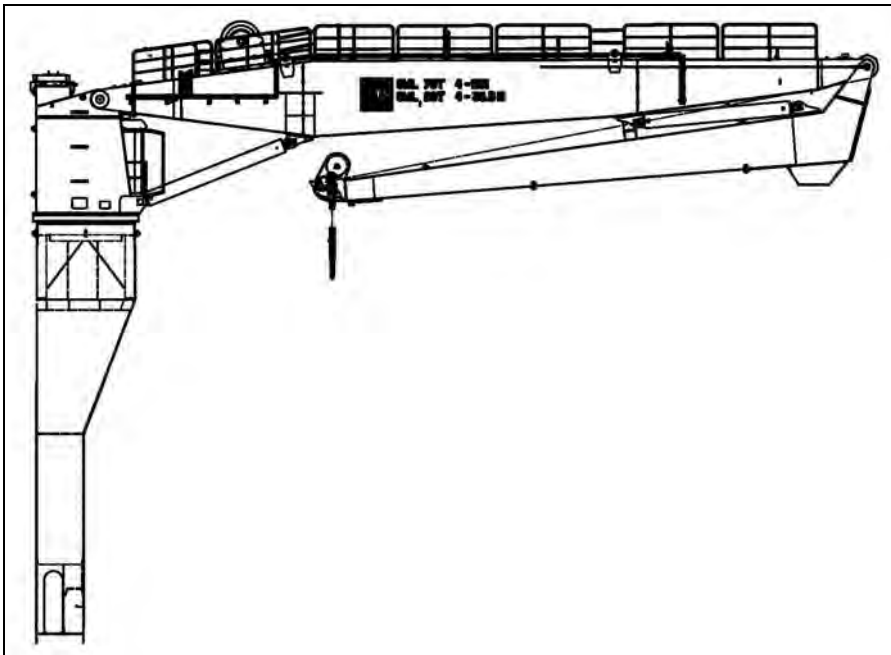


USER MANUAL

TTS Ships Equipment AS



Cargo Crane
CCLKO 2000-70-36,5

RAY Shipping
M/V "Ella"

11857

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TTS Ships Equipment AS

TTS Ships Equipment AS Machine Number:

11857

TTS Ships Equipment AS Project:

Cargo Crane
RAY Shipping
M/V "Ella"

Document Title:

User Manual
CCLKO 2000-70-36,5

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REVISION HISTORY

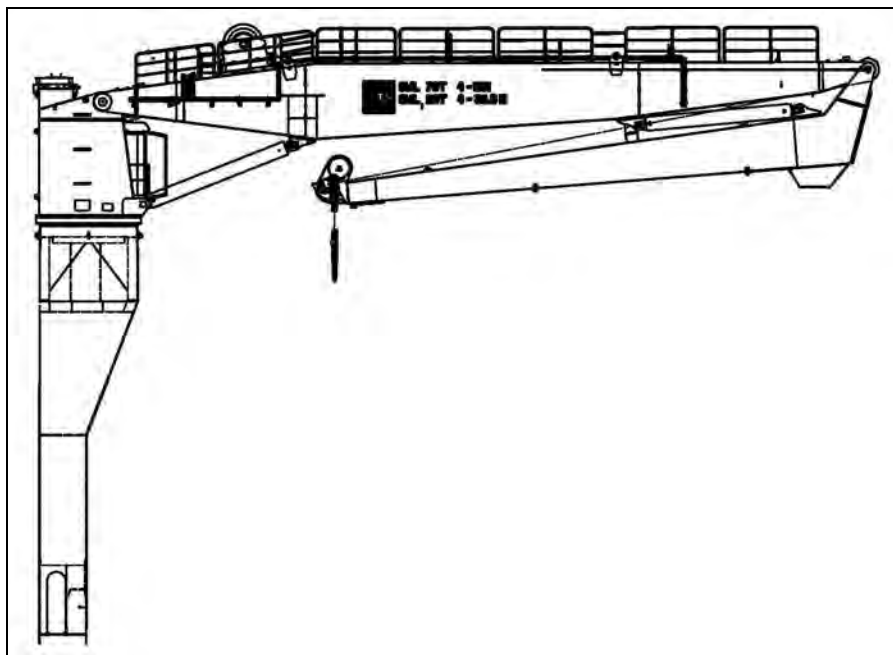
Rev	Date	Chapter	Page	Description

REFERENCE MANUALS

Manual doc. number	Description

USER MANUAL

Introduction



Cargo Crane
CCLKO 2000-70-36,5

RAY Shipping
M/V "Ella"

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1 INTRODUCTION

This user manual describes the Service & Provision Crane supplied by TTS Ships Equipment AS for RAY Shipping.

1.1 Structure and Contents

The user manual is divided into eight chapters; each chapter taking care of each topic in accordance with NS 5820 (Norwegian Standard).

All necessary information is implemented in this manual. The user manual main chapters are listed on front page of each chapter. A chapter index is located on the second page of each chapter.

1.2 Operator Information

For crane operator's qualifications, see also chapter 5.10.1.

All legislative requirements for certified qualifications for the crane operator expressed in ship's flag state or other relevant authorities' rules must be fulfilled. However the operator is required to possess a good knowledge of the cranes safety systems and method of operation.

If a training program for this crane type is required please contact TTS Ships Equipment AS.

1.3 Contact Information

Company Name	Postal Code	Country
TTS Ships Equipment AS	Folke Bernadottesvei 38 P.O. Box 3517 Fyllingsdalen 5845 Bergen Norway	Norway

Company home page

TTS Group ASA: <http://ttsgroup.com>

Company E-mail

TTS Ships Equipment AS: info@tts-se.no

Service & Spare Part

E-mail: service@tts-se.no / service.krs@tts-marine.no

Telephone:

<u>Department</u>	<u>Telephone + 47</u>	<u>Telephone + 47</u>	<u>Fax + 47</u>
Switchboard	55 11 30 50	—	55 11 30 60
Service	38 04 93 49		55 94 74 55
Spare Parts	38 04 93 47	91 19 92 35	38 04 93 41
Spare Parts	38 04 93 54	—	38 04 93 41
After Hour Telephone	38 04 93 02	—	38 04 93 41

1.4 Document Identification

1.4.1 TTS Ships Equipment AS

1. Document Source: TTS Ships Equipment AS
2. Document Type: User Manual
3. Paper Format: A4 and A3
4. Publishing Software: Microsoft Word 2010
5. Electronic Manual Files: User Manual 11857 Rev.2.pdf

1.4.2 Customer

1. Customer: RAY Shipping
2. Shipyard: RAY Shipping
3. Hull Number: N/A
4. Document Title: User Manual
5. Equipment Model: CCLKO 2000-70-36,5
6. Equipment Type: Cargo Crane

1.5 Location of User Manuals

1.5.1 TTS Ships Equipment AS

1 original user manual located at the documentation department.

1.5.2 Customer

Fill out the table below where the copies of user manuals are supposed to be stored.

Number of Copies	Location	Note

1.6 Abbreviations

Following is a table of abbreviations used in TTS Ships Equipment AS User Manuals.

Commercial


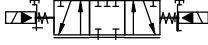

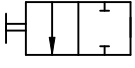
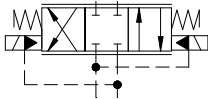




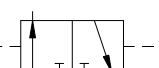

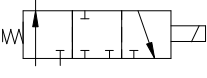


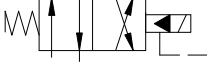
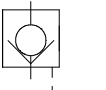

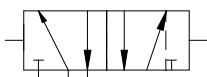
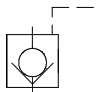
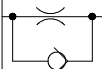
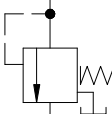
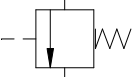

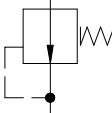

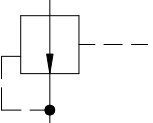
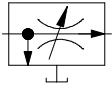


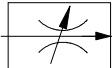
ABS	American Bureau of Shipping
BV	Bureau Veritas
CCS	China Classification Society
DNV	Det Norske Veritas
GL	Germanischer Lloyd
KRS	Korean Register of Shipping
LRS	Lloyds Register of Shipping
NMD	Norwegian Marine Directorate
NPD	Norwegian Petroleum Directorate

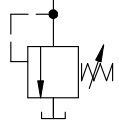


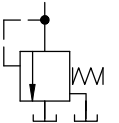

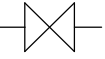
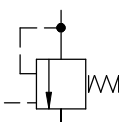
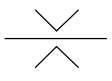
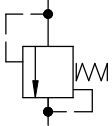

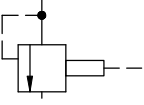


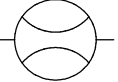

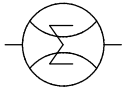


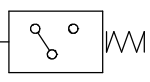

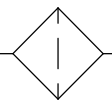


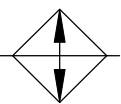

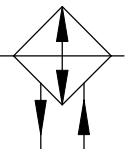


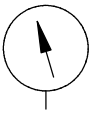
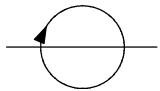
Technical

COG	Center of Gravity
CCW	Counter Clock-wise
CW	Clock-wise
NA	Not Applicable
RPM	Rounds Per Minute
w/o	Without
GA	General Arrangement (main drawing)
GP	General Purpose Deck Crane

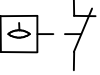

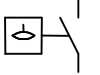

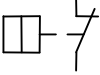

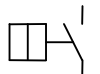













1.7 Hydraulic symbols


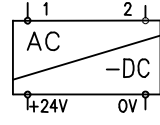



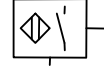
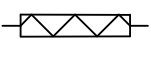
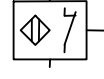

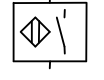

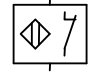


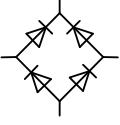

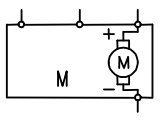
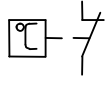
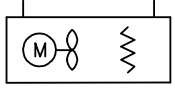

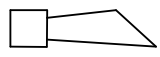
Symbols	Characteristics	Symbols	Characteristics	Symbols	Characteristics
	Control by push-button		Control by electric motor		Control by lever
	Electric motor		Control by plunger		Hydraulic pump with fixed displacement and one flow direction
	Control by plunger with roller		Control by increase of pressure via pilot valve		Hydraulic pump with fixed displacement and two flow direction
	Hydraulic pump with variable displacement and one flow direction		Control by spring		Internal control connection
	Hydraulic pump with variable displacement manually controlled		Combined control with electromagnetic pilot valve		Hydraulic pump with variable displacement pressure controlled via pilot valve
	Control by electromagnet with one winding		Control, alternatively by electromagnet or pilot valve		Hydraulic pump with variable displacement pressure compensated
	Control by electromagnet with two windings each working in separate directions		Control, manual or by spring return		Motor with fixed displacement and one flow direction
	Motor with fixed displacement and two flow direction		Valve position with two directions and shown flow directions		Directional control valve with two continuous variable orifice, three connections, pressure controlled and with spring return to neutral position.
	Motor with variable displacement and one flow direction		Valve position with one closed connection and two directions with shown flow directions		Directional control valve with four continuous variable orifice, four connections, mechanically controlled and with spring return (following valve)
	Valve position with two directions and interconnections		Electrohydraulic servo valve with direct control		Pump/Motor with fixed displacement. Pump in one flow direction, motor in the other



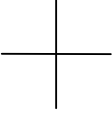
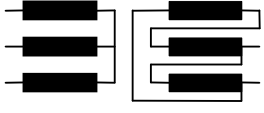





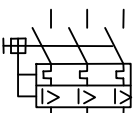

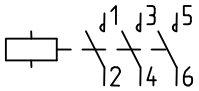

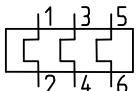

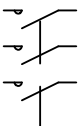

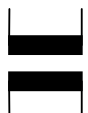
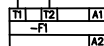
Symbols	Characteristics	Symbols	Characteristics	Symbols	Characteristics
	Valve position with two closed connections and one direction with shown flow direction		Electro hydraulic servo valve with pilot control and mechanical feed back		Pump/Motor with fixed displacement. Pump or Motor in one flow direction
	2/2 Directional control valve, manual controlled to both positions		Electro hydraulic servo valve with hydraulic feed back		Pump/Motor with fixed displacement. Pump or Motor in both flow directions.
	2/2 Directional control valve, pressure contr. and with spring return		Check valve with for the function negligible difference in opening pressure		Pump/Motor with variable displacement. Pump in one flow directions, motor in the other
	3/2 Directional control valve, pressure contr. to both position		Check valve which demands some difference in opening pressure		3/2 Directional control valve, electro-magnetically controlled and with spring return
	Check valve with demands some difference in pressure for shut-off		Valve position with one direction and shown flow direction		4/2 Directional control valve with electro-magnetically controlled pilot valve and with spring return
	Pilot operated Check valve, controlled closing		Valve position with two closed connections		5/2 Directional control valve, pressure contr. to both positions
	Pilot operated Check valve, controlled opening		Check valve with orifice		Sequence valve
	trottle valve, pressure controlled		Switch valve (Double check valve)		Pressure control unit without direct outlet, spring controlled
	Pressure control valve with the orifice normally closed		Pressure control unit without direct outlet pressure controlled		Flow regulator with variable adjustment and discharge of excessive flow
	Pressure control valve with the orifice normally open		Flow regulator with fixed adjustment and discharge of excessive flow		Flow regulator with variable adjustment and without discharge of excessive flow

Symbols	Characteristics	Symbols	Characteristics	Symbols	Characteristics
	Pressure relief valve with adjustable setting		Orifice general symbol		Flow divider
	Pressure relief valve with separate drainage		Orifice viscous (laminar) characteristics		Shut-off valve
	Pressure relief valve, external controlled		Orifice insignificantly depending on viscosity		Differential pressure relief valve
	Throttle valve (simplified symbol)		Proportional pressure relief valve		Throttle valve, manually controlled
	Atmospheric tank with one pipe ending above the fluid surface		Flow measurement unit		Flexible hoses
	Flow gauge		Connections		Accumulator
	Pressure switch with double-throw contact		Crossing connections		Filter, Strainer
	Venting		Plugged connection		Cooler without indication of connections for the cooling medium
	Connections with joint connection		Cooler with indication of connections for the cooling medium		Quick coupling without valve
	Quick coupling with closed valve		Pressure gauge		Swivel connection with one flow direction

1.8 Electric symbols

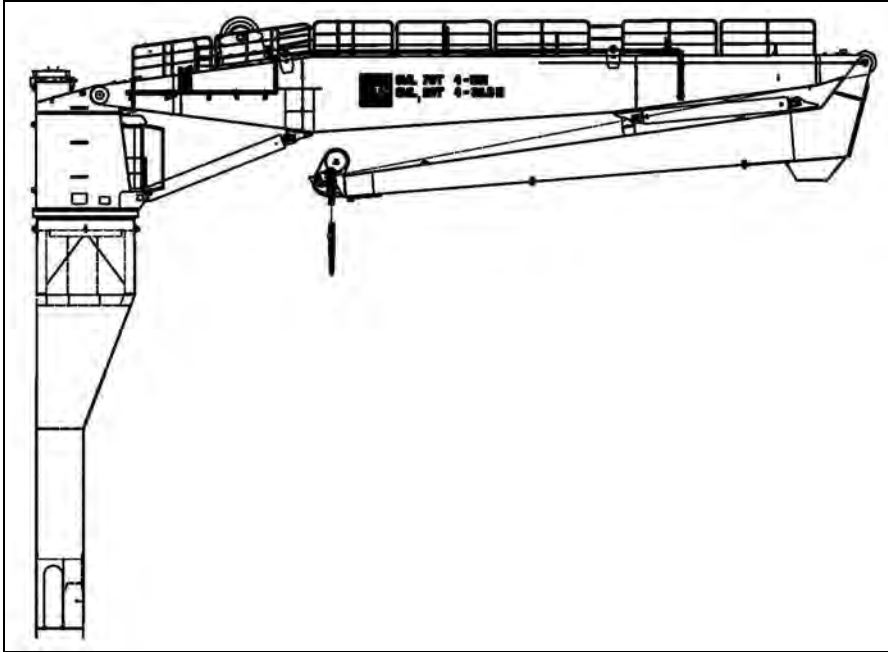
	Level switch Normally closed		Normally open ON-delay contact
	Level switch Normally open		Normally closed ON-delay contact
	Pressostat Normally closed		Normally open OFF-delay contact
	Pressostat Normally open		Normally closed OFF-delay contact
	Solenoid valve		Normally open switch
	Coil for Contact/relay		Normally closed switch
	Coil for ON- delay relay		Normally open selector switch
	Coil for OFF- delay relay		Normally closed selector switch
	Normally open contact		Normally open pushbutton
	Normally closed contact		Normally closed pushbutton

	Floodlight		DC-power supply
	Light		Controller w/potmeter
	Fluorescent tube		Proximity sensor 3-wire DC. Normally open
	Heater		Proximity sensor 3-wire DC. Normally closed
	Diode		Proximity sensor 2-wire AC/DC. Normally open
	Resistor		Proximity sensor 2-wire AC/DC. Normally closed
	Pot-meter		Limit switch Normally closed
	Rectifier		Limit switch Normally open
	Window wiper		Thermostat Normally closed
	Heater with fan		Thermostat Normally open
			Alarm horn

	<p>Conductor junction</p>		<p>Current transformer</p>
	<p>Crossed conductor, no connection</p>		<p>Three-phase transformer</p>
	<p>Slip ring with brush</p>		
	<p>Fuse</p>		<p>AM-Meter</p>
	<p>Circuit breaker</p>		<p>Hour meter</p>
	<p>Circuit breaker</p>		<p>Motor</p>
	<p>Contactor</p>		<p>Outlet</p>
	<p>Thermal overload-relay</p>		<p>Plug/Socket</p>
	<p>Disconnect switch</p>		<p>Thermistor relay</p>
	<p>Single phase transformer</p>		

USER MANUAL

Main Data



Cargo Crane
CCLKO 2000-70-36,5

RAY Shipping
M/V "Ella"

11857

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2 MAIN DATA

The below stated speeds apply during maximum load and working radius against the stated heel plus trim conditions. A speed tolerance of +10% to -5% is within the accepted range and should be taken into consideration.

2.1 Technical Specification

TTS Ships Equipment AS – Equipment Type

Type:	CCLKO 2000-70-36,5
Machine number:	11857
Lifting capacity (SWL):	70 T
Working radius - max:	36,5 m
Working radius - min:	3,9 m
Lifting speed at SWL:	0-15 m/min
Lifting speed at light load:	0-40 m/min
Number of fall:	4
Hoisting height:	40 m
Luffing time main jib:	120 sec
Luffing time knuckle jib:	60 sec
Slewing sector:	360° unlimited
Slewing speed:	0-0,9 rpm
Heel + trim conditions:	5°+ 2°
Weight of crane (without base column):	~90 T

2.2 Hydraulic Pressure

Main pressure:	~280 bar
Winch up:	~260 bar
Winch down:	~250 bar
Stabilizing winch:	~200 bar
Jib up:	~250 bar
Jib down:	~200 bar
Slew:	~280 bar

2.3 Pump Capacity

Ref. drawing: 11857H001

2.4 El. Motor Data

El. data:	440 V / 60 Hz / 3 ph	
Starter method:	Y/D	
Power rating continuous S1:	158 kW	226 A
Power rating S6-40% ID:	229 kW	328 A
Starting current (DOL)	1716 A	
Starting current (Y/D)	572 A	
Rotational speed (approx.):	1770 rpm	
Rotation seen from fan end:	CW (See arrow-sign on fan end)	
Enclosure:	IP 55	
Insulation class:	F	
Heating:	230 V	99 W

2.5 External Connections

Electric connection - see drawing: 11857EB1 - 11857EB4
11857ES1 - 11857ES7

2.6 Restrictions in Use

Subject equipment must only be used for the prescribed purpose and within the specified limitations referred to in chapter 5.9. The operator must be qualified according to chapter 5.10.

Repairs and modifications must not be carried out without prior written approval from TTS Ships Equipment AS, except for the minor corrections that are described in the maintenance chapter. If such work is carried out by others; TTS Ships Equipment AS's procedures for this kind of work must be followed. Only approved materials and original spare parts must be used.

2.7 Restrictions in Guarantee

TTS Ships Equipment AS refuses all responsibility caused by breach of the restrictions described in the section above. The guarantee for good performance is strictly linked to the correct and careful application of the instructions in this user manual. If, during the warranty period, these restrictions are breached, the warranty/guarantee shall no longer be valid.

2.8 Name Plate

The nameplate is located at the main control platform.

The nameplate is a rectangular plate with rounded corners and four corner registration marks. At the top center is the TTS logo, consisting of three vertical bars followed by the letters 'TTS'. Below the logo are three horizontal input fields. The first field is preceded by the text 'SERIAL NO.', the second by 'TYPE', and the third by 'MONTH/YEAR'. At the bottom center of the plate, the text 'TTS Marine ASA' is written above 'NORWAY'.

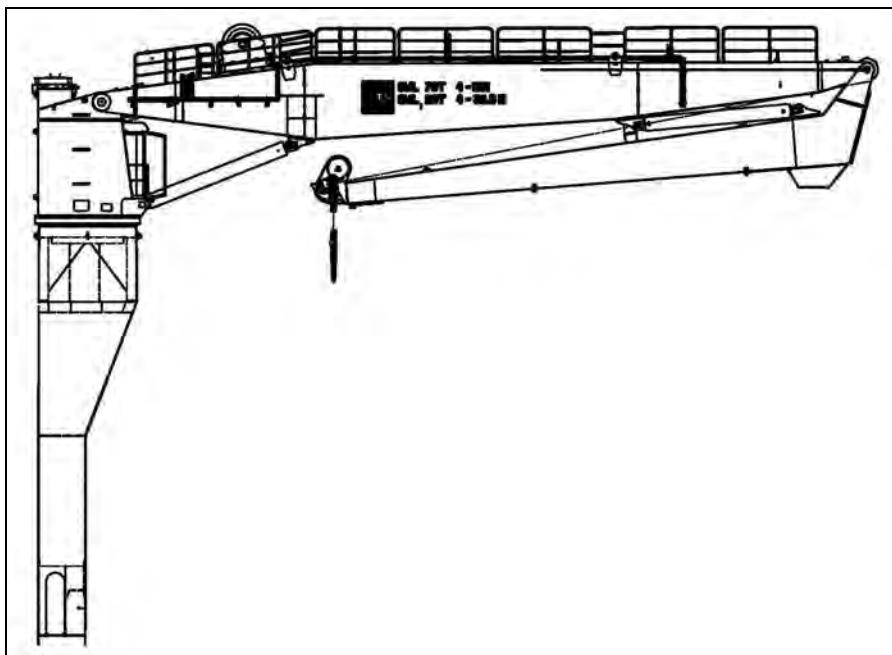
*Figure 2-1
Nameplate*

2.9 Certificates

All the relevant certificates are supplied in a separate file.

USER MANUAL

Technical Description



Cargo Crane
CCLKO 2000-70-36,5

RAY Shipping
M/V "Ella"

11857

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3 TECHNICAL DESCRIPTION

3.1 General

This crane is of electro hydraulic crane type. This means that an electric motor is used to drive a hydraulic pump.

The pump supplies a flow of oil at high pressure, which is utilized as the transmitting force to propel the hydraulic motors as the means to operate the hoisting winch, stabilizing winch for load turner, hydraulic cylinder, luffing and folding the jib and the slewing motion.

3.2 Safety System

The crane is equipped with following safety system:

3.2.1 Control system

Load monitoring system

- Hook load, ie actual load versus permitted load.
- Load cell.

Load limiting system

- All main hydraulic circuits are protected from over-pressure by relief valves set to values corresponding to crane's capacities.

Overload alarms.

Emergency stop.

3.2.2 Drive system

Electric motor

- Thermistor protection.

Hydraulic power unit

- High hydraulic oil temperature alarm / stop.
- Low hydraulic oil level alarm / stop.
- Low hydraulic oil pressure alarm / stop.

3.2.3 *Slewing machinery*

Load holding valve which will freeze motion in case of hydraulic pressure drop.

Fail safe multi-disc brake. Brake is spring operated and pressure released.

3.2.4 *Luffing machinery*

Load holding valve which will freeze motion in case of hydraulic pressure drop.

Luffing cylinder(s) designed to reduce speed before reaching end positions.

3.2.5 *Hoisting machinery*

Main winch

- Manual Overload Protection System (MOPS).
- Load holding valve which will freeze motion in case of hydraulic pressure drop.
- Fail safe multi-disc brake. Brake is spring operated and pressure released.
- 3 turns of wire rope remain on winch drum when all wire rope is paid out.
- Hook stop in upper and lower most positions.

3.3 Main machinery

3.3.1 *Slewing machinery*

Slew bearing

- Ship rated from reputable and recognized Maker
- Ball / Roller bearing
- Bolts and nuts of high tensile steel

Slew gear

- Gear with brake, motor and load control valve as one complete unit
- Internal pinion drive

3.3.2 *Luffing machinery*

Luffing cylinder

- Quantity = 2 pc
- Chrome protected piston rod with cuff of stainless steel (AISI 316) material on upper section
- Spherical bearings
- Double acting

Folding cylinder

- Quantity = 1 pc
- Chrome protected piston rod with cuff of stainless steel (AISI 316) material on upper section
- Spherical bearings
- Double acting

3.3.3 *Hoisting machinery*

Main winch

- Wire drum, grooved.
- Load dependent hoisting speed.
- Wire rope
 - Low-rotating type
 - Galvanized protection
 - Length suitable for specified hoisting height
- Main hook / Load block
 - Swivel and safety lock

Wire sheaves

- Fixed wire sheave bracket
- Double roller bearings
- Grease nipples

3.3.4 Miscellaneous**Nuts and bolts for installation of components:**

- < 12 mm of stainless steel (AISI 316) material
- ≥ 12 mm of galvanized material

3.4 Control Systems**3.4.1 Operator's cabin**

Located in front of crane house between cylinders

Access by door in front of crane house, Internal entrance from deck through pedestal

Entrance door, lockable

Mounted on vibration dampeners

Made from mild steel material

- Shot blasted to SA 2.5.
- Zinc metallised (40 micron).
- Colour of top coat as per crane.

Air condition unit.

Properly insulated, 20 mm thick black foam in roof and side walls

Maximum average noise level inside cabin ≤ 80 db(A)

Cabin flooring of rubber mat

Cabin heater / blower

Internal lighting, 1 x 15 W roof mounted above seat.

Fire extinguisher, 2 kg ABC-dry powder

Windows

- Front window, 1 pc of 5 mm thickness, green tinted.
- Side windows, 2 pcs of 5 mm thickness, green tinted.
- Floor window, 2 pcs of 5 mm thickness, clear
- Roof window, 1 pc of 5 mm thickness, gray coloured

All windows of tempered safety glass

Roof window can be opened for ventilation

Front window fitted with wiper and washer

Comfortable, ergonomic operator's chair with integrated control handles

- Fixed position
- Adjustable armrest
- Adjustable headrest

Foot rest, fixed.

Miscellaneous equipment

- Coat hooks, 1 pc.

3.4.2 Cabin controls

Main control valve

Spring centred control handles

- Right handle
 - Hoisting up / down motion – Y-axis
 - Luffing up / down motion knuckle jib – X-axis
 - Turning knob / Load Turner
- Left handle
 - Luffing up / down motion main boom – Y-axis
 - Slewing right / left motion – X-axis

All motions are of infinite variable (stepless) control from zero to full speed

Control panel with crane safety information

- Touch screen
- Mode selection
- Load indication with allowable load / radius information

Cabin console

- Wiper and washer switches
- Heater control and thermostat
- Lamps and switches for all auxiliary crane functions

Warning horn

Instruction and name plates in English

3.5 Hydraulic Arrangements

3.5.1 Hydraulic system

Open / Closed loop system.

Variable displacement pump(s) for open loop.

Hydraulic motor(s).

- Fixed displacement bent axis piston motor(s) for slewing motion.
- Variable displacement bent axis piston motor(s) for winch(es) of variable speed.

3.5.2 Hydraulic oil tank

Integrated in crane

Hatch for inspection and cleaning

Drain valve

Full flow return filter(s)

Filling of system through return filter(s)

Sight glass with temperature indicator

Level sensor (switch) for low level alarm and low, low level stop

Temperature sensor for cooler control and automatic stop in case of over-heating

3.5.3 *Hydraulic oil cooler*

Oil to air cooler; electrically fan driven

- Radiator suitable for marine environment

3.5.4 *Hydraulic lines*

Pipes

- Internal of mild steel material
- External:
 - ≤ 42 mm outside diameter of stainless steel (AISI 316) material
 - > 42 mm outside diameter of mild steel material

Pipe fittings

- Zinc plated mild steel material.
- External fittings are painted and protected by Denso tape against corrosion

Hoses

- High rubber quality for best resistance against sunlight and salinity
- Wire braided for applicable specified hydraulic pressure ratings

Hose couplings

- Zinc plated mild steel material.
- External couplings are painted and protected by Denso tape against corrosion

3.5.5 *System cleanliness*

**All components are thoroughly cleaned prior to installation
Cleanliness to NAS level 8**

3.6 Electric Arrangements

3.6.1 *Power supply*

Slip ring assembly for transfer of electric power to crane's rotating sections

3.6.2 *Electric motor(s) (for applicable zone)*

Motor rating S6-40 % ID.

Protection class IP55.

Insulation class F.

Temperature rise class F.

Still stand heating against condensation

Asynchronous motor

Squirrel cage

Self-cooling (fan)

3.6.3 *Electric motor starter*

Protection class IP54.

Safety door (main isolation) switch

Start push button – green colour

Stop push button – red colour

Emergency push / pull button – red colour

Lamps

- Power on – white colour
- Running – green colour
- Still stand heating – blue colour

Still stand heating control

Potential-free contact for motor running feedback

Thermistor overload protection relay

Ampere meter

Hour counter

3.6.4 *Lighting*

Light inside operator's cabin

Light inside pedestal

Light inside machine room

Flood light on boom

3.6.5 *Miscellaneous (when applicable)*

Cable trays of hot dip galvanized material

- Brackets, nuts, bolts and washers of hot dip galvanized material

3.7 Steel structures

3.7.1 General

Primary steel of certified material qualities
All primary steel is fully traceable
Primary steel is certified by 3.1.B certificate

3.7.2 Pedestal section

Lower end of pedestal is prepared for welding to deck

After welding to deck, it is buyer's responsibility to check evenness of pedestal's top flange and if required machine it to fall within acceptable tolerances.

Access ladder with guard cage

Internal deck

Junction box (for applicable zone) for connection of electric power supply

Slip ring assembly for connection of electric power supply

Ventilation arrangement

3.7.3 Crane house section

Operator's cabin.

Access ladder

Machine room

Hydraulic oil tank

All major hydraulic equipment

Cylinder luffing bracket(s).

3.7.4 *Boom section(s)*

Box boom (main)

- Welded steel box structure
- Internal stiffeners
- Replaceable bushings in boom hinge
- Cylinder luffing bracket(s)
- Main winch
- Winch foundation bracket(s)
- Platform with hand rails for service of winch(es)
- Hand rails along top.

Knuckle jib

- Welded steel box structure
- Internal stiffeners
- Replaceable bushings in jib hinge
- Cylinder luffing bracket(s)

3.7.5 *Miscellaneous*

Platform(s) of hot dip galvanized steel material

Approximately 10 m boom support

Floor of steel grating

Ladder(s) of hot dip galvanized steel material

Handrail(s) of hot dip galvanized steel material

3.7.6 *Lifting lugs*

Crane as a complete unit

Pedestal

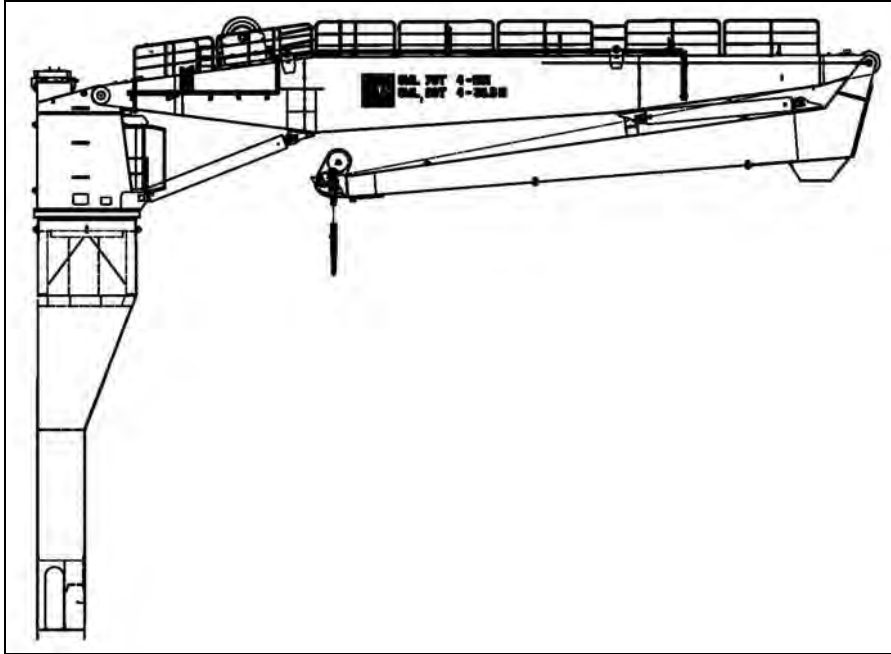
Crane house

Box boom (main)

Knuckle jib

USER MANUAL

Preparation Installation



Cargo Crane
CCLKO 2000-70-36,5

RAY Shipping
M/V "Ella"

11857

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4 PREPARATION / INSTALLATION

4.1 General

As a minimum requirement of the various classification organizations the substructure must be designed to withstand the cranes max. bending moment with a 25% overload.

The crane base or counter base with bolting flange welded to the hull substructure is regarded as part of the hull and is therefore a classification item. All welding and machining work on these items at the yard are the responsibility of the yard. The same applies for the classification approval work related to the above items.

The crane is normally delivered with the el. motor built into the crane base. The el. motor is equipped with a heating element, which must be “on” when the crane is not in use. The crane may also be delivered without an el. motor, for connecting to an existing hydraulic system.

The crane is normally not delivered with el. motor starter, motor protector, electric cable, lower flange mounting bolts, nuts and washers unless requested and purchased by the customer.

4.1.1 Mounting of TTS Ships Equipment AS Cranes

See the following section before installation of the crane:

- The crane is to be welded directly to the deck or some other type of support.
- As a minimum requirement (of the various classification organizations) the deck must be designed to withstand the cranes max. bending moment with a 25% overload.
- To avoid distortion of the slew bearing, we recommend that the crane base is welded to the substructure before the crane king with slew bearing is connected to crane base.
- Check adjoining welding grooves to obtain an even gap through the circumference. Also an evenly distributed heat input is required to avoid distortion.
- The flange is obviously more exposed to distortion if the deck stiffeners, platforms etc. are welded to crane base. All such welding has to be completed and the structure has to return to normal temperature before the slew bearing support flange is measured for flatness.

Before mounting the base and slew column with slew bearing together; check the following points:

- The flange machined surface is clean and free from paint and welding slag, etc.
- Check the bolt length. Only the bolt types indicated in the parts list are to be used.
- The bolt holes in the base flange must match so that the bolts go freely through the holes and without resistance when rotated in the holes.
- Hardened washers as indicated in parts list and on the G.A. drawing are to be used under bolt heads.
- The tightening torque indicated on the G.A. drawing is based upon a lightly oiled bolt thread surface. We recommend lubricating with MOLYCOTE 1000 because of its relative stability between tightening torque and bolt tension with special consideration given to re-tightening.
- MOLYCOTE 1000 is also a corrosion inhibitor.
- The crane construction is a complete unit with the el. motor built into the crane base.
- The el. motor is equipped with a heating element. This must be “ON” when the crane is not in use.

4.2 Prior to Starting the Crane

- a) Check that all hydraulic connections are in accordance with the hydraulic diagram.
- b) Check that all hydraulic connections are tightened up firmly.
- c) Check that all bolts are tightened with correct torque.
- d) Check that all electrical connections are in accordance with the el. interface drawing.
- e) Check and activate / deactivate emergency stop stations.
- f) Fill up the hydraulic oil tank through the oil filling connector, located in front of the return filter. It is of outmost importance that only pure clean oil is used. Under no conditions must water, dirt or other foreign matter enter the tank. Impurities and moisture will drastically reduce the efficiency and life span of the hydraulic system.
- g) The crane have been operated and tested at the production workshop prior to delivery. However, improper storage and handling during transport may result in oil leakage. Therefore, check the oil level at gearboxes (winch/slew) and top up if necessary, making sure to use approved oil. (See the lubrication chart under the Chapter Maintenance).

All pressure control valves have been adjusted by the manufacturer and must not be altered.

4.3 Start up, Idle Operation

Start the motor for idle operation and check the hydraulic system for leaks.

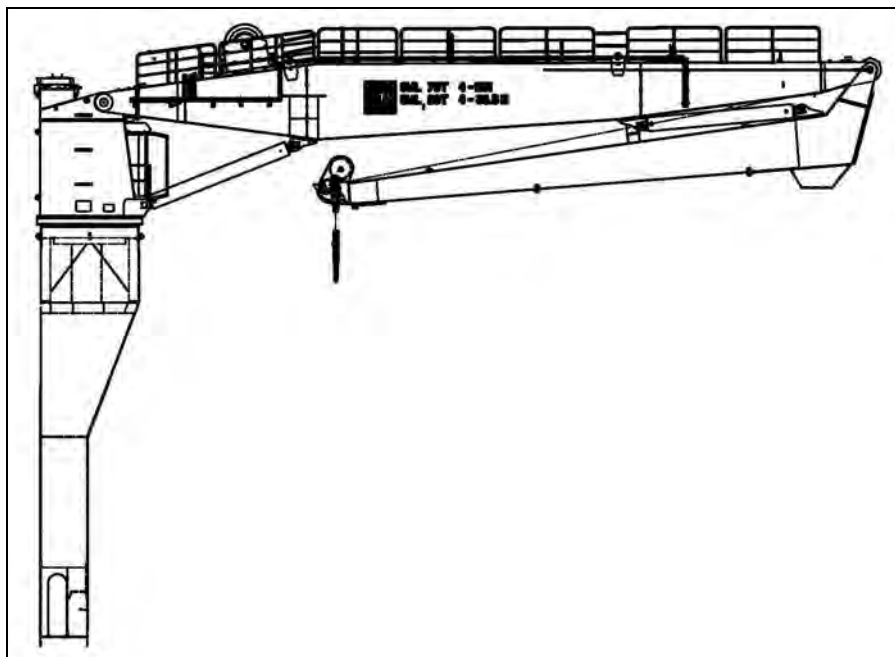
NOTE:

Setting of El. motor rotation direction is depending on pump direction - see chapter 2 main data. Check fan end on motor (ref. Arrow-sign). If motor is rotating in the wrong direction, interchange 2 phases and check again.

THE MOTOR MUST BY NO MEANS BE ALLOWED TO RUN IN THE WRONG DIRECTION, AS THIS WILL ADVERSELY AFFECT THE LIFE SPAN OF THE PUMP.

USER MANUAL

Operating Instructions



Cargo Crane
CCLKO 2000-70-36,5

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5 OPERATING INSTRUCTIONS

At this stage it is assumed that the equipment has been installed and commissioned, and thus is ready for ordinary routine operation. It is also assumed that the operator is familiar with the overall system and has studied the technical description and drawings.

5.1 SAFETY SUMMARY

	Warning Must be observed to prevent serious injury.
---	---

CAUTION!	Must be observed to prevent damage of equipment and/or loss of operating effectiveness.
-----------------	---

Note	Must be observed for correct and efficient operation.
-------------	---



It is the responsibility and duty of all involved personnel to fully understand the SAFETY measures, by which hazards are reduced or eliminated. Personnel must familiarize themselves with all aspects of safety before operating the equipment.

The following points sum up the safety aspects related to operating the equipment:

- Only qualified and authorized personnel must be allowed to operate the equipment.
- The equipment must be operated as described to prevent any damage to the equipment.
- Hydraulic oil and lubricants may contain toxic additives that by repeated skin contact or inhalation can be dangerous to your health. Study the safety data sheets of the different compounds, and protect yourself as required.
- The user shall inspect the equipment for operational adequacy and readiness prior to start-up of operations. The user shall repair and replace any non-functional circuits and any worn or damaged parts of the equipment before operation starts. Poor maintenance jeopardizes health and safety.
- The user is responsible for work-area security. All non-essential personnel and elements must be cleared from the equipment operational influence area.
- Never leave tools or other loose objects on the equipment.

5.2 NORMAL OPERATION

The load must not be lifted off the ground / deck by means of the luffing motion.
The load should always be lifted off the ground / deck by the winch to which it is attached.

5.2.1 Pre-start Preparations

- Inspect the equipment visually to verify that it is ready for operation.

If the crane is used only sporadically, the following inspections/checks/test runs should be performed prior to use. With frequent use, inspections/checks/test runs once a day should normally be sufficient.

	Description
1	<p>Check oil level in the hydraulic oil tank. The level should be approximately in the middle of the upper sight glass.</p> <p>Note The level should be checked with the jib in horizontal position.</p>
2	Inspect all hydraulic hoses and connections for sign of leakage. Rectify immediately if any are found.
3	Inspect the crane for signs of external damage. Replace or repair if any are found.
4	Start up and run all crane motions without load in the hook to check for normal performance.
5	Check that "hoisting up" stops at the predetermined distance from the jib head. Also check that "slow down" before the stop is functioning.
6	Check that "luffing up" stops at the max. luffing angle.
7	Check that "luffing down" stops at the min. angle to clear the jib rest.
6	If the ambient temperature is less than -10deg C, let the crane run in idling condition until the oil temperature reaches +10deg C.


5.2.2 Starting

5.2.2.1 Starter Cabinet

Common routines with starter cabinets –A901 and –A902 before starting the crane, refer to chapter 5.3.1.

- Turn on main disconnection switch: –Q1, –Q2 (starter cabinet –A901).
- Ensure that SOURCE lamp –H13 is lighted up.
- Start motor by –S14 green push button and make sure that lamp –H11 *Motor Running* is lighted up, HPU motor can be started/stopped from starter cabinet and from operator panel –IB300 inside crane cabin.

5.2.2.2 Crane Cabin

	Warning
	Crane operator shall always set CONTROL LEVER switch –S03 to OFF prior to raising from operator chair or while taking a break during sitting in the chair. Switch is located on the operator panel –IB300, refer to chapter 5.3.5.

Following shall be performed from operator's chair:

- Ensure that none of four Emergency buttons are activated.
- Turn on key switch –S02 Control System on the operator panel –IB300.
- Ensure that System ON lamp –H01 is lighted up.
- Ensure that operator terminal –IB310 is activated and displaying Operating Display screen
- Check lamps with the Lamp Test button, refer to chapter 5.3.7.2.
- Check alarm list for presence of any active alarms refer to chapter 5.3.7.6, and eliminate the cause of alarms.
- Start HPU motor by pushing button –SH01/-SH02 HPU Motor –M1/-M2 Start.
- Ensure that HPU motor running lamp –SH01/-SH02 is lighting up.
- Check for any alarm or abnormal situation (noise, vibration, etc.)
- Turn switch –S03 Control Lever to ON.
- Auxiliary devices may be operated as appropriate.
- Do a routine, check in Operating Display Screen for important information like load in hook, hydraulic pressure, drive directions in mimic arrows.

5.2.3 During Operation

Observe the equipment now and then during operation.

5.2.3.1 Load chart

Load chart for winch operation is shown as drawings Load Chart Sheet 1-4 in chapter 8.

CAUTION!

Always obey crane load chart.
Do not overload the crane.
When winch mode: Lift the load only by winch operation,
never by main jib or knuckle jib.

In Harbour mode the crane winch in normal use has two lifting modes, SWL 70 tons and 20 tons. Safety working load 70 tons is limited to max working radius of 11.0 m and safety working load of 20 tons is limited to max working radius of 36,5 m. SWL is depended on crane mode, outreach and significant wave height.

Following requirements need to be met to activate Winch mode:

- System lamp –H01 is on.
- Control lever switch –S03 is turned on.
- Telescope is fully retracted.

5.2.4 Parking

Crane jib should be parked in a jib rest when the crane is not in use. When crane is in parked position, jib cylinder(s) shall be in completely retracted position. This is to avoid corrosion of piston rod.

	Description
1	Secure hook block and tight wire. Do not over tight!!
2	Stop pump motor
3	Note that the motor still-stand heating is automatically switched on when the pump motor is stopped. The heating will stay on as long as power supply to the crane is not interrupted.

5.2.4.1 Crane Cabin

- Stop HPU motor by pushing button –S04/-S05 HPU Motor –M1/-M2 Stop on the operator panel –IB300.
- Ensure that HPU motor running lamp –SH01/-SH02 has been switched OFF and HPU motor has stopped.
- Switch CONTROL LEVER switch –S03 to OFF.
- Do a routine check for abnormal alarms, etc.
- Turn off key switch –S02 Control System.

5.3 DESCRIPTION OF CONTROLS

5.3.1 Starter Cabinets

Ref. Drawing: 11857DP1, 11857DP2

The Starter cabinets –A901 and –A902 are fitted inside crane house close to HPU. Starter cabinet door layouts, are shown on the *Figure 5-1* and *Figure 5-2*.

This crane has an electrical power supply of 440VAC/ 60Hz / 3ph. This power supply is connected into the starter cabinet –A901. Inside this starter cabinet there are two main disconnection switches to be used to connect main power supply to both starter cabinets:

- Q1 (to connect main power supply to starter cabinet –A901),
- Q2 (to connect main power supply to starter cabinet –A902),

Disconnection switches –Q1 and –Q need to be switched on for make it possible to start HPU for motors –M1 and –M2. Pushing the start button located on starter cabinets may then start the HPU and motors. Then check that the MOTOR RUNNING lamps illuminates.

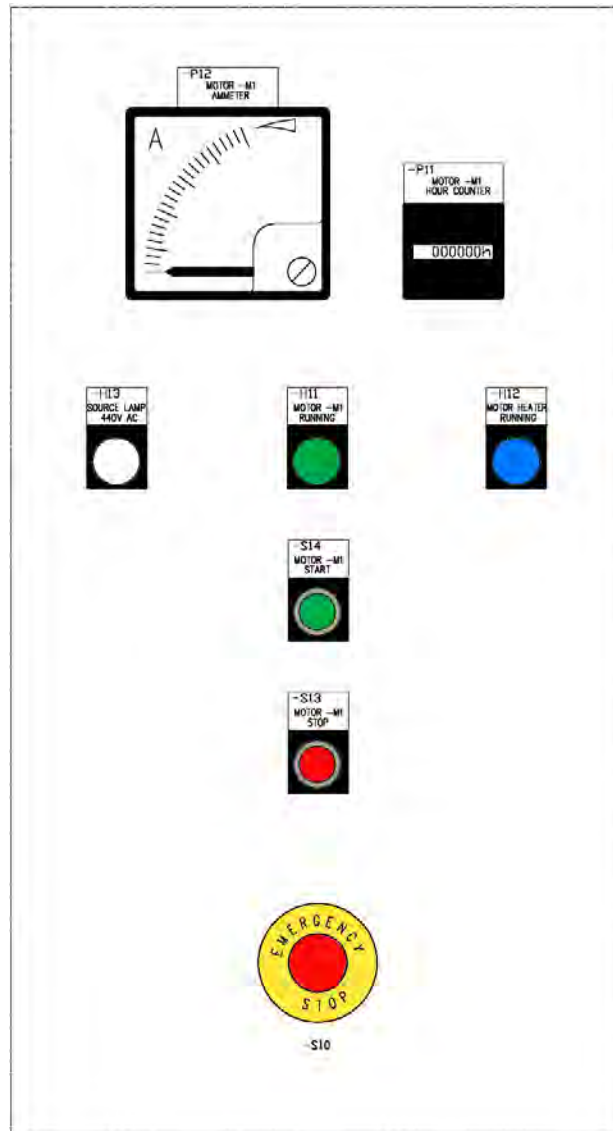


Figure 5-1 Starter cabinet –A901 door layout

Starter cabinet –A901 includes following gears:

- S10 - Emergency Stop button – to be used in emergency situation. Activating (pushing down) this button will stop HPU and motor –M1, oil cooler and ventilation fan, also all valves will be switched off and the output zero signal will be set to all proportional valves. Crane movements will stop immediately. Button keeps its position, so the emergency situation is present until the button is reset. Resetting is possible by pulling and /or turning the button
- S13 - Motor Stop button - pushing the button will stop HPU and motor –M1
- S14 - Start button – pushing the button will start HPU and motor –M1
- H11 - Motor Running Lamp (green) – indicates status of HPU motor –M1
- H12 - Motor Heater Running Lamp (blue) – indicates status for motor space heater
- H13 - Source Lamp (white) – indicates availability of main power supply for starter cabinet
- P11 - Ampere meter – indicates HPU motor current
- P12 - Hour counter – showing how many hours HPU motor has been running

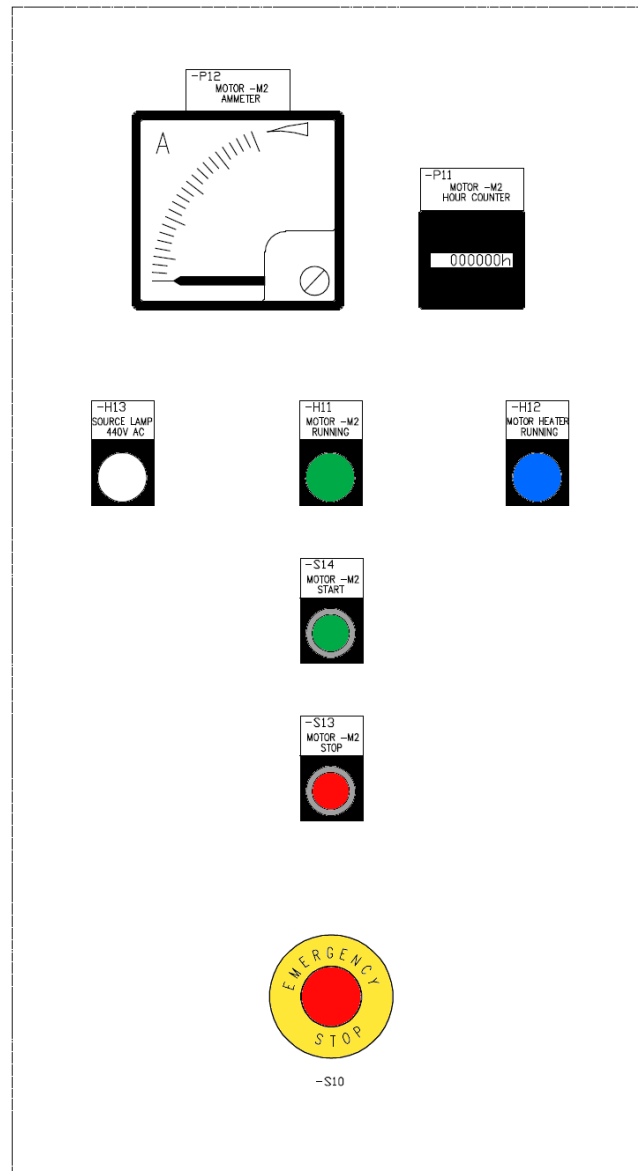


Figure 5-2 Starter cabinet –A902 door layout

Starter cabinet –A902 includes following gears:

- S10 - Emergency Stop button – to be used in emergency situation. Activating (pushing down) this button will stop HPU and motor –M2, oil cooler and ventilation fan, also all valves will be switched off and the output zero signal will be set to all proportional valves. Crane movements will stop immediately. Button keeps its position, so the emergency situation is present until the button is reset. Resetting is possible by pulling and /or turning the button
- S13 - Motor Stop button - pushing the button will stop HPU and motor –M2
- S14 - Start button – pushing the button will start HPU and motor –M2
- H11 - Motor Running Lamp (green) – indicates status of HPU motor –M2
- H12 - Motor Heater Running Lamp (blue) – indicates status for motor space heater
- H13 - Source Lamp (white) – indicates availability of main power supply for starter cabinet
- P11 - Ampere meter – indicates HPU motor current
- P12 - Hour counter – showing how many hours HPU motor has been running

Motor heater preventing condensation for both motors –M1 and –M2 is on (blue lamp –H12 Motor Heater Running) when the HPU motor is stopped. The heating will stay on as long as power supply to the starter cabinet is not interrupted and main disconnection switch –Q1 and –Q2 inside starter cabinet –A901 are on.

5.3.2 Control Cabinet –A140



Figure 5-3 Control Cabinet –A140

Control Cabinet –A140 is fitted inside crane house. Some I/O signals (from encoders, pressure switches, level switches, feedback switches and on/off and proportional valves, temperature transmitter, pressure transmitters, load link) are communicating with PLC using DeviceNet, refer to chapter 5.3.4 *Control Cabinet –A340*. This cabinet contains of following main components which are shown on the *Figure 5-3*.

At upper and middle part of Control Cabinet –A140 it is placed:

- DeviceNet Communication Unit –D301.
- SmartSlice digital input modules: -D301.1/1, -D301.1/2.
- SmartSlice digital output modules: -D301.2/1, -D301.2/2.
- SmartSlice analog input modules: -D301.3/1, -D301.3/2.
- SmartSlice analog output modules: -D301.4/1, -D301.4/2, -D301.4/3.
- Amplifiers / Converters for adapting standard PLC output signals to proportional valve signals: -U320, -U321, -U322, -U323, -U324.
- Output relays, terminals connections and fuses.

5.3.3 Cabin Layout

Cabin layout is shown on the *Figure 5-4*.

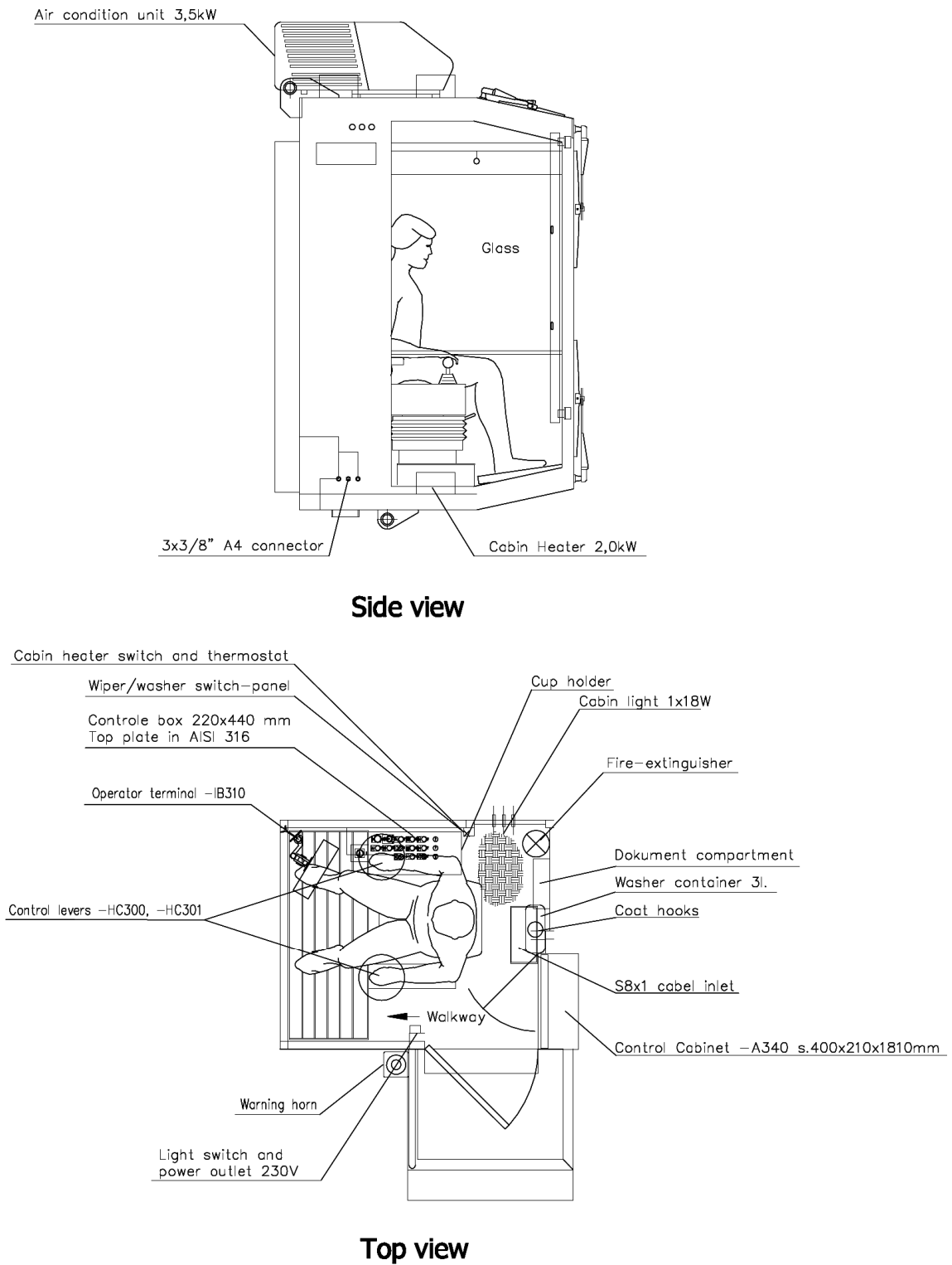
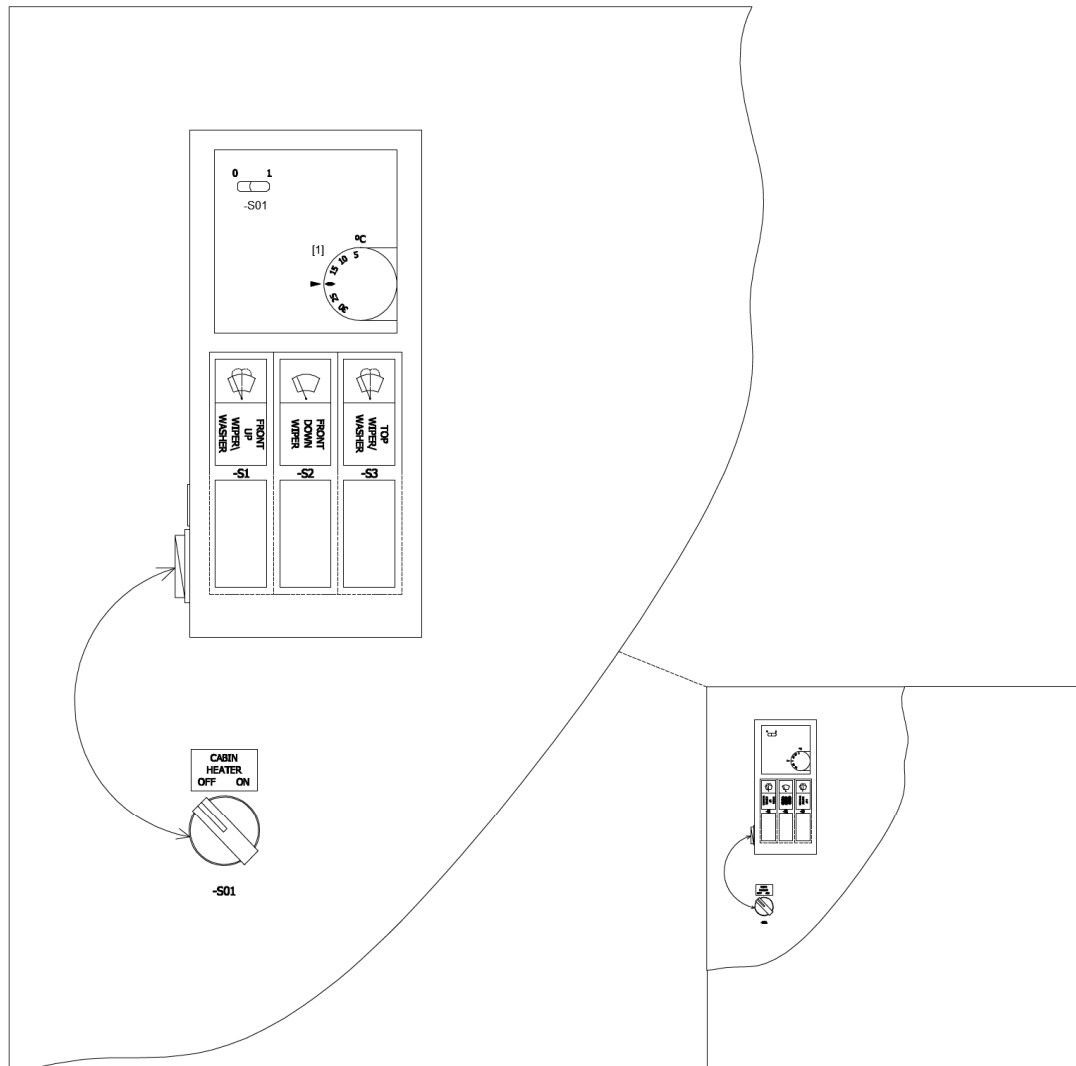


Figure 5-4 Cabin Layout

Crane cabin is equipped with following equipment:

- Control cabinet –A340
- Light switch –S320 and socket outlet –X340
- Cabin heater –M360
- Cabin heater control switch –S01 and thermostat –S02, which are shown on the *Figure 5-4*
- Wiper/Washer switches – for activating windows wipers and washer.



Side view

Figure 5-5 Cabin heater control switch and thermostat, wiper/washer switches

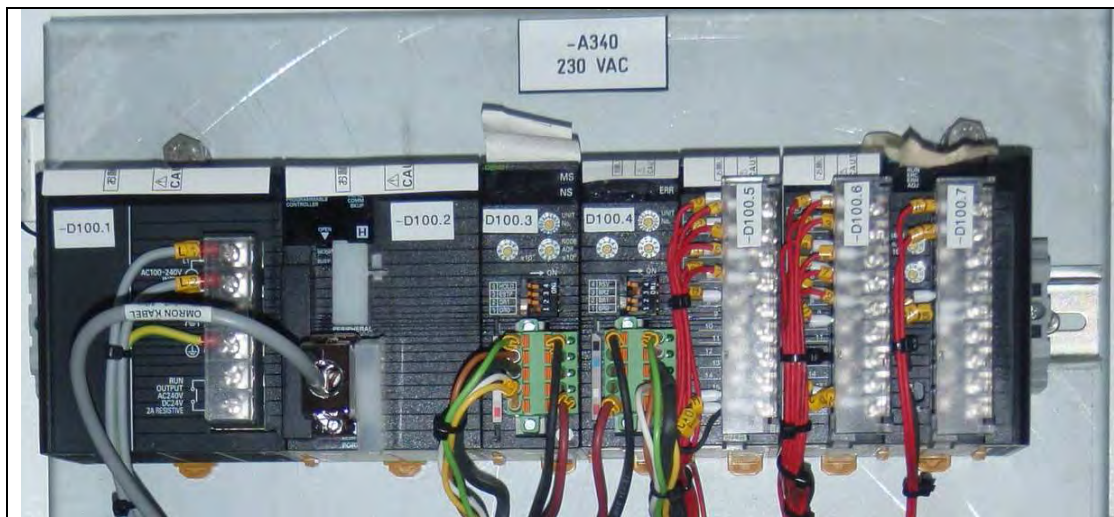
The cabin fan heater –M360 is mounted below operator seat. This heater contains of an electrical heating element, fan and control panel. Output air duct is placed on the floor. Control panel contains of switch and thermostat and it is installed on the right hand side of right window. Control switch –S01 turns air circulation on (heating is off). To activate temperature control switch –S02 need to be turned on. The temperature can be adjusted (5-30 .) by rotating knob[1]. To turn on wiper/washer on front upper window switched on switch –S1. To activate lower wipers placed on front window switch –S2 need to be turned on. Switch –S3 is intended to switch on top wiper/washer.

