ROMAS MARINE

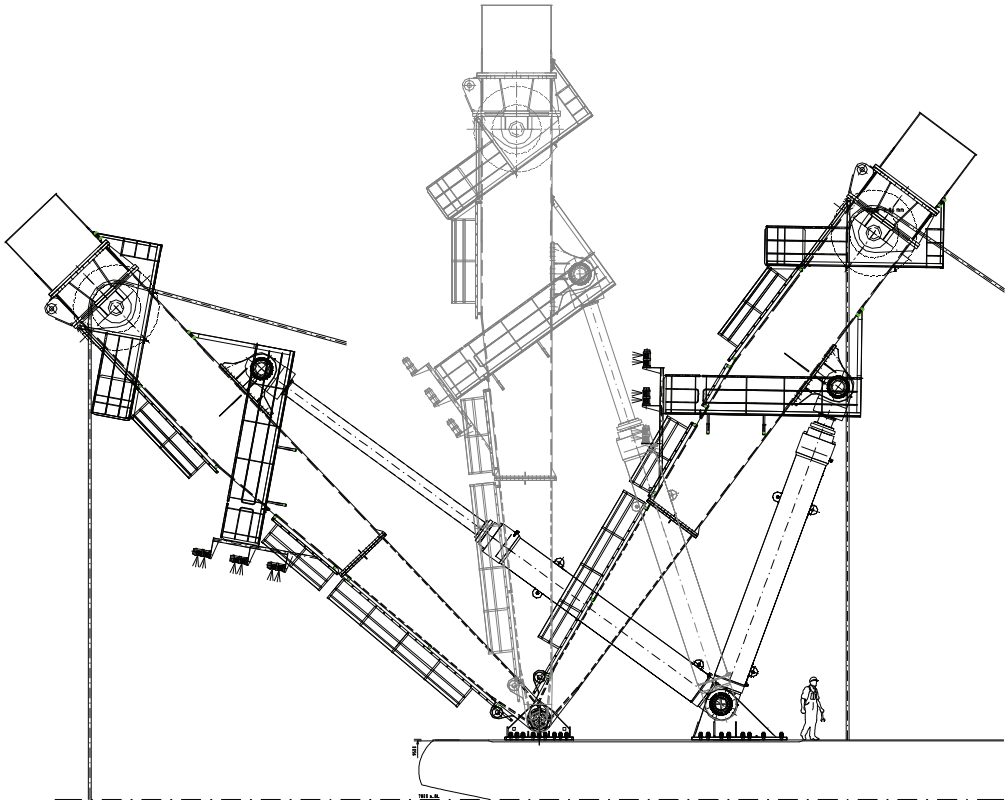
subject:

A-FRAME

SWL 250 t

item:

OPERATING MANUAL
BEDIENUNGSANWEISUNG



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Client Code

Hitzler Werft Code

A. 2178

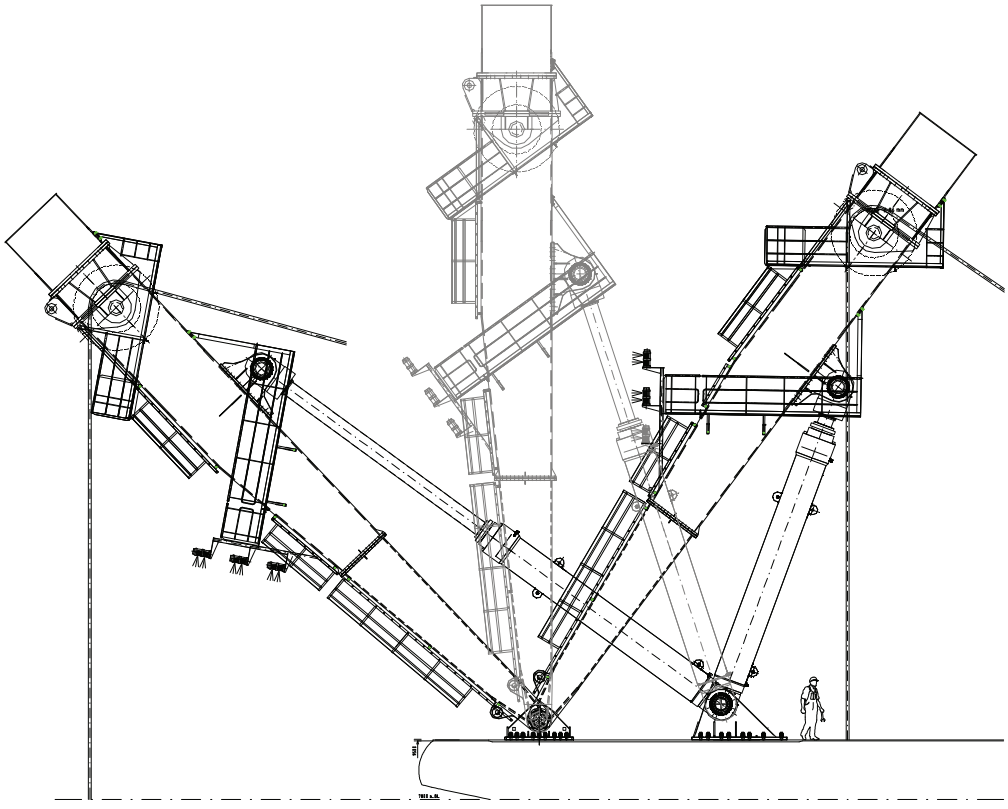
Subject:

A-FRAME

250 t SWL

Item:

OPERATING MANUAL



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4							
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0	19.03.2010	PRELIMINARY	16	HW/Pa		HW	

Contents

1. General

System description

The A-frame is designed for mounting at the stern of the following ships:
AHT "JANUS"
AHT "URSUS"
AHT "URANUS"
AHT "ORCUS"

The A-frame is designed as an offshore crane for the following operating conditions:

Load-bearing capacity	250 t SWL
Sea state	5
Significant wave height	3.9 m
Outreach measured from pivot point of pivot bearing	13 m sternwards to 9 m forwards
Operating speed under load,	approx. 260 sec. sternwards; approx. 200 sec. forwards
Clear width between uprights at top	8.60 m
Width between bearing points	11.40 m
Vertical height to pivot point of pulley	17.70 m above deck

Workspace illuminated by 4 x 400-W HQL suspended luminaires (Annex 7.5).

Hydraulics with radio remote control.

The system is supplied by a separate power pack that is installed in a 40-ft container (Annex 7.10).

The power pack comprises two diesel-hydraulic units mounted on anti-vibration mounts, with radiator cooling, start/stop monitoring, fuel tank and a hydraulic-fluid reservoir.
Access to the container by two end faces each mounted access doors that are accessible via a suitable platform.
The container is positioned on the port-side container setdown above the cargorail.

The connections between the power pack and the on-board electrics and hydraulics connections are made by means of flexible plug connections and quick-release couplings, respectively, underneath the container floor to the junction box on the cargorail and to the hydraulics connections on deck.

The connecting cables and hydraulic hoses are stowed in the power pack container.

Abbreviations used
PS = port SB = starboard

1.1 A-frame

Manufacturer

Hitzler Werft GmbH
Bahnhofstr. 4-12
21481 Lauenburg / Elbe
Germany

Phone : +49 (0)4153 588-0
Fax : +49 (0)4153 588-100
E-mail : info@hitzler-werft.de
Internet : www.hitzler-werft.de

Transport dimensions

The transport dimensions of the component parts are coordinated for transport with 40' flat-rack containers.
Length: 12.192 m
Width: 2.438 m
Max. component weight: approx. 35 t

Transport dimensions of assembled A-frame

Length: 22.00 m
Width: 14.90 m
Height: 6.10 m

Transport weight: approx. 238 t
Position of centre of gravity: approx. 10.85 m above axis of A-frame hinge at leading edge of A-frame legs

Transport locks for assembled A-frame

A-frame legs: 1 HEM 300 H-beam; length 10.900 m; bolted
Bolted connection: 16 x M30x100-8.8 bolt per DIN EN 24014
32 x B31 plain washer per DIN 125
16 x M30-8.8 nut

Hydraulic cylinders: 4 HEB 200 H-beams; length 1.950 m; bolted together
Bolted connection: 8 x M64x270-10.9 bolt per DIN 931
8 x A66 plain washer per DIN 6916
8 x M64-8.8 nut per DIN 934

Hoisting eyes

Transport eyes: 4 x NG 120 with inside Ø 130 mm
Eyes on crossbeam and leg: 16 x NG 16
Eyes on hydraulic cylinders: 4 x NG 20

Paint system

Epoxy system from Hansa Schiffsfarben GmbH

Inside	Item no.	Colour	RAL	250	mµ
HANSAPOX Multicolor HS	33235-93690-2077	creme white		125	mµ
HANSAPOX Multicolor HS	33235-73520-2077	pebble grey		125	mµ
Outside	**Item no.**	**Colour**	**RAL**	**325**	**mµ**
HANSAPOX Multicolor HS	33235-73520-2077	pebble grey		125	mµ
HANSAPOX Multicolor HS	33235-93690-2077	creme white		125	mµ
HANSADUR Topcoat	33140-1002-0011	sand yellow	1002	75	mµ

1.2 Power pack

Transport dimensions

The dimensions are identical with those of a standard 40' container.
Length: 12.192 m
Width: 2.438 m
Height: 2.591 m

Transport weight: approx. 25 t
Position of centre of gravity: ##

2. Assembly

2.1 A-frame components

Assembly materials

Assembly materials – A-frame
Components

- Top beam, ~ 33.0 t
- Leg upper section PS, ~28.5 t
- Leg upper section SB, ~28.5 t
- Leg lower section PS + deck hinge, assembled, ~13.0 t
- Leg lower section SB + deck hinge, assembled, ~13.0 t
- Pulley carrier upper section, ~6.2 t
- Arm element PS, ~0.4 t
- Arm element SB, ~0.4 t
- Pulley carrier lower section with pulley assembled, ~10.1 t
- Top hinge of hydraulic cylinder PS with pin, ~4.5 t
- Top hinge of hydraulic cylinder SB with pin, ~4.5 t
- Deck hinge of hydraulic cylinder PS with pin, ~6.2 t
- Deck hinge of hydraulic cylinder SB with pin, ~6.2 t
- Hydraulic cylinder PS, ~34.9 t
- Hydraulic cylinder SB, ~34.9 t
- A-frame transport lock, ~2.8 t
- Hydraulic cylinder transport locks, ~ 0.6 t

Bolted connection per Annex 7.1, ~2.5 t

Hexagon-head screw:	24 pces	M36x120-8.8	DIN 931
	: 12 pces	M36x170-10.9	DIN 931
	: 232 pces	M36x190-10.9	DIN 931
	: 16 pces	M36x200-10.9	DIN 931
	: 180 pces	M36x230-10.9	DIN 931
Hexagon nut	: 880 pces	M36-8.8	DIN 934
Washer	: 880 pces	A37	DIN 6916

Assembly materials – platforms and ladders
Components ~ 7.1 t

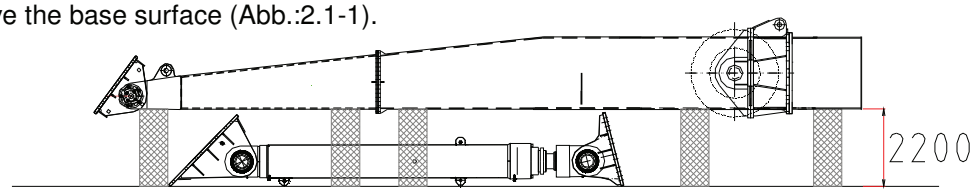
- Ladder 1 PS
- Ladder 1 SB
- Ladder 2 PS
- Ladder 2 SB
- Ladder 3 PS
- Ladder 3 SB
- Ladder 4 PS
- Ladder 4 SB
- Lamp mast PS
- Platform A pulley PS
- Platform A pulley SB
- Platform B pulley PS
- Platform B pulley SB
- Platform A leg PS
- Platform A leg SB
- Platform B leg PS
- Platform B leg SB

Bolted connection

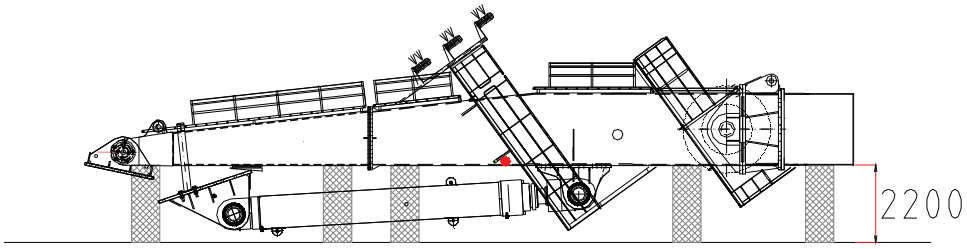
Hexagon-head screw:	288 pces	M16x35-A4	DIN 933
Hexagon nut	: 16 pces	M16-A4	DIN 934
Washer	: 288 pces	A17-A4	DIN 125

Preparatory work

Position support blocks capable of carrying heavy loads (5 on each side). The top edge of the blocks must be min. 2.20 m above the base surface (Abb.:2.1-1).



2.1 - 1



2.1 - 2

Assembly

Lay out the PS and SB hydraulic cylinders on the floor with a clearance of 12.08 m between the hinges.

Assemble the PS hydraulic cylinder deck hinge and bolt per Annex 7.1.

Assemble the PS hydraulic cylinder top hinge and bolt per Annex 7.1.

Assemble the SB hydraulic cylinder deck hinge and bolt per Annex 7.1.

Assemble the SB hydraulic cylinder top hinge and bolt per Annex 7.1.

Set the top beam down on the supports blocks (clearance between flange plate and hinge axis approx. 5.765 m) and secure.

Set the PS leg upper section down on the PS support blocks.

Align the PS leg upper section on the PS support blocks with the top beam and pull up to the bolted connection flange.

Bolt the PS leg upper section to the top beam per Annex 7.1.

Set the SB leg upper section down on the SB support blocks.

Align the SB leg upper section on the SB support blocks with the top beam and pull up to the bolted connection flange.

Bolt the SB leg upper section to the top beam per Annex 7.1.

Set the PS leg lower section down on the PS support blocks.

Align the PS leg lower section on the PS support blocks with the PS leg upper section and pull up to the bolted connection flange.

Bolt the PS leg lower section to the PS leg upper section per Annex 7.1.

Set the SB leg lower section down on the SB support blocks.

Align the SB leg lower section on the SB support blocks with the SB leg upper section and pull up to the bolted connection flange.

Bolt the SB leg lower section to the SB leg upper section per Annex 7.1.

Assemble the transport lock between the A-frame legs.
Crane in the upper pulley housing and pull up to the bolted connection flange of the top beam.

Bolt the upper pulley housing to the top beam per Annex 7.1.

Assemble the PS arm element to the top beam and pulley housing and bolt per Annex 7.1.

Assemble the SB arm element to the top beam and pulley housing and bolt per Annex 7.1.

Crane in the pulley carrier lower section together with the pulley and pull up to the bolted connection flange of the upper pulley housing.

Bolt the pulley carrier lower section with the pulley to the upper pulley housing per Annex 7.1.

Make the electrical connections of the load pins (per Annex 7.6).

Secure the PS hydraulic cylinder to prevent if from rotating and raise the top hinge.

Align the top PS hinge flange with the flange plate of the leg upper section and pull together.

Bolt the PS hydraulic cylinder top hinge to the PS leg upper section per Annex 7.1.

Secure the SB hydraulic cylinder to prevent if from rotating and raise the top hinge.

Align the top SB hinge flange with the flange plate of the leg upper section and pull together.

Bolt the SB hydraulic cylinder top hinge to the SB leg upper section per Annex 7.1.

Raise the PS lower hydraulic cylinder hinge and move it to its stowage position (Fig.: 2.1-2). To protect the cylinder baseplate from being damaged by the hinge flanks, position a block of wood in between.

Assemble the transport lock and chock the hydraulic cylinder hinge at the leg lower section.

Raise the SB lower hydraulic cylinder hinge and move it to its stowage position (Fig.: 2.1-2). To protect the cylinder baseplate from being damaged by the hinge flanks, position a block of wood in between.

Assemble the transport lock and chock the hydraulic cylinder hinge at the leg lower section.

Assemble and bolt on ladder 1 on PS per Annex 7.3.

Assemble and bolt on ladder 1 on SB per Annex 7.3.

Assemble and bolt on ladder 2 on PS per Annex 7.3.

Assemble and bolt on ladder 2 on SB per Annex 7.3.

Assemble and bolt on ladder 3 on PS per Annex 7.3.

Assemble and bolt on ladder 3 on SB per Annex 7.3.

Assemble and bolt on ladder 4 on PS per Annex 7.3.

Assemble and bolt on ladder 4 on SB per Annex 7.3.

Assemble and bolt on lamp mast on SB per Annex 7.3.

Assemble and bolt on platform A leg on PS per Annex 7.3.

Assemble and bolt on platform B leg on PS per Annex 7.3.

Assemble and bolt on platform A leg on SB per Annex 7.3.

Assemble and bolt on platform B leg on SB per Annex 7.3.

Assemble and bolt on platform A pulley on PS per Annex 7.3.

Assemble and bolt on platform B pulley on PS per Annex 7.3.

Assemble and bolt on platform A pulley on SB per Annex 7.3.

Assemble and bolt on platform B pulley on SB per Annex 7.3.

2.2 Assembling A-frame onboard

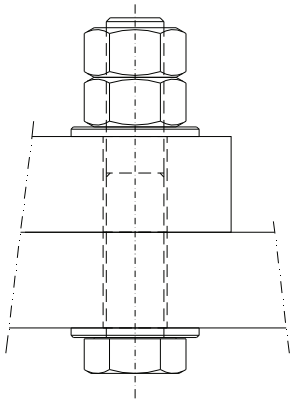
Assembly materials

Materials for bolting to foundation per Annex 7.1

Hexagon-head screw: 72 x M64x270-10.9 DIN 931

Hexagon nut: 144 x M64-8.8 DIN 934

Washer: 144 x A66 DIN 6916



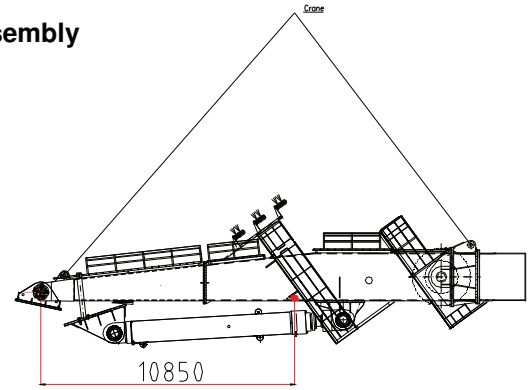
2.2 - 1

Preparatory work on board

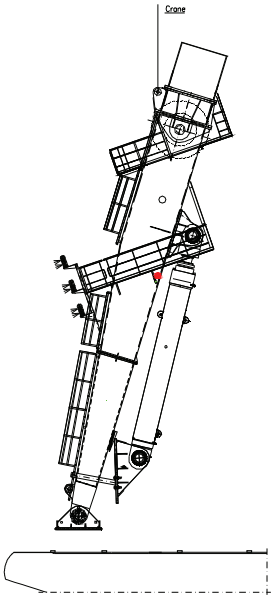
Before assembling the A-frame for the first time, position the stopper plates at the foundation areas per Annex 7.2.

Remove all 72 dummy plugs from the foundation holes (Annex 7.4).

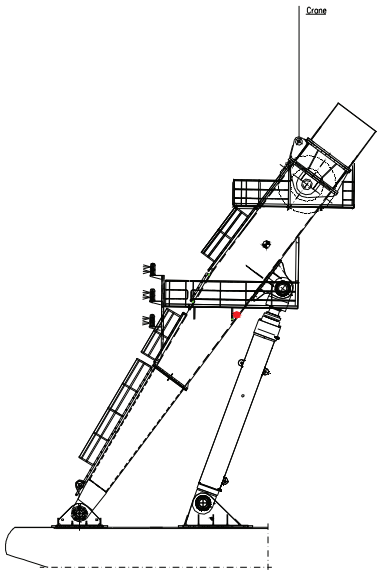
Assembly



2.2 - 2



2.2 – 3



2.2 - 4

Fasten the hoisting tackle to the 4 transport eyes (NG 120).

Position the load hooks above the A-frame centre of gravity (Fig.: 2.2-2).

Lift the A-frame and transport it from the storage area to the stern of the ship.

Set the A-frame upright, with the hydraulic cylinders facing towards the bow.
Set the foundation plates of the frame hinges down onto the rear top plate position (hull trimmed sternwards) (Fig.: 2.2-3).

Provisionally bolt together the foundation plates of the frame hinges.

Disassemble the transport locks of the hydraulic cylinders and store them away.

Slowly tilt the A-frame towards the bow until the foundation plates of the hydraulic cylinder hinges can be set down on the front top plate position (Fig.: 2.2-4).

Provisionally bolt together the foundation plates of the hydraulic cylínder hinges.

Unfasten the hoisting tackle.

Disassemble the transport lock from the A-frame legs and store it away.

Complete the bolted connections of the top plates as shown in Fig. 2.2-1 and tighten to the torque specified in Annex 7.1.

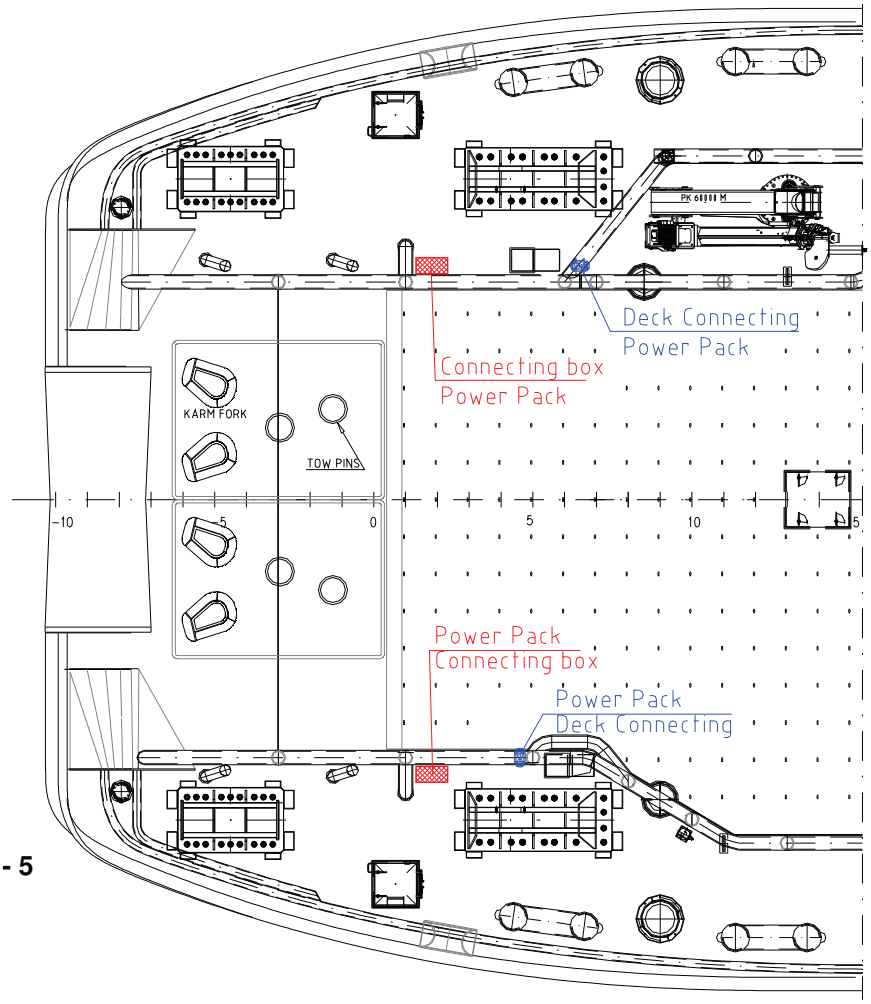
Connect the electrical connections of the A-frame to the PS and SB junction boxes on the cargorail; see Annex 7.9.

Connect the sensors to the PS and SB junction boxes on the cargorail; see Annex 7.9.

Mount the ship's stern lamps on the lamp mast (SB) of the A-frame and connect to the electrical system.

Connect the hydraulic connections of the PS and SB cylinders to the PS and SB deck connections underneath the cargorail using the appropriate hydraulic hoses; see Annex 7.8.

Lubricate all lubricating points of the A-frame bearing pins, hydraulic cylinders and pulley.



2.2 - 5

2.3 Power pack / Hydraulik system

Assembly materials

4 locking pins for guide cones of stowage frame.

Assembly

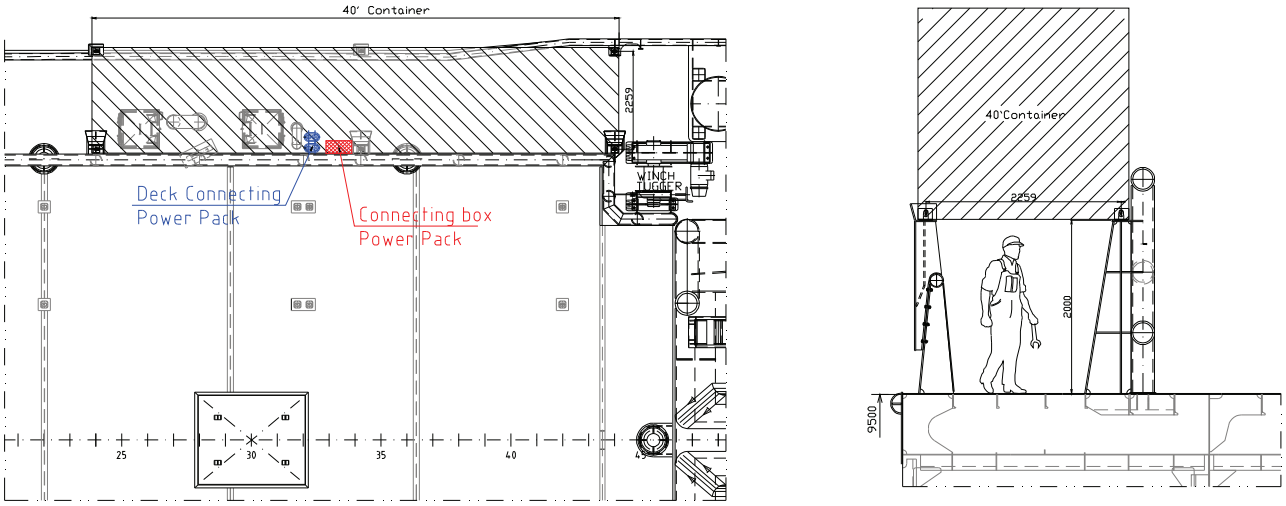
Crane the power pack container on board and set it down on the PS onto the 40' container setdown on the cargorail (Fig.: 2.3-1).

Fit the guide cone locking pins at each corner of the container and secure.

Connect the electrical connections of the power pack to the PS junction box on the cargorail; see Annex 7.9.

Connect the sensors to PS junction box on the cargorail; see Annex 7.9.

Connect the hydraulic connections of the power pack to the relevant deck connections on the cargorail on PS using the appropriate hydraulic hoses; see Annex 7.8.



2.3 - 1

3. Putting Into Service

3.1 Power pack / Hydraulik system

See Annex 7.10

See Annex 7.11

See Annex 7.12

4. Function Test

4.1 A-frame

General:

Before beginning the function test, carry out a stability calculation with the projected load condition and relevant A-frame load (example per Annex 7.13).

The results of the stability calculation must be submitted in advance to the classification society for approval of the function test.

A function and load test must be conducted under the supervision of the classification society every time the A-frame is assembled onboard a ship.

A heeling test must be conducted under the supervision of the classification society every time the A-frame is assembled onboard a ship and a stability book compiled.

The power pack must be commissioned before beginning the function test.

Function test without load:

The procedure of the function test is a matter for the classification society to decide upon.

This test serves to verify the operability of all components and systems, and can be conducted without load.

Swing the A-frame from its stowage position through its top position to the working position and back to its stowage position.
In the process, make sure that no parts of the ship's hull or equipment restrict the operating area or hinder operation.

Test the emergency stop equipment.

Function test on the safety equipment:

Test conditions:

- Ship moored to the pier at a location sheltered from waves
- Gentle breeze
- Load condition of the ship following the stability calculation is to be such that an even keel can be expected.

The procedure of the function test is a matter for the classification society to decide upon.

This test serves to verify the operability of all safety systems, and must be conducted with the appropriate maximum loads.

Check the number of hoisting cable layers on the winch drum. The number of cable layers stated in the table in Annex 7.7 must not be exceeded for the corresponding loads.

Feed the hoisting cable of the winch drum into the A-frame pulley.

Attach appropriate loads to the hoisting cable with the aid of load fasteners approved for these loads.

With respect to the maximum loads, in accordance with the load selector on the winch control console (for A-frame operation), check whether the winch blocks hauling-in and is only capable of paying out.

Test the emergency stop function.

The test on the maximum loads can be conducted when the A-frame is in its stowage position.

Function test under test load (dynamic load test):

Test conditions:

Ship moored to the pier at a location sheltered from waves
Calm
Load condition of the ship following the stability calculation is to be such that an even keel can be expected when the A-frame's working position is reached.

Required test load for hoisting gear on ships with load capacity > 50 t per ILO:

SWL + 10% = 250 t + 25 t = **275 t test load**

Check the number of hoisting cable layers on the winch drum. The number of cable layers stated in the table in Annex 7.7 must not be exceeded for the corresponding loads.

Feed the hoisting cable of the winch drum into the A-frame pulley.

Attach the test load to the hoisting cable with the aid of load fasteners approved for such loads.

Secure the test load in such a way that it is impossible for it to swing out to the side. If the test load is not secured, there is a danger of uncontrolled heeling and therefore of the ship losing stability.

Leave the mode selector on the winch control console set to towing mode. The test load can not be hoisted when "A-frame" mode is selected (maximum load exceeded).

Hoist the test load slowly and hold it there.

Swing the A-frame from its stowage position through its top position to the working position by paying out the hoisting cable such that the test load keeps a constant clearance from the pulley.

Carry out a brake test by activating the emergency stop equipment.

Swing the A-frame from its working position through its top position to the stowing position by hauling in the hoisting cable such that the test load keeps a constant clearance from the pulley.

Set down the test load slowly.

Unfasten the test load.

The inspector from the classification society present inspects the hoisting gear, including the foundation.

4.2 Power pack / Hydraulik system

See Annex 7.10

See Annex 7.11

See Annex 7.12

5. Work Procedures

5.1 A-frame

General:

Before setting off on a voyage, the scheduled assignment must be planned in detail and stability calculations conducted to verify compliance with the stability criteria.

Max. weather conditions for use of the A-frame:
Wind speed 5 Beaufort
Significant wave height 3.9 m

Use hawsers, shackles and other lifting equipment of a rating approved for the load to be hoisted.

The weights of the pieces of equipment hoisted using the A-frame must be known and attested.

The lower drum (load drum) of the towing winch must always be used to hoist the weights with the A-frame.
The mode selector on the winch control console must be set to "A-Frame" mode and the relevant maximum load be set at the load selector. Weights higher than this value can not be lifted.

Refer to the table in Annex 7.7 for the max. permissible number of cable layers on the winch drum for the weight to be lifted.

Before you start work with the A-frame, check the load condition on the basis of the stability calculation and set the appropriate condition.

Instructions for working with the plough:

Use the lower hawser (hoisting cable) of the lower winch drum (load drum) to hoist out the plough with the A-frame and the hawser (towing hawser) of the upper winch drum (towing drum) to tow over the stern roller.

Feed the hoisting cable of the load drum into the A-frame pulley.

Fasten the hoisting cable to the hoisting gear and the towing hawser to the towing attachment of the plough.

Raise the plough with the hoisting cable.

Swing the A-frame from its stowage position through its top position to the working position by paying out the hoisting cable and towing hawser such that the load keeps a constant clearance from the pulley.

Lower the plough to operating depth using the hoisting cable, paying out the towing hawser in a controlled manner on the disengaged towing drum (controlling by means of the drum brake of the towing drum).

Switch the winch drive from the load drum to the towing drum.
The brake must always be engaged and the hawser taut when switching the winch drive.

Get the ship under way making slight headway and pay out the towing hawser correspondingly, paying out the hoisting cable on the disengaged load drum in a controlled manner (controlling by means of the drum brake of the load drum).

Keep paying out until the towing hawser assumes the required towing angle in relation to the surface of the water.

Adjust the towing winch as described in the operating instructions applicable to winching.

Start towing.

When towing the plough, make sure that you do not use the hoisting cable for towing, otherwise there is a danger of the A-frame being overloaded and the ship becoming unstable.

Haul in the plough by following the reverse sequence of steps.

Whenever paying out and hauling in, make sure that the load hawser (hoisting cable) and towing hawser run clear of one another.

5.2 Power pack / Hydraulik system

See Annex 7.10

See Annex 7.11

See Annex 7.12

6. Disassembly

6.1 A-frame

Move the A-frame to its stowage position.

Remove the hoisting cable from the A-frame pulley.

Disconnect the hydraulic connection of the cylinders; see Sec. 6.2.

Disconnect the electrical connection of the A-frame; see Sec. 6.2.

Disconnect the sensors from the relevant monitoring unit; see Sec. 6.2.

Detach the ship's stern lamps from the lamp mast (SB) of the A-frame.

Assemble the transport lock between the A-frame legs.

Fasten the hoisting tackle to the 4 transport eyes (NG 120).

Undo and remove the foundation plate bolts of the hydraulic cylínder hinges.

Use the hoisting tackle to slowly set the A-frame upright until the foundation plates of the hydraulic cylinder hinges detach from the stopper plates and the load hook is positioned above the centre of gravity.

Rotate the lower hydraulic cylinder hinges towards the A-frame legs and move the cylinders to their stowage position (Fig.: 2.2-3). To protect the cylinder baseplate from being damaged by the hinge flanks, position a block of wood in between.

