

SPMT Description

KAMAG 2400 ST

-	03-05-2012	First version					22
Rev.	Date	Description	Dept.	Edited	Verified	Approved	Pg

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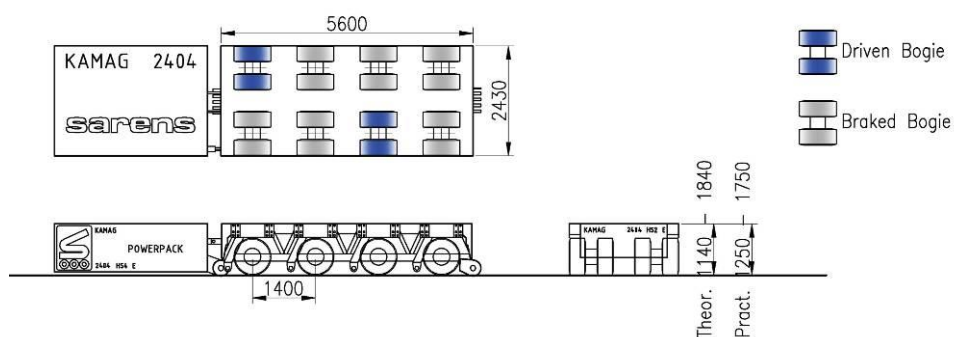
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1 DATA KAMAG 2400 ST

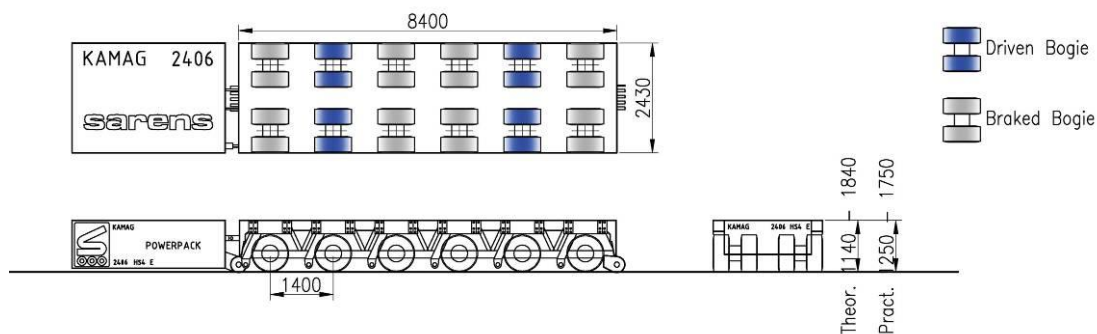
1.1 General trailer info

Self-propelled Platform trailers Kamag are of modular construction, and may be assembled from units of 4 or 6 axles to trailer configurations of the required carrying capacity or size.

4 axle module :



6 axle module :



1.2 General technical information

K 2404



Technical data

Item	51000163		51000162	
Type	K 2404 ST HS2E		K 2404 HS2E	
Tyre filling	PU-filling		Air filling 10 bar	
Speed	1 km/h	3 km/h	1 km/h	3 km/h
Payload	172,600 kg	140,600 kg	133.800 kg	122.600 kg
Admissible gross weight	192,000 kg	160,000 kg	152.000 kg	140.800 kg
Dead weight	19,400 kg		18,200 kg	
Admissible axle load	48,000 kg	40,000 kg	38,000 kg *)	35,200 kg
Platform dimensions	approx. 5,600 x 2,430 mm			
Coupling length	approx. 5,600 mm			
Platform height driving position	approx. 1,490 mm			
Axle compensation	approx. +/- 350 mm			
Platform height lowered	approx. 1,140 mm			
Steering / steering angle	electronical hydraulical + 130°/-100°			
Number of wheel bogies / braked	8 / 4			
Wheel bogies driven	2			
Tractive force	120 kN			

*) max distance less than 300m, at 0.5 km/h and distance less than 300m: 40,000 kg