- Operator panel –IB300, refer to chapter 5.3.5
- Control levers, refer to chapter 5.3.6
- Operator terminal –IB310, refer to chapter 5.3.7
- Warning horn –H340
- Light fixture –E320, refer to chapter 5.3.8
- Air condition unit –R330, refer to chapter 5.3.9

5.3.4 Control Cabinet –A340

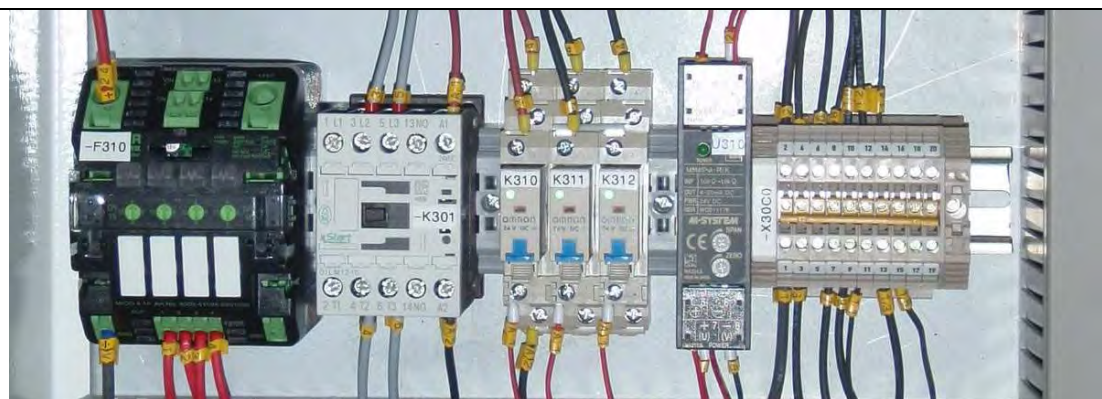
Control Cabinet –A340 is mounted inside crane cabin and it is placed on the right hand side close to the cabin entrance door, refer to *Figure 5-4 Cabin Layout*.

This cabinet has the crane control system build in. The crane control system contains of following main components which are shown on the *Figure 5-6*:



PLC (Programmable Logic Controller) which contains the following modules:

- DeviceNet Communication Unit –D100.3
- User Defined CAN unit –D100.4
- I/O (input/output) modules for different type of signals (-D100.5 – digital inputs, -D100.6 – digital outputs, -D100.7 – analog inputs)



- Electronic auxiliary circuit switch –F310
- Contactor relay 24 VDC
- Output relays 24 VDC

- Potentiometer transmitter –U310
- Terminal connections 0V

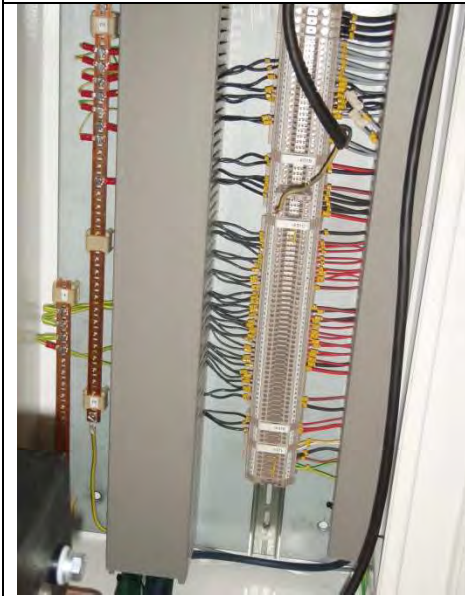
- Circuit breakers 230 VAC
- Terminal connections 24 VDC

- Circuit breakers 230VAC

- Power supply 24 VDC system




- Unregulated power supply 24 VDC



- Terminal connections

Figure 5-6 Control Cabinet –A340

5.3.4.1 Fuse / Line Description Overview

		CRANE: 11857 Drawing Ref.: 11857E01-E04		Control cabinet: –A340	
FUSE NO.	INVENTORY OF CIRCUIT:	FUSE AMPERE	FUSE CHAR.		
	230V AC SYSTEM:				
-F301	Power supply for crane control system. PLC and transformers 230 VAC / 24 VDCs.	10A	C		
-F302	Light fixtures inside king. Flood light, main jib tip, knuckle jib tip.	13A	C		
-F303	Light fixture and service socket, cabin.	10A	C		
-F304	Air conditioning unit, cabin.	10A	C		
-F305	Ventilation fan 1 with heater, cabin.	13A	C		
-F306	Ventilation fan 2 with heater, cabin.	13A	C		
-F307	Spare.	10A	C		
-F308	Light fixtures inside pedestal.	4A	C		
	LOW VOLTAGE SYSTEM:				
-F310.1	24 VDC. DeviceNet, remote I/O .	4-10A			
-F310.2	24 VDC. Analog input.	4-10A			
-F310.3	24 VDC. Digital input.	4-10A			
-F310.4	24 VDC. Digital output. Operator display.	4-10A			
-F320	24 VDC. CAN-bus joysticks.	2A	C		
-F321	24 VDC. On/Off valves (solenoid valves).	13A	C		
-F322	24 VDC. Screen wipers, screen washers, warning horn.	13A	C		

5.3.5 Operator Panel –IB300

Operator panel layout is shown on the *Figure 5-7*.
 Right joystick: Ref. appendix, modification 861185, ch 5.12.8.

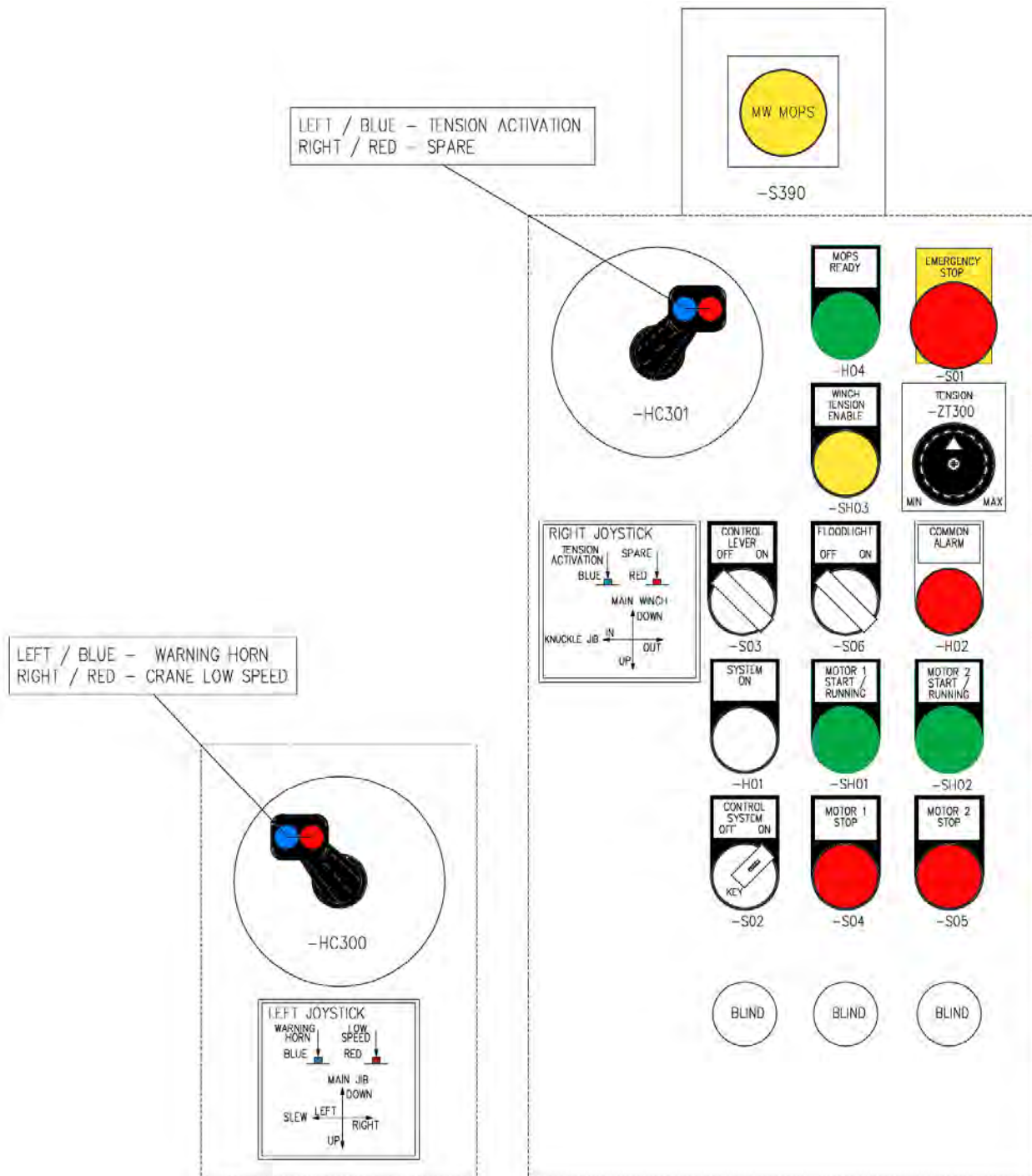


Figure 5-7 Operator panel –IB300 and control levers located on left and right hand side of operator seat

Operator panel is mounted on the right hand side of operator and contains of following switch gears and lamps:

- **-S390 - MOPS (Manual Overload Protection System) button**

This button is placed beside right joystick –HC301 and consists of protection cover which is mounted to avoid accidental activation. Button keeps its position, so MOPS is present until the button is reset. Resetting is possible by pulling the button. When MOPS is activated the alarm will occur and external horn will sound to warn the personnel.

- **-H04 - MOPS READY lamp**

This lamp is used to indicate when Manual Overload Protection System is ready to use.

- **-S01 - EMERGENCY STOP button**

This button should be used in emergency situation. Activating (pushing down) this button will stop HPU, motor, oil cooler and ventilation fan, also all valves will be switched off and the output zero signal will be set to all proportional valves. Crane movements will stop immediately. Button keeps its position, so the emergency situation is present until the button is reset. Resetting is possible by pulling and /or turning the button.

- **-SH03 - WINCH TENSION ENABLE button with lamp**

This button is used to enable tension on winch. The yellow lamp indicates when the tension is successfully enabled. Tension activating button is located on the right joystick, see chapter 5.3.6. In addition to activate tension, the joystick must be in hoisting position and the yellow lamp *WINCH TENSION ENABLE* must illuminate.

- **-ZT300 - TENSION potentiometer**

Tension potentiometer allows to adjust tension from min. to max. value by crane operator.

- **-S03 - CONTROL LEVER OFF-ON switch**

It is used to switch left and right control lever OFF or ON (it is destined to be used prior to operator is rising from the operator seat).

- **-S06 - FLOODLIGHT OFF-ON switch**

It is used to turn OFF or ON the lights on main and knuckle jib.

- **-H02 - COMMON ALARM lamp**

The red lamp indicates in case of any alarm.

- **-H01 - SYSTEM ON lamp**

The white lamp indicates when control system is switched ON.

- **-SH01 – MOTOR 1 START / RUNNING button with lamp**

The button is used to start HPU and motor –M1, green lamp is integrated with MOTOR 1 START button and indicates motor running feedback from this motor.

- **-SH02 – MOTOR 2 START / RUNNING button with lamp**

This button is used to start HPU and motor –M2, green lamp is integrated with MOTOR 2 START button and indicates motor running feedback from this motor.

- **-S02 – CONTROL SYSTEM OFF-ON key switch**

This switch is used to turn OFF or ON control system. Note that when control system OFF is selected, operator terminal –IB310 is turned OFF.

- **-S04 – MOTOR 1 STOP button**

This button is used to stop HPU and motor –M1.

- **-S05 – MOTOR 2 STOP button**

This button is used to stop HPU and motor –M2.

5.3.6 Control Levers –HC300, -HC301

Control console in cabin is equipped with two manually operated joysticks (control levers). Left joystick –HC300 is placed on the left hand side of operator seat, right joystick –HC301 is placed on right hand side of operator seat and it is mounted on the left corner of operator panel –IB300, refer to the chapter 5.3.5, *Figure 5-8*.

The joysticks are operated by pushing / pulling. When the joysticks are not operated, they return to the middle / neutral position. Signal from joystick is proportional with its position. There are four direction contacts (two for each axis) to avoid uncontrolled movements.

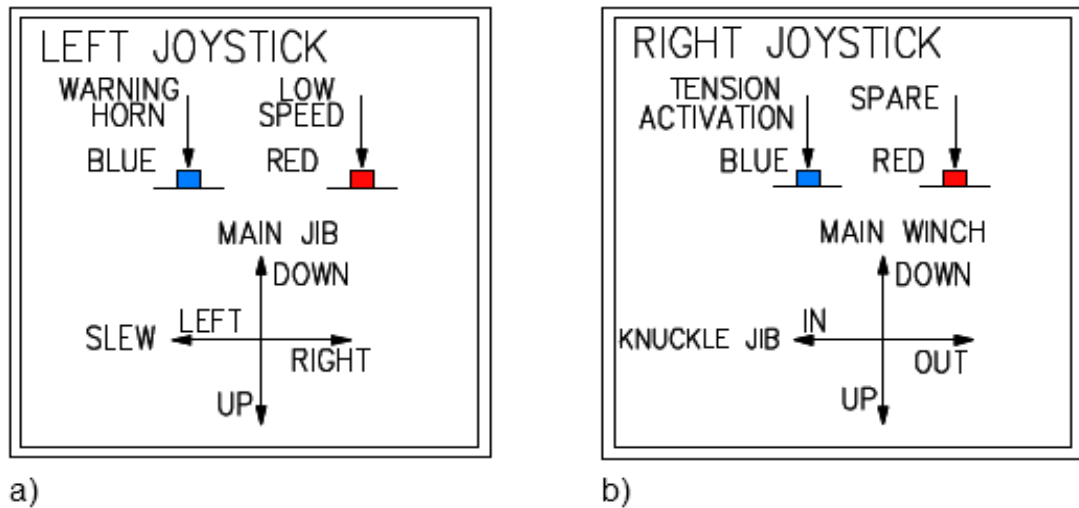


Figure 5-8 Control levers layout: a) left control lever –HC300, b) right control lever –HC301

The following functions are controlled by left joystick –HC300:

- X-axis: push lever in left direction to slew left.
- X-axis: push lever in right direction to slew right.
- Y-axis: push lever forwards to lower the main jib.
- Y-axis: pull lever backward to raise the main jib.
- Left BLUE button – WARNING HORN, push to activate \ deactivate. Activation can be done by pushing and holding the button, release the pushing will deactivate warning horn.
- Right RED button – LOW SPEED / fine driving, push button for selecting fine driving mode for all of crane movements. Pushing this button once will activate fine driving and next push will deactivate this function. When this function is activated the status will be displayed on operator terminal –IB310: *Fine driving*.

The following functions are controlled by right joystick –HC301:

Ref. appendix, modification 861185, ch 5.12.8.

- X-axis: push lever in left direction to drive knuckle jib in.
- X-axis: push lever in right direction to drive knuckle jib out.
- Y-axis: push lever forwards to lower the winch.
- Y-axis: pull lever backward to hoist the winch.
- Left BLUE button – TENSION ACTIVATION, push to activate \ deactivate. Activation can be done by pushing and holding the button, release the pushing will deactivate tension mode. The status will be displayed on operator terminal –IB310.
- Right RED button – SPARE, can be used in future for some other needed function.

5.3.7 Operator Terminal –IB310

Operator display is mounted on a swing arm in front of operator seat inside cabin and it is shown on *Figure 5-7*. It is a multi-functional panel. Besides giving crane operator vital information about different crane status, values, alarms, it also serves as input device for parameters into crane control system. These are password protected. To turn on the operator terminal, control system must be switched on. This is the preset screen at star up of control system.

Inputting or selecting field is based on a Touch Screen Principle.

It has also a screen showing real time sensor values and output signals for ease of checking, testing and fault diagnose.

Hierarchical structure of display menu is represented on *Figure 5-9*.

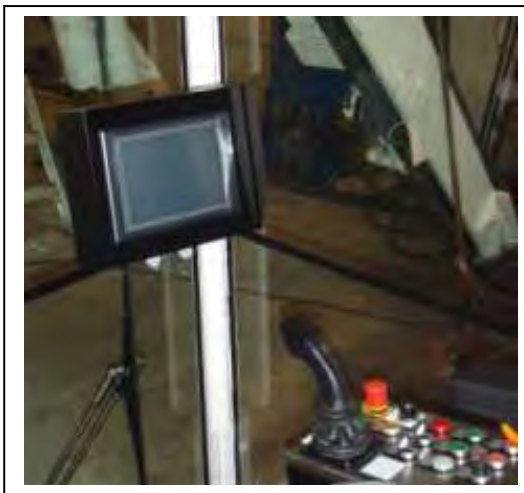


Figure 5-8 Operator terminal –IB310

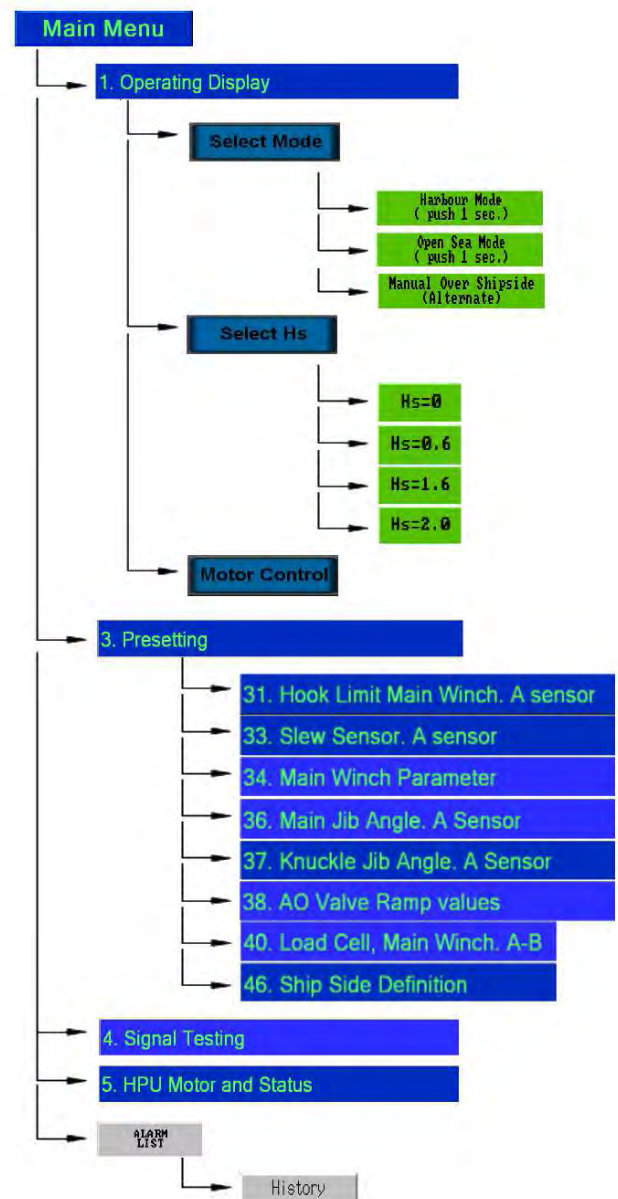


Figure 5-9 Hierarchical structure of display menu

CAUTION!

Handle LCD screen with care, keep it clean. Do not use metal parts for tapping on LCD touch screen. Avoid dirty/oily fingers.

5.3.7.1 Operating Display

Some of fields (current date and time, last active alarm and its registration time, etc.) which are shown on the operating display page are common for different pages, they will be described on *Figure 5-10* only once.

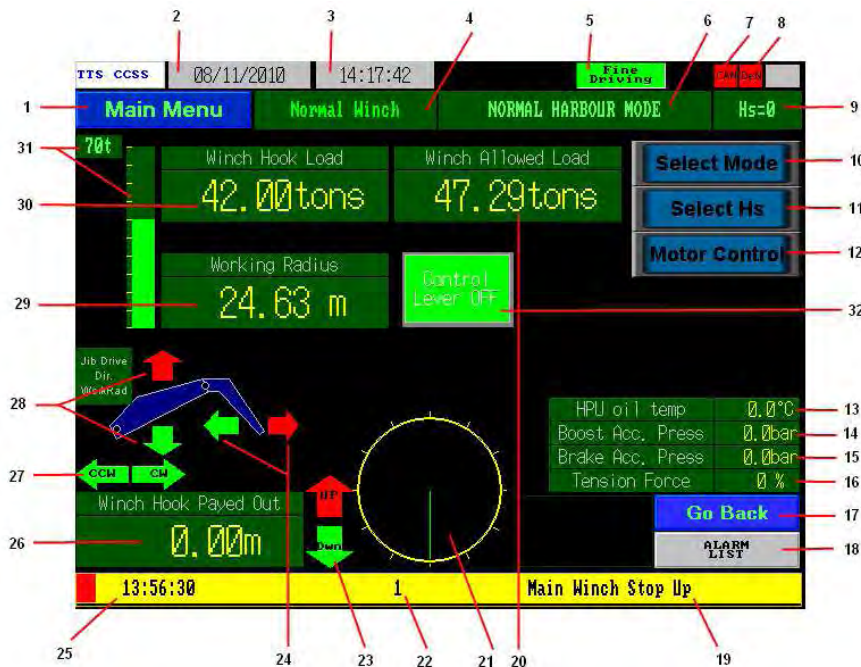


Figure 5-10 Operator's display - Operating Display

1. **Main Menu** - access to main menu display page, refer to chapter 5.3.7.2.
2. Current date. May be adjusted by tapping this field.
3. Current time. May be adjusted by tapping this field.
4. Winch mode, has three following status: *Normal Winch* / *Tension Winch* / *MOPS=ON*.
5. Status of Fine Driving (Low Speed) function which can be activated by pushing the red button on left control lever, refer to chapter 5.5.5. When fine driving function will be activated colour of the button on operating display page will change from dark green to light green.
6. Status of crane modes function: *Normal Harbour Mode* or *Open Sea, Internal Mode* / *Open Sea, External Mode*. It can be switched in appropriate conditions by selecting the mode from pos. 10 *Select Mode*.
7. Information status for CanBus (signal from control levers –HC300, HC3001). If everything is working properly - green colour. When there is something wrong the colour is red.
8. Information status that DeviceNet. If everything is working properly - green colour. When there is something wrong the colour is red.
9. Status of selected *Significant Wave Height* - *Hs*, [m]. Please note that this selection is possible only in *Open Sea Mode*. The value of *Hs* can be selected from selector button placed on Operating Display page - *Select Hs*, refer to point 9. Depending on the position of crane slew sector in *Open Sea Internal Mode* *Hs*=0.6. When *Normal Harbour Mode* is selected then *Significant Wave Height* can't be selected, it means that *Hs*=0, refer to *Figure 5-10*.
10. Crane mode selector button *Select Mode* ⇒ *Harbour Mode* / *Open Sea Mode* / *Manual Over Shipline (Alternate)*.

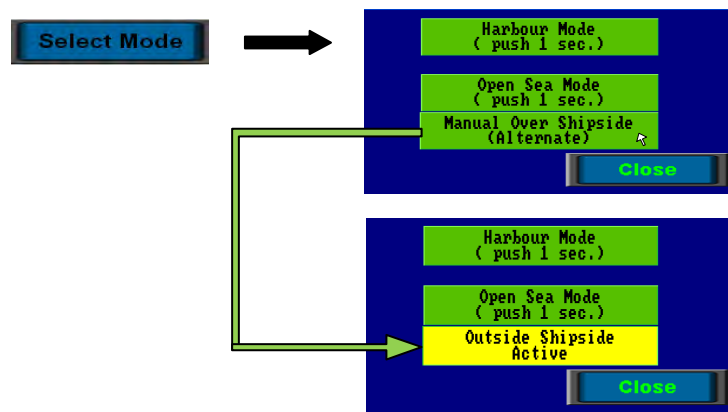


Figure 5-11 Selector button "Select Mode"

Crane is supplied with two different working modes: *Harbour* and *Open Sea*. *Harbour* mode is used as a purpose to lift loads between vessel and quay side and sheltered waters. MOPS and Tension is disabled in this mode. *Open Sea* selection mode is divided on External (above sea level) and Internal (above deck) mode. *Open Sea Internal* mode is used to lift the loads on vessel's deck in open sea and it can be activated by pushing the selector button *Open Sea*. Next push will deactivate this mode and then it will automatically jump over to *Harbour Mode*. When *Open Sea, Internal Mode* will be selected it will be a corresponding status displayed on operating display in filed number 6, refer to *Figure 5-12a* and *Figure 5-12b*.

External mode is used to discharge cargo onto a barge in open sea costal waters and it can be switched on by selector button *Manual Over Shipside (Alternate)*. When this mode is selected it will be a corresponding status displayed on operating display in filed number 6, refer to *Figure 5-12a*, *Figure 5-12b*, . That means that in *Open Sea Mode* crane operator has to select the appropriate mode to indicate if the crane is working over shipside (*Open Sea, Internal Mode*) or outside shipside (*Open Sea, External Mode*).

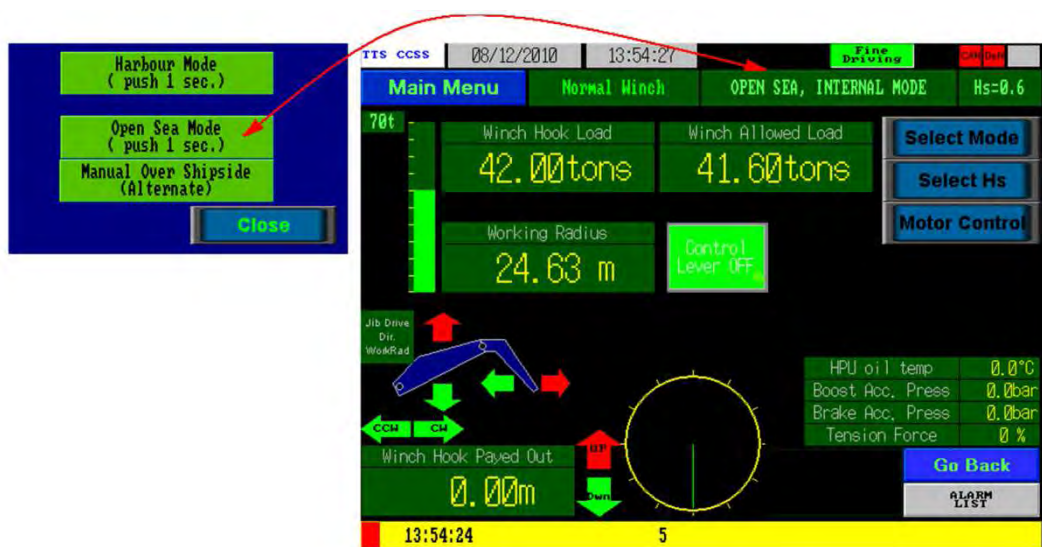


Figure 5-12a Selector button "Open Sea Mode"- Open Sea, Internal Mode

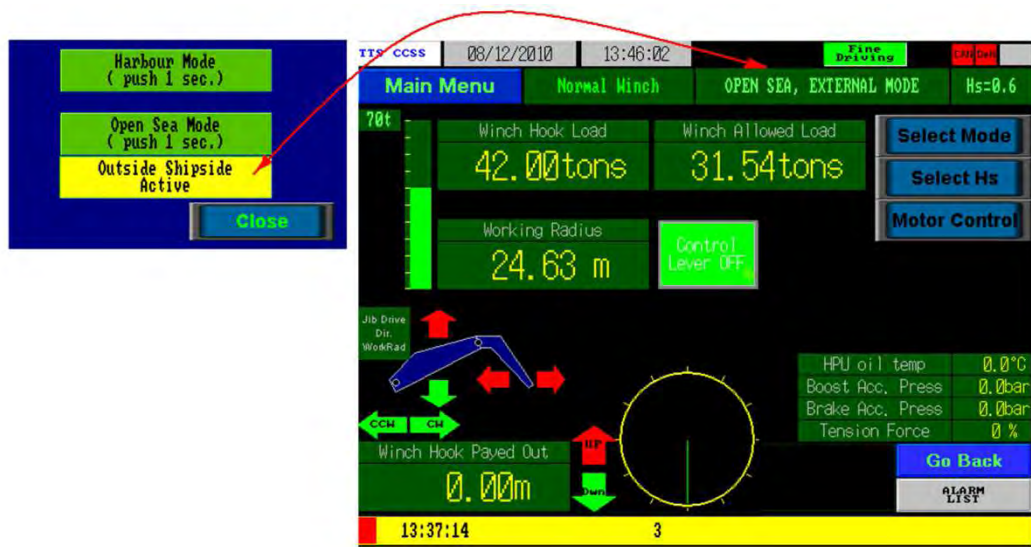


Figure 5-12b Selector button "Open Sea Mode"-Open Sea, External Mode

11. *Significant Wave Height (Hs)* selector button. In *Open Sea Mode* crane operator can define one of four possible values of Hs. This is possible by pressing the selector button on the touch screen for 3 sec. for appropriate significant wave height. Yellow colour of the button means that selected Hs is activated.
- 12.

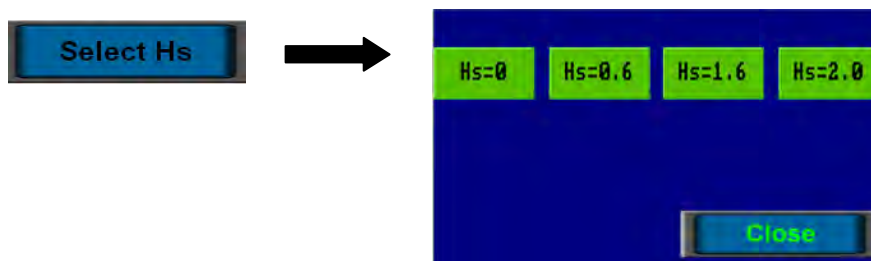
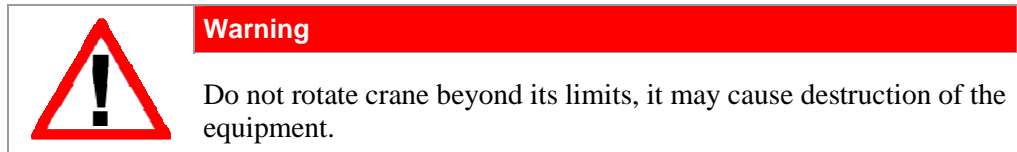


Figure 5-13 Selector button "Select Hs"

13. *Motor Control* selector button.
This page is available from *Operating Display* by choosing *Motor Control* selector button and as well from *Main Menu* page by pushing selector button: **5. HPU Motor and Stats**, refer to *chapter 5.3.7.5*.
14. Current HPU oil tank temperature, °C.
15. Boost Accumulator Pressure, bar.
16. Brake Accumulator Pressure, bar.
17. Tension Force, %.
18. **Go Back** button – allows to return to the previous display page.
19. **ALARM LIST** button – direct access to the Alarm List, refer to *chapter 5.3.7.6*.
20. Last active alarm.
21. Winch allowed load according to SWL (*Safety Working Load*) depended on crane mode and outreach.

22. Crane slew sector. Green line represents actual angle. Crane slew sector is limited by 360° , so operator should keep an eye on the slew sector chart.



23. Number of active alarms.
24. Winch UP/DOWN availability arrows, shows if crane could be operated in corresponding direction, green colour – available, red – not available for example due to limits or overload.
25. Alarm registration time.
26. Length of payed out wire on the winch.
27. Crane slew *Clockwise/Counter Clockwise* availability arrows, shows if crane could be operated in corresponding direction, green – available, red – not available.
28. Main jib UP/DOWN availability arrows. For example if arrow for direction main jib up is red then main jib can't be operated UP, if it is green then it can be operated.
29. Knuckle jib IN/OUT availability arrows, green – available, red – not available.
30. Working radius in meters.
31. Hook load according to crane mode and outreach, in metric tons.
32. Load chart showing load on hook according to crane mode and outreach. Total scale is equal to crane SWL (*Safety Working Load*).
33. Control lever OFF/ON lamp. Red lamp indicates when control levers are switched ON. Green lamp indicates when control levers are switched OFF.

5.3.7.2 Main Menu

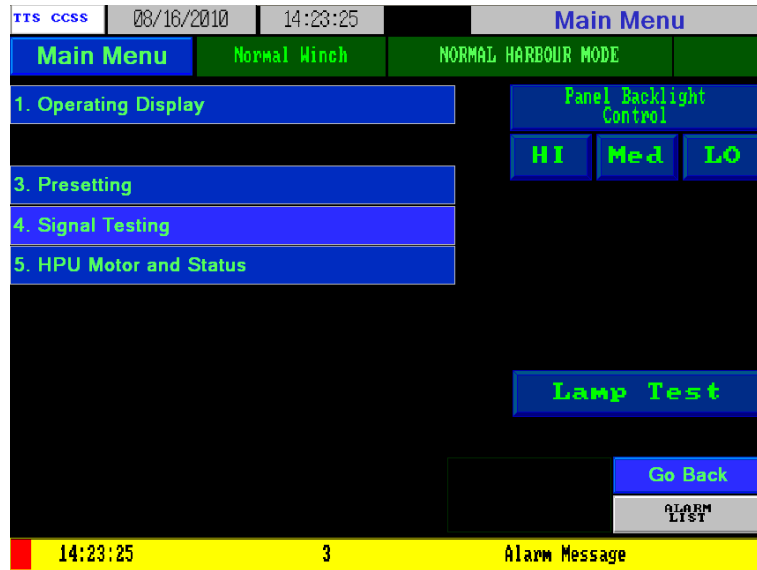


Figure 5-14 Operator's display - Main Menu

Main Menu page provides access to the following submenus:

- Operating Display, refer to chapter 5.3.7.1.
- Presetting, refer to chapter 5.3.7.3.
- Signal Testing, refer to chapter 5.3.7.4.
- HPU Motor and Status, refer to chapter 5.3.7.5.
- Panel Backlight Control to adjust display backlight: **HI**gh, **Med**ium, **LO**w.
- **Lamp Test** button – activation/checking by turning on all lamps on the operator panel –IB300.

5.3.7.3 Presetting



Figure 5-15 Operator's display – Presetting

Presetting screen must only be entered by qualified personnel. All of submenu screens are password protected. There are two passwords, one for setting the screens (it can be inserted by operator) and the other one for parameter screens (it can be inserted only by TTS service personnel).

Presetting menu page provides access to following submenus:

- Hook Limit Main Winch, A Sensor, refer to chapter 5.3.7.3.1.
- Main Winch Parameter, refer to chapter 5.3.7.3.2.
- Main Jib Angle, A Sensor, refer to chapter 5.3.7.3.3.
- Knuckle Jib Angle, A Sensor, refer to chapter 5.3.7.3.4.
- AO Valve Ramp Values, refer to chapter 5.3.7.3.5.
- Load Cell, Main Winch A-B, refer to chapter 5.3.7.3.6.

5.3.7.3.1 Hook Limit Main Winch

From **Main menu** page push **Presetting** and **31. Hook Limit Main Winch. A sensor**. Hook limit settings display page is password protected.

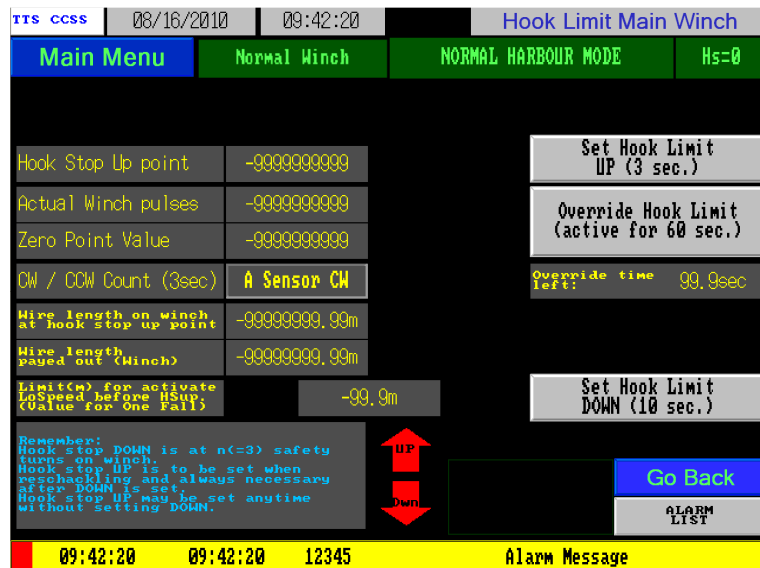


Figure 5-16 Operator's display - Hook Limit Main Winch. A sensor

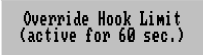
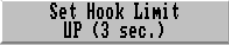
For correct and efficient operation follow the instructions in the left display corner.

CAUTION!

Always set Hook stop down point first. Hook stop down point is at least **3 safety turns** of wire on winch. Hook stop up is to be set when reshackling and always necessary after hook stop down is set.


How to set main winch hook limits:

- Lower winch until it will be 3 safety turns on the winch drum. If necessary, use button **Override Hook Limit (active for 60 sec.)** to override hook limit stop.
- When winch drum contains 3 turns of wire push button **Set Hook Limit DOWN (10 sec.)** and hold it for ten seconds until the field "**Zero Point Value**" will change its value to present "**Actual winch pulses**".
- Hoist winch and check that "**Actual winch pulses**" value increase while operating winch up.
- If "**Actual winch pulses**" decreases while hoisting the winch, push button **A Sensor CW** and hold it for 3 second, it should change its status to: **A Sensor CCW**.
- Normal value for **CW / CCW Count (3sec)** field for main winch is **A Sensor CW**.

- Continue to hoist winch until it reaches its max. up position. If necessary, use button  to override hook limit stop.
- When hook is in its max. up position push button  and hold it for 3 seconds, field “**Wire length on winch at hook stop up point**” should change its value to actual wire length which has spooled on winch drum.
- Input value in [m] to activate Low speed before hook stop up.
- Check activation of limits stop and low speed by operating the winch.

5.3.7.3.2 Main Winch Parameter

To access to this display page from **Preset Menu** page choose position: **34. Main Winch Parameter**. Main Winch Parameter display page is password protected.



Warning

Adjusting the winch parameters can result in drop of load.

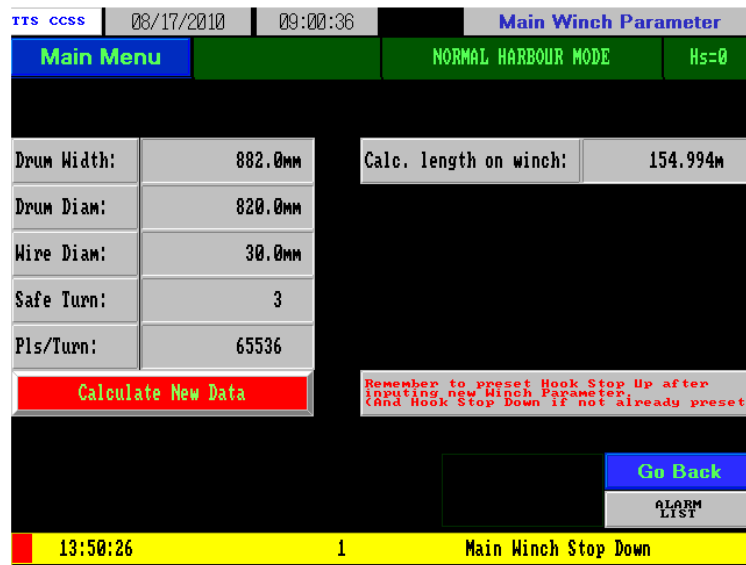


Figure 5-19 Operator's display – Main Winch Parameter

Usually this page is used only in case of exchanging the winch or winch wire for a new type and also in case when new PLC or encoder with different settings will be changed for a new one.

Input required data for the winch in fields on the display page:

- Drum width, mm.
- Drum diameter, mm.
- Wire diameter, mm.
- Number of safety turns.
- Number of pulses per turn for winch encoder (65536), refer to encoder user manual.

To update value for “**Calculate length on winch**” push button



CAUTION!

Remember to preset Hook Stop Up after inputting new winch parameter (and Hook Stop Down if not already preset).

5.3.7.3.3 Main Jib Angle

To access to this display page from **Preset Menu** page choose position: **36. Main Jib Angle. A sensor**. Main Jib Angle settings display page is password protected.

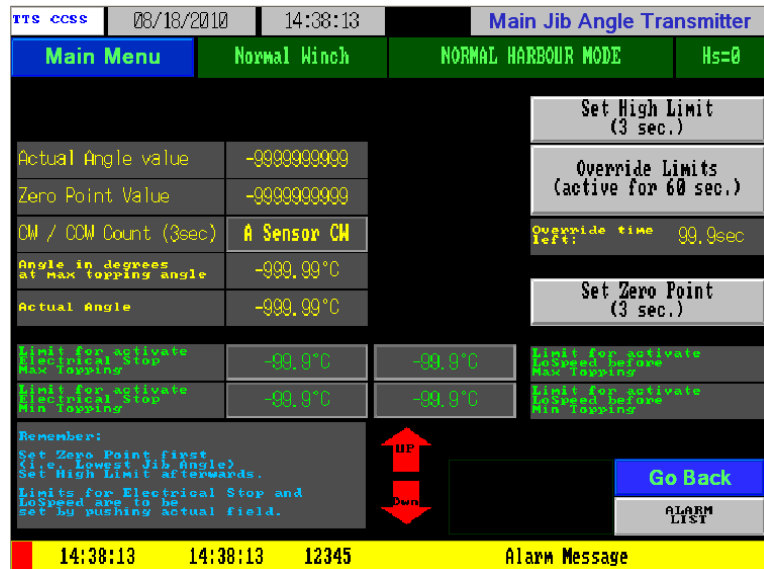


Figure 5-20 Operator's display – Main Jib Angle. A sensor

CAUTION!


For correct and efficient operation follow the instructions in the lower left display corner.

Always set Zero point first.

Main Jib Zero point is lowest jib angle. Set high limit afterwards.

How to set main jib angle limits:

- Operate main jib down until it reaches its minimal topping mechanical stop limit.
If necessary, use button **Override Limits (active for 60 sec.)** to override main jib limit stops.
- When main jib is in its lowest position push button **Set Zero Point (3 sec.)** and hold it for 3 seconds. Field **“Actual Angle”** should change its value to **0.0°**. Field **“Zero Point value”** should change its value to present **“Actual Angle value”**.
- Operate main jib up, check that **“Actual Angle value”** increases while operating main jib up.
- If **“Actual Angle value”** decreases while operating main jib up, push button **A Sensor CW** and hold it for 3 seconds, it should change its status to **A Sensor CCW**.
- Normal value for **CW / CCW Count (3sec)** field for main jib is **A Sensor CCW**.
- Continue to operate main jib up until it reaches its maximal topping mechanical stop limit. If necessary, use button **Override Limits (active for 60 sec.)** to override jib limit stops.

- When main jib is in its highest position push button  and hold it for 3 seconds. Field “**Angle in degrees at max topping**” change its value to present “**Actual angle**” value.
- Perform setting up limits for stop and low speed activation.

Setting up limits for stop and low speed activation:

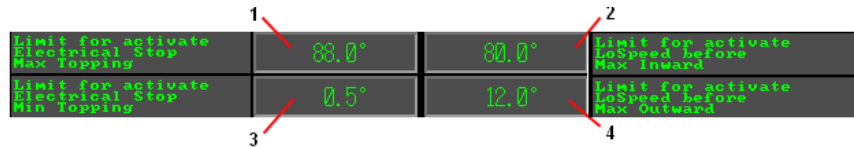


Figure 5-21 Main Jib Angle – Setting up limits for stop and low speed activation

- Push field **1** (refer to *Figure 5-21*) and input value for electrical stop max topping.
- Push field **2** (refer to *Figure 5-21*) and input value for activating Low Speed (MAIN JIB UP) before electrical stop max topping.
- Check activation of electrical stop and low speed by operating main jib.
- Push field **3** (refer to *Figure 5-21*) and input value for electrical stop min topping.
- Push field **4** (refer to *Figure 5-21*) and input value for activating Low Speed (MAIN JIB DOWN) before electrical stop min. topping.
- Check activation of electrical stop and low speed by operating main jib.
- Figure above is showing guiding values for main jib angle settings.

5.3.7.3.4 Knuckle Jib Angle

To access to this display page from **Preset Menu** page choose position: **37. Knuckle Jib Angle. A sensor**. Knuckle Jib Angle settings display page is password protected.

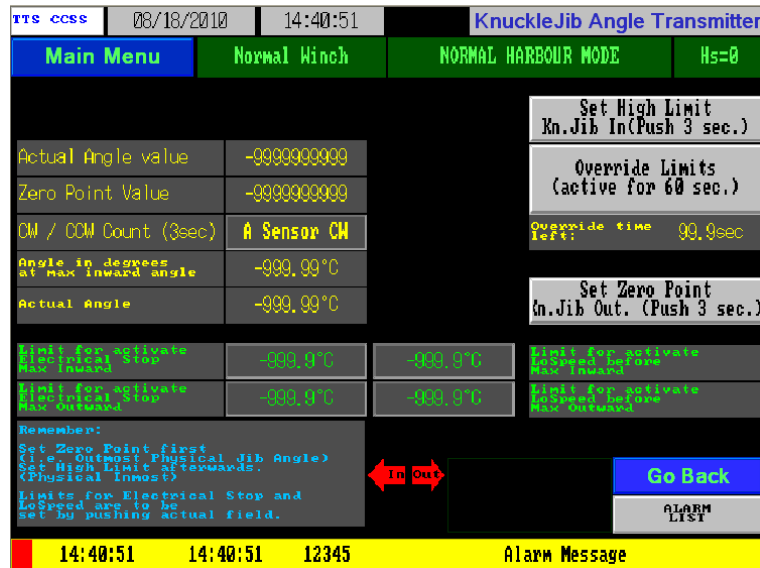


Figure 5-22 Operator's display – Knuckle Jib Angle. A sensor

CAUTION!

For correct and efficient operation follow the instructions in the lower left display corner.

Always set Zero point first.

Knuckle Jib Zero point is outmost jib angle. Set high limit afterwards – inmost position.

How to set knuckle jib angle limits:

- Operate knuckle jib out until it reaches its max outward position. If necessary, use button **Override Limits (active for 60 sec.)** to override knuckle jib limit stops.
- When knuckle jib is in its max outward position push button **Set Zero Point (3 sec.)** and hold it for 3 seconds. Field **“Actual angle”** change its value to **0.0°**. Field **“Zero Point Value”** change its value to present **“Actual angle value”**.
- Operate knuckle jib in, check that “Actual angle value” increases while operating knuckle jib in.
- If **“Actual angle value”** decreases while operating jib in, push button **A Sensor CW** and hold it for 3 seconds, its status changes to **A Sensor CCW**.
- Normal value for field **CW / CCW Count (3sec)** for knuckle jib is **A Sensor CCW**.
- Continue to operate knuckle jib in until it reaches its max inward position. If necessary, use button **Override Limits (active for 60 sec.)** to override jib limit stops.
- When knuckle jib is in its max inward position push button **Set High Limit Kn.Jib In (Push 3 sec.)** and hold it for 3 seconds. Field **“Angle in degrees at max inward angle”** change its value to present **“Actual angle”** value.
- Perform setting up limits for stop and low speed activation.

Setting up limits for stop and low speed activation:

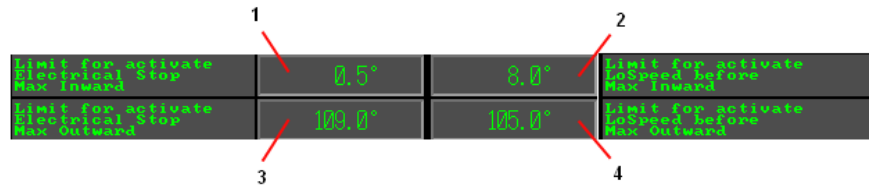


Figure 5-23 Knuckle Jib Angle – Setting up limits for stop and low speed activation

- Push field 1 (refer to Figure 5-23) and input value for electrical stop max inward position.
- Push field 2 (refer to Figure 5-23) and input value for activating Low Speed (KNUCKLE JIB IN) before electrical stop max inward position.
- Check activation of electrical stop and low speed by operating knuckle jib.
- Push field 3 (refer to Figure 5-23) and input value for electrical stop max outward position.
- Push field 4 (refer to Figure 5-23) and input value for activating Low Speed (KNUCKLE JIB OUT) before electrical stop max outward position.
- Check activation of electrical stop and low speed by operating knuckle jib.
- Figure above is showing guiding values for knuckle jib angle settings.

5.3.7.3.5 AO Valve Ramp Values

To access to this display page from **Preset Menu** page choose position: **38. AO Valve Ramp Values**. AO Valve Ramp Values display page is password protected.

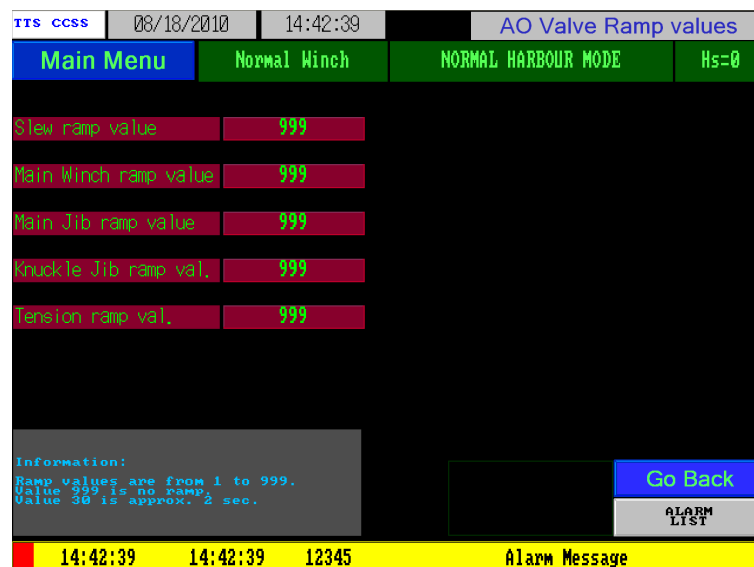


Figure 5-24 Operator's display – AO Valve Ramp values


CAUTION!

For correct and efficient operation follow the instructions in the lower left display corner.
Ramp values should be in range from 1 to 999. Value 999 means NO ramp.
Value 30 is approximately 2 seconds.

5.3.7.3.6 Load Cell, Main Winch

To access to this display page from **Preset Menu** page choose position: **40. Load Cell, Main Winch. A-B**. Main Winch load cell Parameter display page is password protected.

Warning



Adjusting the winch load cell may cause overload and destruction of equipment.

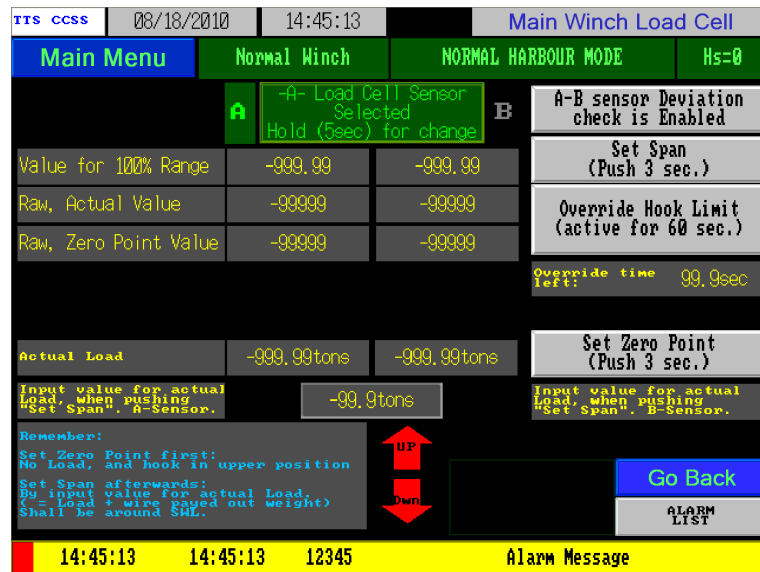


Figure 5-25 Operator's display – Main Winch Load Cell

CAUTION!

For correct and efficient operation follow the instructions in the lower left display corner.
 Always set Zero point first.
 No load and hook in upper position.
 Set span afterwards: by input value for actual load - should be around SWL (Safety Working Load).

How to calibrate main winch load cell:

- Hoist winch with no load to hook stop up position.
- Push button Set Zero Point (Push 3 sec.) and hold it for 3 seconds. Field “**Actual Load**” should change its value to **0.00 tons**.
- To ensure the accuracy of the calibration use a Span Load close to SWL, if possible. The weight input must be in metric tons. Use a calibrated load or use a certified load cell to measure the load.
- Input value [tons] for actual load that will be used for span.



Figure 5-26

- Lift the load, use button **Override Hook Limit (active for 60 sec.)** if necessary.
- Wait until the load value is stabilised, then push button **Set Span (Push 3 sec.)** and hold it for 3 seconds. Field “**Actual Load**” should change its value and it will be equal to the value of Span load.
- Check the readings by lifting available calibrated load or by using external load cell.

5.3.7.4 Signal Testing

To access to this display page choose position: **3. Signal Testing** from **Main Menu** page, refer to *Figure 5-14*.



Figure 5-27 Operator's display – Signal Testing

Signal Testing screen is especially designed for service purposes and provides general information about available sensors. This screen contains of following information:

1. Digital in-signals and digital out-signals.
2. Analog in-signals, calculated analog values and analog out-signals to proportional valves.
3. Analog sensor values. Motor hour-c shows accumulated running time for HPU motor.
4. Counting pulses from encoders for: main winch, slew, main jib and knuckle jib.

5.3.7.5 HPU Motor Status

This page is available from *Main Menu* page by pushing selector button: **5. HPU Motor and Stats** and also from **Operating Display** page by choosing **Motor Control** selector button, refer to chapter 5.3.7.1.

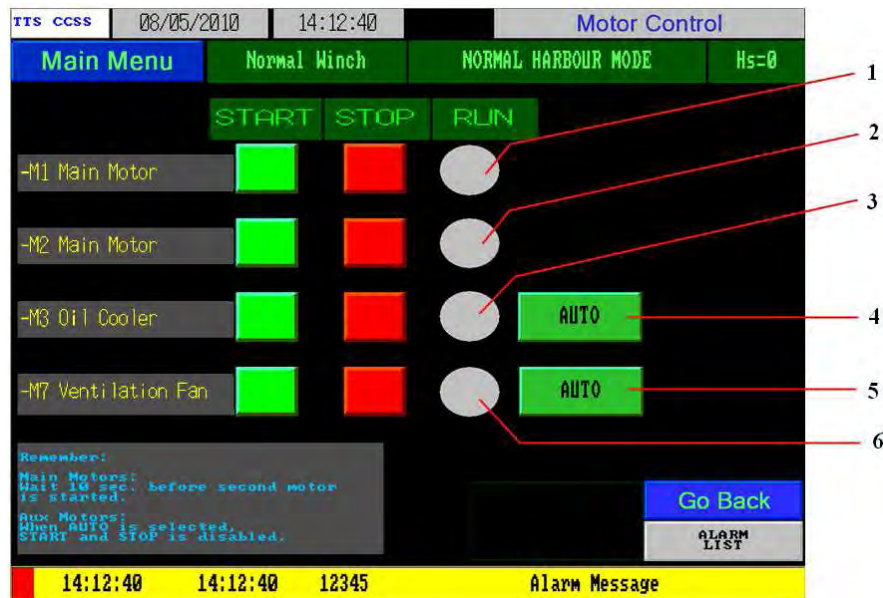


Figure 5-28 Operator's display – HPU Motor and Status (Main Menu) / Motor Control (Operating Display)

HPU Motor and Status /Motor Control page provides information about control status for main HPU motors. Main motors –M1, –M2 can be controlled locally, from starter cabinet or from crane cabin (*Operator Panel –IB300, Operator's display –IB310*).

1. Running status for Main HPU Motor –M1: green – motor is running.
2. Running status for Main HPU Motor –M2: green – motor is running.
3. Running status for Oil Cooler Motor –M3: green – motor is running.
4. Running status for Ventilation Fan –M7: green – motor is running.

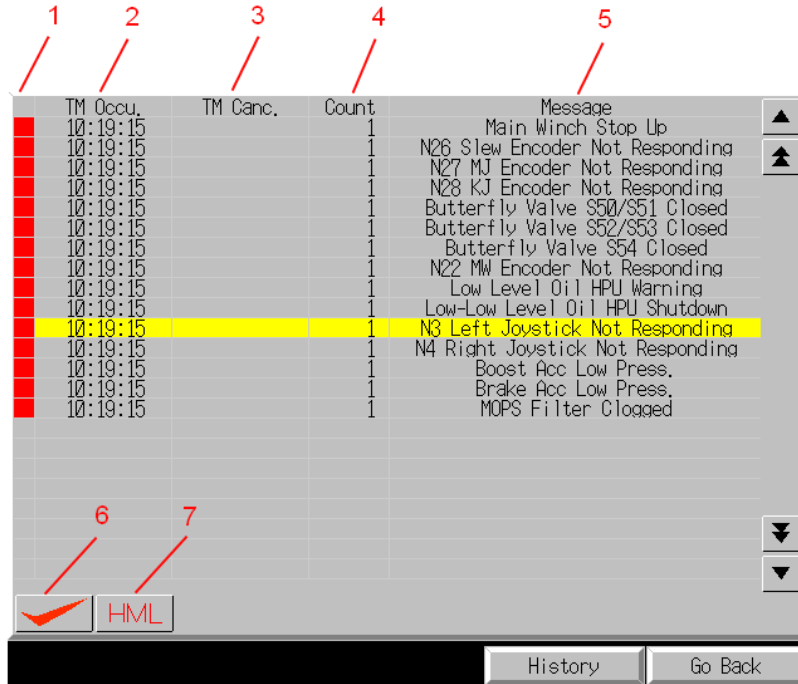
Oil Cooler and Ventilation Fan motors can be controlled manually or automatically. *AUTO* mode for Ventilation Fan Motor, means that it is started when one of the main motors (–M1 or –M2) is running. Actual text in field for selector button of control status (AUTO or MANUAL) describes present status.

CAUTION!

For correct and efficient operation follow the instructions in the lower left display corner.
 When one HPU motor is running remember to wait 10 seconds before starting second motor.
 When AUTO status for oil cooler motor / ventilation fan is selected, start and stop is disabled.




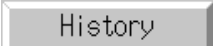
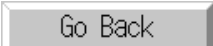
5.3.7.6 Alarm List

Alarm list is available by pressing button  from every display's page. The page is for reading actual active alarms. It contains alarms which have status "occurred and not cancelled". Display order of alarm messages is "new date and time"




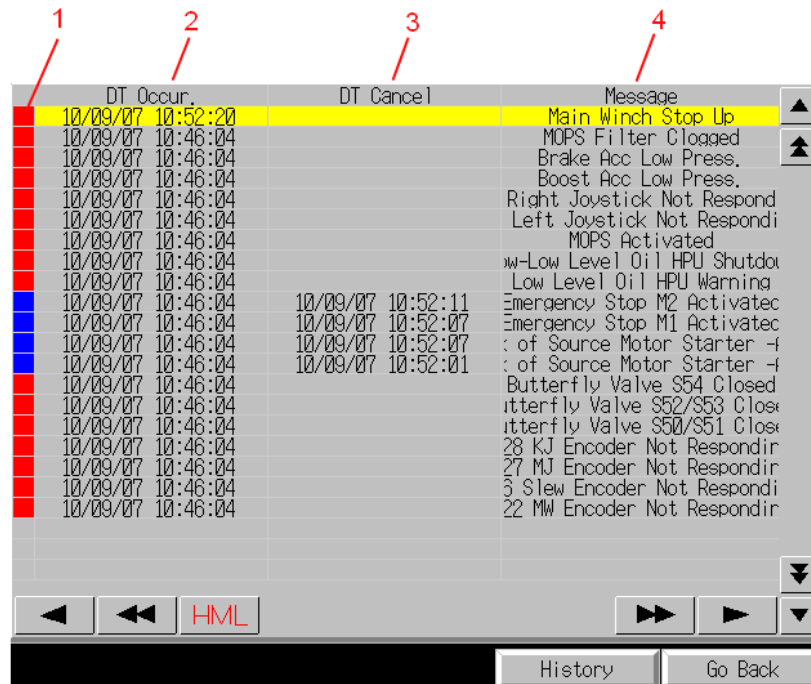
1	2	3	4	5
TM Occu.	TM Canc.	Count	Message	
<input checked="" type="checkbox"/>	10:19:15	1	Main Winch Stop Up	▲
<input checked="" type="checkbox"/>	10:19:15	1	N26 Slew Encoder Not Responding	▲
<input checked="" type="checkbox"/>	10:19:15	1	N27 MJ Encoder Not Responding	
<input checked="" type="checkbox"/>	10:19:15	1	N28 KJ Encoder Not Responding	
<input checked="" type="checkbox"/>	10:19:15	1	Butterfly Valve S50/S51 Closed	
<input checked="" type="checkbox"/>	10:19:15	1	Butterfly Valve S52/S53 Closed	
<input checked="" type="checkbox"/>	10:19:15	1	Butterfly Valve S54 Closed	
<input checked="" type="checkbox"/>	10:19:15	1	N22 MW Encoder Not Responding	
<input checked="" type="checkbox"/>	10:19:15	1	Low Level Oil HPU Warning	
<input checked="" type="checkbox"/>	10:19:15	1	Low-Low Level Oil HPU Shutdown	
<input checked="" type="checkbox"/>	10:19:15	1	N3 Left Joystick Not Responding	
<input checked="" type="checkbox"/>	10:19:15	1	N4 Right Joystick Not Responding	
<input checked="" type="checkbox"/>	10:19:15	1	Boost Acc Low Press.	
<input checked="" type="checkbox"/>	10:19:15	1	Brake Acc Low Press.	
<input checked="" type="checkbox"/>	10:19:15	1	MOPS Filter Clogged	

Figure 5-29 Operator's display – Alarm List

1. Colour code for alarm: red – alarm has occurred and not checked; purple – alarm has occurred and checked by operator (by means of button ).
2. Time of alarm occurrence.
3. Time of alarm cancelling.
4. Alarm counter (how many times alarm has occurred during the session), alarm counter for active alarm is also shown on the operating display page, refer to chapter 5.3.7.1.
5. Alarm message.
6.  button for checking alarms, after checking, colour code for alarm in Alarm history (refer to chapter 5.3.7.7) will change to blue.
7.  button – applies filter for alarms: **H** – high alarms, **L** – low alarms, **M** – middle alarms.
8.  button – push for selecting alarm history, refer to chapter **Error! Reference source not found.**
9.  button – returns to previous display page.

5.3.7.7 Alarm history

Alarm history list is available by pressing button  from alarm list page, refer to previous chapter.




DT Occur.	DT Cancel	Message
10/09/07 10:52:20		Main Winch Stop Up
10/09/07 10:46:04		MOPS Filter Clogged
10/09/07 10:46:04		Brake Acc Low Press.
10/09/07 10:46:04		Boost Acc Low Press.
10/09/07 10:46:04		Right Joystick Not Respond
10/09/07 10:46:04		Left Joystick Not Respondi
10/09/07 10:46:04		MOPS Activated
10/09/07 10:46:04		Low Level Oil HPU Shutdow
10/09/07 10:46:04		Low Level Oil HPU Warning
10/09/07 10:46:04	10/09/07 10:52:11	Emergency Stop M2 Activated
10/09/07 10:46:04	10/09/07 10:52:07	Emergency Stop M1 Activated
10/09/07 10:46:04	10/09/07 10:52:07	: of Source Motor Starter -f
10/09/07 10:46:04	10/09/07 10:52:01	: of Source Motor Starter -f
10/09/07 10:46:04		Butterfly Valve S54 Closed
10/09/07 10:46:04		Butterfly Valve S52/S53 Clos
10/09/07 10:46:04		Butterfly Valve S50/S51 Clos
10/09/07 10:46:04		28 KJ Encoder Not Respondir
10/09/07 10:46:04		27 MJ Encoder Not Respondir
10/09/07 10:46:04		3 Slew Encoder Not Respondi
10/09/07 10:46:04		22 MW Encoder Not Respondir

Figure 5-30 Operator's display – Alarm history

Alarm history page provides history of alarms occurred during the session and contains following information:

1. Colour code for alarm: red – alarm has occurred and still not checked; blue – alarm has occurred and has been cancelled.
2. Date and time of alarm occurrence.
3. Date and time of alarm cancelling.
4. Alarm text message. To see the whole alarm text message use horizontal arrow bars.

 button – applies filter for alarms: **H** – high alarms, **L** – low alarms, **M** – middle alarms.