Assemble the transport lock and chock the hydraulic cylinder hinge at the leg lower section.

Undo and remove the foundation plate bolts of the A-frame hinges.

Lift the A-frame off the hull (hull trimmed towards the bow).

Move the A-frame to its storage area.

Set the A-frame down on support blocks, with the hydraulic cylinders facing downwards.

Unfasten the hoisting tackle.

Insert dummy plugs into all 72 foundation holes on board the ship (Annex 7.4).

6.2 Power pack / Hydraulik system

Disconnect the hydraulic connections and stow the hydraulic hoses in the power pack container; see Anlage 7.8.

Disconnect the electrical connections and stow the cables in the power pack container; see Anlage 7.9.

Disconnect the sensors from the relevant monitoring units; see Sec. 7.9.

Prepare the power pack container equipment for container transport; see Annex 7.10.

Release the guide cone locking pins at each corner of the container and remove.

Hook up the container and crane it off the ship.

7. Annex List

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7.4 4783.26 - Blindkappen für Fundamentlöcher.dwg (Dummy plugs for foundation holes)
7.5 Datenblatt-Strahler HQL 400.pdf (Data sheet HQL 440 spotlight)
7.6 LastMessBolzen-11000kN.tif (Load pins)
7.7 Seillagen auf Lasttrommel bei A-Framebetrieb.pdf (Cable layers on winch drum during A-frame operation)
7.8 Hydraulic Connections.pdf
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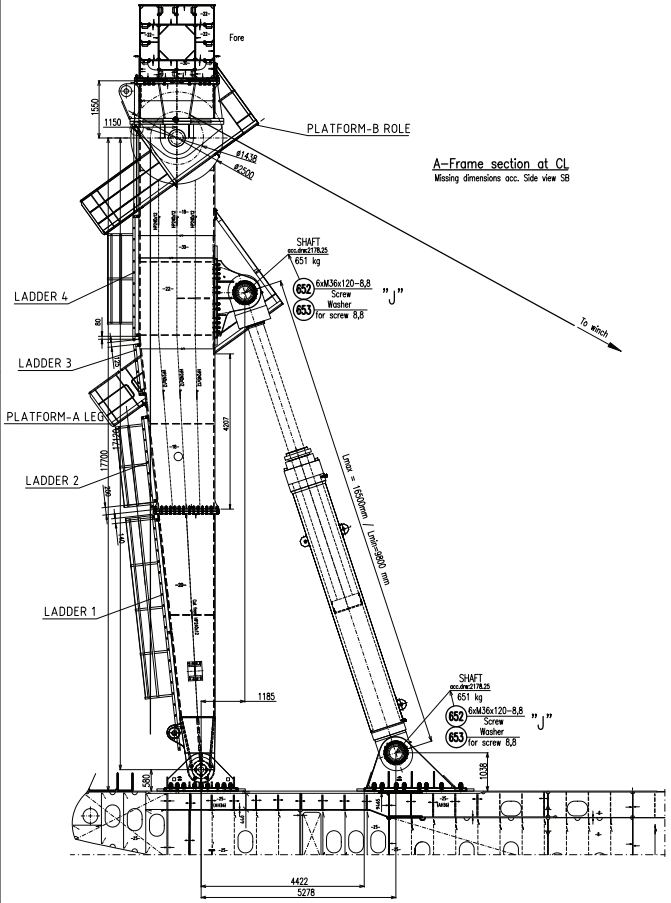
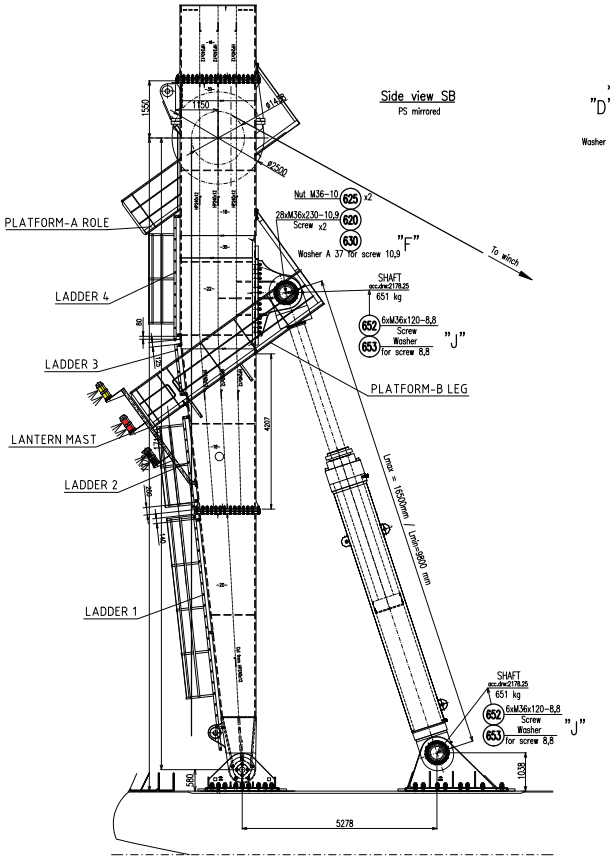
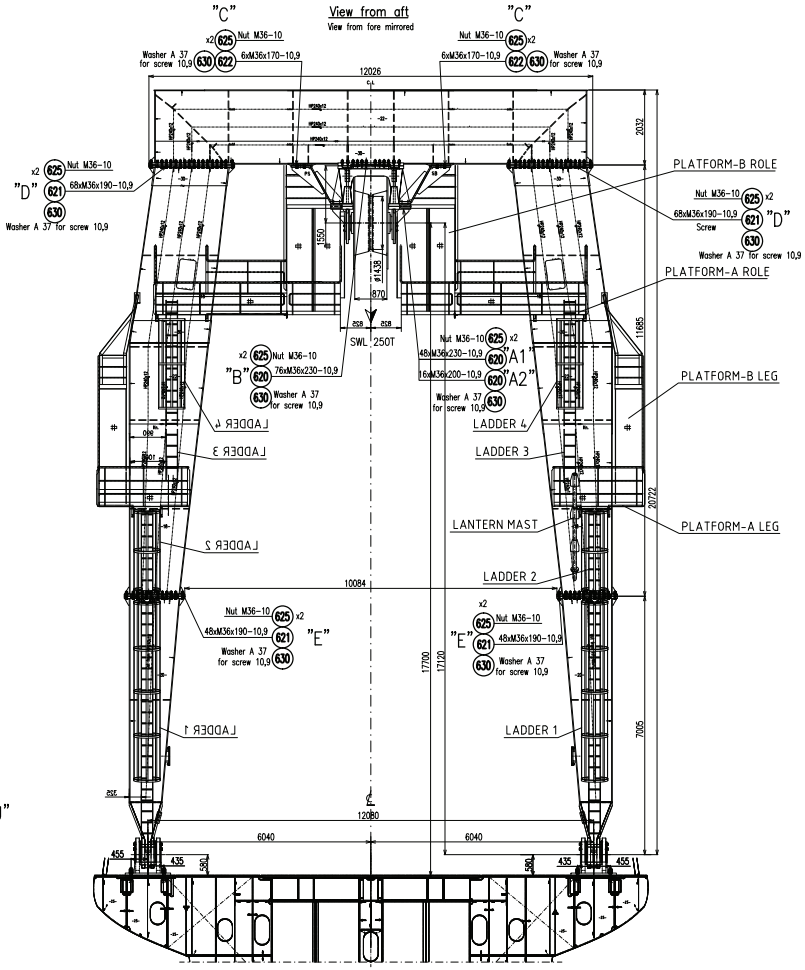
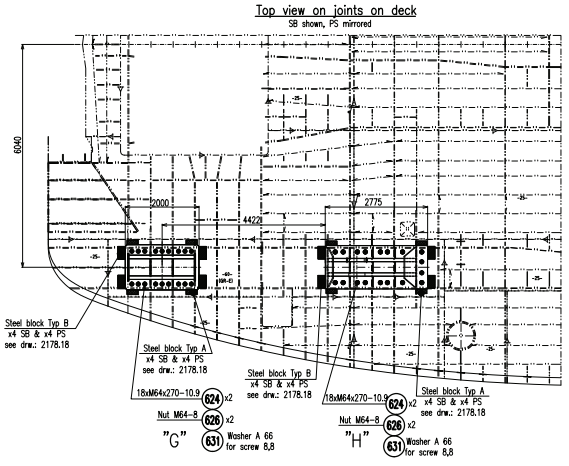
7.10 Power-Pack-Instruction Manual_R01.pdf
7.11 Hydraulic drive-Configuration Manual_R01.pdf
7.12 A-Frame Cylinder Specification_R00.pdf
7.13 Tank filling and stability for A-frame trial



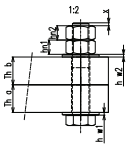




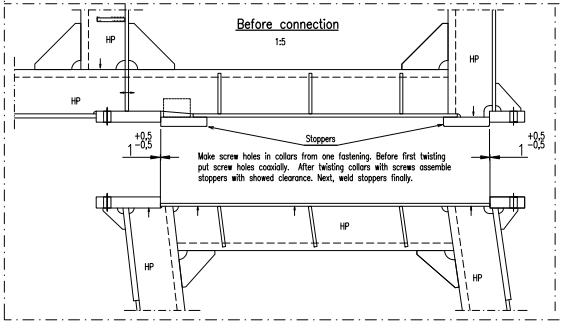


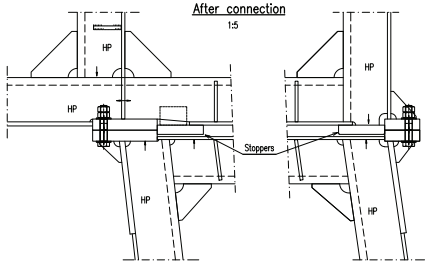
Dimensions screw connections of A-Frame

Type of screw connection see drw..	Dim Ø	Festigkeitsklassen Class of screw	Thickness Th a mm	Thickness Th b mm	Thickness Washer h w1 mm	Thickness Washer h w2 mm	Height Nut h n1 mm	Height Nut h n2 mm	Additional lenght x (over nut) mm	Length min mm	Screw	Quantity of screw at connection	Quantity of connections on A-Frame	Quantity of screws Total	Tightening torque unlubricated Nm
A1	M 36	10.9	80	80	6	6	31	31	6.3	230	M36x230-10.9	48	1	48	2 480
A2	M 36	10.9	80	50	6	6	31	31	6.3	200	M36x200-10.9	16	1	16	2 480
B	M 36	10.9	80	80	6	6	31	31	6.3	230	M36x230-10.9	76	1	76	2 480
C	M 36	10.9	50	50	6	6	31	31	6.3	170	M36x170-10.9	6	2	12	2 480
D	M 36	10.9	60	60	6	6	31	31	6.3	190	M36x190-10.9	68	2	136	2 480
E	M 36	10.9	60	60	6	6	31	31	6.3	190	M36x190-10.9	48	2	96	2 480
F	M 36	10.9	80	80	6	6	31	31	6.3	230	M36x230-10.9	28	2	56	2 480
G	M 64	8.8	60	80	11	11	53	53	11.2	270	M64x270-8.8	18	2	36	14 415
H	M 64	8.8	60	80	11	11	53	53	11.2	270	M64x270-8.8	18	2	36	14 415
J	M 36	8.8	50	-	11	-	-	-	-	120	M36x120-8.8	6	4	24	2 480



Typical screw connections of A-Frame parts





INDEX	REVISION NOTE	DATE	NAME
B	Up date lettering	11.03.10	HW/Pat
A	Ship structure from NB 256/257 implemented.	10.11.08	HW/Lad

MAN Ferrostaal AG

	DATE	NAME
2007		
DRAWN	29.08.	HW/SK
CHECKED		
RELEASED		
SCALE	1:50	

CLIENT / PLANT: A-Frame SWL 250t

TITLE: A-Frame SWL 250t - Assembly drawing

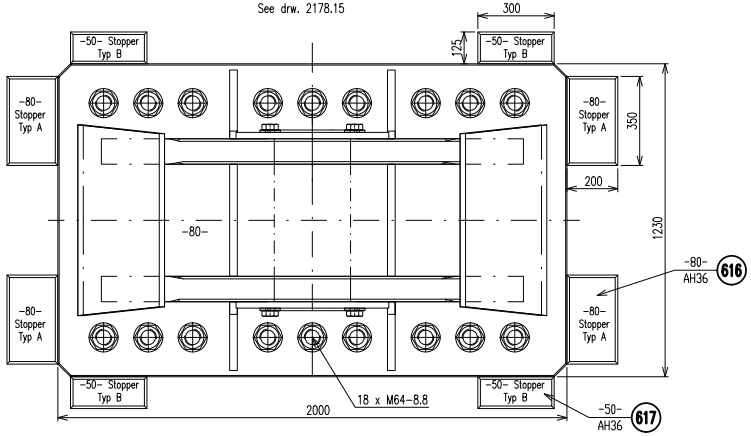
DRWG No. CONS. 2178.00 REV.INDEX B

DRWG No. Client: PAGE No. 1/1

PSP No. A.2178

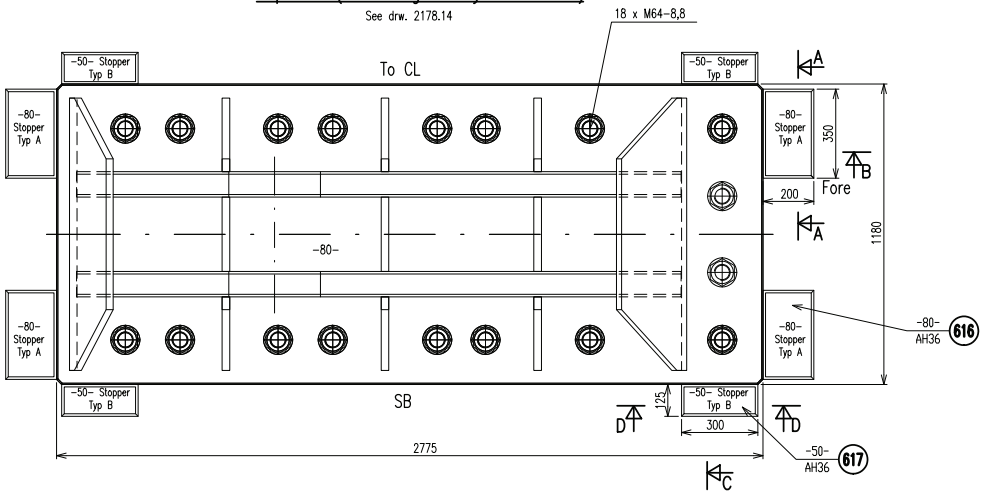
Top view (Deck hinge of A-Frame – Housing)

See drw. 2178.15



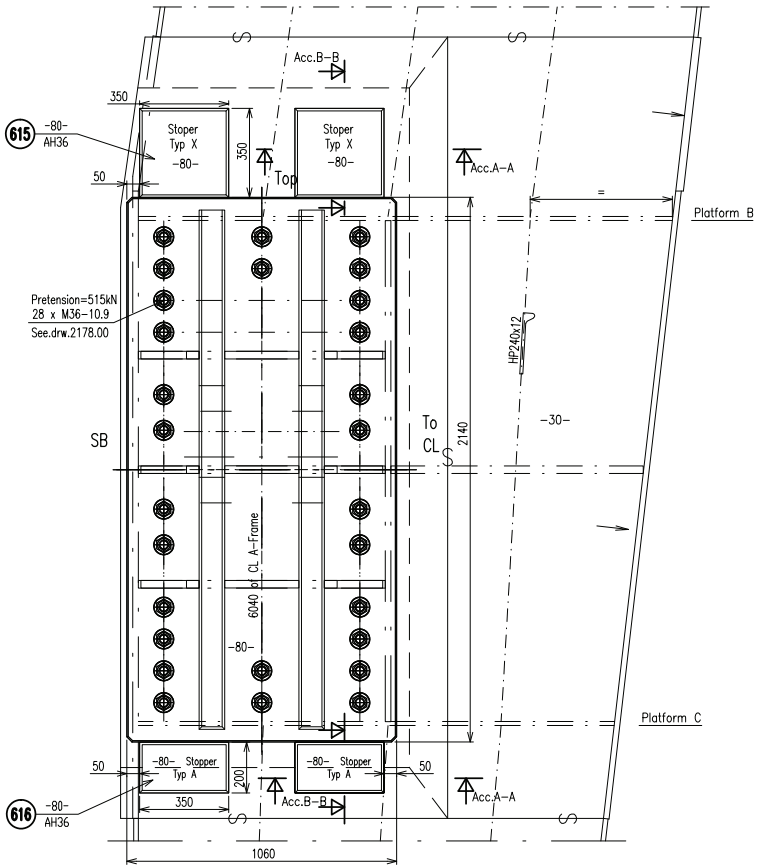
Top view (Deck hinge of hydraulic units)

See drw. 2178.14



View from fore (Top hinge of hydraulic units)

See drw. 2178.13



A – A

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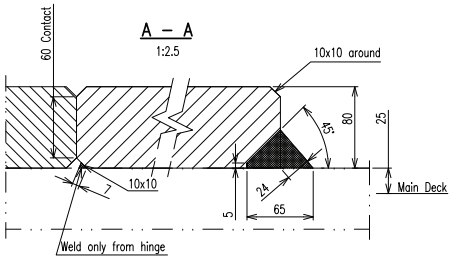

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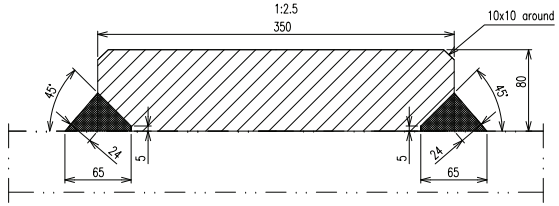

C – C

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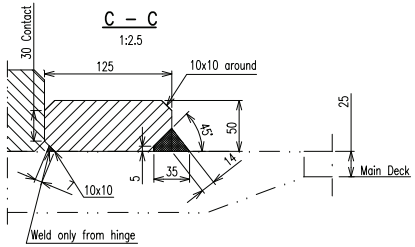
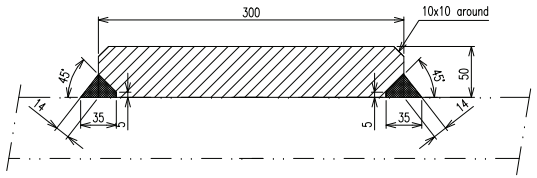
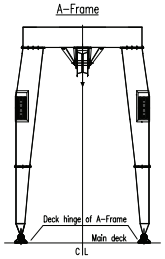


D – D

1:2.5





A-Frame leg construction shown on SB, PS to be made mirrored

NOTE:

- SHARP EDGES TO BE REMOVED.
- ALIGNMENT AND WELDING DETAILS TO BE TO SURVEYORS SATISFACTION.

REV INDEX	REVISION NOTE	DATE	NAME
A	Bemassung Details A-A bis D-D geändert.	04.11.08	Kli

HITZLER WERFT

MAN Ferrostaal AG

	DATE	NAME
2007		
DRAWN		
CHECKED		
RELEASED		
SCALE	1:10	

CLIENT / PLANT: A-Frame SWL250t

TITLE: Blocking plates

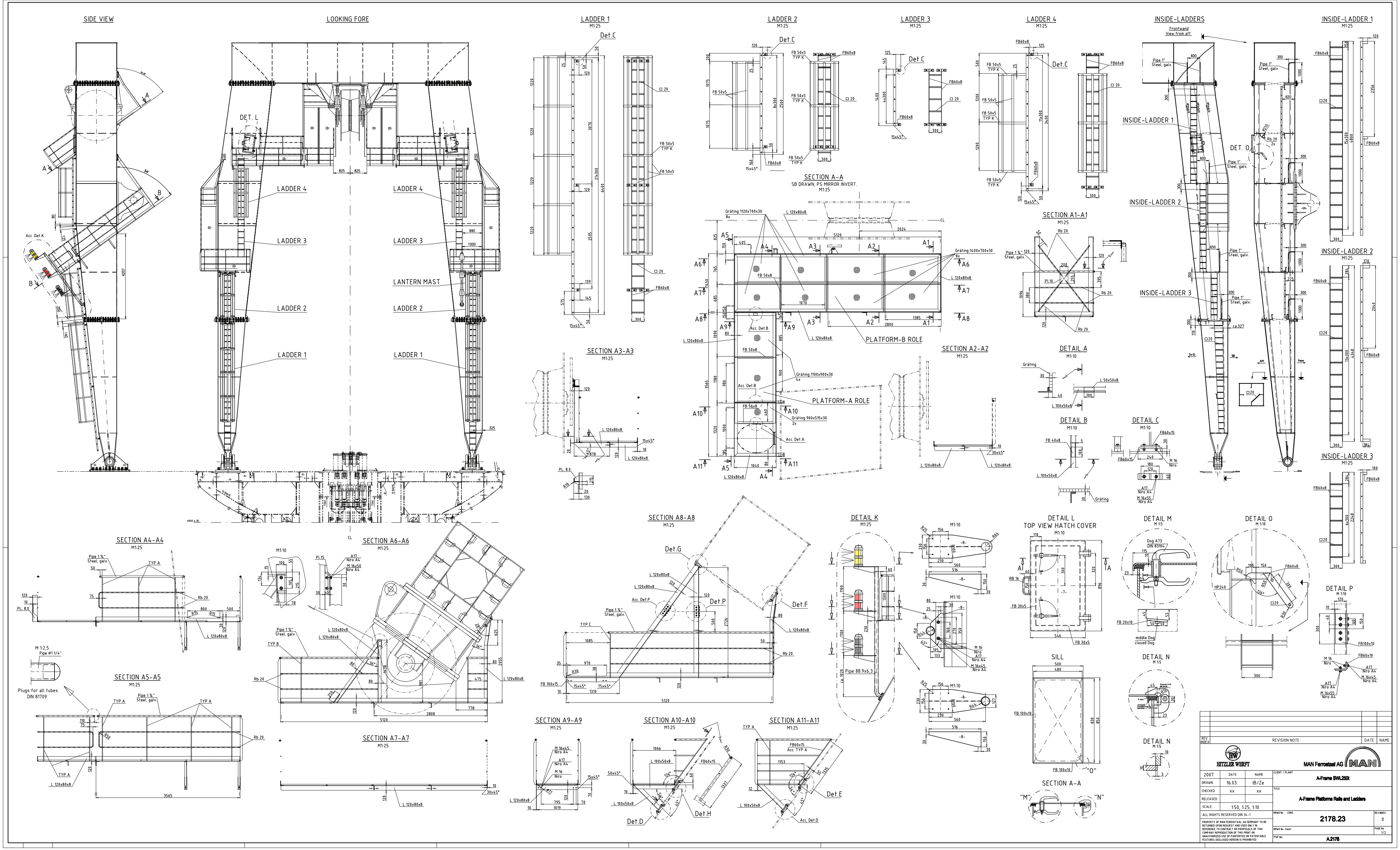
DRWG No CONS. 2178.18

REV INDEX A

DRWG No Client:

PAGE No. 1/1

PSP No. A.2178



REV. INDEX	REVISION NOTE	DATE	NAME

HITZLER WERFT

MAN Ferrostaal AG

2007	DATE	NAME
DRAWN	16.03.	IB/Ze
CHECKED	xx	xx
RELEASED		
SCALE	1:50, 1:25, 1:10	

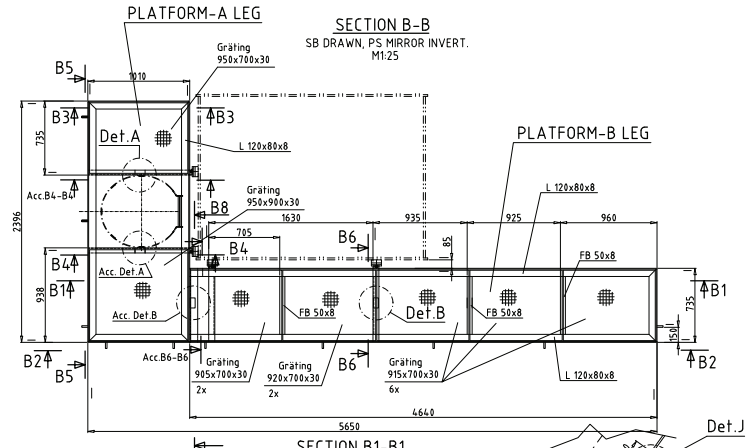
CLIENT / PLANT: A-Frame SWL250t

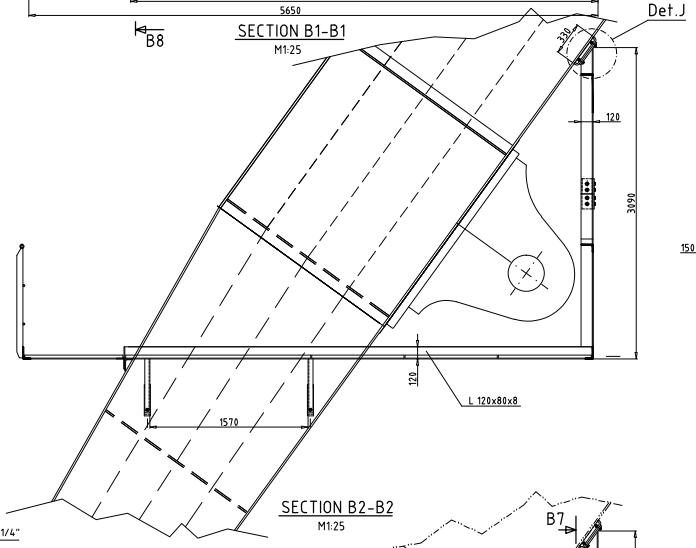
TITLE: A-Frame Platforms Rails and Ladders

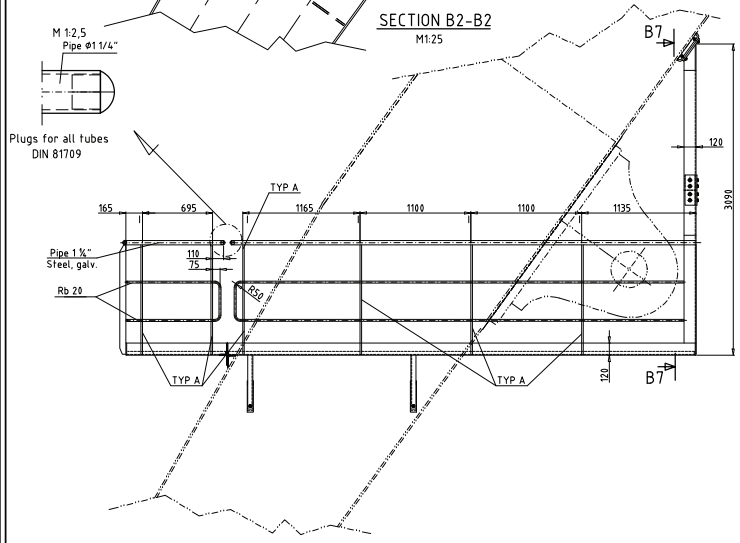
DRWG No CONS. 2178.23 — REV.INDEX 0

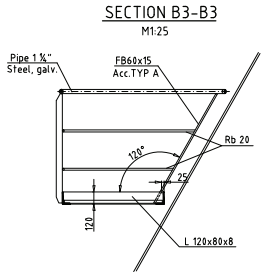
DRWG No Client: — PAGE No. 1/2

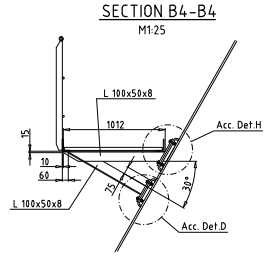
PSP No. A.2178

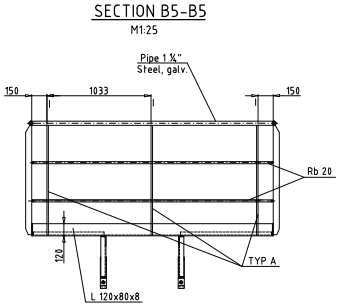


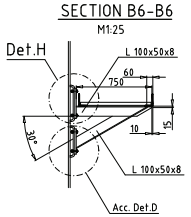


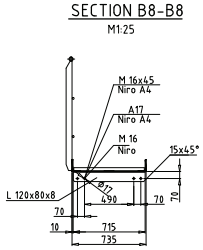


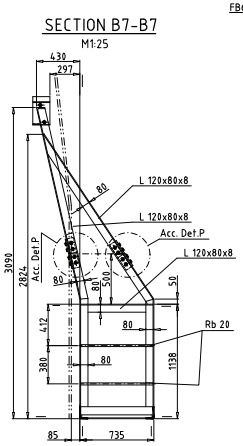


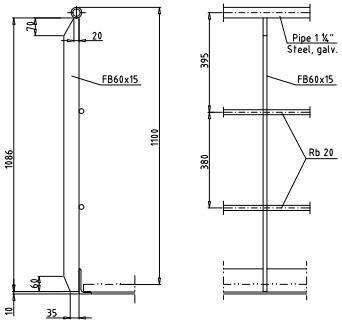


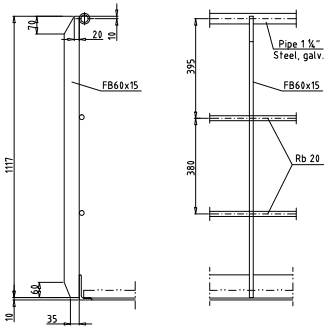


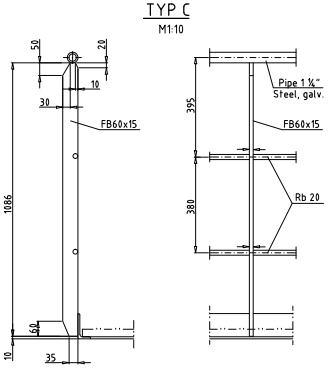


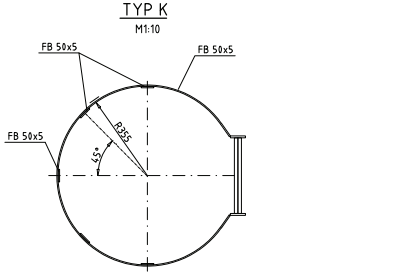


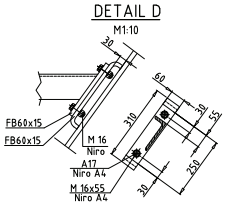


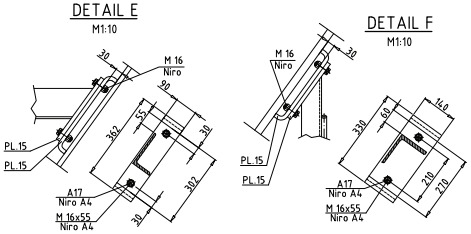


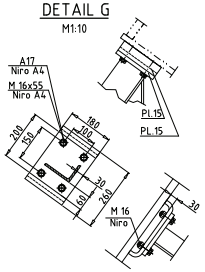


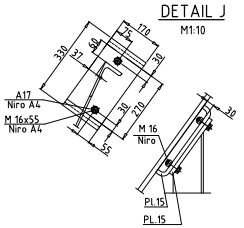


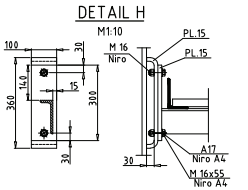












REV. INDEX	REVISION NOTE	DATE	NAME

HITZLER WERFT

MAN Ferrostaal AG

	DATE	NAME
2007		
DRAWN	16.03.	IB/Ze
CHECKED	xx	xx
RELEASED		
SCALE	1:50, 1:25, 1:10	

CLIENT / PLANT: A-Frame SWL250t

TITLE: A-Frame Platforms Rails and Ladders

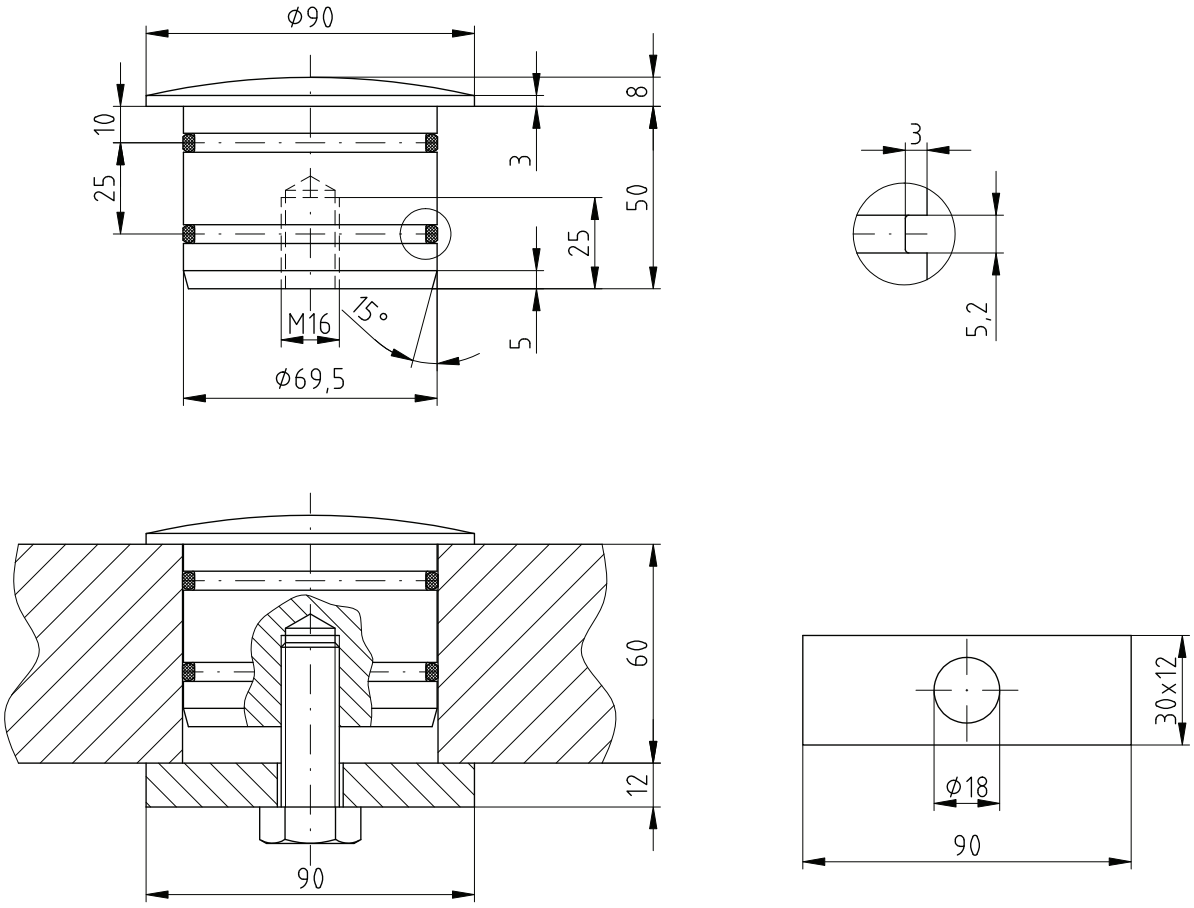
DRWG No CONS.: 2178.23

REV.INDEX: 0

DRWG No Client:

PAGE No.: 2/2

PSP No.: A.2178



72 Bolzen pro Schiff
144 O-Ringe pro Schiff
O-Ring ϕ4x64

4 Schiffe

Schraube M16x45-DIN 933, verz.
Flachstahl 30x12

HITZLER WERFT

MAN Ferrostaal AG

2007	DATE	NAME
DRAWN	25.06.07	HW / Kuse
CHECKED		
RELEASED		
SCALE	1:2; 1:1	

CLIENT / PLANT: 220t. Long Distance AHT

TITLE: Blindkappen für Fundamentlöcher

DRWG No CONS. 4783.26

REV.INDEX 0

DRWG No Client:

PAGE No.

