation. The beam construction, along with its width, makes the DCF stable, torsion resistant and service-friendly.

The frame is 3D modulated (Catia V5) and designed (FEM) in order to eliminate critical tensions under various kinds of strain. The mechanically welded chassis has been optimized according to strength, weight and stability.

## 2 Engine

The Cummins engine provides power for driving and the working hydraulics. The engines are low-emission turbo diesels with fuel injectors and intercoolers. The design of the combustion chambers, along with the precise fuel injection control, ensures more efficient combustion to provide lower emissions with increased torque and power. The engines meet the latest emission as we offer a Volvo Tier 4i option.

The radiator is a 3 chamber design with a single fan to provide cooling for the engine and transmission. The engine cooler's separate expansion chambers are fitted with a level sensor that indicates low coolant level.

## 3 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 time. The transmission system consists of a torque converter and a gearbox. The gearbox is automatic, but can partly be shifted manually.

## 4 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 gears down in two stages, differential and hub reduction. The engine provides maximum torque at the drive wheels, which spares the transmission.

## 5 Steering system

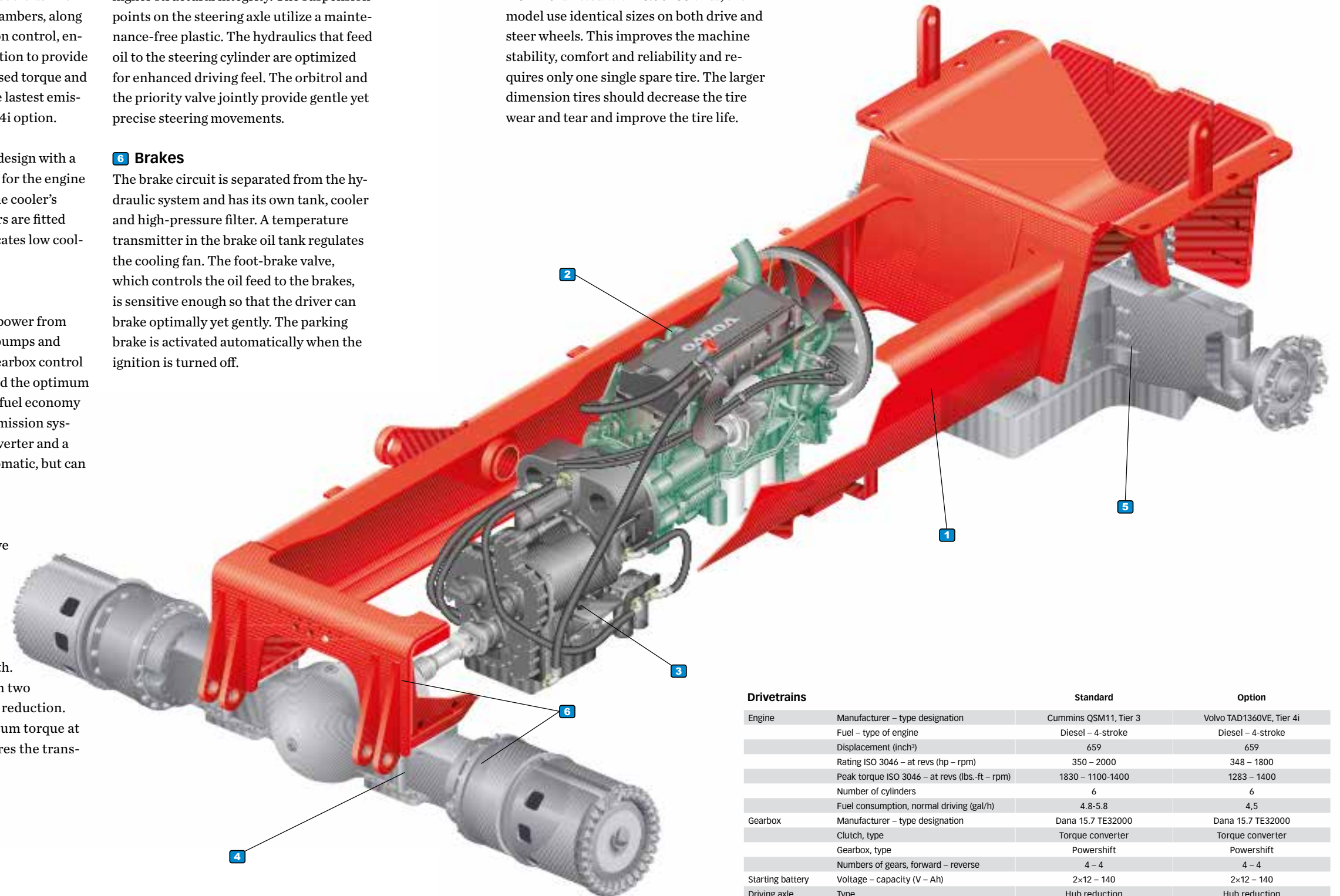
The steering axle is built from a single piece of high strength steel, which means fewer parts requiring less maintenance and higher structural integrity. The suspension points on the steering axle utilize a maintenance-free plastic. The hydraulics that feed oil to the steering cylinder are optimized for enhanced driving feel. The orbitrol and the priority valve jointly provide gentle yet precise steering movements.