List of alarms is represented in the Table 5-1.

Table 5-1 List of alarms

Alarm	Buzzer inside -IB300	Text message on -IB310	Common alarm lamp on -IB300	Warning horn
N22 MW Encoder Not Responding	x	x	x	
N26 Slew Encoder Not Responding	x	x	x	
N27 MJ Encoder Not Responding	x	x	x	
N28 KJ Encoder Not Responding	x	x	x	
Butterfly Valve S54 Closed	x	x	x	
Butterfly Valve S50/S51 Closed	x	x	x	
Butterfly Valve S52/S53 Closed	x	x	x	
Lack of Source Motor Starter -A901	x	x	x	
Lack of Source Motor Starter -A902	x	x	x	
Emergency Stop M1 Activated	x	x	x	
Emergency Stop M2 Activated	x	x	x	
Tension Activation Error	x	x	x	
90% Load Exceeded	x	x	x	
100% Load Exceeded	x	x	x	x
100++% MW Overload Stop Activated	x	x	x	x
Main Winch Stop Up	x	x	x	
Low Level Oil HPU Warning	x	x	x flashing	
Low-Low Level Oil HPU Shutdown	x	x	x	
High Temp. Oil Warning 75°C	x	x	x flashing	
High Temp. Oil Shutdown 85°C	x	x	x	
Motor M1 Error - NO feedback	x	x	x	
Motor M2 Error - NO feedback	x	x	x	
Temp.Transmitter Oil tank Broken Wire	x	x	x	
Load Cell1 MW Broken Wire	x	x	x	
MOPS Activated	x	x	x	x
Start Error_CL Active	x	x	x	
N3 Left Joystick Not Responding	x	x	x	
N4 Right Joystick Not Responding	x	x	x	
Press.Trans. Boost Acc. Broken Wire	x	x	x	
Press.Trans. Brake Acc. Broken Wire	x	x	x	
Boost Acc Low Press.	x	x	x	
Brake Acc Low Press.	x	x	x	
MOPS Filter Clogged	x	x	x	
Full Override Activated	x	x	x	
Main Winch Stop Down	x	x	x	
Suction/Return Low Press.	x	x	x	

5.3.8 Lighting equipment and socket outlet

Cabin contains a light fixture which is placed on the right hand side behind and right over the crane operator seat – refer to chapter 5.3.3, *Figure 5-3 Cabin Layout*.

Cabin light may be switched on/off (switch –S320). This switch together with socket outlet is placed on the left hand side of the cabin close to the entrance door.

5.3.9 Air condition unit

For operating instructions of air condition unit –R330, refer to separately supplied user manual.

5.4 MANUAL OVERLOAD PROTECTION SYSTEM MOPS

The MOPS can be activated by the operator in case of entanglement i.e. a supply vessel or similar, if the wire load must be released to prevent/minimize damage done to the crane.

MOPS can be activated by yellow push button –S390 located in the cabin on the operator panel –IB300. An alarm will occur when the MOPS will be activated, external horn will sound. The MOPS is re-set by pulling up MOPS button. The alarm stops and the crane can be operated normally depending on damage on the crane.

MOPS accumulators must be charged to engage Manual Overload Protection System. When the accumulators are charged the MOPS Ready lamp –H04 on operator panel –IB300 is lighted up, refer to chapter 5.3.5, *Figure 5-7*. It means that accumulators are charged and the crane is ready for MOPS. If the accumulators are not charged, MOPS Ready lamp –H04 is not lighted up, as well it will occur an alarm on the operator display –IB310: *Boost Acc. Low Press/ Brake Acc. Low Press*, depending which accumulator is not charged.

Manual Overload Protection System is direct hydraulic solution. When valve “140” is activated, the winch motor is short-circuited and brake released. The MOPS is available even in “dead ship” conditions, without any power supply from ship.

The maximum torque acting on the winch will be limited to a preset force. If the actual load exceeds preset level the winch will automatically pay out more wire to avoid damage to the winch/crane. The hook limits will stop paying out wire.

5.5 TENSION MODE

CAUTION!

It is not possible to activate Tension mode if hook load is higher than 1.0 ton. If no load is attached to hook, winch will run at full hoist speed. There is a CT-force hysteresis when winch goes from paying in to out and opposite.

Tension mode activation procedure:

The accumulators must be charged to engage Tension mode. When the accumulators are charged the Winch Tension Enable yellow lamp –SH03 on operator panel –IB300 is lighted up, refer to chapter 5.3.5, Figure 5-7. That means that Tension can be activated.

- Selecting first step for tension mode is shown by a flashing status lamp –SH03. Push the Winch Tension Enable button –SH03 on operator panel. This means that constant tension is not selected, only prepared for selection.
- If load on hook is less than 0.7 ton, tension mode can be activated.
- To activate tension pull the right joystick in hoisting position to obtain Tension. In Open Sea mode Tension force can be adjusted by potentiometer –ZT300, refer to chapter 5.3.5, Figure 5-7. When releasing the joystick in tension mode, tension force will be adjusted to zero.
- While in tension mode push left blue button on right joystick Tension Activation. To deactivate tension push this button second time.

When Tension is activated it will be a message shown on Operating Display page display page, refer to chapter 5.3.7.1, Figure 5-10. In case of any problems with activating tension alarm message will occur on the operator display –IB310: *Tension Activation Error*.

5.6 EMERGENCY STOP

The emergency stop system includes the following options:

- Electric emergency stop button located inside crane house on the starter cabinet –A901.
- Electric emergency stop button located inside crane house on the starter cabinet –A902.
- Electric emergency stop button located on the operator panel on the right side of the chair.
- Electric emergency stop button installed outside crane foundation.

Deactivating emergency stop can be done by turning the electric mushroom type button CW. Prior to deactivating the emergency stop, ensure that the reason for activating the emergency stop has been identified and cleared up.

CAUTION!

Avoid using Emergency stop button for a crane normal stop procedure.
Emergency stop button is for Emergency use only.

5.7 EMERGENCY OPERATION

This crane has been designed for emergency operation in case of loss of power.

Reference Drawing: 11857H001

5.7.1 Lowering of winch

1. Connect hand pump's suction line (1/2" hose) to suction connector 923.1 located in tank bottom or to a bucket of hydraulic oil.

Note An alternatively quick connector on the suction line must be dismantled before putting suction hose into the bucket.

2. Pressure line (3/8" hose)-female quick connector 903.1 shall be connected to male quick connector 904.2.
3. Additionally flexible hose ended by female quick connector 904.1 shall be connected to male quick connector 903.
4. Make sure that flow control valve 907 is completely close (max. to the right) .
5. By using hand pump recharge accumulator 911 to approximately 200 bar.
6. Close ball valve 925 located next to maneuvering valve.
7. Open ball valve 905.4 located on the aluminium plate.
8. Carefully start to open flow control valve 907, observe load lowering.
9. Lowering can be controlled by flow control valve 907. If lowering will stop before reaching safe position, accumulator has to be recharged by hand pump ones more.
10. For immediately stopping of lowering open valve 925.

Note Eventually valves on hand pump to be kept closed.
After reaching safe position set all valves in previous state.

5.7.2 Lowering of jib

1. Open valve 905.1.
2. Slowly start to open valve 905.2, observe the jib. Jib will start to move down.
3. Speed of lowering depends from actual load on the hook.
4. Acceleration can be controlled by adjusting valve 905.2.
5. After reaching safe position set all valves in previous state.

Note Emergency operation instruction is also located inside the cranehouse on the wall.

5.8 DISTURBANCE FOR OPERATION

If the hydraulic system oil gets overheated the power will be reduced dramatically and some crane functions may stop. Risk for damage of components (pump) is considerable. It will also result in an automatic shut down if HPU LoLo level is sensed or if hydraulic oil temperature exceeds 85°C. The HPU motor is equipped with internal thermistors to detect overheating. If motor is overheated it will stop. Crane functions will also stop if the 110% SWL limit is exceeded.

5.9 HAZARDS AND PROTECTIVE MEASURES

The following points sum up the safety aspects related to operation:

- The equipment must only be used for the prescribed purpose.
- The safe working load (SWL) of the machine must never be exceeded. If the machine is overloaded, construction damages may occur. This may not be noticed during normal use of the machine. TTS Ship Equipment AS is not responsible for damage caused by overload.
- The equipment is powered by high pressure hydraulic oil. Beware of the risk of pipe/hose burst.
- If anyone gets hydraulic oil into their eyes or open wounds, wash at once with lots of fresh water.
- No personnel without authorization are allowed to operate the crane.
- Do not under any circumstances operate the crane when the ships heel + trim exceed 5° + 2°.
- Do not operate the crane when wind speeds exceed 20 m/s.
- No tools or loose items must be left on the crane jib.
- The crane is not designed for ice or snow on the structure. Great care must be taken to avoid ice falling down on personnel below the crane.
- Do not operate the crane with personnel other than the crane driver on the crane.
- The crane driver must always be able to see the hook / load, or be in direct contact with somebody who can see the hook / load.
- Do not adjust the various relief valve settings to other values than shown in the Hydraulic flow diagram for the crane.

5.10 OPERATOR'S QUALIFICATION REQUIREMENTS

There is no legislation that requires the operator of the equipment to be certified. However, the operator is required to possess good knowledge of the equipment's safety systems and method of operation.

Any intended operator of this equipment is required to gain experience in operating the equipment under the supervision of experienced operators.

- If the crane operator should temporarily be physically or psychically unfit, he shall not operate cranes.
- The crane operator shall not be preoccupied with anything that might disturb him while operating the crane.
- During load handling, the crane operator shall not start the crane before having an unobstructed view of the signalman or the whole load.
- The crane operator shall only comply with the signals given by the designated signalman. He shall at any time respond to the request for emergency stop, no matter from what source the request might come.
- The crane operator is responsible for all crane handling, and also for the crane handling being carried out in a safe and reliable way. If safety in any way might be questioned, the crane operator shall have authority to stop the crane, and he may refuse handling loads till load handling may be carried out in a safe and reliable way.
- Every day before the cranes are taken into use, the crane operator shall carry out all the necessary movements with the crane, and also carry out such maintenance work as is necessary in order to satisfy himself that the machinery functions satisfactorily. He shall make sure that all safety devices are in their right places and are functioning properly and also that the wire ropes are in a reliable condition.
- Cranes shall not be used if any of the limit switches or other safety equipment should be defective.
- No hoisting gear / equipment shall be used for cargo that is so heavy as to exceed its S.W.L. Whenever several wire slings or chains are used, due regard must be paid to mutual angles. The crane operator shall be informed of the correct weight of the loads he is to hoist.
- Equipment shall be protected against the weather. The storage shall be divided into certain marked areas for the various types of equipment and groups of hoisting gear of similar capacity. The crane operator shall keep the storage space in order. When in use, slings with fasteners and fittings shall be inspected daily to ascertain whether they have suffered any overloading, excessive wear and tear, or damage. Slings found to be defective, shall not be used. A survey chart giving S.W.L. for all types and sizes of equipment used on the installation shall be posted in the storage space.
- The load shall be attached to the hook by means of slings or other devices. Adequate protection shall be provided between the slings and sharp surfaces on the load hoisted.
- Cranes shall only be used for vertical hoisting and lowering of cargo.
- The crane operator must not leave the operator's seat / position while load is hanging in the hook.
- A suitable container or basket shall be used for transportation of smaller cargo.

5.11 TRAINING PROGRAM FOR OPERATORS

Training programs are available from TTS Marine Cranes AS if required, but subject to separate agreement and described separately.

5.12 APPENDIX, MODIFICATION 861185

Project No: 11857
Modification: 861185
Adding Cable reel drum, Load turner
and Stabilizing winch.
Ship (Location) : Luka

Project History, Technical Modifications:**REVISION HISTORY:**

Rev	Date	Sign.	Description
1	22-05-2012	JOB	Initial description of new 861185 conversion.

5.12.1 Overview

The main issues for this modification is:

- Adding load turner
- Adding cable reel drum for electrical supply
- Adding stabilizing winch for load turner
- Electric, hydraulic and mechanic additions

5.12.2 Background details

Mechanic and hydraulic drawings are supplied in another document.

5.12.3 Electric Drawings.

Following electric drawings have been changed:

11857EB2
11857EB3
11857ES3
11857ES4
11857E13
11857C03
11857DN2
11857DN3
11857DN4

Following electric drawings are new:

11857ES5
11857ES6
11857ES7
11857C05
11857C10

5.12.4 Software program versions:

For PLC: 11857PO1may07
For DeviceNET: 11857_2012may07
For Display: 11857PN1MAY18_2012

5.12.5 Implementation into existing control system.

This is a change with added components on crane as well as brackets, wiring and piping and also a SW change in control system.

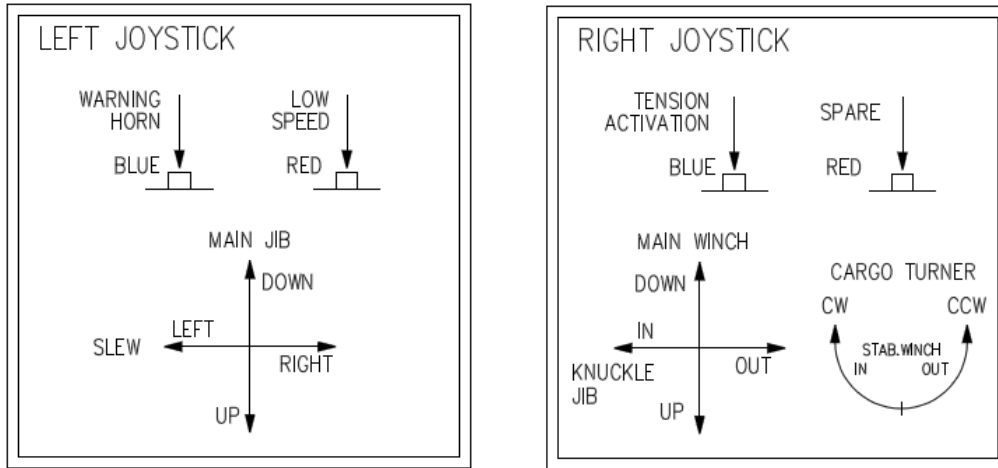
5.12.6 Functional description and Interlocking details.

5.12.7 Cable Reel Drum.

Cable reel drum is permanently mounted on crane and will supply to load turner necessary electric power. The contact point for load turner is fixed on the moving hook assembly. Therefore the cable reel drum is activated whenever the crane main functions are activated to compensate for necessary cable tension.

5.12.8 Load Turner or Cargo Turner.

The load turning device is equipped with an internal motor for making possible turning of the load. The loadturner may be operated by the crane operator. There is a new thumbwheel knob on right hand control lever for this. See picture below.



Right Joystick change:

- X-axis: push lever in left direction to drive knuckle jib in.
- X-axis: push lever in right direction to drive knuckle jib out.
- Y-axis: push lever forwards to lower the winch.
- Y-axis: pull lever backward to hoist the winch.
- Z-axis: Thumb wheel: CW and CCE rotation of cargo turner
- Z-axis: Thumb wheel: Service mode, Stab winch IN / OUT.
- Left BLUE button – TENSION ACTIVATION, push to activate \ deactivate. Activation can be done by pushing and holding the button, release the pushing will deactivate tension mode. The status will be displayed on operator terminal –IB310.
- Right RED button – SPARE, can be used in future for some other needed function.

5.12.9 Stabilizing Winch for Load Turner.

To reduce counter-slewing of hook when slewing cargo there is a stabilizing winch.

The stabilizing winch wire is fastened to the hook assembly.

The control of the stabilizing winch is automatic. It is activated whenever main winch, jib and knuckle jib is operated, either up or down. And it is also activated at load turner driving.

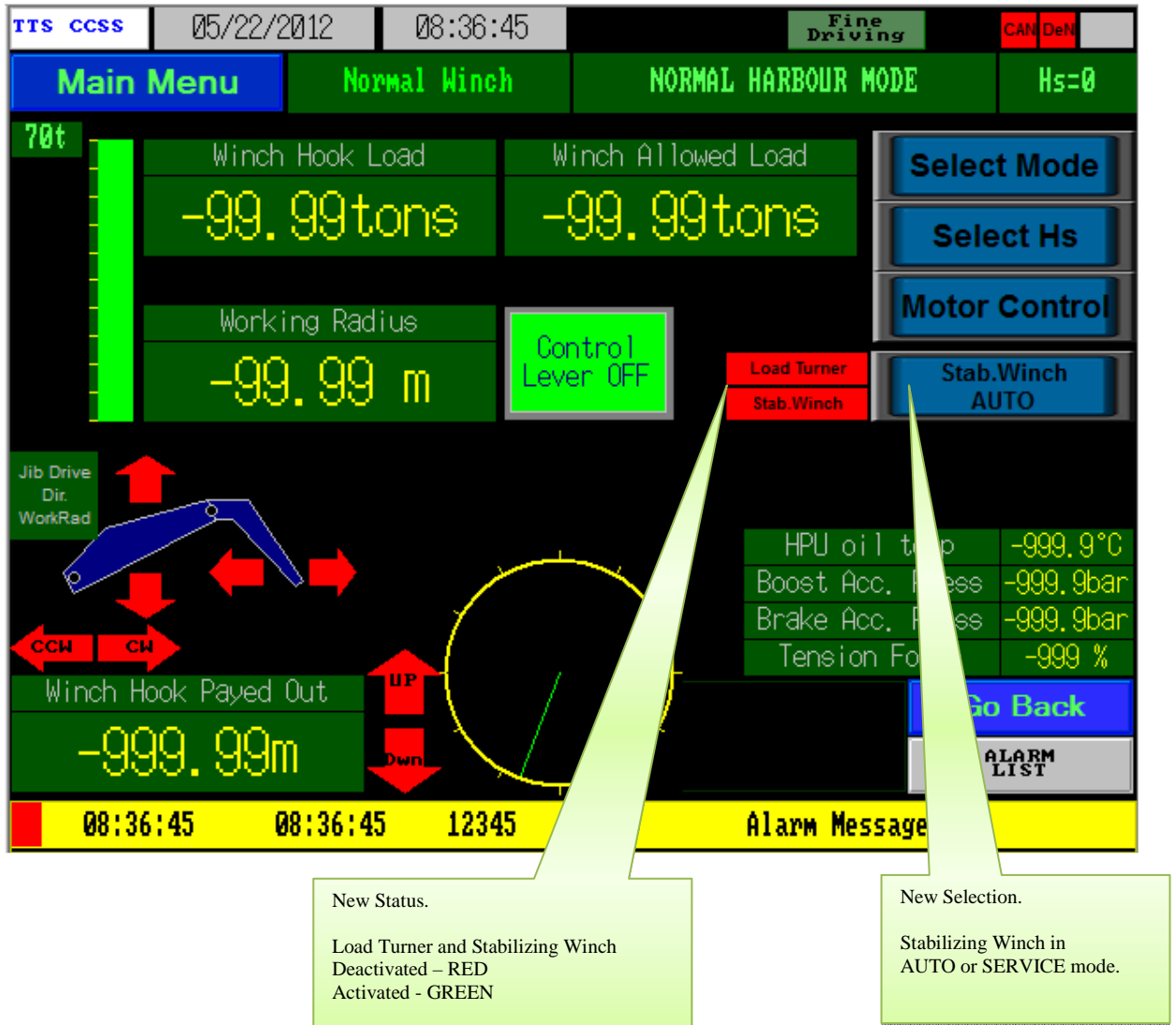
There is a higher signal to winch at load turner/winch up driving than at winch down driving. In addition the stab winch has a force/tension adjustment. This system is also fully automatic and is preset to a low value in case of empty hook driving / load turning into a load dependant value in case of heavy load turning.

The stabilizing winch may be run manually in case of service situations. This is selected from operator display. Ref picture in 5.12.11

The load turner as well as the stabilizing winch may each and separately be deactivated and activated from the operator display which also shows actual status.

5.12.10 Operator Display changes:

5.12.11 Normal Operator Display:



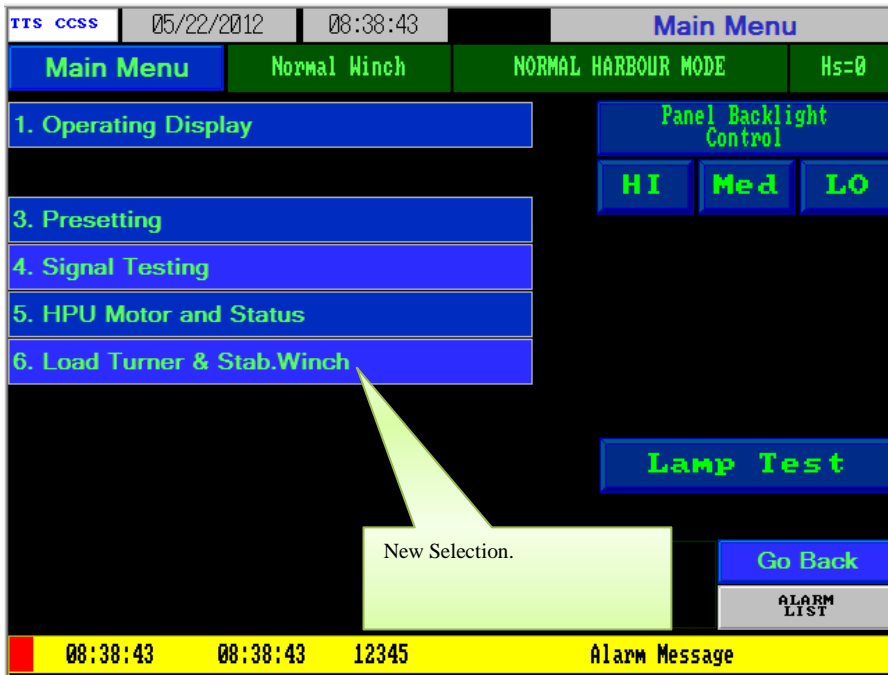
5.12.12 Additional Alarms.

- Cable Reel Motor Overload
- Load Turner Motor Overload

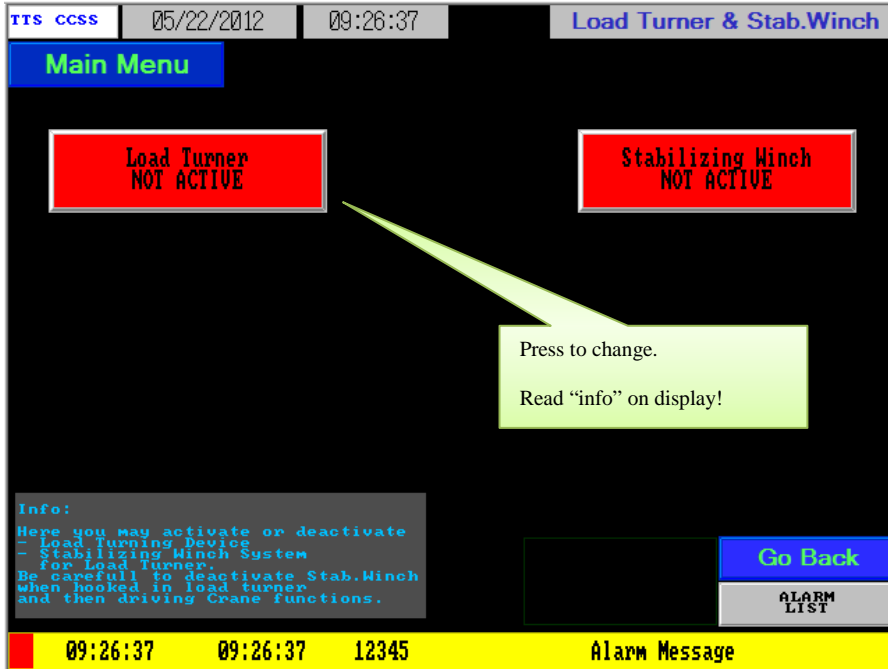
5.12.13 Menu Structure – New Items.

Pressing Main Menu will display this:

At this display, press “Load Turner & Stabilizing Winch”.....



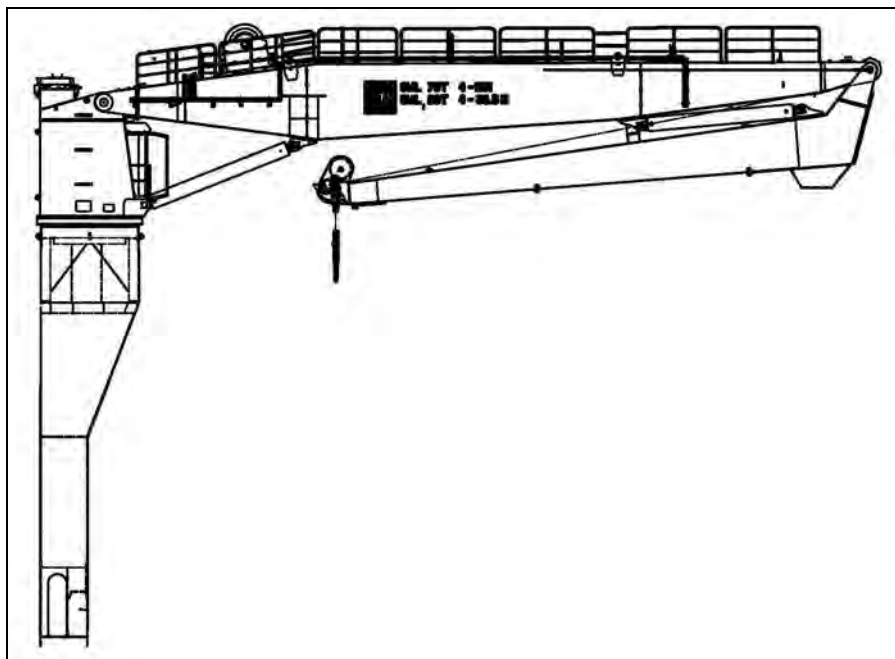
....and then this will pop up.



...for Activating or Deactivating Load Turner and/or Stabilizing Winch.

USER MANUAL

Maintenance



Cargo Crane
CCLKO 2000-70-36,5

RAY Shipping
M/V "Ella"

11857

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6 MAINTENANCE

6.1 General

The following points sum up the safety aspects related to maintenance:

- Only qualified and authorized personnel are allowed to carry out maintenance work.
- Use fall protection equipment.
- A warning sign must be placed at the control panel while maintenance is carried out.
- Ensure that all controllers are placed in the “off” position, and the main switches are open and locked.
- The area below the crane must be cleared and a barrier erected to prevent injury from a falling object.
- Beware of the risk of pipe/hose burst.
- No welding of lugs, brackets etc. must take place on the equipment.
- Only original spare parts must be used - this includes hydraulic hoses.
- Replace all guards and other safety devices before leaving a crane.
- Remove all stops, tools, loose parts and other material and dispose of them before completing the repair job.

If there's any question about maintenance, please contact TTS Ships Equipment AS Service Department. See “Contact Information” in chapter 1.

6.1.1 *Maintenance Log*

It is recommended to establish a Maintenance Log for this equipment. All maintenance, abnormal observations and repairs should be logged. Upon request, the log should be made available to the TTS Ships Equipment AS Serviceman.

A sample maintenance log is included in the appendix section back in this chapter.

6.2 Hydraulic System

The operation and lifespan of a hydraulic system is greatly dependant upon the quality of the hydraulic oil.

The lubrication schedule in the instruction manual indicates the type of oil to be used and frequency of oil changes.

A hydraulic system when in use will always produce particles. The amount and hardness of the particles varies dependant upon how well the system functions and where in the system the particles are produced.

Each type of pollutant entering the oil will reduce the quality. In order to avoid reducing the oil quality, or in the worst case, damaging costly components it is of outmost importance that the oil quality to be maintained as close to that of new oil for the systems entire lifespan.

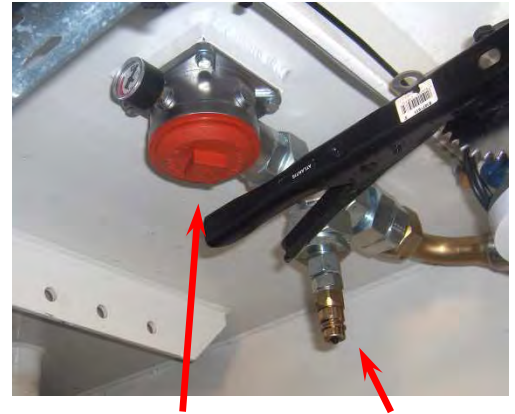
Therefore are the built in filters which function continuously while the system is in use an important part of the hydraulic system.

The hydraulic system flow diagram with its parts list in the instruction manual indicates the location and type of filter used in the system. Regardless of the filter type such as suction filter, pressure filter or return oil filter.

In many cases the filters are equipped with indicators that reveal the condition of the filter. As soon as the indicator signals a dirty or contaminated filter, the filter element is to be replaced immediately.

The oil should be laboratory tested at least every 6 months. The lab report will help in determining the life span of the oil.

Under no circumstances shall a filter operate more than one year without changing the filter element. A clogged filter element causes a BY-PASS through the filter, which result in the system operating with un-filtered oil.



Oil filter / Refill valve



Drain valve



*Oil level glass
and thermometer*

6.2.1 *Hydraulic Oil Change*

Before draining the oil tank, all hydraulic cylinders must be retracted.

After the tank has been drained, remove access cover, hatch cover and check visually for dirt inside the tank. Clean the tank thoroughly.

Replenishment must be carried out through the filling valve. This is to secure that the oil is passing through the return filter before entering the hydraulic system. In order to avoid contamination of the system oil, this plug should always be used whether it is oil change or replenishment of oil.

6.3 **Electric system**

6.3.1 *Introduction*

General maintenance of the electric equipment of the crane is important in order to prevent unexpected breakdown.

The following general advice may be useful.

Relevant block-diagram and detailed circuit diagrams and placed in chapter 8.

Start the crane and try out all combinations of movements that are practical. This will show if the electric functions are working satisfactory.

Inspect all electric equipment, cabinets and components.

Any defective component must be repaired or replaced without delay. A detailed inspection and overhaul at two-years intervals is recommended.

Check that all screws and nuts are securely tightened in the cabinets.

Check also that all switches and push buttons are operating correctly, and that cable connections are perfectly tight and all insulating parts are intact.

Make sure that inspection door gaskets seal perfectly.

6.3.2 *Earth connection, hull*

Verify that the protective earth connections at the crane are made to the ship's hull. Clean contact surfaces when required.

6.3.3 *Earth connection crane*

Check crane system earth connections, and clean contact surfaces as required.

6.3.4 *Control levers*

Clean contacts, insulating parts, cams, contact rolls and rotary potentiometers.

Make sure that all cable connections are clean and secure tightened.

Clean the control levers, and grease their sliding surfaces. Check on the return springs and grease lightly so that no grease transfers to the contacts.

6.3.5 *Slip-ring unit*

Slip rings fitted inside base should be checked once pro month.

- Disconnect power to the crane.
- Check and clean surface of the slip rings.
- Check and clean brushes, and check spring pressure.
- Reconnect power to the crane.

6.3.6 *Contactors*







Once pro month check contactors -K1 and -K2 in starter cabinets -A901 and -A902.

- Disconnect power to the starter.
- Remove Arc Chambers.
- If contacts are slightly burnt, clean fingers
- If the contacts are badly burnt, change contacts with new ones
- Fit Arc Chambers
- Reconnect power to the crane.

6.4 Lubrication Standard

6.4.1 Lubrication Selection Chart






Oil Lubrication

CODE AND USE OF OIL/LUBR.	GENERAL SPECIFICATION	EXAMPLE					
		SHELL	ESSO	* FAMM	MOBIL	KLÜBER	CASTROL
1)  SLEWING GEARBOX	DIN 51517-CLP 150 OR 220 ISO-VG 150/220 (MINERAL OIL)	SPIRAX AX 80 OR OMALA OIL 150	SPARTAN 150	MEROPA 150	MOBILGEAR 630 OR 629	KLUBEROIL GEM 1-220	ALPHA SP 150
1)  WINCH GEARBOX Without sprague clutch	DIN 51517-CLP 150 OR 220 ISO-VG 150/220 (MINERAL OIL)	SPIRAX AX 80 OR OMALA OIL 150	SPARTAN 150	MEROPA 150	MOBILGEAR 630 OR 629	KLUBEROIL GEM 1-220	ALPHA SP 150
1) 2)  WINCH GEARBOX With sprague clutch	DIN 51519 ISO-VG 32 (MINERAL OIL)	TEGULA 32	TORQUE FLUID N 45	RANDO HDZ 32	MOBIL DTE 24	X	HYSPIN AWH-M32
1)  WINCH GEARBOX Continuous Operation Seabed winches	PGLP DIN 51502-220 (SYNTHETIC OIL)	SHELL TIVELA OIL WB	SPARTAN SYNTETIC S220	PINNACLE MARINE GEAR 220	MOBIL GLYGOYLE 30	KLUBERSYNTH GH 6-220	ALPHASYN HG 220
1)  SPREADER GEAR FOR PUMPS	PGLP DIN 51502-220 (SYNTHETIC OIL)	SHELL TIVELA OIL WB	GEAR OIL S220	PINNACLE MARINE GEAR 220	MOBIL GLYGOYLE 30	KLUBERSYNTH GH 6-220	ALPHASYN HG 220
 HYDR. OIL ON SYSTEM	ISO-VG46 HV 46cST/40° VI*150 POUR POINT -40°	TELLUS OIL T 46	NUTO H 46 OR UNIVIS N 46	RANDO HDZ 46	DTE 15 M	X	HYSPIN AWH-M46

1) Mineral and Synthetic oil are not to be mixed. See General Specification.

2) Oil used for gearbox with sprague clutch must not contain MoS2 or other low friction additives. Oil must stand the FZG test A/8 3.90 DIN 51314, failure load stage, equal or better than 12.

Grease Lubrication

CODE AND USE OF OIL/LUBR.	GENERAL SPECIFICATION	EXAMPLE					
		SHELL	ESSO	* FAMM	MOBIL	KLÜBER	CASTROL
 PLAIN BEARING BRONZE	GREASE WITH MOLYBDENDI-SULPHIDE, MoS2	RETINAX HDX		MOLYTEX EP 2	MOBIL-GREASE SPESIAL	X	MS 3 or LMM grease
3)  PLAIN BEARING COMPOSITE	GREASE WITH EP ADDITIVES	ALVANIA EP 2 OR 3 GREASE	BEACON EP 2 N	MULTIFAK EP 2	MOBILLUX EP2	CENTOPLEX 2 EP	LMX grease
 ROLLER /BALL BEARING	GREASE WITH EP ADDITIVES	ALVANIA EP 2 OR 3 GREASE	BEACON EP 2 N	MULTIFAK EP 2	MOBILLUX EP2	CENTOPLEX 2 EP	LMX grease
 WIRE ROPE	SALT WATER RESISTANT GREASE WITH CORROSION PROTECTIVE INHIBITORS	ENSIS FLUID G	SURRET N5K	TEXCLAD 2	MOBILARMA 798	X	SPHEREROL SX2 grease
 OPEN GEAR	GREASE WITH GOOD ADHESIVE PROPERTIES	RHODINA EP	X	TEXCLAD 2	X	GRAFLOSCON A-G1 ULTRA	SPHEREROL SX2 grease

3) Grease used for Composite plain bearings must not contain Molybdendisulphid, MoS2

GENERAL: The products selected should be solvent refined, containing additives against oxidation, corrosion and foaming Also anti-wear and/or EP additives should be included. For use of equipment in extreme hot or cold climate, please contact TTS Marine ASA for advise.

* FAMM (Fuel And Marine Marketing) is an organisation incorporating Chevron and Texaco.

6.4.2 Typical Lubrication Points

The following grease nipple and lubrication points are typical for most TTS cranes:

- Slew gear box: oil change.
- Winch gear box: oil change.
- Winch gear sealing: grease nipple.
- Winch-end bearing: grease nipple.
- Slew ring bearing: grease nipple.
- Internal slew ring gear/pinion: lubricate.
- Wire sheaves: grease nipples.
- Winch wire: lubricate.
- Cylinder hinge bolt: grease nipple.
- Jib hinge bolt: grease nipple.
- Cardan shaft: grease nipples.
- Electric motor: grease nipples.
- Control platform gate: grease nipple.



Winch gear



Winch-drum bearing



Lower cylinder hinge



Jib Hinge



Slew. ring bearing



Hatches, Doors



Internal slew. ring/
Slew. Gear pinion



Upper cylinder hinge

6.5 Lubrication Equipment Model

6.5.1 Oil Quantities

Hydraulic System Oil:	~1300 Litres
Slew Gearbox (3 gear each 5,5 litres):	~16,5 Litres
Winch Gearbox	~12 Litres

6.5.2 Lubrication Chart

Reference drawing: 11857-02

The “Lubrication Chart” is included as a separate drawing in chapter 8.

See the lubrication schedule for correct service and interval.

6.5.3 Lubrication Schedule

Ref. 6.12.1 Appendix A - Maintenance Log

If the yearly operating time is less than 1000 hours, please consider a separate interval for the lubrication schedule. For an accurate estimate of lubrication intervals we recommend oil analyses once or twice a year.

Following is a lubrication schedule for the first 1000 hours:

	Winch gear box Slew. gearbox	Winch gear sealing	Slew ring bearing, Winch-end bearing	Slew ring – internal gear/ pinion, Winch wire	Hydraulic system oil Return filter	Wire sheaves, Hook stop	Electric motor, jib bolt sealing, Cardan shaft	Table description A=Check oil level. B=Change oil C=Lubrication. D=Change filter E=Clean and check for leakage. F=Check torque tightness of bolts/Screws
HOURS ↓								Date – Notes – Signature
___050	A	C			A			
___100	A	C	C		A			
___150	A	C			A			
___200	AB	CE	C	C	A	C	C	
___250	A	C			A			
___300	A	C	C		A			
___350	A	C			A			
___400	A	CE	C	C	A	C	C	
___450	A	C			A			
___500	A	C	CF*		AD			
___550	A	C			A			
___600	A	CE	C	C	A	C	C	
___650	A	C			A			
___700	A	C	C		A			
___750	A	C			A			
___800	A	CE	C	C	A	C	C	
___850	A	C			A			
___900	A	C	C		A			
___950	A	C			A			
___000	AF	CE	CF*	C	BD	C	C	

*Slew ring only; Every 500 hours or min every year.

Lubrication Schedule

6.6 Slew-/Winch Gear

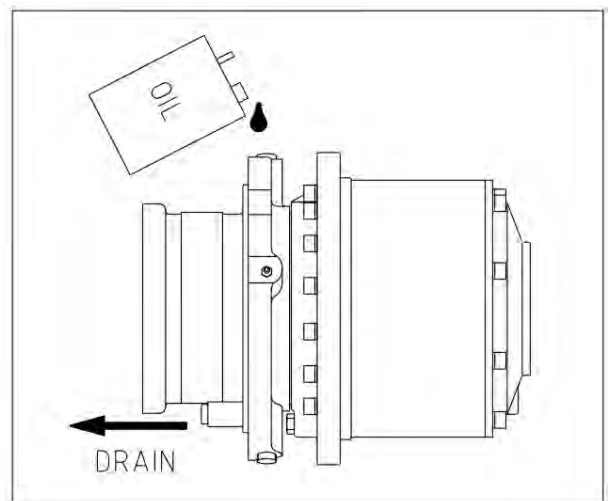
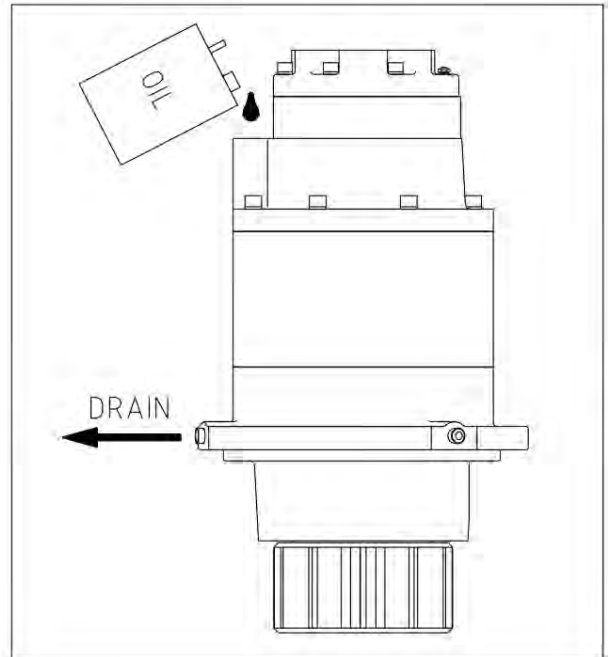
The slew and winch gear needs an oil change every 1000 operating hours or at least once per year.

Oil quantity is marked on the nameplate. The oil should be drained with the gearbox at operating temperature.

To change oil, do as follows:

- Unscrew the filling plug, relief valve and the drain plug.
- Once the oil has been drained, replace the drain plug.
- Fill up the exact amount of oil or up to oil level sight glass.
- After filling up, replace relief valve and the filling plug.

It is essential that the relief valve is removed during filling or topping up. Failure to do so will result in trapped air giving a false oil level. A period of 30 minutes should be allowed after filling or topping up to allow trapped air to vent through the relief valve hole and stabilize the oil level.



6.7 Slew ring

6.7.1 Lubrication and Maintenance

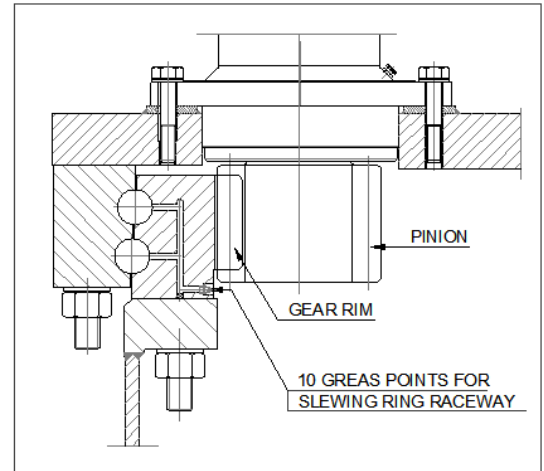
The first re-lubrication of the raceway and the gear rim has to take place immediately after installation. For every subsequent lubrication, acid free, non-resinous, water-repellent and non-ageing greases with adequate heat resistance properties must be used exclusively.

For recommended lubricants type and specification, see section 6.4

The order in which the lubricants are listed is not in order of recommendation. Questions related to lubricants should be clarified with the lubricant manufacturer or TTS Service department.

For use of crane at low temperatures special lubricants may be necessary. Ref. the operating temperature range for applied lubricants. For use in extreme hot or cold climate, TTS Service department should be contacted.

The grease filling is there to reduce friction, seal the bearing and provide protection against corrosion. Therefore, the bearing must always be greased liberally so that a collar of fresh grease forms around the whole circumference of the bearing gaps and seals. The bearing should be rotated during re-lubrication.



SLEWING RING LUBRICATION

(Typical)

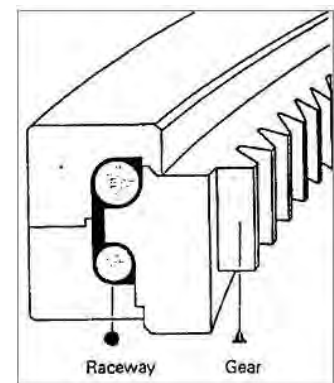
6.7.2 Lubrication period for the raceway system

Questions relating to lubricants should be clarified with the lubricant manufacturer. When automatic lubricating devices are used, pump ability must be confirmed by the lubricant manufacturer. Application at sub-zero temperatures will require special lubricants, for instance molykote TTF 52

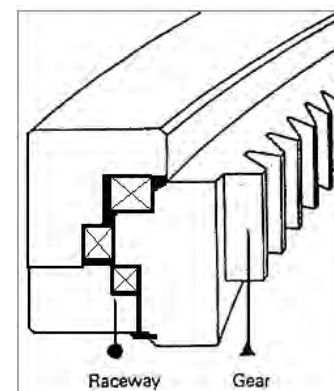
Lubrication intervals are to be selected according to the operating conditions; generally every 100 operating hours, roller bearing every 50 operating hours. Shorter greasing intervals in tropical regions must be used in the presence of high humidity, dust or dirt, strong temperature fluctuations, and for continuous rotation.

If there are standstill times between bearing installation and equipment start-up, special maintenance procedures will be required, e.g. re-lubrication under rotation no later than after 3 months and every 3. months thereafter.

Before and after prolonged stoppage of the equipment, relubrication is absolutely necessary. This is especially important after a winter shutdown. When cleaning the equipment, care must be taken to prevent cleaning agents from damaging the seals or penetrating into the raceways.



TYPICAL BALL BEARING (DOUBLE)



TYPICAL ROLLER BEARING

6.7.3 Lubrication intervals for Crane Slewing gear rim and pinions:

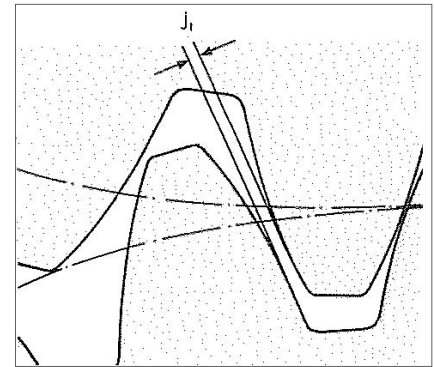
Gear rim and pinions are to be greased sufficiently with recommended grease.
See lubrication schedule in section 6.5.3

6.7.4 Checking of backlash:

Ref. drawing: 21361M600 - Slewing machinery assembly

Check the tooth engagement by measuring the backlash using a feeler gauge or a lead wire every 500 hours of operation. Backlash is shown in sketch.

If adjustment becomes necessary, see "installation" and "backlash adjustment" notes on a.m. drawing or contact TTS's service department. See chapter 1.3.

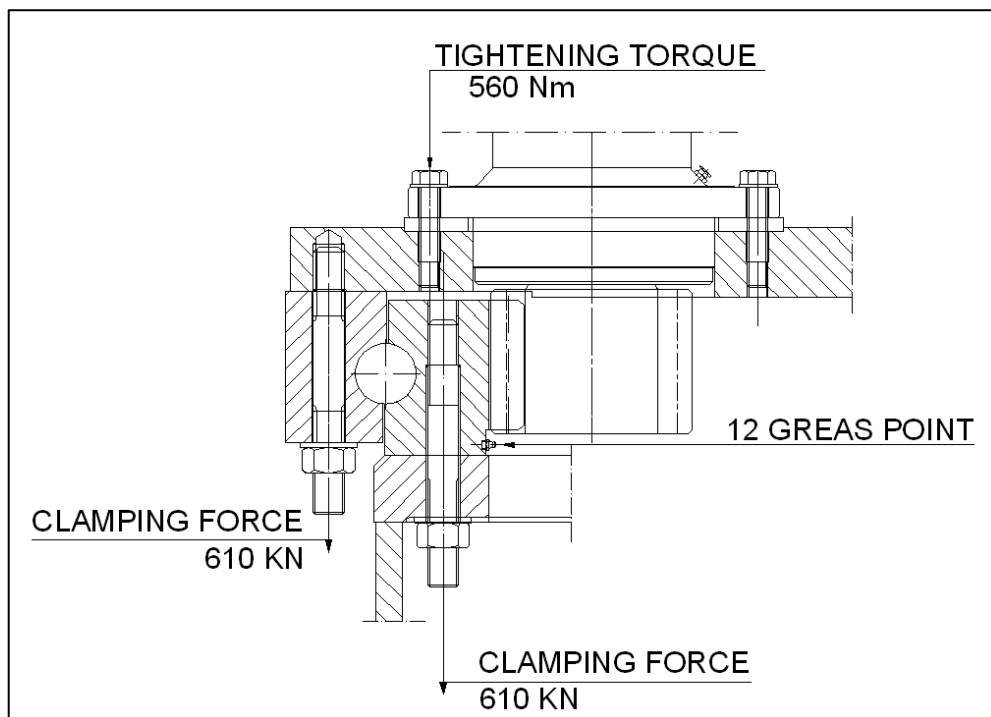


BACKLASH MEASUREMENT

6.7.5 Checking of bolts

To compensate for settling phenomena, it is necessary to retighten the bolts with the specified tightening torque. During this operation the bolted connection must be relieved of all tensile stressed coming from external loads. This should be checked after approximately 100 operating hours at the latest. Thereafter, checking should be repeated about every 600 operating hours or every 3 months.

Under special operating conditions, or if specific test instructions so require, the interval between checks should be changed correspondingly.



SLEW RING FASTENERS CLAMPING FORCE

6.7.6 Checking of the raceway systems

In their delivered condition large-diameter antifriction bearings have clearances which guarantee good operating conditions and functional safety. When the bearing is put into operation, we recommend to perform a base measurement and to log the results as future standard of reference.

After a prolonged operating time, bearing clearances will increase. It is, therefore recommended to check the axial movement or settling at each annual survey. The new measurements should be compared with the base measurements to determine the wear of the raceway system.

Ref. section 6.8 for guidelines regarding the wear measurement ("Rocking test").

6.7.7 Slew Ring Wear Test (Rocking test):

1. General

During operation of a crane, the slew bearing will be exposed to wear in the raceway. This wear will cause an increase in the bearing clearance, which for safe operation, only must attain a certain value.

For assessing the condition of the bearing at all time, the bearing clearance must be measured, recorded and evaluated with frequent intervals.

The first measurement has been done before delivery of the crane. This measurement shall be used as a reference for all future measurements.

2. Measuring conditions

The measuring should preferably be performed with level ship in harbour or sheltered water.

It is also important, that the conditions are the same each time a measurement is done. The required conditions are shown in the heading of the measurement report.

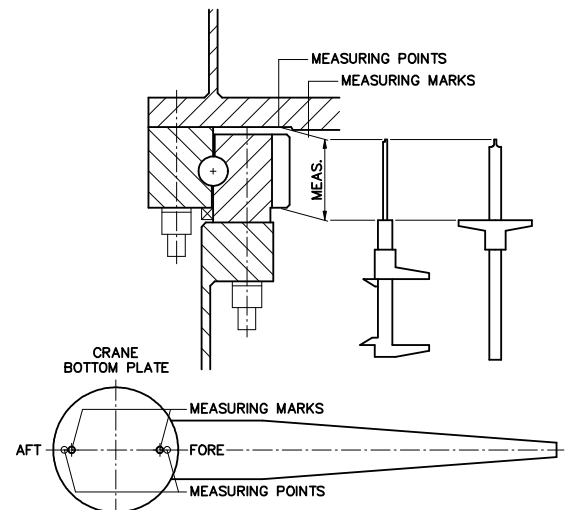
The measuring points shall be free of oil and dirt etc. while measuring, and the surface at the measuring points should be free of any roughness. It shall also be checked, that no burrs have built up at the underside of the teeth. If so, these should be removed before measuring.

3. Measuring method

The measuring method is shown in the sketch. The distance between the underside of the gear teeth and the underside of the rotating crane house shall be measured fore and aft on the rotating crane house, with the crane positioned at every 90 deg.

All measurements shall be done with an accuracy of 0,1 mm, and can be done with standard measuring tools as slide calipers or depth gauges.

Two marks are made in the underside of the crane house bottom plate as $\varnothing 6$ mm tap holes positioned near and in line with the fore and aft measuring points.



4. Procedure.

- Apply the measuring conditions as stated in the heading of the measurement report
- Slew the crane so that the crane boom is pointed forward on the ship, and measure the distance between underside of gear teeth and bottom of crane house fore and aft at the crane, and record it into the measurement report, ref. E-16-086.
- Then turn the crane 90 deg successively with the boom pointing to starboard – aft – port respectively. In all positions the distances shall be measured fore and aft on the crane and recorded accordingly.
- After all the measuring has been done and recorded, the results shall be compared with the reference values, and the deviations shall be calculated and entered into the measurement report.
The deviation is always to be calculated as the deviation between the reference – and the actual measurement.
- Sign and date the report.

5. Evaluation of measurement

Max allowable deviation is shown in the heading of the measurement report.

When the deviation reach the max allowable value, the bearing has to be replaced.

Due to the normal long delivery time for such components, TTS should be contacted in good time before this value is reached.

Initial measuring frequency is 12 month. However, when the calculated deviation reach approx. 50% of allowable value, the frequency should be increased to about 6 month. If the measured wear escalate, or comes near the allowable, the intervals should be shorten further.

Slew ring wear measurement report. Ref. Section 6.12.2 Appendix B :

CRANE WITH INSIDW PEDESTAL FLANGE

CONDITION FOR MEASURING	POSITION OF CRANE BOOM								CRANE NO. BEARING SIZE
	FORWARD		STB		AFT		PORT		
ELEV. OF FOLD. JIB FROM PARK. [deg]									11857
SWING OF FOLD. JIB FROM PARK. [deg]									092.50.3123
OUTREACH [m]									MAX. ALLOW. DEVIATION [mm]
LOAD IN HOOK [t]									2,6
MEASUREMENT	FORE	AFT	FORE	AFT	FORE	AFT	FORE	AFT	DATE / SIGN

1	MEASURED [REFERENCE]								
2	MEASURED								
	DEVIATION								
3	MEASURED								
	DEVIATION								
4	MEASURED								
	DEVIATION								
5	MEASURED								
	DEVIATION								
6	MEASURED								
	DEVIATION								
7	MEASURED								
	DEVIATION								
8	MEASURED								
	DEVIATION								
9	MEASURED								
	DEVIATION								

Slew ring measurement table

6.8 Re-tightening of Slew Ring Bolts

Ref. Drawing: Slewing machinery assembly – 21361M600

The safe operation of the slew ring (bearing) is dependant upon proper tightening of the bolts. It is very important that the bolts are regularly checked and re-tightened if necessary.

EVERY YEAR:

- Inspect slewing ring bolts and nuts.
- Check bolts by use of torque wrench (less than M24) or bolt tensioner.

EVERY 4 YEAR:

- Retighten according to table below.

The required tension / torque indicated are based upon lightly oiled bolt threads and nut / bolt heads.

For re-tightening of bolts (Grade 10.9) use the following tension / torque moments:

Bolt size:	Torque moment Nm:	Pre-tensioning KN:
M24	560	
M36		610

The first bolt check is to be made after test loading, thereafter once every year.

In the event that the bolts are loosening up between check intervals, increase the frequency of the bolts checks, and contact TTS service department. See “Contact information” in chapter 1.3.

6.9 Load Turner

Ref. 6.12.5 Appendix Load Turner Manual

6.10 Cable Reel

Ref. 6.12.6 Appendix Cable Reel Manual

6.11 Wire Rope

A long history of examining returned ropes and those in service has clearly shown that internal degradation, mainly by corrosion and fatigue mechanisms, can be a serious and unsuspected cause of rope failure.

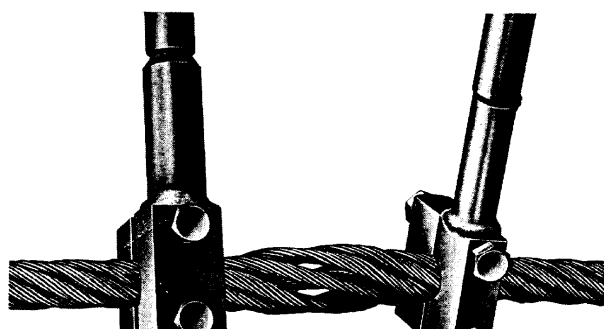
In several instances, a normal external examination could not have revealed the extent of the internal degradation even in situations where a failure was imminent under normal working conditions due solely to the extent of the internal degradation.

Based on this experience, it cannot be an overstatement to say that no rope examination is complete until an assessment of the internal condition at appropriate positions has been made.

6.11.1 Method of Examination

By the use of simple tools used with care, a 6 or 8 stranded rope and Multi-Strand and "Paragon" type rope up to at least 28 mm diameter can be opened sufficiently to permit a reasonable determination of the internal condition.

The method consists of firmly attaching to the rope two correctly sized clamps about 100 - 200 mm apart. By contra rotating these clamps in the direction to unlay the rope the rope strands will be lifted away from the core.



Examination of wire rope

Extreme care is necessary during this operation to ensure that the strands are not excessively moved such that they become permanently deformed.

With the small openings now presented, a small probe such as a screwdriver may be used to manipulate the strands and displace any grease or debris which may be obscuring the inner regions.

Because it is generally impracticable to examine a rope internally over its entire length, suitable areas have to be selected.

In the case of ropes working over drums, pulleys or sheaves, it is usual to examine those areas entering or leaving the grooves when maximum loads, particularly shock loads, are experienced, or areas which remain for long periods, in exposed places such as over a jib head pulley.

On some running ropes, but usually more relevant to standing ropes such as pendants, the areas adjacent to terminations should be given particular attention.

6.11.2 Summary of Wire Examination

- Lower hoist to unload rope sheaves.
- Unwind all wire rope from the hoist drum to expose all parts of a rope, making sure that the rope does not rewind in the reverse direction.
- Inspect sheaves, sockets, dead-ends, thimble joints, and all wire rope hardware.
- During rope changes, check the sheaves for worn bearings, broken flanges, proper groove size, smoothness, and contour.
- Inspect all parts of the cable, cleaning wire rope only as required to complete an inspection. Excessive removal of lubrication will lead to damage.
- Re-lubricate rope to prevent corrosion, wear, friction, and drying out of the core.
- Check for ropes that may have been operated dry (unlubricated). Replace dry ropes. There may be hidden damage that is not detected by visual inspection.
- Compare the rope length and diameter with the original dimensions. Lengthening accompanied by diameter reduction is often an indication of interior core defects.

6.11.3 Replacing the Wire

In the maintenance log; establish a schedule of rope replacement to change wire rope before it breaks. Periodic replacements do not take the place of inspections. If rope breaks or inspections reveal abnormal wire breakage or defects, reduce the time between replacements.

Handling and installation of the rope should be carried out in accordance with a detailed plan and should be supervised by a competent person.

When a new rope is fitted a variation in size compared with the old worn rope will be apparent. The new rope may not fit correctly into the previously worn groove profile and unnecessary wear and rope distortion is likely to occur. This may be remedied by machining out the grooves before the new rope is installed.

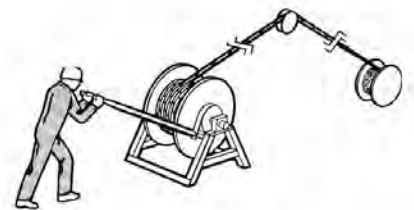
Place the rope in a suitable stand, which allows it to rotate and be braked to avoid overrun during installation. Roll it out straight ensuring that it does not get contaminated with dirt moisture etc.

Always double check wire connection on winch drum and block/jib.

NOTE:

WHEN REPLACING WIRE – ALWAYS PROVIDE 5 – 10 % BACK-TENSION OF ROPE SWL.

Wrong
Note the kinks forming!



Handling of wire

6.12 Appendices

6.12.1 Appendix A - Maintenance Log

All maintenance, abnormal observations and repairs should be logged. Upon request, this log should be made available to the TTS Ships Equipment AS Serviceman. Please have a copy made of the sample maintenance log and keep it as a separate document in this user manual.

	Winch gear box Slew. gearbox	Winch gear sealing	Slew ring bearing, Winch-end bearing	Slew ring – internal gear/ pinion, Winch wire	Hydraulic system oil Return filter	Wire sheaves, Hook stop	Electric motor, jib bolt sealing, Cardan shaft	Table description A=Check oil level. B=Change oil C=Lubrication. D=Change filter E=Clean and check for leakage. F=Check torque tightness of bolts/Screws
HOURS ↓								Date – Notes – Signature
___ 050	A	C			A			
___ 100	A	C	C		A			
___ 150	A	C			A			
___ 200	AB	CE	C	C	A	C	C	
___ 250	A	C			A			
___ 300	A	C	C		A			
___ 350	A	C			A			
___ 400	A	CE	C	C	A	C	C	
___ 450	A	C			A			
___ 500	A	C	CF*		AD			
___ 550	A	C			A			
___ 600	A	CE	C	C	A	C	C	
___ 650	A	C			A			
___ 700	A	C	C		A			
___ 750	A	C			A			
___ 800	A	CE	C	C	A	C	C	
___ 850	A	C			A			
___ 900	A	C	C		A			
___ 950	A	C			A			
___ 000	AF	CE	CF*	C	BD	C	C	

*Slew ring only; Every 500 hours or min every year.

Maintenance log - Lubrication

6.12.2 Appendix B – Slew Ring Wear Measurement Report (Rocking test log)

REF. E-07-080

CRANE WITH INSIDE PEDESTAL FLANGE
--

CONDITION FOR MEASURING	POSITION OF CRANE BOOM								CRANE NO. BEARING SIZE
	FORWARD		STB		AFT		PORT		
ELEV. OF FOLD. JIB FROM PARK. [deg]									11857
SWING OF FOLD. JIB FROM PARK. [deg]									092.50.3123
OUTREACH [m]									MAX. ALLOW. DEVIATION [mm]
LOAD IN HOOK [t]									2,6
MEASUREMENT	FORE	AFT	FORE	AFT	FORE	AFT	FORE	AFT	DATE / SIGN

1	MEASURED [REFERENCE]								
----------	----------------------	--	--	--	--	--	--	--	--

2	MEASURED								
	DEVIATION								

3	MEASURED								
	DEVIATION								

4	MEASURED								
	DEVIATION								

5	MEASURED								
	DEVIATION								

6	MEASURED								
	DEVIATION								

7	MEASURED								
	DEVIATION								

8	MEASURED								
	DEVIATION								

9	MEASURED								
	DEVIATION								

Continued from previous page

REF. E-07-080

Page 2 of 2

MEASUREMENT	POSITION OF CRANE BOOM								DATE / SIGN
	FORWARD		STB		AFT		PORT		
	FORE	AFT	FORE	AFT	FORE	AFT	FORE	AFT	
10	MEASURED								
	DEVIATION								
11	MEASURED								
	DEVIATION								
12	MEASURED								
	DEVIATION								
13	MEASURED								
	DEVIATION								
14	MEASURED								
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16	MEASURED								
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17	MEASURED								
	DEVIATION								
18	MEASURED								
	DEVIATION								
19	MEASURED								
	DEVIATION								
20	MEASURED								
	DEVIATION								

6.12.4 Appendix D – Major Repairs and Modifications Log

Date Performed:	Contract Reference:	Document or Drawing Reference:
Description of Major Repairs and Modifications:		

Date Performed:	Contract Reference:	Document or Drawing Reference:
Description of Major Repairs and Modifications:		

6.12.5 Appendix – Load Turner Manual

INSTRUCTION MANUAL**ROTATOR CT 70 SWL 70 T****SERIAL NO. 70033**

Prior to putting into service.
Study the safety regulations
In the manual.

General information

There are two types of machine regulations, within the domain of the National Board of Occupational Safety and Health; directives for the product and directives for the working environment. The intentions of the instructions are to make uniform the product requirements in each country in order to eliminate the so-called trade barriers. This agreement to conformity makes the technical requirements of the products the same in all member countries. The intention of regulating the working environment is that no country will gain unfair business advantages by maintaining a poor working environment (making their products cheaper than products of other countries by risking the health and safety of their employees). In the machine regulations there are three different parties; the manufacturer, the company and the operator. The manufacturer or his agent is responsible for the machine meeting the minimum requirements, the implication of this is that the machine is to be accompanied by instructions for use. The company/ the user is required to train the driver/operator so he can use the machine properly. The driver/ operator is to follow the rules and instructions necessary for him to protect himself and others from accidents and to run the machine properly.