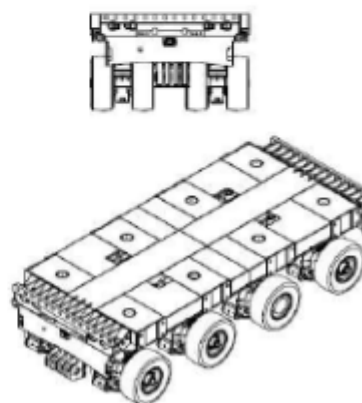
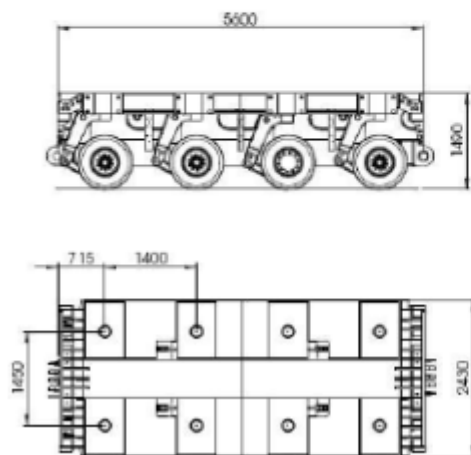
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Brake performance	160 kN
Tyres	16 x 355/65 R 15 Conti IC40
Bending moment	approx. +/- 9,250 kNm
Moment of inertia	1,298,000 cm ⁴
Section modulus	20,600 cm ³
Max speed unladen	12 km/h
Operating temperature	approx. -20 °C up to +45 °C



K 2406



Technical data

Item	51000165		51000164	
Type	K 2406 ST HS4E		K 2406 HS4E	
Tyre filling	PU-filling		Air-filling 10 bar	
Speed	1 km/h	3 km/h	1 km/h	3 km/h
Payload	261,000 kg	213,000 kg	202,800 kg	186,000 kg
Admissible gross weight	288,000 kg	240,000 kg	228,000 kg	211,200 kg
Dead weight	27,000 kg		25,200 kg	
Admissible axle load	48,000 kg	40,000 kg	38,000 kg *)	35,200 kg
Platform dimensions	approx. 8,400 x 2,430 mm			
Coupling length	approx. 8,400 mm			
Platform height driving position	approx. 1,490 mm			
Axle compensation	approx. +/- 350 mm			
Platform height lowered	approx. 1,140 mm			
Steering / steering angle	elektronical-hydraulical approx. + 130°/-100°			
Number of wheel bogies / braked	12 / 6			
Wheel bogies driven	4			
Tractive force	240 kN			
Brake performance	240 kN			

*) max distance less than 300m, at 0.5 km/h and distance less than 300m: 40,000 kg

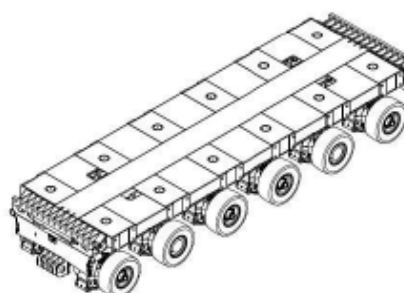
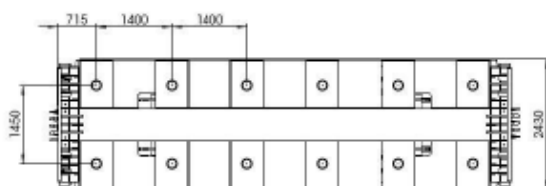
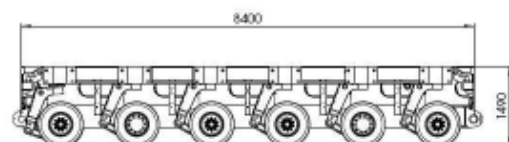
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Tyres	24 x 355/65 R 15 Conti IC40
Bending moment	ca. +/- 9,250 kNm
Moment of inertia	1,298,000 cm ⁴
Section modulus	20,600 cm ³
Max speed unladen	12 km/h
Operating temperature	approx. -20 °C up to +45 °C



Standard accessories:

- 1 set of coupling pieces end to end
- 1 hydraulic coupling bolt

1.3 Structure

The self-propelled trailers are constructed of a mechanical welded chassis made up from S690 and S355.

The end - to - end coupling of the trailer is designed in a way that principally a hydraulic pin - type locking is available, i.e. the hydraulically adjustable pin is on one coupling side per trailer, the other coupling side is free. The connection above is designed as a bolted connection.



Fig: Trailer coupling

Because the electronic systems are grounded through the trailer frame it is not permitted to perform any arc welding onto the Kamag trailer frame or any other apparatus mounted on it.

1.4 Axles

Two independent axles for one axle line support the frame of the trailer. Each axle (wheel bogie) has 2 tyres, which results in 4 tyres for one axle line.

