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## Rope actuated **Knuckle Boom Crane**

THE ROPE ACTUATED KNUCKLE BOOM CRANE IS UNIQUE IN ITS KIND AND COMBINES (SUBSEA) HEAVY LIFT CAPABILITIES WITH LOAD CONTROL FEATURES OF A CONVENTIONAL KNUCKLE BOOM CRANE.

The capacity range offered for this crane type extends from approximately 400 to 2,000 tonnes Safe Working Load (SWL).

# INTRODUCTION

## VERSATILE HOISTING CONFIGURATIONS

The rope Actuated Knuckle Boom Crane offers the flexibility of working over the Main Boom as well as over the Knuckle Jib without the need for re-reeving. When operating over the Main Boom in single fall, the hoist wires are picked up by the Knuckle Jib when folding out. This does not require any manual reeving operations, as the hoisting wires are secured by a counter sheave that is actuated from the operators' cabin.

Additional pull-in winches enable the Knuckle Jib to be folded in toward the Main Boom. This allows for lifting operations close to the pedestal e.g. for safe rigging preparations and optimal use of available deck space, yet limiting pendulum swing of the hook block.

Different hoisting modes allow for various operations:

- **Lifting over Main Boom**
  - lifting of heavy loads
- **Lifting over Knuckle Jib**
  - handling tall objects
  - increased deck coverage
  - easy and safe rigging preparation near center line
  - reduction of hoist wire pendulum length

With a special rope guiding arrangement, the crane can rotate beyond 360° avoiding blind spots on deck.

## COMPACT AND LIGHT WEIGHT DESIGN

The Knuckle Jib can be folded inwards completely within the Main Boom structure and locked when not in use. The advantages of this geometry offers a compact design in storage position and allows quick and unhindered hoisting operations over the Main Boom. Also, the lifting capacity is maximized for Main Boom operation, since the weight of the Knuckle Jib is located at the most convenient position possible. Compared to a cylinder actuated Knuckle Boom Crane, the crane weight to lifting capacity ratio is favorable.

## ENERGY EFFICIENT

The Rope Actuated Knuckle Boom Crane is designed with two Main Hoist winch arrangements, both located below deck. Both winches can be operated simultaneously for maximum lifting capacity, and separately for smaller loads in most common operations, which reduces the overall power consumption of the crane.

The Main Hoist system is outfitted with Active Heave Compensation (AHC) by means of a linear compensation system. This system employs a combination of an active part, for the dynamic compensation, and a passive part, for the support of the static hook load. This combination results in a more efficient power requirement while in AHC mode.

The linear AHC system is equipped with an equalizer function that ensures the alignment of the two hoist wires in a two winch hoisting arrangement. It is designed as such that it also allows for the use of the AHC system in single winch operations.

## PERFORMANCE

<b>Fall arrangements</b>	Over Main Boom	Over Knuckle Jib	
Main hoist <sup>(a)</sup>	2x 1-fall & 2x 2-fall	2x 1-fall	
Auxiliary hoist	1-fall	1-fall	
	<sup>(a)</sup> Main hoist winches can also be used independently (e.g. 1x 1-fall over Main Boom)		
<b>Lifting capacity</b>	2x 2-fall	2x 1-fall	Dynamic factor
Main hoist <sup>(b)</sup>	800t@23m	225t@25m*	1.3
	700t@25m		1.3
	1-fall		
Auxiliary hoist	50t@64m		1.3
	<sup>(b)</sup> See also the working ranges on drawing no 0010_010		
	* at 54m hook height above slew bearing		
<b>Constant tension</b>	2x 1-fall	2x 2-fall	
Main hoist	60t	120t	
<b>Hook speed</b>	Main hoist 2x 1-fall	Main hoist 2x 2-fall	Auxiliary hoist 1-fall
Maximum SWL	20m/min	10m/min	30m/min
Constant tension <sup>(c)</sup>	70m/min	35m/min	
	<sup>(c)</sup> Listed speed only available when rope on top layer of drum		
<b>Heavy compensation</b>	Passive/active compensation by means of in-line hydraulic cylinders on Main Hoist		
Dynamic factor	1.3		
Capacity in 2x 2-fall <sup>(d)</sup>	800t in-air weight / 640t submerged weight up to 1200m water depth 750t in-air weight / 600t submerged weight up to 1500m water depth		
Capacity in 2x 1-fall <sup>(d)</sup>	400t in-air weight / 320t submerged weight up to 1200m water depth 250t in-air weight / 200t submerged weight up to 3000m water depth		
Heave motion in 2x 1-fall	+/- 4m in 8s – 15s		
<b>Tugger winch</b>			
Maximum rope pull	2x 25t		
Speed with maximum SWL	75m/min		
<b>Slewing</b>			
Slewing range	200° CW / 200° CCW		
Maximum SWL	0.25rpm		
Empty hook	0.50rpm		
<b>Luffing of Main boom</b>	Lifts over main boom	Lifts over knuckle jib	
Luffing time	5 min	4 min	
<b>Folding of Knuckle jib</b>			
Folding time	3 min		