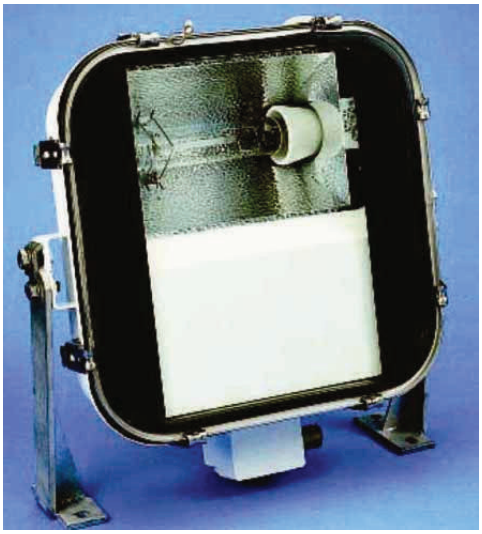
PSP No. NB254 "JANUS"

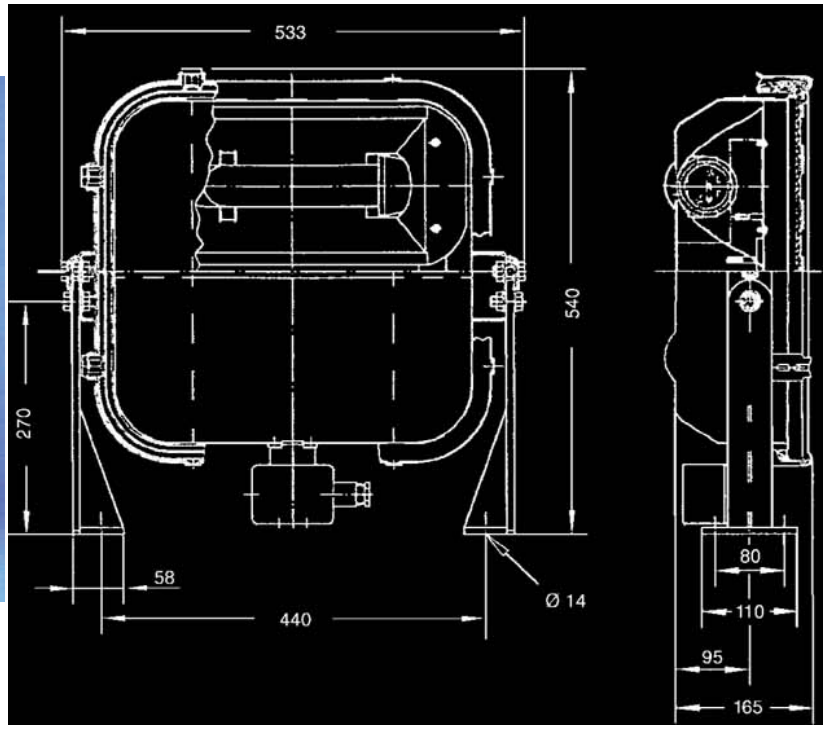
DECKMA GmbH
Decksmaschinen und Automation Vertriebs GmbH

Datenblatt / Data sheet

HPS - Strahler / HPS - floodlight

DE-GIFL 1x250/400 HPS





Materialien	Edelstahl Gehäuse, weiss pulverbeschichtet. Reflektor aus poliertem Aluminium.. Rostfreie Edelstahlschrauben Sicherheitsglas Abdeckung. Anschlussdose E40 Lampenfassung	**Materials**	Body of stainless steel, white powder finish. Reflector of polished Aluminium. Stainless steel screws. Clear safety glass guard. Connection Box E40 lamp socket
Kabeleinführung	2 Kabelverschraubungen M24x1,5	**Cable entry**	2 cable glands M24x1,5
Gewicht	20 kg	**Weight**	20 kg
Schutzart	IP 67	**Protection class**	IP 67
Anschluss	3-Fach Terminalblock für je 2 x 6 qmm	**Connection**	3-way 2 x 6 sq.mm terminal block
Spannung	230V / 60Hz	**Voltage**	230V / 60Hz

Type	Merkmale	Features	Best. Nr / Order No
DE-GIFL 1 x 250 Watt HPS E40	1 x 250W Natrium-Strahler Edelstahlgehäuse integriertes Vorschaltgerät	1 x 250W Sodium-floodlight Stainless steel body internal ballast	337 0008
DE-GIFL 1 x 400 Watt HPS E40	1 x 400W Natrium-Strahler Edelstahlgehäuse integriertes Vorschaltgerät	1 x 400W Sodium-floodlight Stainless steel body internal ballast	337 0012

Tel.: +49 (0)4105 / 65 60 – 0 * DECKMA GmbH * Fax: +49 (0)4105 / 65 60 – 25
E-mail: info@deckma-gmbh.de * Internet: www.deckma-gmbh.de

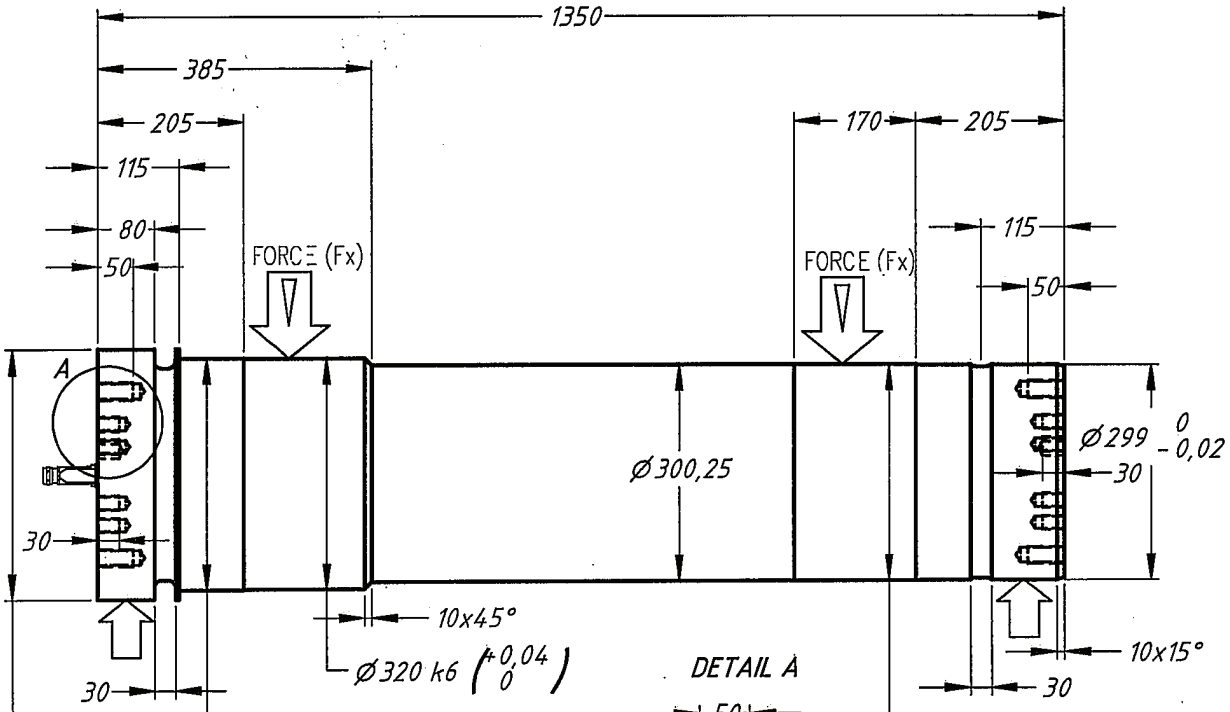
www.sensy.com

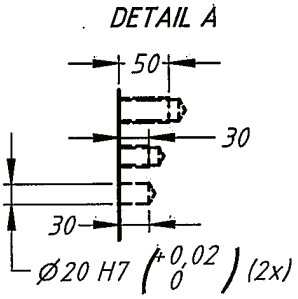
CE **Approval drawing**
Dessin d'approbation

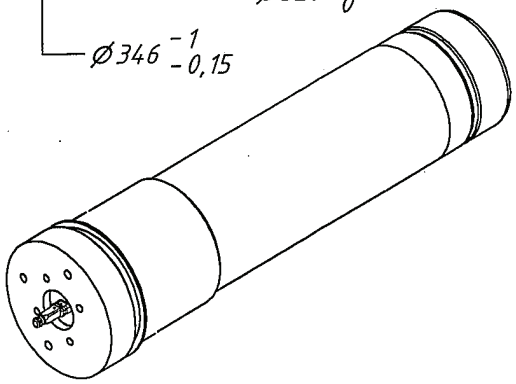
LOAD PIN
AXE DYNAMOMÉTRIQUE

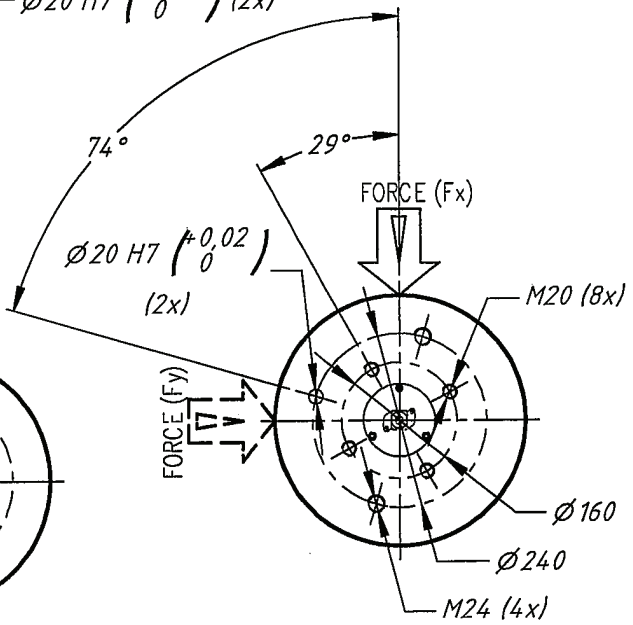
model- modèle **5000D-11000kN**

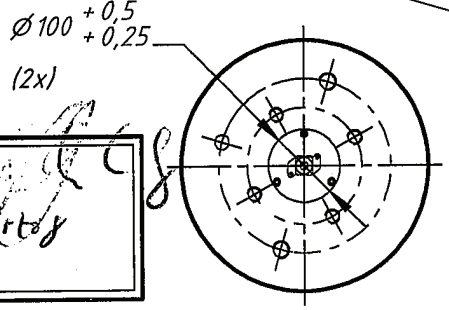
1st BCI N°(SENSY)	:20080661
Customer- Client :	HATLAP
Rev.	Rev. 11/08/2008











APPROVAL-APPROUVE:
NAME / NOM : C. Harley
DATE : 11.5.08

Ingress protection rating- Indice de protection IP67 Cable- Câble	Weight (Axle) Poids (Axe)	789,87 kg	(Plate) (Plaquette)
NOM.CAPACITY - CAPACITÉ NOM. : 11000kN	Proof tested to Testé en usine à 150% of nominal load de la charge nominale		
	Material Matière 16%Cr - 4%Ni	Overload capacity Charge à la rupture >300%	

Comm.: 05.7385+88														
Hull No.:	**254+255**													
Customer: MAN Ferrostaal AG														
E-DD-Towing Winch 1500/3200 + 3000/4000														
												Beiwerte n. GL		
drum ø	1200	mm	/ 3000mm		untere Seiltrommel, Seilauflauf unten							Hublastbeiwert y	2.5	
rope ø	86	mm	1600m									Gebrauchsbeiwert K1	3.00	ab 160t
drum length	2020	mm										Erhöhungsbeiwert fe	1.5625	
min drum speed	1.25	min^{-1}	12 Pol / 50Hz											
max drum speed	2.5	min^{-1}	6 Pol / 50Hz											
drum torque Low Speed	1929	kNm	max brake holding torque	2572	kNm									
drum torque High Speed	964.5	kNm	brake torque whith spring	643	kNm									
max rope layer	11													
	The data confirm to the rope layer (x)													

rope layer (x)	rope length (m)	rope length in layer (x) (m)	rope running on dia (x) mm	rope speed Low Speed (m/min)	rope speed High Speed (m/min)	max time for rope length Low Speed (s)	min time for rope length High Speed (s)	pull Low Speed (kN)	pull High Speed (kN)	brake holding load (kN)	spring holding load (kN)	Minimum breaking load of the rope MBL (n. GL) [kN]	SWL @ Seastate 5 [t]	Service coefficient K1 (by GL)
1	87	87	1286	5.1	10.1	1033.6	516.8	3000.0	1500.0	4000.0	1000.0	6263	122	3.34
2	187	100	1435	5.6	11.3	1064.7	532.4	2688.5	1344.3	3584.7	896.2	5831	110	3.47
3	298	111	1584	6.2	12.4	1070.7	535.3	2435.6	1217.8	3247.5	811.9	5465	99	3.59
4	421	123	1732	6.8	13.6	1085.0	542.5	2227.5	1113.7	2970.0	742.5	5123	91	3.68
5	556	135	1881	7.4	14.8	1096.6	548.3	2051.0	1025.5	2734.7	683.7	4833	84	3.77
6	702	146	2030	8.0	15.9	1098.9	549.4	1900.5	950.2	2534.0	633.5	4573	77	3.85
7	860	158	2179	8.6	17.1	1107.9	553.9	1770.5	885.3	2360.7	590.2	4338	72	3.92
8	1030	170	2327	9.1	18.3	1116.2	558.1	1657.9	829.0	2210.6	552.6	4134	68	3.99
9	1212	182	2476	9.7	19.4	1123.1	561.5	1558.2	779.1	2077.5	519.4	3934	64	4.04
10	1405	193	2625	10.3	20.6	1123.4	561.7	1469.7	734.9	1959.6	489.9	3766	60	4.10
11	1610	205	2774	10.9	21.8	1129.1	564.6	1390.8	695.4	1854.4	463.6	3607	57	4.15

Comm.: 06.7535+41														
Hull No.: 256+257														
Customer: MAN Ferrostaal AG														
E-TD-Towing Winch 2500/4000 + 5000/6000												Beiwerte n. GL		
drum ø	1200	mm	/ 3400mm		2 x Seiltrommel unten , Seilauflauf unten							Hublastbeiwert y	2.5	
rope ø	86	mm	2000 m									Gebrauchsbeiwert K1	3.00	ab 160t
drum length	2020	mm										Erhöhungsbeiwert fe	1.5625	
min drum speed	0.9	min^{-1}												
max drum speed	1.8	min^{-1}												
drum torque Low Speed	3215	kNm	max brake holding torque	3858	kNm									
drum torque High Speed	1608	kNm	brake torque whith spring	965	kNm									
max rope layer	13													

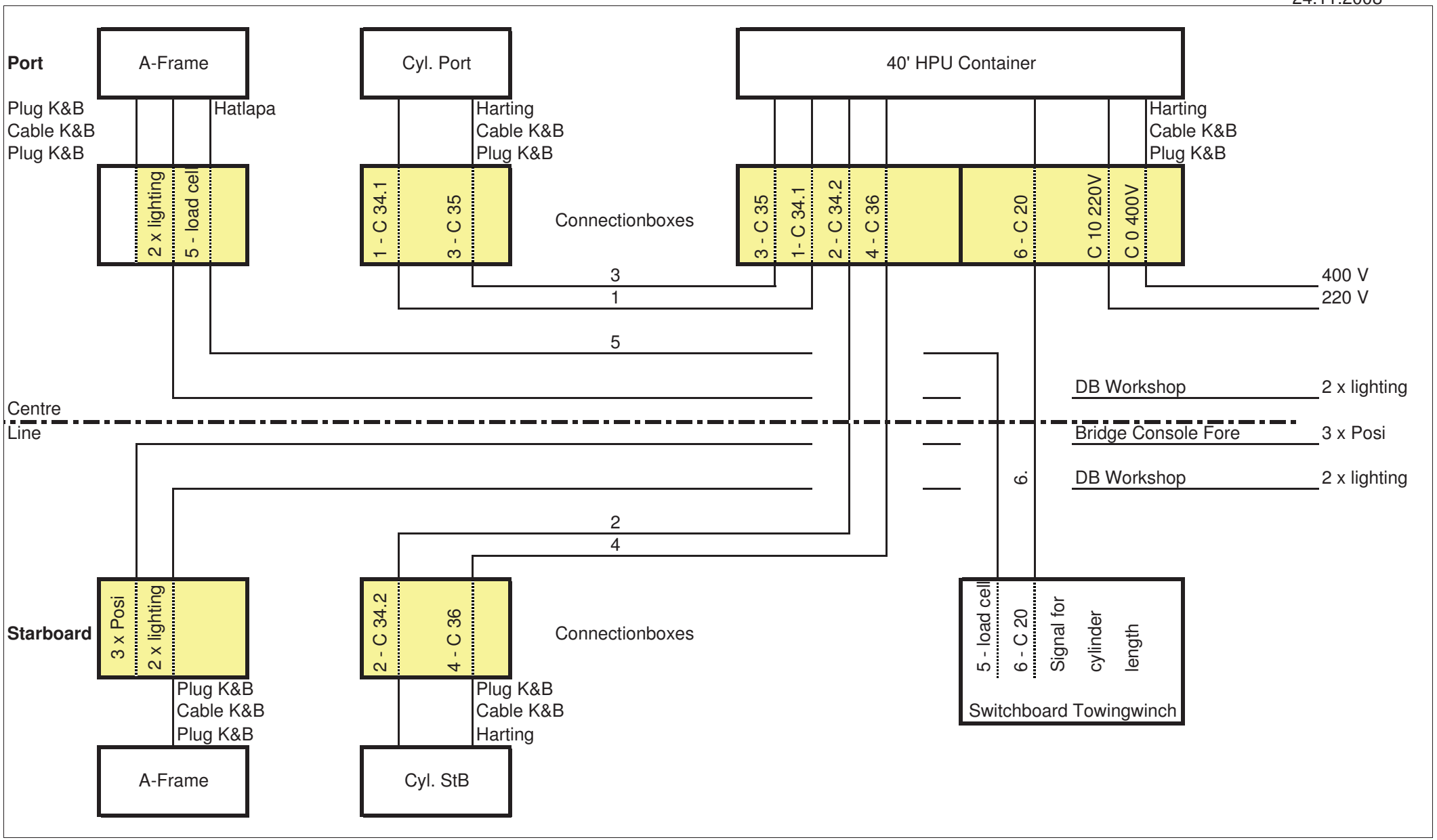
The data confirm to the rope layer (x)

rope layer (x)	rope length (m)	rope length in layer (x) (m)	rope running on dia (x) mm	rope speed Low Speed (m/min)	speed High Speed (m/min)	for rope length Low Speed (s)	min time for rope length High Speed (s)	pull Low Speed (kN)	pull High Speed (kN)	brake holding load (kN)	spring holding load (kN)	Minimum breaking load of the rope MBL (by GL) [kN]	SWL @ Seastate 5 [t]	Service coefficient K1 (by GL)
1	87	87	1286	3.6	7.3	1435.6	717.8	5000.0	2500.8	6000.0	1500.8	9375	204	3.00
2	187	100	1435	4.1	8.1	1478.8	739.4	4480.8	2241.1	5377.0	1344.9	8402	183	3.00
3	298	111	1584	4.5	9.0	1487.1	743.5	4059.3	2030.3	4871.2	1218.4	7611	166	3.00
4	421	123	1732	4.9	9.8	1507.0	753.5	3712.5	1856.8	4455.0	1114.3	7147	151	3.08
5	556	135	1881	5.3	10.6	1523.0	761.5	3418.4	1709.7	4102.1	1026.0	6794	139	3.18
6	702	146	2030	5.7	11.5	1526.2	763.1	3167.5	1584.2	3801.0	950.7	6493	129	3.28
7	860	158	2179	6.2	12.3	1538.7	769.4	2950.9	1475.9	3541.1	885.7	6197	120	3.36
8	1030	170	2327	6.6	13.2	1550.3	775.1	2763.2	1382.0	3315.9	829.4	5941	113	3.44
9	1212	182	2476	7.0	14.0	1559.8	779.9	2596.9	1298.9	3116.3	779.5	5697	106	3.51
10	1405	193	2625	7.4	14.8	1560.2	780.1	2449.5	1225.1	2939.4	735.2	5481	100	3.58
11	1610	205	2774	7.8	15.7	1568.2	784.1	2318.0	1159.3	2781.5	695.7	5273	95	3.64
12	1827	217	2923	8.3	16.5	1575.4	787.7	2199.8	1100.2	2639.8	660.3	5087	90	3.70
13	2056	229	3071	8.7	17.4	1582.4	791.2	2093.8	1047.2	2512.5	628.5	4907	85	3.75

Hydraulicconnections
between
A-Frame and HPU-Container

		Parts		A1 / A2 each 1 x Ps und Stb		B1 / B2 each 1 x Ps und Stb		T3 / T4 each 1 x Ps und Stb	as per Hydr. Diagram 05-025306a0_0501
	Cylinder	housing		9601-32 BSP (2")		9603-24 BSP (1 1/2")		9416-16 BSP (1")	
		dust cap		9604-32 (2")		9604-24 (1 1/2")		9418-16 (1")	
	Hose-end	quick release pin		9602-32		9602-24		9414-16	
		dust cap		9603-32		9603-24		9417-16	
	HOSE	hose		-		-		-	
	Hose-end	quick release pin		9602-32		9602-24		9414-16	
		dust cap		9603-32		9603-24		9417-16	
	Connection on deck	housing		9601-32 BSP (2")		9603-24 BSP (1 1/2")		9416-16 BSP (1")	
		dust cap		9604-32 (2")		9604-24 (1 1/2")		9418-16 (1")	
Maindeck									Maindeck

Maindeck									Maindeck
	Connection on deck	housing		9601-32 BSP (2")		9603-24 BSP (1 1/2")		9416-16 BSP (1")	
		dust cap		9604-32 (2")		9604-24 (1 1/2")		9418-16 (1")	
	Hose-end	quick release pin		9602-32		9602-24		9414-16	
		dust cap		9603-32		9603-24		9417-16	
	HOSE	hose		-		-		-	
	Hose-end	quick release pin		9602-32		9602-24		9414-16	
		dust cap		9603-32		9603-24		9417-16	
	Container	housing		9601-32 BSP (2")		9603-24 BSP (1 1/2")		9416-16 BSP (1")	
		dust cap		9604-32 (2")		9604-24 (1 1/2")		9418-16 (1")	


Port
A-Frame
Cyl. Port
40' HPU Container
Plug K&B
Cable K&B
Plug K&B
Hatlapa
Harting
Cable K&B
Plug K&B
Harting
Cable K&B
Plug K&B
2 x lighting
5 - load cell
1 - C 34.1
3 - C 35
Connectionboxes
3 - C 35
1 - C 34.1
2 - C 34.2
4 - C 36
6 - C 20
C 10 220V
C 0 400V
3
1
5
400 V
220 V
DB Workshop
2 x lighting
Centre
Line
Bridge Console Fore
3 x Posi
6.
DB Workshop
2 x lighting
2
4
Starboard
3 x Posi
2 x lighting
2 - C 34.2
4 - C 36
Connectionboxes
5 - load cell
6 - C 20
Signal for
cylinder
length
Switchboard Towingwinch
Plug K&B
Cable K&B
Plug K&B
Plug K&B
Cable K&B
Harting
A-Frame
Cyl. StB

MAN Ferrostaal AG

250 t SWL

A-frame Hydraulic

REV.	DESCRIPTION	DATE	DRAWN	CHECKED
01	Title changed / chapter 9 revised	19-01-09	RR	SB

TITLE: **Instruction manual**	FILE: S:\PROJECTS_S&E\NL000817-MAN-AHT-Uranus-A-frame\11-Engineering\PE-manual\Manual in bewerking\NL000817-02-59-0000-IML-0000-R01-Instruction Manual.doc		
	PRINTED: 1/20/2009 9:39 AM	DATE:	
	DRAWN: R. Rikken	26-11-08	
	CHECKED: S. Boeijen	26-11-08	

PROJECT:	DOCUMENT:	SIZE:	REV.:
NL000817	**02-59-0000-IML-0000**	**A4**	**01**

Rexroth Bosch Group

P.O. BOX 32 · NL-5280 AA BOXTEL · THE NETHERLANDS

Revisions

Rev.	By	Chapter	Description	Reason
00	R. Rikken		Original version.	
01	R. Rikken		Title changed / Chapter 9 revised	

Explanation of revision marks:
| aaaaaaa = Revised text
| aaaaaaa = Revised text
| ... = Deleted text
| ~~aaaaaaa~~ = Deleted text

Table of contents

List of figures

1 Introduction

1.1 Instruction manual

1.1.1 Purpose of the instruction manual

This document provides a technical description of the hydraulic drive & control system for the A-frame, designed by Bosch Rexroth B.V. - Systems & Engineering under order number NL000817.

This manual also gives warnings and cautions, tells if any particular training is required and specifies personal protection equipment if necessary.

The system is manufactured by:

Bosch Rexroth B.V. - Systems & Engineering
P.O. Box 32
5280 AA Boxtel
The Netherlands
Phone : +31 (0)411 - 651951
Fax : +31 (0)411 - 688681
Internet : www.boschrexroth.com/S&E

1.1.2 Instruction manual within the total set of documentation

This document is part of the complete instruction manual delivered with the hydraulic drive & control system. The instruction manual contains all documents as described in [4].

1.1.3 Readability

In this instruction manual, the following symbols are used to denote the several aspects:

NOTE
Suggests and advises the user for safe, correct and easy use of the system.

CAUTION
Warns the user for possible damage to the system or facility.

WARNING
Warns for possible injury to personnel if the operator does not follow the instructions carefully.

1.1.4 Specific user groups

This manual is written for skilled and qualified:
- operation personnel;
- installation and maintenance personnel.

Skilled and qualified personnel must have:
- sufficient technical education and training;
- experience with comparable systems.

WARNING
All persons who are in the vicinity of, or work on the system must obey the safety precautions according to section 2 of this manual.

NOTE
Specific training for this hydraulic drive & control system can be arranged by Bosch Rexroth B.V. - Systems & Engineering.

Chapter 2 deals with the safety of the installation and is of the utmost importance for everyone who works with the installation or is even present in the vicinity of the installation.

1.2 Structure of the manual

This manual contains the technical information necessary for safe and correct operation and maintenance of the hydraulic drive & control system, limited to the Bosch Rexroth B.V. scope of supply. This manual contains the following chapters:

Chapter 1 - Introduction
Chapter 2 - Safety
Chapter 3 - Hydraulic system description
Chapter 4 - Control system description
Chapter 5 - User interface
Chapter 6 - Operation
Chapter 7 - Maintenance and repair
Chapter 8 - Troubleshooting
Chapter 9 - Storage
Chapter 10 - Spare parts

The chapter **INTRODUCTION** provides the structure of this manual.

The chapter **SAFETY** deals with the safety aspects of the hydraulic drive & control system.

The chapter **HYDRAULIC SYSTEM DESCRIPTION** only contains a general description of the hydraulic equipment.

The chapter **CONTROL SYSTEM DESCRIPTION** only contains a general description of the controls necessary for the operation of the hydraulic drive & control system.

The chapter **USER INTERFACE** contains a general description of the interactive display as provided on the power unit control cabinet.

The chapter **OPERATION** only contains general instructions necessary for the operation of the hydraulic drive & control system.

The chapter **MAINTENANCE AND REPAIR** contains instructions for maintenance and repair on the hydraulic drive & control system.

The chapter **TROUBLESHOOTING** contains descriptions of the various alarms and warnings that can occur as well as how to act upon their occurrence.

The chapter **STORAGE** contains the description of the handling of the container on a storage location.

The chapter **SPARE PARTS** contains instructions and guidelines for ordering spare parts.

1.3 Referenced documents

The following table shows all referenced documents, which are applicable for the hydraulic drive & control system:

[1]	1434423_10	Instruction manual – hydraulic cylinder
[2]	ab01-01-02	Operating instructions for hydraulic systems
[3]	NL000817-02-59-0000-CFM-0000	Configuration manual
[4]	NL000817-02-59-0000-IML-1000	Instruction manual - Contents
[5]	NL000817-02-59-2100-CID-0000	Circuit diagram – PUCC
[6]	NL000817-02-59-2100-LDE-0000	Layout diagram – PUCC
[7]	NL000817-02-59-2100-PLE-0000	Parts list – PUCC
[8]	NL000817-02-59-2100-COD-0000	Connection diagram – PUCC
[9]	NL000817-02-59-2300-LDE-0000	Layout diagram – Junction boxes
[10]	NL000817-02-59-2300-PLE-0000	Parts list – Junction boxes
[11]	NL000817-02-59-2300-COD-0000	Connection diagram – Junction boxes
[12]	Manual-diesel engines	Diesel engine features and control
[13]	Messenger operation guide - LEBM3227-00	Operator's guide – Diesel engine
[14]	AOS_MG00	Radio transmitter spectrum 1/2/3 Operating instructions
[15]	AO735G00	Radio Receiver FSE735 Notes on the installation, Initial Start-up, Operation.

1.4 Terms and abbreviations

End-user	:	MAN Ferrostaal AG
Customer	:	MAN Ferrostaal AG
Main contractor	:	Bosch Rexroth B.V. - Systems & Engineering
Manufacturer	:	Bosch Rexroth B.V.
Certifying authority	:	Germanischer Lloyd (GL)
CIMS©	:	Ceramax Integrated Measuring System
DFT	:	Dry Film Thickness
HP	:	High Pressure
HPU	:	Hydraulic Power Unit
LED	:	Light Emitting Diode
N.A.	:	Not Applicable
PLC	:	Programmable Logic Controller
PUCC	:	Power Unit Control Cabinet
RCT	:	Radio Control Transmitter
RCR	:	Radio Control Receiver
RPM	:	Rotation Per Minute
TBS	:	Technical Breakdown Structure

2 Safety

This section deals with health, safety and environmental aspects that can result from the use of the system.

The safety aspects are subdivided in general safety aspects (subsection 2.1) and specific safety aspects (subsection 2.2). The specific safety aspects precede the disclosure of the specific operations to which they relate.

2.1 General safety aspects

NOTE

- Distribute the instruction manual among all personnel that operates or maintains the system. Verify that it is of the latest revision.
- Make sure that all instructions are read and clearly understood.
- Make sure that personnel comply with all relevant rules and legislation regarding health, safety and environmental aspects.
- Maintain the installation, spare parts, machinery and tools as described in this manual.
- Keep the installation and its environment clean and tidy.
- The guarantee expires when:
  - the instructions in this manual were not obeyed;
  - the system was overloaded or operated wrongly;
  - the installation was modified without prior written consent of Bosch Rexroth B.V.;
  - non-Bosch Rexroth B.V. approved spare parts were used.
- Maintain a log, noting and dating all inspections, maintenance, repairs, adjustments, test results and exchange of parts.
- Maintain a log, noting and dating all failures, the cause of the failures and the remedy.
- Use cleaning agents and solvents sparingly. Use of aggressive products can cause damage to parts.
- Only use recommended lubricants, tools and test equipment or permitted alternatives, according to original Bosch Rexroth B.V. instructions.

CAUTION

- Only use the system for its intended purpose.
- Personnel authorized to operate or maintain the installation must be qualified to perform their respective tasks.
- Personnel authorized to operate or maintain the installation must be informed regarding special instructions and responsibilities.
- Personnel authorized to operate or maintain the installation must inform their superiors regarding modifications in the installation.
- Personnel authorized to operate or maintain the installation must inform their superiors regarding operational changes they experience, e.g. increased noise level.
- Old lubricants and exchanged hydraulic oil must be processed in an environmentally accepted manner according local legislation.

- The hydraulic equipment operates with oil under high pressure. Furthermore, large amounts of energy can be accumulated in the hydraulic system.
- Be prepared to activate the emergency-stop if an emergency arises. Do not restart the system until the problem has been remedied.
- Operate the installation carefully and cautiously. It can be expected that personnel operates the installation and acts with care for its own safety, health, and well-being and for that of others.
- Personnel must:
  - operate and handle machinery, tools, dangerous goods and auxiliary gear in a professional and correct manner;
  - never modify, bypass or remove safeguards from the machinery;
  - report dangerous situations and near misses to their superiors;
  - cooperate to support a healthy environment;
  - use the issued personal safety equipment according to the regulations;
  - not perform any activities that could endanger health or cause damage to the system.