Each axle is connected to the frame by a hydraulic cylinder and a slewing ring, which makes it possible for each axle to have a maximum rotation of ± 100 degrees. A second hydraulic cylinder connected to the slewing ring by means of a rotation frame actuates the rotation of the axle. This cylinder is manipulated by use of a hydraulic servo valve, which allows accurate steering.

The other hydraulic cylinder guarantees an equal load distribution between the different axles of one hydraulic group because they are connected with each other by means of a 3-way valve. The basic principle is that the load charges are being transported onto the wheels of the trailer. Each wheel is mounted on an oscillating axle. Each axle has a hydraulic suspension, permitting:

* An equal load distribution between the axles regardless of the surface altitude differences on which the transport has to take place. The load distribution is possible thanks to the intercommunication of the hydraulic cylinders. The cylinders are under a constant pressure, independent from the suspension height.

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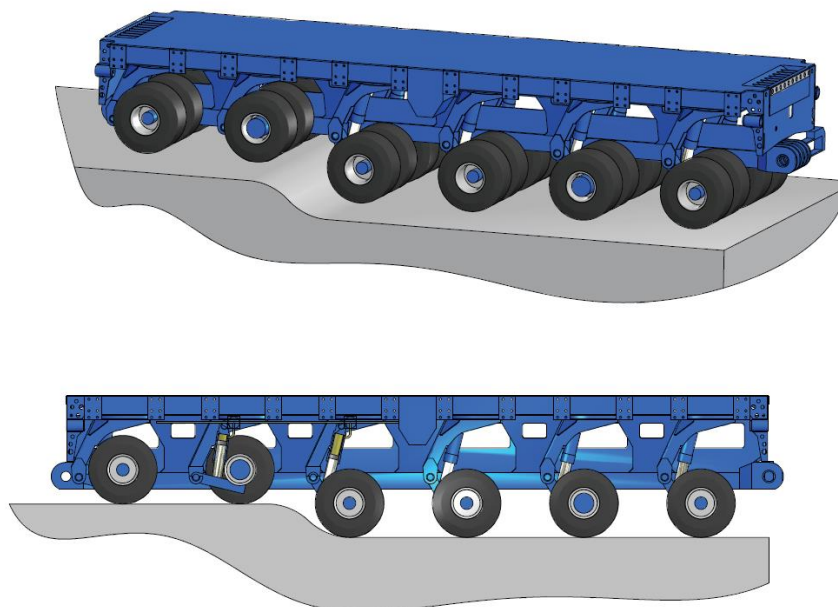


Fig: Suspension of the trailer.

* The height variation of the loading platform: operation of self-lowering and self-lifting within the limitations of hydraulic cylinder strokes.

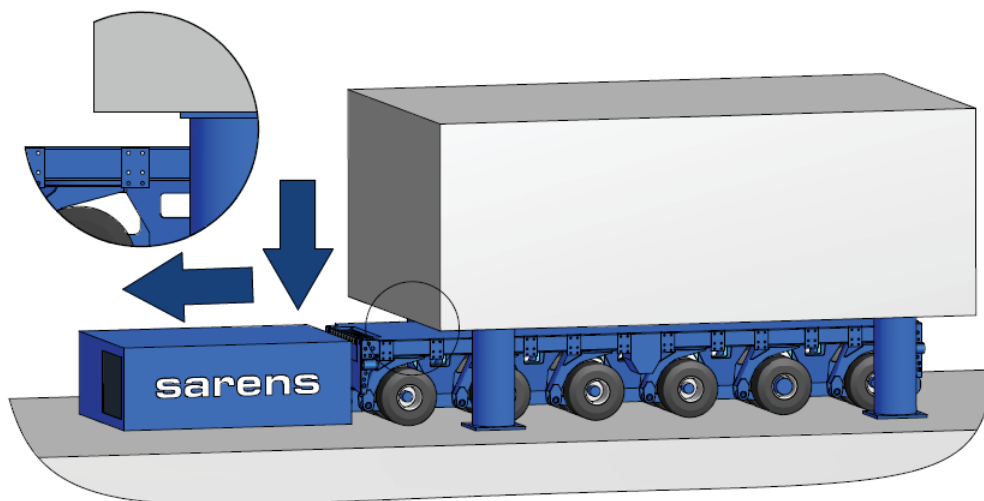


Fig : Height variation of the platform.