Explanation of symbols

The instructions contain important information, which is to be understood by all users, prior to putting the machine in use. Therefore we have placed symbols in the instructions where we particularly want to focus your attention.



Vital information warning for incident which can result in personal injury if instructions are not followed.



Vital information on how to prevent personal and equipment damage.



Advice on operation, care and maintenance of the machine.

Explanation of decals

Decals conveying vital information are placed in strategic areas on the machine. The users of the machine must understand what the decals mean before they operate the machine.



Warning! Danger of getting crushed.



Wear protective helmet, ear protectors, protective goggles and visor.



Prior to using, study the safety regulations in the manual.



Wear durable, non-slip gloves.



Wear reinforced boots with non-slip soles.

Safety regulations

The following list of safety regulations is an excerpt from the general safety precautions which we want to emphasize. Our intention is to make the personnel aware of the risks and dangers when the cargo-turner is in operation.

1. Study and learn the meaning of all the warning symbols, safety precautions and instructions in the manual. Study and learn the meaning of all the decals on the machine. See that you fully understand the instructions before you start operating the cargo-turner.
2. Report all incidents and accidents to the responsible foreman.
3. If possible, use protective gloves, reinforced boots and protective goggles to protect your hands, feet and eyes from getting cut or crushed; and to protect them from solvents, grease and oil.
4. Permit no unauthorized or under-aged persons in the working area.
5. Warning, prohibiting and informative decals must not be concealed, changed or damaged.
6. Do not climb onto the instrument or allow anyone else to.
7. Check the instrument for damage before each use. Repair damage before using the instrument.
8. Do not allow untrained personnel to start or use any of the equipment without the guidance of a trained operator.

Product information

NOH's cargo-turner is used to efficiently hoist cargo and place it exactly where the crane operator wants it. It can be used for all types of lifting equipment; on cranes, in docks or on ships. Use of the cargo-turner increases efficiency by reducing the amount of time required for loading and unloading which also reduces operating costs and risk of accidents.

Putting into operation

It is important that everyone who is to use the cargo-turner is given the opportunity to read through the instructions with an instructor or another trained person.



For the introduction we recommend that you:

1. Go through the instructions carefully to determine possible difficulties.
2. Check that all safety devices are in place.



Unauthorized personnel must not be within the working area when the cargo-turner is in operation

Mounting

The crane on which the cargo-turner is to be mounted must be approved (been granted a test hoisting certificate) and must meet the prevalent rules and regulations.

1. Attach the crane rope to the cargo turner and connect the electric supply cable. Prior to the test run check that the lift sling / slings is / are securely attached to the cargo turner.
2. During the test run and operation of the cargo-turner nobody is permitted within the working area.
3. Never hoist a load above or near people, and make sure that the operator has a good view of the working area.

Removal

1. When removing the cargo-turner it should be placed in the transport frame supplied with it.
2. Remove the lift sling and disconnect the electric supply cable.



Prior to removing the inspection cover, the operator must be certain that the power supply is disconnected. Beware Danger of getting crushed. (see picture 1)



Picture 1

Description of function

The hydraulic aggregate consists of an electric motor and a hydraulic pump. Rotation of the cargo-turner clockwise or counter clockwise is regulated by the electric motors direction of rotation. A valve block mounted on the hydraulic tank controls the oil flow. The pressure relief valve and the pressure gauge for both directions are also located on the block. (see picture 2).

In order to check and adjust pressure it is necessary to install a stop on the rotating part of the rotator. (see picture 3).

When installing the stop the cargo-turner must be turned manually.

The hydraulic motor is equipped with two relief valves that are preset to 110 bar.

These relief valves are fitted in order to protect the hydraulic motor from induced pressure spikes.

Free turning system.

Control of the free turning function is done by the crane driver, via a separate electrically activated control valve (picture 4).

The purpose of this valve is to give the driver the possibility of avoiding over twisting of the hoist ropes.

wire ropes.

Spare parts

When replacing damaged parts ensure that they are original parts approved by the manufacturer.

Care and maintenance

1. The purpose of all service and repair should be to maintain or restore the cargo-turner to it's original function. If the function of the machine is altered, the party responsible for the alteration will be held liable according to the Machine Directive.
2. Any person who repairs and services the machine should be conversant with the construction and operation of the machine.
3. The person responsible for operating the machine must know when and how the machine is to be serviced.

This high quality cargo-turner will have a long productive life even when used a rough environment.

To get the most out of the cargo-turner, functionally and economically it must be maintained and serviced properly.



Picture 2



Picture 3



Picture 4

Care and maintenance (cont.)

Slewing ring: Lubricate after every 40 hours of use (one weeks work).

To guarantee good lubrication and sufficient protection for the bearing it is necessary that it is completely surrounded by the lubricant that covers and fills the space between the roller bearing surfaces. The cargo-turner should be rotated while lubricating so that the lubricant can find its' way between the rings. (see picture 5).

Slewing ring gear and pinion

Lubricate every eight weeks. After the gears have been cleaned, lubricate them using a brush or a aerosol spray.



Exercise caution when lubricating the bearing and gears, great risk of being crushed.



Picture 5

Lubricate bearing here

The following or equivalent products should be used for lubricating:

<u>Manufacturer</u>	<u>Slewing ring bearing</u>	<u>Gear and pinion</u>
BP	Energrease LSEP2	Energol Wire Rope EP Fluid H Energrease GG
ESSO	Beacon EP2	Surett 30 Open Gear Lubricant ESLIC
Shell	Alvania EP2	Carduim Compound Open Gear Grease 1029
Mobil Oil	Mobil Grease Larital 2	Dorcia 150 Mobiltac D

Checking the slewing ring bolts

- * 2 weeks to three months after the cargo-turner is put into operation
Check that all bolts are tightened to the recommended torque value.
- * Every time the cargo turner is removed or at least annually or every 2000 hours of operation the torque of all bolts should be checked. If one or more bolts appear to have loosened to less than 80% of the recommended torque replace the bolts that are loose and those on either side of the loose bolts.
If 20% of the bolts in a ring have a torque value that is less than 80% of the recommended, replace all the bolts in the ring.
- * When replacing the slewing ring or every 7 years or 14000 hour of operation, all bolts must be replaced. The torque values stated are for lubricated bolts.

Recommended bolt torque values

M16 bolt quality 12.9 = 335 Nm.

To check bolts of the inner ring; remove the cover, which is located on the rotating part.(see picture 6).



Picture 6

Hydraulic power unit

After eight hour of use...

- * Check oil level (level should be between the marks on the oil level indicator).
- * Check for leaks.

After 50 hours of use...

- * Check that the hydraulic couplings, the mounting bolts for the hydraulic power unit, the hydraulic oil tank and the hydraulic motor are tight.
Whenever the cargo turner is removed, loose screws or bolts should be tightened and possibly secured by applying for example, Loctite.
- * Check hydraulic hoses.
- * Make sure electric cables and plugs are not broken and are clean.

After 250 hours of use...

*Check hydraulic pressure.
In order to check the maximum working pressure, the rotating part must static. In order to ensure this, the stop plate must be fitted as shown in picture 3.
With the rotation blocked, the pressure should be 90 bar.



Picture 7



While checking the pressure the operator should not stand in front the open inspection cover.
(see picture 7)

After 2000 hours of operation...

Change hydraulic oil and return oil filter.



Clean all equipment after each commission. Inspect equipment for damage and repair any possible damage so that it is operable for the next commission. Make sure that electric plug is not broken and is clean.

After 2000 hours of operation the hydraulic oil should be changed.

Remove the drain plug from the discharge valve, and attach a hose the end of which should be put into a container for waste oil. Open the discharge valve.
The inside of the oil tank can be cleaned through the cover on the side of the tank.
Close the discharge valve and screw in the plug.
Change the oil return filter and fill with new hydraulic oil. The oil level should be between the marks on the oil level gauge.
Refit the breather filler cap.

The oil tank capacity is approx. 18Lt.

Type of hydraulic oil: Shell Tellus T 32 S
 BP Bartran HV 32
 ESSO Univis N 32
 Mobil Flowrex SHS 32



When handling grease and oil great caution should be exercised.
Avoid skin contact.

Annual Maintenance

1. Clean equipment thoroughly.
2. Inspect for wear and tear.
3. Exchange damaged parts, touch- up damaged areas and give anti-corrosive treatment.
4. Lubricate all bearings.
5. Renew test hoisting certificate according to regulations.

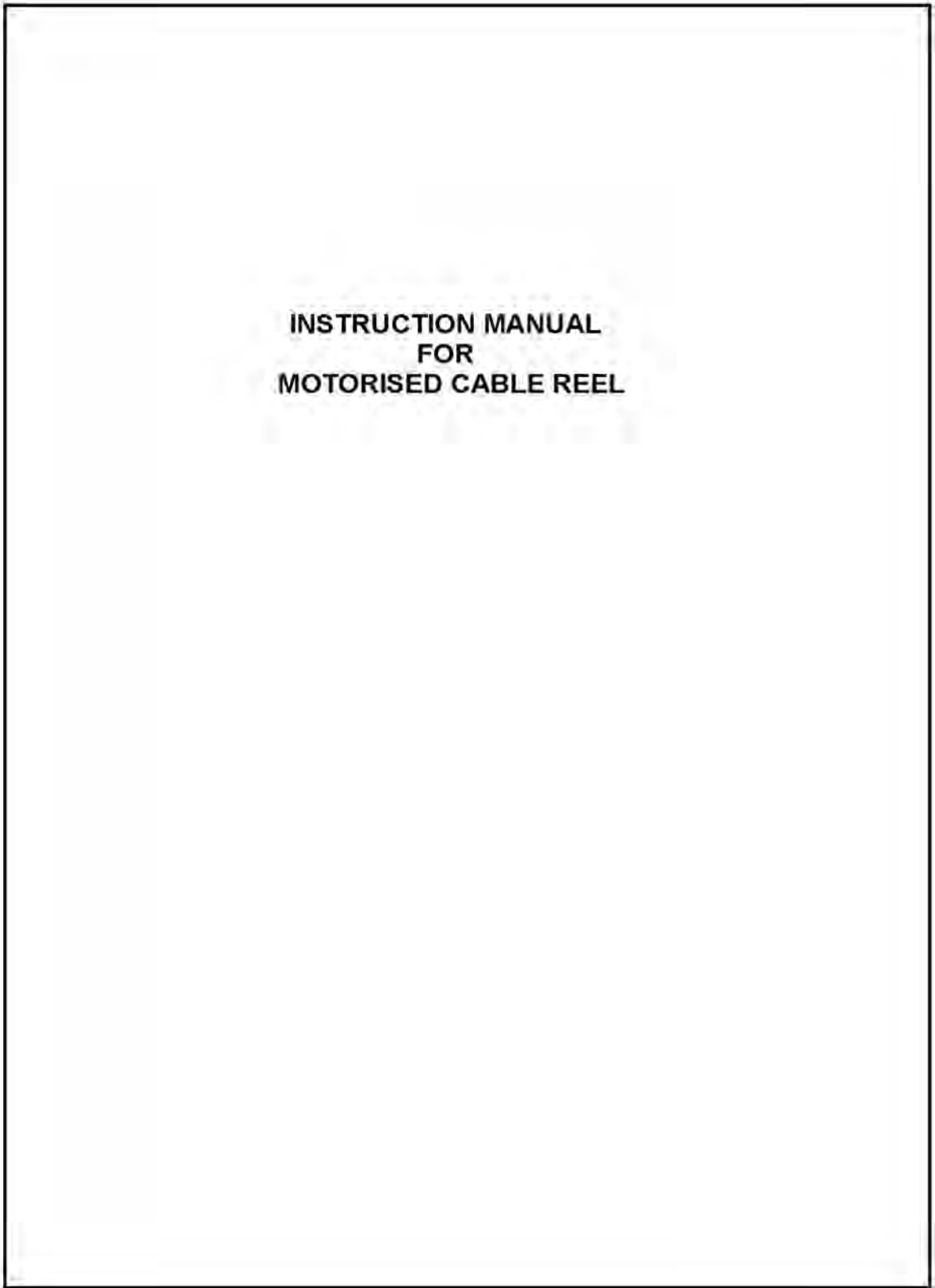
Conditions of guarantee:

The guarantee does not cover damage that has occurred due to misuse or because repairs have been carried out incorrectly. The guarantee is also invalid if other than original parts have been used to repair the machine. The guarantee is also invalid if the instructions in the instruction manual have not been adhered to.

Technical specifications

Type	CT 70
Serial No.	70033
Build year.	04-2012
Lifting capacity	70 ton SWL
Weight	1900 kg
Electric motor	440 V 60 Hz 4,3 kW
Solenoid valve	230 V 60 Hz
Working pressure	90 Bar
Rotation torque.	3600 Nm
Rotation speed	2,0 rev/min
Inspecta certificate no.	120405

6.12.6 Appendix – Cable Reel Manual



DISCLAIMER

This Instruction Manual is intended as a guide to the installation, usage and maintenance of the specified Cavotec equipment.

Cavotec does not accept liability for any loss or damage suffered as a result of using this manual.

Prior to installing, operating or maintaining the equipment, read the GENERAL WARNINGS AND SAFETY GUIDELINES located on the following page.

If in doubt, always refer to the original equipment manufacturer.

The equipment warranty will be voided if the technical guidelines for the installation, usage and maintenance have not been correctly followed.

Only suitably qualified maintenance personnel who have read and understood every part of this document are authorised to maintain the specified equipment.

The information contained within this document is subject to change at any time without notice.

VERSION HISTORY

Rev.	Revised by:	Approved by:	Revision Date	Comments
A	E. Rossetto	P. Rosenwald	06.04.12	Primary issue

GENERAL WARNINGS AND SAFETY GUIDELINES



Reel operation is remotely controlled by the machine on which it is installed. Drum rotation can therefore occur at any time, so it is important to keep well clear during machine operation.

If it is necessary to be near the reel during operation (eg. while commissioning), be aware of the location of the nearest emergency stop button and exercise caution.

Prior to performing maintenance on the reel, ensure that the machine long travel and reel motor are isolated by an authorised person.

If work is to be done inside the collector enclosure, the drive centre or the motor terminal blocks, ensure that all relevant circuits are isolated by an authorised person prior to removing any covers.

Warning labels on the collector enclosure are there to remind personnel of the danger.

Prior to touching any electrical connection, confirm with an appropriate meter that there is no power. Failure to do so may lead to serious injury or death.

Note that any heaters or travel limit switches in the collector enclosure may still have tension on the terminals even if the main power is switched off.

Only suitably qualified maintenance personnel who have read and understood every part of this document are authorised to maintain the specified equipment.

STORAGE INSTRUCTIONS

For correct storage of Cavotec cable reels, maintain the goods in the original packing in a closed warehouse, protected from the rain and in an ambient that prevents the formation of condensation.

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SECTION 2 – CABLE REELING SYSTEM OVERVIEW

Large mobile machines such as cranes, stackers and ship loaders rely on an external electrical power source to operate. In many cases, these machines also require analogue and/or digital data conduits for control and feedback. This power and data is typically transmitted through a composite flexible cable comprising of copper conductors for power and hard wire control circuits, and optical fibres for digital data. Since these machines can travel over relatively long distances, this cable needs to be quite long, and a means of handling the cable in a controlled manner is required. A Cable Reeling System typically carries out this function.

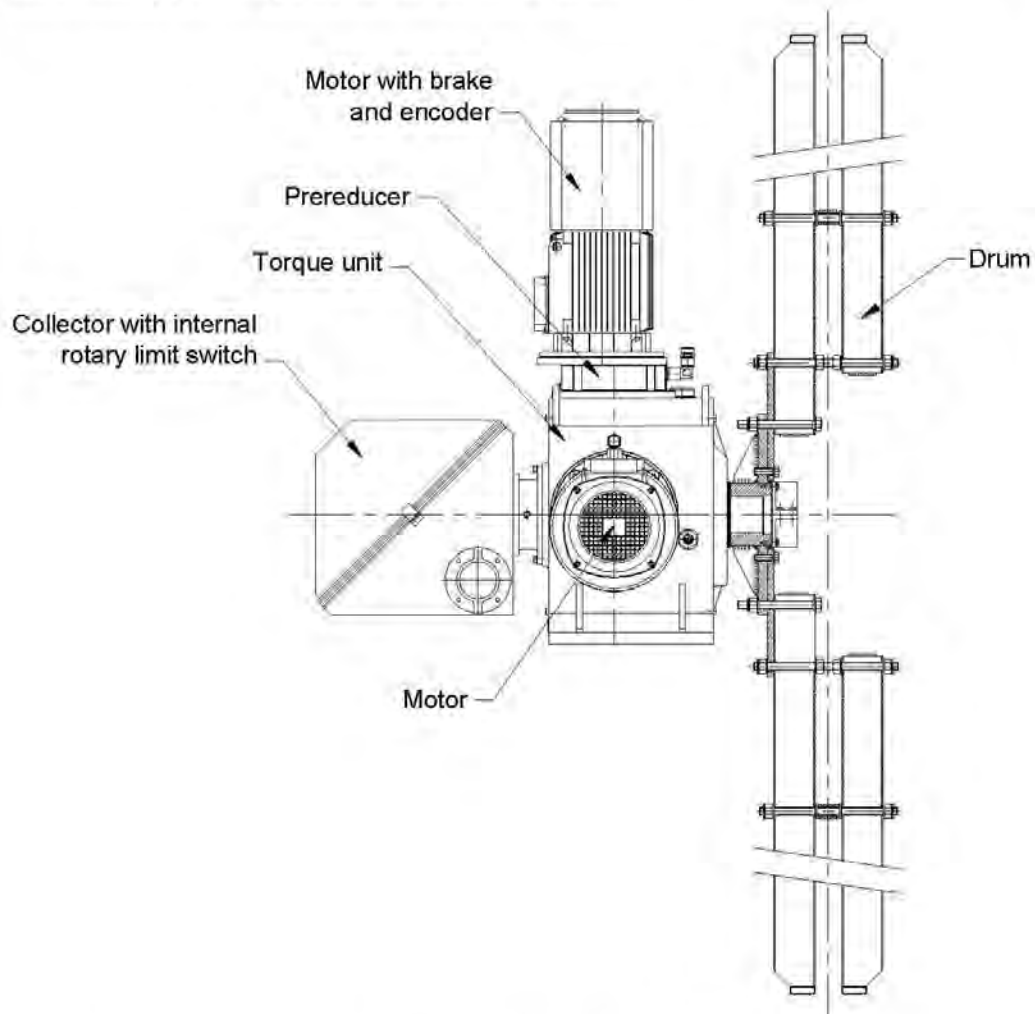


Figure 1 – Typical cable reeling system

2.1 DRUM

- 2.1.1 A drum stores cable by rotating in the appropriate direction as the machine travels towards the feedpoint. The internal diameter of the drum is selected to meet the minimum bend radius requirements of the cable and to ensure an optimal relationship between reeling torque and cable tension. The external diameter of the drum is selected to ensure

that the full cable length can be accommodated. The compartment width of the drum depends on the cable diameter and the type of lay selected (eg. monospiral, 3-2-3, random).

- 2.1.2 Drums are typically fabricated from mild steel RHS, and can be painted or hot-dip galvanised. The drum sides can be either fully welded (for smaller drums) or composite designs. All fasteners are stainless steel.

2.2 TORQUE UNIT

- 2.2.1 A torque unit is typically a specially designed reduction gearbox with a large bore main shaft through which the cable can be fed, and a high overhung load capacity. The torque output of this unit is regulated by mechanical or electrical means. An example of a mechanical torque regulator is the Hydrodynamic oil immersed friction drive. Electrical torque regulators include torque motors, permanent magnet clutches and flux vector controlled AC motors.

- 2.2.2 The optimum torque output of a torque unit is just sufficient to recover and pay out cable in all modes of operation without placing undesirable stress into the typically fragile conductors. The speed output of the torque unit can vary greatly in relation to the machine speed because of the changing winding diameter, and the differences are generally taken up by mechanical or electrical slippage.

2.3 MOTOR

- 2.3.1 Motors are typically Totally Enclosed Fan Cooled (TEFC) type, are fitted with sealed for life bearings, and have IP55 protection ratings. When used with flux vector drives, the motors are oversized to preclude the need for forced cooling.

- 2.3.2 Cavotec motors are supplied with class F insulation. Optional Klixon switches or thermistors are embedded in the windings to provide a means of protecting the motor from over-temperature conditions.

2.4 BRAKE

- 2.4.1 The brake prevents the reeler from unwinding cable when the power supply to the reeler motor is turned off.

- 2.4.2 Cavotec brake motors are equipped with failsafe electromagnetic brakes utilising asbestos free brake pads. These brake pads have a high resistance to wear and operate reliably at high temperatures.

- 2.4.3 The electromagnet is driven by direct current, and is characterised by a very simple design, low hum level and no vibrations. Due to direct current use, the current intensity is very low.

- 2.4.4 The electromagnetic coil is designed to be continuously activated. A special compound surrounds the coil in the electromagnetic housing and makes the coil humidity and vibration proof.

- 2.4.5 The rectifier is housed in the motor terminal box, and it is specifically designed for electromagnetic brakes. It is compact, high temperature resistant and unaffected by voltage variations.

2.5 COLLECTOR

- 2.5.1 The collector facilitates the transmission of power and data between the rotating reeling cable and the fixed machine cables.

- 2.5.2 The collector consists of a number of rotating sliprings (typically 4 for power applications) against which a number of fixed copper-graphite brush tips rub. Insulators and air separate each phase.

2.5.3 The collector may also include a fibre optic rotary joint used to transmit optical data across the rotating interface.

2.5.4 Collectors are typically housed in stainless steel enclosures with anti-condensation heaters.

2.6 ROTARY LIMIT SWITCH

2.6.1 A geared rotary limit switch for reel full and reel empty detection is typically supplied with the collector, mounted either internally or externally of the collector enclosure.

2.6.2 The rotary limit switch can be fitted with a potentiometer or rotary transducer to give a precise indication of the amount of cable on the drum at any time.

SECTION 3 - DRIVE MODULE

3.1 DELIVERY

- 3.1.1 The torque unit, base frame (if supplied), collector, prereducer/s (if supplied) and motor/s are supplied pre-assembled as a completed drive module. Check that this module has arrived in good condition.
- 3.1.2 Note any special instructions in the *Delivery* subsection of SECTION 1.

3.2 INSTALLATION

- 3.2.1 Check that the structure onto which the drive module is to be mounted is flat and free from distortion.
- 3.2.2 Lift the drive module using the lifting points provided. The total weight of the module is indicated in the *Delivery* subsection of SECTION 1.
- 3.2.3 Bolt the drive module to the mounting structure using high tensile bolts of appropriate length with the dimensions indicated in the *Delivery* subsection of SECTION 1, ensuring that it is level by using a spirit level. Ensure that the face of the drum mounting flange is parallel to the direction of machine travel. Use shims or packing pieces as necessary and bolt down securely.

3.3 ELECTRICAL INSTALLATION

- 3.3.1 Referring to the electrical schematics located in SECTION 13, run, gland and terminate appropriate cables between the reeler control centre and the various components supplied.
- 3.3.2 Run, gland and terminate an appropriate cable/s between the collector brushgear and the machine's power/control inlet.

SECTION 4 – DRUM

4.1 DELIVERY

4.1.1 The drum has been supplied pre-assembly.

4.2 DRUM INSTALLATION

4.2.1 Lift the drum by using an appropriately rated sling wrapped around the inner ring. The drum weight is indicated in the *Drum* subsection of SECTION 1.

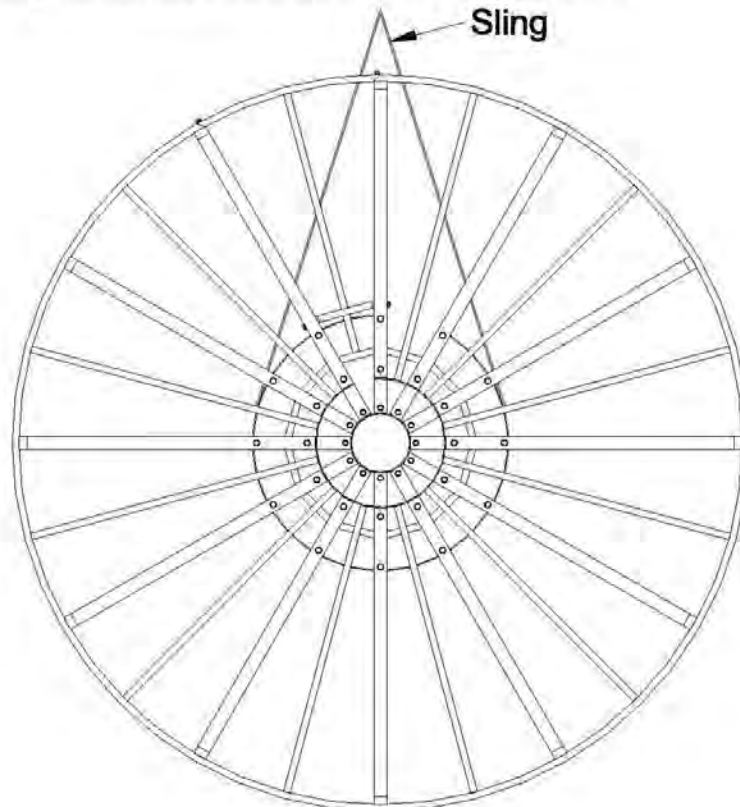


Figure 2 – Lifting drum

4.2.2 Present the drum to the drive flange as shown in Figure 3, lining up the tie rods holes in the intermediate flange with those in the drive flange.

4.2.3 Fit the nuts (7+8) and washers (9), and tighten to 16Nm.

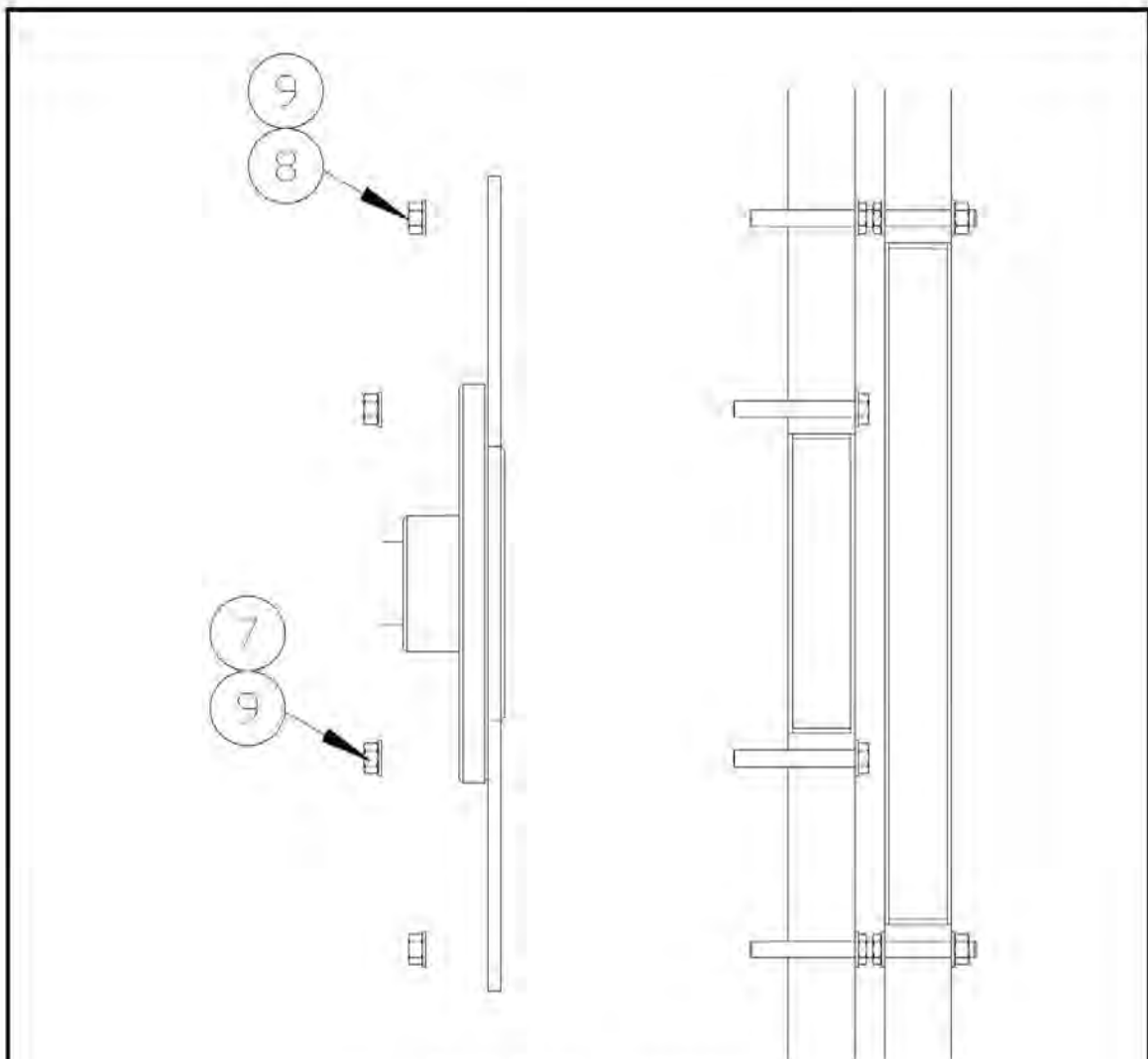


Figure 3 – Drum installation

4.3 SPACING ADJUSTMENT

- 4.3.1 In order to ensure reliable performance of the reel, it is very important that the spacing between the spokes is accurately set.
- 4.3.2 Measure the exact diameter of the cable/hose at a minimum of 3 points along its length and calculate the average value D .
- 4.3.3 Referring to Figure 4, loosen all nuts (a) and (b) on the external main spokes.
- 4.3.4 If the drum width $S1$ is greater than $D+4\text{mm}$, or less than $D+1\text{mm}$, partially remove each tie-rod (c) one at a time, and remove or insert washers (w) to bring the width to within the correct range.
- 4.3.5 Re-insert each tie-rod, refit each washer and loosely refit each full-nut.
- 4.3.6 Once the adjustment has been completed, tighten all the full-nuts to 16Nm.
- 4.3.7 Adjust the parallelism of every main spoke pair (internal and external) so that $S2$ is between $D+2\text{mm}$ and $D+3\text{mm}$.

- 4.3.8 To increase S_2 , loosen nut (a) and tighten nut (b). To decrease S_2 , loosen nut (b) and tighten nut (a).
- 4.3.9 Tighten all the full-nuts to 16Nm, and check the spacing again.

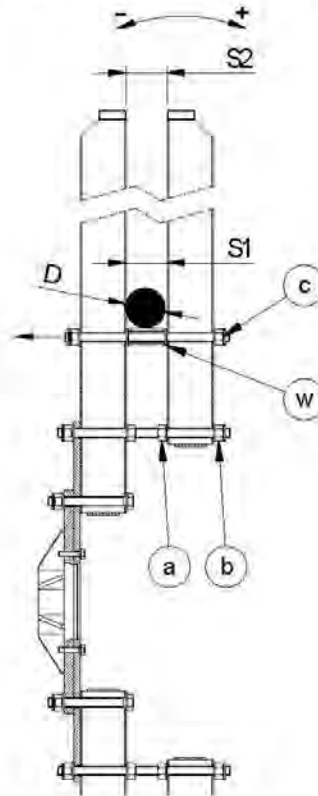


Figure 4 – Spacing adjustment

4.4 PERIODIC MAINTENANCE

- 4.4.1 Verify the tightness of all fasteners.
- 4.4.2 Check the drum width, and adjust as necessary following the procedures described in section 4.3.
- 4.4.3 Verify the fixing of the first turn of cable on the drum.
- 4.4.4 Verify that the cable entry gland is properly fitted.

SECTION 5 - CABLE

5.1 CABLE PREPARATION

- 5.1.1 Check that the cable diameter and weight are as originally specified (see *Cable* subsection of SECTION 1 for cable details) and ensure that the cable length does not exceed that for which the reel was designed.
- 5.1.2 Generally, reputable manufactures will supply their cables free of induced twist on storage drums. If, however, the cable on the storage drum is second hand, or the supplier cannot guarantee the cable to be free of induced twist, the cable should be prepared in accordance with the following.
- 5.1.3 The transport drum should be supported on stands or rollers to allow free rotation. The cable must always be pulled from the top of the drum. Refer to Figure 5.

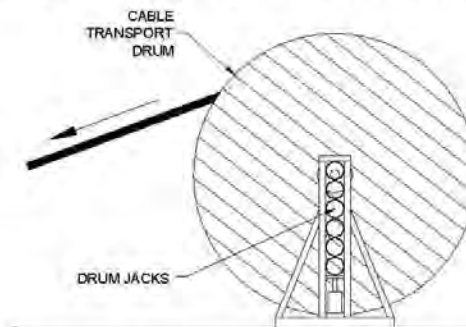


Figure 5 – Cable Transport Drum

- 5.1.4 Lay out the full length of the cable as it is pulled off the drum, either by manhandling with one person every 5m approximately or by pulling over cable rollers. ***On no account should the full length of the cable be dragged over the ground, nor should a dozer, tractor or any other powered machine be used to pull or drag the cable.***
- 5.1.5 There may be some twist evident in the cable, which is due to the manufacturing process, and this should now be removed. Leave one end of the cable fixed (eg. still attached to the transport drum) and working from this end, run the twist out of the cable by either (a) placing a suitable bar under the cable and walking towards the free end while gently moving the bar up and down (Figure 6), or (b) forming a coil of cable as near as possible to the fixed end and rolling it along to the free end (Figure 7). If there is a lot of twist in the cable, the process described above may need to be repeated several times.

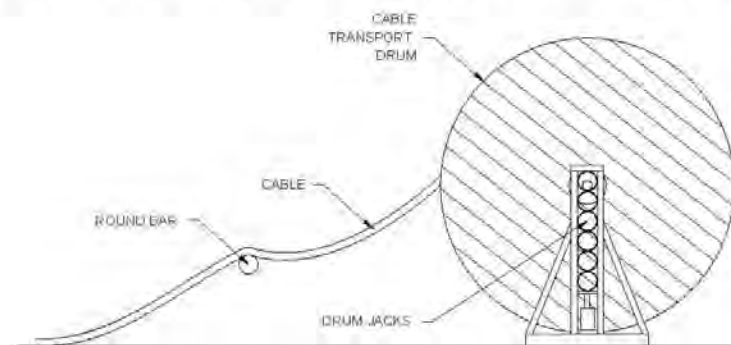


Figure 6 – Removal of Cable Twist Using Round Bar

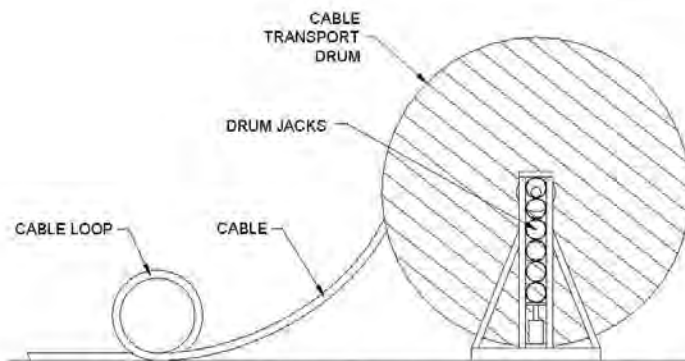


Figure 7 – Removal of Cable Twist Using Cable Coil Method

5.2 CABLE INSTALLATION

- 5.2.1 In order to ensure satisfactory performance of a reeling cable, the following installation procedure should be adopted. If the cable has been layed out according to the instructions in Section 5.1, then it should be rewound onto the storage drum before being transferred to the reeler using the method described below.
- 5.2.2 Manually rotate the reeler drum so that the opening in the inner ring is pointing vertically upwards.
- 5.2.3 With the machine located as close to the feed point as possible, feed the cable from the top of the cable transport drums directly onto the top of the reeler drum (refer to Figure 9).
- 5.2.4 Continue feeding it through the opening of the inner ring of the drum, out through the space between the spokes and then through the cable gland as shown in Figure 8.

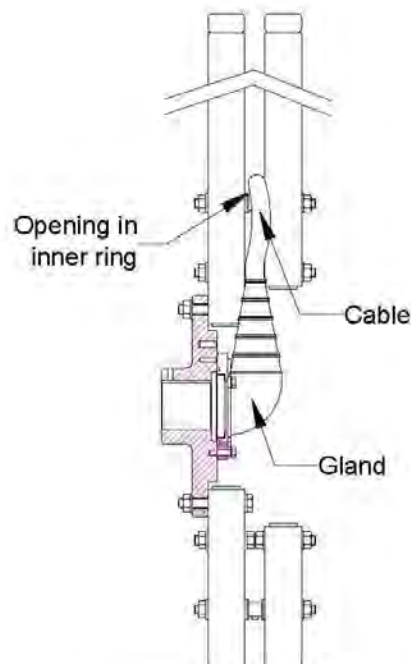


Figure 8 – Cable entry

- 5.2.5 Once the cable has been terminated to the sliprings in the collector, tighten the cable gland to exclude moisture and dirt.
- 5.2.6 Secure the cable onto the drum inner band with a number of heavy duty cable ties.

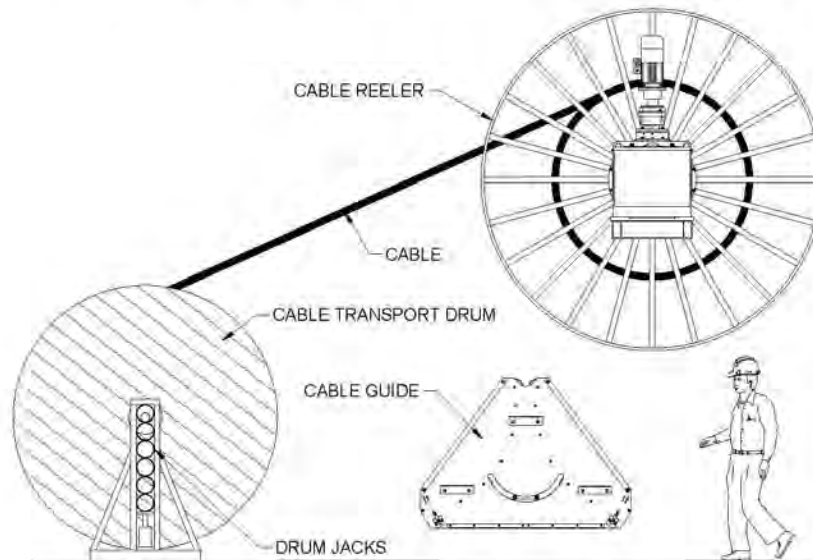


Figure 9 – Correct Method of Cable Installation

- 5.2.7 The drive unit needs to be energised to rotate the reel for cable fitting.



Ensure that an operator is available to immediately switch off the motor in the event of a problem.

- 5.2.8 The cable can now be wound onto the reel, and it is essential that this be done with the cable under some tension to ensure uniform tight layering on the reel. It is most important that the cable be wound onto the reel drum without any induced twist. Figure 9 shows the correct method of cable transfer from the storage drum. The use of any other method will induce twist in the cable.
- 5.2.9 The ends of the cable can now be passed down through the cable guide (if fitted) and manually pulled along the ground or cable tray to the nearby feedpoint.
- 5.2.10 Lay out the cable as it is pulled off the reel, either by manhandling with one person approximately every 5 m or by pulling over cable rollers. ***On no account should the cable be dragged over the ground, nor should a dozer, tractor or any other powered machine be used to pull or drag the cable.***

5.3 PERIODIC MAINTENANCE

- 5.3.1 The cables should be inspected after a short time in operation. Twisting may occur as the cable runs in due to the lay of the cable relaxing slightly under operation. This twisting will tend to move towards the feed point over time, and can eventually cause damage to the cable. If twisting is apparent at any time, the cable should be freed at the feed point with the reel at the furthest point of travel (ie. with all the cable paid out), and the twist should be removed by following the instructions in Section 5.1. Due to variations in operating conditions, it is impossible to state an exact number of cycles which need to be carried out, or period of time after which twisting will cease, and in some cases it may be several weeks. Periodic inspections are advisable after the machine has begun operation.

SECTION 6 – COLLECTOR



Ensure that all circuits are isolated by an authorised person prior to removing the cover of the collector housing. Electrical connections should only be carried out by qualified persons.

6.1 REELING CABLE CONNECTION

- 6.1.1 Reeling cable termination is best done before feeding the cable through the torque unit shaft into the collector.
- 6.1.2 Strip the outer sheath in order to expose sufficient core length to respect the core dimensions specified in the *Reeling Cable Terminations* subsection of SECTION 1.
- 6.1.3 Terminate each core with an appropriately sized terminal to suit the ring side fixtures specified in the *Collector* subsection of SECTION 1.
- 6.1.4 Feed the cable through the torque unit shaft into the collector, and connect each core to the corresponding slipping terminal.
- 6.1.5 Tighten the cable gland on the drum side of the torque unit.

6.2 FIXED CABLE CONNECTION

- 6.2.1 Feed the fixed cable through the gland mounted on the side of the collector housing, ensuring that it is well supported so as not to put any bending force on the gland.
- 6.2.2 Strip the outer sheath in order to expose sufficient core length to neatly arrive at the brushgear connection points, and shorten individual cores as necessary.
- 6.2.3 Terminate each core with an appropriately sized fitting to suit the brush side fixtures specified in the *Collector* subsection of SECTION 1.
- 6.2.4 Ensure that the cores are neatly arranged and properly supported inside the collector housing, and ensure that the cores are not in contact with live metal parts.
- 6.2.5 Tighten the cable gland.

6.3 ANTI-CONDENSATION HEATER

- 6.3.1 Fit a suitably sized cable gland to the removable blanking plate located on the side of the collector housing for the heater cable.
- 6.3.2 Pass the heater connection cable through this gland up to the heater terminal block. Fix the cable well along the path selected, and ensure that it does not come any closer than 50mm to live metal parts.
- 6.3.3 Strip the cable cores to the correct length, and terminate using appropriately sized blade terminals.
- 6.3.4 Connect the cable cores to the appropriate terminals as indicated by the schematic referenced in the *Drawings* subsection of SECTION 1. Tighten the screws to 0.8Nm.
- 6.3.5 The heater should remain energised at all times in order to prevent the formation of condensation.

6.4 FINAL CHECKS

- 6.4.1 Before closing the housing and applying current to the collector for the first time, ensure that:
 - all the carbon brushes are correctly aligned in the slipping grooves.
 - all the brush arms are correctly aligned with the sliprings.

- all the electrical connections are correctly tightened.
- all cores are sufficiently clear of each other and rotating and live metal parts.

6.5 PERIODIC MAINTENANCE

- 6.5.1 The sliprings and brushgear should be inspected to ensure good contact and alignment is maintained between the sliprings and brushes. Worn brushes should be replaced.
- 6.5.2 Verify tightness of all electrical connections.
- 6.5.3 If necessary, the sliprings can be lightly cleaned with glass paper, and then wiped clean with a cloth dampened with methylated spirit.
- 6.5.4 Vacuum the carbon dust from the insulators, cable terminations and floor of the collector housing. Alternatively, use a brush or a lint free cloth. ***Never use water or solvents for cleaning.***
- 6.5.5 The housing cover seal should be checked and replaced if necessary.

SECTION 7 – RAVASI BASE ROTARY LIMIT SWITCH



The limit switch is located inside the collector enclosure. Ensure that all circuits are isolated by an authorised person prior to removing any covers. Electrical connections should only be carried out by qualified persons.

7.1 GENERAL

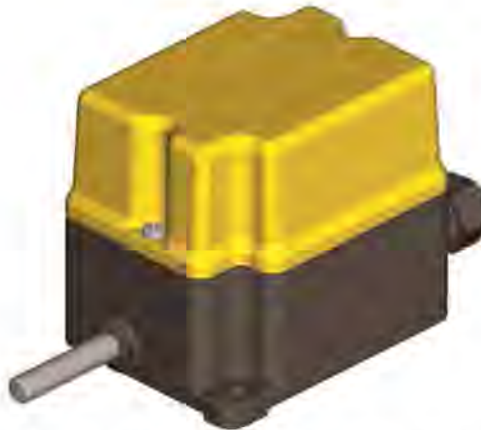


Figure 10 – MF2C rotary limit switch

- 7.1.1 The rotary limit switch consists of a number of cam activated switches. These cams rotate via a gear reduction connected to the input shaft, with one turn of the input shaft resulting in a partial rotation of the cams that is proportional to this gear reduction.
 - 7.1.2 Transmission and gear driving shafts are made of stainless steel to prevent oxidation and wear.
 - 7.1.3 The gear wheels and the driving bushes are made of self-lubricating thermoplastic material, suitably chosen to reduce the wear to a minimum and to maintain the accuracy of the couplings over time.
 - 7.1.4 Sintered bronze bushes are moulded into the base of the limit switch to optimise the shaft rotation and to prevent rubbing with plastic material.
 - 7.1.5 The technical specification of this limit switch can be found in the Limit Switch subsection of SECTION 1.
- ### 7.2 ELECTRICAL CONNECTION
- 7.2.1 Remove the covers of the collector and limit switch, ensuring beforehand that all live electrical circuits have been isolated.
 - 7.2.2 Fit a suitably sized cable gland to the removable blanking plate located on the side of the collector housing.
 - 7.2.3 Pass the limit switch connection cable through this gland and into the cable gland located at the rear of the limit switch. Fix the cable well along the path selected, and ensure that it does not come any closer than 50mm to live metal parts.
 - 7.2.4 Strip the cable cores to the correct length, and terminate using appropriately sized forked lugs.
 - 7.2.5 Connect the cable cores to the appropriate terminals as indicated by the schematic referenced in the Drawings subsection of SECTION 1. Tighten the screws to 0.8Nm.

7.2.6 Tighten the cable gland, and refit the limit switch and collector covers.

7.3 SETTING

7.3.1 Travel the machine towards the cable feedpoint and note the rotation direction of the cable drum when viewed from the drive side.

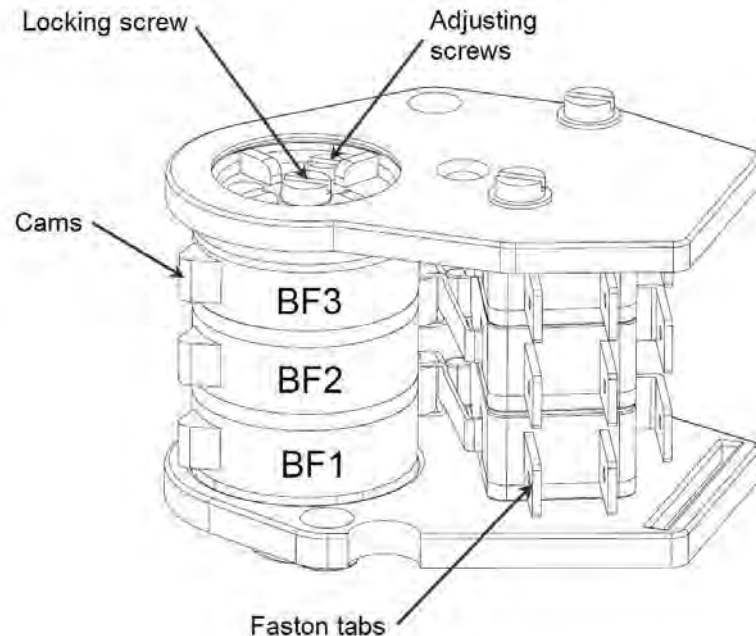


Figure 11 – Geared rotary limit switch

7.3.2 Position the machine as close to the feedpoint as possible, then set the reel full switch BF1 as follows:

- Remove the covers of the collector and limit switch, ensuring beforehand that all live electrical circuits have been isolated.
- Loosen the central locking screw (refer to Figure 11).
- If the drum was turning clockwise during recovery, turn the BF1 cam in the anti-clockwise direction using adjusting screw 1 until it just activates the switch (there will be an audible click).
- If the drum was turning anti-clockwise during recovery, turn the BF1 cam in the clockwise direction using adjusting screw 1 until it just activates the switch (there will be an audible click).
- Tighten the locking screw.
- Ensure that the incoming wires are connected to the normally closed tabs 11 & 12.
- Refit the covers of the collector and limit switch

7.3.3 Position the machine as far from the feedpoint as possible, then set the reel empty switch BF2 as follows:

- Remove the covers of the collector and limit switch, ensuring beforehand that all live electrical circuits have been isolated.

- Loosen the central locking screw (refer to Figure 11).
- If the drum was turning clockwise during recovery, turn the BF2 cam in the clockwise direction using adjusting screw 2 until it just activates the switch (there will be an audible click).
- If the drum was turning anti-clockwise during recovery, turn the BF2 cam in the anti-clockwise direction using adjusting screw 2 until it just activates the switch (there will be an audible click).
- Tighten the locking screw.
- Ensure that the incoming wires are connected to the normally closed tabs 11 & 12.
- Refit the covers of the collector and limit switch

7.3.4 Travel the machine back towards the feedpoint and ensure that the reel full switch does not trip within the normal travel limits.

7.3.5 Travel the machine away from the feedpoint and ensure that the reel empty switch does not trip within the normal travel limits.

7.3.6 The spare switches, if used, should be set using the procedures described above.

7.4 PERIODIC MAINTENANCE



Ensure that all live electrical circuits have been isolated before performing any maintenance inside the collector housing.

7.4.1 Check that the wires are properly connected to the tabs.

7.4.2 Check that the central cam locking screw is properly tightened.

7.4.3 Check that the front and rear bush covers are correctly fitted.

7.4.4 Check that the cable gland is tight.

7.4.5 Check that the cover is correctly fitted, and that the holding screws are tight

SECTION 8 - TORQUE UNIT

8.1 GENERAL

- 8.1.1 The torque unit is the primary support for all the components of the cable-reel. It reduces the motor speed to the value that is required for the cable reel, at the same time multiplying the torque output of the motor.
- 8.1.2 The T4 epicyclical torque unit has one primary conical gear driving second and third stage planetary gears.
- 8.1.3 An additional pre-reducer can be fitted to provide additional speed reduction/torque multiplication.
- 8.1.4 A maximum of one motor can be installed.
- 8.1.5 All gears are immersed in oil and the gearboxes require very little maintenance.

8.2 PERIODIC MAINTENANCE

- 8.2.1 After the first 500 hours of operation, and every 10,000 hours thereafter, drain the oil from the torque unit and replace it with the type specified (or approved equivalent) in the *Torque Unit* subsection of SECTION 1.
- 8.2.2 Between oil change intervals, perform occasional checks on the oil level using the level gauge and top up as necessary with the oil specified.
- 8.2.3 After every 10,000 hours of operation, replace the grease in the pre-reducer/s with the type specified (or approved equivalent having Brookfield viscosity of 4000) in the *Pre-reducer* subsection of SECTION 1.
- 8.2.4 Check for oil leakage or unusual noises, and rectify as necessary.
- 8.2.5 Check for water ingress and replace oil if necessary.
- 8.2.6 Ensure that the breather is clean and not blocked.

SECTION 9 - MOTOR



Ensure that all circuits are isolated by an authorised person prior to removing any covers. Electrical connections and motor maintenance should only be carried out by qualified persons.

9.1 ELECTRICAL CONNECTION

- 9.1.1 Ensure nameplate data matches the available power supply.
- 9.1.2 Remove the cover of the motor terminal box, **ensuring beforehand that all live electrical circuits have been isolated.**
- 9.1.3 Measure the winding resistances between each phase and earth, and between individual phases, and ensure that they are greater than 5 M Ω .
- 9.1.4 Run and gland an appropriate power cable, and connect the cable cores to the appropriate terminals as indicated by the schematic referenced in the *Drawings* subsection of SECTION 1. Ensure that sufficient air-gap exists between the connections.
- 9.1.5 Run and gland an appropriate cable for the motor fan, and connect the cable cores to the appropriate terminals as indicated by the schematic referenced in the *Drawings* subsection of SECTION 1.
- 9.1.6 Run and gland an appropriate cable for the thermal sensor, and connect the cable cores to the appropriate terminals as indicated by the schematic referenced in the *Drawings* subsection of SECTION 1.
- 9.1.7 Run and gland an appropriate cable for the brake, and connect the cable cores to the appropriate terminals on the rectifier as indicated by the schematic referenced in the *Drawings* subsection of SECTION 1.
- 9.1.8 If a heater has been fitted, run and gland an appropriate cable, and connect the cable cores to the appropriate terminals as indicated by the schematic referenced in the *Drawings* subsection of SECTION 1.
- 9.1.9 Prior to closing the terminal boxes, ensure that all connections have been properly tightened.

9.2 PERIODIC MAINTENANCE

- 9.2.1 Clean cooling air passages using low-pressure water spray.
- 9.2.2 Ensure that all electrical connections are properly tightened.
- 9.2.3 Ensure that all glands are correctly tightened and sealing correctly.
- 9.2.4 Ensure that the brake is functioning correctly.
- 9.2.5 The ball bearings are sealed for life, and therefore maintenance free.

SECTION 10 - BRAKE



Ensure that all circuits are isolated by an authorised person prior to removing any covers. Electrical connections and brake maintenance should only be carried out by qualified persons.



Operation of the manual brake release (if supplied) can result in uncontrolled unwinding of the cable/hose on the reel. Ensure that this does not put personnel at risk.

10.1 GENERAL

10.1.1 The fail-safe brake is mounted on the motor shaft and prevents unwinding of the reel when the motor is not energized. Its DC coil is powered from the AC supply via a rectifier mounted in the motor terminal box. The torque setting of the brake is set such that if the cable were to be pulled off the reel with the motors de-energised, the resulting tension would not damage the cable.

10.2 MANUAL RELEASE

10.2.1 The optional manual brake release is activated by a lever which protrudes from the fan cowling. This lever can be removed if required by unscrewing it.

10.3 BRAKE ADJUSTMENT

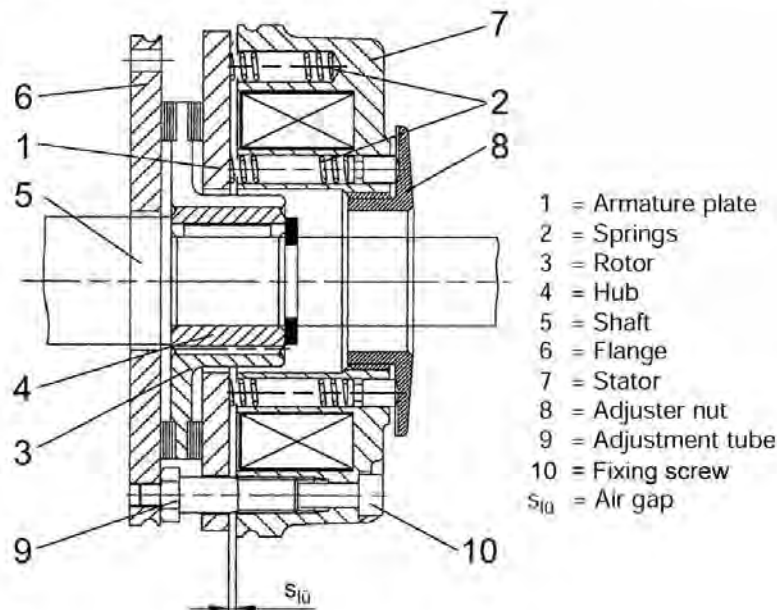


Figure 12 – Brake

10.3.1 In order to ensure that the correct braking torque is maintained, it is important to occasionally adjust the air gap s_{ij} so that it remains in the range 0.2 to 0.5 mm. This can be done as follows:

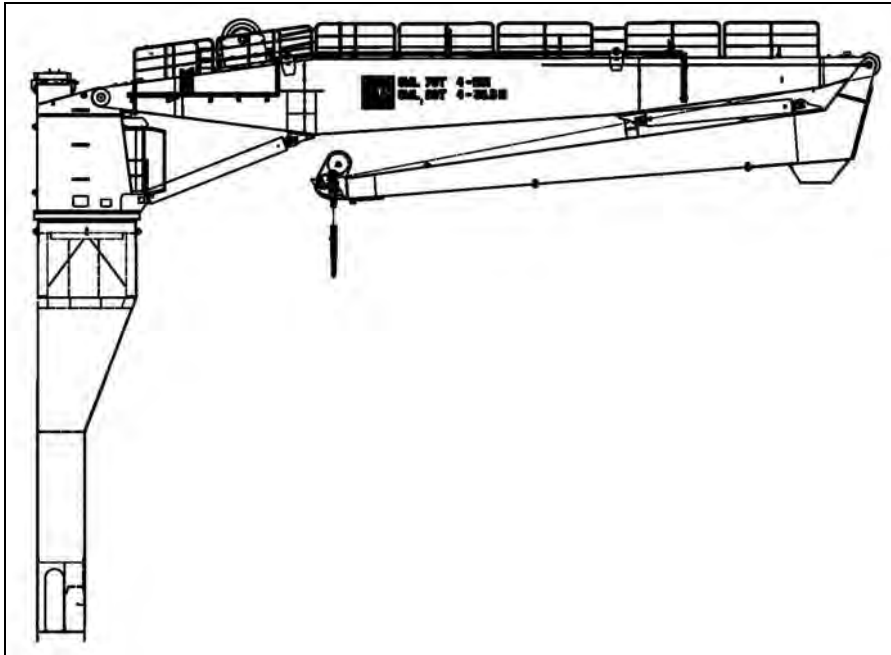
- Isolate the motor and brake from the supply.
- Clean the motor with a low pressure water spray.

- Remove the cowlings, encoder (if fitted) and fan.
- Loosen the 3 fixing screws (10).
- Turn the adjustment tubes (9) in the anti-clockwise direction until the air gap s_{10} is 0.2 mm all around.
- Re-tighten the fixing screws.
- Refit the fan, encoder (if fitted) and cowlings.

10.3.2 Measure the thickness of the rotor, and replace it if the dimension is less than 7.5 mm.

USER MANUAL

Data Sheets / Spare Parts



Cargo Crane
CCLKO 2000-70-36,5

RAY Shipping
M/V "Ella"

11857

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DATA SHEETS / SPARE PARTS

General

Part lists for all components used in this TTS Ships Equipment AS product are found as attachments in chapter 8.

Several of the components listed in chapter 8 consist of other sub-components. Some of these components have sub-components that may be obtained as separate Spare Parts. This will allow for substituting only one or more sub-components, instead of substituting the entire component.

Data sheets and component Spare Parts lists for these sub-components are not included in this user manual.

7.1.1 Spare Parts included in the delivery

The following spares are included in the delivery:

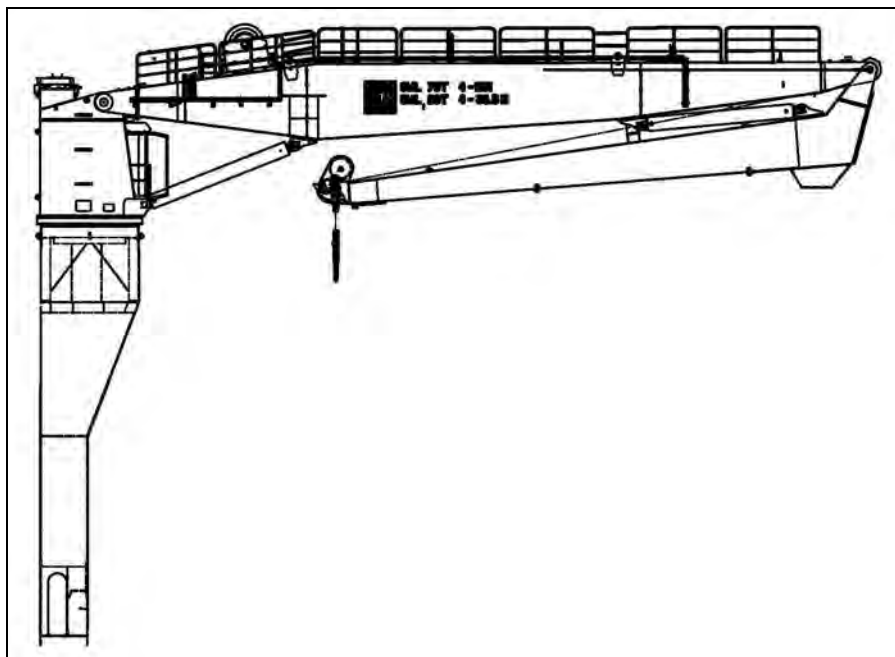
- Spare oil filter insert.

7.1.2 Spare Parts Ordering

For ordering of Spare Parts, please see chapter 8.3.

USER MANUAL

Parts List/ Drawings



Cargo Crane
CCLKO 2000-70-36,5

RAY Shipping
M/V "Ella"

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8 PARTS LIST / DRAWINGS

8.1 Drawing List Index

Part lists and drawings are included as a separate attachment back in this chapter.