WARNING
Use work gloves, safety shoes (with steel toes and soles), and approved safety helmet when any work with or on the system is performed.

2.2 Specific safety aspects

CAUTION

- The installation and the area around the installation must be free of obstacles before the equipment is started.
- Adjustments and parameters must never be altered, unless it is disclosed in this instruction manual.
- The prescribed maintenance tasks and checks disclosed in this instruction manual must be performed.
- If cracks or damage to parts of the installation is observed, the installation must not be utilized anymore until the defect parts are exchanged or repaired.
- Do not switch on the system unless all wiring is properly connected.
- If failures are observed, the operation must be ended as soon as possible using a controlled stop. The installation must not be restarted unless the failure is remedied.
- Excessive leakage from hydraulic fluid precludes system operation until the leakage is corrected.
- Personnel that operates, maintains or repairs the system must never undertake actions that cause damage to the installation or environment or that otherwise cause dangerous situations.

WARNING

- Never operate the installation in a hazardous area, as the equipment is not designed to be explosion proof, unless specified in project-related documentation.
- Always ensure that it is impossible to switch on the installation during maintenance and repair of the installation.
- Never work on or in the vicinity of moving machine parts unless it is impossible to perform the task required in another way.
- The settings of safety related equipment must not be modified without written consent of Bosch Rexroth B.V.
- Personnel must work with caution in the vicinity of live high-voltage parts, i.e. parts conducting over 30 Vrms or 50 VDC. A second person must be in attendance. Use a padlock to lock the main switch in the ‘OFF’ position.

3 Hydraulic system description

The total system consists of the following main components:
- Hydraulic Power Unit (HPU), refer to section 3.1
- 2x A-frame cylinders (double-acting cylinders), refer to section 3.2
- Interconnecting pipe work, refer to section 3.3

3.1 Hydraulic power unit

The hydraulic power unit consists of:
- 1x housing: a standard 40 ft. container suitable for seawater environment
- 2x 250 kW diesel engine (1800 rpm)
- 2x hydraulic double-pumps
- 2x hydraulic reservoir including appendages, cooling and filter
- 1x hydraulic steering manifold
- 1x control system

3.1.1 Environmental conditions

The HPU is designed in order to comply with the following environmental conditions:

Atmosphere
- Seawater environment
- Non-hazardous area
- Splash zone applicable

Seawater temperature
- Minimum : + 2 °C
- Maximum : +32 °C

Outside air temperature
- Minimum : -10 °C
- Maximum : +40 °C

Outside relative humidity
100 % at 40 °C

3.1.2 Technical specifications

- The housing is designed, manufactured, assembled, preserved and tested according standards of “Bosch Rexroth B.V. – Systems & Engineering”.

- In addition, the system is designed according the following international accepted design rules and standards:
  - ISO-standards
  - DIN-standards
  - NEN- and EN-standards

- On all documentation, the SI-unit system is used.

3.1.2.1 Housing

- The size of the housing is identical to a standard 40 ft. container with the following basic dimensions: L x W x H = 12192 mm x 2438 mm x 2591 mm.

- The housing is suitable for mounting on open deck of a sea-going vessel. For easy mounting, corner fittings, suitable for transport as a 40 ft. container, are provided.

- The housing is provided with two watertight doors.

- Provisions are made for sea-fasten equipment inside of the housing, e.g. for the oil barrels, connecting hoses to the HPU and cylinders, etc.

- Stainless steel fastening screws are used.

- The hinges are provided with grease nipples.

- The housing contains a stainless steel nameplate according the standard rules of labeling containers of CSC.

- Inside the container a stainless steel plate shows the following data:
  - Serial number
  - Name of manufacturer
  - Address of manufacturer
  - Drawing number of assembly
  - Date of manufacturing
  - Weight

Figure 3-1: Identification plate

- The floor of the container is provided with an integrated oil drip pan, suitable for the full capacity of the oil reservoirs (min. 9000 liter). Because of the trim of the vessel, the drip pan is divided in several parts. On top of the floor, a grid is installed.

- The sidewalls and the ceiling are provided with proper isolation, suitable for environmental conditions as mentioned in section 3.1.1 (sound isolation not required, inside of container also suitable for salt-water environment). At the inside, stainless perforated steel is provided. The isolation is fire-resistant according standard rules for offshore equipment.

- The long sides of the container are equipped with bolted panels meant for equipment positioning and service purposes (control cabinets, manifold, hydraulic oil tank). Openings for ventilation air supply are made at one side.

- Both head sides of the container are equipped with bolted panels meant for equipment positioning and service purposes (hydraulic oil tank, diesel engine). In the head sides, walking doors and openings for ventilation of the diesel engines are provided. At the outside, these openings are covered with suitable hatches. The housing is wind and watertight with all hatches and doors closed (splash zone applicable).

Figure 3-2: Container (head side)

WARNING
During operation, all hatches have to be in the open position.

- The housing is provided with sufficient standard strip-light fittings, mounted to the roof inside the container. Sufficient socket walls are provided, suitable for Marine application. The cable is routed to the Power Unit Control Cabinet (PUCC).
The voltage on board is 400 Volt, 50 Hz.

- Two fire extinguishers suitable for offshore application are supplied.

- Four bolts M12 are welded to the lower outside of the container to provide connections for protective earth to the vessel.

Figure 3-3: Earth connection

- A flashlight and an acoustic horn are installed on the roof of the container.

- A hydraulic manifold is provided in the bottom of the container for connection of the hydraulic hoses.

Figure 3-4: Manifold

- The electrical connection box contains 7 connectors as shown in Figure 3-5.

Figure 3-5: Electrical connection box

1. Connector 2XC34-1 : Solenoids cylinder left

2. Connector 2XC34-2 : Solenoids cylinder right

3. Connector 2XC10 : Power supply 230 VAC single phase for:
   - Diesel engine starting battery charger
   - Container (HPU) lighting
   - PUCC lighting
   - PUCC panel heating.

4. Connector 2XC0 : Main power supply 3x 440 VAC

5. Connector 2XC20 : Analogue output signals for cylinder positions

6. Connector 2XC35 : Cylinder left
   - 3x CIMS position sensors
   - 2x Proximity switches

7. Connector 2XC36 : Cylinder right
   - 3x CIMS position sensors
   - 2x Proximity switches

- The HPU is provided with 2 emergency-stop pushbuttons located on the doorpost of the container. An emergency-stop will shut down the system within 6 to 10 seconds.

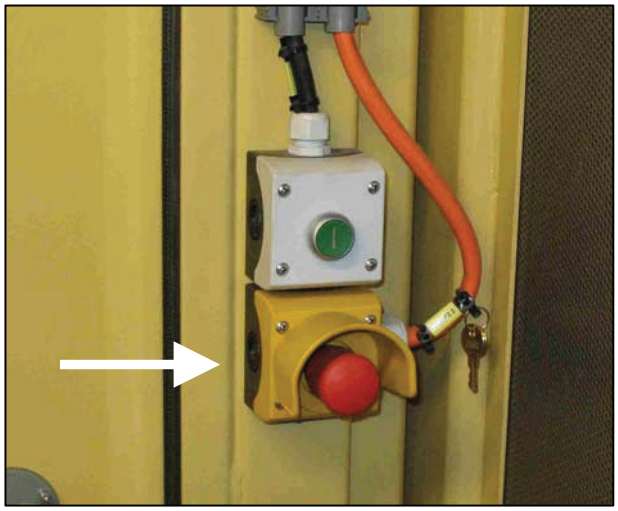


Figure 3-6: Emergency-stop

- Emergency-stop pushbuttons are also provided on the power unit control cabinet and on the Radio Control Transmitter (RCT).
- On the local diesel control panels, a pushbutton is provided to stop only the diesel engine.
- The HPU is provided with 2 impulse pushbuttons to switch on/off the HPU room lighting. These pushbuttons are located on the doorpost of the container.

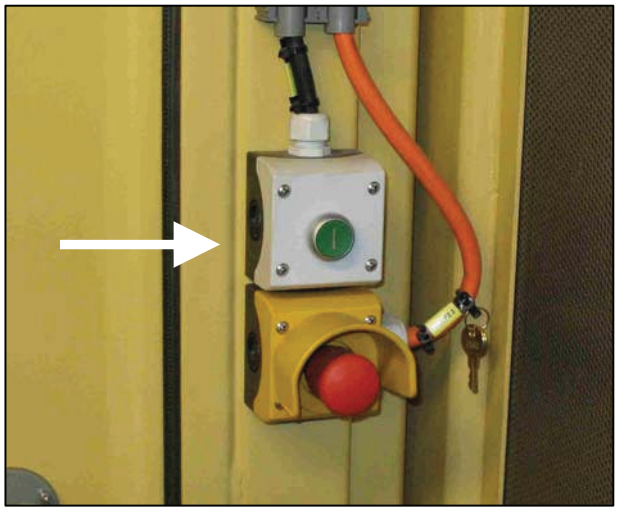


Figure 3-7: Impulse pushbutton lighting

3.1.2.2 Diesel engine

Two diesel engines 250 kW x 1800 rpm (C-rating) are provided, with turbo according to the latest EU standards concerning emission demands, certified for non-road applications.

Figure 3-8: Diesel engine

- At each engine, a hydraulic double-pump is installed, including all necessary appendages such as fuel tank (min. 500 liter) with level indicator, piping, drain, standard dynamo's for 24 Voltage, cooling water pump, fuel filters, radiator-cooling with fan, expansion tank, etc.

- For refilling the reservoirs, a filling point with quick-(dis)connect couplings and a filter are installed at the inside of the container.

- For each diesel engine, a removable exhaust pipe is installed on the roof of the container.

- All rotating parts are protected by covers.

- The diesel engines are electronically controlled and are provided with a control panel that consists of start-, stop- and emergency-buttons, several alarms and indicators, such as oil level, oil temperature, cooling liquid level and temperature, fuel level and RPM indication, refer to section 4.3.

- The diesel engine starting batteries (24 VDC) with isolation switch are located near the fuel oil tank.
- The power supply of the diesel engine motor management and control system is also supplied from this battery package.

Figure 3-9: Battery package with isolation switch

3.1.2.3 Hydraulic equipment

The hydraulic equipment consists of a valve-block, hydraulic medium and conditioning and safeguarding equipment (filtering, cooling, reservoir level). The hydraulic medium is contained in hydraulic reservoirs.

The valve-block contains all required hydraulic controls for operation of the system.

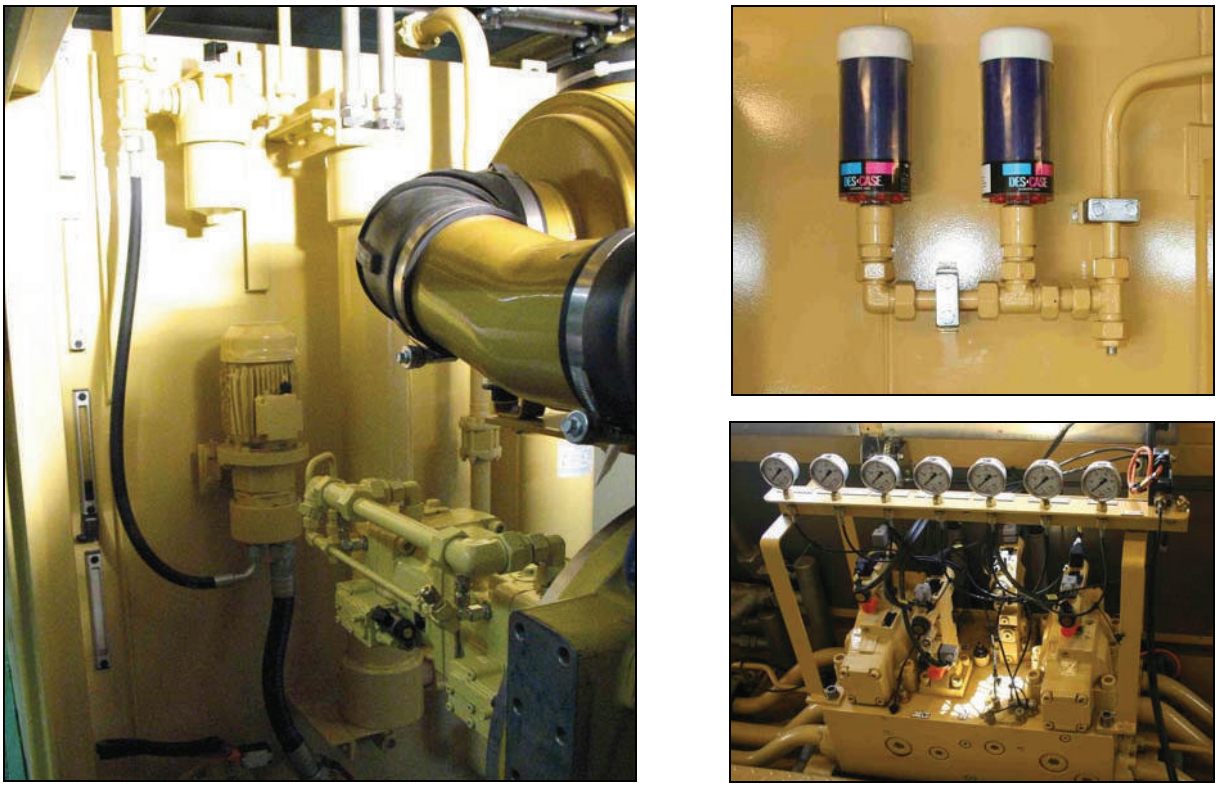


Figure 3-10: Hydraulic equipment

3.2 A-frame cylinders

- The hydraulic cylinders are designed for outdoor use in an offshore environment and are suitable for operation in a non-hazardous area.

- The hydraulic cylinders are designed suitable for ISO-VG-46-HVLP mineral oil and are delivered flushed/cleaned to a fluid cleanliness level in accordance with NAS 1638 Class 7 (or better).

- Each hydraulic cylinder is provided with a stainless steel nameplate in an easily readable position, mounted with stainless steel screws or with stainless steel straps. This nameplate contains the following data:
  - Manufacturers' name
  - Model number
  - Tag number information according the relevant hydraulic diagram

- All electrical components are provided with stainless steel text plates (mounted with stainless steel screws or with stainless steel straps) with electrical coding in accordance with the markings on the hydraulic diagram.

- Measurement coupling G ¼" - Stainless steel 316L.

- Grease nipples of stainless steel 316L.

3.2.1 Environmental conditions

The cylinders are designed in order to comply with the following environmental conditions:

Atmosphere
- Humid, salt laden and corrosive offshore atmosphere
- Splash zone applicable

Steel design temperature
- Minimum : - 20 °C
- Maximum : +60 °C

Operating temperature
- Minimum : - 20 °C
- Maximum : +60 °C

Relative humidity
- Max. 100%

3.2.2 Technical specifications

Design criteria

• Minimum design temperature	:	-20	°C
• Maximum design temperature	:	+60	°C
• Design pressure	:	300	bar
• Static test pressure bottom-side	:	450	bar
• Maximum pushing force	:	14.108	kN
• Maximum pulling force	:	6.158	kN
• Working angles	:	35.7° – 108.3° with the horizontal, rod up	
• Guided rod end	:	Yes	
• External side loads	:	Not allowed	
• External eccentric forces	:	Not allowed	

Cylinder

• Type	:	Double-acting cylinder	
• Piston diameter	:	780	mm
• Rod diameter	:	480	mm
• Stroke	:	6.700	mm
• Outside diameter	:	915	mm
• Maximum cylinder extracting speed	:	15.3	mm/s
• Minimum cylinder retracting speed	:	3	mm/s
• Weight	:	30.000	kg

Rod protection : CERAMAX CEC 2.2

Mountings

- Rod side : Spherical bearing GE 360
  including stainless steel grease nipple
  including protective flanges with V-seal
- Bottom side : Spherical bearing GE 360
  including stainless steel grease nipple
  including protective flanges with V-seal

Construction

- Lifting lugs : Yes
- Cushioning : N.A., speed limited at 15.3 mm/s
- Provisions for mounting junction box

Hydraulic connections

- Size on bottom side : SAE 2”-6000 psi, suitable for mounting valve-block
- Size on rod side : SAE 1 1/2”-6000 psi
- Minimess connections : 4 (2 plugged)
- Leakage line connections : 1 drain chamber CIMS, 1 optional vent line rod side

Position measurement

- 3x Ceramax Integrated Measuring System (CIMS©) Mark III
  - Output signal: digital output, incremental encoder 1024*(A+B) pulses per 10 mm.
  - CIMS stroke measurement protection class IP68.
  - CIMS delivered with high-speed counter cards.
- 2x Position switch
  - Position switch mounted including protective cover suitable for offshore environment.
  - Position switch including fixed cable to junction box.

Seals

- Rod seals : Low friction
- Piston bearing : Impregnated fabric bearing strips
- Rod bearing : Impregnated fabric bearing strips

Piping

- HP-pipe from 48.3 x 6.3 St. 37.4 from manifold to rod side
- Leakage line from rod side to connection point at bottom side, 25 x 2.5 stainless steel
- Piping for electrical cabling from rod side to junction box, 30 x 3 stainless steel

3.3 Interconnecting pipe work

The hydraulic interconnecting pipe work consists of pipes, hoses, valves, flanges, welding nipples and any other pipe connections or components between the HPU and the cylinders.

All hydraulic interconnecting pipe work is designed and pressure tested according to the requirement of the certifying authority.

All interconnecting pipe work is flushed properly in accordance with NAS 1638 Class 7 (or better).

4 Control system description

The control system consists of:

- 1x Power unit control cabinet including PLC
- 1x Radio remote control system
- 2x Diesel engine control system

4.1 Power unit control cabinet

The Power Unit Control Cabinet (PUCC) comprises:

- Power distribution and fuses
- Control system hardware
- Relays and control system interfaces
- Control panel with:
  - Diesel engine messenger display
  - Indicators / controls for the HPU
  - Interactive display
  - Emergency-stop pushbutton

Door 1 ***Door 2***

Figure 4-1: Layout PUCC

Control	Code	Status	Function
Door 1			
MAIN SWITCH			Switches the main supply 440 VAC to the PUCC on/off.
The following controls on door 1 are identical for hydraulic unit 1 and hydraulic unit 2			
DIESEL ENGINE MESSENGER DISPLAY			To control the diesel generator sets.
FILTRATION PUMP START / RUN (Pushbutton-indicator, green)		Pressed On	Activates the filtration pump. The filtration pump is activated.
FILTRATION PUMP STOP / FAILURE (Pushbutton-indicator, red)		Pressed On	Deactivates the filtration pump, the green indicator 'Start/ Run' extinguishes. A failure occurred in the filtration pump, the alarm message is shown on the interactive display.
FILTRATION PUMP AUTO/MANUAL (Selector switch)		AUTO MAN	The filtration pump starts automatically after start up of the diesel engine or at heating the hydraulic oil. The filtration pump can be operated with the start/stop-pushbuttons.
HEATER 1 ON (Indicator, blue)		On	E-heater 1 is activated.
HEATER 1 FAILURE (Indicator, red)		On	An electrical failure occurred in E-heater 1.
HEATER 2 ON (Indicator, blue)		On	E-heater 2 is activated.
HEATER 2 FAILURE (Indicator, red)		On	An electrical failure occurred in E-heater 2.
Door 2			
INTERACTIVE DISPLAY			See section 5.
ACCEPT ALARM (Pushbutton-indicator, yellow)		Pressed	Acknowledges the alarms/error messages.
STOP HOOTERS (Pushbutton-indicator, yellow)		Pressed	Stops the hooters and flashlights, which are activated in case of an alarm, a warning or other important messages.
EMERGENCY STOP (E-stop button)		Pressed	Stops all motions and engages the brakes.

4.2 Radio remote control system

A radio remote control system is used to enable free positioning of the operator to get a clear view of the operation.

The Radio Control Transmitter (RCT) communicates with the Radio Control Receiver (RCR), which is installed in the container and is connected to the HPU control system.

The main control and monitoring functions as well as an emergency-stop are available at the RCT for safe and accurate operations.

For technical specifications and operating instructions, please refer to the manuals [14] and [15].

Figure 4-2: RCR

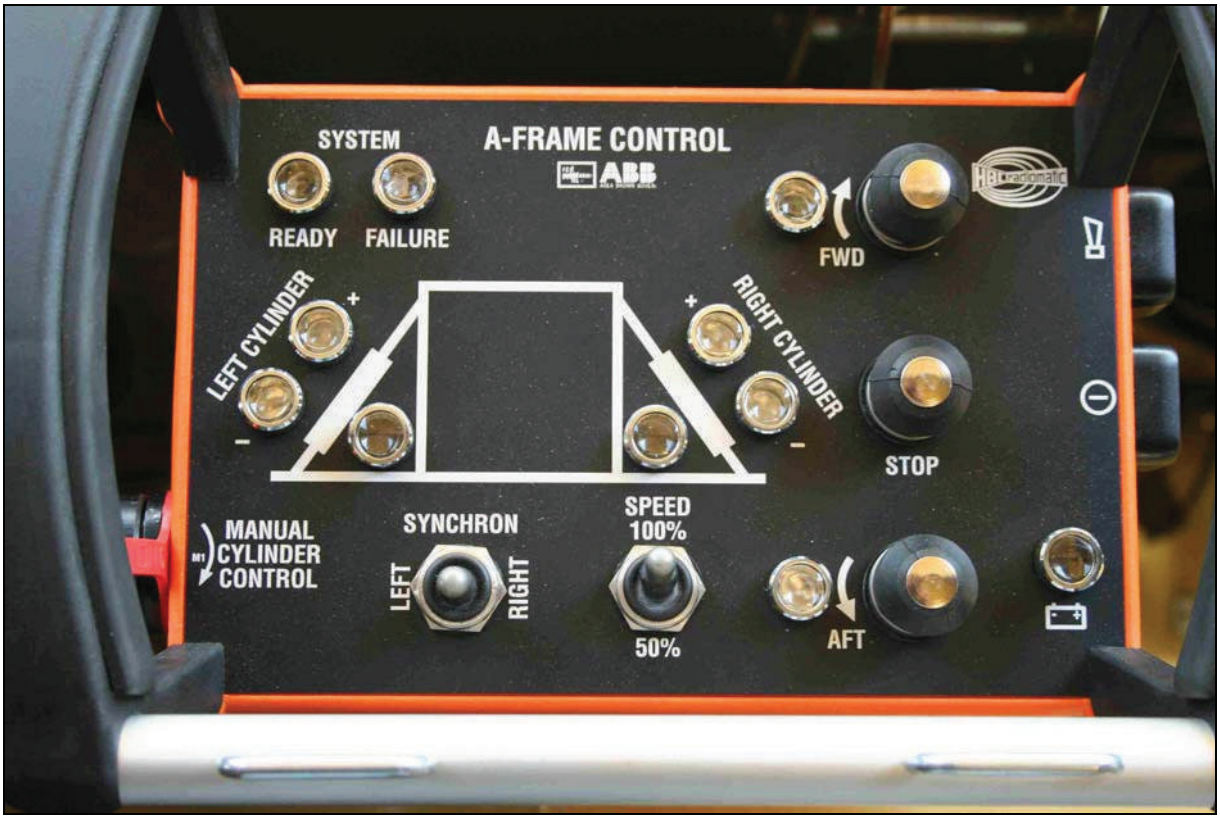


Figure 4-3: Layout RCT (top view)

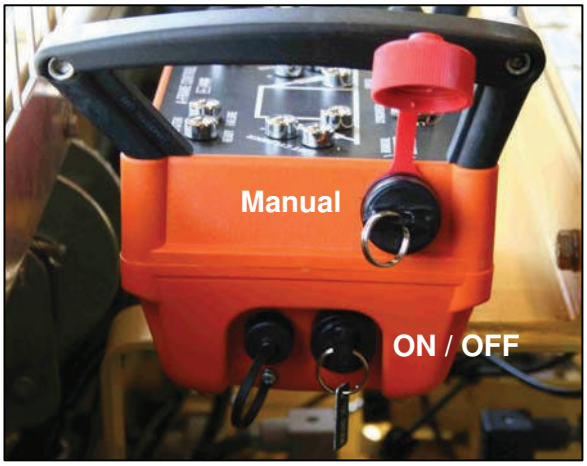


Figure 4-4: Layout RCT (side view)

Control	Code	Status	Function
ON/OFF SWITCH (Key switch with frequency code , on left-side of the RCT)		-	Turns the RCT on/off.
MANUAL CYLINDER CONTROL (Key switch, on left-side of the RCT)		-	Activates manual control.
SYSTEM READY (Indicator, green)		On	The system is ready.
SYSTEM FAILURE (Indicator, red)		On	A failure has occurred.
LEFT CYLINDER + (Indicator, yellow)		On	The left cylinder is being extended.
LEFT CYLINDER - (Indicator, yellow)		On	The left cylinder is being retracted.
LEFT CYLINDER OK / FAILURE (Indicator, green / red)		Green Red	Left cylinder functions properly. Left cylinder / position sensor failure.
RIGHT CYLINDER + (Indicator, yellow)		On	The right cylinder is being extended.
RIGHT CYLINDER - (Indicator, yellow)		On	The right cylinder is being retracted.
RIGHT CYLINDER OK / FAILURE (Indicator, green / red)		Green Red	Right cylinder functions properly. Right cylinder / position sensor failure.
FWD (Pushbutton + indicator, yellow)		Pressed On	Moves the A-frame forward. The A-frame is moving forward.
STOP (Pushbutton)		Pressed	Stops the A-frame movement.
AFT (Pushbutton + indicator, yellow)		Pressed On	Moves the A-frame backward. The A-frame is moving backward.

Control	Code	Status	Function
CONTROL SELECTION (Spring-return switch)		Left	After the key-operated “Manual cylinder control” switch is switched to ON position, only the left cylinder of the A-frame can be moved.
		Synchron	After the key-operated “Manual cylinder control” switch is switched to NORMAL position, both cylinders of the A-frame can be moved synchronized.
		Right	After the key-operated “Manual cylinder control” switch is switched to ON position only the right cylinder of the A-frame can be moved.
SPEED (Switch)		100%	Sets the A-frame movement speed to 100% at operation.
		50%	Sets the A-frame movement speed to 50% at operation.
HORN (Pushbutton, on right-side of the RCT)		Pressed	Activates an audible alarm.
POWER ON (Pushbutton, on right-side of the RCT)		Pressed	Turns the RCT on/off.
BATTERY (Indicator, green / red)		Green	System is ready for operation.
		Red	When the LED “Battery” blinks red, the remaining power in the battery of the RCT is low. The battery is just capable to energize the RCT for a few more minutes. After the system is stopped, the RCT has to be switched off and the battery has to be replaced as soon as possible. If this signal is ignored, the RCT loses power and switches off. Consequently, the operation mode “Emergency-stop” is activated.
EMERGENCY STOP (E-stop button, on right-side of the RCT)		Pressed	Activates the emergency-stop circuit.

4.3 Diesel control system

The diesel engines can be controlled by the diesel control panel installed at each diesel engine set. The diesel engine can be started and stopped via the control system.

The diesel engine control panel has the following controls:

- Start/stop switch
- Speed toggle switch
- Emergency-stop; this emergency-stop is a hard stop and will immediately shut down the engine, which can cause damage to the engine. Therefore, only use this emergency-stop in case the PUCC emergency-stop is not working.
- Auxiliary controls and indicators

Figure 4-5: Layout diesel control panel

For control of the diesel engine, refer to the diesel engine instruction book [12].

In the PUCC, a messenger display for each diesel engine is provided to be able to obtain an alarm and warning signal for the control system. For detailed information of this messenger display, please refer to [13].

Figure 4-6: Diesel messenger display

5 User interface

The complete configuration can be entered into the control system via the interactive display on the PUCC.

5.1 Main screen

The main menu shows the following data:

- Status
- Position gate
- Misalignment 1-2
- Cylinder positions

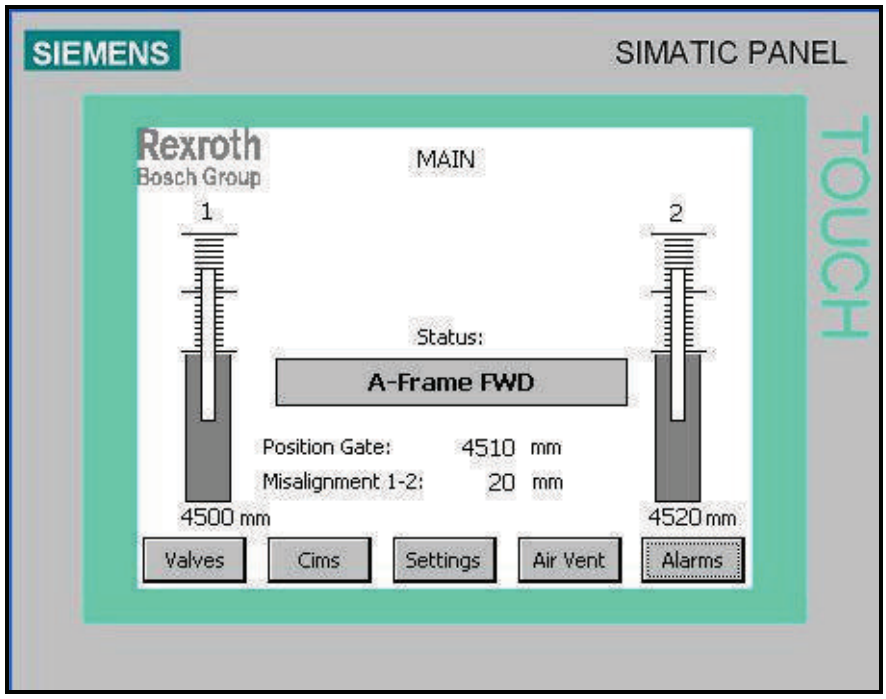


Figure 5-1: Main screen

The main menu of the interactive display features a number of soft keys, which initiate different menus (see Figure 5-1):

- Valves : opens the ‘Valves’ menu, refer to section 5.2.
- CIMS : opens the ‘CIMS’ menu, refer to section 5.3.
- Settings : opens the ‘Settings’ menu, refer to section 5.4.
- Air Vent : opens the ‘Air vent’ menu, refer to section 5.5.
- Alarms : opens the ‘Alarms’ menu, refer to section 5.6.

5.2 Valves

5.2.1 Valve status 1

The 'Valve status 1' screen shows the actual on/off status of the hydraulically operated valves and the set point in % of the proportional valve on the hydraulic pumps.

Press Next to scroll to the 'Valve status 2' screen.

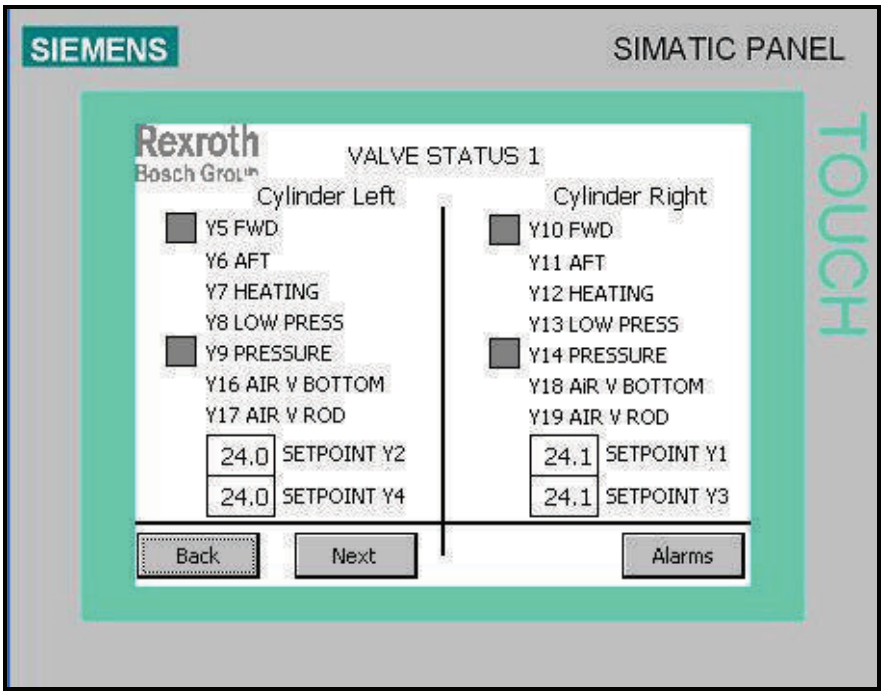


Figure 5-2: Valve status 1

5.2.2 Valve status 2

The ‘Valve status 2’ screen shows the following details:

- Actual open/closed status of the motor-operated cooling water valves
- E-motor filtration pumps on/off
- E-heaters in hydraulic reservoir on/off
- Oil temperature in the hydraulic reservoir
- Fuel oil level of diesel engines

Press Back to scroll to the ‘Valve status 1’ screen.