## DESIGN CRITERIA

<b>Design</b>																													
Certification by	Lloyd's Register																												
Main design code	Lloyd's Register Code for Lifting Appliances in a Marine Environment (July 2018)																												
<b>Environmental conditions</b>																													
Operational temperature	-20° C to +40° C																												
Design temperature	-10°C																												
Relative humidity	Up to 100%																												
Heel / trim	Max inclination 2° (2° Heel or 2° Trim or combination max 2°)																												
Off- & side lead	Up to 2°																												
<b>Subsea lifting conditions</b>																													
Buoyancy factor load	0.800																												
Buoyancy factor hook	0.873																												
Buoyancy factor rope	0.851																												
<b>Crane classification</b>																													
	According to FEM 1.001 (1998)																												
Class of utilization	U1																												
State of loading	Q1																												
Group classification for crane	A1																												
<b>Classification of mechanisms</b>																													
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	<table border="1"> <thead> <tr> <th></th> <th>Main Hoist</th> <th>Auxiliary Hoist</th> <th>Slewing</th> <th>Luffing</th> <th>Folding</th> <th>Tugger</th> </tr> </thead> <tbody> <tr> <td>Duration of use</td> <td>T5</td> <td>T2</td> <td>T2</td> <td>T2</td> <td>T2</td> <td>T2</td> </tr> <tr> <td>Spectrum class</td> <td>L1</td> <td>L1</td> <td>L1</td> <td>L1</td> <td>L1</td> <td>L1</td> </tr> <tr> <td>Group classification for mechanism</td> <td>M4</td> <td>M1</td> <td>M1</td> <td>M1</td> <td>M1</td> <td>M1</td> </tr> </tbody> </table>		Main Hoist	Auxiliary Hoist	Slewing	Luffing	Folding	Tugger	Duration of use	T5	T2	T2	T2	T2	T2	Spectrum class	L1	L1	L1	L1	L1	L1	Group classification for mechanism	M4	M1	M1	M1	M1	M1
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## INTERFACE DATA

<b>Weights (+/- 10%)</b>				
Crane (excl. pedestal, incl. AHC)	945 tonnes			
Below deck equipment (incl. wire rope)	830 tonnes			
Pedestal	Subject to height, deck interface and access			
<b>Pedestal loads (+/- 10%)</b>				
Loads occur simultaneously and include all relevant dynamic factors Loads are to be applied at slew bearing / pedestal flange interface level				
Overturning moment	380,000kNm			
Axial load	21,000kN			
Radial load	2,100kN			
Slewing moment	28,000kNm			
<b>Utility requirements</b>				
Main power	690V / 60Hz 3-ph for electric motors and HPU			
Auxiliary power	440V / 60Hz 3-ph for e.g. lighting, HVAC and power sockets			
UPS	230V / 60Hz 1-ph for Aircraft Warning Lights			
<b>Power balance</b>				
Main consumers	Nominal	Peak draw	Peak feed	Idle
AHC HPU	Adjustable (by pressure setting)			
Load range 0-100t		1,000kW		100kW
Load range 100-200t		1,700kW		100kW
Load range 200-800t		2,700kW		100kW
AHC N2 compressor (not during AHC)	50kW			
AHC Cooler (continuous)	30kW			
Rectifier – electric drives		2,400kW	2,400kW	
Auxiliaries	TBD			

# WORKING RANGE & LOAD CURVES