See the following index of enclosed drawings:

8.1.1 Mechanical / Hydraulic Drawings

Customer: RAY Shipping
11857 CCLKO 2000-70-36,5

Drawing Number	Description
11857-G01	GENERAL ARRANGEMENT
11857GAL	MAIN PART LIST
11857-02	LUBRICATION CHART
11857-01	REEVING DIAGRAM
Loadcurves 1-4	LOAD CHART, 4 sheets
151709	STAB. WINCH ARRANGEMENT
151817	ADDITIONAL STAB. WINCH AND ROTATOR
129137	BASE COLUMN ASSEMBLY
A2-10126	MAIN WINCH ARRANGEMENT
21361M600	SLEWING DRIVE ARRANGEMENT
A3-13158	LUFFING CYLINDER HINGE ASSEMBLY
A3-13159	FOLDING CYLINDER HINGE ASSEMBLY
A3-13167	JIB HINGE ASSEMBLY
A3-13260	OUTER JIB LIMIT SWITCH ARRANGEMENT
A2-10135	JIB LIMIT SWITCH BETW. SLEWING AND JIB
A3-13165	KNUCKLE JIB HINGE ASSEMBLY
A3-13164	SHEAVE HOUSE ASSEMBLY, INNER HINGE
A3-1059	WIRE SHEAVE S630
A2-9899	JIB HEAD ASSEMBLY, MAIN
A2-10530	HOOK BLOCK WITH CARGO TURNER, 50T
A3-13661	FLOODLIGHT ASSEMBLY
A3-15765	PUMP DRIVE MAIN ASSEMBLY
11857H001	HYDRAULIC CIRCUIT, 2 sheets

8.1.2 *Electric Drawings*

Customer: RAY Shipping
11857 CCLKO 2000-70-36,5

Drawing Number	Description
11857EB1-EB2	BLOCK DIAGRAM, ELECTRICAL
11857EB3-EB4	BLOCK DIAGRAM, INSTRUMENT
11857ES1-ES2	EL.CIRCUIT DIAGRAM, -A901 MAIN STARTER 1
11857ES3-ES4	EL.CIRCUIT DIAGRAM, -A902 MAIN STARTER 2
11857ES5-ES7	EL.CIRCUIT DIAGRAM, -A910 AUX STARTER
11857E01-E05	EL.CIRCUIT DIAGRAM, 230 VAC / 24 VDC SYSTEM
11857E10	EL.CIRCUIT DIAGRAM, PLC CONFIGURATION
11857E11-E12	EL.CIRCUIT DIAGRAM, DEVICENET
11857E13	EL.CIRCUIT DIAGRAM, CANBUS
11857E20-E23	EL.CIRCUIT DIAGRAM, DIGITAL INPUT
11857E24-E26	EL.CIRCUIT DIAGRAM, DIGITAL OUTPUT
11857E27-E29	EL.CIRCUIT DIAGRAM, ANALOG INPUT
11857E30-E31	EL.CIRCUIT DIAGRAM, ANALOG OUTPUT
11857C01-C5	CABLE WIRNG DIAGRAM, ELECTRICAL
11857C10-C16	CABLE WIRNG DIAGRAM, INSTRUMENT
11857DP1	EL.PANEL LAYOUT, -A901 MAIN STARTER
11857DP2	EL.PANEL LAYOUT, -A902 MAIN STARTER
11857DP3	EL.PANEL LAYOUT, -JB400/440/480 JUNCTION BOX
11857DP4	EL.PANEL LAYOUT, -A340 CONTROL CABINET
11857DP5	EL.PANEL LAYOUT, -A922 EMG. STOP BOX
11857DP6	EL.PANEL LAYOUT, -IB300 OPERATOR PANEL

8.3 Spare Parts Ordering

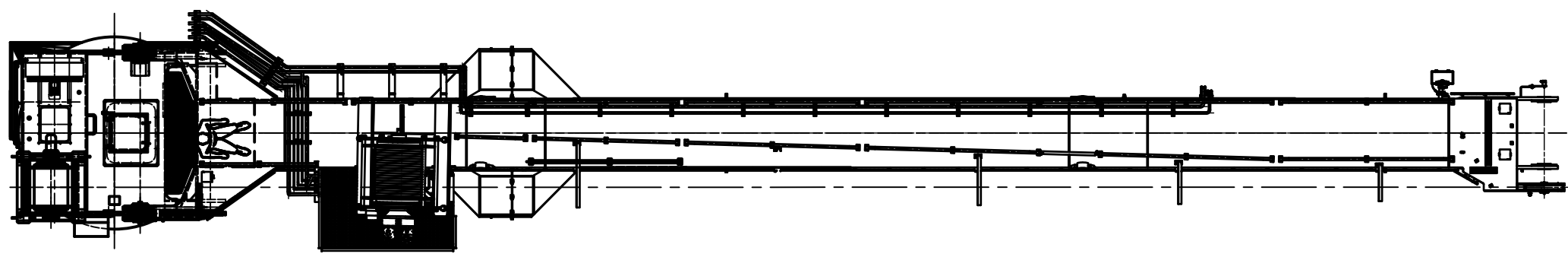
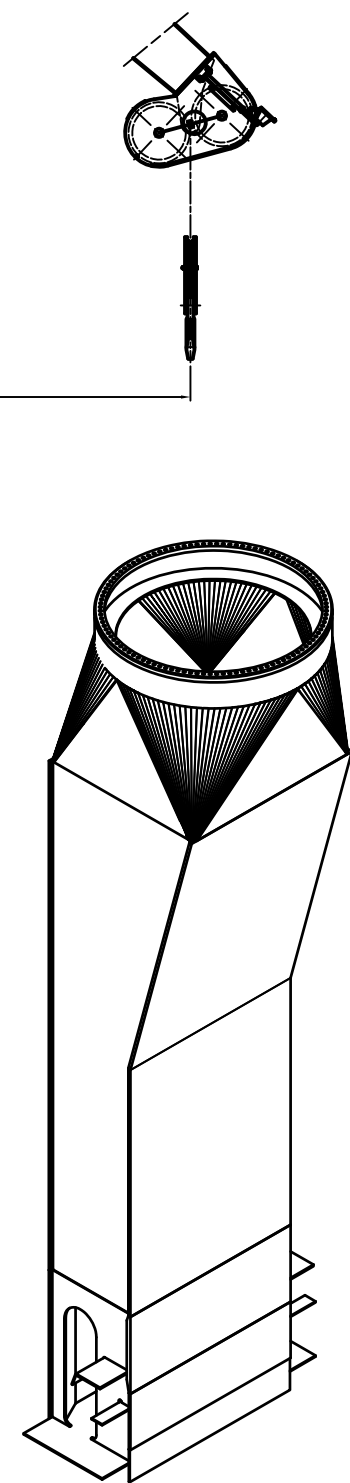
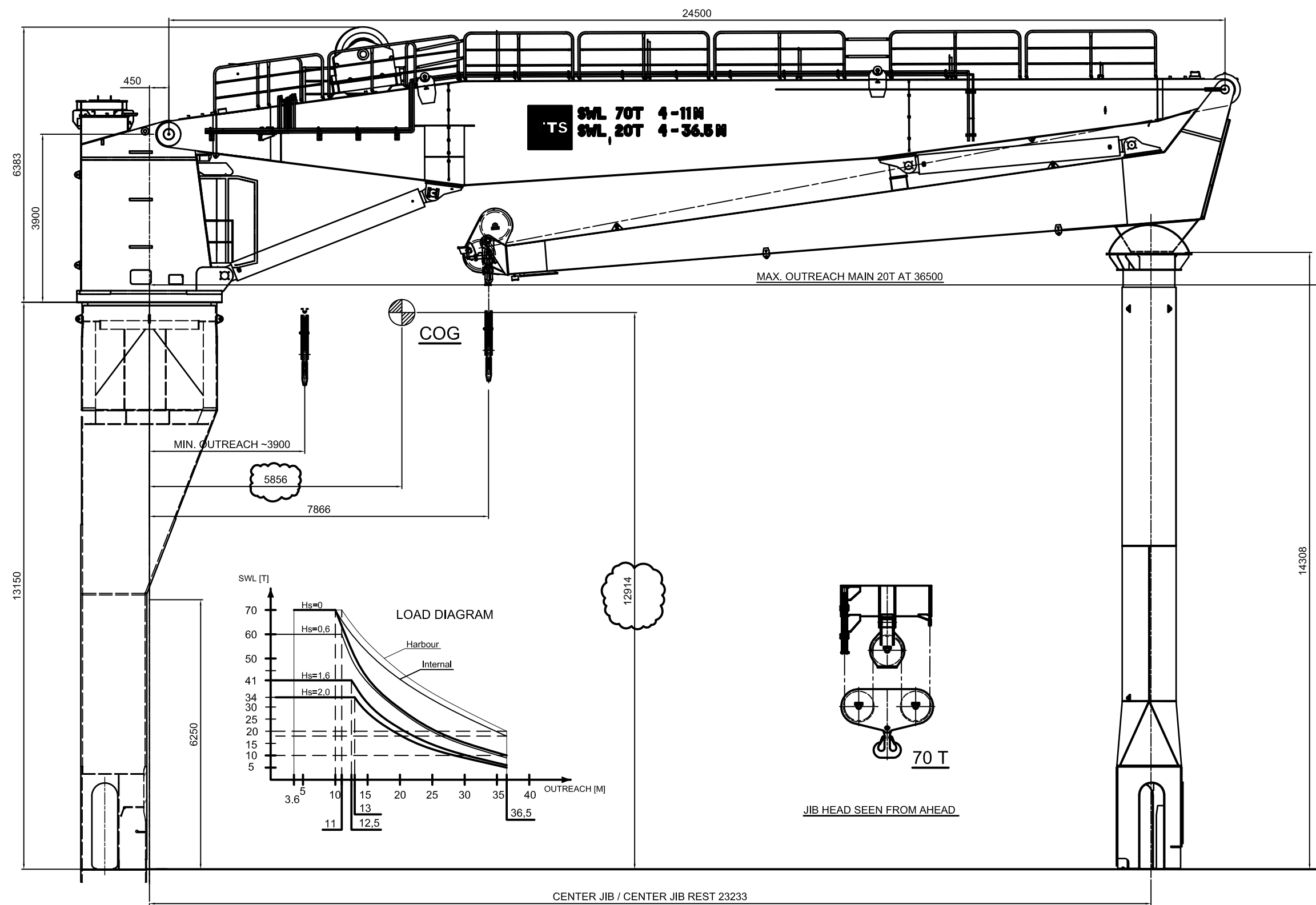
Please use the following example when ordering spare parts:

Supplier: TTS Marine AS Service Box 602 N-4606 Kristiansand Norway Phone: (+47) 38 04 95 00 Telefax: (+47) 38 04 93 41		Customer: Office Address: Delivery Address:	
		Contact Person: Phone: Telefax:	
Machine Type: Machine Number: Main Drawing:		Notes/Customer Order ID:	
Qty.	Item No.	Item Name / Description	Drawing Ref.

WARNING:

DURING THE WARRANTY PERIOD, ALL REPAIR AND MAINTENANCE WORK MUST BE CARRIED OUT IN ACCORDANCE WITH TTS SHIPS EQUIPMENT AS'S PROCEDURES AND APPROVAL. THIS INCLUDES APPLYING APPROVED MATERIALS AND ORIGINAL SPARE PARTS.




REV	ALTERATION	REVISED	APPROVED
01	RELEASED FOR COSTUMER APPROVAL		12.11.09 / FTU
02	UPDATED DRAWING, DISTANCE TO JIB REST		11.03.10 / FTU
03	UPDATED DRAWING, DISTANCE TO JIB REST		30.03.10 / FTU
04	DISTANCE TO JIB REST CHANGE		13.04.10 / FTU
1	CHANGE JIB COG, RELEASE DRAWING FOR PRODUCTION		15.06.10 / FTU
2	CHANGE DISTANCE TO JIB REST 23235		17.06.10 / FTU



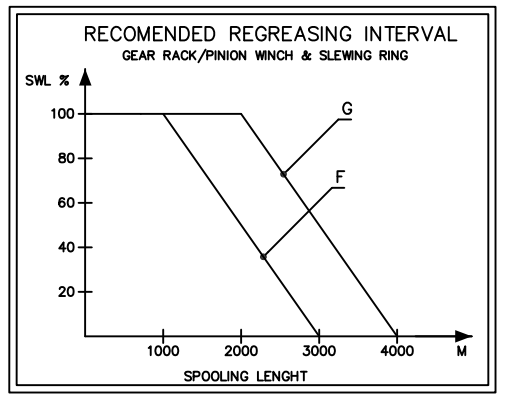
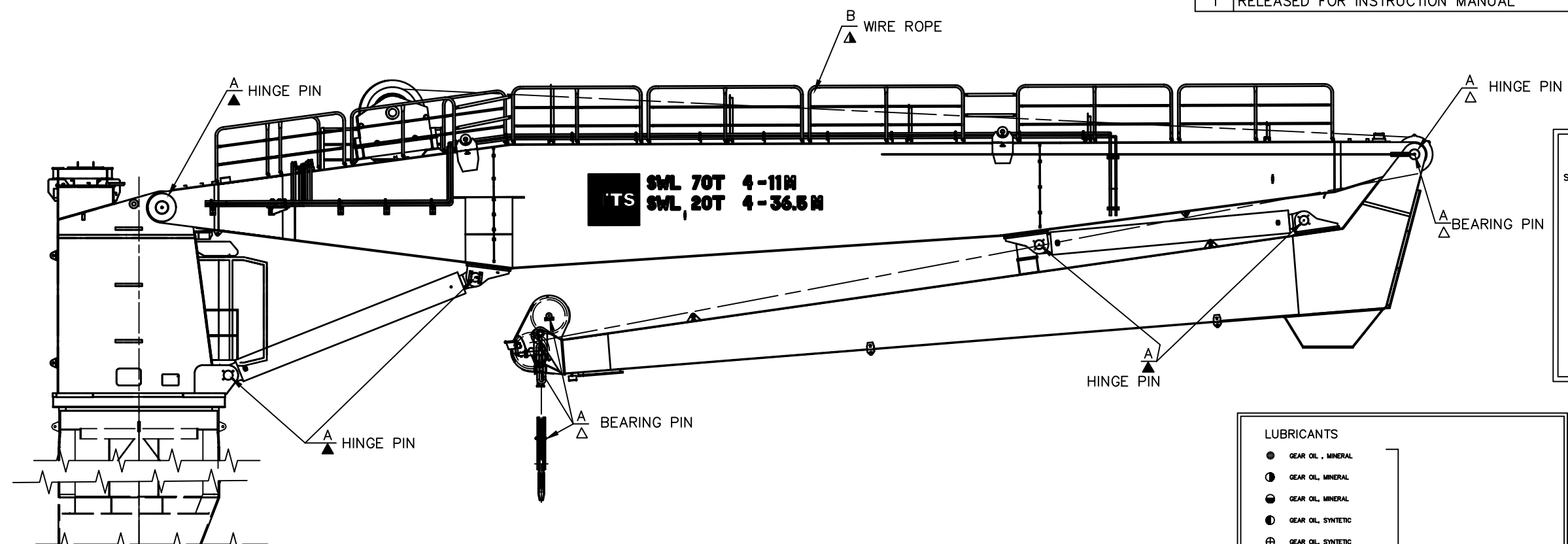
WEIGHT OF BASE COLUMN (HOLE BASE COLUMN): 41T
 WEIGHT OF CRANE WITH OUT OIL: 90T
 TOTAL WEIGHT OF CRANE WITH OIL: 133T

REV	ALTERATION	REVISED	APPROVED
01	RELEASED FOR COSTUMER APPROVAL		12.11.09 / FTU
02	UPDATED DRAWING, DISTANCE TO JIB REST		11.03.10 / FTU
03	UPDATED DRAWING, DISTANCE TO JIB REST		30.03.10 / FTU
04	DISTANCE TO JIB REST CHANGE		13.04.10 / FTU
1	CHANGE JIB COG, RELEASE DRAWING FOR PRODUCTION		15.06.10 / FTU
2	CHANGE DISTANCE TO JIB REST 23235		17.06.10 / FTU

DESIGNER	08.01.10 / FTU	CHECKED	08.01.10 / FTU	APPROVED	15.06.10	PROJECT	
<p style="text-align: center;">TTS TTS Marine Cranes AS</p>							
<p style="text-align: center;">CCLK 2000-70-36,5 GENERAL ARRANGEMENT 20T WINCH</p>				<p style="text-align: center;">SCALE: 1:50</p>		<p style="text-align: center;">11857-G01</p>	
<p style="text-align: right;">REPLACES: 11857-G01</p>							

REV	ALTERATION	DATE / SIGN		
1	RELEASED FOR PRODUCTION	09.09.10 / FTU		
TOTAL CRANE WEIGHT APPROX. [KG] : ~116480				
	HYDRAULIC HOSES	23		-
	HYDRAULIC CIRCUIT DIAGRAM	22	11857H01	-
	ELECTRIC BLOCK DIAGRAM	21	11857ES1	-
1	REEVING ARRANGEMENT	20	11857-01	2062
1	FLOOD LIGHT ASSEMBLY	19	A3-13258	12
		18		
1	NAME PLATE	17	A4-1400	-
1		16		
1		15		
1	INNERHINGE / FOLDING HINGE	14	A3-13165	180
1	JIB HEAD ASSEMBLY	13	A2-9899	180
1	FOLDING JIB SUPPORT	12	127268	1145
1	JIB HINGE ASSEMBLY	11	A3-13167	290
1	OUTER CYLINDER HINGE ASEMBLY	10	A3-13159	5200
1	CYLINDER HINGE ASSEMBLY	9	A3-13158	10400
1	SLEWING DRIVE ARR.	8	21361M600	4700
1	OUTER JIB	7	127709	14514
1	INNER JIB	6	127464	31834
1	MAIN WINCH ARRANGEMENT	5	A2-10126	2000
		17.5T		
1	CABIN	4	A2-10000	900
1	BASE COLUMN ARRANGEMENT INSIDE	3	A2-10531	142
1	SLEWING COLUMN ASSEMBLY OUTSIDE	2	A1-14445	22650
1	BASE COLUMN	1	128698	20270
NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT
THIS DRAWING IS THE PROPERTY OF TTS Marine ASA AND MUST NOT BE REPRODUCED WITHOUT OUR WRITTEN CONSENT				
DRAWN	FTU	09.09.10	CHECKED	09.09.10 /FTU
APPROVED			09.09.10 / FTU	
PROJECT				
GPKCO 2000-70-36.5M CRANE NO.: 11857				
DRWG NAME			SCALE	FORMAT
MAIN PART LIST			1:1	  E
			DRWG NO	REV
			11857GAL	1
REPLACES		REPLACED BY		DRWG FOLDER

REV	ALTERATION	DATE / SIGN
1	RELEASED FOR INSTRUCTION MANUAL	FTU 15.09.10



LUBRICANTS

- GEAR OIL, MINERAL
- ① GEAR OIL, MINERAL
- ⊙ GEAR OIL, MINERAL
- ⊙ GEAR OIL, SYNETIC
- ⊕ GEAR OIL, SYNETIC
- HYDRAULIC OIL
- ▲ EP GREASE, NO MoS2
- ▼ EP GREASE
- △ EP GREASE
- ▲ GREASE/LUB FOR WIRE ROPE
- ▽ GREASE FOR OPEN GEARS

FOR EXACT OIL AND LUBRICANTS SPECIFICATION, REF. SELECTION CHART DOC. 503

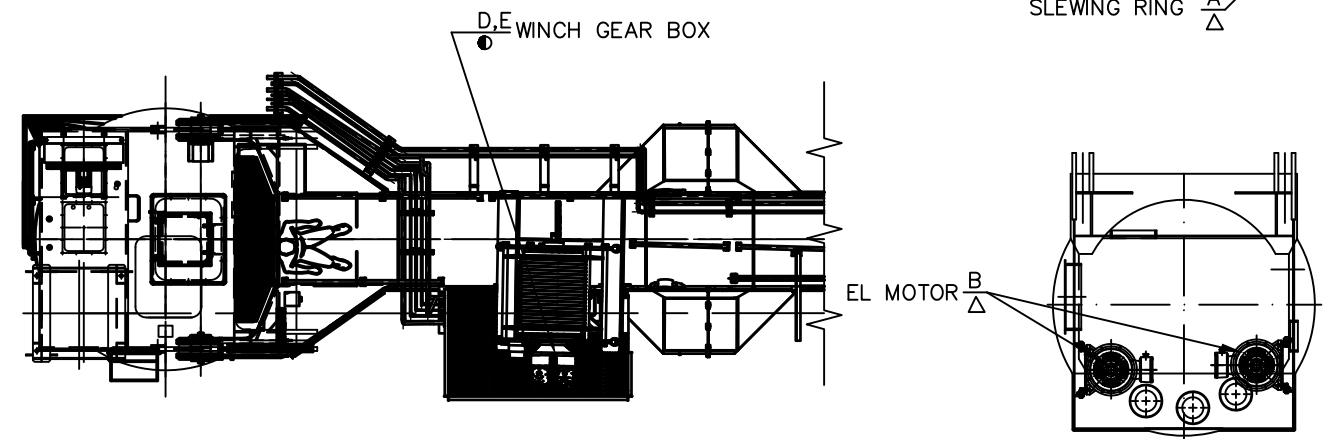
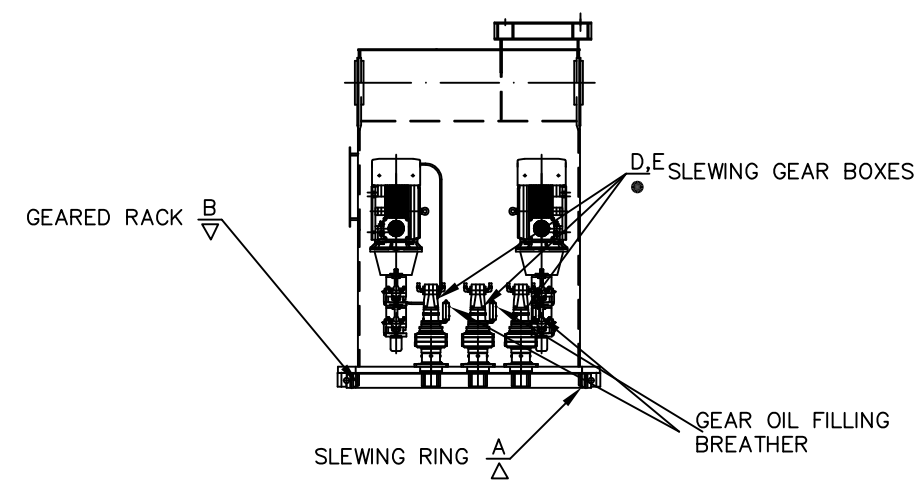
LUB. MAINTENANCE INTERVALS

A: GREASE EVERY MONTH
 B: GREASE EVERY 2. MONTH
 C: TAKE SAMPLE AND ANALIZE OIL EVERY 6. MONTH. CHANGE OIL WHEN NECESSARY. CHANGE FILTER WHEN INDICATOR IS RED OR AT LEAST ONCE A YEAR.
 D: CHANGE OIL AFTER 200HRS. SERVICE. AFTER THAT CHANGE ONCE A YEAR.
 E: CHECK OIL LEVEL EVERY WEEK

(FOR GENERAL MAINTENANCE, REF. DOC. 501)

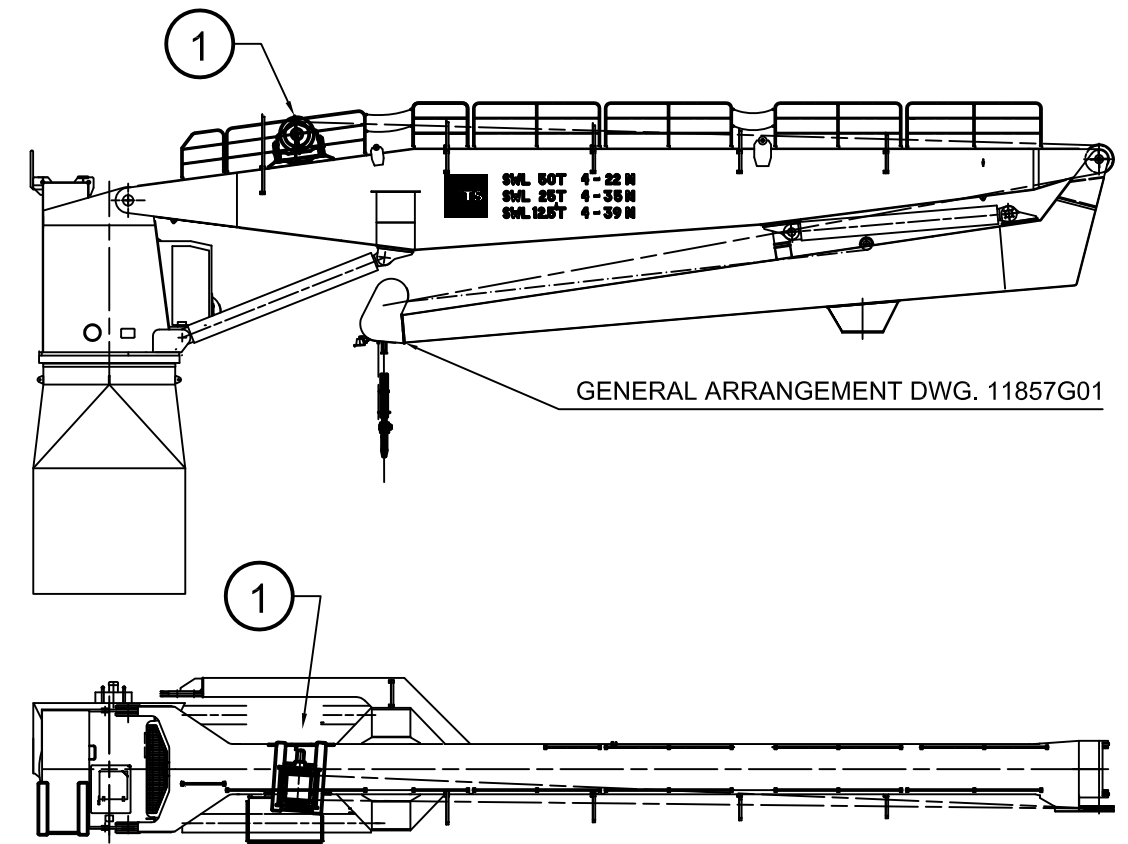
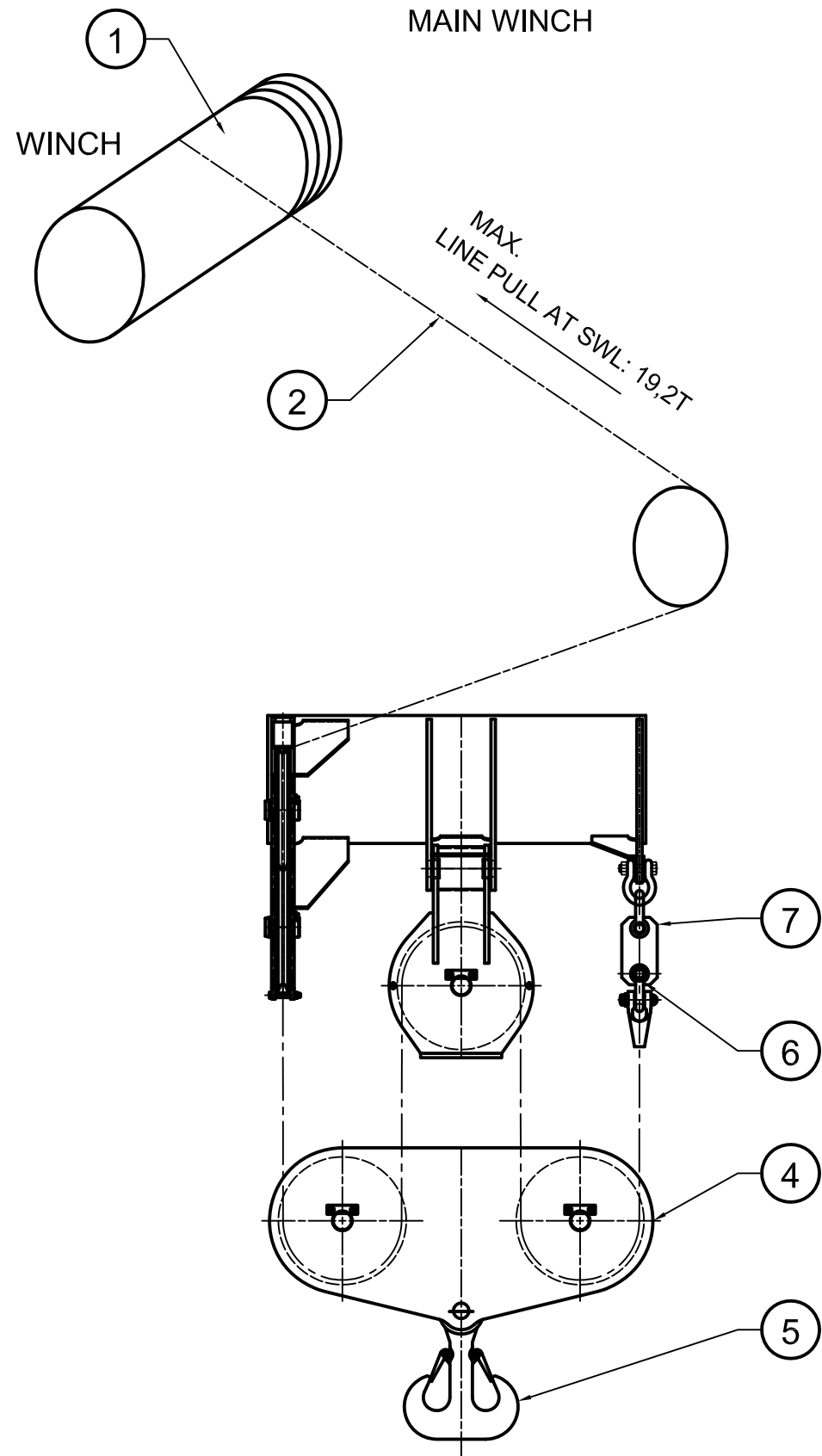
IN MACHINEROOM

- Oil filter/Oil filling C ○
- Oil level temp. E
- El. motor B △
- Slewing ring A △
- 3 x Slewing gear box D,E ●
- Hinge pin A △



NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT		
THIS DRAWING IS THE PROPERTY OF TTS Marine ASA AND MUST NOT BE REPRODUCED WITHOUT OUR WRITTEN CONSENT						
DRAWN	FTU 15.09.10	CHECKED	FTU 15.09.10	APPROVED		
PROJECT						
DRWG NAME						
LUBRICATION POINTS & INTERVALS		SCALE	1:100	FORMAT	A3	E
REPLACES		DRWG NO	11857-02-1		REV	
REPLACED BY		DRWG FOLDER	11857			

REV	ALTERATION	REVISED	APPROVED
1	RELEASED FOR PRODUCTION		09.09.10 / FTU



TOTAL WEIGHT [kg] ~2062

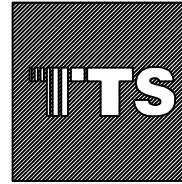
2	LOAD LINK	SWL 17.5T	9		42
3	SHACKLE RED PIN	25T	6		70
1	EYE HOOK SWL 70T		5	112194	140
1	HOOK BLOCK 2 SHEAVES		4		960
1	WIRE Ø30 L= 210 M		2		850
1	MAIN WINCH SWL 17.5T		1		-
NOS	ITEM / DIMENSION		POS	MATR / DRWG / ART NO	WEIGHT

THIS DRAWING AND THE DESIGN ARE THE PROPERTY OF TTS MARINE CRANES AS AND SHALL NOT BE USED AND REPRODUCED WITHOUT OUR WRITTEN CONSENT					
DRAWN	09.09.10 / FTU	CHECKED	09.09.10 / FTU	APPROVED	09.09.10 / FTU
PROJECT	CCLK 2000-77-36.5 CRANE NO.: 11857				
DRWG NAME	REEVING DIAGRAM ROPE CONSTR. & CHARACTERISTICS			FORMAT	A2
				SCALE	1:25
				DRWG NO	11857-01
				REPLACES	
				REPLACED BY	

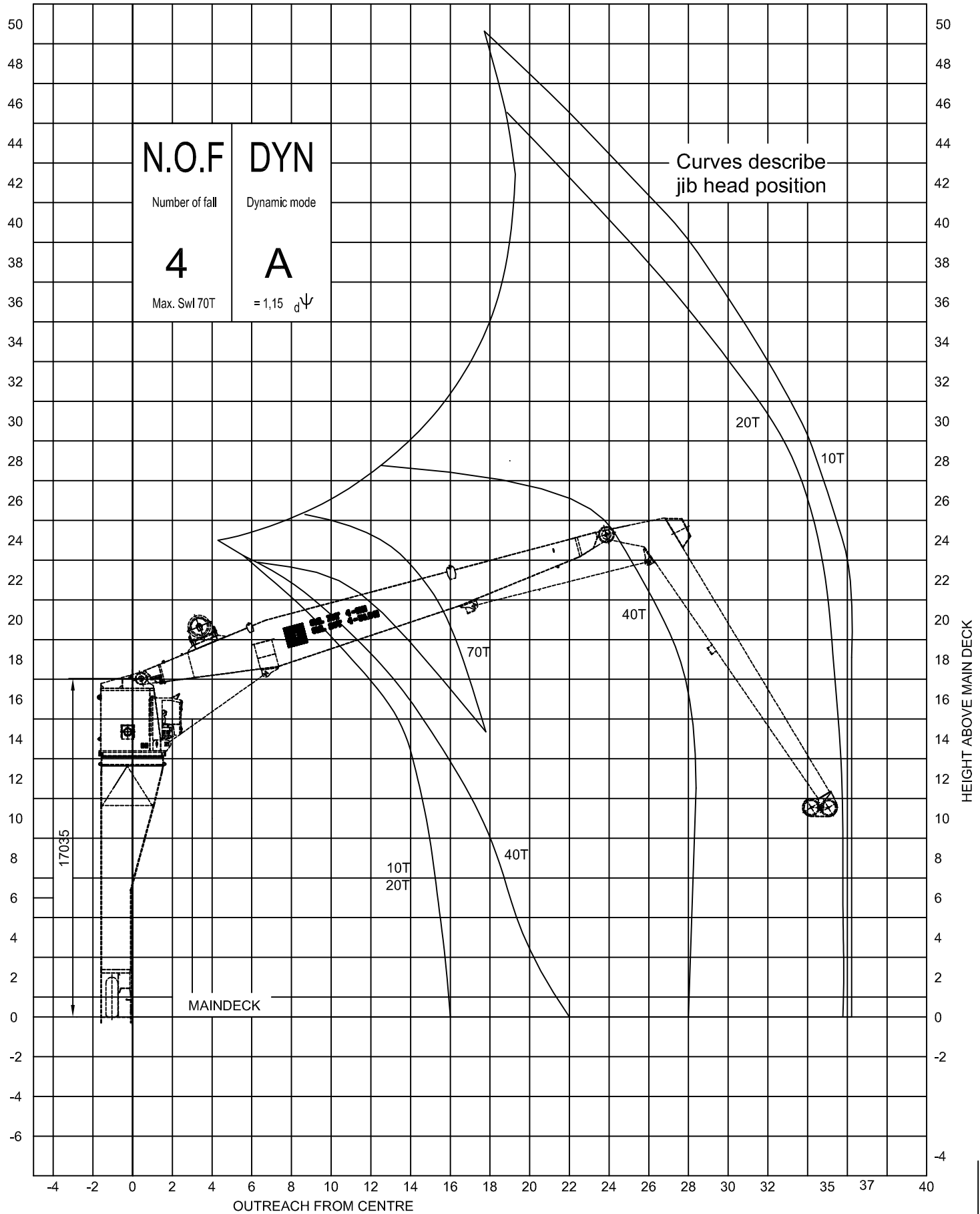
Load Chart No.: 1

REV. 1
17.11.2011

LOAD CONDITION:
Dyn. Factor 1,15
Harbour condition



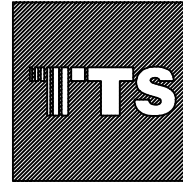
SEASTATE "A"



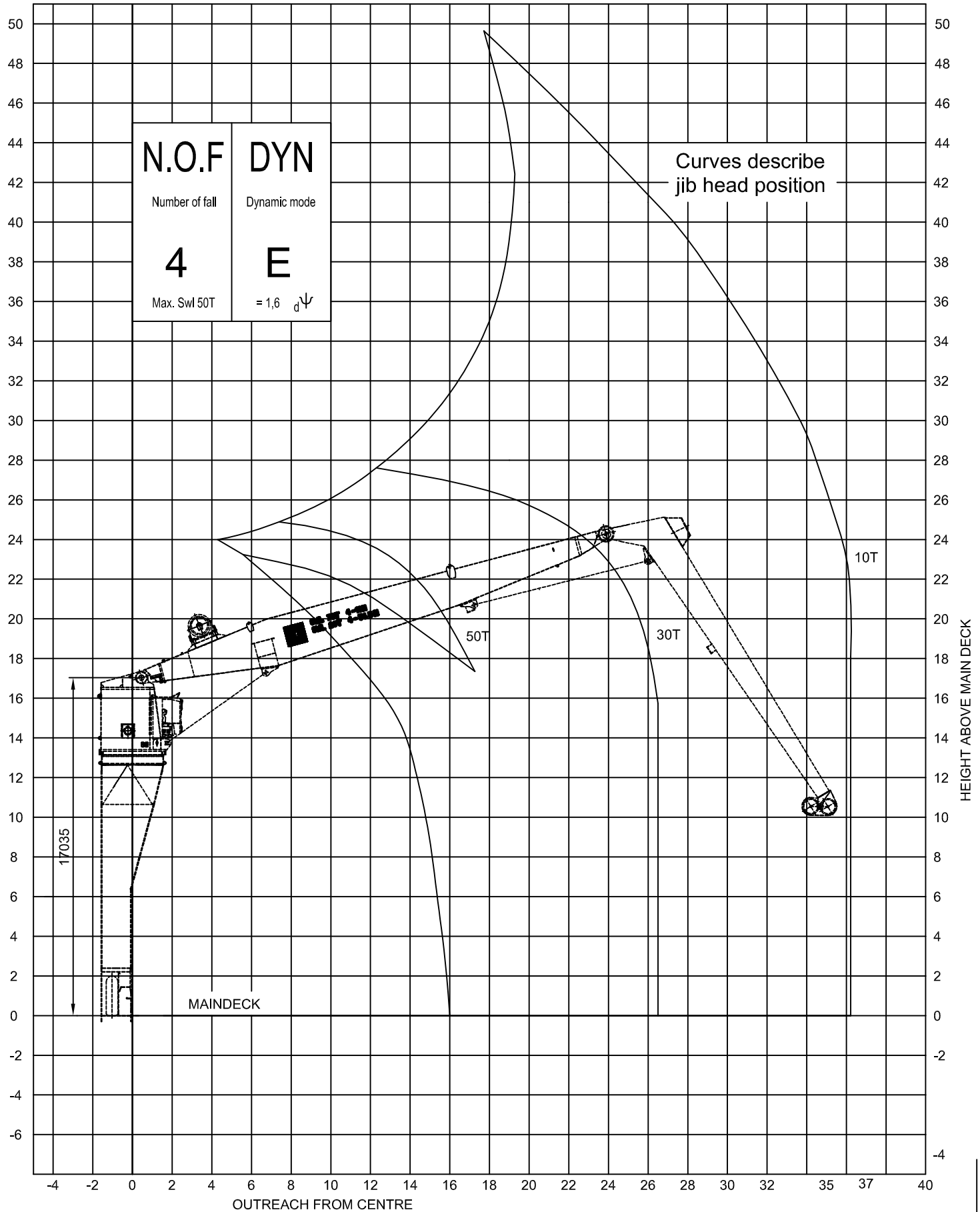
Load Chart No.: 2

REV. 1
17.11.2011

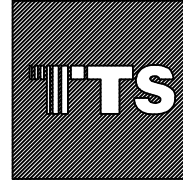
LOAD CONDITION:
Dyn. Factor 1,6
HS = 0.6M



SEASTATE "E"



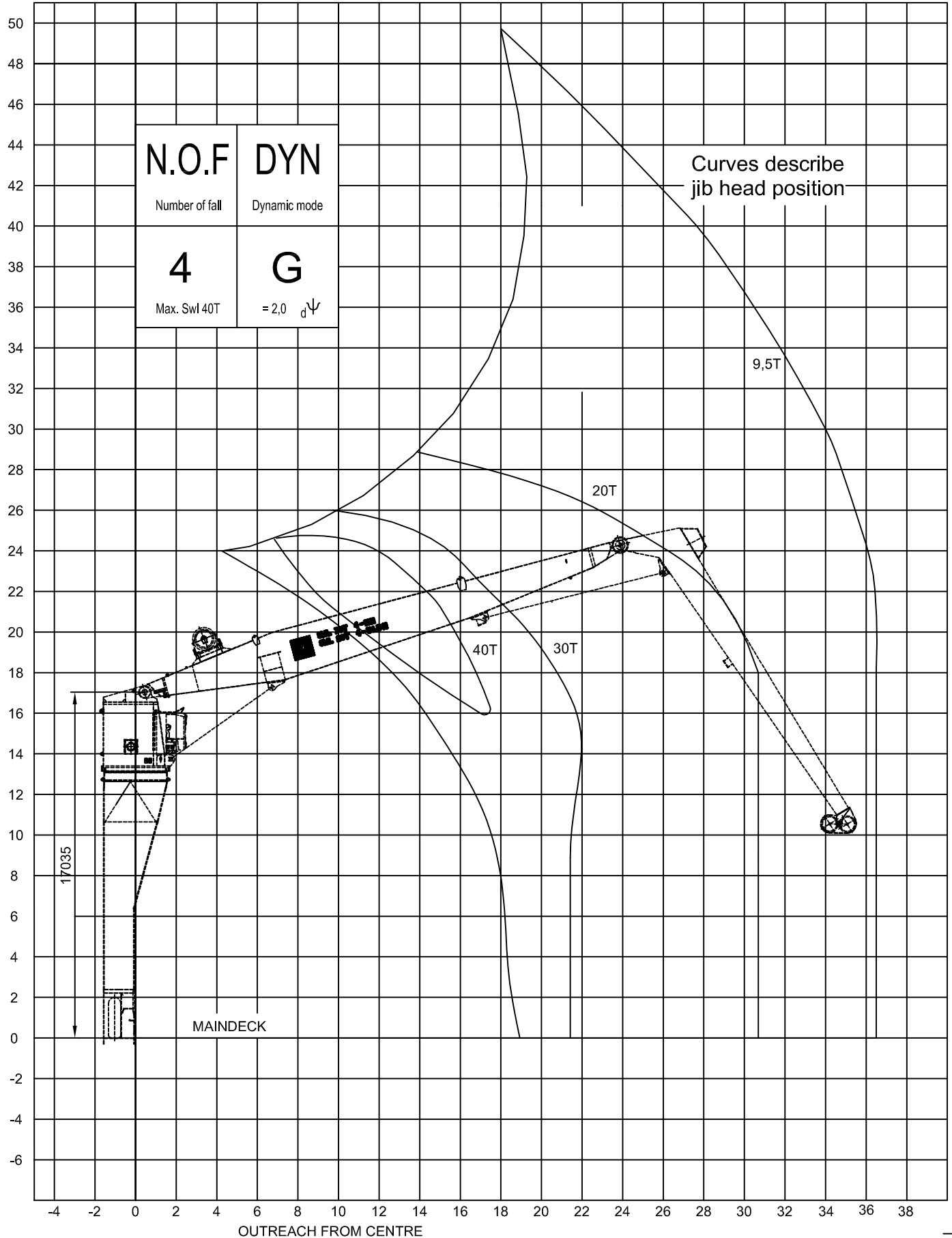
Load Chart No.: 3



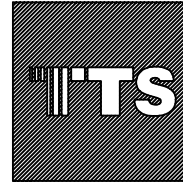
SEASTATE "G"

REV. 1
17.11.2011

LOAD CONDITION:
Dyn. Factor 2,0
HS = 1.6M



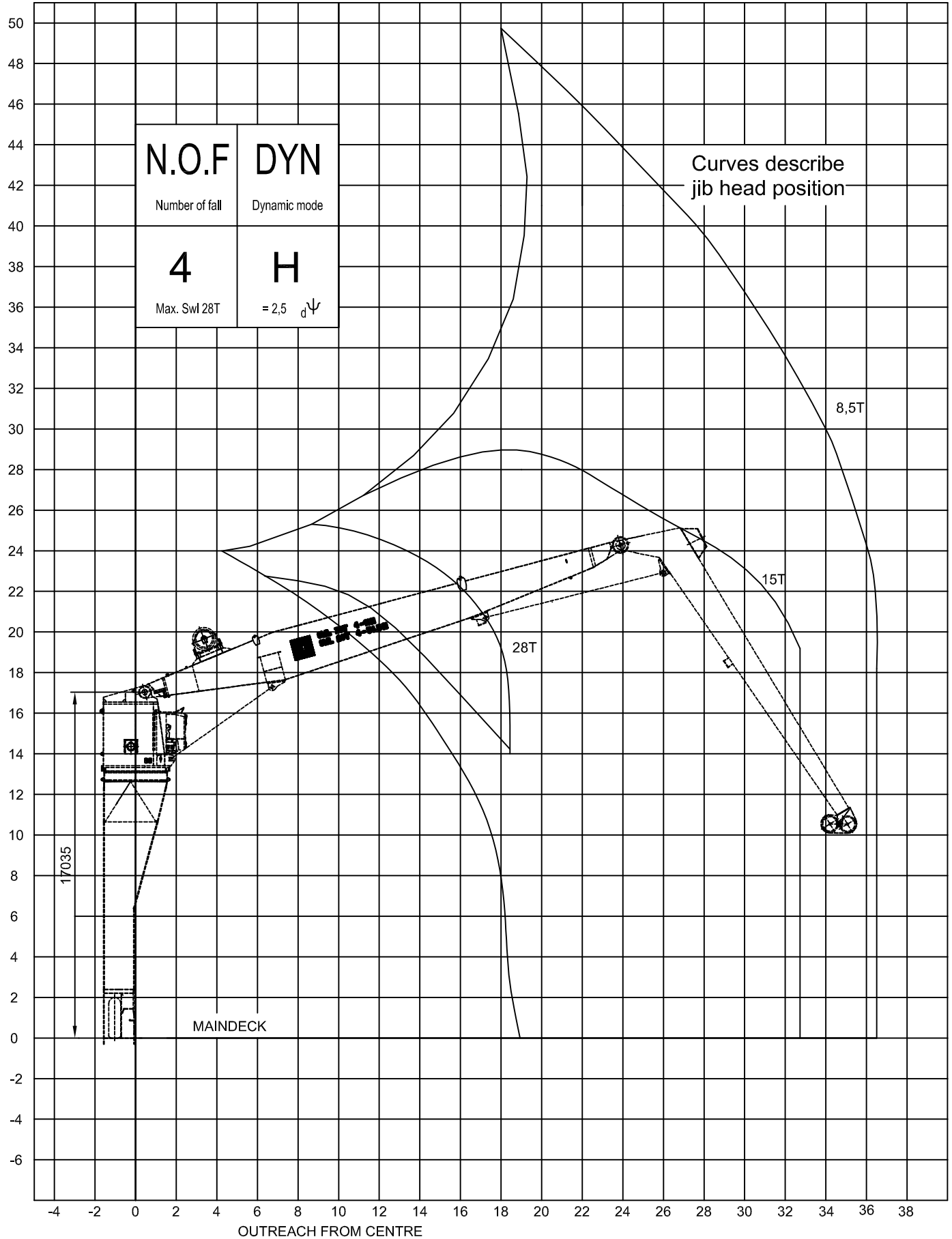
Load Chart No.: 4



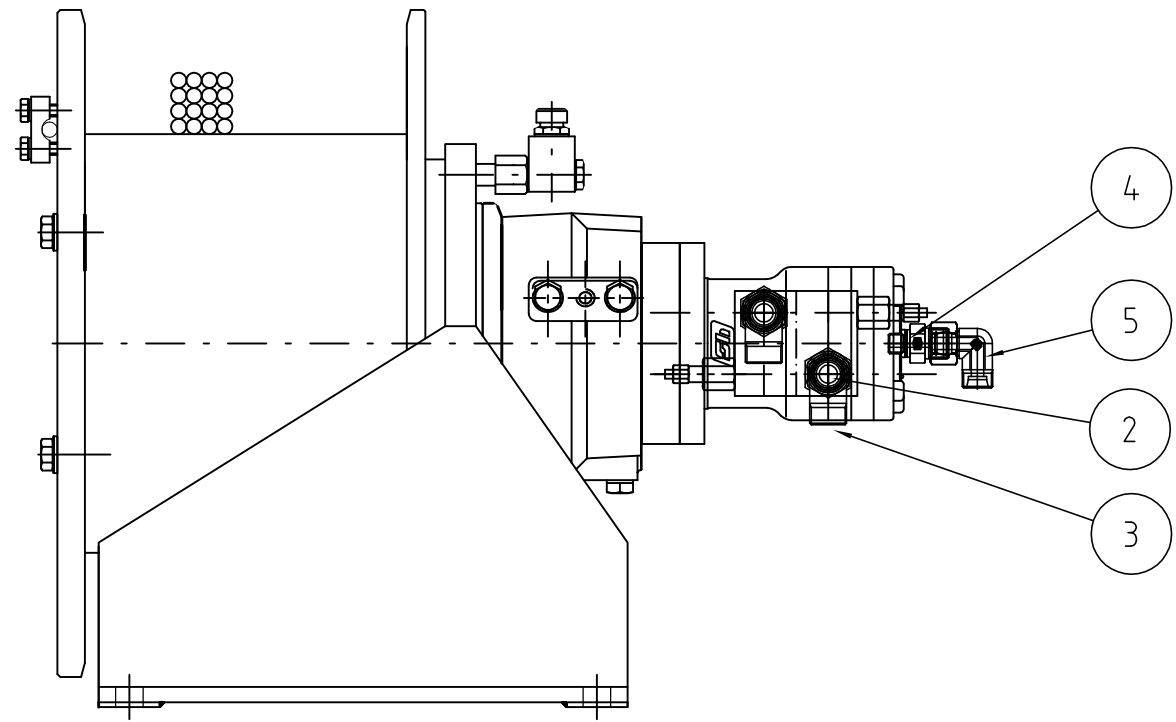
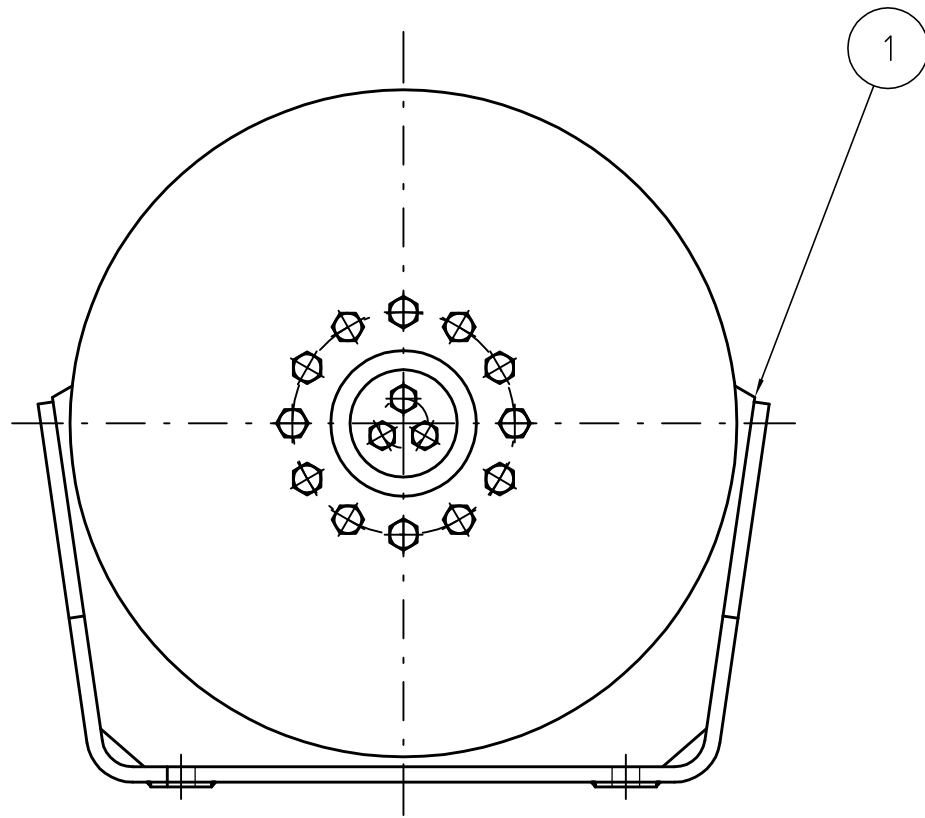
SEASTATE "H"

REV. 1
17.11.2011

LOAD CONDITION:
Dyn. Factor 2,5
HS = 3,0M



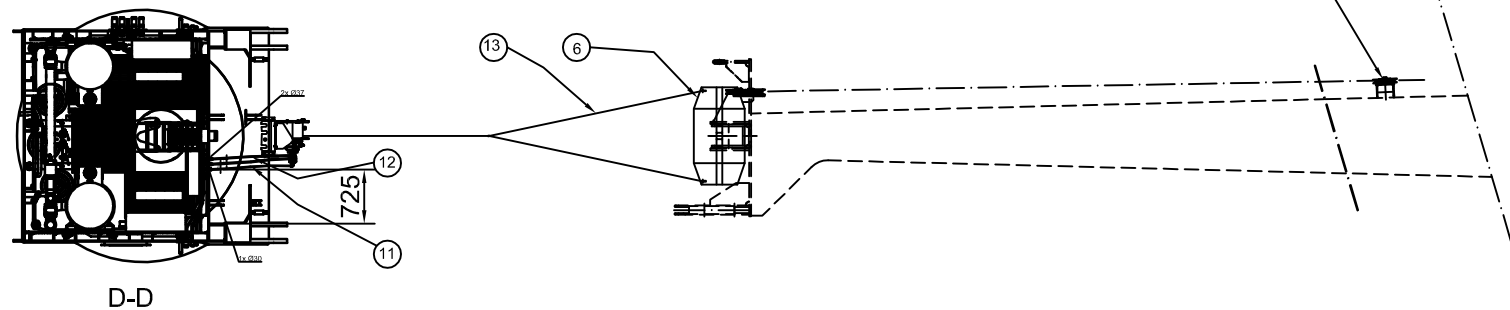
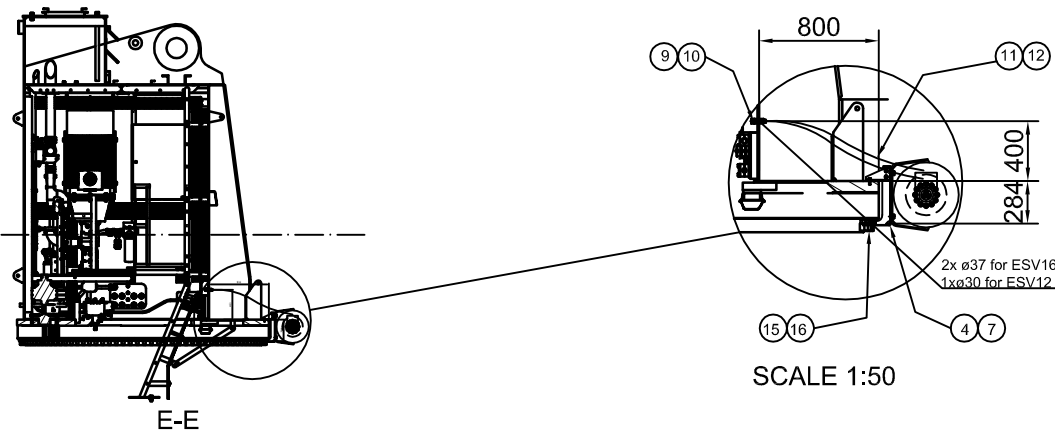
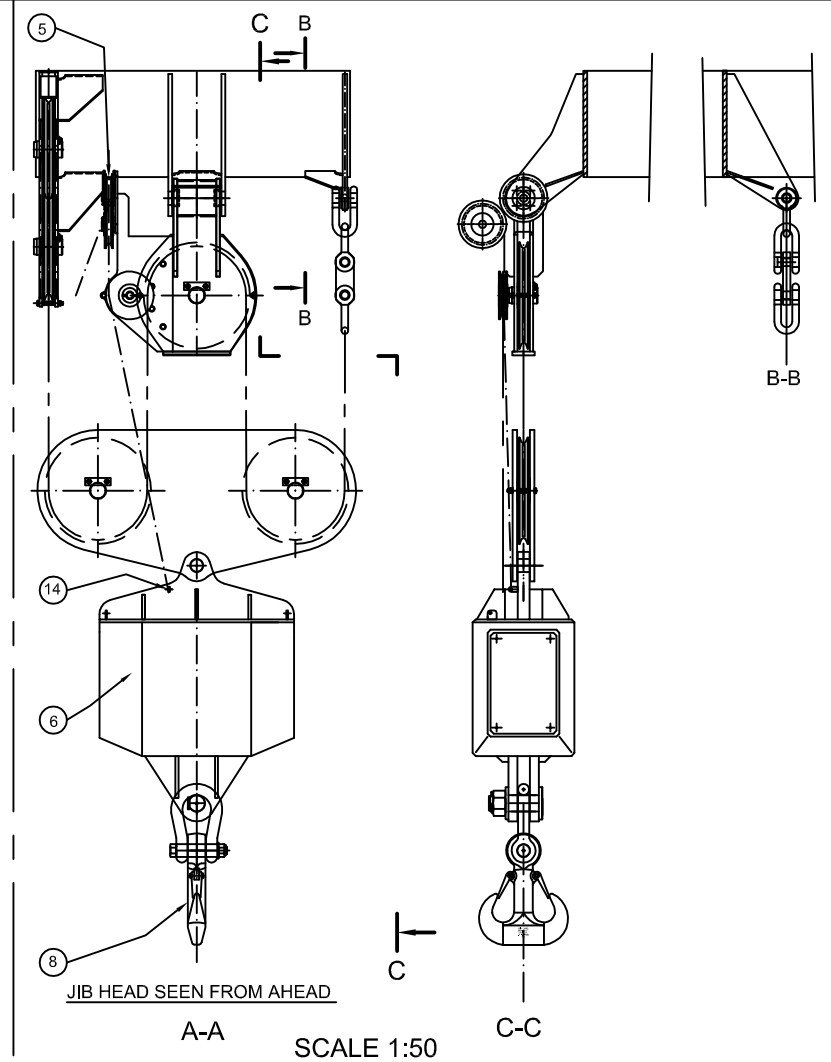
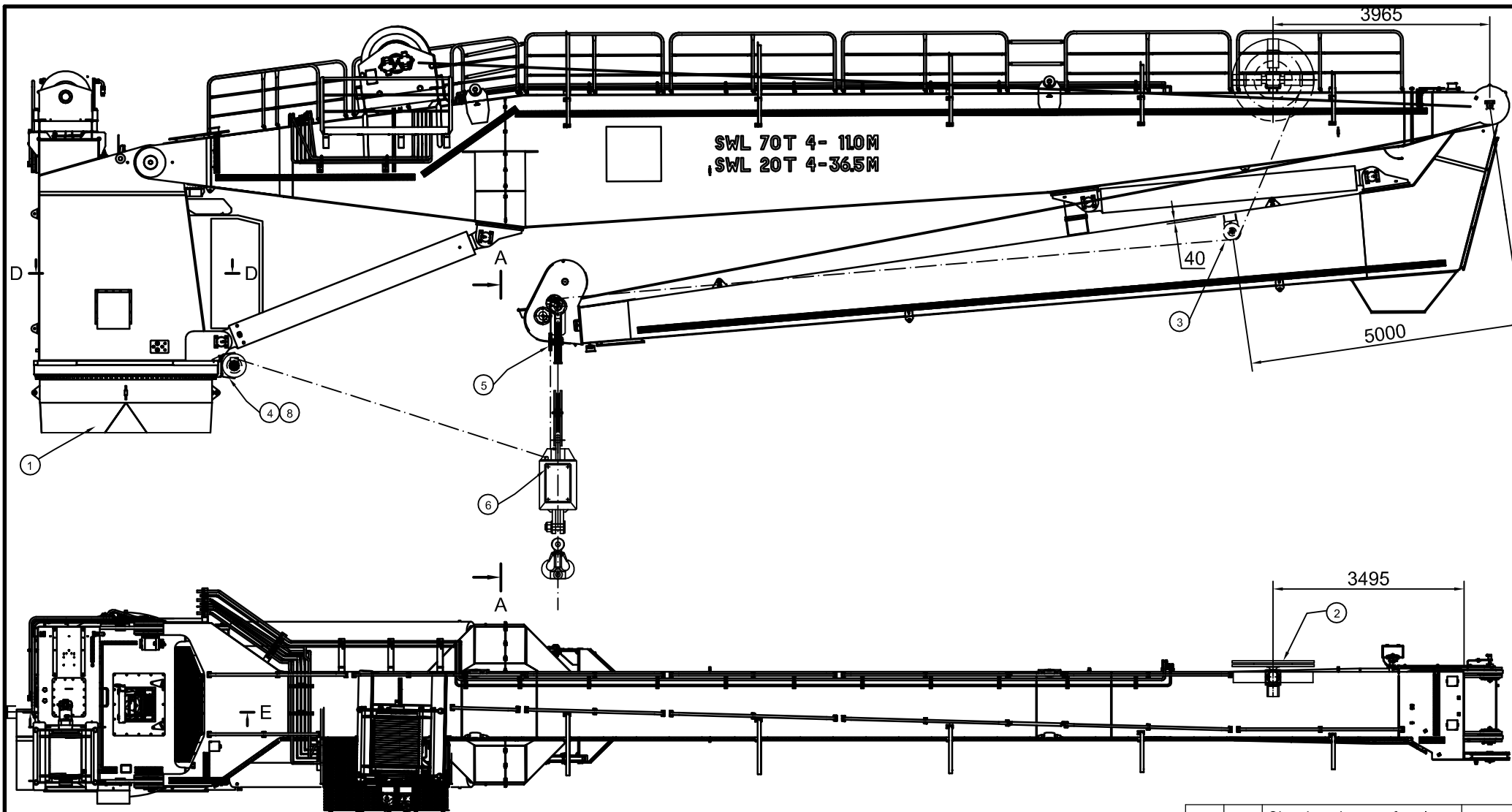
THE DRAWING AND THE DESIGN IS THE PROPERTY OF TTS Ships Equipment AS AND MUST NOT BE DISCLOSED TO ANY THIRD PERSON WITHOUT OUR WRITTEN PERMISSION.