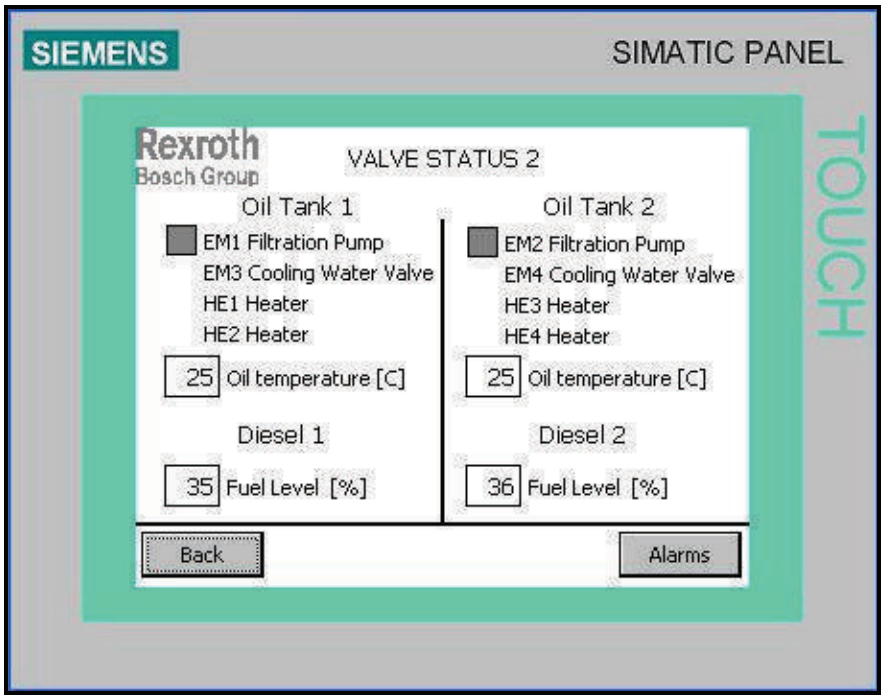


Figure 5-3: Valve status 2

5.3 CIMS

The ‘CIMS Values’ screen shows the actual values of the three CIMS sensors that indicate the position of the cylinders.

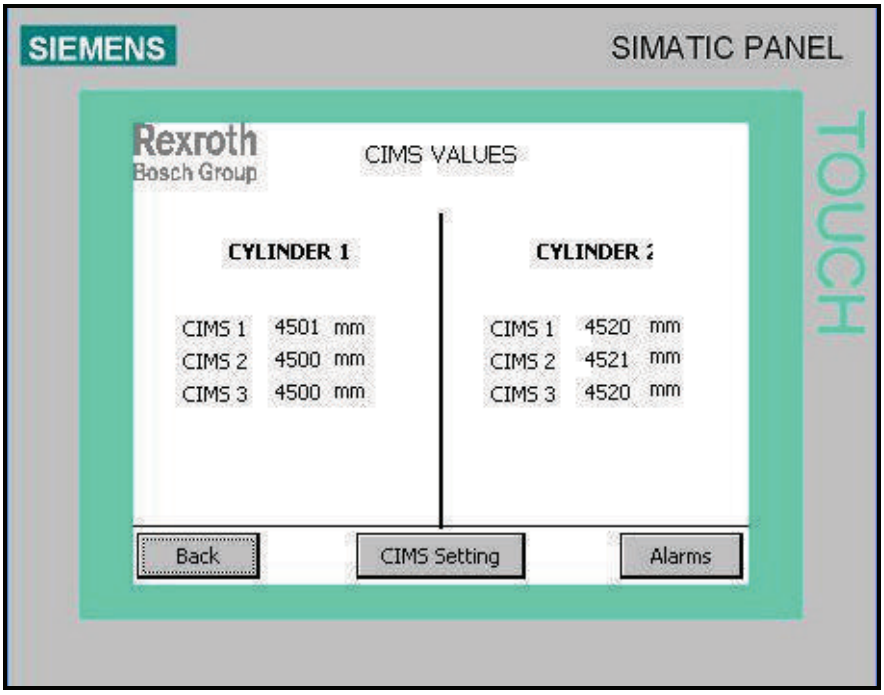


Figure 5-4: CIMS Values

After installing the cylinders of the A-frame on the ship deck connected to the A-frame, press CIMS Setting. The ‘CIMS Setting Log on’ screen will popup, refer to section 5.3.1.

5.3.1 CIMS Setting Log on

To adjust the settings, a username and password are required. These are provided in the configuration manual [3].

Enter the username and password and press OK; the 'CIMS Values' screen will popup again.

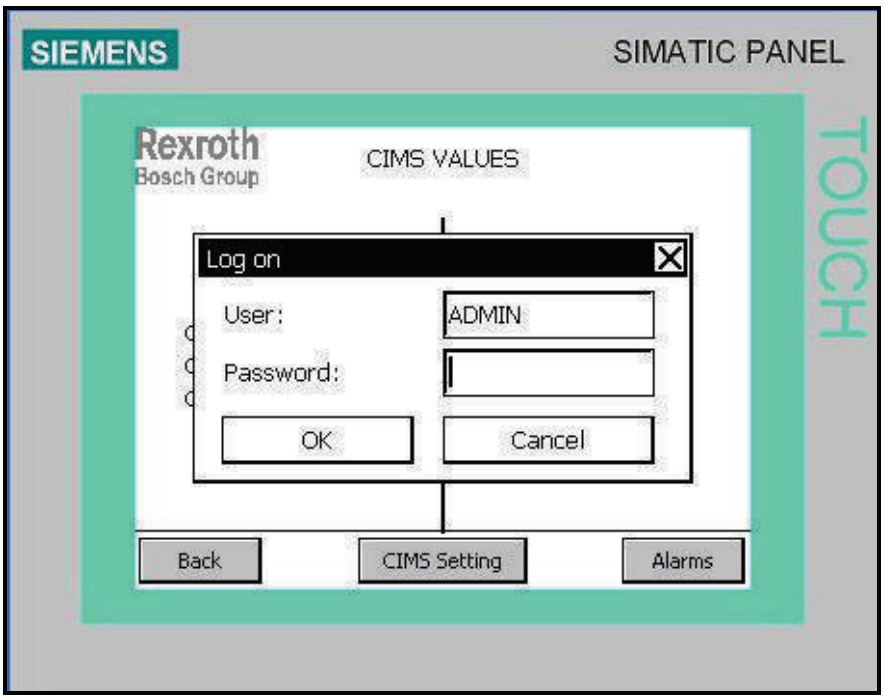


Figure 5-5: CIMS Setting Log on

After pressing CIMS Setting once more, the 'CIMS Reset' screen will popup, refer to section 5.3.2.

5.3.2 CIMS Reset

If the A-frame is in ZERO (start) position, press both Reset 3xCIMS to Preset Value buttons.

To synchronize the CIMS position values, press both Reset 3xCIMS to mean value buttons.

After a failure of a CIMS position sensor, set each CIMS position value to the preset value with the buttons CIMS 1 to CIMS 3.

Press Back to return to the 'CIMS Values' screen.

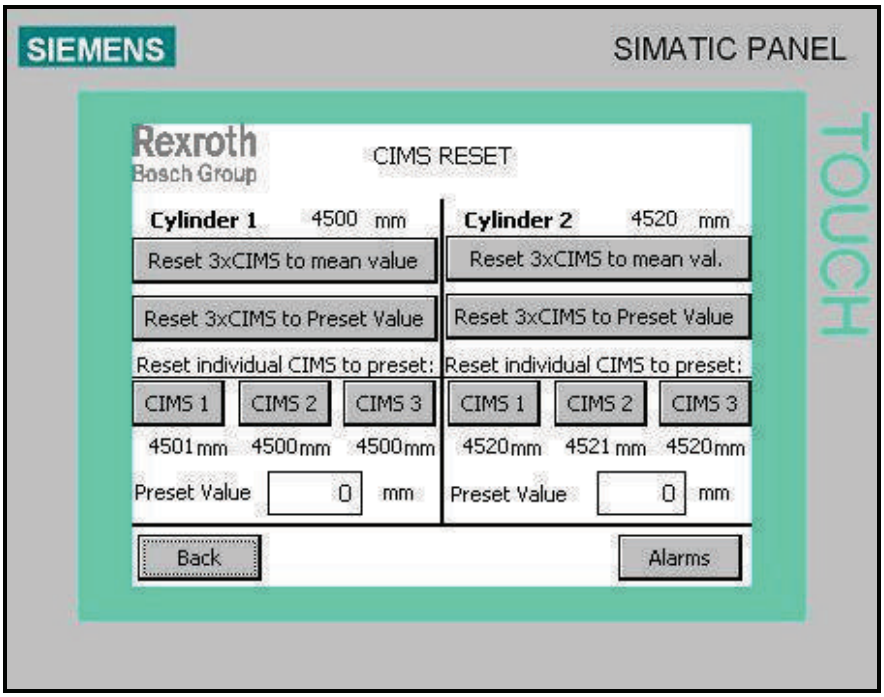


Figure 5-6: CIMS Reset

5.4 Settings

After the Settings button in he main screen is pressed, the ‘Settings Log on’ screen will popup, refer to section 5.4.1.

5.4.1 Settings Log on

To adjust the settings, a username and password are required. These are provided in the configuration manual [3].

Enter the username and password and press OK; the main screen will popup again.

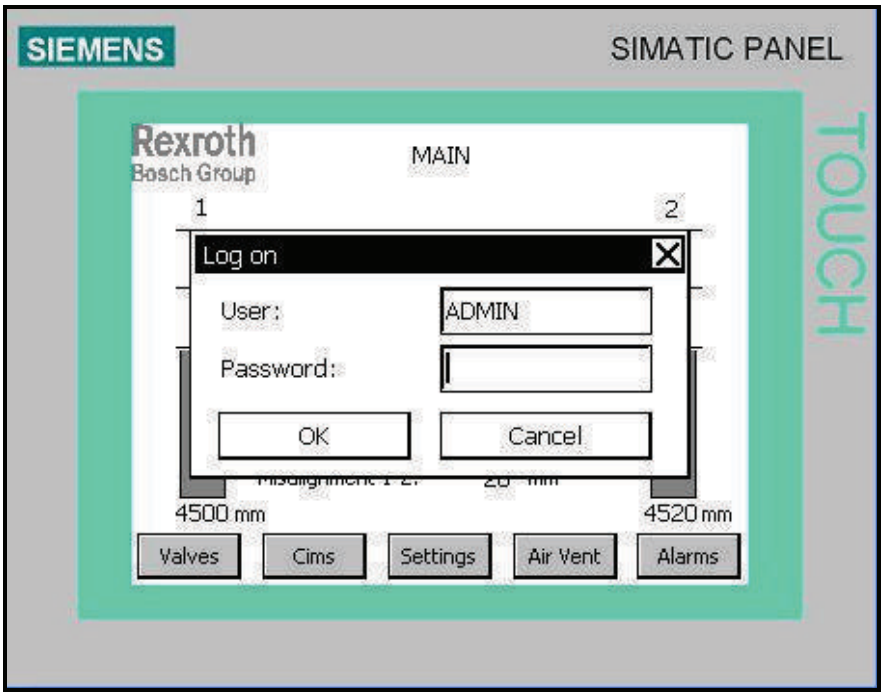


Figure 5-7: Settings Log on

After pressing Settings once more, the ‘Settings’ screen will popup, refer to section 5.4.2.

5.4.2 Settings 1 / Settings 2

In the ‘Settings 1’ and ‘Settings 2’ screens, the preferred settings can be entered. Press Next or Back to navigate between the screens.

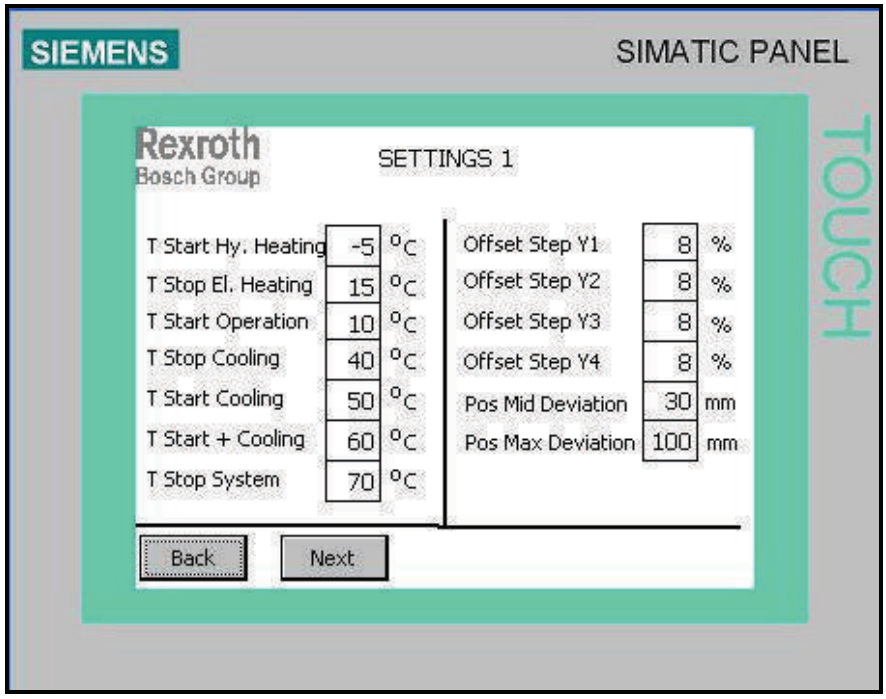


Figure 5-8: Settings 1

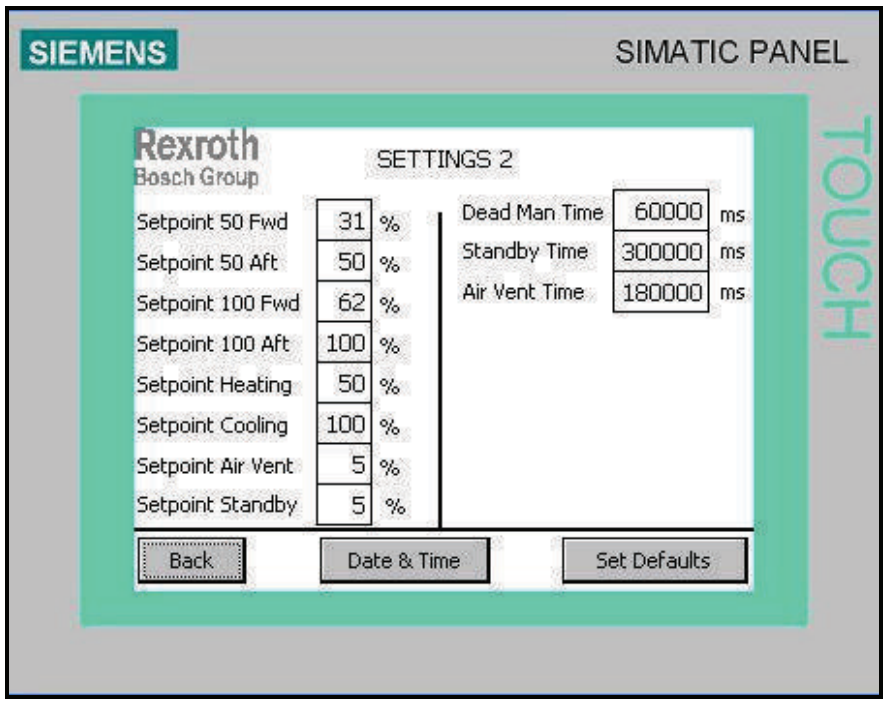


Figure 5-9: Settings 2

5.4.3 Default settings

Press Set Defaults in the 'Settings 2' screen to reset all values to the default settings.

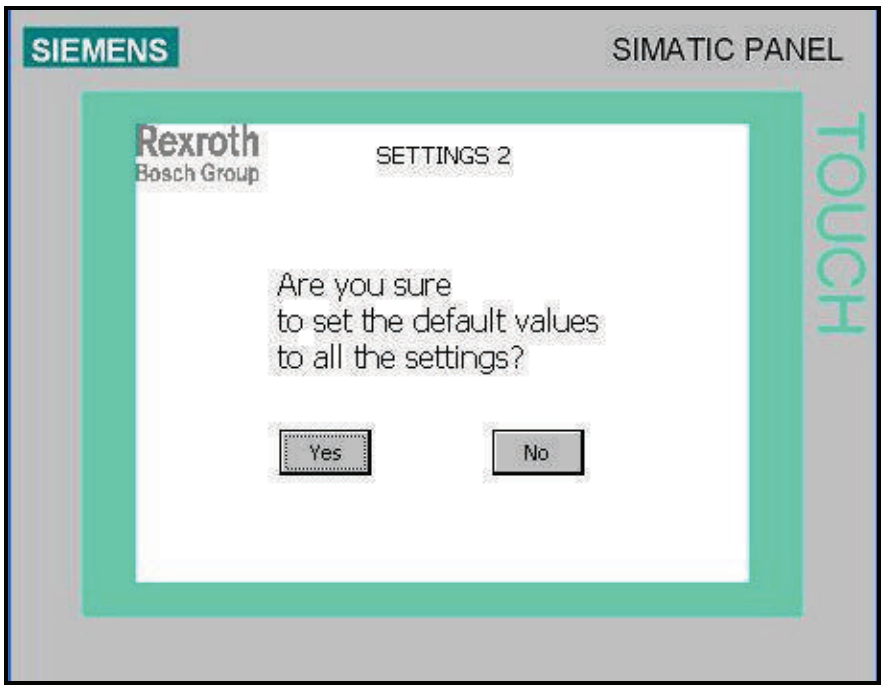


Figure 5-10: Default settings

5.4.4 Date & Time

Press Date & Time in the 'Settings 2' screen to change the current date and time.

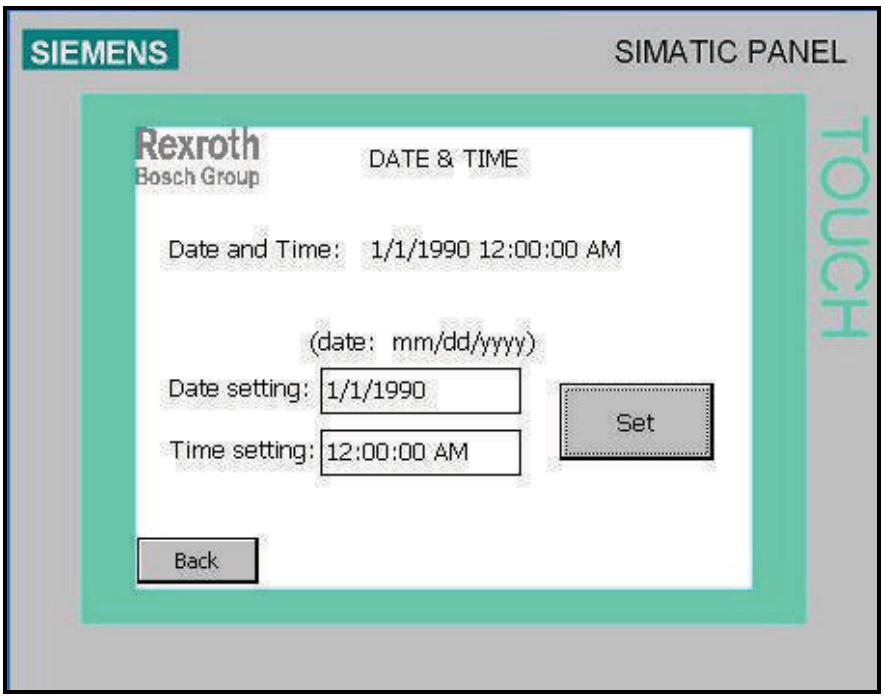


Figure 5-11: Date and Time

5.5 Air vent

After installing the cylinders of the A-frame on the ship deck, the 'Air Vent' menu can be used to air vent the cylinders.

After the Air Vent button in the main screen is pressed, the 'Air Vent Log on' screen will popup, refer to section 5.5.1.

5.5.1 Air vent Log on

To adjust the settings, a username and password are required. These are provided in the configuration manual [3].

Enter the username and password and press OK; the main screen will popup again.

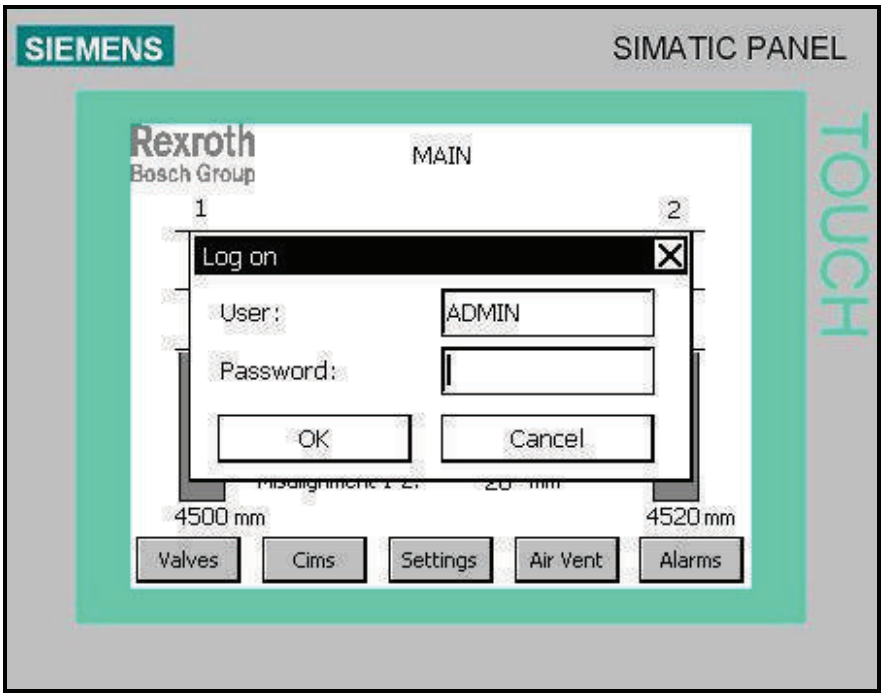


Figure 5-12: Air Vent Log on

After pressing Air Vent once more, the 'Air Vent' screen will popup, refer to section 5.5.2.

5.5.2 Air Vent

The ‘Air vent’ menu can be used to air vent the cylinders.

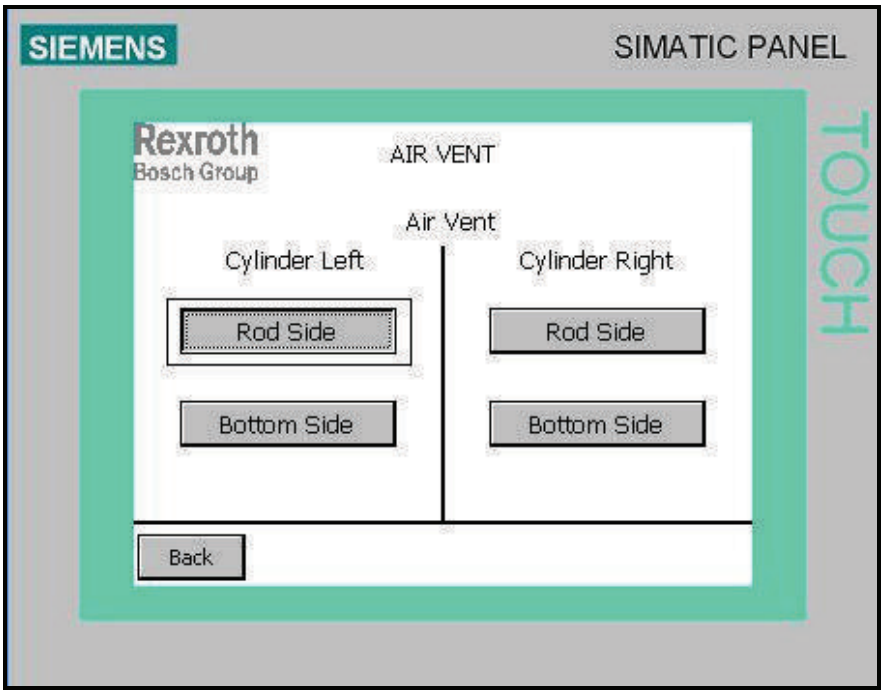


Figure 5-13: Air Vent

5.6 Alarms

When Alarms is pressed in the main screen, the 'Alarms' screen opens. This screen shows all alarms and warning messages.

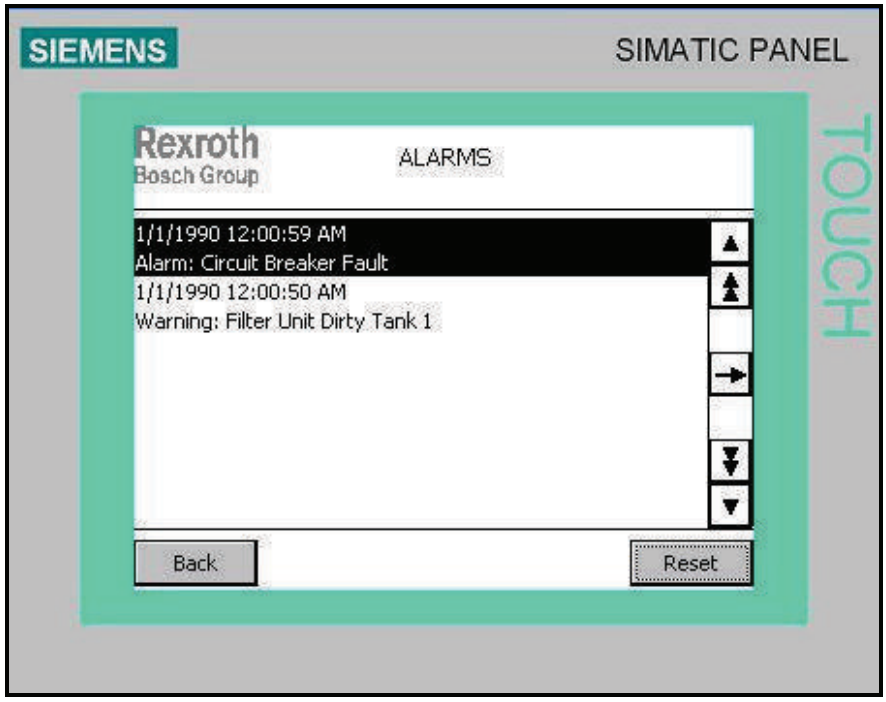


Figure 5-14: Alarms

6 Operation

This chapter contains general information necessary for the operation of the hydraulic drive system.

CAUTION

- Excessive leakage from hydraulic fluid precludes system operation until the leakage is corrected.
- Do not operate the hydraulic drive system during starting up or stopping of the E-motors to prevent damage to the pump and loaded start up of the E-motor.

CAUTION
Always study the general operating instructions for hydraulic systems as provided [2] before the system is operated.

6.1 Emergency-stop

CAUTION
Only use the emergency-stop in case of a dangerous situation that involves injury of persons or damage to the equipment.

WARNING
Only reset the emergency-stop after the problem that causes the dangerous situation has been solved.

6.2 Prepare for operation

- Make sure the diesel exhaust pipes are properly installed on the roof of the container.

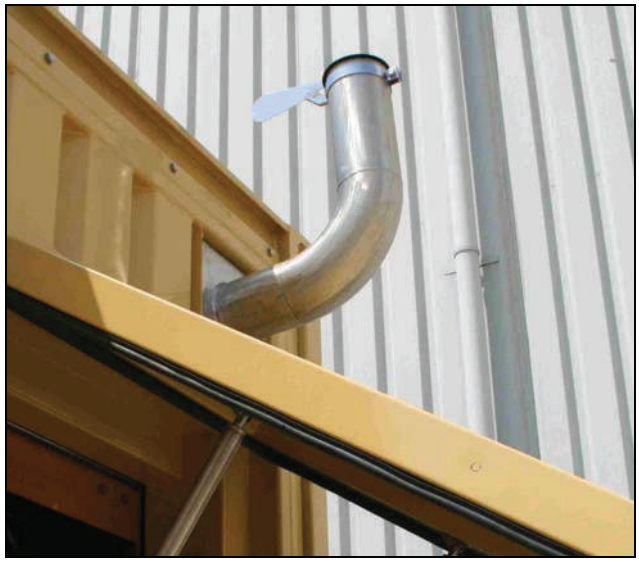


Figure 6-1: Exhaust pipe

- Make sure that the flashlights and the acoustic horn are installed on the roof of the container and are properly connected to the electrical system, see Figure 6-2 and Figure 6-3.

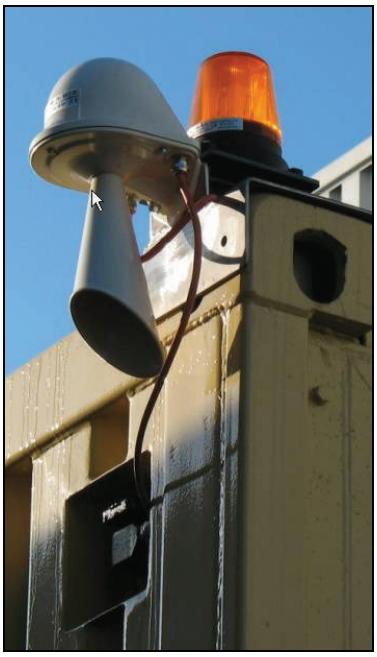


Figure 6-2: Horn

Figure 6-3: Flashlight

6.3 Activities prior to operation

Before the hydraulic equipment is started, do the following checks:

- Inspect the oil level visually.
- Inspect all filter elements visually.
- Check for oil leakage.
- General inspection of hoses, piping, wiring and connectors.
- Check if the hydraulic power unit functions properly.
- Check if the structure is free to move.

WARNING
During operation, all hatches have to be in the open position.

6.4 Operating instructions

6.4.1 Start up the system

1. Check on the radio control transmitter that the green LED “SYSTEM READY” is blinking. If not, press the pushbutton POWER ON on the RCT to turn the RCT on.
2. Set the two selector-switches AUTO/MAN on door 1 of the PUCC to ‘AUTO’. The E-motors of the filtration pumps start automatically if the diesel engines are running or if the electric heating is turned on.
3. Start the diesel engines, which must be running on normal speed 1800 RPM:
   - 3.1. Set the start/stop-switch on the diesel control panel in position 2; see Figure 4-5.
   - 3.2. Check all instrumentation on the control panel according the diesel engine instruction book, refer to [13].
   - 3.3. Set the spring-return starting switch for a short time in position 3; see Figure 4-5, to start the diesel engines. The diesels run on idle speed.
   - 3.4. Set the engine speed to normal speed with the speed switch by toggle in the ‘UP’ position to 1800 rpm.
4. Check that the power supply LED (yellow) on the RCR in the container is blinking.

6.4.2 Left cylinder in forward direction

6.4.2.1 Start up with a speed of 50%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘MANUAL’ position.
2. Hold the 3-position spring-return switch SYNCHRON on the ‘LEFT’ position.
3. Set the 2-position switch SPEED on ‘50%’.
4. Press the pushbutton FWD to move the left cylinder with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT starts to blink.

6.4.2.2 Start up with a speed of 100%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘MANUAL’ position.
2. Hold the 3-position spring-return switch SYNCHRON on the ‘LEFT’ position.
3. Set the 2-position switch SPEED on ‘100%’.
4. Press the pushbutton FWD to move the left cylinder with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT starts to blink.

6.4.2.3 Stop by pushbutton

When the cylinder is in operation in the forward direction, press the pushbutton STOP to stop the left cylinder with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT stops to blink.

6.4.2.4 Stop by proximity switch

When the cylinder is in operation in the forward direction and the proximity switch ES6 is active, the left cylinder stops to move with a ramp-time of 1 second. The yellow LED “FWD” on the RCT stops to blink.

6.4.3 Right cylinder in forward direction

6.4.3.1 Start up with a speed of 50%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘MANUAL’ position.
2. Hold the 3-position spring-return switch SYNCHRON on the ‘RIGHT’ position
3. Set the 2-position switch SPEED on ‘50%’.
4. Press the pushbutton FWD to move the right cylinder with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT starts to blink.

6.4.3.2 Start up with a speed of 100%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘MANUAL’ position.
2. Hold the 3-position spring-return switch SYNCHRON on the ‘RIGHT’ position.
3. Set the 2-position switch SPEED on ‘100%’.
4. Press the pushbutton FWD to move the right cylinder with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT starts to blink.

6.4.3.3 Stop by pushbutton

When the cylinder is in operation in the forward direction, press the pushbutton STOP to stop the right cylinder with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT stops to blink.

6.4.3.4 Stop by proximity switch

When the cylinder is in operation in the forward direction and the proximity switch ES8 is active, the right cylinder stops to move with a ramp-time of 1 second. The yellow LED “FWD” on the RCT stops to blink.

6.4.4 A-frame in forward direction

6.4.4.1 Start up with a speed of 50%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘NORMAL’ position.
2. Set the 2-position switch SPEED on ‘50%‘.
3. Press the pushbutton FWD to start moving with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT starts to blink.

6.4.4.2 Start up with a speed of 100%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘NORMAL’ position.
2. Set the 2-position switch SPEED on ‘100%’.
3. Press the pushbutton FWD to start moving with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT starts to blink.

6.4.4.3 Stop by pushbutton

When the A-frame is in operation in the forward direction, press the pushbutton STOP to stop movement of the A-frame with a ramp-time of 5 seconds. The yellow LED “FWD” on the RCT stops to blink.

6.4.4.4 Stop by proximity switch on the left cylinder

When the left cylinder is in operation in the forward direction and the proximity switch ES6 is active, the left cylinder stops to move with a ramp-time of 1 second. The yellow LED “FWD” on the RCT stops to blink.

6.4.4.5 Stop by proximity switch on the right cylinder

When the right cylinder is in operation in the forward direction and the proximity switch ES8 is active, the right cylinder stops to move with a ramp-time of 1 second. The yellow LED “FWD” on the RCT stops to blink.

6.4.4.6 Stop by “Out of synchronization”

When the cylinder is in operation in the forward direction and the CIMS position sensors detect an “out of synchronization” of more than 100 mm, the movement stops with an alarm on the touch screen. The faulty position of the cylinders is indicated by the ‘+’ and ‘-‘ indicators (yellow) on the RCT.

The “out of synchronization” setting is adjustable in the ‘Settings’ screen, see Figure 5-8 in section 5.4.2.

6.4.5 Left cylinder in afterward direction

6.4.5.1 Start up with a speed of 50%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘MANUAL’ position.
2. Hold the 3-position spring-return switch SYNCHRON on the ‘LEFT’ position.
3. Set the 2-position switch SPEED on ‘50%’.
4. Press the pushbutton AFT to move the left cylinder with a ramp-time of 5 seconds. The yellow LED “AFT” on the RCT starts to blink.

6.4.5.2 Start up with a speed of 100%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘MANUAL’ position.
2. Hold the 3-position spring-return switch SYNCHRON on the ‘LEFT’ position.
3. Set the 2-position switch SPEED on ‘100%’.
4. Press the pushbutton AFT to move the left cylinder with a ramp-time of 5 seconds. The yellow LED “AFT” on the RCT starts to blink.