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

## Wheels and tires

Tires are an important cost factor to consider when improving operational performance. Therefore the Kalmar DCF410 is fitted with 18.00x33 tires, the model use identical sizes on both drive and steer wheels. This improves the machine stability, comfort and reliability and requires only one single spare tire. The larger dimension tires should decrease the tire wear and tear and improve the tire life.



### Drivetrains

		Standard	Option
Engine	Manufacturer – type designation	Cummins QSM11, Tier 3	Volvo TAD1360VE, Tier 4i
	Fuel – type of engine	Diesel – 4-stroke	Diesel – 4-stroke
	Displacement (inch³)	659	659
	Rating ISO 3046 – at revs (hp – rpm)	350 – 2000	348 – 1800
	Peak torque ISO 3046 – at revs (lbs.-ft – rpm)	1830 – 1100-1400	1283 – 1400
	Number of cylinders	6	6
Gearbox	Fuel consumption, normal driving (gal/h)	4.8-5.8	4,5
	Manufacturer – type designation	Dana 15.7 TE32000	Dana 15.7 TE32000
	Clutch, type	Torque converter	Torque converter
	Gearbox, type	Powershift	Powershift
Starting battery	Numbers of gears, forward – reverse	4 – 4	4 – 4
	Voltage – capacity (V – Ah)	2x12 – 140	2x12 – 140
Driving axle	Type	Hub reduction	Hub reduction



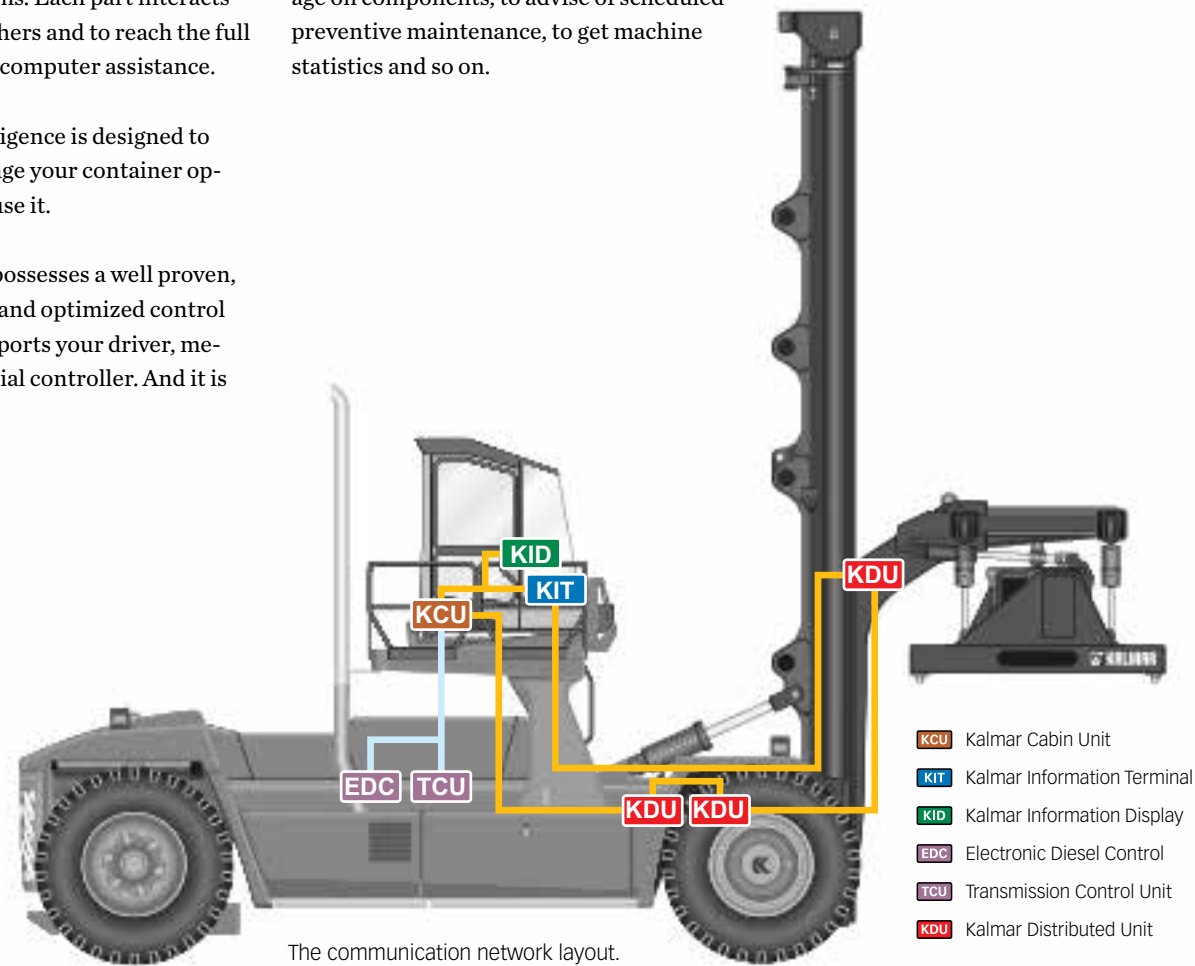
# The simple way to put bits and pieces together