5	1	ADJUST. SWIWEL ELBOW		CF	N125266	0
4	1	MALE STUD CON.		CF		0
3	3	ADJUST. SWIWEL ELBOW		CF	N125265	0
2	2	MALE STUD CON.		CF	N124969	0
1	1	WINCH				0

Pos	Nos	Denomination	Type/Standard	Material	Art/Dwg. no	Tot. Weight
SHIPYARD-ORDER				PRODUCT		
REV	ALTERATION	DATE	NAME	VIEW ISO 5456-2:5.1	MATERIAL	WEIGHT
				DENOMINATION STABILISATOR WINCH ASSEMBLY		
				DRAWN	26.03.12	EST
				CHECK		
				APPR.		
STANDARD		SIZE	SCALE	ARTICLE NO.	SHEET	
		A3	1:5			
DRAWING NO.					PAGE NO.	REV.
151709						A

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POS	QTY	TITLE / ITEM	TYPE / SIZE / DIMENSION	STD.	MATR	PART / DRWG / ART	Drwg	WEIGHT
14	1	Chord anchorage for el.				129243		
13	1	Wire for Cargo Turner	Swl 1500 Kg		Dwg.151679		x	
12	3	Hoses	462C9C916168X1200K13					
11	1	Hoses	462C9C912126X1200K13					
10	2	ESV16SX				N120355		
9	1	ESV12SX						
8	1	Hook 80 Ton W/shackle	25V DIN 15402/82019		Dwg. R120363-1	R120363-1	x	145 Kg
7	1	Stab. Winch assembly	BWF010/2 /25/FL635-010/BR80		Dwg.151709		x	120 Kg
6	1	Cargo Turner	CT 70 Std		Dwg.151772		x	
5	1	Steel Construction - Ass	Additional for Rotator			N150192	x	
4	1	Steel Construction - Ass	Bracket for Stabilisator Winch			N150579	x	
3	1	Steel Construction - Ass	Cable Sheave			N150524	x	
2	1	Cable Motor Assembly				151754	x	
1	1	Steel Construction - Ass.				N128082	x	nn

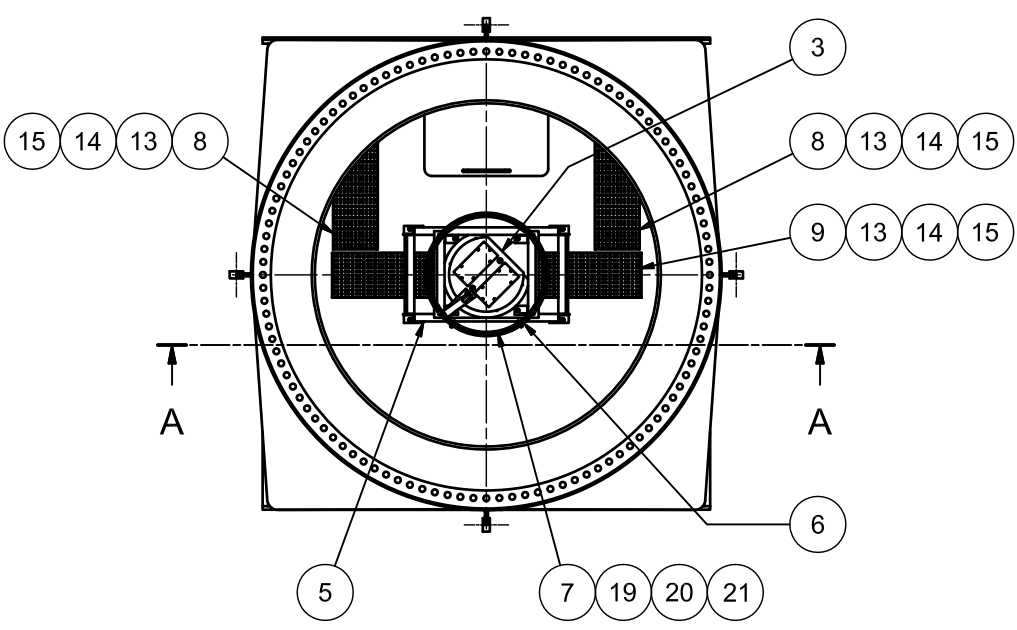
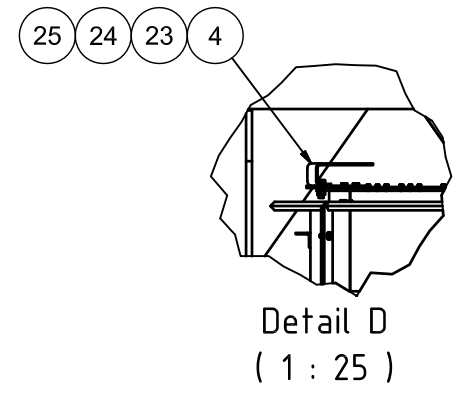
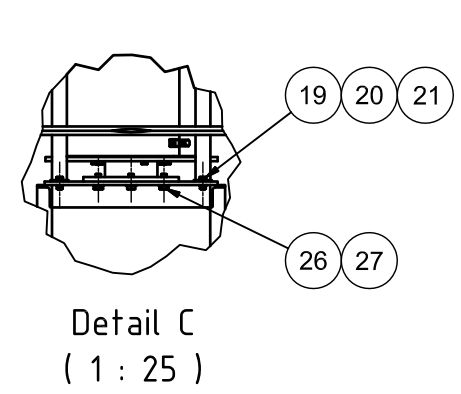
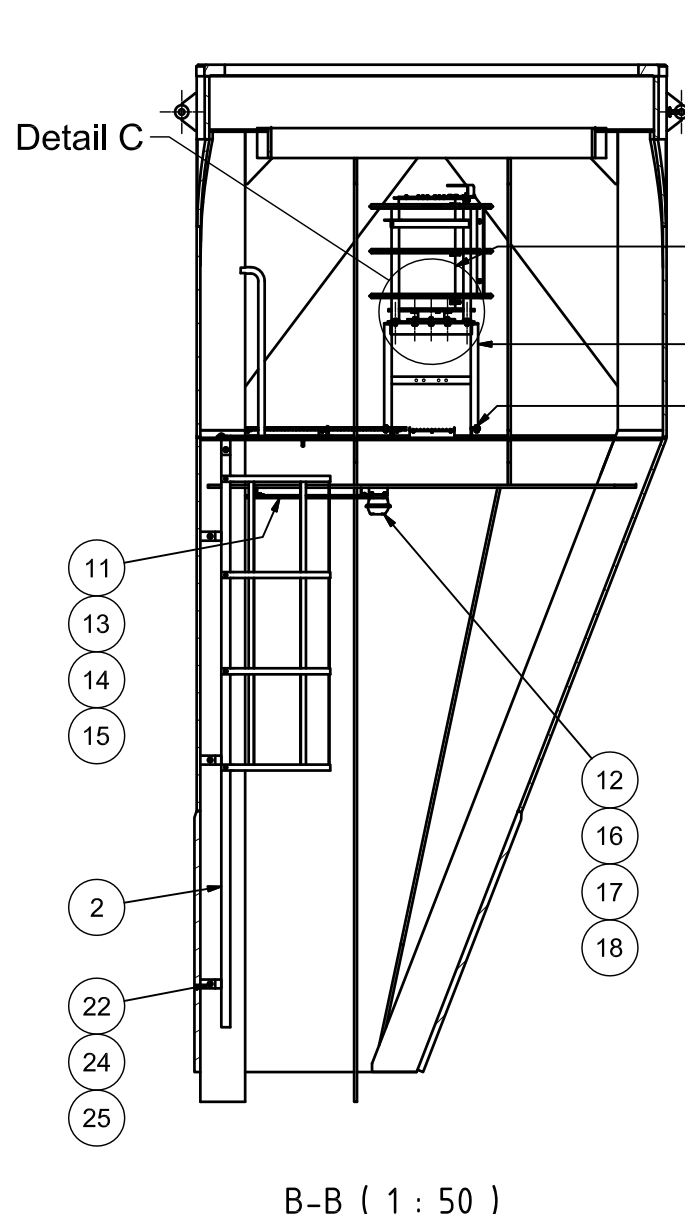
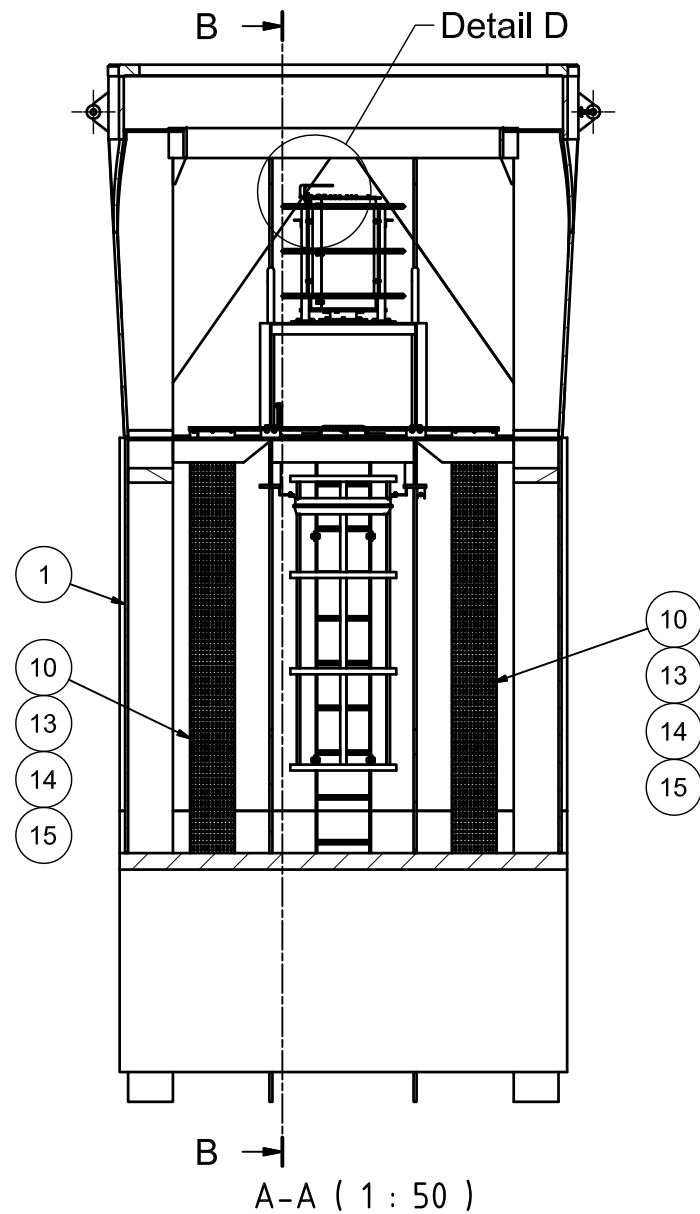
POS	QTY	TITLE / ITEM	TYPE / SIZE / DIMENSION	STD.	MATR	PART / DRWG / ART	Drwg	WEIGHT
16	8	Washer M36	ø37/66x5 mm		Hot Galv			
15	4	Nut Hex	36 mm		Hot Galv	N141769		

SHIPYARD-ORDER 11857 Ray Shipping				PRODUCT			
REV	ALTERATION	DATE	NAME	VIEW ISO 5456-2:5.1	MATERIAL	WEIGHT	
				DENOMINATION Arrangement ADDITIONAL EQUIPMENT			
				DRAWN 20.03.12 EST	STANDARD	SIZE A3	SCALE 1:100
DRAWING NO.				PAGE NO.		REV.	
				151817		A	

INVENTOR

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REV	ALTERATION	DATE	NAME
A	RELEASED FOR PRODUCTION	03.05.2010	FTU

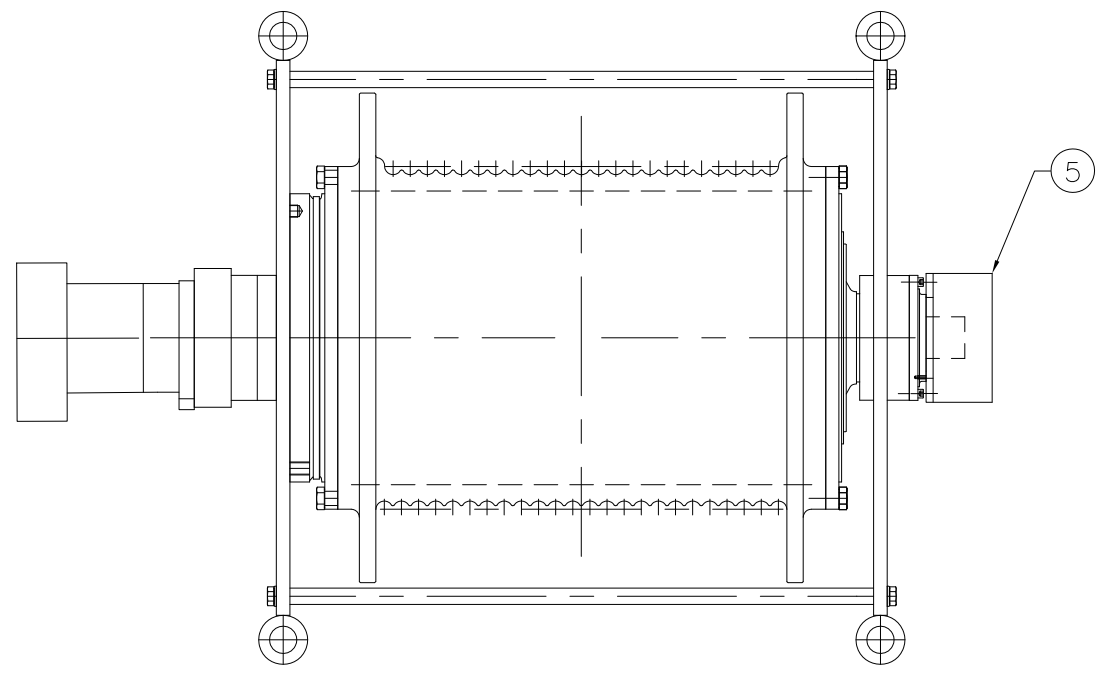
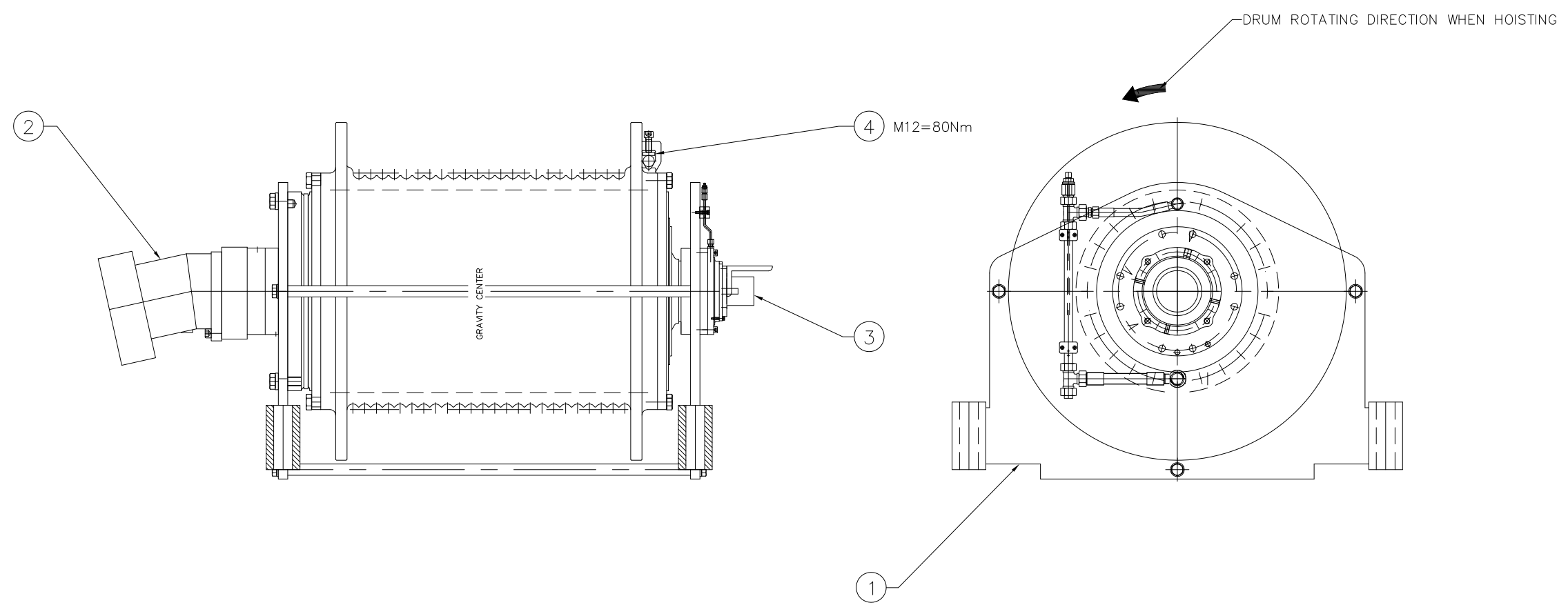


POS	QTY	TITLE / ITEM	TYPE / SIZE / DIMENSION	STD.	MATR	PART / DRWG / ART	Drw	WEIGHT
27	4	Washer	M18			129528		0
26	4	Hex-Head Bolt	M18			129526		0.1
25	9	Hex Head Nut	M16			A01592		0
24	18	Washer	M16			A02320		0
23	1	Hex-Head Bolt	M16			A00503		0.1
22	8	Hex-Head Bolt	M16			A02806		0.1
21	20	Hex Head Nut	M12			A02987		0
20	40	Washer	M12			A02330		0
19	20	Hex-Head Bolt	M12			A01530		0
18	4	Hex Head Nut	M8			A0007T		0
17	8	Washer	M8			A02328		0
16	4	Hex-Head Bolt	M8			A001H2		0
15	65	Hex Head Nut	M6			A02984		0
14	65	Washer	M6			A02327		0
13	65	Hex- Button Head Screw	M6			N128944		0
12	1	Light Armature				N129492		47
11	1	Cable Tray				N127895		1
10	2	Cable Tray				N127899		17.4
9	1	Cable Tray				N127899		9
8	2	Cable Tray				N127899		4.8
7	1	Slipring Frame - Unit 2				129014	x	6.8
6	1	Slipring Frame - Unit 1				129009	x	40.5
5	1	Slipring - Frame Table				129500	x	86.4
4	1	Slip Ring - Bracket				129491	x	0.7
3	1	Slipring				129079		0
2	1	Ladder Steel NS 2654	Steel Construction Outfitting			129068	x	83.8
1	1	Steel Construction - Detail	Base Column			128920	x	20298.9

TTS-ORDER		PRODUCT	
VIEW		ISO 5456-2:5.1	WEIGHT 20623.04 kg
DATE		DENOMINATION	
NAME		Base Column - Assembly	
DRAWN	15.03.2010	KEH	
CHECK	03.05.2010	FTU	
APPR.	03.05.2010	FTU	
STANDARD		SIZE A3	SCALE 1:50
DRAWING NO. 129137		ARTICLE NO.	SHEET OF 1
PAGE NO.		REV. A	



REV	ALTERATION	SIGN / DATE
1	RELEASED FOR PRODUCTION	FTU 22.09.06



TOTAL WEIGHT [kg] ~2000

1	BRACKET FOR PROTECTION ENCODER	5	A4-12562	1
5	WIRE FASTENER	4		-
1	ENCODER	3		-
1	WINCH MOTOR W/ VALVE	2		-
1	AUX. WINCH SWL 15T	ZOLLERN	109458	2000
NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT

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DRAWN	FTU 22.09.06	CHECKED	FTU 22.09.06	APPROVED
PROJECT	CRANE 20669-72			
DRWG NAME	MAIN WINCH ARRANGEMENT SWL 15 T			
SCALE	-	FORMAT	A2	REV 1
DRWG NO	A2-10126-1			
REPLACES	REPLACED BY	DRWG FOLDER	20669	

REV	ALTERATION	DATE / SIGN
1	RELEASED FOR PRODUCTION	12.02.2008 / AAO

INSTALLATION

THE OUTER RING IS MARKED WITH AN "S" NEAR THE TYPE PLATE OR FILLER PLUG, INDICATING THE HARDENING GAP IN THE RACWAY. THIS GAP SHOULD BE POSITIONED APPROX. 90° TO THE MAIN LOADING AXIS.

THE GEARRING IS MARKED WITH PAINT ON THREE TEETH INDICATING WHERE TO MESH THE BACKLASH BETWEEN GEARRING AND PINION.

BEFORE MOUNTING TO THE SLEWING COLUMN, THE UPPER CONTACT SURFACE OF THE BEARING HAS TO BE CLEANED FREE OF PAINT, TECTYL ETC, AND LOCTITE 586 AVX HAS TO BE APPLIED ON THE FULL CONTACT AREA.

SLEWING GEAR SHALL BE MOUNTED WITH THE MAX ECCENTRICITY MARK AS INDICATED ON DRAWING. CORRECT BACKLASH SHALL BE OBTAINED AFTER POSITIONING AND FASTENING OF SLEWING GEAR BY MOVING THE SLEW BEARING / SLEWING COLMN. BACKLASH TO BE 0.5–0.6 mm

USE FLUID GASKET, LOCTITE 574 OR EQUAL, AS SEAL BETWEEN GEARBOX FLANGE AND FOUNDATION AND BETWEEN BEARING AND BASE COLUMN RING FLANGE.

SLEWING RING BOLTS TO BE TIGHTENED WITH HYDRAULIC TENSION TOOL TO A CLAMPING FORCE OF 610 KN
CROSS TIGHTENING TO BE USED, SEE ILLUSTRATION OF TIGHTENING SEQUENCE.

BACKLASH ADJUSTMENT

ONLY TO BE USED IF BACKLASH HAVE CHANGED DUE TO SETTING OR TO COMPENSATE FOR WEAR ON PINION AND GEARING.

ΔE = CHANGE IN BACKLASH ACCORDING TO NO. OF HOLES TURNED

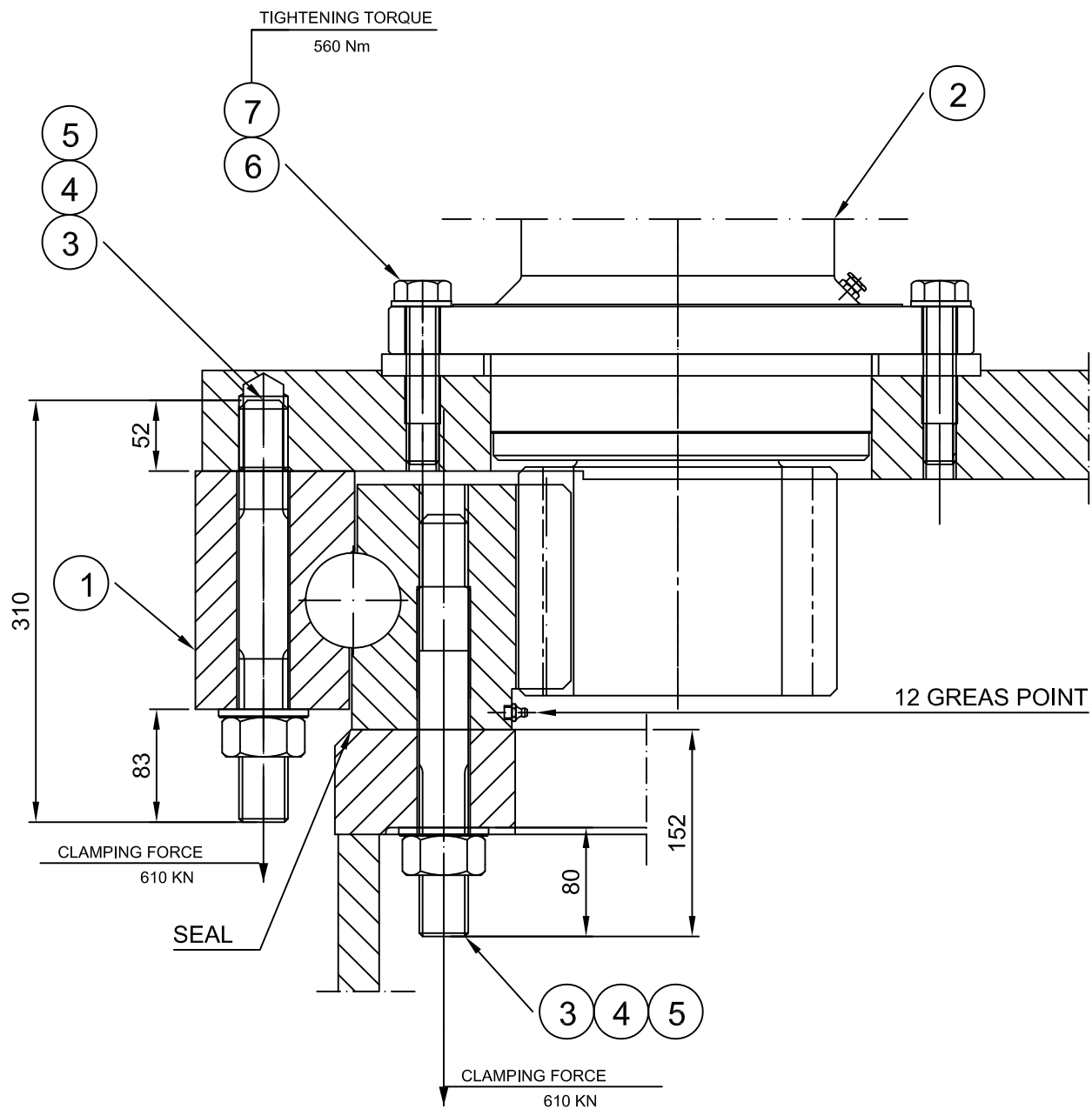
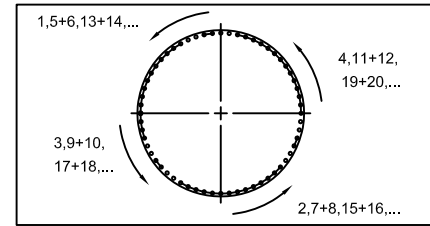
LUBRICATION

GEARBOX IS FILLED WITH AVIA HYPOID 90EP OIL OR EQUIVALENT PRIOR TO DELIVERY. OIL LEVEL TO BE CHECKED AFTER ASSEMBLING OF SLEWING MACHINERY.

BRAKE TO BE FILLED WITH 0.2 ltr HYDRAULIC OIL PRIOR TO MOUNTING OF MOTOR.

BEARING RACEWAY TO BE REGREASED (AT ALL GREASE NIPPLES) WHEN MOUNTING, USING GREASE TYPE MOBILUX EP2 OR EQUIVALENT.
GEARRING TO BE CLEANED AND GREASED WHEN MOUNTING USING GREASE TYPE MOBILTAC 81 OR EQUIVALENT.

TIGHTENING SEQUENCE



TOTAL WEIGHT APPROX [kg] ~ 4545

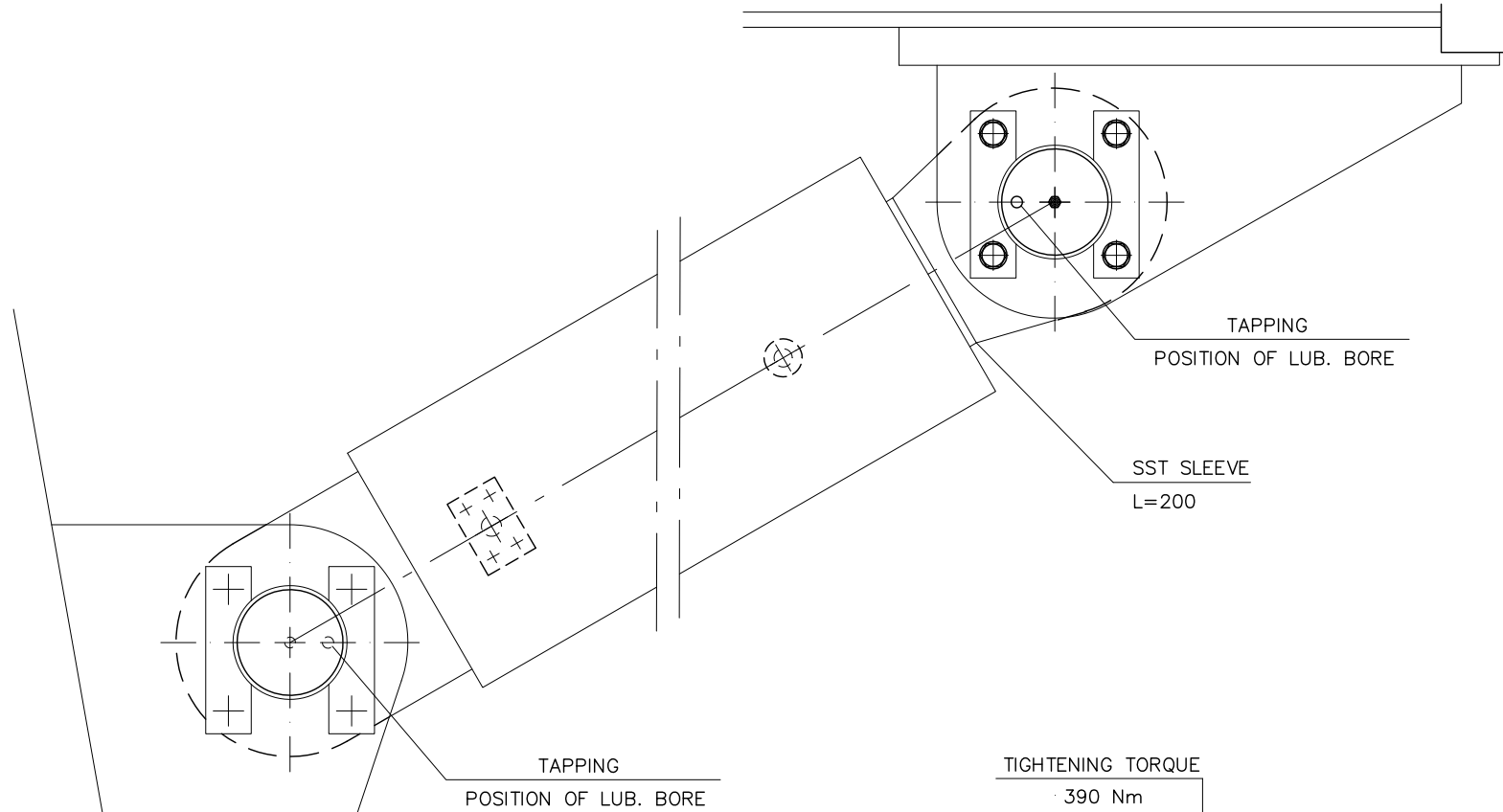
72	WASHER	7	96751	2
72	HEX SCREW, 10.9	M24	18867	34
220	WASHER	5	97088	12
216	NUT	4	97079	42
216	STUD BOLT, 10.9	M36	97033	531
3	SLEWING GEAR	2	Hydr.circuit	990
1	SLEW BEARING	2000 tm	1	Acc.to comp.spec. 113818 2988
NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT

THIS DRAWING IS THE PROPERTY OF TTS Marine ASA AND MUST NOT BE REPRODUCED WITHOUT OUR WRITTEN CONSENT

DRAWN	12.02.2008 / AAO	CHECKED	12.02.2008 / AAO	APPROVED	12.02.2008 / AAO
PROJECT	SLEWING BEARING 2000 TM WITH 108 HOLE				
DRWG NAME	SLEWING MACHINERY ASSEMBLY				
REPLACES	REPLACED BY	DRWG FOLDER	21361		

SCALE	1:5	FORMAT	A3	E
DRWG NO	21361M600 - 1			

REV	ALTERATION	DATE / SIGN
1	RELEASED FOR PRODUCTION	FTU 10.03.06



INSTALLATION

CYLINDER TO BE MOUNTED WITH LOAD CONTROL VALVE AND HYDR. PIPING PRIOR TO INSTALLATION.

THE BEARING IS DESIGNED FOR SLIDING DIRECTLY ON THE AXLE. THE SPHERICAL SURFACE IS MAINLY FOR SELFALIGNMENT AND NOT FOR SLIDING.

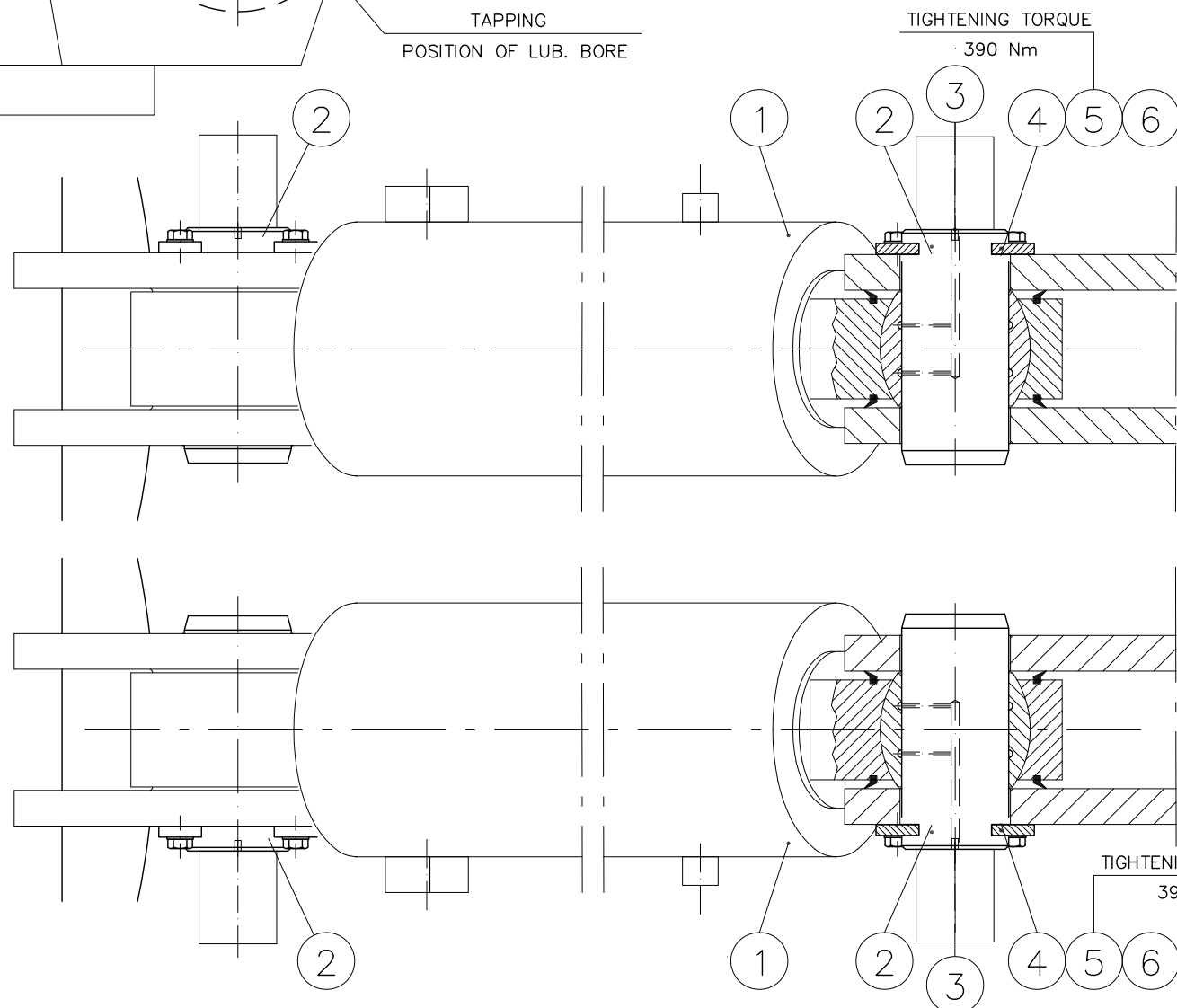
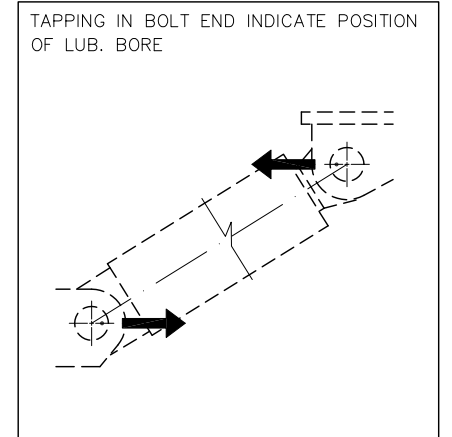
DURING WORKSHOP PREPARATION THE SPHERICAL AND SLIDING SURFACES OF THE BEARING ARE TO BE TREATED WITH MOLYKOTE PASTE TYPE Cu-7439 Plus OR EQUIVALENT.

NOTE DIRECTION OF LUBRICATION BORE TO OBTAIN CORRECT DISTRIBUTION OF GREASE.

LUBRICATION

AFTER MOUNTING, AND AT EVERY FOLLOWING 50-100-.... HOURS OF OPERATION, CYLINDER HAS TO BE GREASED AT ALL GREASE NIPPLES USING GREASE TYPE EP2 OR EQUIVALENT. REF. COMPARISON CHART K-07-16.

LUBRICATION CHANNEL



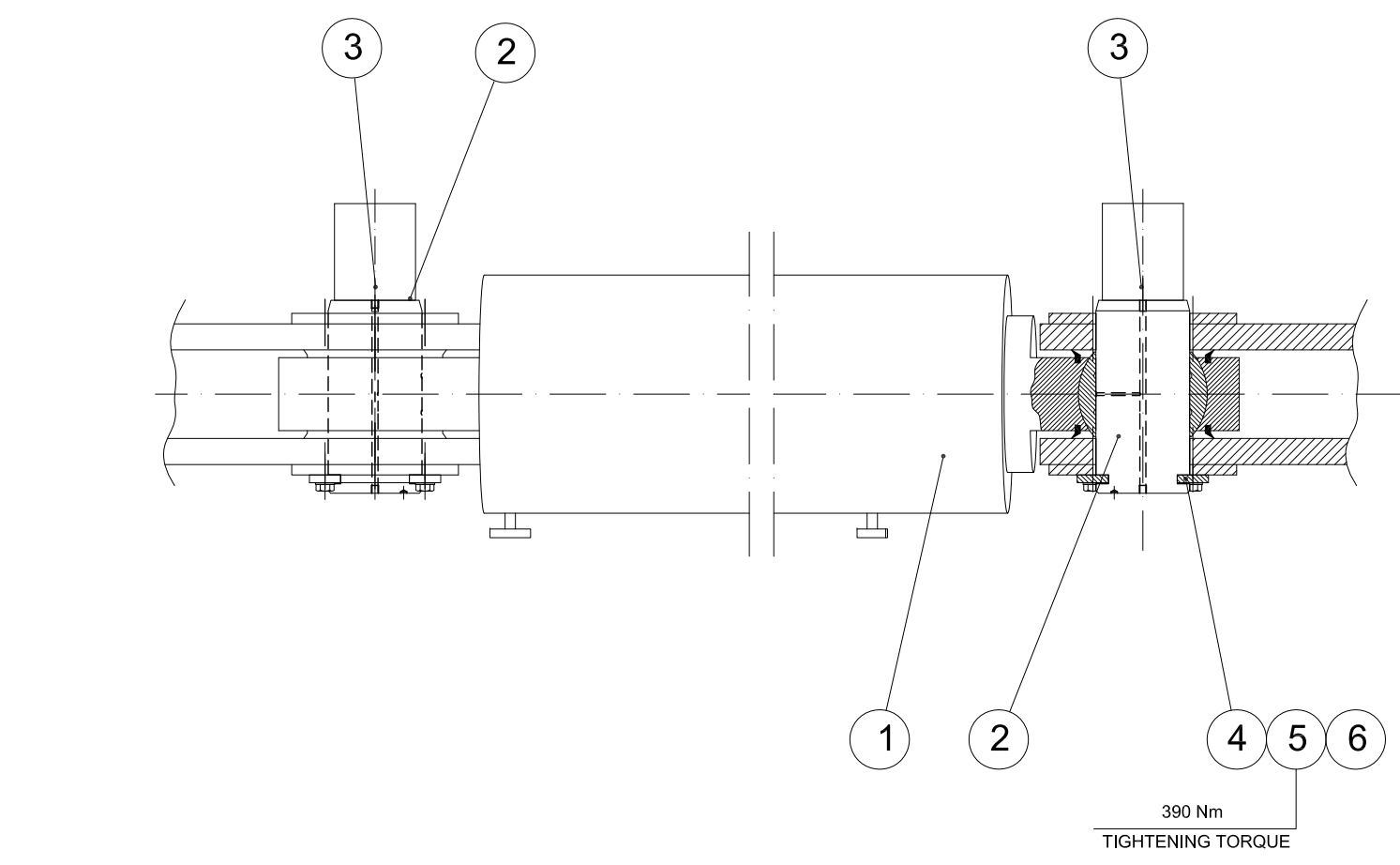
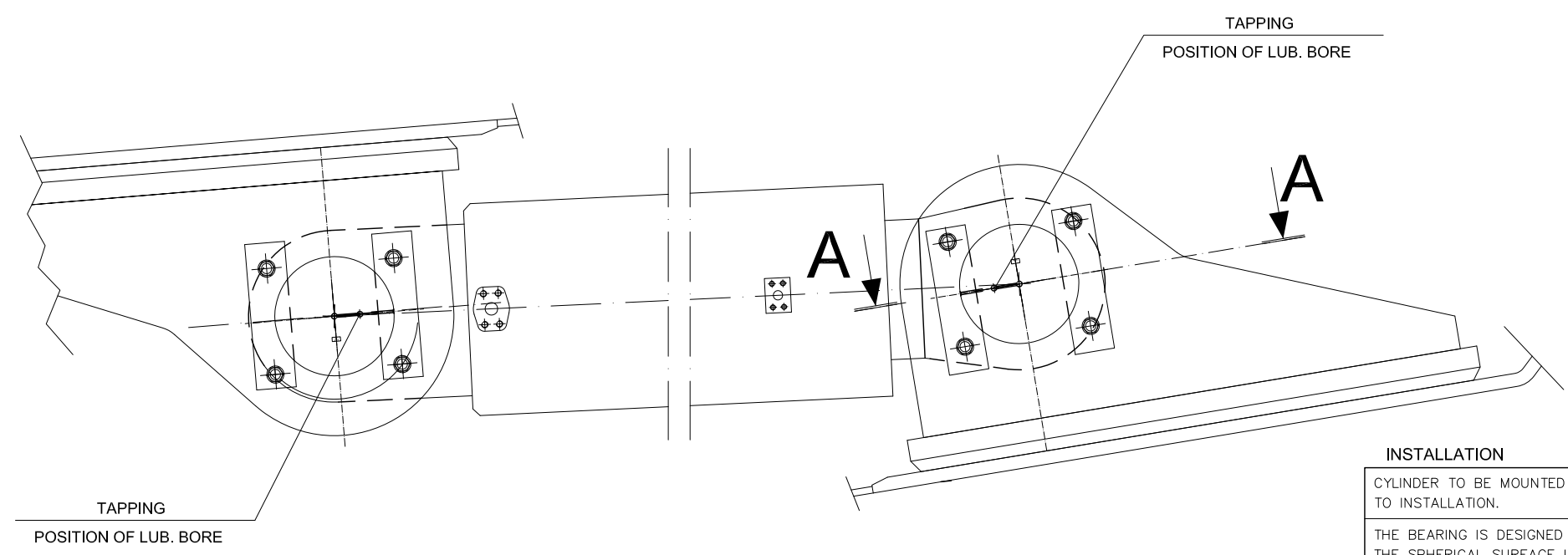
TOTAL WEIGHT APPROX [kg] ~ 10380

16	WASHER	6	100904	-
16	HEX SCREW	5	25172	1
8	LOCK PLATE	4	A4-1000	12
4	AUTOMATIC GREAS CARTRIDGE	3		1
4	BOLT	2	A4-1088	264
2	CYLINDER	1	112156	10100
NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT

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DRAWN BY FTU	10.03.06	CHECKED BY	APPR BY
PROJECT			
DOUBLE CYLINDER			
DRWG NAME		SCALE	
CYLINDER HINGE ASSEMBLY		DRWG NO	
MASTER DRWG		REPLACES	A3-13158-1 REV 1

REV	ALTERATION	DATE / SIGN
1	RELEASED FOR PRODUCTION	FTU 10.03.06



INSTALLATION

CYLINDER TO BE MOUNTED WITH LOAD CONTROL VALVE AND HYDR. PIPING PRIOR TO INSTALLATION.

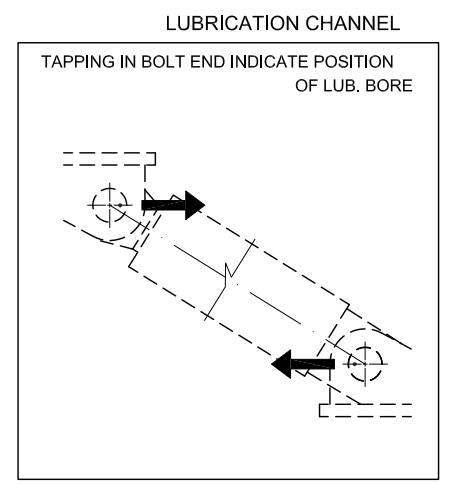
THE BEARING IS DESIGNED FOR SLIDING DIRECTLY ON THE AXLE. THE SPHERICAL SURFACE IS MAINLY FOR SELFALIGNMENT AND NOT FOR SLIDING.

DURING WORKSHOP PREPARATION THE SPHERICAL AND SLIDING SURFACES OF THE BEARING ARE TO BE TREATED WITH MOLYKOTE PASTE TYPE Cu-7439 Plus OR EQUIVALENT.

NOTE DIRECTION OF LUBRICATION BORE TO OBTAIN CORRECT DISTRIBUTION OF GREASE.

LUBRICATION

AFTER MOUNTING, AND AT EVERY FOLLOWING 50-100-.... HOURS OF OPERATION, CYLINDER HAS TO BE GREASED AT ALL GREASE NIPPLES USING GREASE TYPE EP2 OR EQUIVALENT. REF. COMPARISON CHART K-07-16.



TOTAL WEIGHT APPROX [kg] ~ 5190

NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT
8	WASHER	6	100904	-
8	HEX SCREW	5	25172	1
4	LOCK PLATE	4	A4-1000	6
2	AUTOMATIC GREAS CARTRIDGE	3		1
2	BOLT	2	A4-1088	132
1	CYLINDER	1	A3-13116	112160
5050				

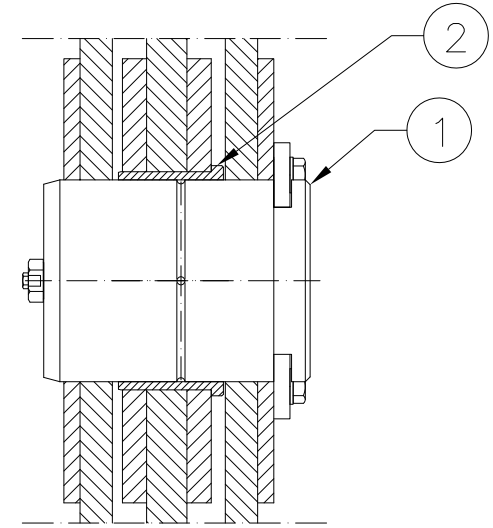
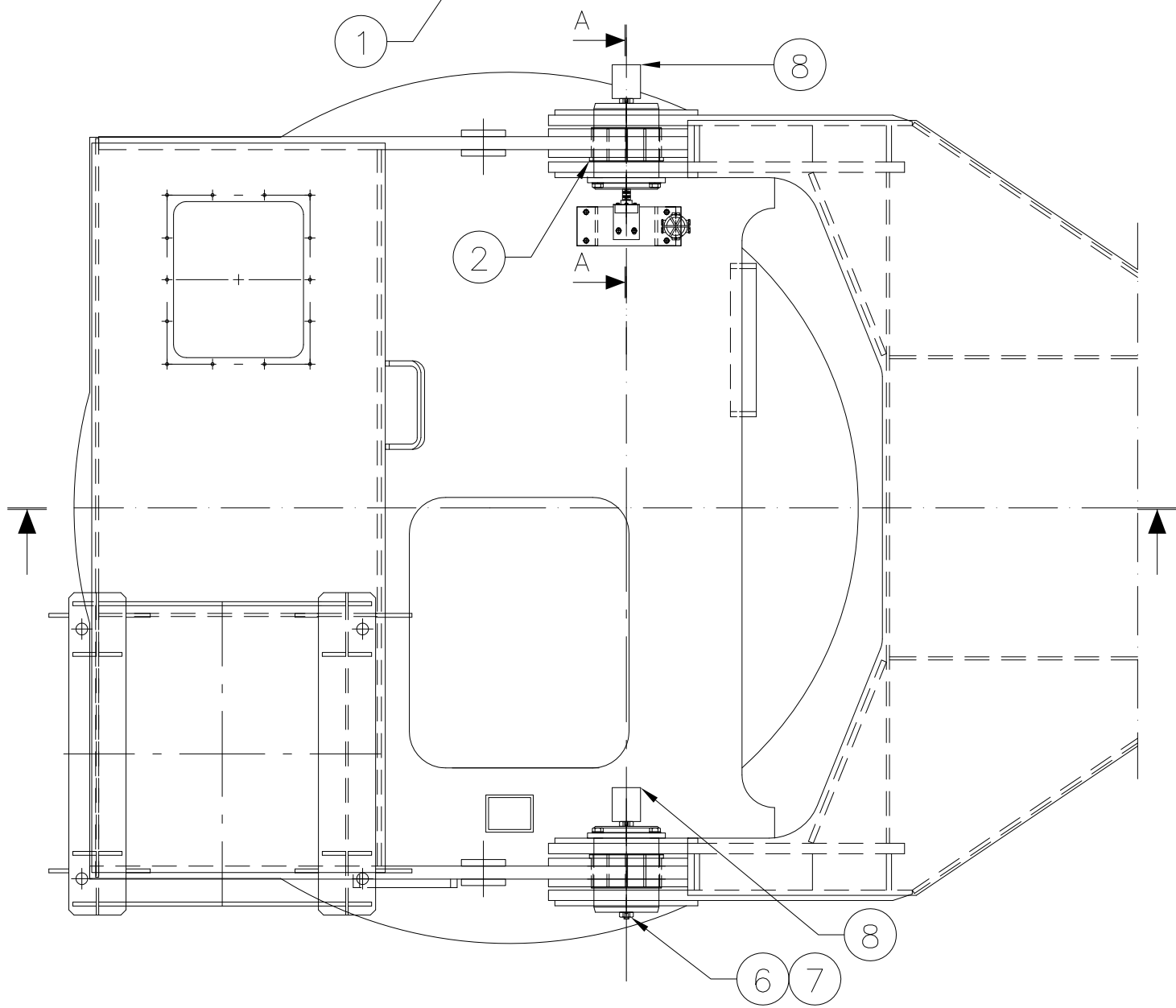
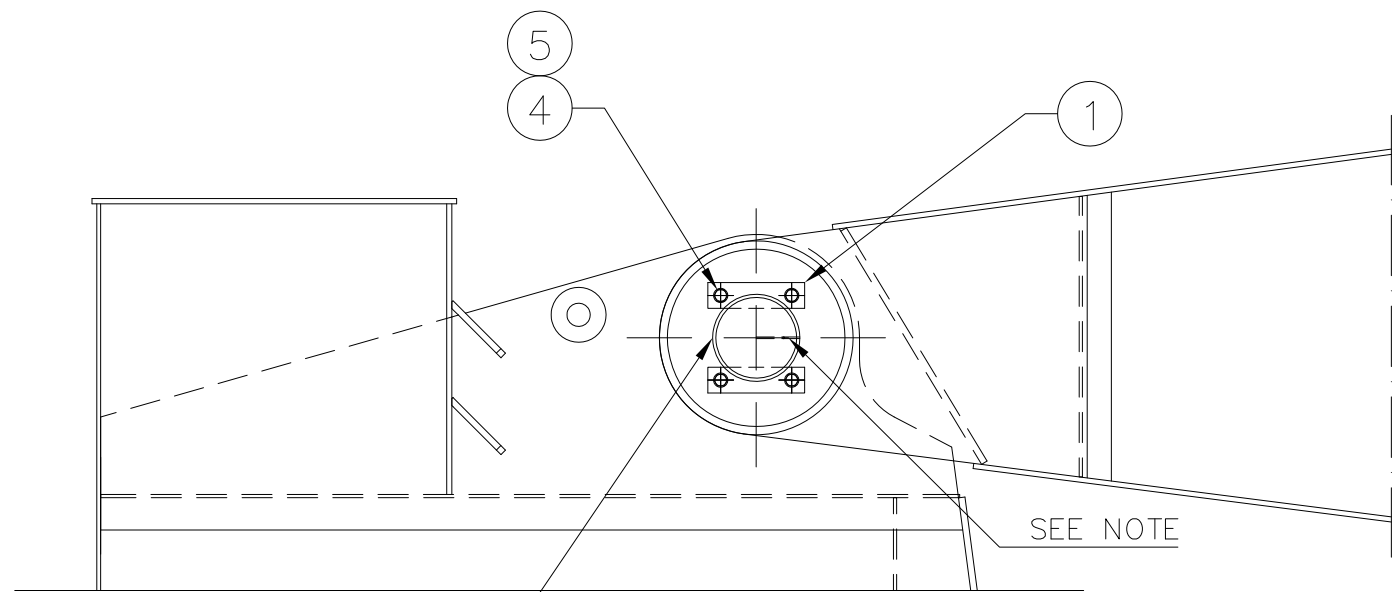
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DRAWN	FTU 10.03.06	CHECKED	FTU 10.03.06	APPROVED
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PROJECT				
DRWG NAME				
CYLINDER HINGE ASSEMBLY FOLDING CYLINDER		DRWG NO	A3-13159	REV
				- 1

REPLACES	REPLACED BY	DRWG FOLDER	20669
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REV	ALTERATION	SIGN / DATE
1	RELEASED FOR PRODUCTION	FTU 13.03.06
2	CHANGE DIRECTION FOR BOLT	FTU 30.01.07



INSTALLATION

DURING WORKSHOP PREPARATION THE SLIDING SURFACES OF THE BEARING ARE TO BE LUBRICATED WITH "ARROW ALUMINIUM SEIZE EEZE" OR EQUAL.

NOTE DIRECTION OF LUBRICATION CHANNEL TO OBTAIN CORRECT DISTRIBUTION OF GREASE.

LUBRICATION

AFTER MOUNTING, AND AT EVERY FOLLOWING 50-100-.... HOURS OF OPERATION, HINGE HAS TO BE GREASED AT ALL GREASE NIPPLES USING GREASE TYPE EP2 OR EQUIVALENT.(REF. COMPARISON CHART K-07-16.)

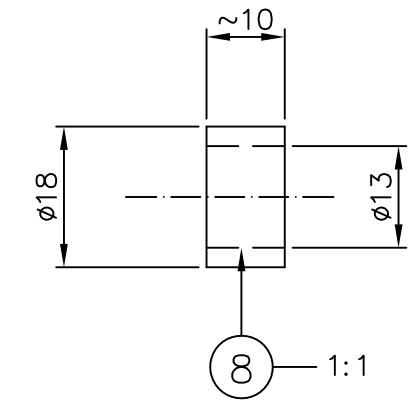
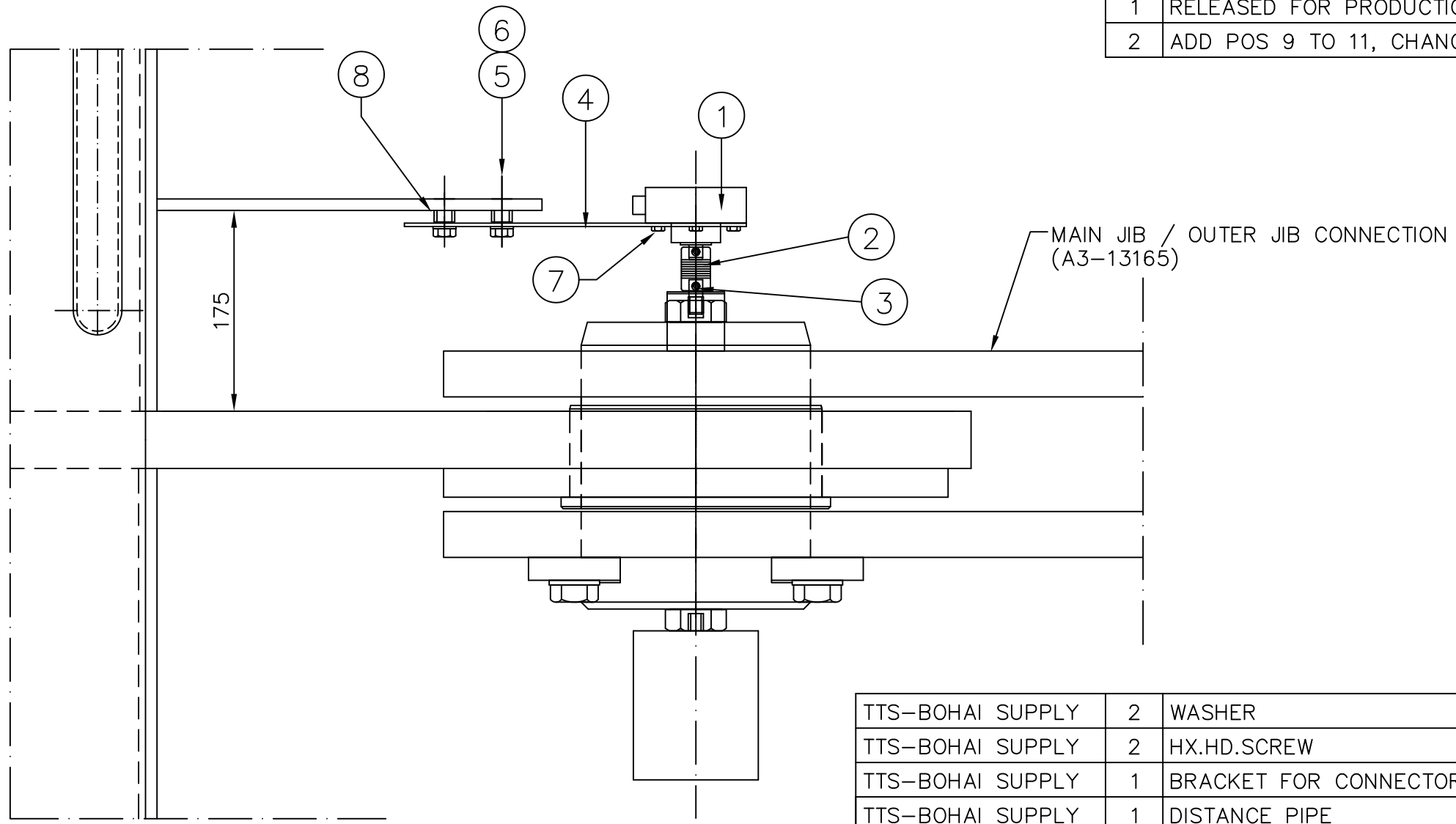
WEIGHT OF EQUIPMENT [kg] ~ 290

2	AUTOMATIC GREAS CATRIDGE	8		1
1	PLUG	7	65843	-
1	PLUG	6	A4-12052	-
8	WASHER	5	26560	-
8	HEX. HEAD BOLT	4	14789	3
4	LOCKING PLATE	3	A4-1000	7
2	JIB HINGE BEARING	2	A4-12307	22
2	JIB HINGE BOLT	1	A4-12306	254
NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT

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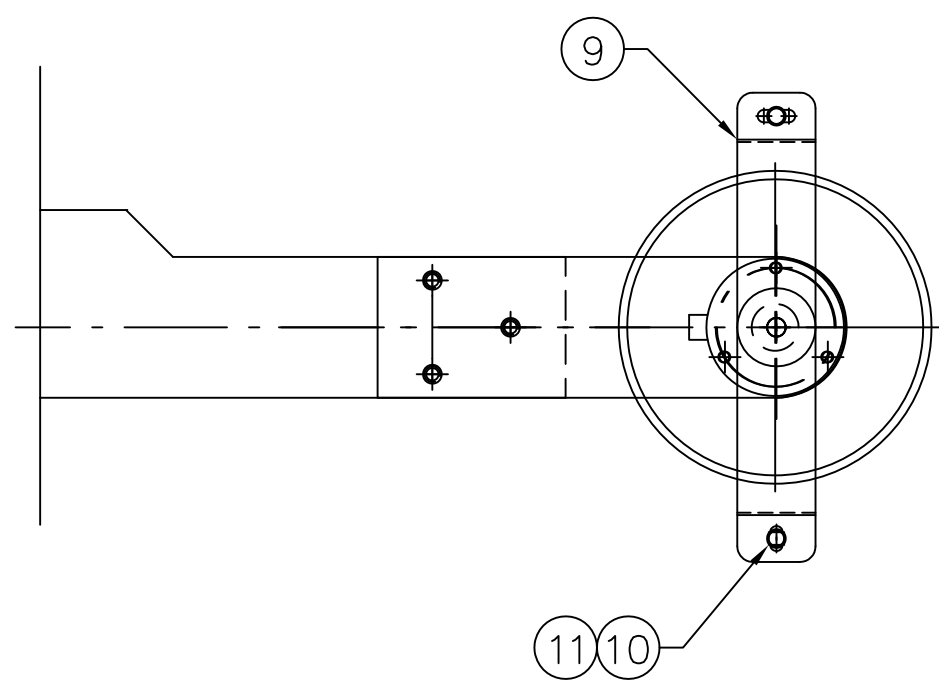
DRAWN	FTU 14.03.06	CHECKED	FTU 14.03.06	APPROVED
PROJECT	2000TM			
DRWG NAME	JIB HINGE SLEWING/INNER JIB			
REPLACES	REPLACED BY	DRWG FOLDER	20669	
		SCALE	1:25	FORMAT
				A3
		DRWG NO	A3-13167-2	
				REV
				2

REV	ALTERATION	SIGN / DATE
1	RELEASED FOR PRODUCTION	FTU 06.06.06
2	ADD POS 9 TO 11, CHANGE DISTANCE IN POS 8	FTU 14.06.06



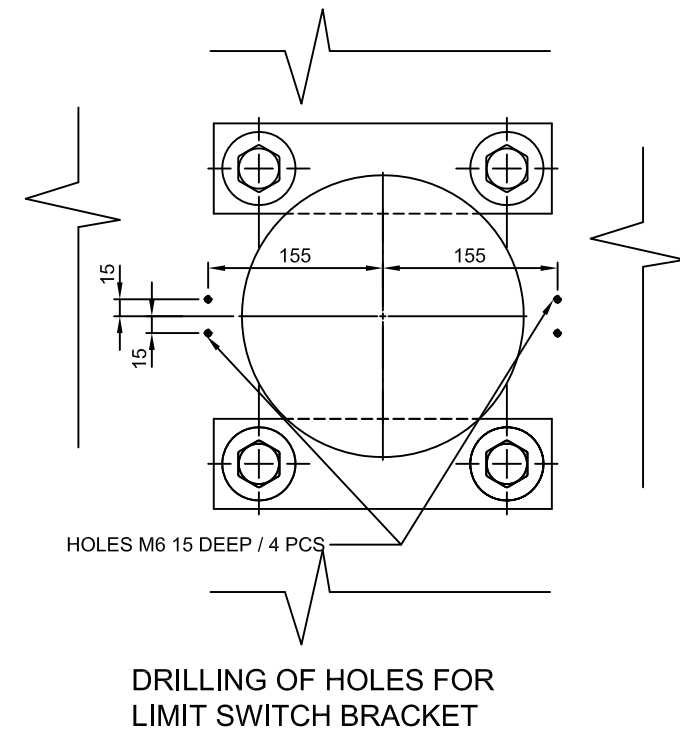
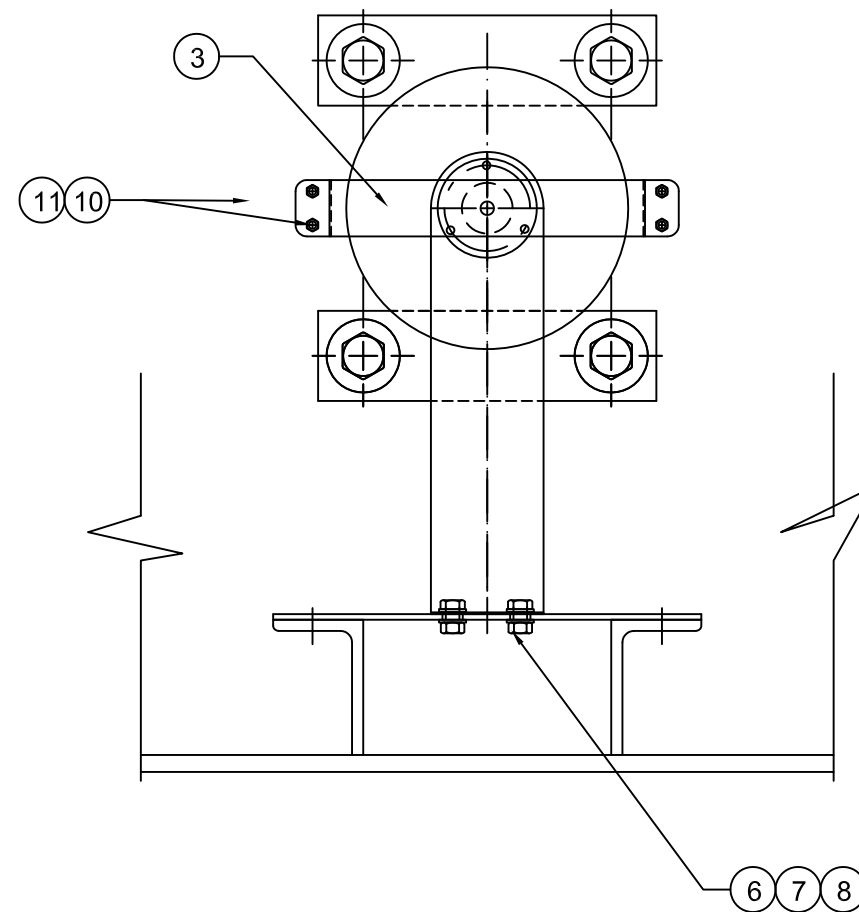
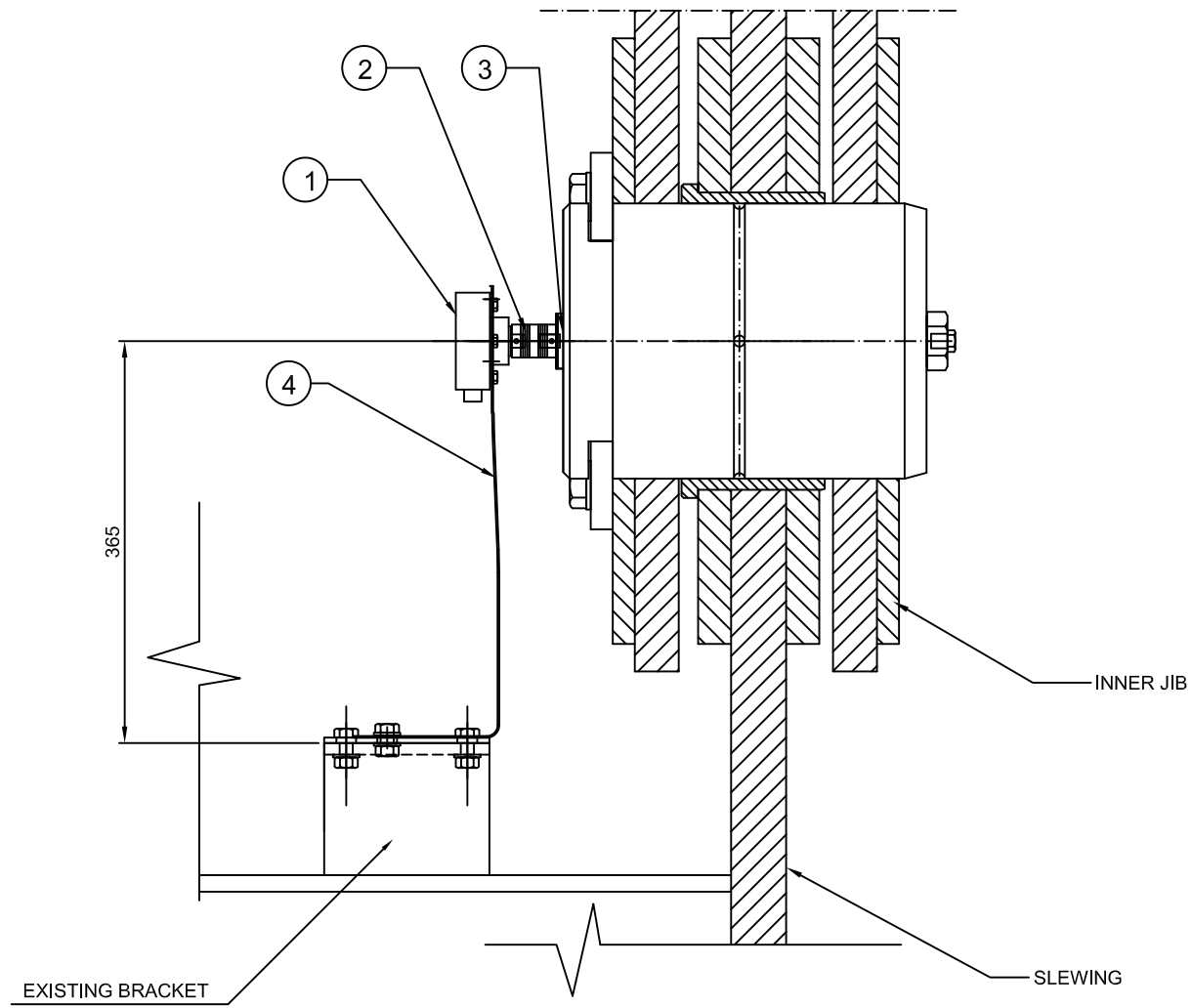
TOTAL WEIGHT APPROX. [kg] ~5