6.4.5.3 Stop by pushbutton

When the cylinder is in operation in the forward direction, press the pushbutton STOP to stop the left cylinder with a ramp-time of 5 seconds. The yellow LED “AFT” on the RCT stops to blink.

6.4.5.4 Stop by proximity switch

When the cylinder is in operation in the forward direction and the proximity switch ES6 is active, the left cylinder stops to move with a ramp-time of 1 second. The yellow LED “AFT” on the RCT stops to blink.

6.4.6 Right cylinder in afterward direction

6.4.6.1 Start up with a speed of 50%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘MANUAL’ position.
2. Hold the 3-position spring-return switch SYNCHRON on the ‘RIGHT’ position.
3. Set the two-position switch SPEED on ‘50%’.
4. Press the pushbutton AFT to move the right cylinder with a ramp-time of 5 seconds. The yellow LED “AFT” on the RCT starts to blink.

6.4.6.2 Start up with a speed of 100%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘MANUAL’ position.
2. Hold the 3-position spring-return switch SYNCHRON on the ‘RIGHT’ position.
3. Set the two-position switch SPEED on ‘100%’.
4. Press the pushbutton AFT to move the right cylinder with a ramp-time of 5 seconds. The yellow LED “AFT” on the RCT starts to blink.

6.4.6.3 Stop by pushbutton

When the cylinder is in operation in the forward direction, press the pushbutton STOP to stop the right cylinder with a ramp-time of 5 seconds. The yellow LED “AFT” on the RCT stops to blink.

6.4.6.4 Stop by proximity switch

When the cylinder is in operation in the forward direction and the proximity switch ES8 is active, the right cylinder stops to move with a ramp-time of 1 second. The yellow LED “AFT” on the RCT stops to blink.

6.4.7 A-frame in afterward direction

6.4.7.1 Start up with a speed of 50%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘NORMAL’ position.
2. Set the two-position switch SPEED on ‘50%’.
3. Press the pushbutton AFT to start moving with a ramp-time of 5 seconds. The yellow LED “AFT” on the RCT starts to blink.

6.4.7.2 Start up with a speed of 100%

1. Set the key-operated switch MANUAL CYLINDER CONTROL in ‘NORMAL’ position.
2. Set the two-position switch SPEED on ‘100%’.
3. Press the pushbutton AFT to start moving with a ramp-time of 5 seconds. The yellow LED “AFT” on the RCT starts to blink.

6.4.7.3 Stop by pushbutton

When the A-frame is in operation in the forward direction, press the pushbutton STOP to stop movement of the A-frame with a ramp-time of 5 seconds.

6.4.7.4 Stop by proximity switch on the left cylinder

When the left cylinder is in operation in the forward direction and the proximity switch ES6 is active, the left cylinder stops to move with a ramp-time of 1 second.

6.4.7.5 Stop by proximity switch on the right cylinder

When the right cylinder is in operation in the forward direction and the proximity switch ES8 is active, the right cylinder stops to move with a ramp-time of 1 second.

6.4.7.6 Stop by “Out of synchronization”

When the cylinder is in operation in the forward direction and the CIMS position sensors detect an “out of synchronization”, the movement stops with an alarm on the touch screen. The faulty position of the cylinders is indicated by the ‘+’ and ‘-‘ indicators (yellow) on the RCT.

The “out of synchronization” setting is adjustable in ‘Settings’ screen, see Figure 5-8 in section 5.4.2.

6.5 Instructions after operation

NOTE
To protect the piston rods for damage and corrosive environment when the system is out of operation, it is advisable to leave the hydraulic cylinders in retracted position.

After operation is finished, shutdown the power supply to the hydraulic power unit.

7 Maintenance and repair

This section contains a description of the minimal required maintenance activities. All the prescribed maintenance activities must be performed before start-up of the system. In case the hydraulic system is in operation, the maintenance activities must be performed according to the specified interval.

These intervals assume a system usage of 1 hour per day, 5 days per week and 52 weeks per year.

Any personnel using these instructions should be familiar with:
- safety instructions;
- operating instructions.

Regularly check the installation for corrosion and damage.

A logbook of the installation must be maintained. In this logbook must be entered when, what, why and how repairs were done and when certain maintenance tasks were performed. Record the findings during routine and/or special maintenance.

NOTE
A service/maintenance book must be prepared, in which is laid down which parts of the installation must be checked and where actions can be noted. All check and inspection results must be documented in this service book.

CAUTION
- General maintenance instructions for the hydraulic equipment are provided in the following datasheets (refer to [4]):
  “Rexroth RE 07075 - Hydraulic fluids”
  “Rexroth RE 07080 - Hydraulic pumps and motors”
- “Rexroth RE 07100 - Hydraulic cylinders”
  “Rexroth RE 07300 - Industrial valves”
  “Rexroth RE 07900 - Hydraulic systems”
- Always study the concerning component datasheets as mentioned in [4] before maintenance activities are performed.

WARNING

- Never change the settings of the components, according to the hydraulic diagram (e.g. pressure relief valves and pressure switches), without written consent of Bosch Rexroth B.V.
- Do not switch on the electric power while maintenance is carried out on the system unless absolutely necessary. Use a padlock to lock the main switch in the 'OFF' position.
- Do not work on the hydraulic drive systems electrical system with power applied unless absolutely necessary. If servicing must be carried out while power is applied, it is the responsibility of the individual to exercise proper caution when working in the vicinity of high voltages (in excess of 30 Vrms or 50 VDC). A second person must be in attendance.
- Always wear the obligatory safety gear such as safety shoes, helmet, gloves and clothing when maintenance or repair activities are performed.
- Replace interconnecting hoses immediately when damage or corrosion is found.

WARNING

- Work on/with the system must only be performed by persons who are authorized to do so, based on their training and qualifications. In addition, the persons must be assigned by the operating company.
- Inform the persons in charge of modifications carried out on the system and changes in the operating behavior (e.g. excessive noise level).
- Do not perform any activities that could endanger health or cause damage to the system.

7.1 Environmental regulations

This section contains the instructions that must be obeyed to protect the environment against pollution.

CAUTION
Do not spill hydraulic oil and lubricants on the floor. Take care of environmental friendly disposal. Always follow the relevant national rules and regulations.

7.2 Preservation

All equipment that is not made out of stainless steel or is not galvanized is provided with a preservation system that complies with the environmental conditions.

7.2.1 General remarks

- Before execution of the grit blasting pre-treatment, remove all welding spatters with appropriate equipment.
- For rolled and machined steel: Remove all contamination, oil and grease. Remove all rust and mill scale by means of grit blasting up to a grade of SA2.5 according to the ISO standard 8501-1:1988.
- Sharp edges of beams, plates etc. must be beveled-off or rounded to ensure that the preservation can be applied properly.
- In order to prevent contact-corrosion, the direct contact (macro elements) between various unpreserved metals must be avoided. If this is the case however, sufficient electrical insulation is required among the individual parts.
- Where stainless steel is welded on normal steel, at least two centimeters of the stainless steel (calculated from the welding point) has to be preserved as well.
- During the pre-treatment and preservation all threaded holes, machined surfaces for matching parts and shaft holes must be adequately protected by means of well fitting plastic tops or caps that can only be removed by the mechanic on site at the time of final mounting.
- For the repair on site of all coating systems, described hereafter and all surfaces without a coating system after the final mounting of the installation, such as bolts, nuts, matching parts, etc., change the pre-treatment into hand- or power tool wire brushing up to a grade of ST3 according to the ISO standard 8501-1:1988. Replace the first coating by primer with a Dry Film Thickness (DFT) of 50 microns. Apply by brush only. Finish off with the second and third layer as described for each respective item.
- All surfaces not within easy reach for application with a spray pistol must be pre-treated by brush for each layer before the spray application of this layer.
- Application must be in accordance with the paint manufacturers' specification.

Required data sheets can be downloaded from the website: www.sigmacoatings.com

7.2.2 HPU

All equipment that is not corrosion resistant must be provided with the following preservation system:

1. Pre-treatment
   - Remove all contamination, oil and grease.
   - Remove all rust and mill scale by means of grit blasting up to a grade of SA2.5 according to the ISO standard 8501-1:1988.

2. Paint system

1st layer	50	µm	Epoxy Sigmacover primer (7413)
2nd layer	75	µm	Epoxy Sigmacover CM Miocoat
3rd layer	75	µm	Sigmadur HB Finish, RAL 1002 (sand yellow)
	---------- +		
Total DFT:	200	µm	

3. After-treatment
   - Remove the mask tape and any remains of the tape glue.

7.2.3 A-frame cylinders

The cylinders must be provided with the following preservation system:

1. Pre-treatment
   - Remove all contamination, oil and grease.
   - Remove all rust and mill scale by means of grit blasting up to a grade of SA2.5 according to the ISO standard 8501-1:1988.

2. Paint system

1st layer	50	µm	Sigmacover primer
2nd layer	75	µm	Intermediate coat Sigma CM Miocoat
3rd layer	75	µm	Top coat Sigmadur HB Finish
	---------- +		
Total DFT:	200	µm	

   The end color of the painted materials must be RAL 1002 (sand yellow).

3. After-treatment
   - Remove the mask tape and any remains of the tape glue.

7.3 General notes on maintenance

Following general notes on maintenance can significantly increase the lifetime of the hydraulic equipment.

7.3.1 Hydraulic

Keep the oil in good condition:
- The oil temperature should never exceed 60 ºC.
- The normal working temperature of oil should be between 45 ºC and 50 ºC.
- Regularly, check the oil temperature during operation.

Keep the oil clean:
- Replace the oil filters regularly, dependent on usage, every 1 or 2 years.
- Immediately replace the oil filter if the filter dirty indicator gives a warning when the oil temperature is above 25 ºC. For lower oil temperatures, the indicator does not work properly.
- Drain and refill the medium separator between oil and air regularly (each year or after long operation).
- Regularly (each year), send oil samples for check-up. For instance, oil samples can be used to check on metal particles in the oil that indicate the amount of wear of the pumps and valves.
- Check if the low-pressure air supply to the hydraulic tank is still working and replace the water filters when humid.
- Replace the air dryers on the hydraulic tank when humid.

Keep the system clean:
- Regularly clean the outside of the manifold blocks.
- Before any hydraulic equipment or sensor is replaced, first clean the surrounding area.

7.3.2 Electrical

Keep the system clean:
- Keep the control cabinets clean.
- Remove dust on the control cards, these get heated too much when dust accumulates on the cards.
- Check the functioning of the cabinet heating, thermostat and hydrostat.

Electric motors:
- Keep the cooling fans of the E-motors clean.
- Check the functioning of the cooling fans on the motor and in the wall of the HPU.

7.4 Planned maintenance

CAUTION
In the event that instructions and/or maintenance intervals deviate from each other, the most profound instructions must be executed.

The intervals in the following maintenance schedule are only suggestions due to the wide operational range of the installation. Because of the various operational circumstances, it is only feasible to supply generic maintenance intervals. The generic maintenance intervals must be adapted by the operator to meet the actual local operational circumstances, as there are, dirt, sand, moisture, ambient temperature, load cycle etc. It is sensible to base the most economic intervals on gained experience and good practice.

When failures or extraordinary circumstances that cause an electrical and or mechanical overload of the installation or parts thereof, such as overload or short circuit, are experienced, the related maintenance task(s) must be performed immediately.

Do the maintenance tasks regularly and correctly to achieve an undisturbed operation, long life cycle and to prevent extensive damage.

7.4.1 Mechanical system

Component	1 month (before/during every operation)	6 months	1 year
Mechanical construction	• Clean the system. • Check for loose items and damage.	Check the preservation and if damaged repair.	
Diesel motor	• Check for oil leakage. • Check the oil level. • Check the oil temperature and oil pressure. • Check for abnormal noise.		• Check the wear of the shaft seals. • Check the flows and the pressures. • Take an oil sample for a lab test.
Cooling system	Visually check for leakage and damage.		
Pumps	Visually check for leakage and damage.		

7.4.2 Electrical system

Component	1 month	3 months	1 year	3 years	> 15 years
Total system	Check for loose wires.				
PUCC	Check the indication lights.	• Visually check the inside and outside. • Check the voltage and the insulation. • Check the heating. • Check the E- stop.	• Check the function. • Check all connections both electrical and mechanical. • Measure the insulation value. • Check the moving contacts of the switches and relays. • Replace the indication lights. • Clean from dust.		• Replace all moving contacts of switches and relays. • Replace the fuse holders.
Radio remote control system	Check the indication lights.	• Visually check the inside and outside. • Check the E-stop. • Check the controls.	• Check the function. • Check all connections both electrical and mechanical.	Replace all fuses.	
PLC		• Visually check the inside and outside. • Check the power supply.	• Check the function. • Check all connections both electrical and mechanical.		Replace the PCB's.
Electric motor	Check for abnormal noise.	Clean the motor housing from the outside.	• Check the insulation. • Check the foundation for cracks and impressions.	• Check the torque of all bolts. • Check all cables and insulation.	Complete shop overhaul.
Pressure transmitters, temperature switches, sensors	• Visually check the inside and outside. • Check the power supply. • Check the insulation.		• Check the function. • Check all connections both electrical and mechanical. • Calibrate and set the pressure transmitters, temperature switches and sensors.		Replace all pressure transmitters, temperature switches and sensors including their PCB’s.

7.4.3 Hydraulic system

Component	1 month	1 year	3 years	> 15 years
Hydraulic pump	• Check for oil leakage. • Check the oil level. • Check the oil temperature and oil pressure. • Check for abnormal noise.	• Check the wear of the shaft seals. • Check the flows and the pressures. • Take an oil sample for a lab test.		Complete shop overhaul.
Proportional and servo valves	Visually check for leakage and damage.			Complete shop overhaul.
Air breather	Check for contamination.			Complete shop overhaul.
Filter	Exchange only if the 'Filter dirty' indication is active and the oil temperature is above 25 °C.	Check the filter indicator on the electrical and hydraulic side.	Change all filters.	
Hydraulic hoses	Visually check for leakage, corrosion and damage.		Replace all hoses that are located in the open air.	Replace all hoses.

7.5 Special activities

7.5.1 HPU

CAUTION

- Do not spill hydraulic oil and lubricants on the floor. Take care of environmental friendly disposal. Always follow the relevant national rules and regulations.
- The hydraulic system contains several components, which are sensitive to contamination. When any part of the hydraulic equipment is dismantled make sure to work clean, so no contamination or dust can enter the hydraulic system. Flush if necessary.
- After abnormal wear or damage of components in the hydraulic installation is discovered, it is very important to remove all wear parts and particles out off the hydraulic installation.
  In case of doubt or serious damage, dismantle the complete system, clean and replace the hydraulic fluid.

7.5.1.1 Hydraulic fluid

The hydraulic power system must be filled up with hydraulic fluid according original design.
The hydraulic power units must be flushed properly according NAS 1638 Class 7 (or better).

CAUTION
The approved hydraulic oil for this hydraulic system is mineral oil ISO-VG-46-HVLP. Use only this specified type of hydraulic oil for oil filling or topping-up.

Regularly take an oil sample of the hydraulic oil and let a qualified laboratory check the oil quality and properties. Change the hydraulic oil if necessary.
The sample intervals are:

- First inspection after 50 hours of operation.
- Second inspection after 500 hours of operation.
- Third inspection after 1000 hours of operation.
- Subsequent inspection every 2000 hours of operation or at least once a year.

7.5.1.2 Diesel system

For more details of oil changes and lubrication activities on the diesel system, refer to the diesel manuals [12] and [13].

7.5.2 A-frame cylinders

For maintenance activities to be performed on the hydraulic cylinders, please refer to [1].

7.5.3 Interconnecting hoses / quick-(dis)connect couplings

De-pressurize the interconnecting hoses and quick-(dis)connect couplings. Drain all hydraulic fluid to the tanks, before any of the interconnecting hoses or quick-(dis)connect couplings are replaced.

Flush all interconnecting hoses or quick-(dis)connect couplings properly in accordance with NAS 1638 Class 7 (or better).

7.6 Repair

NOTE
Contact Bosch Rexroth B.V. - Systems & Engineering or Bosch Rexroth B.V. Services for council before repairs are carried out. The guarantee expires when repairs are carried out unprofessionally.

8 Troubleshooting

This section provides guidelines to find and remedy the cause of several known failures.

NOTE
Always contact Bosch Rexroth B.V. - Systems & Engineering for council before repairs and troubleshooting are carried out. The guarantee expires when repairs are carried out unprofessionally.

CAUTION
When abnormal wear or damage of components in the hydraulic installation is detected, it is very important to remove all wear parts and particles out off the hydraulic installation.
In case of doubt or serious damage dismantle the complete system, clean the system and replace the hydraulic fluid.

8.1 Hydraulic system

8.1.1 Unusual or excessive noise

Possible cause	Reason	Remedy
Cavitations in the hydraulic pump.	The hydraulic fluid is too cold (< -10°C).	Warm up the hydraulic fluid (system) by heating the interior of the power unit.
	The air breather is clogged.	Check the air breather.
Air bubbles in the hydraulic fluid or formation of foam.	Penetration of air through the pump shaft sealing.	• Replace the shaft and/or pump shaft sealing. • Check the seal housing (on the pump) for damage.
	Penetration of air through the suction pipe connections.	Tighten the connections and/or replace the seals.
	The hydraulic system air-bleed is insufficient.	Air-bleed the system (after a period of rest).
	The fluid level is too low.	Fill up the fluid reservoir.
Mechanical vibrations and/or noise.	Incorrect alignment or loose shaft coupling.	Re-align or re-install the shaft coupling.
Pump, hydraulic motor or cylinder.	Worn, damaged or incorrect assembled pump, motor or cylinder.	Repair or replace the concerning parts.
	Vibration and/or shocks of interconnecting piping.	Improve the installation of interconnecting piping.
Pressure or flow control valves.	Unstable pressure or flow control valves.	Correct if possible.

8.1.2 External fluid leakage

Possible cause	Reason	Remedy
Abnormal hydraulic pressure.	Damaged seals.	Remedy the cause and replace the seals.
	Stretched bolts or screws.	Remedy the cause and replace the bolts or screws.
Incorrect or damaged components/parts.	Porous or damaged parts.	Replace the part.
	Damaged seals.	Remedy the cause and replace the seals.
	Incorrect connection bolts are used.	Replace with correct connection bolts.
Incorrect installation / assembly.	Incorrect placed seal.	Replace the seal.
	Bolts or screwed connections are tightened incorrectly.	Tighten properly, not excessive.
	Incorrect or damaged seals.	Place new seals.

8.1.3 Non or insufficient fluid flow

Possible cause	Reason	Remedy
Cavitations in the hydraulic pump.	See section 8.1.1.	See section 8.1.1.
Air bubbles in the hydraulic fluid or formation of foam.	See section 8.1.1.	See section 8.1.1.
Pump, hydraulic motor or cylinder is worn.	See section 8.1.1.	See section 8.1.1.
Rotation speed of the hydraulic pump is too low.	See section 8.1.1.	See section 8.1.1.
Incorrect rotation direction of the hydraulic pump.	Incorrect connections E-motor.	Re-connect the E-motor.
Internal leakage from the pressure-line to the return-line.	See section 8.1.5.	See section 8.1.5.
Flow control valves, Throttle valves.	The valve is adjusted incorrectly.	Re-adjust the valve.
	The valve is clogged or blocked, caused by dirt, or damaged.	Clean or replace the concerning valves.
Frequency power supply.	The rotation frequency is too low.	Check and remedy the rotation frequency.

8.1.4 Fluid temperature too high

Possible cause	Reason	Remedy
Internal leakage from pressure-line to return-line.	The setting of the relief valve is too low.	Re-adjust to correct settings.
	• The control valves function incorrectly. • The seals are worn.	See section 8.1.5.
Excessive heating of the pump, hydraulic motor or cylinder.	Loss of efficiency caused by wear.	Repair or replace.
The temperature of the environment is too high.	The temperature is above the design conditions.	Install a cooler.
The cooling water supply is too little.	Failure in the cooling water supply pump.	Check the pump, start another pump, clean the seawater oil cooler.
	The cooling water temperature is too high.	Cooling water temperature is > 35 °C
The system is overloaded.	The air pressure does not equalize the load sufficiently.	Re-adjust the passive (air) pressure.

8.1.5 Insufficient hydraulic pressure

Possible cause	Reason	Remedy
Cavitations in the hydraulic pump.	See section 8.1.1.	See section 8.1.1.
Fluid temperature is too high.	The pump is damaged or worn.	Repair or replace the pump.
	Excessive heat generation in the system.	Find and remedy the cause.
Speed of the hydraulic pump, the hydraulic motor and the cylinder is too low.	Slipping drive or incorrect driving motor, the frequency of the power supply is too low.	Remedy the cause.
	The by-pass valve is not closed completely.	Remedy the cause.
Incorrect pressure adjustments, internal leakage from the pressure-line to the return-line.	Incorrect pressure settings.	Re-adjust the settings.
	The by-pass valve is not closed completely.	Remedy the cause.
	The control valves do not close/open (sufficiently) caused by dirt, damage, wear or electrical failure.	Find the malfunctioning component, clean, repair or replace. Check the functioning of the electrical equipment.
	Sealing of the hydraulic motor or cylinder is worn or damaged.	Repair or replace the malfunctioning parts.

8.1.6 Unusual/excessive pressure, fluctuations in flow, vibrations

Possible cause	Reason	Remedy
Cavitations in the hydraulic pump.	See section 8.1.1.	See section 8.1.1.
Air bubbles in the hydraulic fluid or formation of foam.	See section 8.1.1.	See section 8.1.1.
Air pockets in the hydraulic system.	The hydraulic system air-bleed is insufficient.	Air-bleed the system.
Mechanical vibrations.	See section 8.1.1.	See section 8.1.1.
Unstable pressure of flow control valves.	See section 8.1.1.	See section 8.1.1.
	Damaged valve seat.	Repair or replace the concerning valve.
	• Insufficient dampening function of a valve. • Power frequency fluctuates.	• Re-adjust the concerning valve. • Stabilize the generator.
Incorrect adjusted or obstructed control valves.	Incorrect settings.	Adjust and secure adjustment.
	Worn or damaged control valves.	Clean, repair or replace the concerning component.
	The control valves function incorrectly caused by contaminated hydraulic fluid.	• Replace the hydraulic fluid. • If necessary, clean the components and piping separately.

8.2 Hydraulic power unit

Check on the interactive display or on the messenger display on the PUCC, which warnings/errors do occur.

8.2.1 Alarm messages

The following alarms are shown on the messenger display on the front of the PUCC and can be accepted by the ACCEPT ALARM pushbutton.

Message	Cause	Solution
Tank 1 Hydraulic oil level low	The hydraulic oil level in tank 1 is low.	Check for leakage. Refill oil.
Tank 1 Hydraulic oil level too low	The hydraulic oil level in tank 1 is too low.	Shut down the system immediately, check for leakage, repair and refill oil.
Tank 1 Hydraulic oil temperature high	The hydraulic oil temperature in tank 1 is high.	
Tank 1 Hydraulic oil temperature too high	The hydraulic oil temperature in tank 1 is too high.	Shut down the system immediately and let the oil cool down.
Tank 1 Filter dirty filtration pump	The filter of the filtration pump of tank 1 is dirty.	Replace the filter in the filtration pump.
Tank 1 Return filter dirty	The return filter of tank 1 is dirty.	Replace the return filter.
Tank 1 Suction valve 1 not open	Suction valve 1 of tank 1 is not open.	Check why the valve is closed. If allowed, open suction valve 1.
Tank 1 Suction valve 2 not open	Suction valve 2 of tank 1 is not open.	Check why the valve is closed. If allowed, open suction valve 2.
Tank 2 Hydraulic oil level low	The hydraulic oil level in tank 2 is low.	Check for leakage. Refill oil.
Tank 2 Hydraulic oil level too low	The hydraulic oil level in tank 2 is too low.	Shut down the system immediately, check for leakage, repair and refill oil.
Tank 2 Hydraulic oil temperature high	The hydraulic oil temperature in tank 2 is high.	
Tank 2 Hydraulic oil temperature too high	The hydraulic oil temperature in tank 2 is too high.	Shut down the system immediately and let the oil cool down.
Tank 2 Filter dirty filtration pump	The filter of the filtration pump of tank 2 is dirty.	Replace the filter in the filtration pump.
Tank 2 Return filter dirty	The return filter of tank 2 is dirty.	Replace the return filter.
Tank 2 Suction valve 1 not open	Suction valve 1 of tank 2 is not open.	Check why the valve is closed. If allowed, open suction valve 1.
Tank 2 Suction valve 2 not open	Suction valve 2 of tank 2 is not open.	Check why the valve is closed. If allowed, open suction valve 2.

Message	Cause	Solution
Diesel engine 1 Fuel level low	The fuel level of diesel engine 1 is low.	Check for leakage. Add fuel.
Diesel engine 1 Fuel level too low	The fuel level of diesel engine 1 is too low.	Shut down the system immediately. Check for leakage, repair and add fuel.
Diesel engine 1 Failure	A failure occurred in diesel engine 1.	
Diesel engine 2 Fuel level low	The fuel level of diesel engine 2 is low.	Check for leakage. Add fuel.
Diesel engine 2 Fuel level too low	The fuel level of diesel engine 2 is too low.	Shut down the system immediately. Check for leakage, repair and add fuel.
Diesel engine 2 Failure	A failure occurred in diesel engine 2.	
Emergency-stop on PUCC	The emergency-stop button on the PUCC is pressed.	Turn the button clockwise to undo the emergency-stop.
	The emergency-stop circuit of the emergency-stop button at the PUCC is not okay.	Check the wiring of the emergency-stop button by means of diagram [5].
Emergency-stop on front container door	The emergency-stop button on the front container door is pressed.	Turn the button clockwise to undo the emergency-stop.
	The emergency-stop circuit of the emergency-stop button on the front container door is not okay.	Check the wiring of the emergency-stop button by means of diagram [5].
Emergency-stop on rear container door	The emergency-stop button on the rear container door is pressed.	Turn the button clockwise to undo the emergency-stop.
	The emergency-stop circuit of the emergency-stop button on the rear container door is not okay.	Check the wiring of the emergency-stop button by means of diagram [5].
Emergency-stop on the RCT	The emergency-stop button on the RCT is pressed.	Turn the button clockwise to undo the emergency-stop.
	The emergency-stop circuit of the emergency-stop button at the RCT is not okay.	Check the wiring of the emergency-stop button by means of diagram [5].
Circuitbreaker failure	One or more circuitbreakers failed	

8.2.2 Diesel

For more details on troubleshooting activities for the diesel engine, refer to [12] and [13].

8.3 Radio remote control system

For more details on troubleshooting activities for the radio remote control system, refer to [14] and [15].

9 Storage

9.1 HPU

9.1.1 Storage conditions

- The complete hydraulic power unit is containerized in a 40' container, which is watertight to protect the HPU against the direct influence of the weather.
- The 40' container is able to withstand salt-water splashes during heavy weather.
- Condensation inside the container must be prevented, as well as the presence of corrosive materials and vapors.

- When the storage location is planned, take into account that the free space around the HPU must be at least 2 m to be able to open the access doors and ventilation hatches.
- Connect the earth point(s) of the HPU to a reliable earth connection.
- Hook up the HPU to an auxiliary power supply (220 V) to make sure that the batteries of the diesel system are loaded and the E-heaters and the lighting system can be used.
- Switch on the E-heaters and adjust the thermostat of the heating units to keep the interior of the HPU above the freezing point.

9.1.2 Requirements for optimum condition

In order to maintain the HPU in an optimum condition during the storage period, the HPU must undergo a thorough inspection every 6 months. During this, the following must be taken into account:

- Preservation; Check for damage and corrosion, pay special attention to the underside and the roof of the HPU.
- Hydraulic medium; Check on oxidation or acidification of the mineral oil, open the drain valve on the oil reservoir to check for free water.
- Check the breather filters of the oil reservoir, and check the oil reservoir internally for contamination and paint condition.

Depending on the findings, corrective actions must be carried out.

9.1.3 Verification of usability

If it is not possible to meet the storage conditions specified in the foregoing section, the HPU must be subjected to a thorough inspection. Before the HPU is taken into operation its usability must be confirmed by means of a functional test.

9.2 Cylinders

For more information on the storage conditions of the cylinders and the requirements for optimum condition, please refer to chapter 4 of the "Cylinder - Instruction manual" according referenced document [1].

10 Spare parts

10.1 Ordering spare parts

CAUTION

- Spare parts must always comply with the specifications as required by Bosch Rexroth B.V.
- When spare parts are ordered from Bosch Rexroth B.V. directly, it is guaranteed that these spare parts comply with the specifications as required by Bosch Rexroth B.V.

In this section, the procedure how to order spare parts from Bosch Rexroth B.V. is disclosed.

The next information is a prerequisite in order to be able to deliver the required spare parts in the shortest possible time:

- Order number = NL000817.
- Full drawing number or the parts list that contains the required spare part(s).
- Position number of the required spare part(s).
- Number of required spare part(s).

A spare parts order must always be done in writing. In urgent cases however, it is possible to order by telephone or fax.

Phone : +31. (0)411.651951*
Fax : +31. (0)411.677814

*) In that case, such an order must always be backed up by a written order confirmation as soon as possible.

Spare parts orders must be send to:

Bosch Rexroth B.V. - Systems & Engineering
P.O. Box 32
5280 AA Boxtel
The Netherlands

10.2 Recommended spare parts

Refer to the spare parts lists, according the following documents:

[1]	r902129360_en_4068_2500_20080820101018	Axial piston unit
[2]	r902129362_en_2028_2412_20080820101101	Axial piston unit
[3]	1434423_10	Hydraulic cylinder

For each of the spare parts, the following items are described:

- Technical Breakdown Structure (TBS) number.
- Description of the spare part.
- Supplier of the spare part.

At the end of their lifetime, dispose of replaced parts or wearing parts according local legislation. Contribute to recycling waste material by separating and recycling refuse.

MAN Ferrostaal AG

250 t SWL

A-frame Hydraulic

REV.	DESCRIPTION	DATE	DRAWN	CHECKED
01	Title changed	13-01-09	RR	SB

TITLE:

Configuration manual

FILE: S:\PROJECTS_S&E\NL000817-MAN-AHT-Uranus-A-frame\11-Engineering\PE-manual\Manual in bewerking\NL000817-02-59-0000-CFM-0000-R01-Configuration.doc

PRINTED: 1/20/2009 9:41 AM		DATE:
DRAWN:	R. Rikken	26-11-08
CHECKED:	S. Boeijen	26-11-08

Rexroth Bosch Group

PROJECT:	DOCUMENT:	SIZE:	REV.:
NL000817	**02-59-0000-CFM-0000**	**A4**	**01**

P.O. BOX 32 · NL-5280 AA BOXTEL · THE NETHERLANDS

Revisions

Rev.	By	Chapter	Description	Reason
00	R. Rikken		Original version.	
01	R. Rikken		Title changed	

Explanation of revision marks:
| aaaaaaa = Revised text
| aaaaaaa = Revised text
| ... = Deleted text
| ~~aaaaaaa~~ = Deleted text

Table of contents

1 Introduction

This document provides the necessary data to be able to adjust the settings of the hydraulic drive & control system for the A-frame, designed by Bosch Rexroth B.V. - Systems & Engineering under order number NL000817.

The system is manufactured by:

Bosch Rexroth B.V. - Systems & Engineering
P.O. Box 32
5280 AA Boxtel
The Netherlands
Phone : +31 (0)411 - 651951
Fax : +31 (0)411 - 688681
Internet : www.boschrexroth.com/S&E

End-user	:	MAN Ferrostaal AG
Customer	:	MAN Ferrostaal AG
Main contractor	:	Bosch Rexroth B.V. - Systems & Engineering
Certifying authority	:	Germanischer Lloyd (GL)

2 Log on

The complete configuration can be entered into the control system via the interactive display on the PUCC.

To adjust the settings the following username and password must be used.

User name	Password
ADMIN	*817*

MAN Ferrostaal Aktiengesellschaft

AHT "URANUS" – A-Frame

Rexroth
Bosch Group
Released for production

G swagten
2007.03.3
0 09:36:03
+02'00'

REV.	DESCRIPTION	DATE	DRAWN	CHECKED

TITLE:

A-Frame Cylinder
Detail Specification

FILE: S:\projects\NL000817-MAN-AHT-Uranus-A-frame\11-Engineering\PE-hydrauliek\NL000817-02-59-1000-SPC-0000-R00-A-Frame Cylinder Specification.doc
PRINTED: 3/28/2007 10:46:00 AM

		DATE:
DRAWN:	S. Boeijen	27-03-07
CHECKED:	G. Swagten	28-03-07

Rexroth
Bosch Group

PROJECT:	DOCUMENT:	SIZE:	REV.:
NL000817	02-59-1000-SPC-0000	A4	00

P.O. BOX 32 · NL-5280 AA BOXTEL · THE NETHERLANDS

Revisions

Rev.	By	Chapter	Description	Reason
00	SB		Original version.	

Explanation of revision marks:
| aaaaaaa =Revised text
| aaaaaaa =Revised text
| ... =Deleted text
| ~~aaaaaaa~~ =Deleted text

Table of Contents

1 Introduction

1.1 Purpose

The purpose of this document is to define all requirements for the A-Frame Cylinders for the Hydraulic drive & control system system for the AHT “URANUS” – A-Frame. The Hydraulic drive & control system is to be designed and delivered by Bosch Rexroth B.V. - Systems and Engineering to MAN Ferrostaal Aktiengesellschaft.

All requirements for the equipment are specified in this document. Any deviation from this specification shall be clearly mentioned to and approved by Bosch Rexroth B.V.- Systems and Engineering.

1.2 Scope

This document will define all necessary specifications for designing, manufacturing, assembling, testing and delivering the equipment.