All vehicles today – cars, highway trucks, wheel-loaders, cranes etc – are constructed with more and more sophisticated components and systems. Each part interacts closely with the others and to reach the full potential requires computer assistance.

This built-in intelligence is designed to support and leverage your container operations, not confuse it.

The Kalmar DCF possesses a well proven, thoroughly tested and optimized control system, which supports your driver, mechanics and financial controller. And it is simple to use.

It is designed to get the most out of the machine during the top-pick operations, to improve safety, to avoid unnecessary damage on components, to advise of scheduled preventive maintenance, to get machine statistics and so on.



## The reliable distributed control system

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 or electrohydraulic functions with voltage. The communication system controls and checks that the functions have been activated, waits in standby mode or indicates faults.

Both the power-feed and communication system form an integrated network distributed to the critical areas of the machine. The main components of the network are the control units (nodes). Each node has its own processor and integrates with each other. All communication, control signals and signal information are sent via data buses. All nodes in the network are talking and listening to each other.

The data transfer is secured by a CAN-bus (two-wire) technology, which means high reliability and extremely low risk for disruption. CAN-bus loops have been used in the Kalmar machines since 1995.

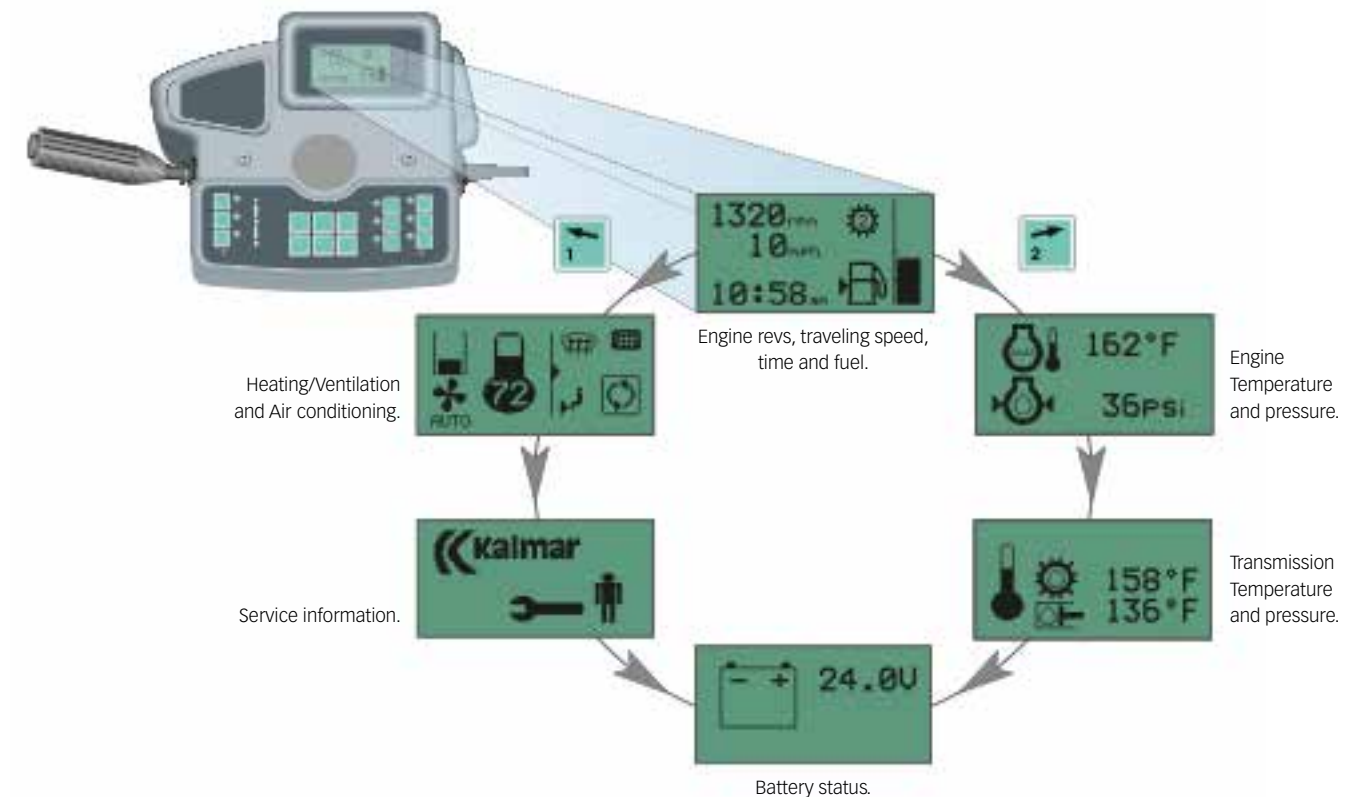
The power-feed for the functions are supplied separately via distribution boxes located in the cabin. The power is distributed and guided by instructions generated from the communication network.