Loads can be raised or lowered (as shown in fig. above) by this technique, providing continuous support.

Each of the trailers lifting cylinders has a 3-way valve which allows interconnecting/splitting of the different cylinders in-between each other. With this individual setting of these valves the trailer lifting system can be set to a 1, 2, 3 or 4 points hydraulic suspension.

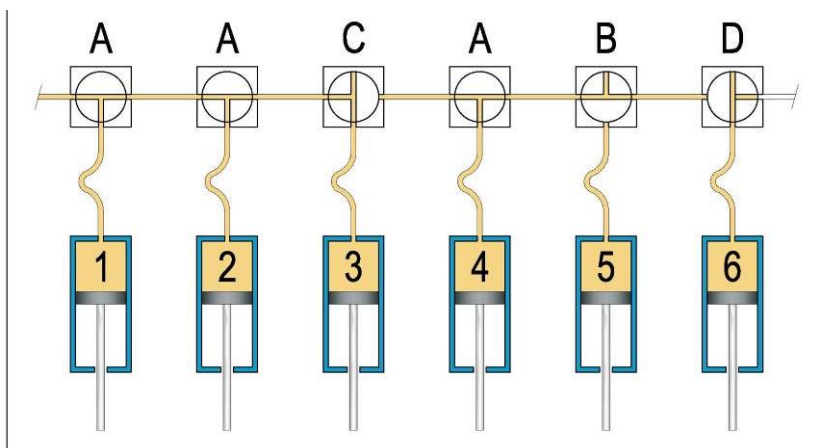


Fig: Different positions of the 3-way valves.

- Position A: the cylinder is open and oil can pass through from 2 sides.
- Position B: the cylinder is closed.
- Position C: the cylinder is open and oil can pass through from the left side only; it cannot pass to the next valve.
- Position D: same as position C, but the oil can only come through from the right side.

1.5 Brakes

Each not-driven axle is equipped with hydraulic actuated brakes. This means that the brakes are only released when there is a hydraulic pressure in the actuator. The advantage of this system is that it doesn't suffer from weather conditions like humidity, ice, ...

The brake system is designed in such a way that in case of engine problems, electronic problems, the pressure in the brake system is released and the brakes lock. It is also possible to mechanically deactivate the brake on one or several axles in case of mechanical problems. In case of emergency the brakes can be activated by means of buttons located on the remote, side of trailers & powerpacks.



Fig: Positions emergency buttons

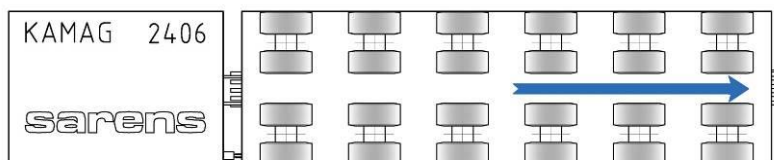
1.6 Steering and configuring

The position of the trailers during an operation can be different for each individual trailer combination. To solve this, each trailer module is equipped with a Programmable Logic Controller (PLC) which receives as input the position of the module in the plane combination of trailers by means of X, Y coordinates and an angle. By means of this information, the PLC calculates the desired angle for each axle of the module and actuates the servo-valve. The trailer has an electronic steering system with different possibilities. It is very easy to change the steering programme quickly. During specialized transports the available steering programs are extremely useful.

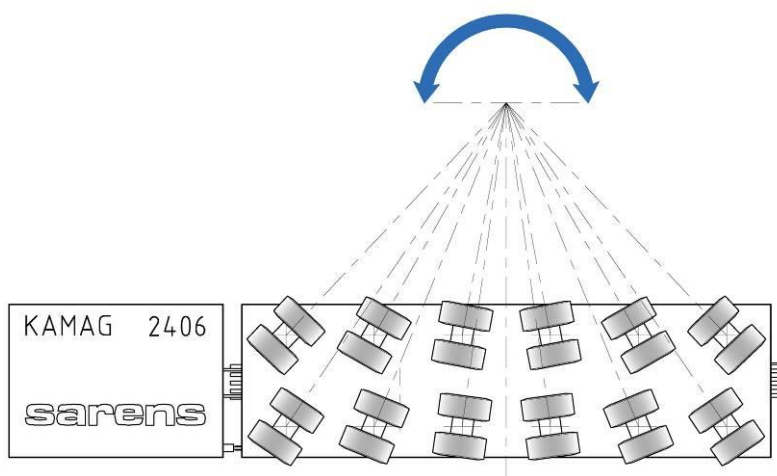
The following steering modes are available:

- Normal drive (outside turning radius >0)
- Normal drive (inner turning radius <0)
- Rotation on the spot (Circle drive)
- Transverse drive (Both directions)
- Diagonal drive (Crab Drive)

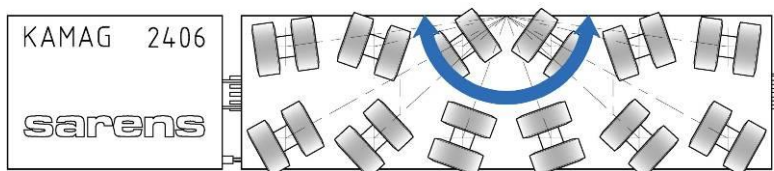
- Normal drive



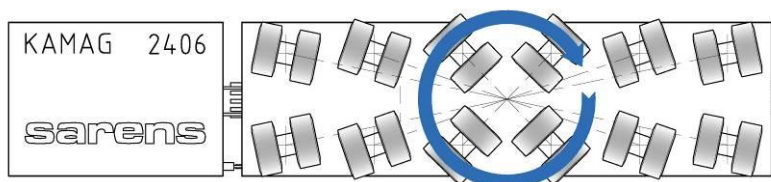
- Normal drive (outside turning radius >0)



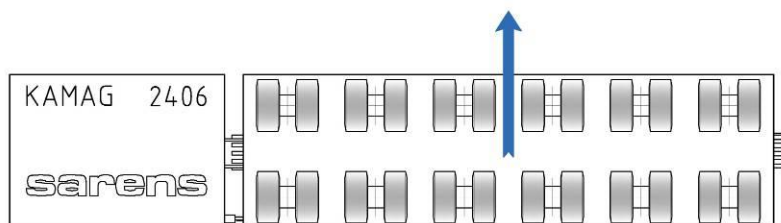
- Normal drive (inner turning radius <0)



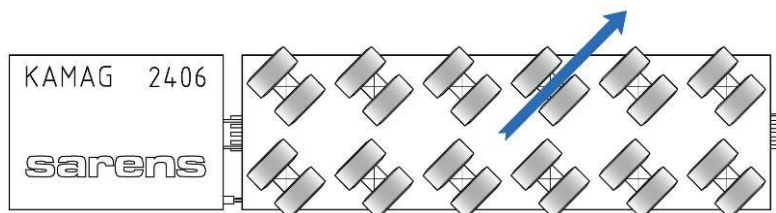
- Rotation on the spot (Circle drive)



- Transverse drive (Both directions)



- Diagonal drive (Crab Drive)