1.3 Reference Documents

[1]	T.B.D.	Hydraulic Diagram – A-Frame System
[2]	T.B.D.	Dimension Drawing – Junction Box
[3]	05-T.B.D.	Assembly drawing - Valveblock

1.4 Abbreviations

END-USER	: MAN Ferrostaal Aktiengesellschaft
CUSTOMER	: MAN Ferrostaal Aktiengesellschaft
CERTIFYING AUTHORITY	: GL
MAIN CONTRACTOR	: Bosch Rexroth B.V. - Systems & Engineering
MANUFACTURER	: Bosch Rexroth B.V. - Cylinders

2 Scope of supply

The MANUFACTURER shall design, manufacture, assemble, test and deliver following equipment and related documentation :

2 off A-Frame Cylinders, as described in section 3.2 of this document.

Set off Documentation, as defined in section 8 of this document.

3 Technical specification

The following sections provide detail technical specifications for the equipment.

3.1 General design data

The hydraulic cylinder shall be designed for outdoor use in an offshore environment.

The hydraulic cylinder shall be suitable for operation in a **non-hazardous area.**

The hydraulic cylinder shall be designed suitable for **ISO-VG 46 HVLP** Mineral Oil and shall be delivered flushed/cleaned to a fluid cleanliness level in accordance with **NAS 1638 Class 7** (or better).

Each hydraulic cylinder shall be provided with a stainless steel name plate in a easily readable position, mounted with stainless steel drive screws or with stainless steel straps containing at least following data :

- Manufacturer's name
- Model number
- Tag nummer information according relevant hydraulic diagram

All electrical components shall be provided with stainless steel text plates (mounted with stainless steel drive screws or with stainless steel straps if drive screws are not applicable) with electrical coding accordance with the markings on the hydraulic diagram.

Cylinder shall be provided with suitable lifting provisions.

Measurement coupling G ¼”-Stainless Steel 316L.

Grease nipples Stainless Steel 316L.

3.2 Main design data

Main design data for the hoist cylinder are:

- Type : Double Acting Cylinder
- Piston diameter : 780 mm
- Rod diameter : 480 mm
- Stroke : 6.700 mm
- Outside diameter : 915 mm **[HOLD]**
- Maximum Cylinder extracting speed : 15.3 mm/s
- Minimum Cylinder retracting speed : 3 mm/s
- Weight :30.000 kg **[HOLD]**

Design criteria:

- Minimum design temperature : -20 °C
- Maximum design temperature : +60 °C
- Design pressure : 300 bar
- Static test pressure bottom-side : **450 bar**
- Maximum pushing force :14.108 kN
- Maximum pulling force : 6.158 kN
- See Appendix A for cylinder loads related to cylinder stroke / working angle

- Working angles : 35.7 – 108.3 ° with to horizontal, rod up

- Guided rod end : Yes
- External side loads : Not allowed
- External eccentric forces : Not allowed
- Buffers : Not Applicable,
  speed limited at 15.3 mm/s

Rod Protection : CERAMAX CEC 2.2

Mountings:

- Rod side : Specirical bearing GE 360
  including stainless steel grease nipple
  including protective flanges with V-seal
- Bottom side : Specirical bearing GE 360
  including stainless steel grease nipple
  including protective flanges with V-seal

Construction :

- Lifting lugs : Yes
- Cushioning : Not Applicable,
  speed limited at 15.3 mm/s Rod
- Provisions for mounting Junction Box ref. [2]

Hydraulic connections :

- Size on bottom side : SAE 2”-6000 psi, suitable for mounting valveblock ref. [3]
- Size on rod side : SAE 1 1/2”-6000 psi
- Minimess connections : 4 off (2 plugged)
- Leakage line connections : 1 off drain champer CIMS
  1 off optional vent line rod side

Position Measurement :

- **3 x** Ceramax Integrated Measuring System (CIMS) Mark III
- Output signal : digital output, incremental encoder 1024*(A+B) pulses per 10mm
- CIMS stroke measurement protection class IP68.
- CIMS© delivered with high speed counter cards **[HOLD, to be defined with control systems]**

- 2 x Balluff position switch
- Position switch mounted inclusing protective cover sutable for offshore environment
- Position switch including fixed cable to Junction Box

Seals :

- Rod seals : Low friction
- Piston bearing : Impregnated fabric bearing strips
- Rod bearing : Impregnated fabric bearing strips

Piping :

- HP-pipe from 48.3x6.3 St. 37.4 from manifold to rod side
- Leakage line from rodside to connection point at bottom side, 25 x 2.5 Stainless Steel
- Piping for electrical cabling from rodside to junction box, 30 x 3 Stainless Steel **[HOLD]**

3.3 Life Time [HOLD]

Lifetime: 20 years
Duty cycle: 200 operations / year.

One operation means :
- one full load cycle according Appendix A for lowering the load using the A-Frame
- 24 hours in extended position with load variations caused by vessel's movement
  Estimation of load variation : 5.500 kN ± 10 % approx. "harmonic" motion pattern, with periods between 15 and 5 seconds

4 Applicable rules / standards

The hoist cylinders shall be designed, manufactured, assembled and tested according to REXROTH Standardand to the requirements of the CERTIFYING AUTHORITY.

In addition the equipment shall be designed according following additional/related international accepted design rules and standards:

- ISO standards
- DIN standards
- NEN and EN standards

On all documentation SI-unit system shall be used.

5 Environmental conditions

The hoist cylinders shall be designed in order to comply with following environmental conditions:

Atmosphere
- Humid, salt laden and corrosive offshore atmosphere
- Splash zone applicable

Steel Design Temperature
- Minimum : -20°C
- Maximum : +60°C

Operating Temperature
- Minimum : -20°C
- Maximum : +60°C

Relative humidity:
- Max. 100%

6 Preservation

The hoist cylinders shall be provided with following preservation system:

a) Pre-treatment :
- Sharp edges (after milling), fillets, corners and welds shall be rounded/smoothened by grinding.
- During the pretreatment and the application of paint, all threaded holes and shaft holes shall be thoroughly protected by a well-fitting plastic plug that can only be removed by the mechanic at the final assembly.
- Remove dirt and grease. All surfaces must be free from oil, rust, dirt, etc.
- Mill scale and rust shall be removed to a cleanliness according ISO-8501-1 : SA 2½ (shotblasting)

b) Paint System :

– 1st layer	50	µm	Sigmacover Primer
– 2nd layer	75	µm	Intermediate coat Sigma CM Miocoat
– 3rd layer	75	µm	Top coat Sigmadur HB finish
	---------- +		
Total DFT :	200	µm	

The end color of the painted materials shall be :
RAL 1002 (Rexroth Blue)

c) After-treatment :
- Remove mask tape and any remains of the tape glue.

7 Quality

This section defines all project quality aspects for designing, manufacturing, assembling, testing and delivering the equipment as specified in section 3 of this document.

7.1 Quality assurance / quality inspection

A project related QA/QI program, based on ISO 9001 -1994, shall be issued by the MANUFACTURER at project start-up for approval by the MAIN-CONTRACTOR and CERTIFYING AUTHORITY.

All load carrying parts of the hoist cylinders shall be supplied with a Material Test Certificate according **EN 10204-3.2** according requirements of CERTIFYING AUTHORITY

HP-piping shall be supplied with a Material Test Certificate according **EN 10204-3.2** according requirements of CERTIFYING AUTHORITY

7.2 Testing

The purpose of testing shall be to prove that the equipment meets the requirements of this specification and associated documents.

The Final Acceptance Test of all cylinders shall be prepared and executed by the MANUFACTURER according to MANUFACTURER 's test procedures and shall be witnessed by the MAIN CONTRACTOR, CUSTOMER and the CERTIFYING AUTHORITY

The Final Acceptance Test shall consist of, but not limited to :

- Dimensional Inspection
- Pressure Test
- Preservation Control
- Cleanliness Control
- Document Control
- Control of Material/Test Certificates

The hydraulic test pressure of the hoist cylinders shall be **1.5 x design pressure** (=450 bar) for a duration of at least **10 minutes**.

A weight test shall be executed for at least one cylinder.

All measuring and testing shall be carried out with calibrated measuring devices.

Each tested cylinder shall be supplied with a Test Inspection Certificate according **EN 10204-3.2**.

8 Documentation

This section defines all documentation, which will be supplied by the MANUFACTURER.

All documentation (including data sheets) will be written in **ENGLISH** language.

The MANUFACTURER shall supply an Operating & Maintenance Manual for the equipment, with at least the following as-built documentation :

- General Arrangement / Assembly Drawings, showing overall dimensions, mounting details and any other interface connection of the delivered equipment
- Parts List
- Data Sheets of each component used on the delivered equipment
- Maintenance Requirements / Instructions

Required number of O&M Manuals : **3 copies**
+ DXF or DWG file for dimensional drawings
+ PDF files for assembly
+ WORD file for text documents

The MANUFACTURER shall supply a Data Book for the equipment, with at least the following as-built documentation :

- Material/Test Certificates
- Weight Certificate
- Flushing & Cleaning Certificates
- FAT-Records

Required number of Data Books : **3 copies**

9 Preparation for delivery

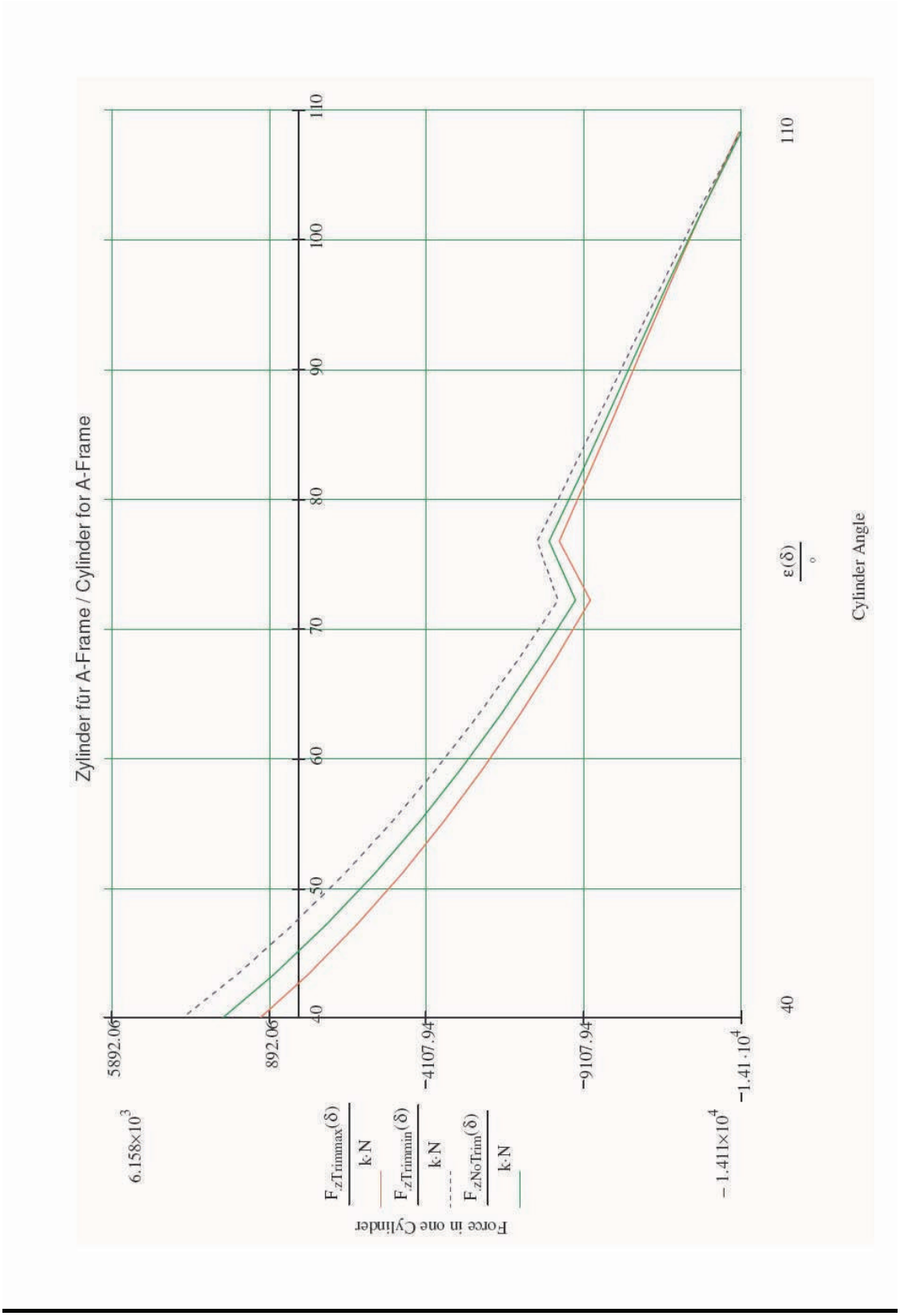
The MANUFACTURER shall ensure that all equipment will be delivered in a clean condition. During Factory Acceptance Test (prior to delivery), the cleanliness of the hydraulic cylinder shall be in accordance with **NAS 1638 Class 7** (or better). The MANUFACTURER shall demonstrate that these standards have been met (documented).

The hydraulic hoist cylinder shall be delivered without hydraulic fluid, but with a corrosion inhibitor if required according MANUFACTURER standards.

All external connections (interface points) shall be steel plugged.

The equipment shall be suitably packed for transportation.

Appendix A : Cylinder Loads



3

Schwenkwinkel des Rahmens / Angle of Frame	Zylinderkräfte bei min / kein / max. Trimwinkel des Schiffs / cylinder load with min. / no / max. trim of vessel			Länge d. Zylinders / length of cylinder	Lagewinkel des Zylinders / angle of cylinder
$\delta =$ (°)	$F_{zTrimmin}(\delta) =$ (kN)	$F_{zNoTrim}(\delta) =$ (kN)	$F_{zTrimmax}(\delta) =$ (kN)	$l(\delta) =$ (mm)	$\varepsilon(\delta) =$ (°)
45	6158	4714	3354	16504	35.7
50	3925	2626	1413	16194	39.4
55	1938	766	-319	15863	43.3
60	145	-915	-1887	15510	47.1
65	-1495	-2455	-3325	15136	51.1
70	-3012	-3881	-4658	14744	55.1
75	-4431	-5215	-5906	14335	59.2
80	-5771	-6476	-7087	13911	63.4
85	-7050	-7680	-8215	13473	67.7
90	-8285	-8843	-9305	13024	72.2
95	-7613	-8004	-8316	12566	76.7
100	-8592	-8927	-9182	12102	81.5
105	-9578	-9858	-10055	11634	86.4
110	-10590	-10813	-10951	11167	91.5
115	-11654	-11816	-11892	10704	96.8
120	-12802	-12900	-12908	10248	102.4
125	-14083	-14108	-14040	9807	108.3

0°: horizontal, Zählrichtung im Uhrzeigersinn positiv
0°: horizontal, counting clockwise

HITZLER WERFT GmbH

Bahnhofstr. 4 - 12
21481 Lauenburg / Elbe

Tel.: 04153 / 588-0
Fax: 04153 / 588-100
Email: info@hitzler-werft.de

originating office address:

client code

Hull-No 257

Hitzler Werft code

A.7097

STAB 029A275.1

client

Mützelfeldtwerft GmbH

Woltmannstrasse 2 • 27472 Cuxhaven

vessel:

ORCUS

IMO 9398541
GL 113073

item:

LOAD CASES
A-Frame Test with 275 t

Test condition:
Ship on quay at wave protected position
Weather should be windless

distribution:

Mützelfeldtwerft GmbH, Cuxhaven

supplementary notes:

The longitudinal centre of gravity (LCG) is relate to frame 0.
The vertical centre of gravity (VCG) is relate to waterline 0.
The distance from baseline to waterline 0 is 0,016m.

rev.	Date	description	pages	prepared	checked	approved	authorized
4							
3							
2							
1	27.04.2010	A-FRAME TEST - UPDATE	14	HW/Pa		HW	
0	19.03.2010	A-FRAME TEST	14	HW/Pa		HW	

Contents

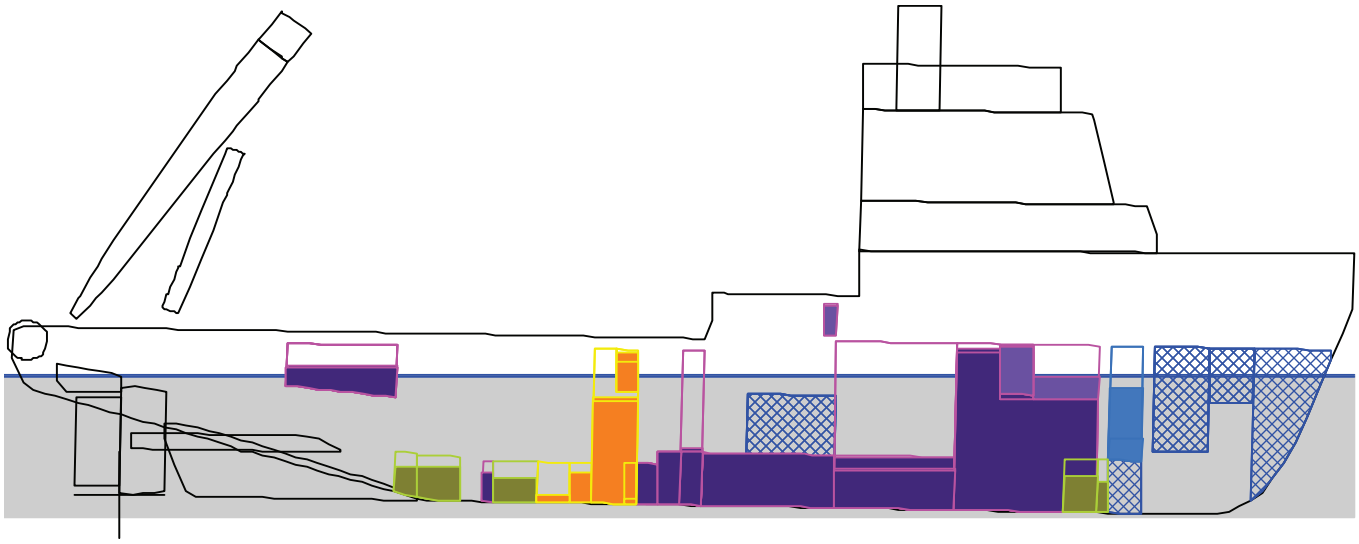
1.1 A-Frame store position with test load

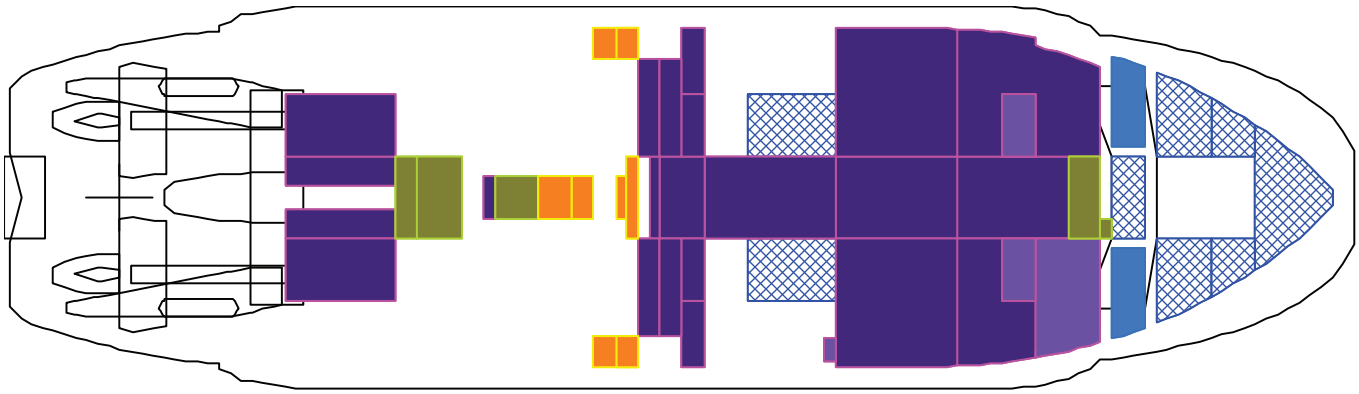
Floating Status at brackish water

Draft FP	8.110 m	Heel	stbd 0.75 deg.	GM(Solid)	1.357 m
Draft MS	7.418 m	Equil	Yes	F/S Corr.	0.107 m
Draft AP	6.725 m	Wind	Off	GM(Fluid)	1.250 m
Trim	fwd 1.08 deg.	Wave	No	KMt	9.559 m
LCG	32.497f m	VCG	8.201 m	TPcm	12.10
Displacement	6 719.44 MT	WaterSpgr	1.010		

Loading Summary

Item	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
Light Ship	4 371.52	31.219f	0.057s	8.492
Deadweight	2 347.92	34.877f	0.055p	7.661
Displacement	6 719.44	32.497f	0.018s	8.201





Fluid Legend

Fluid Name	Legend	Weight (MT)	Load%
BW		382.68	82.82%
FRESH WATER		29.35	35.00%
HFO		1 223.89	36.47%
MGO		50.98	35.27%
VAR		50.70	42.00%
OILS		54.92	61.61%

Fixed Weight Status

Item	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
LIGHT SHIP	4 371.52	31.219f	0.057s	8.492u
.CREW AND EFFECTS	10.00	48.250f	0.000	13.800u
.PROVISIONS+	5.40	52.350f	0.000	10.000u
.TOWING TOOLS	10.00	29.180f	0.130s	10.340u
A-FRAME CYLINDER STORE	69.76	4.280f	0.000	15.160u
A-FRAME FOUNDATION	21.88	0.521f	0.000	9.920u
A-FRAME STORE POS	140.36	5.290f	0.000	21.650u
POWER PACK	23.00	20.400f	7.850p	12.720u
WEIGHT ON A-FRAME	275.00	7.020f	0.000	24.210u
Total Fixed:	4 926.92	28.615f	0.014s	9.881u

Tank Status

BW

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
01_FOREPK.C	1.010	100.00%	63.09	63.026f	0.000	7.085	0.00
02_BW.P	1.010	100.00%	13.60	60.436f	3.209p	8.142	0.00
03_BW.S	1.010	100.00%	13.60	60.436f	3.209s	8.142	0.00
04_BW.P	1.010	100.00%	50.82	57.758f	3.739p	6.908	0.00
05_BW.S	1.010	100.00%	50.82	57.758f	3.739s	6.908	0.00
36_BW.P	1.010	<empty>					
37_BW.S	1.010	<empty>					
54_BW.C	1.010	100.00%	23.63	54.900f	0.000	1.501	0.00
57_CHAIN_LOCKE	1.010	100.00%	83.57	36.600f	3.950s	3.900	0.00
58_CHAIN_LOCKE	1.010	100.00%	83.57	36.600f	3.950p	3.900	0.00
Subtotals:		82.82%	382.68	49.400f	0.000	5.377	0.00

FRESH WATER

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
06_FW_SIDE.P	1.000	55.00%	23.06	54.863f	4.450p	5.140	8.86
07_FW_SIDE.S	1.000	15.00%	6.29	54.856f	4.214s	3.655	4.22
Subtotals:		35.00%	29.35	54.861f	2.593p	4.822	13.09

HFO

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
10_HFO_DB.C	0.985	98.00%	75.31	48.619f	0.007s	1.470	37.48
11_HFO_DB.C	0.985	98.00%	82.84	42.322f	0.007s	1.470	40.48
12_HFO_DB.C	0.985	98.00%	126.18	34.008f	0.006s	1.454	53.78
18_HFO_DRAIN.C	0.985	70.00%	2.20	20.100f	0.004s	0.805	0.63
19_HFO_OVERFLO	0.985	<empty>					
22_HFO_SIDE.P	0.985	98.00%	288.84	48.982f	5.202p	3.994	12.66
23_HFO_SIDE.S	0.985	98.00%	288.84	48.981f	5.203s	3.994	12.69
24_HFO_SIDE.P	0.985	25.00%	86.97	42.249f	5.371p	1.113	172.44
25_HFO_SIDE.S	0.985	25.00%	86.97	42.247f	5.424s	1.113	173.36
26_HFO_SIDE.P	0.985	<empty>					
27_HFO_SIDE.S	0.985	<empty>					
28_HFO_SIDE.P	0.985	69.00%	53.16	30.253f	5.167p	1.437	4.38
29_HFO_SIDE.S	0.985	69.00%	53.16	30.255f	5.178s	1.437	45.71
32_HFO_SIDE.P	0.985	<empty>					
33_HFO_SIDE.S	0.985	<empty>					
34_HFO_SIDE.P	0.985	<empty>					
35_HFO_SIDE.S	0.985	<empty>					
43_HFO_DAYT.S	0.985	50.00%	12.85	12.248f	1.427s	6.785	2.18
44_HFO_DAYT.P	0.985	50.00%	12.85	12.248f	1.423p	6.785	2.18
45_HFO_SET.S	0.985	50.00%	26.86	12.248f	3.985s	6.785	19.93
46_HFO_SET.P	0.985	50.00%	26.86	12.248f	3.965p	6.785	19.93
Subtotals:		36.47%	1 223.89	41.945f	0.006s	2.950	597.84

MGO

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
08_MGO_OVERFL.	0.840	<empty>					
38_MGO_SIDE.P	0.840	<empty>					
39_MGO_SIDE.S	0.840	40.00%	21.75	51.555f	5.090s	7.045	50.39
40_MGO_DAYT.P	0.840	95.00%	13.99	48.902f	3.940p	8.017	5.32
41_MGO_DAYT.S	0.840	95.00%	13.99	48.902f	3.950s	8.017	5.32
48_EM_GEN.S	0.840	98.00%	1.24	38.630f	8.341s	10.682	0.08
Subtotals:		35.27%	50.98	49.784f	2.379s	7.667	61.12

VAR

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
09_MGO_SLUDGE.	1.000	60.00%	1.06	53.700f	1.701s	0.900	0.05
17_OILY_BILGE.	1.000	60.00%	7.67	21.607f	0.004s	0.690	2.56
20_HFO_SLUDGE.	1.000	70.00%	25.59	16.935f	0.013s	1.043	24.84
50_SEWAGE.C	1.000	70.00%	16.38	52.502f	0.010s	1.050	12.59
51_ENG_COO.P	1.000	<empty>					
52_ENG_COO.S	1.000	<empty>					
56_HFO_SLUDGE.	1.000	<empty>					
Subtotals:		42.00%	50.70	29.905f	0.046s	0.989	40.04

OILS

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
13_HO.C	0.924	90.00%	2.66	27.300f	0.003s	1.035	0.59
14_TO_DRAIN.C	0.924	<empty>					
15_AE_LO.C	0.924	75.00%	4.43	25.201f	0.003s	0.863	1.18
16_LO_REC.C	0.924	20.00%	1.77	23.711f	0.013s	0.230	1.77
30_ME_LO.P	0.924	75.00%	19.27	27.002f	8.389p	3.126	0.82
31_ME_LO.S	0.924	75.00%	19.27	27.002f	8.390s	3.126	0.82
42_TO.P	0.924	85.00%	3.68	27.601f	8.423p	7.420	0.41
49_LO_SHAFTL.S	0.924	70.00%	3.03	27.601f	8.427s	7.240	0.41
53_TO_SLUDGE.C	0.924	15.00%	0.83	27.902f	0.061s	0.173	3.83
Subtotals:		61.61%	54.92	26.852f	0.097p	3.219	9.83

All Tanks

	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
Totals:		42.12%	1 792.52	43.168f	0.028s	3.586	721.92

Righting Arms vs. Heel - IMO RESOLUTION A.749 (18) CHAPTER 3.1
Righting Arms vs Heel Angle

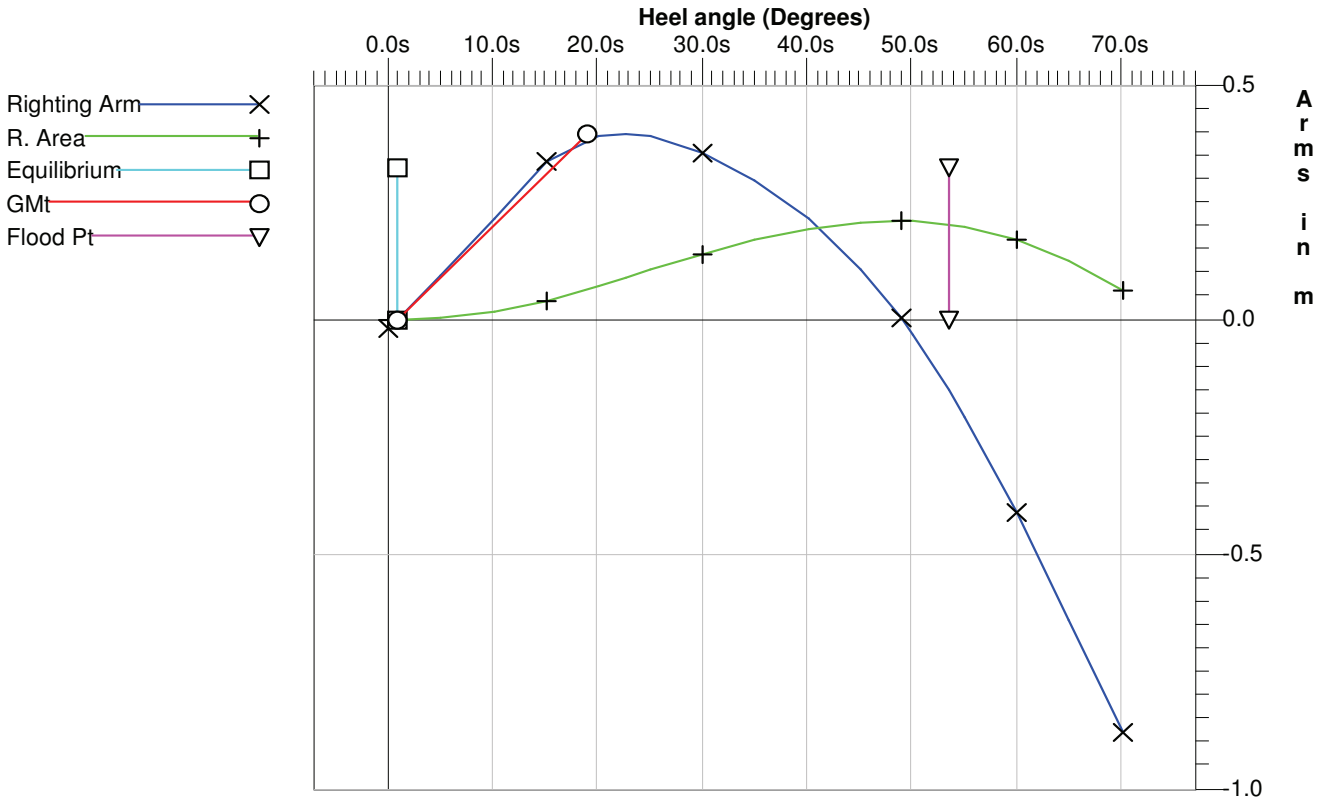
Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)	Notes
0.00	1.08f	6.843	-0.016	0.000	8.648 (1)	
0.74s	1.08f	6.842	0.000	0.000	8.568 (1)	Equil
5.00s	1.09f	6.800	0.095	0.003	8.086 (1)	
10.00s	1.14f	6.669	0.216	0.017	7.469 (1)	
15.00s	1.23f	6.456	0.337	0.041	6.795 (1)	
20.00s	1.27f	6.221	0.392	0.073	6.065 (1)	
22.63s	1.25f	6.105	0.397	0.092	5.664 (1)	MaxRa
25.00s	1.20f	6.009	0.393	0.108	5.294 (1)	
30.00s	1.02f	5.835	0.355	0.141	4.470 (1)	
35.00s	0.74f	5.705	0.298	0.169	3.590 (1)	
40.00s	0.38f	5.605	0.215	0.192	2.658 (1)	
45.00s	0.02a	5.508	0.108	0.206	1.691 (1)	
48.89s	0.36a	5.428	0.003	0.210	0.920 (1)	RaZero
50.00s	0.45a	5.402	-0.031	0.210	0.700 (1)	
53.48s	0.76a	5.311	-0.149	0.205	0.000 (1)	FldPt
55.00s	0.89a	5.266	-0.206	0.200	-0.306 (1)	
60.00s	1.31a	5.098	-0.412	0.173	-1.319 (1)	

65.00s	1.71a	4.889	-0.640	0.127	-2.330 (1)	
70.00s	2.10a	4.644	-0.878	0.061	-3.325 (1)	

Unprotected Flood Points

Name	L,T,V (m)	Height (m)
(1) vent engine room	40.700f, 6.100s, 16.260	8.648

Righting Arms vs. Heel - IMO RESOLUTION A.749 (18) CHAPTER 3.1



IMO RESOLUTION A.749 (18) CHAPTER 3.1

Limit	Min/Max	Actual	Margin	Pass
(1) Area from 0.00 deg to 30.00	>0.0550 m-R	0.141	0.086	Yes
(2) Area from 0.00 deg to 40.00 or Flood	>0.0900 m-R	0.192	0.102	Yes
(3) Area from 30.00 deg to 40.00 or Flood	>0.0300 m-R	0.051	0.021	Yes
(4) Righting Arm at 30.00 deg	>0.200 m	0.355	0.155	Yes
(5) Angle from 0.00 deg to MaxRA	>25.00 deg	22.63	2.37	No
(6) GM at Equilibrium	>0.150 m	1.250	1.100	Yes