## Control functions – support the driver

The driver and machine communicate very simple via the Kalmar Information Terminal and the Information Display located right in front of the driver in the cabin. The two-way communication – from the driver to the machine and opposite – is handled by the KCU (Kalmar Cabin Unit) which is the control node for the entire network.

Information to the driver comprises of alarm warnings, operating details and action-guided information. Messages, status, fault indications etc are presented on the Information Display, while warnings and other monitoring indications are presented to the left.

Messages are only presented when they are relevant to the driver and the operation, so the driver can focus on the job instead of checking meters and indicators.





# We have made sure your investment becomes profitable

To understand the full potential of your investment requires being aware of the details, features and technical matters in a machine like the Kalmar DCF.

But when it comes to availability it is critical that it operates constantly and is kept in good condition with an absolute minimum of maintenance and repairs.



## Less stops and no stops

The Kalmar DCF is designed for long shifts, which means that you may have to replace the driver before you have to call it in for fuel. The good weight/engine power relationship combined with the standard fuel tank designed for 50 hours of operation make these machines run the extra hours you want them to.

The service intervals have been extended to 500 hours, which means that you don't have to take the machine out of work more than 6 times a year (3000 hours utilization).

The DCF is designed for fast daily inspection and preventive maintenance. All checkpoints are easy accessible and concentrated to specific locations. Lubrication free components or central lubrication points have been utilized. The wet disc brake system is practically maintenance free.