TTS-BOHAI SUPPLY	2	WASHER	11		19446	-
TTS-BOHAI SUPPLY	2	HX.HD.SCREW	10		16725	-
TTS-BOHAI SUPPLY	1	BRACKET FOR CONNECTOR PIN	9	A4-12543		0,5
TTS-BOHAI SUPPLY	1	DISTANCE PIPE	8			-
TTS-BOHAI SUPPLY	3	HEX SCREW	7	A4	25215	-
TTS-BOHAI SUPPLY	3	WASHER	6	A4	26772	-
TTS-BOHAI SUPPLY	3	HEX.HEAD SCREW	5		13381	-
TTS-BOHAI SUPPLY	1	BRACKET FOR ENCODER	4	A4-12160		0.3
TTS-BOHAI SUPPLY	1	AXLE FOR COUPLING	3	A4-12158		-
TTS-MARINE SUPPLY	1	COUPLING ITEM NO. 502235	2	REF. X20669EB1, -R43.1		-
TTS-MARINE SUPPLY	1	ENCODER (ANGLE SWITCH) ITEM NO. 502214	1	REF. X20669EB1, -R43		-

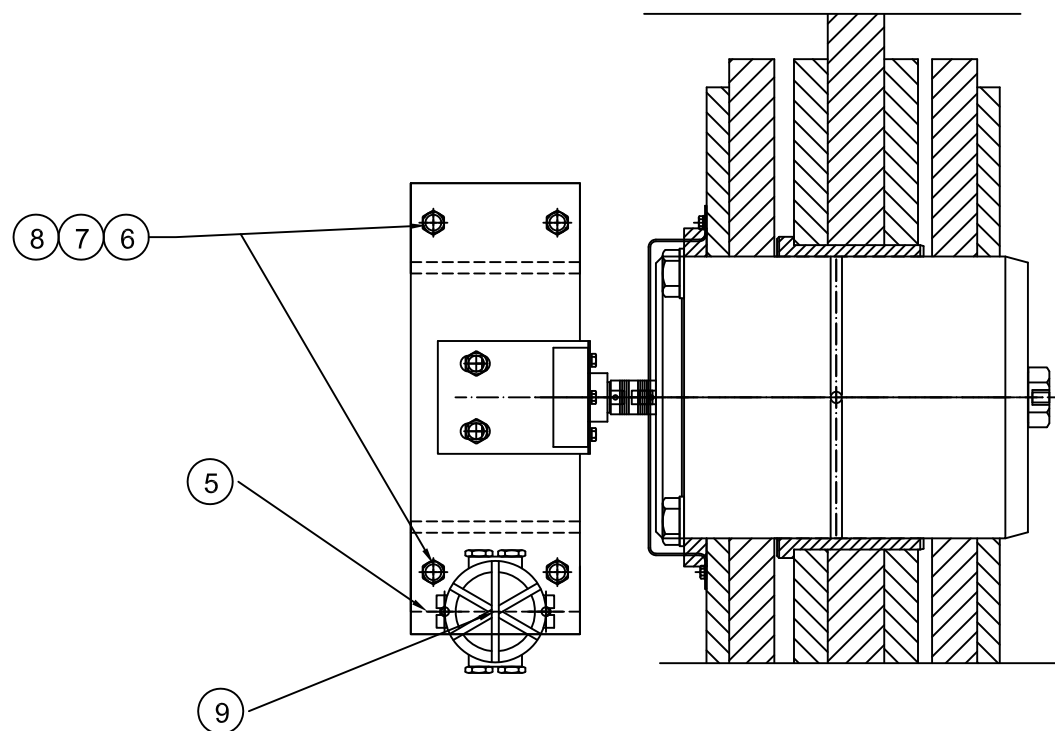


NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT
THIS DRAWING IS THE PROPERTY OF TTS Marine ASA AND MUST NOT BE REPRODUCED WITHOUT OUR WRITTEN CONSENT				
DRAWN	FTU 06.06.06	CHECKED	FTU 06.06.06	APPROVED
PROJECT				
DRWG NAME			SCALE	FORMAT
ASSEMBLY JIB ANGLE SWITCH OUTER JIB			1:5	A3
			DRWG NO REV A3-13260 - 2	
REPLACES	REPLACED BY	DRWG FOLDER 20669		

REV	ALTERATION	SIGN / DATE
1	RELEASED FOR PRODUCTION	FTU 09.10.06



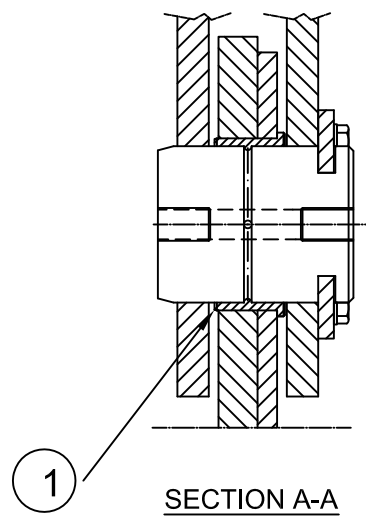
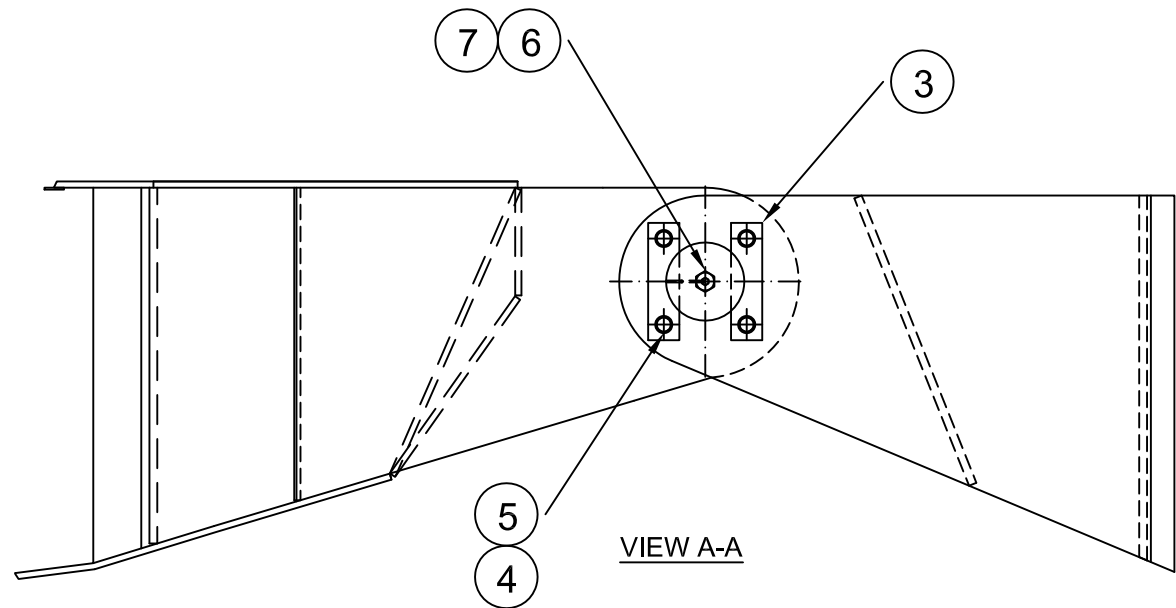
TOTAL WEIGHT APPROX. [KG] ~4



NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT
4	WASHER	11		96749 -
4	HEX HEAD SCREW	10		16725 -
1	JUNCTION BOX	+X35	9	20669EB1 -
6	LOCK NUT	8		13303 -
12	WASHER	7		96747 -
6	HEX. HEAD SCREW	6		13133 -
1	BRACKET	5	A4-12236 XA4-12236	2
1	BRACKET, LIMIT SWITCH	4	A4-12612 XA4-12612	0,5
1	BRACKET WITH CONNECTION PIN	3	A4-12363 XA4-12363	-
1	COUPLING	2	ROTEX	-
1	LIMIT SWITCH	1	20669EB1	REF. 1

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DRAWN	FTU	09.10.06	CHECKED	APPROVED
PROJECT				
JIB LIMIT SWITCH BETW. SLEWING AND JIB			SCALE	1:5
DRWG NAME			FORMAT	E
ARRANGEMENT			DRWG NO	A2-10135 - 1
REPLACES			REPLACED BY	DRWG FOLDER
				20669

REV	ALTERATION	SIGN / DATE
1	RELEASED FOR PRODUCTION	FTU 13.03.06



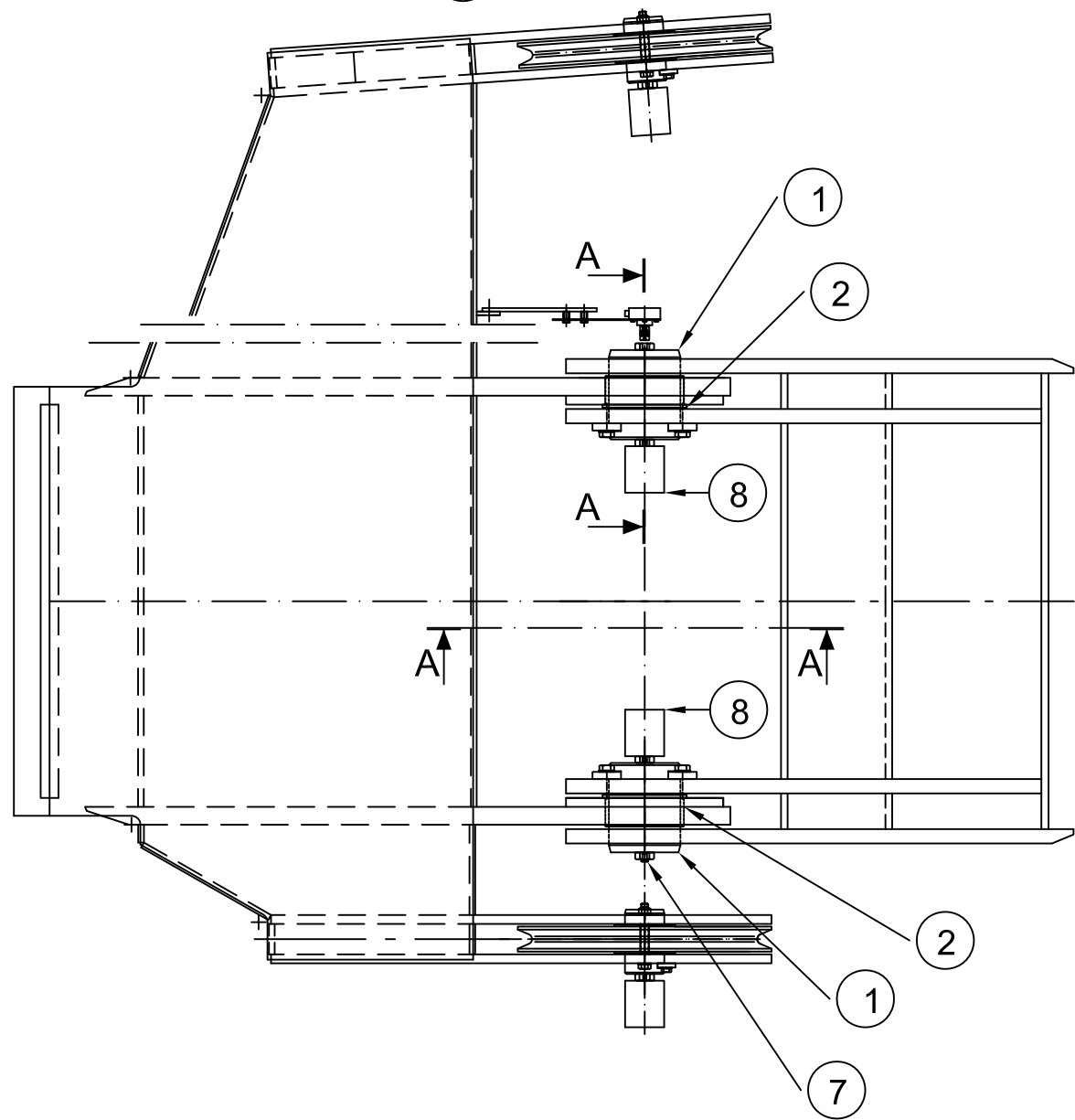
INSTALLATION

DURING WORKSHOP PREPARATION THE SLIDING SURFACES OF THE BEARING ARE TO BE LUBRICATED WITH "ARROW ALUMINIUM SEIZE EEZE" OR EQUAL.

NOTE DIRECTION OF LUBRICATION CHANNEL TO OBTAIN CORRECT DISTRIBUTION OF GREASE.

LUBRICATION

AFTER MOUNTING, AND AT EVERY FOLLOWING 50-100-.... HOURS OF OPERATION, HINGE HAS TO BE GREASED AT ALL GREASE NIPPLES USING GREASE TYPE EP2 OR EQUIVALENT.(REF. COMPARISON CHART K-07-16.)

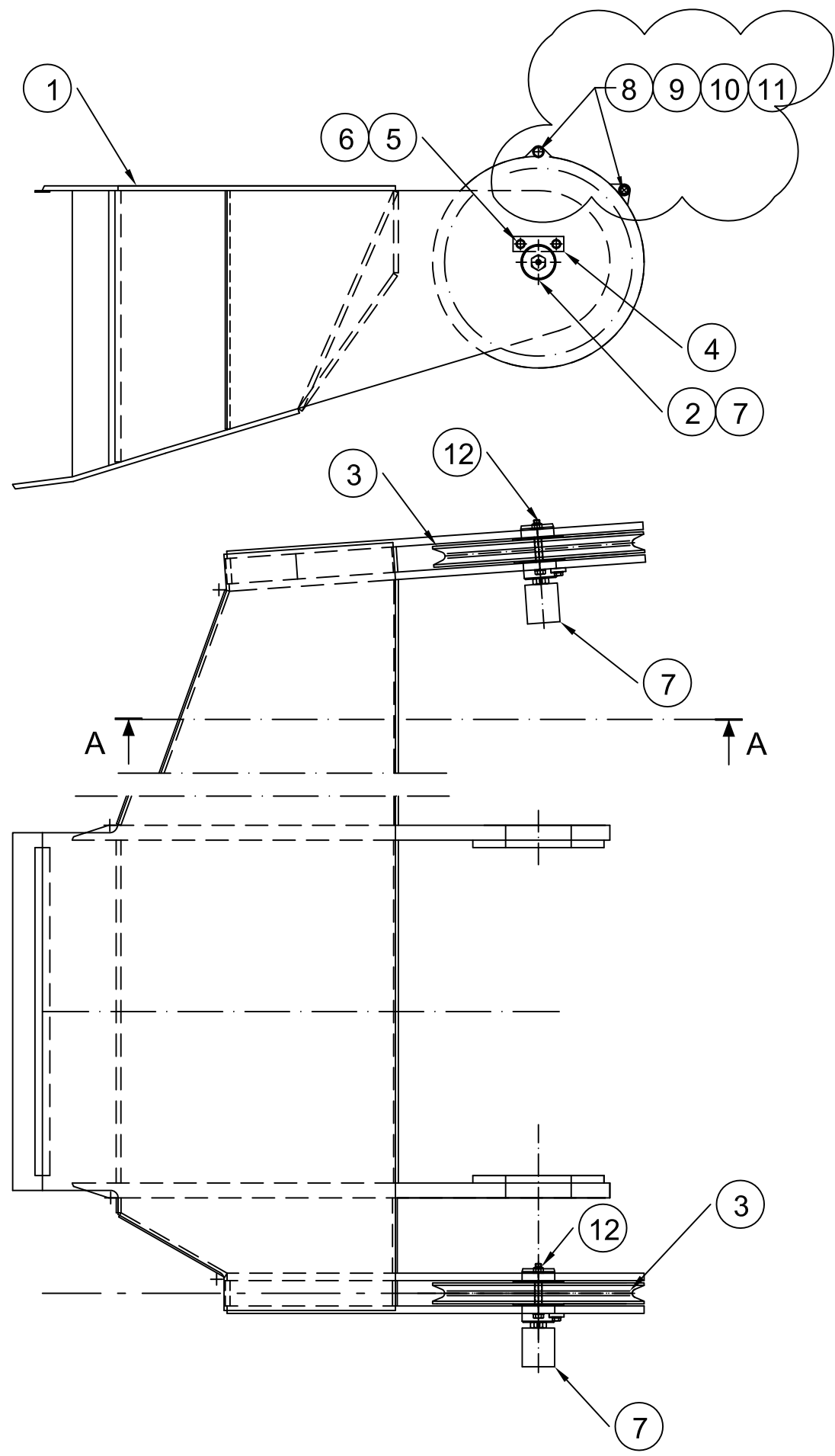


WEIGHT OF EQUIPMENT [kg] ~ 160

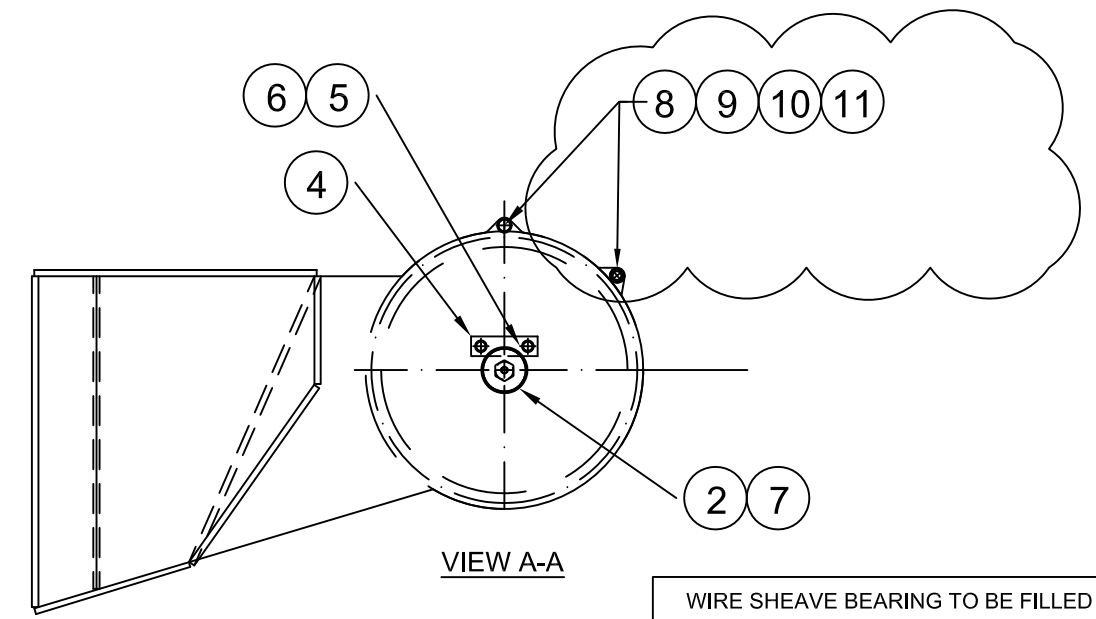
2	AUTOMATIC GREAS CATRIDGE	8		1
1	PLUG	7	65843	-
1	PLUG	6	A4-12052	-
8	WASHER	5	26560	-
8	HEX. HEAD BOLT	4	14789	3
4	LOCKING PLATE	3	A4-1000	7
2	JIB HINGE BEARING	2	A4-12305	22
2	JIB HINGE BOLT	1	A4-12304	126
NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT

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DRAWN	FTU 13.03.06	CHECKED	FTU 13.03.06	APPROVED	
PROJECT					
DRWG NAME	JIB HINGE INNER HINGE/FOLDING HINGE			SCALE	
				FORMAT	A3
				DRWG NO	A3-13165
				REV	- 1
REPLACES		REPLACED BY		DRWG FOLDER	20669



REV	ALTERATION	SIGN / DATE
1	RELEASED FOR PRODUCTION	FTU 13.03.06
2	ADD 2xPOS 8, 9, 10 AND 11	FTU 19.03.07



WIRE SHEAVE BEARING TO BE FILLED WITH GREASE (EP2) IMMEDIATELY AFTER ASSEMBLY.

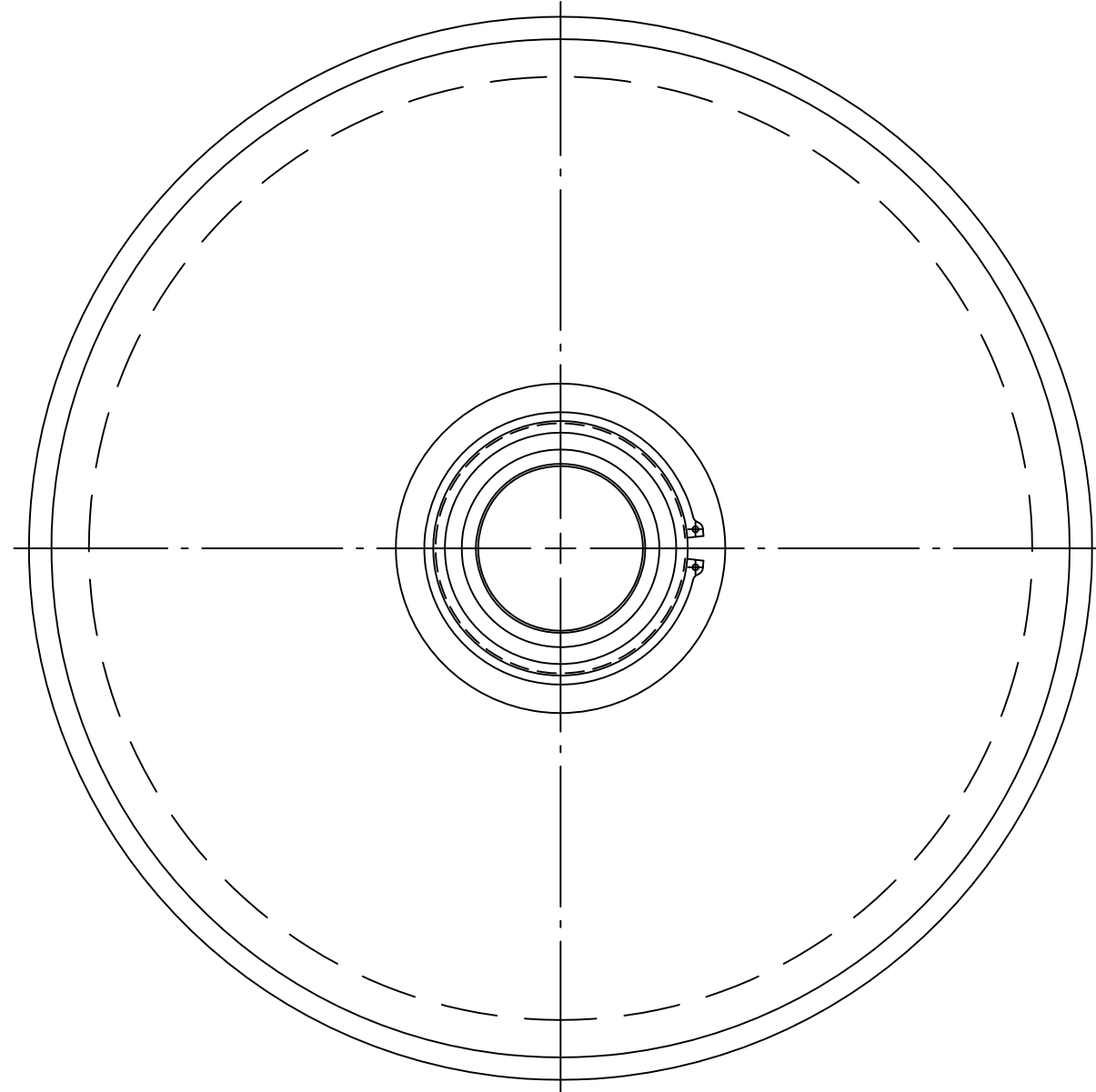
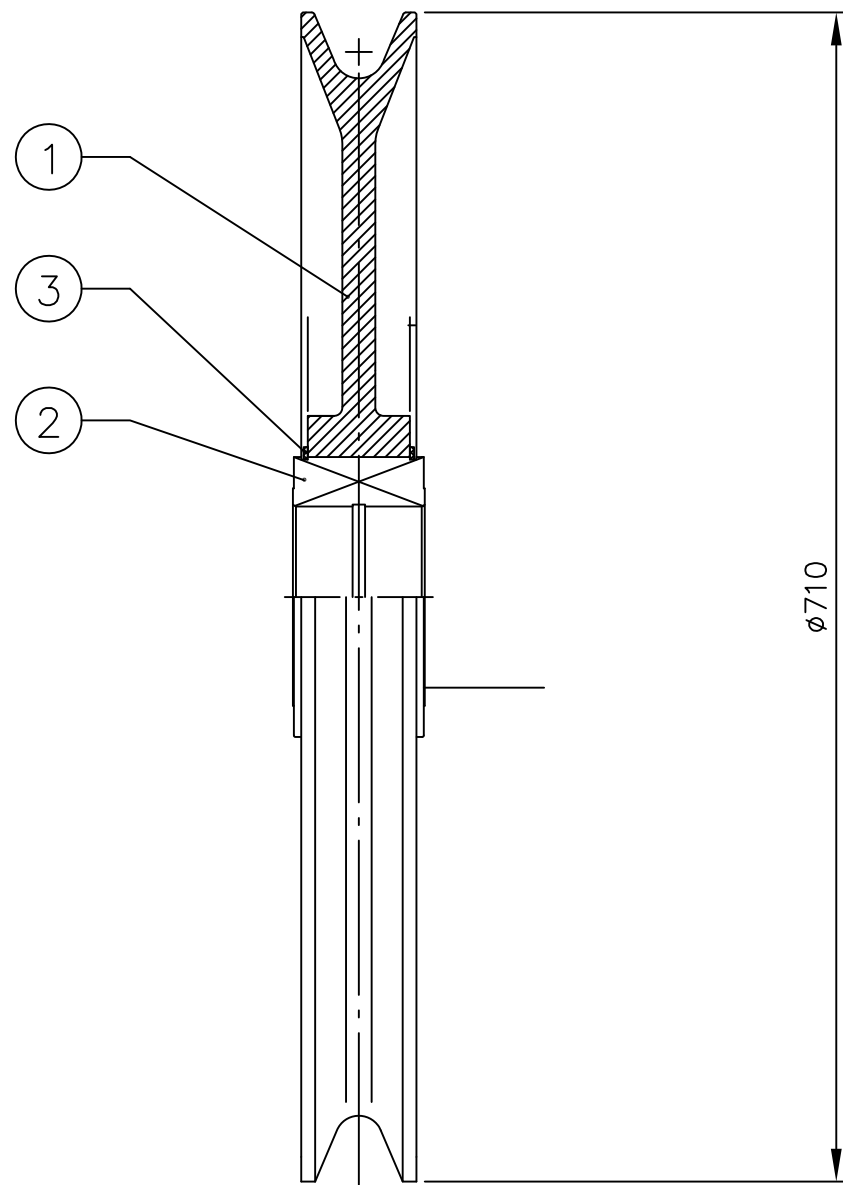
WEIGHT OF EQUIPMENT WITH JIB HEAD [kg] ~3090
 WEIGHT OF EQUIPMENT [kg] ~ 180

NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT
2	PLUG	12	65843	-
8	WASHER	11	100904	-
8	NUT	10	96730	-
4	HEX.HADE SCREW	9	24527	-
4	SPACER PIPE	8		1
2	AUTOMATIC GREAS CATRIDGE	7		1
4	WASHER	6		-
4	HEX HEAD SCREW	5		-
2	LOCK PLATE	4	A4-1000	2
2	WIRE SHEAVE	3	A3-1059 96907	148
2	WIRE SHEAVE BOLT	2	A4-12303	28
1	MAIN OUTER HING	1	A1-13099	2910

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DRAWN	FTU 13.03.06	CHECKED	FTU 13.03.06	APPROVED	
PROJECT					
DRWG NAME	SHEAVE HOUSE ASSEMBLY INNER HINGE			SCALE	
				FORMAT	A3
				DRWG NO	A3-13164 - 2
				REV	2
REPLACES		REPLACED BY		DRWG FOLDER	20669

REV	ALTERATION	DATE / SIGN
2	GENERAL UPDATING	10.01.97 / NCR
3	GENERAL UPDATING	04.12.97 / NCR
4	GROOVE ANGLE WAS 45°	26.01.99 / NCR
5	POS 1 DRWG NO ADDED	24.06.02 / NCR



TOTAL WEIGHT [KG] : ~ 74

2	CIRCLIP	3	10189	
1	ROLLER BEARING	2	36810	
1	WIRE SHEAVE, CAST SHEAVE	1	A3-1182	XA3-1182 65
NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT

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DRAWN RR 11/10/94 CHECKED 18.02.96 / NCR APPROVED 18.02.96 / NCR

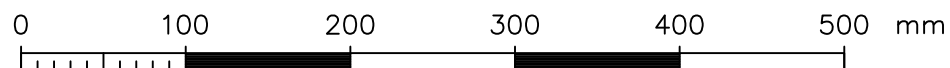
PROJECT

TTS
TTS Marine ASA

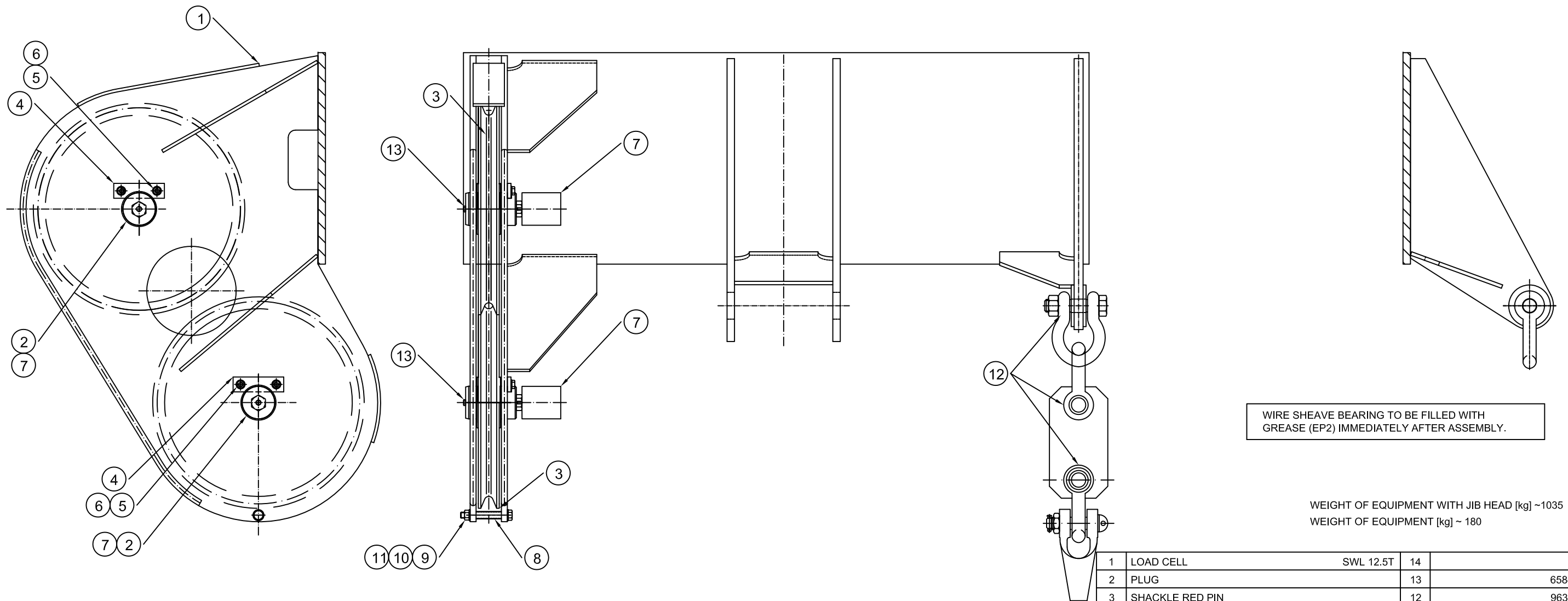
DRWG NAME WIRE SHEAVE S 630 SCALE 1:5 FORMAT E

DRWG NO A3-1059-5 REV 5

REPLACES REPLACED BY DRWG FOLDER



REV	ALTERATION	SIGN / DATE
1	RELEASED FOR PRODUCTION	FTU 13.03.06



WIRE SHEAVE BEARING TO BE FILLED WITH GREASE (EP2) IMMEDIATELY AFTER ASSEMBLY.

WEIGHT OF EQUIPMENT WITH JIB HEAD [kg] ~1035
 WEIGHT OF EQUIPMENT [kg] ~ 180

1	LOAD CELL	SWL 12.5T	14		-	
2	PLUG		13	65843	-	
3	SHACKLE RED PIN		12	96349	-	
2	WASHER FOR		11	100904	-	
1	NUT		10	96730	-	
1	HEX.HADE SCREW		9	24526	-	
1	SPACER PIPE		8		1	
2	AUTOMATIC GREAS CATRIDGE		7		1	
4	WASHER		6		-	
4	HEX HEAD SCREW		5		-	
2	LOCK PLATE		4	A4-1000	2	
2	WIRE SHEAVE		3	A3-1059	96907	148
2	WIRE SHEAVE		2	A4-12301		26
1	JIB HEAD MAIN LIFT		1	A1-13363		855
NOS	ITEM / DIMENSION		POS	MATR / DRWG / ART NO	WEIGHT	

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DRAWN FTU 13.03.06 CHECKED FTU 13.03.06 APPROVED

PROJECT

DRWG NAME: MAIN JIB HEAD ASSEMBLY

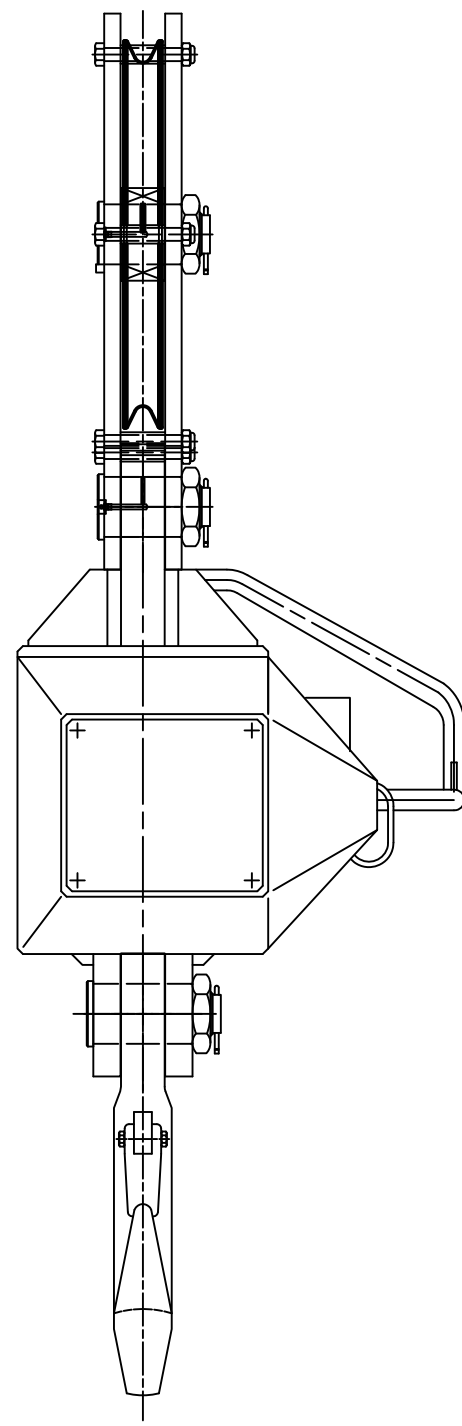
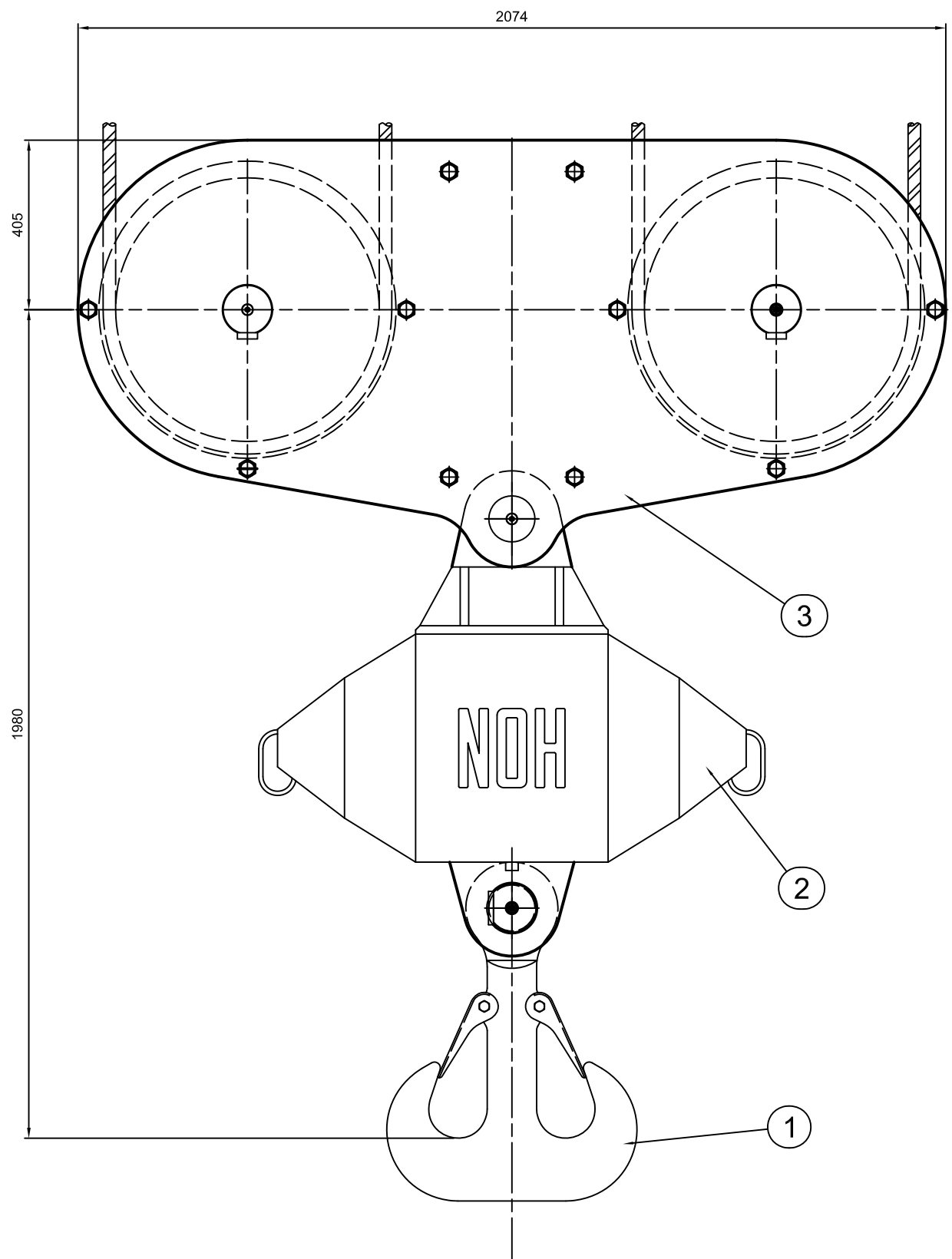
SCALE: 1:10 FORMAT: A2

DRWG NO: A2-9899 REV: 1

REPLACES: REPLACED BY: DRWG FOLDER: 20669



REV	ALTERATION	REVISED	APPROVED
1	RELEASED FOR PRODUCTION		12.02.2008 / AAO



SWL : 50T (IN HOOK/4-FALL)
DYN.FACT. : 1,1
DUTY FACT.: 1.05

ASSEMBLED HOOK BLOCK TO BE TESTLOADED ACCORDING TO DNV RULES
AFTER TESTING, AND BEFORE FINAL PAINTING, THE TEST CERT. No HAS TO BE
STAMPED INTO THE BLOCK WITH 10mm HIGH LETTERS

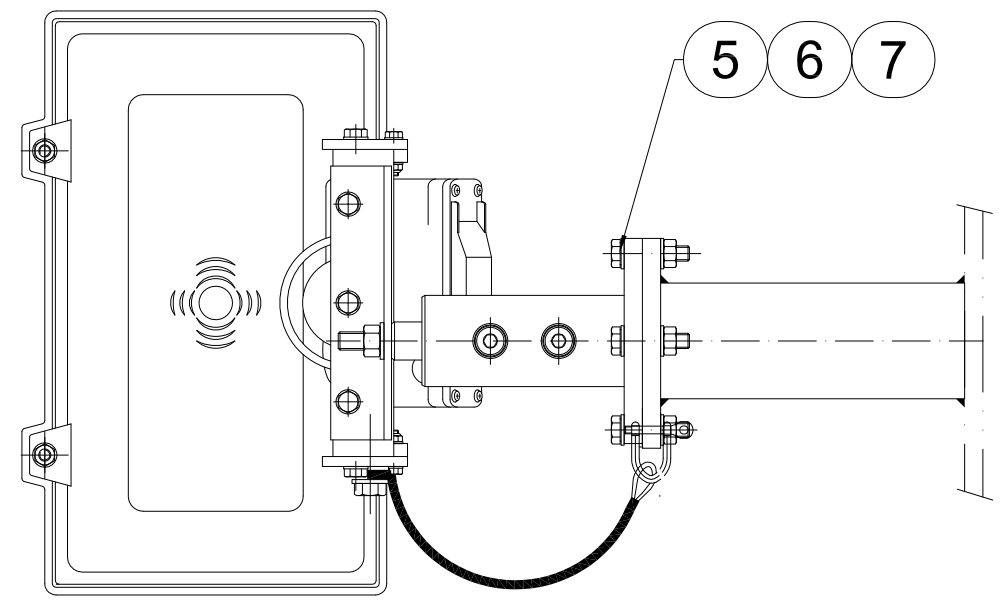
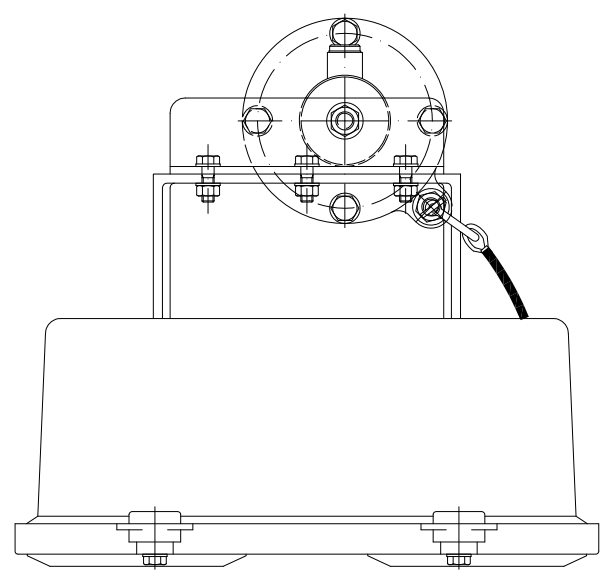
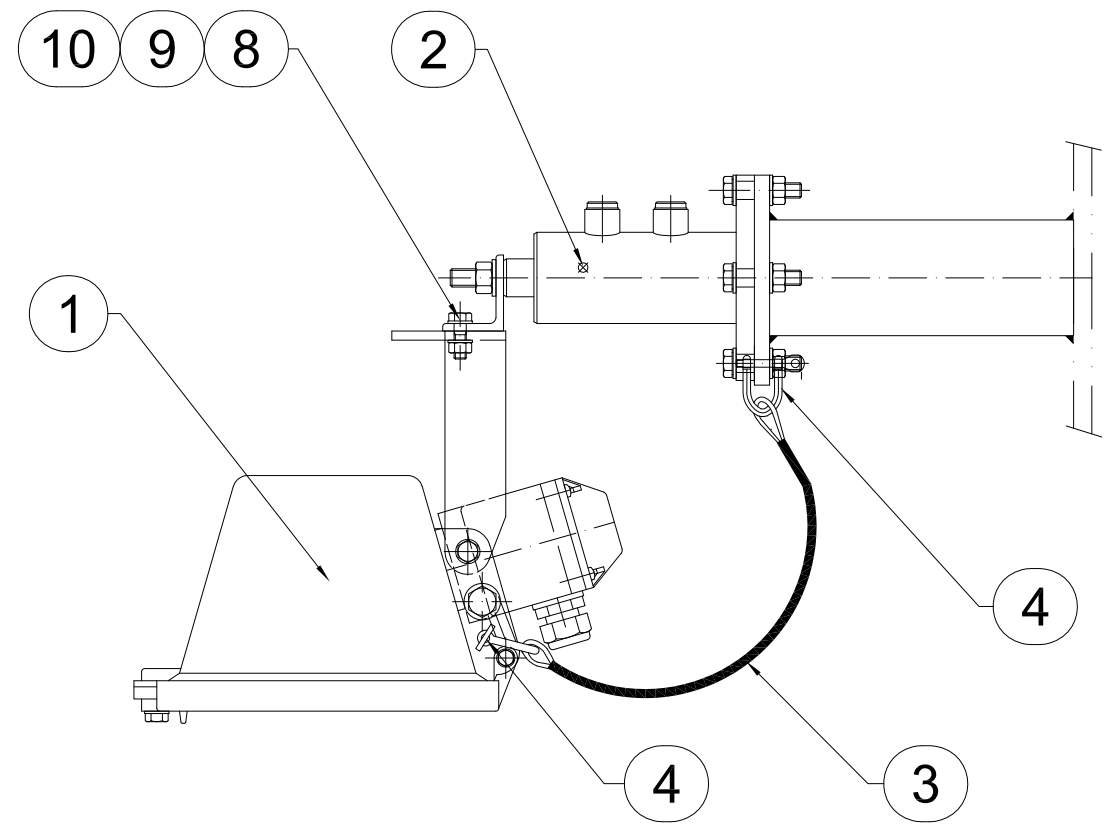
TOTAL WEIGHT, APPROX. ~ 1650 Kg.

1	ROPE BLOCK		3		112193	140
1	CARGO TURNER		2		114155	550
1	HOOK	SWL=50t	1		112194	960
NOS	ITEM / DIMENSION	TAG	POS	MATR / DRWG / ART NO	WEIGHT	

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DRAWN	2007.10.11/ASI	CHECKED	12.02.2008 / AAO	APPROVED	12.02.2008 / AAO	FOLDER	21361-21362	
PROJECT								
DRWG NAME								
HOOK BLOCK ASSEMBLY CARGO TURNER 50t				FORMAT	A2	SCALE	1:10	
				DRWG NO	A2-10530		REV	1
REPLACES				REPLACED BY				

REV	ALTERATION	REVISED	APPROVED
1	RELEASED FOR PRODUCTION	06.08.2007/RAN	17.01.08 / FTU



TOTAL WEIGHT [kg] = 17

NOS	ITEM / DIMENSION	TAG	POS	MATR / DRWG / ART NO	WEIGHT
3	LOOK NUT		10		0
6	WASHER		9		0
3	HEX. SCREW M8		8		0
4	LOOK NUT		7		0
8	WASHER		6		0
4	HEX. SCREW M10		5		0
2	SHACKLE		4	96357	0
1	SECURITY WIRE		3		1
1	CYLINDER DAMPER		2		5
1	FLOOD LIGHT		1		11

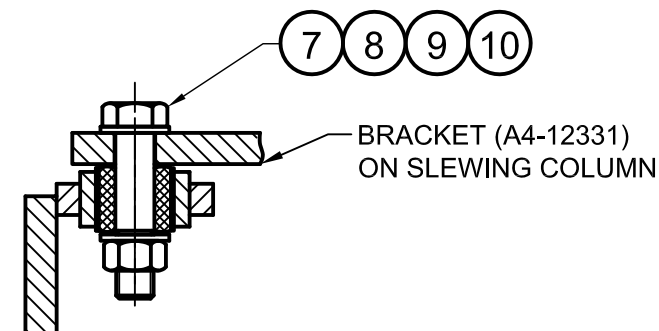
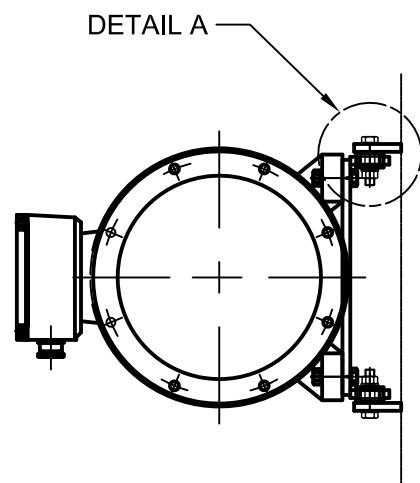
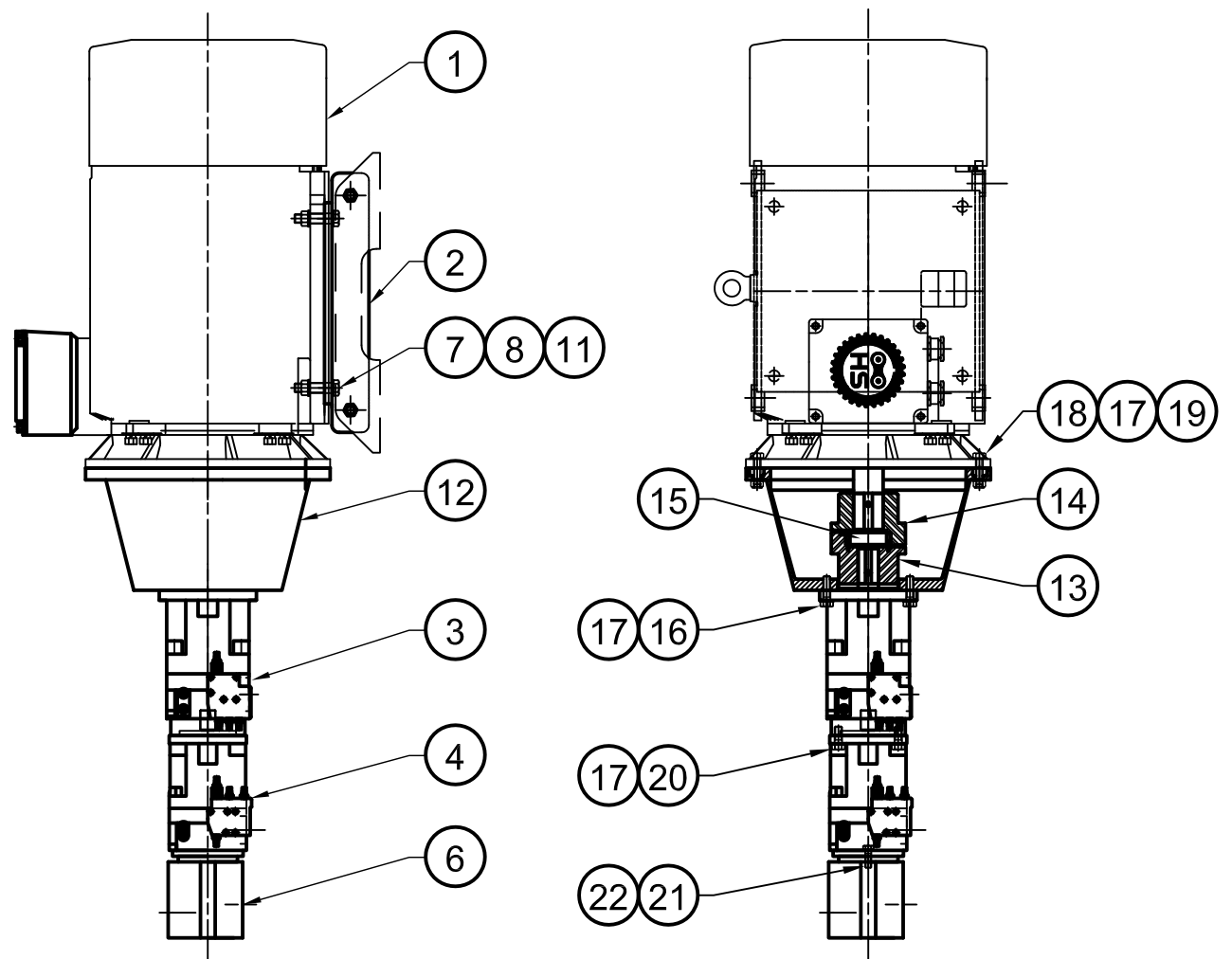
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DRAWN	30-07-2007/RAN	CHECKED	06-08-2007/RAN	APPROVED	17.01.08 / FTU	FOLDER	21222
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PROJECT		TTS TTS Marine Cranes AS					
DRWG NAME		FORMAT	A3	SCALE	1:5	E	
MAIN JIB ASSEMBLY FLOOD LIGHT ASSEMBLY		DRWG NO	A3-13661		REV	1	
		REPLACES			REPLACED BY		

REV	ALTERATION	REVISED	APPROVED
1	RELEASED FOR PRODUCTION		12.02.2008 / AAO

LOCATION FOR PORTS (POS:4,5,6) CHECK ON
HYDRAULIC INSTALLATION DRAWING A1-13496



DETAIL A
SCALE 1:5

TOTAL WEIGHT [kg] ~1431

NOS	ITEM / DIMENSION	POS	MATR / DRWG / ART NO	WEIGHT
2	WASHER	22		-
2	HEX SCREW	21		-
4	HEX SCREW	20		-
8	LOCK NUT	19	16032	1
16	HEX SCREW	18	13003	2
24	WASHER	17	26536	1
4	HEX SCREW	16	12992	1
1	FLEXIBEL COUPLING	15	102947	5
1	FLEXIBEL COUPLING	14	102946	20
1	FLEXIBEL COUPLING	13	102945	20
1	BELLHOUSING	12	102944	80
4	HEX. HEAD SCREW	11	15361	-
4	RUBBER SUSPENSION	10	96968	2
4	HEX. HEAD SCREW	9	18556	2
16	WASHER	8	26560	-
8	NYLOCK NUT	7	16090	1
1	HYDR. GEARPUMP	6	HYDRAULIC DIAGRAM 112163	40
		5		
1	HYDR. PUMP	4	HYDRAULIC DIAGRAM 112149	60
1	HYDR. PUMP	3	HYDRAULIC DIAGRAM 112148	80
1	BRACKET FOR MOTOR	2	A3-13113	76
1	EL. MOTOR	1	ELECTRIC DIAGRAM 112157	1040

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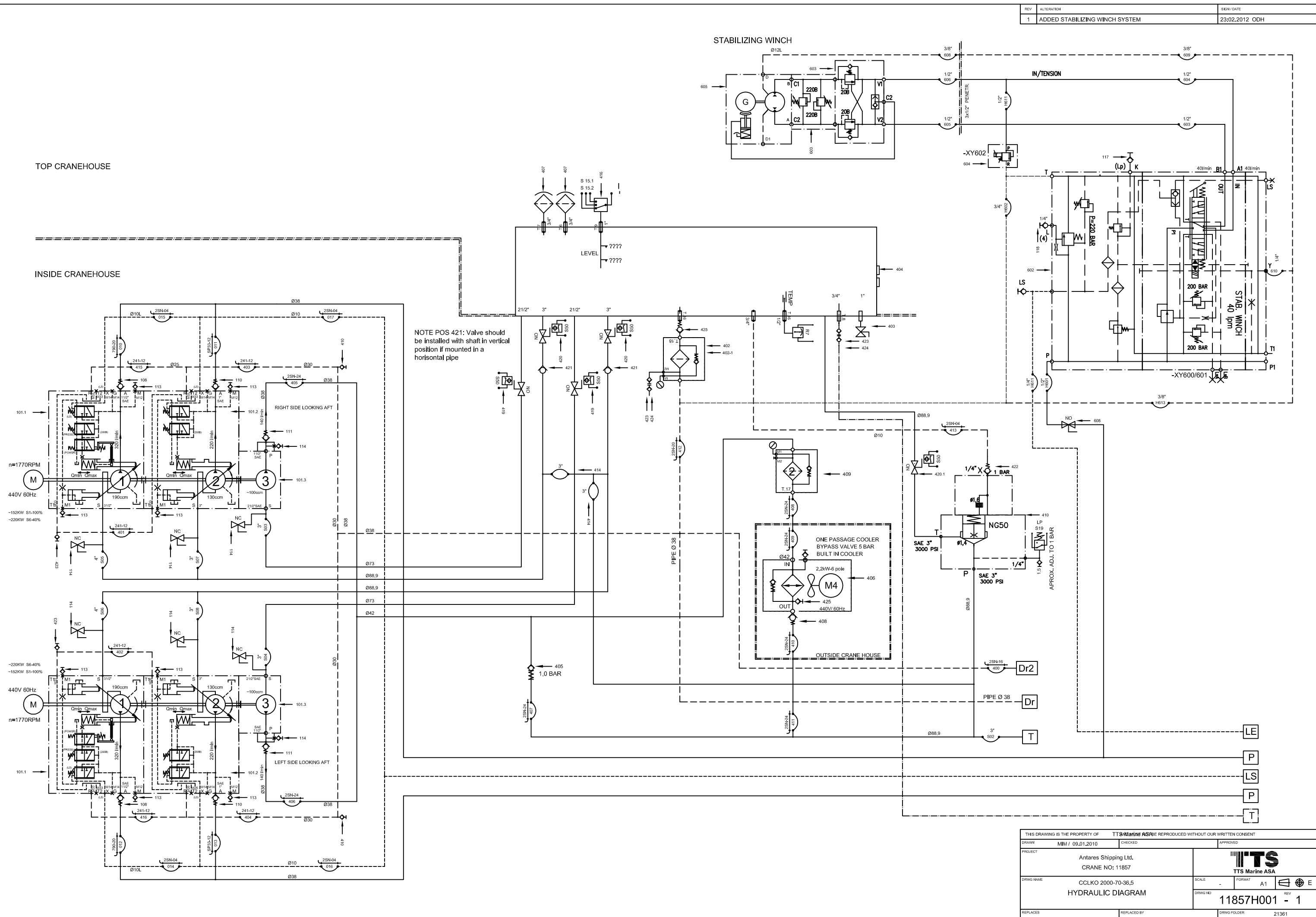
DRAWN	26.09.2007/ASI	CHECKED	12.02.2008 / AAO	APPROVED	12.02.2008 / AAO	FOLDER	21361
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PROJECT	CCLK 2000-50-35				
DRWG NAME	PUMP DRIVE MAIN ASSEMBLY				
FORMAT	A3	SCALE	1:20	REV	1
DRWG NO	A3-15765			REPLACES	REPLACED BY

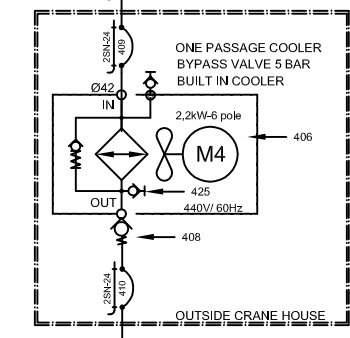
TOP CRANEHOUSE

INSIDE CRANEHOUSE

STABILIZING WINCH

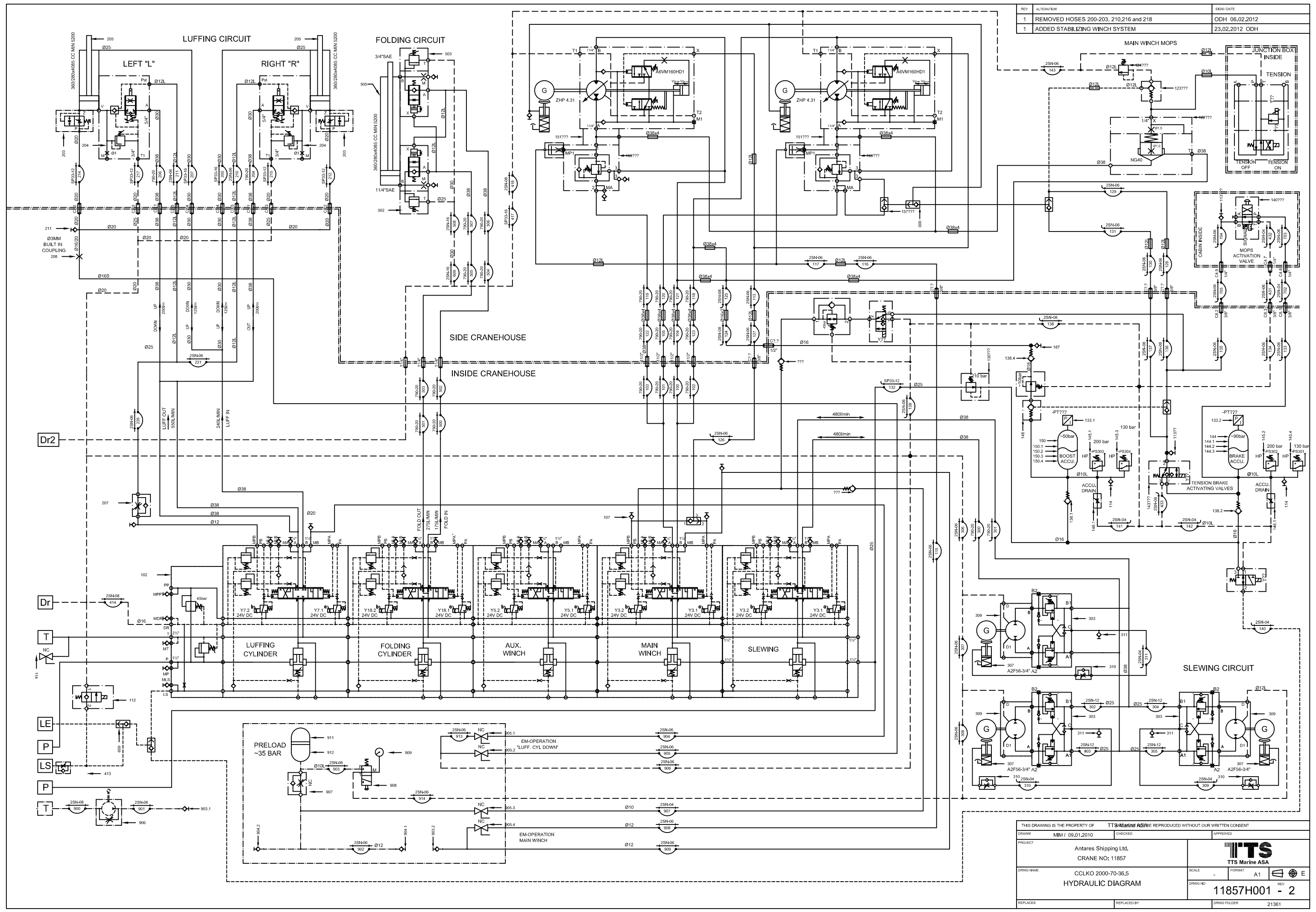


NOTE POS 421: Valve should be installed with shaft in vertical position if mounted in a horizontal pipe