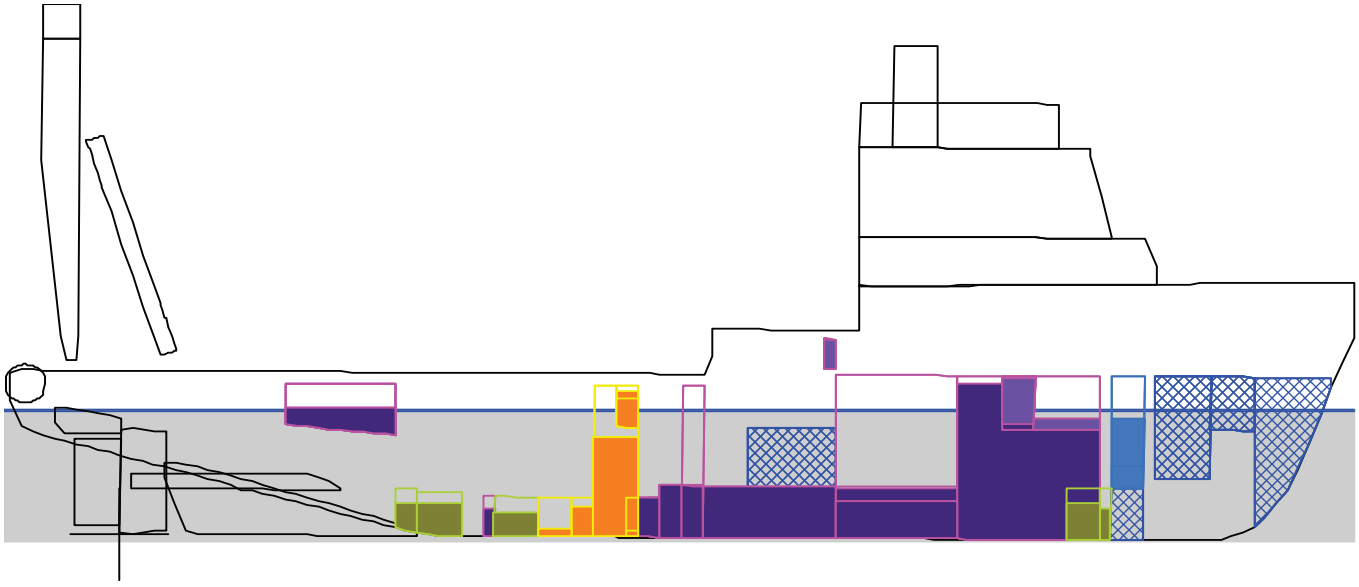
1.2 A-Frame upright with test load

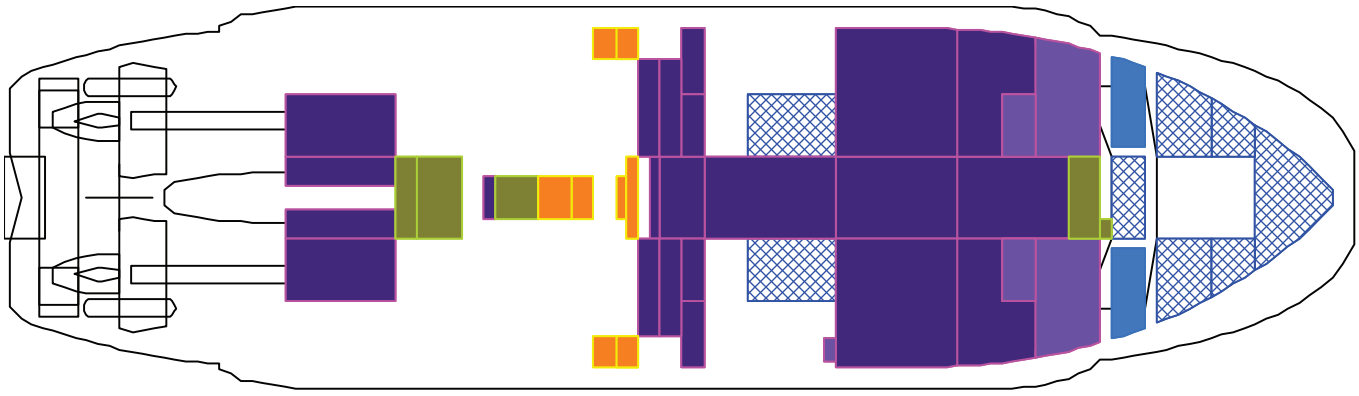
Floating Status at brackish water

Draft FP	7.631 m	Heel	zero	GM(Solid)	1.219 m
Draft MS	7.397 m	Equil	Yes	F/S Corr.	0.111 m
Draft AP	7.163 m	Wind	Off	GM(Fluid)	1.108 m
Trim	fwd 0.36 deg.	Wave	No	KMt	9.611 m
LCG	31.854f m	VCG	8.392 m	TPcm	12.21
Displacement	6 719.45 MT	WaterSpgr	1.010		

Loading Summary

Item	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
Light Ship	4 371.52	31.219f	0.057s	8.492
Deadweight	2 347.93	33.038f	0.106p	8.207
Displacement	6 719.45	31.854f	0.000	8.392





Fluid Legend

Fluid Name	Legend	Weight (MT)	Load%
BW		382.68	82.82%
FRESH WATER		29.35	35.00%
HFO		1 223.89	36.47%
MGO		50.98	35.27%
VAR		50.70	42.00%
OILS		54.92	61.61%

Fixed Weight Status

Item	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
LIGHT SHIP	4 371.52	31.219f	0.057s	8.492u
.CREW AND EFFECTS	10.00	48.250f	0.000	13.800u
.PROVISIONS	5.40	52.350f	0.000	10.000u
.TOWING TOOLS	10.00	29.180f	0.130s	10.340u
A-FRAME CYLINDER UPRIGHT	69.76	0.530f	0.000	16.800u
A-FRAME FOUNDATION	21.88	0.521f	0.000	9.920u
A-FRAME UPRIGHT	140.36	3.200a	0.000	24.130u
POWER PACK	23.00	20.400f	7.850p	12.720u
WEIGHT ON A-FRAME UPRIGHT	275.00	3.355a	0.000	27.220u
Total Fixed:	4 926.92	27.741f	0.014s	10.143u

Tank Status

BW

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
01_FOREPK.C	1.010	100.00%	63.09	63.026f	0.000	7.085	0.00
02_BW.P	1.010	100.00%	13.60	60.436f	3.209p	8.142	0.00
03_BW.S	1.010	100.00%	13.60	60.436f	3.209s	8.142	0.00
04_BW.P	1.010	100.00%	50.82	57.758f	3.739p	6.908	0.00
05_BW.S	1.010	100.00%	50.82	57.758f	3.739s	6.908	0.00
36_BW.P	1.010	<empty>					
37_BW.S	1.010	<empty>					
54_BW.C	1.010	100.00%	23.63	54.900f	0.000	1.501	0.00
57_CHAIN_LOCKE	1.010	100.00%	83.57	36.600f	3.950s	3.900	0.00
58_CHAIN_LOCKE	1.010	100.00%	83.57	36.600f	3.950p	3.900	0.00
Subtotals:		82.82%	382.68	49.400f	0.000	5.377	0.00

FRESH WATER

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
06_FW_SIDE.P	1.000	55.00%	23.06	54.862f	4.455p	5.140	8.91
07_FW_SIDE.S	1.000	15.00%	6.29	54.854f	4.206s	3.655	4.19
Subtotals:		35.00%	29.35	54.860f	2.599p	4.822	13.11

HFO

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
10_HFO_DB.C	0.985	98.00%	75.31	48.606f	0.000	1.470	41.33
11_HFO_DB.C	0.985	98.00%	82.84	42.308f	0.000	1.470	45.46
12_HFO_DB.C	0.985	98.00%	126.18	33.981f	0.000	1.454	66.01
18_HFO_DRAIN.C	0.985	70.00%	2.20	20.100f	0.000	0.805	0.63
19_HFO_OVERFLO	0.985	<empty>					
22_HFO_SIDE.P	0.985	98.00%	288.84	48.981f	5.203p	3.994	12.67
23_HFO_SIDE.S	0.985	98.00%	288.84	48.981f	5.203s	3.994	12.67
24_HFO_SIDE.P	0.985	25.00%	86.97	42.225f	5.399p	1.112	172.68
25_HFO_SIDE.S	0.985	25.00%	86.97	42.225f	5.399s	1.112	172.68
26_HFO_SIDE.P	0.985	<empty>					
27_HFO_SIDE.S	0.985	<empty>					
28_HFO_SIDE.P	0.985	69.00%	53.16	30.253f	5.168p	1.437	4.34
29_HFO_SIDE.S	0.985	69.00%	53.16	30.253f	5.168s	1.437	4.34
32_HFO_SIDE.P	0.985	<empty>					
33_HFO_SIDE.S	0.985	<empty>					
34_HFO_SIDE.P	0.985	<empty>					
35_HFO_SIDE.S	0.985	<empty>					
43_HFO_DAYT.S	0.985	50.00%	12.85	12.220f	1.425s	6.784	2.18
44_HFO_DAYT.P	0.985	50.00%	12.85	12.220f	1.425p	6.784	2.18
45_HFO_SET.S	0.985	50.00%	26.86	12.220f	3.975s	6.784	19.92
46_HFO_SET.P	0.985	50.00%	26.86	12.220f	3.975p	6.784	19.92
Subtotals:		36.47%	1 223.89	41.935f	0.000	2.950	577.00

MGO

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
08_MGO_OVERFL.	0.840	<empty>					
38_MGO_SIDE.P	0.840	20.00%	10.88	51.550f	5.028p	6.725	47.01
39_MGO_SIDE.S	0.840	20.00%	10.88	51.550f	5.028s	6.725	47.01
40_MGO_DAYT.P	0.840	95.00%	13.99	48.901f	3.945p	8.017	5.32
41_MGO_DAYT.S	0.840	95.00%	13.99	48.901f	3.945s	8.017	5.32
48_EM_GEN.S	0.840	98.00%	1.24	38.630f	8.340s	10.682	0.08
Subtotals:		35.27%	50.98	49.780f	0.204s	7.531	104.76

VAR

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
09_MGO_SLUDGE.	1.000	60.00%	1.06	53.700f	1.700s	0.900	0.05
17_OILY_BILGE.	1.000	60.00%	7.67	21.602f	0.000	0.690	2.56
20_HFO_SLUDGE.	1.000	70.00%	25.59	16.926f	0.000	1.043	24.83
50_SEWAGE.C	1.000	70.00%	16.38	52.501f	0.000	1.050	12.59
51_ENG_COO.P	1.000	<empty>					
52_ENG_COO.S	1.000	<empty>					
56_HFO_SLUDGE.	1.000	<empty>					
Subtotals:		42.00%	50.70	29.900f	0.036s	0.989	40.02

OILS

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
13_HO.C	0.924	90.00%	2.66	27.300f	0.000	1.035	0.59
14_TO_DRAIN.C	0.924	<empty>					
15_AE_LO.C	0.924	75.00%	4.43	25.201f	0.000	0.863	1.18
16_LO_REC.C	0.924	20.00%	1.77	23.704f	0.000	0.230	1.77
30_ME_LO.P	0.924	75.00%	19.27	27.001f	8.389p	3.126	0.82
31_ME_LO.S	0.924	75.00%	19.27	27.001f	8.389s	3.126	0.82
42_TO.P	0.924	85.00%	3.68	27.600f	8.425p	7.420	0.41
49_LO_SHAFTL.S	0.924	70.00%	3.03	27.601f	8.425s	7.240	0.41
53_TO_SLUDGE.C	0.924	15.00%	0.83	27.901f	0.000	0.173	3.82
Subtotals:		61.61%	54.92	26.850f	0.100p	3.219	9.82

All Tanks

	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
Totals:		42.12%	1 792.53	43.161f	0.039p	3.582	744.71

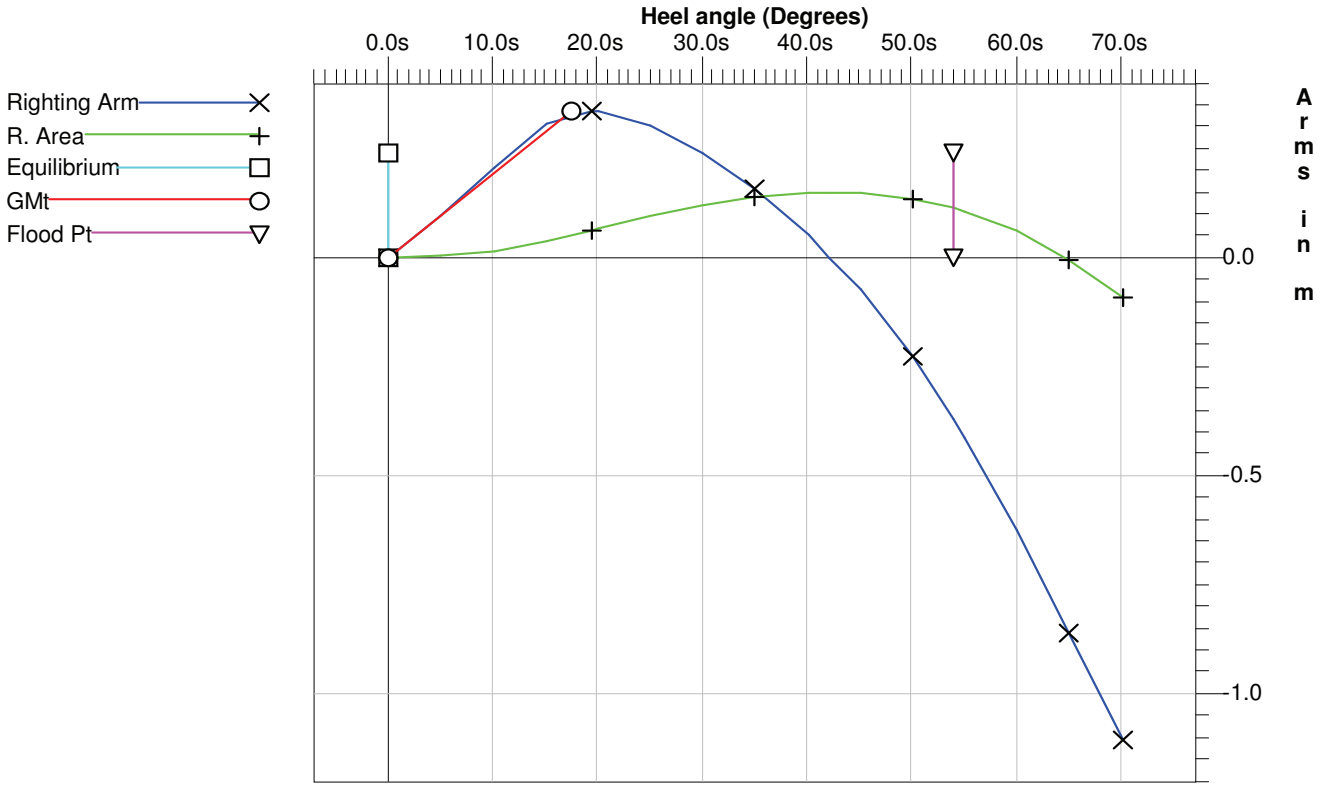
Righting Arms vs. Heel - IMO RESOLUTION A.749 (18) CHAPTER 3.1
Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)	Notes
0.00	0.36f	7.203	0.000	0.000	8.798 (1)	Equil
5.00s	0.39f	7.156	0.099	0.004	8.235 (1)	
10.00s	0.46f	7.015	0.208	0.018	7.615 (1)	
15.00s	0.53f	6.812	0.310	0.040	6.935 (1)	
19.28s	0.54f	6.642	0.337	0.065	6.307 (1)	MaxRa
20.00s	0.53f	6.615	0.336	0.069	6.198 (1)	
25.00s	0.41f	6.448	0.306	0.098	5.421 (1)	
30.00s	0.18f	6.314	0.241	0.122	4.587 (1)	
35.00s	0.13a	6.216	0.158	0.139	3.696 (1)	
40.00s	0.51a	6.142	0.053	0.149	2.755 (1)	
42.11s	0.69a	6.114	0.003	0.150	2.348 (1)	RaZero
45.00s	0.95a	6.076	-0.072	0.148	1.782 (1)	
50.00s	1.41a	5.994	-0.225	0.135	0.787 (1)	
53.92s	1.78a	5.906	-0.369	0.115	0.000 (1)	FldPt
55.00s	1.88a	5.878	-0.412	0.108	-0.219 (1)	
60.00s	2.33a	5.727	-0.625	0.062	-1.231 (1)	
65.00s	2.76a	5.543	-0.860	-0.002	-2.242 (1)	
70.00s	3.18a	5.325	-1.103	-0.088	-3.240 (1)	

Unprotected Flood Points

Name	L,T,V (m)	Height (m)
(1) vent engine room	40.700f, 6.100s, 16.260	8.798

Righting Arms vs. Heel - IMO RESOLUTION A.749 (18) CHAPTER 3.1



IMO RESOLUTION A.749 (18) CHAPTER 3.1

Limit	Min/Max	Actual	Margin	Pass
(1) Area from 0.00 deg to 30.00	>0.0550 m-R	0.122	0.067	Yes
(2) Area from 0.00 deg to 40.00 or Flood	>0.0900 m-R	0.149	0.059	Yes
(3) Area from 30.00 deg to 40.00 or Flood	>0.0300 m-R	0.027	0.003	No
(4) Righting Arm at 30.00 deg	>0.200 m	0.241	0.041	Yes
(5) Angle from 0.00 deg to MaxRA	>25.00 deg	19.28	5.72	No
(6) GM at Equilibrium	>0.150 m	1.108	0.958	Yes

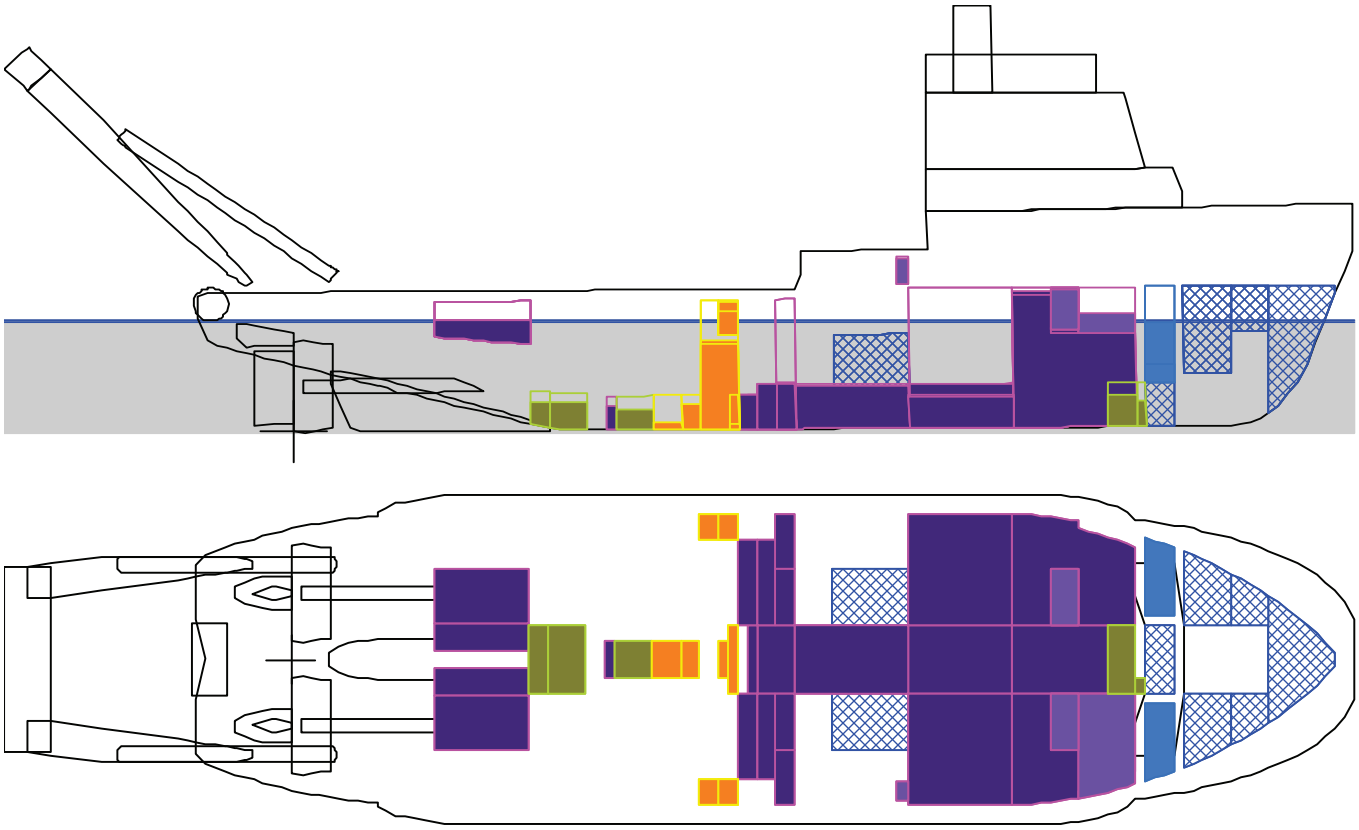
1.3 A-Frame at work position with test load

Floating Status at brackish water

Draft FP	7.097 m	Heel	stbd 0.61 deg.	GM(Solid)	1.622 m
Draft MS	7.410 m	Equil	Yes	F/S Corr.	0.110 m
Draft AP	7.724 m	Wind	Off	GM(Fluid)	1.512 m
Trim	aft 0.42 deg.	Wave	No	KMt	9.702 m
LCG	31.129f m	VCG	8.079 m	TPcm	12.34
Displacement	6 719.45 MT	WaterSpgr	1.010		

Loading Summary

Item	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
Light Ship	4 371.52	31.219f	0.057s	8.492
Deadweight	2 347.93	30.962f	0.056p	7.311
Displacement	6 719.45	31.129f	0.018s	8.079



Fluid Legend

Fluid Name	Legend	Weight (MT)	Load%
BW		382.68	82.82%
FRESH WATER		29.35	35.00%
HFO		1 223.89	36.47%
MGO		50.98	35.27%
VAR		50.70	42.00%
OILS		54.92	61.61%

Fixed Weight Status

Item	Weight (MT)	LCG (m)	TCG (m)	VCG (m)
LIGHT SHIP	4 371.52	31.219f	0.057s	8.492u
.CREW AND EFFECTS	10.00	48.250f	0.000	13.800u
.PROVISIONS+	5.40	52.350f	0.000	10.000u
.TOWING TOOLS	10.00	29.180f	0.130s	10.340u
A-FRAME CYLINDER WORK	69.76	4.090a	0.000	15.420u
A-FRAME FOUNDATION	21.88	0.521f	0.000	9.920u
A-FRAME WORK POS	140.36	12.740a	0.000	19.910u
POWER PACK	23.00	20.400f	7.850p	12.720u
WEIGHT ON A-FRAME WORK	275.00	14.980a	0.000	22.050u
Total Fixed:	4 926.92	26.755f	0.014s	9.714u

Tank Status

BW

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
01_FOREPK.C	1.010	100.00%	63.09	63.026f	0.000	7.085	0.00
02_BW.P	1.010	100.00%	13.60	60.436f	3.209p	8.142	0.00
03_BW.S	1.010	100.00%	13.60	60.436f	3.209s	8.142	0.00
04_BW.P	1.010	100.00%	50.82	57.758f	3.739p	6.908	0.00
05_BW.S	1.010	100.00%	50.82	57.758f	3.739s	6.908	0.00
36_BW.P	1.010	<empty>					
37_BW.S	1.010	<empty>					
54_BW.C	1.010	100.00%	23.63	54.900f	0.000	1.501	0.00
57_CHAIN_LOCKE	1.010	100.00%	83.57	36.600f	3.950s	3.900	0.00
58_CHAIN_LOCKE	1.010	100.00%	83.57	36.600f	3.950p	3.900	0.00
Subtotals:		82.82%	382.68	49.400f	0.000	5.377	0.00

FRESH WATER

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
06_FW_SIDE.P	1.000	55.00%	23.06	54.861f	4.452p	5.140	8.87
07_FW_SIDE.S	1.000	15.00%	6.29	54.851f	4.214s	3.655	4.22
Subtotals:		35.00%	29.35	54.859f	2.595p	4.822	13.09

HFO

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
10_HFO_DB.C	0.985	98.00%	75.31	48.592f	0.006s	1.470	41.33
11_HFO_DB.C	0.985	98.00%	82.84	42.291f	0.006s	1.470	45.47
12_HFO_DB.C	0.985	98.00%	126.18	33.947f	0.006s	1.454	66.02
18_HFO_DRAIN.C	0.985	70.00%	2.20	20.100f	0.003s	0.805	0.63
19_HFO_OVERFLO	0.985	<empty>					
22_HFO_SIDE.P	0.985	98.00%	288.84	48.980f	5.202p	3.994	12.65
23_HFO_SIDE.S	0.985	98.00%	288.84	48.980f	5.203s	3.994	12.68
24_HFO_SIDE.P	0.985	25.00%	86.97	42.201f	5.379p	1.113	172.14
25_HFO_SIDE.S	0.985	25.00%	86.97	42.199f	5.421s	1.113	172.91
26_HFO_SIDE.P	0.985	<empty>					
27_HFO_SIDE.S	0.985	<empty>					
28_HFO_SIDE.P	0.985	69.00%	53.16	30.253f	5.167p	1.437	4.34
29_HFO_SIDE.S	0.985	69.00%	53.16	30.253f	5.173s	1.437	45.09
32_HFO_SIDE.P	0.985	<empty>					
33_HFO_SIDE.S	0.985	<empty>					
34_HFO_SIDE.P	0.985	<empty>					
35_HFO_SIDE.S	0.985	<empty>					
43_HFO_DAYT.S	0.985	50.00%	12.85	12.189f	1.427s	6.784	2.18
44_HFO_DAYT.P	0.985	50.00%	12.85	12.189f	1.423p	6.784	2.18
45_HFO_SET.S	0.985	50.00%	26.86	12.189f	3.983s	6.784	19.93
46_HFO_SET.P	0.985	50.00%	26.86	12.189f	3.967p	6.784	19.93
Subtotals:		36.47%	1 223.89	41.924f	0.005s	2.950	617.47

MGO

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
08_MGO_OVERFL.	0.840	<empty>					
38_MGO_SIDE.P	0.840	<empty>					
39_MGO_SIDE.S	0.840	40.00%	21.75	51.533f	5.088s	7.045	50.35
40_MGO_DAYT.P	0.840	95.00%	13.99	48.899f	3.941p	8.017	5.32
41_MGO_DAYT.S	0.840	95.00%	13.99	48.899f	3.949s	8.017	5.32
48_EM_GEN.S	0.840	98.00%	1.24	38.630f	8.341s	10.682	0.08
Subtotals:		35.27%	50.98	49.773f	2.377s	7.667	61.08

VAR

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
09_MGO_SLUDGE.	1.000	60.00%	1.06	53.700f	1.701s	0.900	0.05
17_OILY_BILGE.	1.000	60.00%	7.67	21.597f	0.004s	0.690	2.56
20_HFO_SLUDGE.	1.000	70.00%	25.59	16.917f	0.010s	1.043	24.83
50_SEWAGE.C	1.000	70.00%	16.38	52.499f	0.008s	1.050	12.59
51_ENG_COO.P	1.000	<empty>					
52_ENG_COO.S	1.000	<empty>					
56_HFO_SLUDGE.	1.000	<empty>					
Subtotals:		42.00%	50.70	29.894f	0.044s	0.989	40.03

OILS

Tank Name	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
13_HO.C	0.924	90.00%	2.66	27.300f	0.002s	1.035	0.59
14_TO_DRAIN.C	0.924	<empty>					
15_AE_LO.C	0.924	75.00%	4.43	25.200f	0.003s	0.863	1.18
16_LO_REC.C	0.924	20.00%	1.77	23.696f	0.011s	0.230	1.77
30_ME_LO.P	0.924	75.00%	19.27	26.999f	8.389p	3.126	0.82
31_ME_LO.S	0.924	75.00%	19.27	26.999f	8.390s	3.126	0.82
42_TO.P	0.924	85.00%	3.68	27.600f	8.424p	7.420	0.41
49_LO_SHAFTL.S	0.924	70.00%	3.03	27.600f	8.426s	7.240	0.41
53_TO_SLUDGE.C	0.924	15.00%	0.83	27.899f	0.050s	0.173	3.83
Subtotals:		61.61%	54.92	26.849f	0.098p	3.219	9.82

All Tanks

	Spgr	Load (%)	Weight (MT)	LCG (m)	TCG (m)	VCG (m)	FSM (MT-m)
Totals:		42.12%	1 792.53	43.153f	0.027s	3.586	741.50

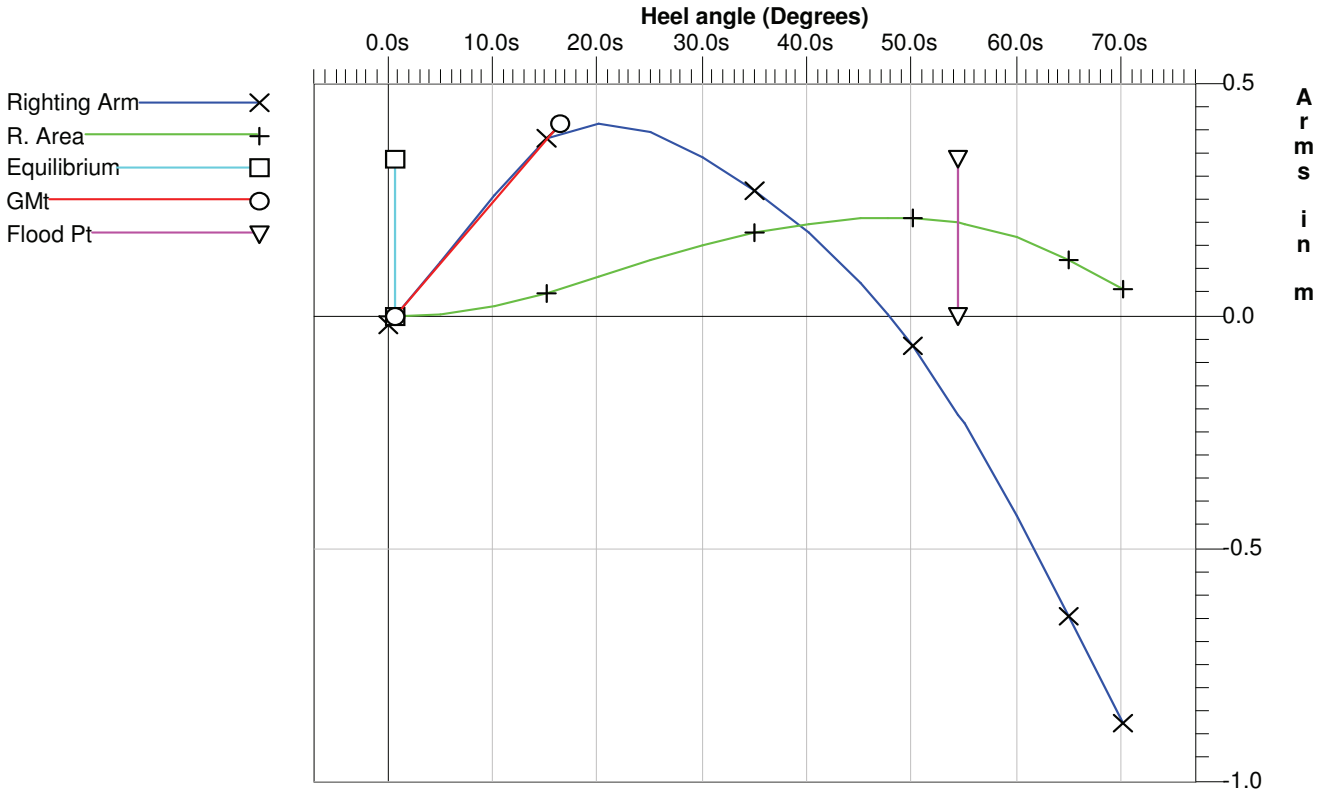
Righting Arms vs. Heel - IMO RESOLUTION A.749 (18) CHAPTER 3.1
Righting Arms vs Heel Angle

Heel Angle (deg)	Trim Angle (deg)	Origin Depth (m)	Righting Arm (m)	Area (m-Rad)	Flood Pt Height (m)	Notes
0.00	0.42a	7.590	-0.016	0.000	8.968 (1)	
0.61s	0.42a	7.589	0.000	0.000	8.902 (1)	Equil
5.00s	0.39a	7.539	0.118	0.004	8.404 (1)	
10.00s	0.31a	7.394	0.261	0.021	7.782 (1)	
15.00s	0.25a	7.207	0.382	0.049	7.096 (1)	
20.00s	0.29a	7.100	0.414	0.084	6.353 (1)	
25.00s	0.52a	6.962	0.394	0.120	5.566 (1)	
30.00s	0.80a	6.873	0.343	0.153	4.722 (1)	
35.00s	1.14a	6.810	0.272	0.180	3.819 (1)	
40.00s	1.56a	6.771	0.181	0.199	2.867 (1)	
45.00s	2.03a	6.736	0.070	0.211	1.885 (1)	
47.60s	2.29a	6.713	0.004	0.212	1.365 (1)	RaZero
50.00s	2.53a	6.685	-0.065	0.211	0.885 (1)	
54.39s	2.97a	6.614	-0.210	0.201	0.000 (1)	FldPt
55.00s	3.04a	6.602	-0.232	0.198	-0.123 (1)	
60.00s	3.53a	6.483	-0.428	0.169	-1.135 (1)	
65.00s	4.00a	6.323	-0.645	0.123	-2.147 (1)	
70.00s	4.43a	6.115	-0.872	0.057	-3.145 (1)	

Unprotected Flood Points

Name	L,T,V (m)	Height (m)
(1) vent engine room	40.700f, 6.100s, 16.260	8.968

Righting Arms vs. Heel - IMO RESOLUTION A.749 (18) CHAPTER 3.1



IMO RESOLUTION A.749 (18) CHAPTER 3.1

Limit	Min/Max	Actual	Margin	Pass
(1) Area from 0.00 deg to 30.00	>0.0550 m-R	0.153	0.098	Yes
(2) Area from 0.00 deg to 40.00 or Flood	>0.0900 m-R	0.199	0.109	Yes
(3) Area from 30.00 deg to 40.00 or Flood	>0.0300 m-R	0.047	0.017	Yes
(4) Righting Arm at 30.00 deg	>0.200 m	0.343	0.143	Yes
(5) Angle from 0.00 deg to MaxRA	>25.00 deg	20.00	5.00	No
(6) GM at Equilibrium	>0.150 m	1.512	1.362	Yes