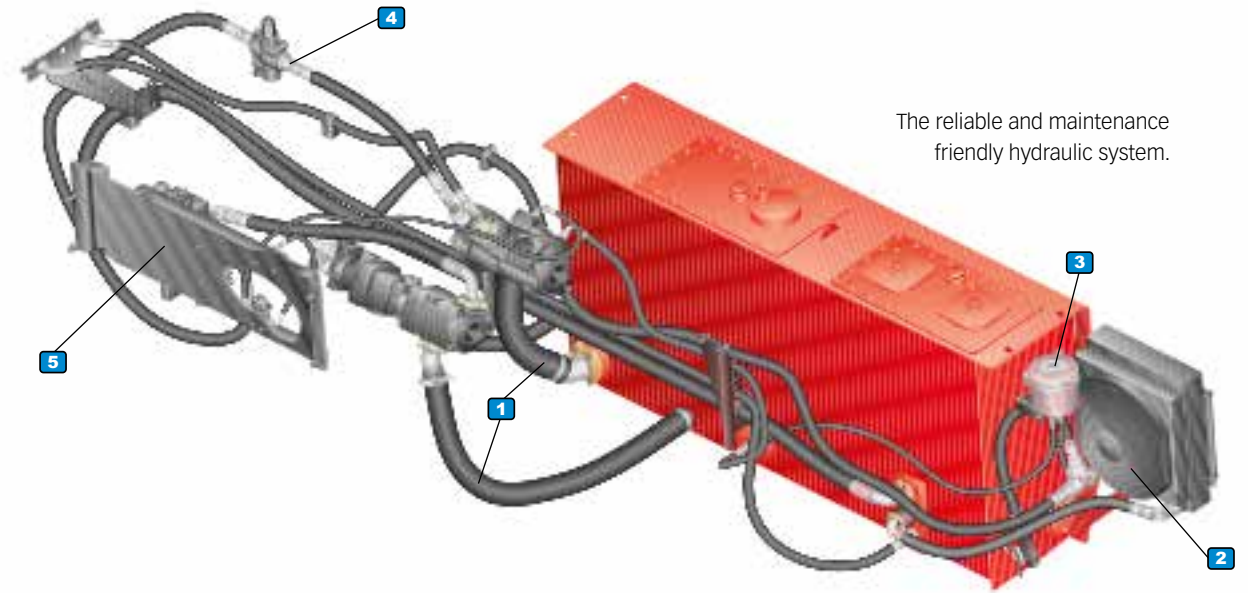


Fewer components makes for increased reliability, only two hoses and one harness runs over the mast wheel.

The indicator and monitoring support built into our control system make sure that the machine won't be misused or maintained incorrectly. The driver and mechanics will always get indications and guidance in time to avoid unnecessary and costly wear and tear or technical breakdowns. No unwanted stops.

## Reliability starts already at the concept stage

One of the guiding principles in designing the DCF was to minimize the number of potential sources of error. Therefore the machines consist of as few components and moving parts as possible. The functionality and operational reliability is assured by extensive testing.



The reliable and maintenance friendly hydraulic system.

## The hydraulic system is critical

No other part of the machine is working so hard under continuous pressure. To secure the reliability we have minimized the number of hydraulic components and couplings.

The main valve has an integrated servo which helps increase precision and control over the oil flow. The hydraulic oil is fed to the carriage and spreader by a variable piston pump, which saves a lot of power and energy compared to continuous oil circulation. Another innovative solution – the valve for the gantry and spreader functions has been mounted on the gantry. The result is an instant and accurate connection between lever and function. This also minimizes the number of hydraulic components in the chassis.

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

## Other improving features:

- 1 Large dimensions of hydraulic hoses improves the hose's lifetime (slower flow, less friction and less heating).
- 2 Thermostatic cooling of both the main system and the brake system improves the oil lifetime (temperature control, optimized working temperature).

- 3 High density filter improves the oil lifetime (clean oil).
- 4 ORFS – leak proof couplings all around improves reliability (minimizes leakage).
- 5 All main hydraulic components at ground level are gathered on a separate plate, bolted to the chassis and therefore simple to remove.



## A safe communication network

The control and monitoring system is the new Kalmar control system, but already successfully applied in more than 10,000 Kalmar machines worldwide.

The redundant CAN-bus system is proven to be excellent in functionality and reliability. The network of control nodes allows for less wiring and connectors which reduces the number of sources of error. The power-feed for each node and the transfer of control signals are independent of the other nodes, which means the risk of disruption becomes minimal. The redundant design means that there are always two paths to choose to maintain communication, which results in extra safety and reliability.





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



**Kalmar** Kalmar offers the widest range of cargo handling solutions and services to ports, terminals, distribution centres and to the heavy industry. Kalmar is the industry forerunner in terminal automation and in energy efficient container handling, with one in four container movements around the globe being handled by a Kalmar solution. Through its extensive product portfolio, global service network and ability to enable a seamless integration of different terminal processes, Kalmar improves the efficiency of every move.  
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