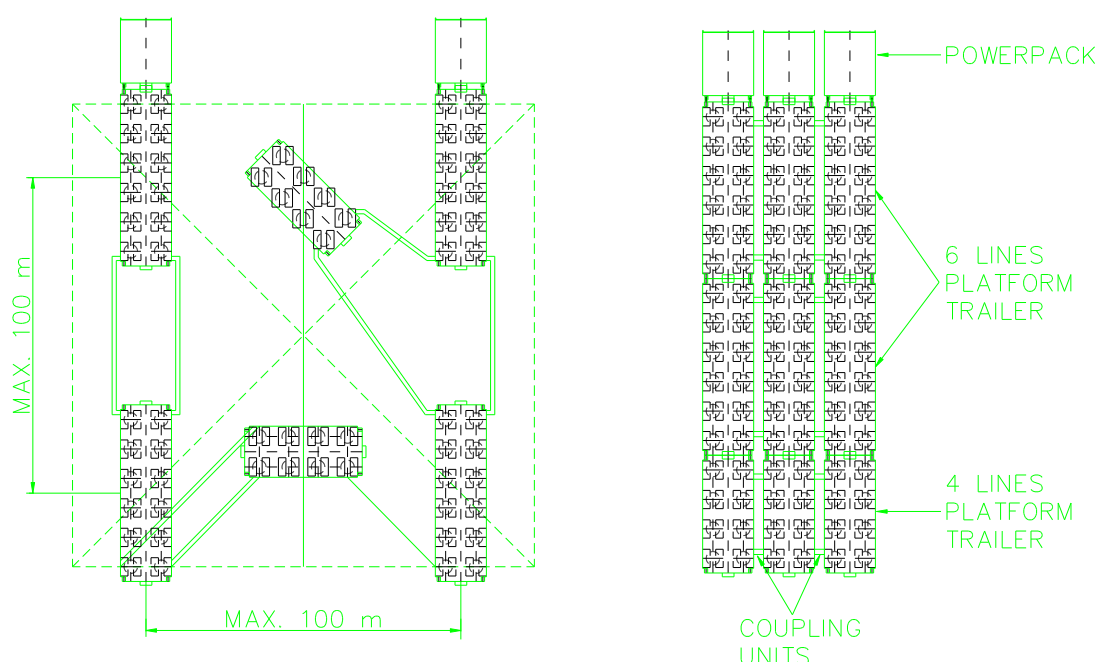


1.7 Control of the combination

A single operator using one remote control can control all the trailers. A dataline links the computers of all the trailers together, enabling to exercise control from a single point.

The 16bits electronic system has a total of 253 available input channels. Each trailer and powerpack requires one input channel resulting in a maximum of +-210 individual trailers and 43 powerpacks possible to control.

Examples of possible trailer configurations:



Through the remote control following parameters can be influenced:

- direction and steering mode
- speed, brakes
- steering angle,
- lifting – lowering
- engine stop, engine rpm, emergency stop
- brakes

The power pack houses following instruments & indicators:

- Engine shutdown
- Lifting, lowering & tilting of power pack
- Engine temperature, rpm & fuel gauge
- Pressure gauge(s) for drive system, steering- / lifting system

- Operating hours
- For engine rpm, lifting and lowering as well as for steering and brake system emergency control levers and/or switches are installed.

2 STABILITY

The objects to transport often are heavy and large. It is important to create optimum stability. To create such stability technical measurements are taken and an engineering analysis must be made. The stability of a SPMT combination is guaranteed through the hydraulic suspension which can be adapted in function of the trailer combination. In normal operation a 3 point suspension system must be achieved through creating 3 individual oilfields.

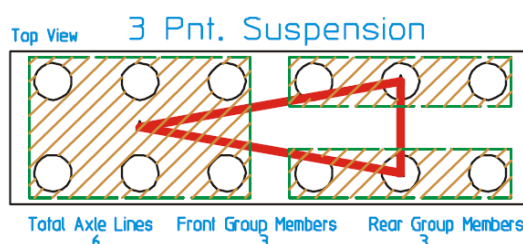


Fig: three-point suspension

A three-point support can be realised by dividing the trailer configuration into three groups. In each group all wheel bogies are connected hydraulically. The oil can flow unlimited from one wheel bogie to another within one particular oilfield. Calculations are made to decide how to divide all wheel bogies.

A four-point support can be realised by dividing all wheel bogies into four groups.

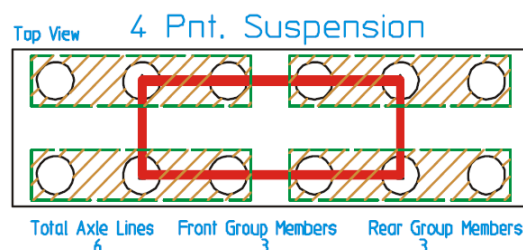


Fig: Four-point suspension

This configuration is not desirable since this configuration is statically indeterminate and requires continues observation/adjusting by operational personnel.

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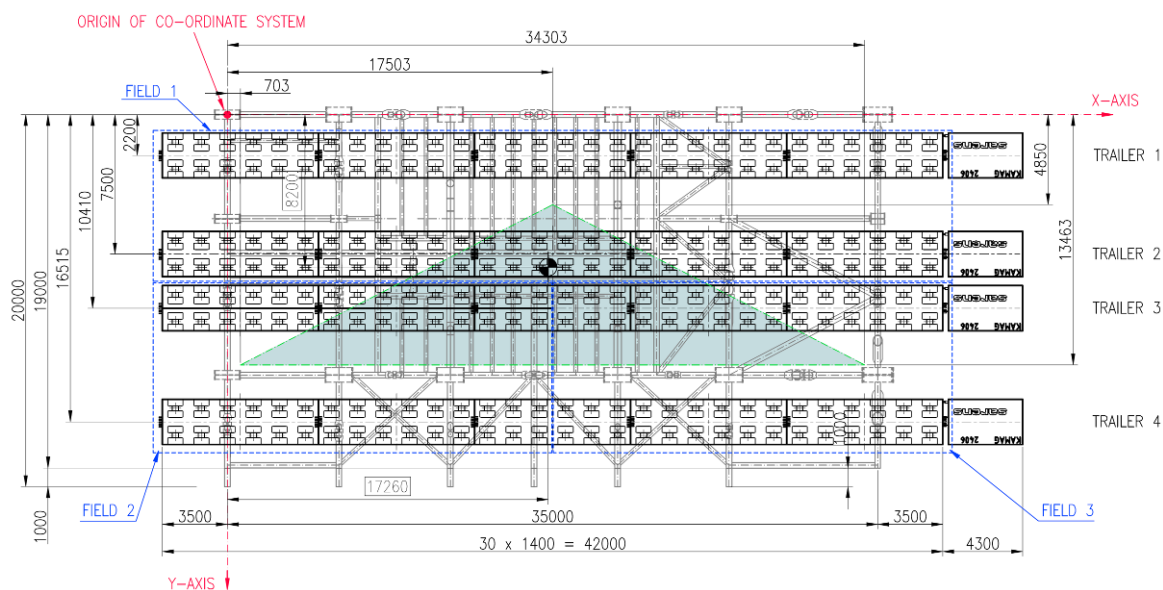


Fig: Kamag configuration with 3 oil fields

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3 PICTURES OF 2400 ST IN USE



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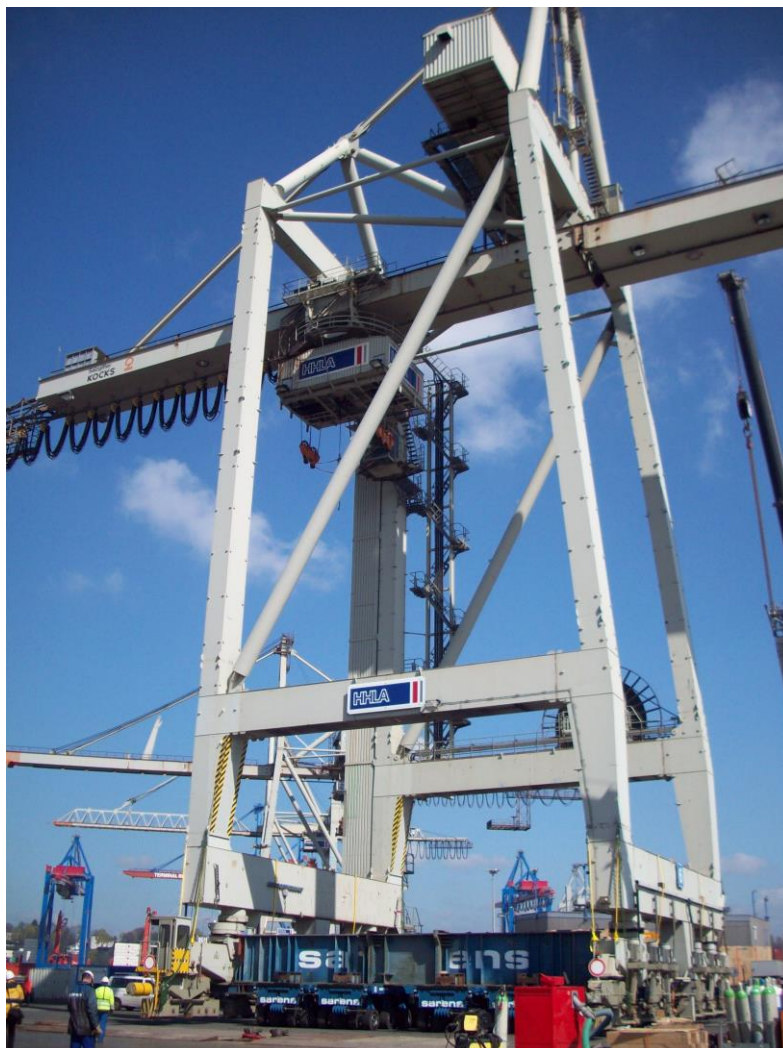
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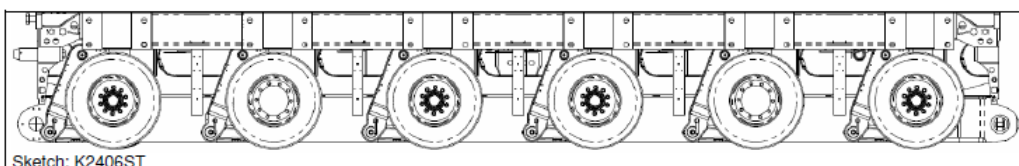
ANNEX : DATA KAMAG 2400 ST

KAMAG Transporttechnik GmbH & Co. KG
Liststr. 3
89079 Ulm
Tel. +49 731 4098 0
www.kamag.com



TYPE: K2400-ST Module Transporter

Technical Data Sheet: for Model Year 2010



Sketch: K2406ST

This table is valid for Module Transporter Type K2400-ST for Model Year 2010 with identical construction style and the following terms are applied:

- Same dimensions to the sectional values
- Same material characteristic
- Same static characteristic
- Same transporter width
- Same transporter height
- Same track
- Same axle spacing
- Endless coupling is possible (Rear end is connected to front end of next transporter)
- Electronic all wheel steering (+100°-130°)
- Drive power and steering power from an additional power pack
- Compatible to 3. generation

Dimensions	Dimensions		TYPE K2404-ST	TYPE K2406-ST
	Length (System)		5600 mm	8400 mm
	Length (Total)		5960 mm	8760 mm
	Axle spacing		1400 mm	
	Width		2430 mm	
	Platform height	Running	1490 mm	
		max.	+350 mm	
		min.	-350 mm	
Loads & Weights	Axles		4	6
	Payload max. (at 1 km/h)*		174t	261t
	Dead weight		18t	27t
	Total weight		192t	288t
	Wheel bogie load (until 3 km/h)		20t	20t
	Wheel bogie load (at 1 km/h)*		24t	24t
	Tyres per wheel bogie		2	2
	Number wheels total		16	24
	Max. tyre load (until speed 3 km/h)		10t	10t
	Max. tyre load (at speed 1 km/h)*		12t	12t

Max. tyre loads include all additional loads (static and dynamic)

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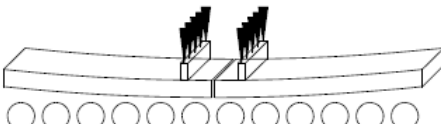
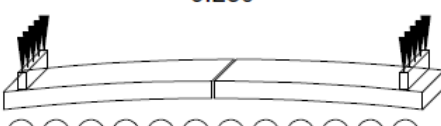
		TYPE K2404-ST	TYPE K2406-ST
Drive System Design	Tyre size	355/65-15 Conti IC40	
	Rim size	9,75-15	
	Tire pressure	(PU - filling)	
	Max. braking force per wheel bogie	40 kN	
	Wheel bogies with brake	4	6
	Max. tractive force per wheel bogie	60 kN	
	Wheel bogies with drive	2 / 4	2 / 4 / (6)
	Steering system	Electronic controlled all wheel steering	
	Steering programs	6	
	Max. Steering Angle	+100 %/-130 °	
	Operation temperature	-20 °C to +40 °C	
	Drive speed unloaded	approx. 12 km/h	
Structural Data Main Structure	Moment of inertia [cm ⁴]	1.298.500	
	Section modulus [cm ³]	approx. 20.600	
	Material	STE690 (Mat. No. 1.8979)	
	Yield stress [N/mm ²]	690	
	Safety factor to yield stress	1.36	
	Max. allowable stress [N/mm ²]	450	
	Max. bending moments	Beam [kNm]	9.250
		Coupling [kNm] Top side compression Standard load case Sketch: 2 x K2406-ST Example	9.250 
	Max. bending moments	Coupling [kNm] Top side tension Sketch: 2 x K2406-ST Example	9.250 
		Top side coupling consists 14 hex screws M48 x 180 12.9 ISO 4014; KAMAG ID: 6-0701095; tightening torque 7000 Nm per each screw	
	Local vertical force across center beam surface, see upper sketch	2.000 kN	

Table for Module Transporter Type K2400-ST

Any longitudinal combinations of the transporter are possible. The load limit of each combination is defined in the „PAYLOAD DIAGRAM“ drawings. The “COG Diagram” drawings shows the overturning limit of the transporter and the overload limit of the axle groups.

Type	Payload	COG Diagram	Type	Payload	COG Diagram
			COG Diagram = Center of Gravity Diagram		