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DRAWN	MM / 09.01.2010	CHECKED
PROJECT	Antares Shipping Ltd. CRANE NO: 11857	APPROVED
DRAWG NAME	CCLKO 2000-70-36,5 HYDRAULIC DIAGRAM	SCALE
REPLACES		REPLACED BY
DRWG NO: 11857H001 - 1		DRWG FOLDER: 21361

REV	ALTERATION	SKN/DATE
1	REMOVED HOSES 200-203, 210,216 and 218	ODH 06.02.2012
1	ADDED STABILIZING WINCH SYSTEM	23.02.2012 ODH

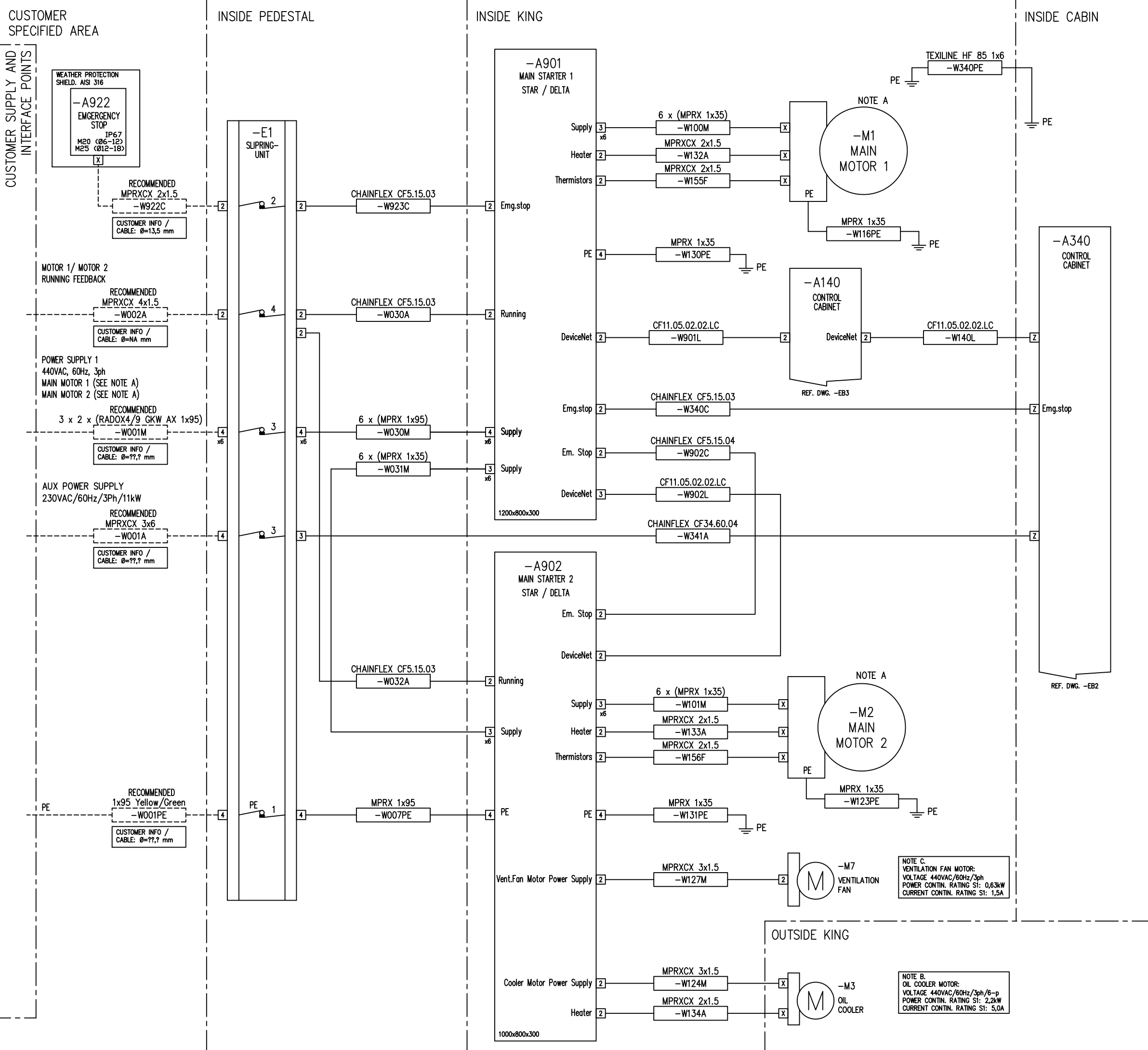


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DRAWN: MIM / 09.01.2010	CHECKED: []
PROJECT: Antares Shipping Ltd. CRANE NO: 11857	APPROVED: []
DRWG NAME: CCLKO 2000-70-36.5 HYDRAULIC DIAGRAM	SCALE: - FORMAT: A1 E
REPLACES: []	REPLACED BY: []
DRWG NO: 11857H001	REV: 2
DRWG FOLDER: 21361	

Position	Drawing No	Qty	Description	Item No
101-1	11857H001	2,00	Axial Piston Pump	112148
101-2	11857H001	2,00	Axial Piston Pump	112149
101-3	11857H001	2,00	GEARPUMP 100CCM	112163
102	11857H001	1,00	CONTROL VALVE, EL.OPERATED	106479
103	11857H001	1,00	LOAD CONTROL VALVE	112174
103,1	11857H001	1,00	LOAD CONTROL VALVE	112174
104-1	11857H001	1,00	FLOW CONTROL VALVE INSERT	102543
104-1.1	11857H001	1,00	FLOW CONTROL VALVE INSERT	102543
104-2	11857H001	1,00	EO ADAPTER MALE-FEMALE BSPP3/8X3/4	10823
104-2.1	11857H001	1,00	EO ADAPTER MALE-FEMALE BSPP3/8X3/4	10823
104-3	11857H001	1,00	Valve adaptor 3/4" f/winch contr. MA-v.	96575
104-3.1	11857H001	1,00	Valve adaptor 3/4" f/winch contr. MA-v.	96575
105	11857H001	1,00	Main winch	REF. A2-10126
106	11857H001	2,00	AXIAL PISTON MOTOR 160CCM	113662
106,1	11857H001	2,00	FLANGE SAE 6000 PSI W/TEST POINT PORT	112678
107	11857H001	2,00	SHUTTLE VALVE. Light.10mm pipe dim	96501
107,1	11857H001	1,00	SHUTTLE VALVE. Light.10mm pipe dim	96501
108	11857H001	2,00	FLANGE VALVE C5V	112191
109	11857H001	2,00	TEE BLOCK SAE 6000,11/4"	102291
110	11857H001	2,00	FLANGE VALVE C5V	112189
111	11857H001	2,00	FLANGE VALVE C5V	109531
112	11857H001	1,00	SOLENOID VALVE 2/2 COMPL. 350 bar	119951
113	11857H001	8,00	MINIMESS. Metrisk. M12x1.5 . Steel	96667
114	11857H001	7,00	BALL VALVE 3/8"	11117
115	11857H001	4,00	MINIMESS 10L	96672
116	11857H001	1,00	SHUTTLE VALVE. Light.10mm pipe dim	96501
117	11857H001	1,00	CHECK VALVE. pipemounted (RHD). Strong	96521
118	11857H001	1,00	Minimess. VKA3/16SA3C . Sterk serie	96683
119	11857H001	1,00	SHUTTLE VALVE. Light.10mm pipe dim	96501
120	11857H001	1,00	SHUTTLE VALVE. Light.12mm pipe di	96502
121	11857H001	3,00	Minimess. VKA3/12LA3C . Lett serie	96673
122	11857H001	1,00	RELIEF VALVE NG 40 for MOPS system	113721
122,1	11857H001	1,00	SPRING for CS40 5 Bar	120566
123	11857H001	1,00	PILOT CHECK VALVE	102562
124	11857H001	1,00	RELIEF VALVE	112071
130	11857H001	1,00	PRESS.RED. VALVE W/BODY	112829
133	11857H001	2,00	PRESSURE TRANSMITTER FOR NITROGEN	120218
138	11857H001	2,00	CHECK VALVE. pipemounted (RHD). Strong	96521
139	11857H001	1,00	PRESSURE REDUCING VALVE	102818
140	11857H001	1,00	MOPS ACTIVATION VALVE w/POS INDICATOR	118578
142	11857H001	1,00	SOLENOID VALVE POPPET-TYPE	110451
143	11857H001	1,00	SOLENOID VALVE POPPET-TYPE	110451
144	11857H001	1,00	ACCUMULATOR SET EHP-C-010	112824
145	11857H001	4,00	PRESS.SWITCH HP	102519
146	11857H001	2,00	NEEDLE VALVE R3/8 with steel body	125515

147	11857H001	1,00	PRESSURE REDUCING VALVE	107145
148	11857H001	1,00	PILOT CHECK VALVE	102562
149	11857H001	1,00	SOLENOID VALVE SPOOL-TYPE	102558
150	11857H001	1,00	ACCUMULATOR SET EHP-C-019	112826
151	11857H001	1,00	Terminal box of polycarbonate, IP66	503538
160	11857H001	1	INLINE FILTER ILF 60l/m, 350bar	400076
160,1	11857H001	1	Filter element for ILF	400077
161	11857H001	1	DIFFERENTIAL PRESSURE CLOGGING INDICATOR	400109
162	11857H001	1	ADAPTOR FOR PIPING CLOGGING INDICATOR	400110
163	11857H001	1	Minimess. VKA3/10SA3C . Sterk serie	96681
164	11857H001	1	ORIFICE M5, 1,0MM	39672
165	11857H001	1	CHECK VALVE, 0.2 BAR CRACKING	400111
203	11857H001	2,00	HOSE RUPTURE VALVE, 3/4 BSP	100965
204	11857H001	2,00	LOAD CONTROL VALVE	96494
205	11857H001	2,00	HYDR.CYLINDER, 360/280	112156
207	11857H001	1,00	FLOW CONTROL VALVE, SINGLE ACTION	21750
208	11857H001	1,00	ORIFICE FITTINGS, GE16S	100959
303	11857H001	3,00	BLOCK COMPL. w/VALVE CARTRIDGE, 3/4'	94754
307	11857H001	3,00	SLEW GEARBOX	109456
309	11857H001	3,00	AXIAL PISTON MOTOR 56CCM	102565
310	11857H001	3,00	FLOW CONTROL VALVE, SINGLE ACTION	21750
311	11857H001	3,00	Minimess. VKA3/12LA3C . Lett serie	96673
402	11857H001	1,00	FILTER, PRESSURE	96585
402-1	11857H001	1,00	FILTERELEMENT, 5MY	96589
403	11857H001	1,00	BALL VALVE 1" COMPLETE W/PLUG	93376
404	11857H001	2,00	LEVEL GAUGE W/TEMP.	93345
405	11857H001	1,00	CHECK VALVE, 2BAR CRACKING	113607
406	11857H001	1,00	Oil / Air Cooler	112048
407	11857H001	2,00	BREATHER FILTER FOR OIL TANK	96591
408	11857H001	1,00	CHECK VALVE, EUROPA 1 1/2"	102790
409	11857H001	1,00	High pressure filter	106471
410	11857H001	1,00	RELIEF VALVE	112200
410,1	11857H001	1,00	Cartridge NG50	106472
410,2	11857H001	1,00	Cover for Cartridge NG50	106473
410,3	11857H001	1,00	Block for Cartridge NG50	106474
415	11857H001	1,00	BALL VALVE 1/2"	11116
416	11857H001	1	LEVEL SWITCH F/OIL TANK	500314
419	11857H001	2	BUTTERFLY VALVE 21/2" W/ LIMIT SWITCH	102791
420	11857H001	3	BUTTERFLY VALVE 3" W/ LIMIT SWITCH	
422	11857H001	1,00	CHECK VALVE, 3bar	119963
423	11857H001	3,00	QUICK CONNECTOR MALE W/CAP	96661
424	11857H001	2,00	QUICK CONNECTOR FEMALE W/CAP	96659
425	11857H001	1,00	CHECK VALVE. pipethreaded to(RHZ).Light	96534
502	11857H001	1,00	CHECK-Q-METER FD 32 REXROTH	39524
503	11857H001	1,00	LOAD CONTROL VALVE	96492
505	11857H001	1,00	HYDR.CYLINDER, 360/280	112160
602	11857H001	1	Manoeuvering valve stab. Winch	
603	11857H001	1	Double relief/balance valve	

604	11857H001	1	Pressure relief valve, el proportional	
605	11857H001	1	Stabilizing winch unit, Special low brake	
606	11857H001	1	Motor	
608	11857H001	1	Ball valve	
609	11857H001	1	Shuttle valve	
609A	11857H001	1	Shuttle valve	
800	11857H001	1,00	Tension control block - adjust.	119988
800,1	11857H001	3,00	BOLT, INNER HEX	39180
903	11857H001	3,00	QUICK CONNECTOR MALE W/CAP	96660
904	11857H001	2,00	Quick Connector. Female W/CAP	96658
905	11857H001	3	BALL VALVE 3/8"	11117
906	11857H001	1,00	EMERGENCY HAND PUMP ARR.	64340
907	11857H001	1,00	FLOW CONTROL VALVE, SINGLE ACTION	21750
908	11857H001	1,00	MANOMETER VALVE	35026
909	11857H001	1,00	PRESSURE GAUGE 0-250 BAR	11080
911	11857H001	1,00	Accumulator Bladder	106477
912	11857H001	1,00	Clamp for Accumulator	106478
925	11857H001	1,00	BALL VALVE 1 1/2"	34746



Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				29.03.10 MMN

--- CABLE SUPPLY AND LAY OUT BY CUSTOMER

(-En) CABLE TRANSITS WITH REFERENCES TO MECH. DRAWING

VENDORS CABLE / TERMINAL LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	C: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	
I: EEX(I) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
W14G Cable no.14 w.380 VAC
X03C1 Terminal list no.3 w. +24 VDC terminals

GLAND INFORMATION Ver. 27/12/2000

Ref.	Gland type	Tread	Diam. cable min	max
A	IPON, 1234M1601	M16	4,0	8,0
B	IPON, 1234M2001	M20	6,0	12,0
C	IPON, 1234M2501	M25	12,0	18,0
D	IPON, 1234M3201	M32	17,0	25,0
X	PART OFF COMP.	-	-	-
Y	REF. NOTE	-	-	-
Z	ROX CABLE TRANSIT	-	-	-

GLAND INFORMATION: 18.12.2006

Ref.	TTS Item no.	Tread	Diam. cable min	max	Ref.	TTS Item no.	Tread	Diam. cable min	max
0	501705	M162K	3,0	8,0	12				
1	501706	M200s	3,0	8,0	13				
2	501707	M200	7,5	11,9	14				
3	501708	M20A	11,0	14,3	15				
4	501710	M25B	13,0	20,2	16				
5	501712	M32C	19,0	26,5	17				
6	501714	M40C2	25,0	32,5	18				
7	501716	M50D	31,5	44,4	19				
8	501718	M63E	42,5	56,3	X	PART OF COMPONENT			
9	501720	M75F	54,5	68,2	Y	REF. NOTE			
10					Z	ROX CABLE TRANSIT			
11									

CUSTOMER: Ray Shipping
HULL NO.:
MACHINE NO.: 11857

⚠ To avoid internal condensation and damage of motor: Connect motor electrical heater,(220 VAC, approx. 100W), in case motor is stored or premounted outdoor prior to crane mounting.

NOTE A:

EL.MOTOR DATA :

MAKER:	SH	ENCLOSURE:	IP: IP55
TYPE:	Y2E2 315M-4	INSULATION CLASS:	F
VOLTAGE:	440 V	TEMP. RISE CLASS:	
PHASE:	3 PH		
FREQUENCY:	60 HZ		
STARTING METHOD:	Y/D		
POWER CONTIN.RATING S1:	158 KW	226 A	
POWER RATING S6-40% I.D.:	229 KW	328 A	
STARTING CURRENT (DOL):		1716 A	
STARTING CURRENT (Y/D):		572 A	
HEATER VOLTAGE:		230 V	
PHASE:		1 PH	
HEATER POWER CONSUMPTION:		1x99 W	

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Designed 17.11.09	Approved 29.03.10 MMN	Projection Scale 1:1	 TTS Marine ASA
Drawn 17.11.09 MMN	Format A1	Replaces: AutoCAD file: 11857EB1	
EL.CONTROL SYSTEM ELECTRICAL EL.BLOCK DIAGRAM			Rev. 11857EB1 0

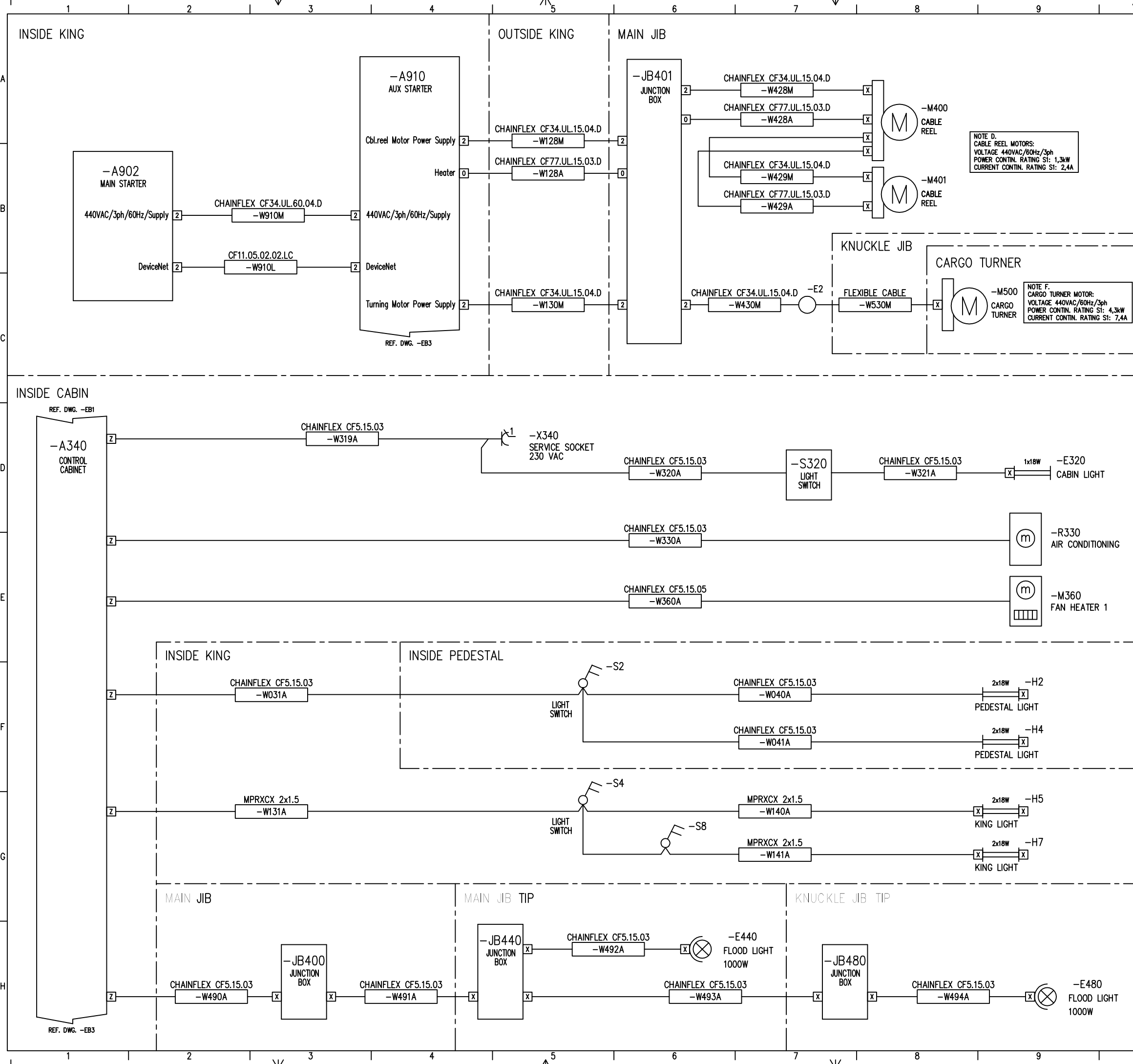
TTS MARINE AS

CUSTOMER PARTLIST

Project: 11857 ShipsEquipment-Ray Shipping
Debtor: 66236 TTS SHIPS EQUIPMENT AS
Hull Number:
Machine Number: 11857

Draw number: 11857EB1 Drawing revision: 0
Item No.: X11857EB1 ELCONTROL SYSTEM
Item group: DRAW DRAWING
CustDocNo

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
		1,00	EL. CONTROL SYSTEM	X11857DN1	11857DN1
		1,00	EL. CONTROL SYSTEM	X11857DN4	11857DN4
		1,00	EL. CONTROL SYSTEM	X11857E01	11857E01
		1,00	EL. CONTROL SYSTEM	X11857E02	11857E02
		1,00	EL. CONTROL SYSTEM	X11857E03	11857E03
		1,00	EL. CONTROL SYSTEM	X11857E04	11857E04
		1,00	EL. CONTROL SYSTEM	X11857E10	11857E10
		1,00	EL. CONTROL SYSTEM	X11857E11	11857E11
		1,00	EL. CONTROL SYSTEM	X11857E12	11857E12
		1,00	EL. CONTROL SYSTEM	X11857E13	11857E13
		1,00	EL. CONTROL SYSTEM	X11857E20	11857E20
		1,00	EL. CONTROL SYSTEM	X11857E21	11857E21
		1,00	EL. CONTROL SYSTEM	X11857E22	11857E22
		1,00	EL. CONTROL SYSTEM	X11857E23	11857E23
		1,00	EL. CONTROL SYSTEM	X11857E24	11857E24



Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	29.03.10 MMN	1	MODIFICATION 861185	10.04.12 ARB

NOTE D.
CABLE REEL MOTORS:
VOLTAGE 440VAC/60Hz/3ph
POWER CONTIN. RATING SI: 1,3kW
CURRENT CONTIN. RATING SI: 2,4A

NOTE F.
CARGO TURNER MOTOR:
VOLTAGE 440VAC/60Hz/3ph
POWER CONTIN. RATING SI: 4,3kW
CURRENT CONTIN. RATING SI: 7,4A

CABLE SUPPLY AND LAY OUT BY CUSTOMER

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	O: 690 VAC
E: Analog signals	X: Specify
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX() circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	
K: 24 VAC	X03C1
L: Special	Terminal list no.3 w.
M: 440 / 450 VAC	+24 VDC terminals

GLAND INFORMATION Ver. 27112000

Ref.	Gland type	Tread	Diam. cable min	max
A	IPON, 1234M1601	M16	4,0	8,0
B	IPON, 1234M2001	M20	6,0	12,0
C	IPON, 1234M2501	M25	12,0	18,0
D	IPON, 1234M3201	M32	17,0	25,0
X	PART OFF COMP.	-	-	-
Y	REF. NOTE	-	-	-
Z	ROX CABLE TRANSIT	-	-	-

GLAND INFORMATION: 18.12.2008

Ref.	TTS Item no.	Tread	Diam. cable min	max	Ref.	TTS Item no.	Tread	Diam. cable min	max
0	501705	M162K	3,0	8,0	12				
1	501706	M200s	3,0	8,0	13				
2	501707	M200	7,5	11,9	14				
3	501708	M20A	11,0	14,3	15				
4	501710	M25B	13,0	20,2	16				
5	501712	M32C	19,0	26,5	17				
6	501714	M40C2	25,0	32,5	18				
7	501716	M50D	31,5	44,4	19				
8	501718	M63E	42,5	56,3	X	PART OF COMPONENT			
9	501720	M75F	54,5	68,2	Y	REF. NOTE			
10					Z	ROX CABLE TRANSIT			
11									

CUSTOMER: Ray Shipping
HULL NO.:
MACHINE NO.: 11857

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Designed 17.11.09	Approved 29.03.10 MMN	Projection Scale 1:1	Format A1	
Drawn 17.11.09 MMN				

Replaces: Replaced by:
AutoCAD file: 11857EB2
11857EB2
Rev. 1

EL.CONTROL SYSTEM
ELECTRICAL
EL.BLOCK DIAGRAM

TTS MARINE AS

CUSTOMER PARTLIST

Project: 11857 ShipsEquipment-Ray Shipping
Debtor: 66236 TTS SHIPS EQUIPMENT AS
Hull Number:
Machine Number: 11857

Draw number: 11857EB2 Drawing revision: 0
Item No.: X11857EB2 ELCONTROL SYSTEM
Item group: DRAW DRAWING
CustDocNo

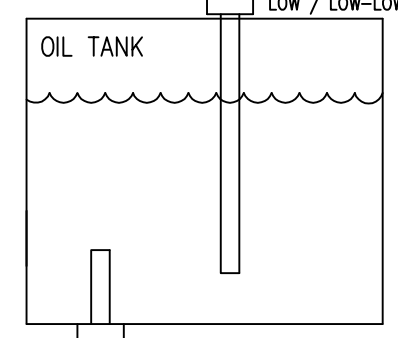
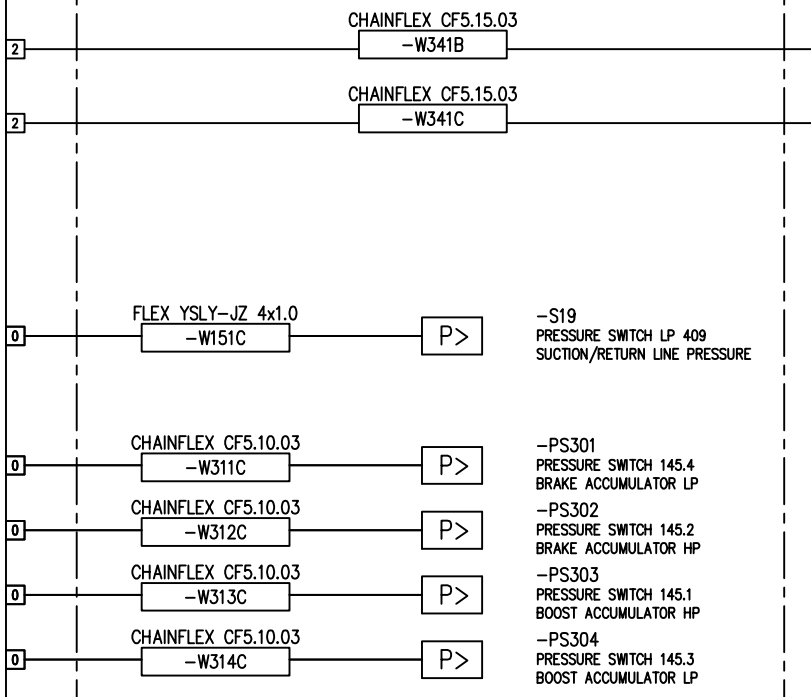
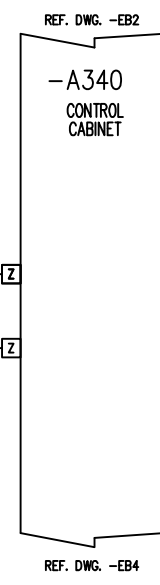
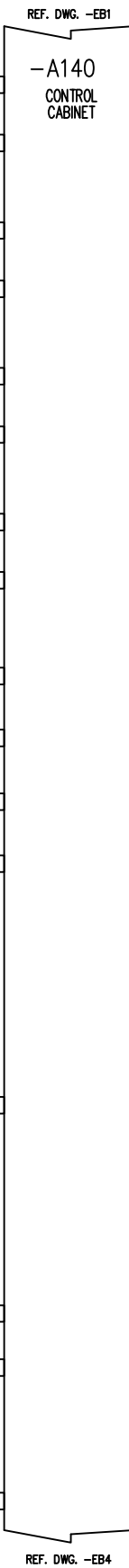
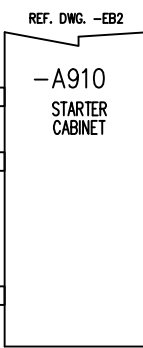
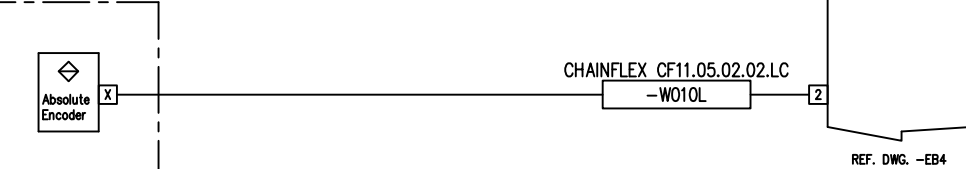
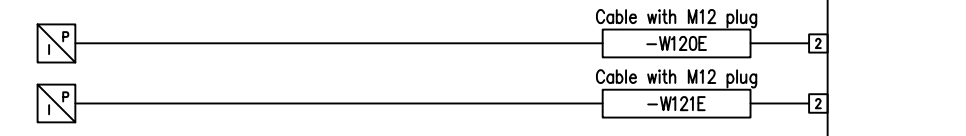
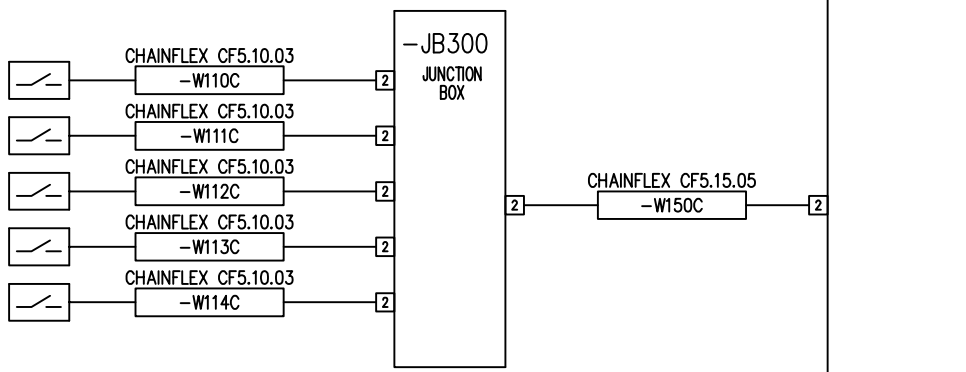
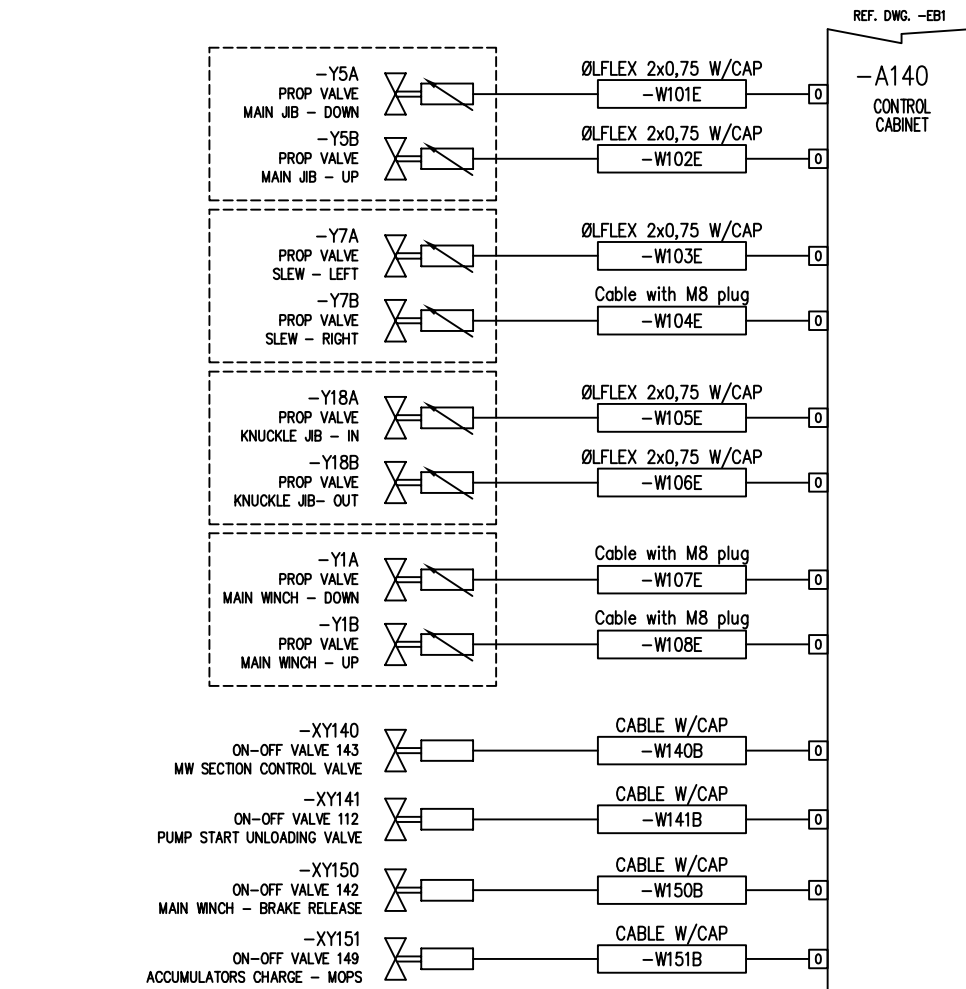
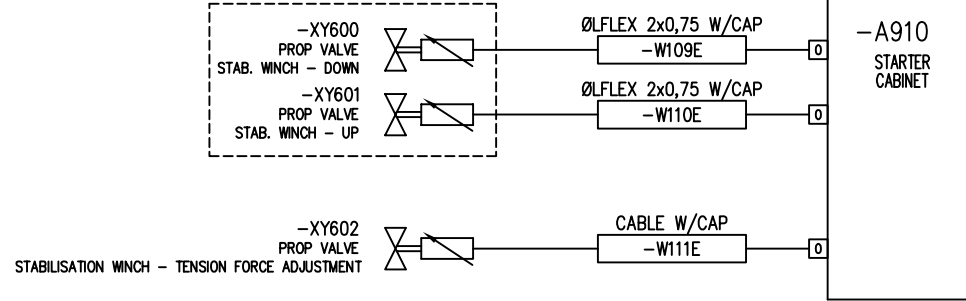
Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-E440	1,00	FLOODLIGHT 230V/60Hz	103061	
	-E440.1	1,00	BRACKET, LIGHT, JIB HINGED	XMBALJA01	MBALJA01
	-E480	1,00	FLOODLIGHT 230V/60Hz	103061	
	-E480.1	1,00	BRACKET, LIGHT, JIB HINGED	XMBALJA01	MBALJA01

INSIDE KING

OUTSIDE KING

INSIDE CABIN

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		
1	CAB. -W150C UPD.	16.04.10	MMN		
2	MODIFICATION 861185	10.04.12	ARB		



----- CABLE SUPPLY AND LAY OUT BY CUSTOMER

(-En) CABLE TRANSITS WITH REFERENCES TO MECH. DRAWING

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/1999

WnnY	XnY[n]	n=0: 0V potential	n=1: +V potential
A: 220 / 230 VAC			
B: 24 VDC unregulated			
C: 24 VDC regulated			
D: 12 VDC			
E: Analog signals			
F: mixed, low voltage			
G: 380 / 400 VAC			
H: 220 / 230 VDC			
I: EXX() circuits			
J: 110 VAC			
K: 24 VAC			
L: Special			
M: 440 / 450 VAC			

EXAMPLES:
W14C Cable no.14 w.380 VAC
X03C1 Terminal list no.3 w. +24 VDC terminals

GLAND INFORMATION Ver. 27120000

Ref.	Gland type	Tread	Diam. cable min	max
A	IPON, 1234M1601	M16	4,0	8,0
B	IPON, 1234M2001	M20	6,0	12,0
C	IPON, 1234M2501	M25	12,0	18,0
D	IPON, 1234M3201	M32	17,0	25,0
X	PART OFF COMP.			
Y	REF. NOTE			
Z	ROX CABLE TRANSIT			

GLAND INFORMATION: 18.12.2006

Ref.	TTS Item no.	Tread	Diam. cable min	max	Ref.	TTS Item no.	Tread	Diam. cable min	max
0	501705	M162K	3,0	8,0	12				
1	501706	M200s	3,0	8,0	13				
2	501707	M200	7,5	11,9	14				
3	501708	M20A	11,0	14,3	15				
4	501710	M25B	13,0	20,2	16				
5	501712	M32C	19,0	26,5	17				
6	501714	M40C2	25,0	32,5	18				
7	501716	M50D	31,5	44,4	19				
8	501718	M63E	42,5	56,3	X	PART OF COMPONENT			
9	501720	M75F	54,5	68,2	Y	REF. NOTE			
10					Z	ROX CABLE TRANSIT			
11									

CUSTOMER: Ray Shipping
HULL NO.:
MACHINE NO.: 11857

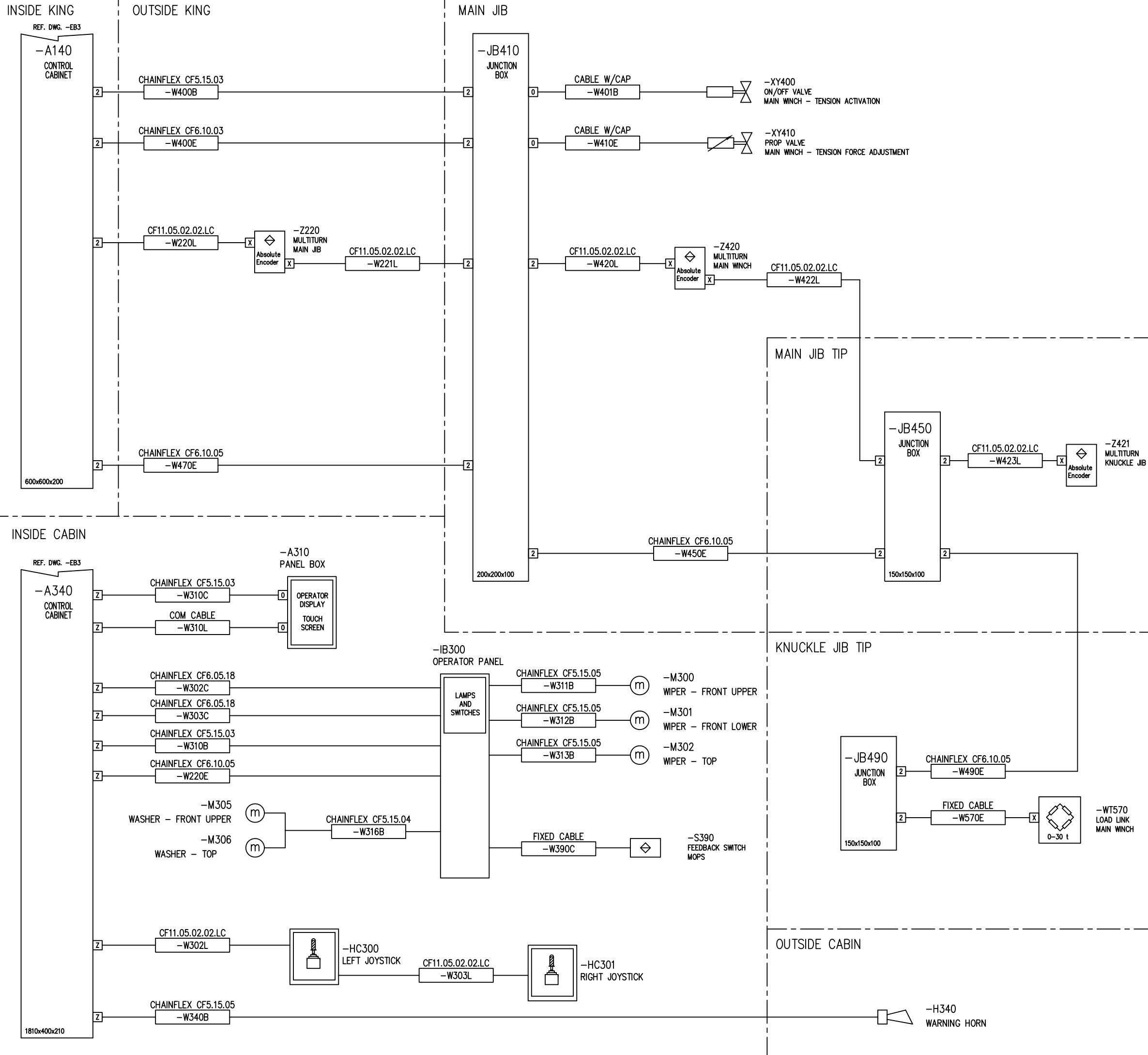
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Designed 18.11.09	Approved 30.03.10 MMN	Projection Scale 1:1	
Drawn 18.11.09 MMN	Format A1	Replaces: Replaced by:	

EL.CONTROL SYSTEM INSTRUMENT EL.BLOCK DIAGRAM

AutoCAD file: 11857EB3
11857EB3

Rev. 2



Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	15.02.10	MMN		

----- CABLE SUPPLY AND LAY OUT BY CUSTOMER

(-En) CABLE TRANSITS WITH REFERENCES TO MECH. DRAWING

VENDORS CABLE / TERMINAL-LIST CODING Ver.1/1999

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	O: 690 VAC
E: Analog signals	X: Specify
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

GLAND INFORMATION Ver. 2712000

Ref.	Gland type	Tread	Diam. cable min	Diam. cable max
A	IPON, 1234M1601	M16	4,0	8,0
B	IPON, 1234M2001	M20	6,0	12,0
C	IPON, 1234M2501	M25	12,0	18,0
D	IPON, 1234M3201	M32	17,0	25,0
X	PART OFF COMP.	-	-	-
Y	REF. NOTE	-	-	-
Z	ROX CABLE TRANSIT	-	-	-

GLAND INFORMATION: 18.12.2006

Ref.	TTS Item no.	Tread	Diam. cable min	Diam. cable max	Ref.	TTS Item no.	Tread	Diam. cable min	Diam. cable max
0	501705	M162K	3,0	8,0	12				
1	501706	M200s	3,0	8,0	13				
2	501707	M200	7,5	11,9	14				
3	501708	M20A	11,0	14,3	15				
4	501710	M25B	13,0	20,2	16				
5	501712	M32C	19,0	26,5	17				
6	501714	M40C2	25,0	32,5	18				
7	501716	M50D	31,5	44,4	19				
8	501718	M63E	42,5	56,3	X				PART OF COMPONENT
9	501720	M75F	54,5	68,2	Y				REF. NOTE
10					Z				ROX CABLE TRANSIT
11									

CUSTOMER: Ray Shipping
HULL NO.:
MACHINE NO.: 11857

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Designed 18.11.09	Approved 15.02.10 MMN	Projection Scale 1:1	
Drawn 18.11.09 MMN	Format A1	Replaces:	
EL. CONTROL SYSTEM INSTRUMENT			AutoCAD file: 11857EB4
EL. BLOCK DIAGRAM			11857EB4
			Rev. 0

TTS MARINE AS

CUSTOMER PARTLIST

Project: 11857 ShipsEquipment-Ray Shipping
 Debtor: 66236 TTS SHIPS EQUIPMENT AS
 Hull Number:
 Machine Number: 11857

Draw number: 11857EB4 Drawing revision: 1
 Item No.: X11857EB4 EL CONTROL SYSTEM
 Item group: DRAW DRAWING
 CustDocNo

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-A310	1,00	BOX FOR OPERATOR TERMINAL 8"	503678	
	-A310.1	1,00	FLAT SCREEN SWING ARM VESA	502547	
	-A310.10	2,00	CABLE GLAND BRASS M16	501705	
	-A310.11	2,00	BACKNUT BRASS M16	500144	
	-A310.12	2,00	TEFLON WASHER M16	12730	
	-A310.2	2,00	U-PIPE CLAMP, AISI 316	118067	
	-H340	1,00	ALARM HORN 10-50Vdc 119dB IP56	114169	
	-HC300	1,00	JOYSTICK 2 AXES CANOPEN	503536	
	-HC301	1,00	JOYSTICK 2 AXES CANOPEN	503536	
	-IB300	1,00	CONTROL PANEL	REF	Cabin Partlist
	-M300	1,00	WIPER MOTOR	REF	Cabin Partlist
	-M301	1,00	WIPER MOTOR	REF	Cabin Partlist
	-M302	1,00	WIPER MOTOR	REF	Cabin Partlist
	-M305	1,00	WASHER MOTOR	REF	Cabin Partlist
	-M306	1,00	WASHER MOTOR	REF	Cabin Partlist

TTS MARINE AS

CUSTOMER PARTLIST

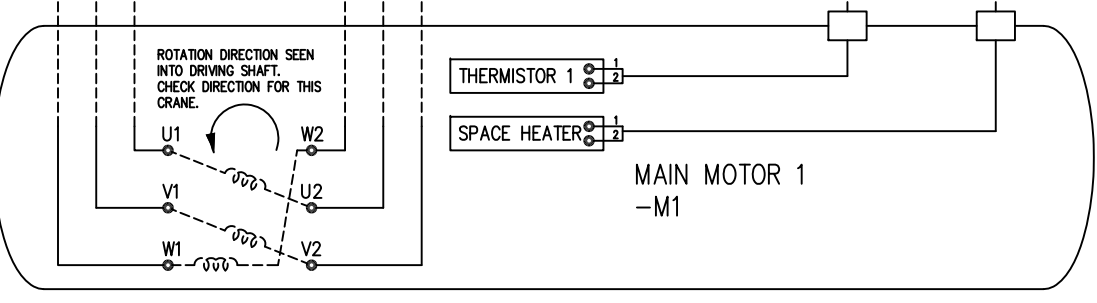
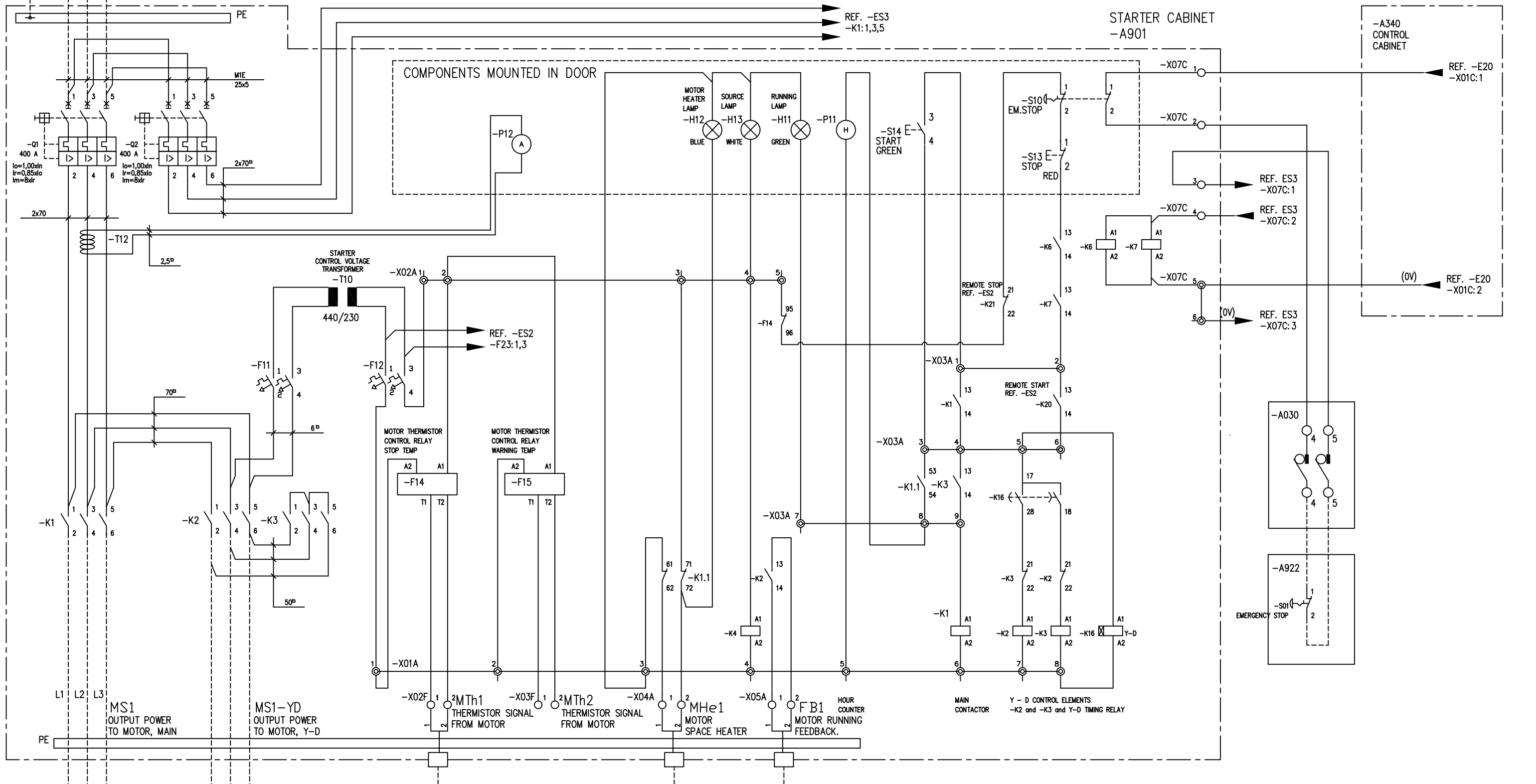
Draw number	11857EB4	Drawing revision	1
Item No.	X11857EB4	EL CONTROL SYSTEM	
Item group	DRAW	DRAWING	
CustDocNo			

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-W319B	7,00	03x1,5mm2 FLEXIBLE CABEL	57255	Cabin Partlist
	-W340B	10,00	05x1,5mm2 300/500V Green FLEX	57245	
	-W390C	1,00	CABLE, PART OF -S390	REF	2362H01
	-W400E	15,00	03x1mm2 300/500V Green FLEXIB	57991	
	-W401E	1,00	VALVE CAP f/PROP VALVEw/5m pur	58471	
	-W420L	5,00	2x2x0.5mm2 BUS CABLE CANbus	502589	
	-W422L	30,00	2x2x0.5mm2 BUS CABLE CANbus	502589	
	-W423L	5,00	2x2x0.5mm2 BUS CABLE CANbus	502589	
	-W470E	20,00	05x1mm2 300/500V Green FLEXIB	57284	
	-W471E	30,00	05x1mm2 300/500V Green FLEXIB	57284	
	-W472E	20,00	05x1mm2 300/500V Green FLEXIB	57284	
	-W473E	1,00	CABLE, PART OF -WT470	REF	
	-WT470	1,00	LOADBOLT 45 T	500639	
	-XY400	1,00	PROPORTIONAL VALVE	REF	21362H01
	-Z220	1,00	ABSOLUTE ROTARY ENCODER DEVICE	500646	
	-Z420	1,00	ABSOLUTE ROTARY ENCODER DEVICE	500646	
	-Z421	1,00	ABSOLUTE ROTARY ENCODER DEVICE	500646	

L3
L2
L1
PE

CRANE INPUT POWER
SUPPLY
440VAC / 60Hz / 3phz.
IP1

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	24.02.10 MMN			
1	MTH2 UPDATE	16.04.10 MMN			



REF. DWG.:
-C01

STARTER CIRCUIT DETAILS
Ref. Drawing: EYM42ES1
Changes from Ref.Drawing:
1. F15 thermistor relay
2. Ref. -ES2 drawing
3. Remote start and stop relay
4. Q2 Circuit Breaker
5. -
Ver:06022002/Jb

VENDORS CABLE / TERMINAL-LIST CODING: Ver.2/2001

WnnY	XnY[n]
A: 220 - 240 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	
E: Analog signals	
F: mixed, low voltage	
G: 380 / 415 VAC	
H: 220 / 230 VDC	
I: EEX(i) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
W14G
Cable no.14 w.380 VAC
X03C1
Terminal list no.3 w.
+24 VDC terminals

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Designed 02.12.09	Approved 24.02.10 MMN	Projection Scale 1:1
Drawn 02.12.09 MMN	Format A1	

EL. CONTROL SYSTEM
-A901 MAIN STARTER 1
EL. CIRCUIT DIAGRAM

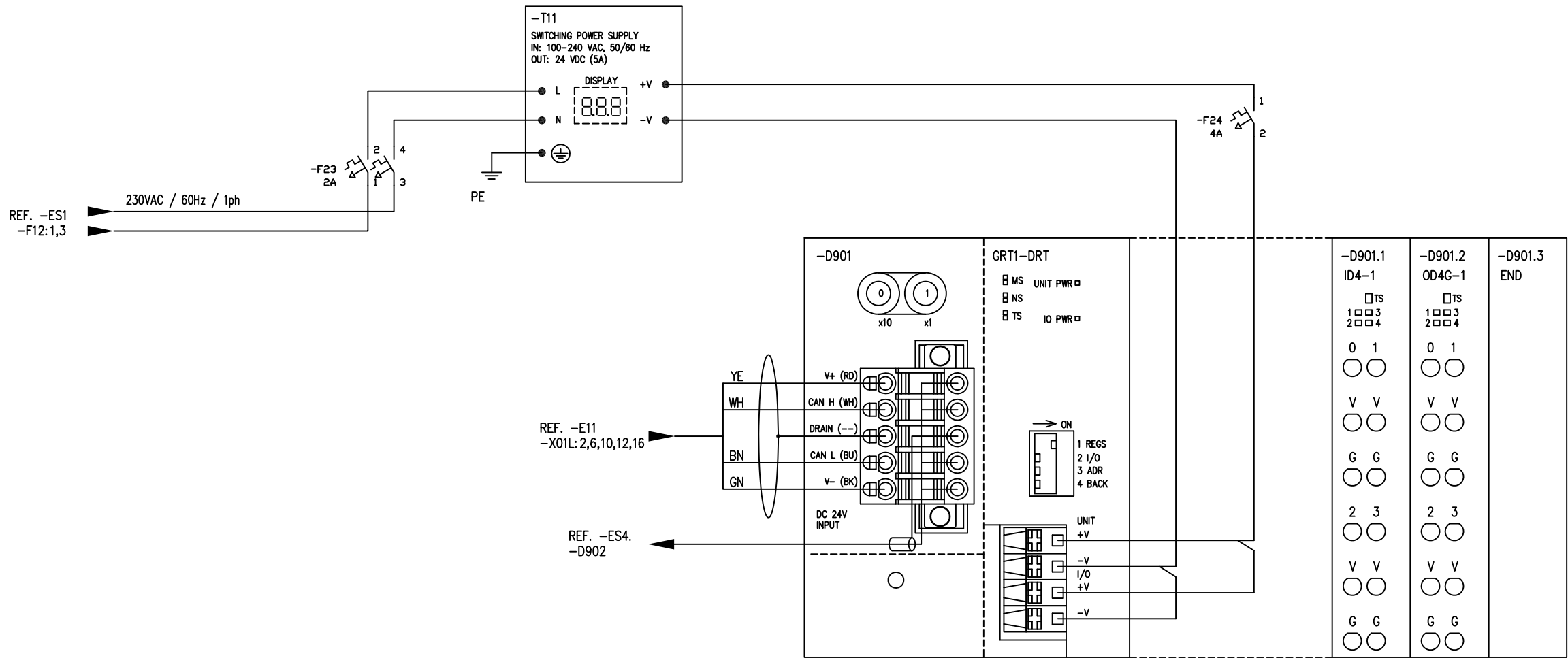
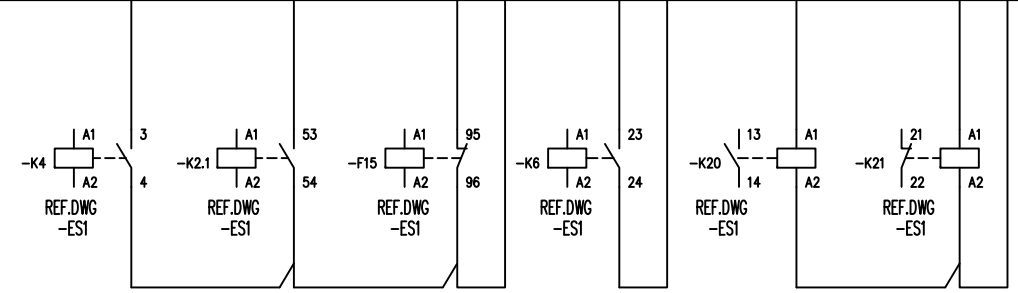
Replaces: Replaced by:
AutoCAD file: 11857ES1
11857ES1

For motor data and component types ref. Project documents.

--- CABLE SUPPLIED AND LAYOUT BY CUSTOMER

-A901
STARTER
CABINET

DESCRIPTION	MOTOR STARTER -A901 SOURCE	MAIN MOTOR 1 -M1 RUNNING	MAIN MOTOR 1 -M1 HIGH TEMP	EMERGENCY STOP ACTIVATION FEEDBACK	MAIN MOTOR 1 -M1 START	MAIN MOTOR 1 -M1 STOP	SPARE	SPARE
CONTROLLER	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE
I/O CARD	-D901.1 / DI	-D901.1 / DI	-D901.1 / DI	-D901.1 / DI	-D901.2 / DO	-D901.2 / DO	-D901.2 / DO	-D901.2 / DO
SIGN./ADD.	3221.00	3221.01	3221.02	3221.03	3520.00	3520.01	3520.02	3520.03
TERM.SIGN.								
TERMINAL	0 V	1 V	2 V	3 V	0 G	1 G	2 G	3 G



VENDORS CABLE / TERMINAL-LIST CODING: Ver.2/2001

WnnY	XnY[n]
A: 220 - 240 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 415 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 /450 VAC	

For motor data and component types ref. Project documents.

CABLE SUPPLIED AND LAYOUT BY CUSTOMER

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Designed 02.12.09	Approved 24.02.10 MMN	Projection 1:1	Scale A1
Drawn 02.12.09 MMN			

Replaces: Replaced by:

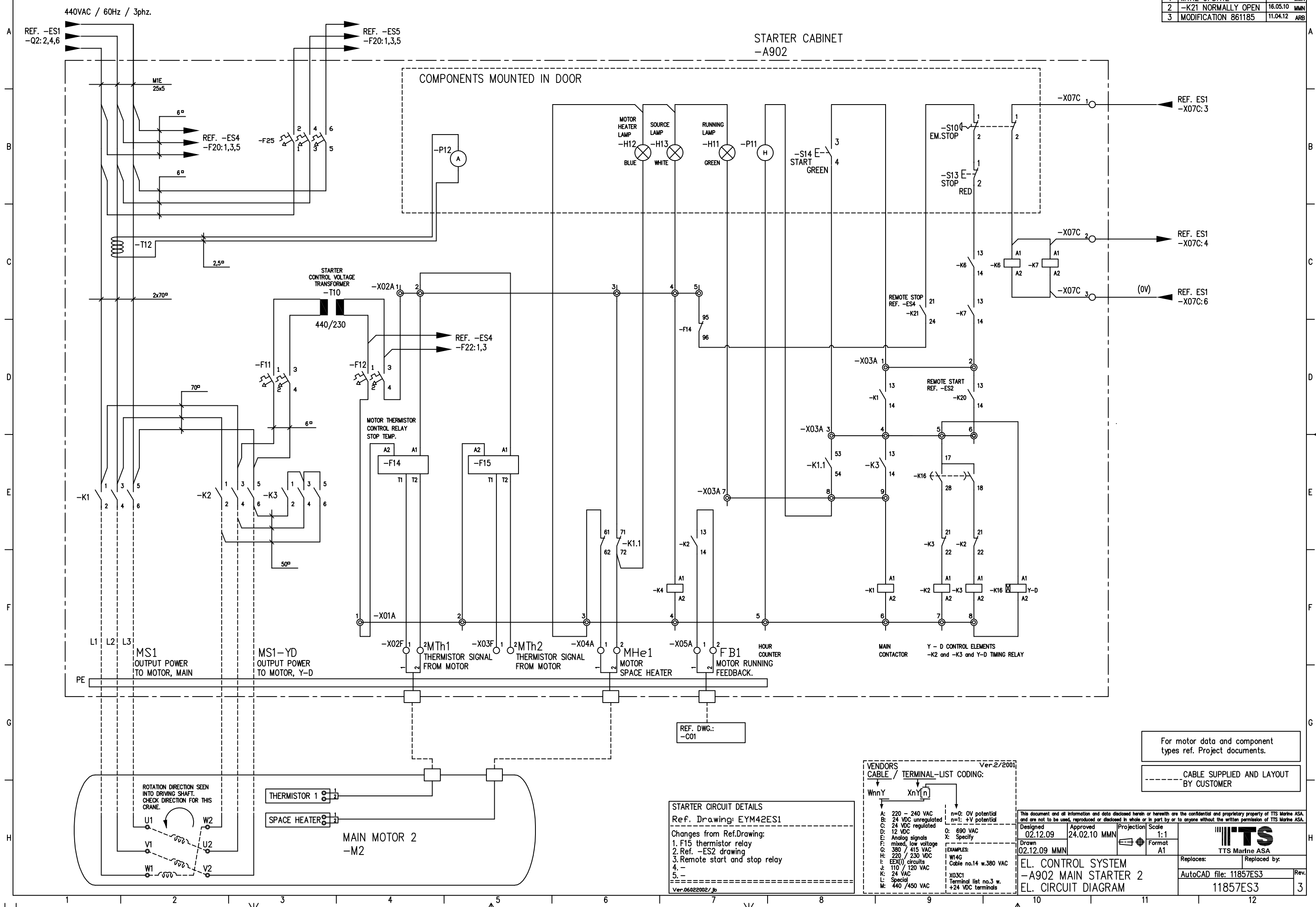
AutoCAD file: 11857ES2

11857ES2

Rev. 0

EL. CONTROL SYSTEM
-A901 MAIN STARTER 1
EL. CIRCUIT DIAGRAM

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	24.02.10	MMN		
1	MTH2 UPDATE	16.04.10	MMN		
2	-K21 NORMALLY OPEN	16.05.10	MMN		
3	MODIFICATION 861185	11.04.12	ARB		



STARTER CIRCUIT DETAILS
 Ref. Drawing: EYM42ES1
 Changes from Ref. Drawing:
 1. F15 thermistor relay
 2. Ref. -ES2 drawing
 3. Remote start and stop relay
 4. -
 5. -
 Ver:06022002/30

VENDORS CABLE / TERMINAL-LIST CODING: Ver:2/2001

WnnY	XnnY[n]
A: 220 - 240 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	
E: Analog signals	O: 690 VAC
F: mixed, low voltage	X: Specify
G: 380 / 415 VAC	
H: 220 / 230 VDC	
I: EX(X) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
 W14G
 Cable no.14 w.380 VAC
 X03C1
 Terminal list no.3 w. +24 VDC terminals

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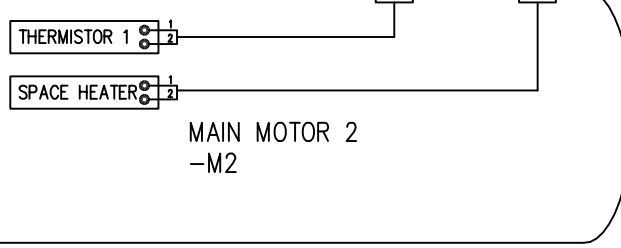
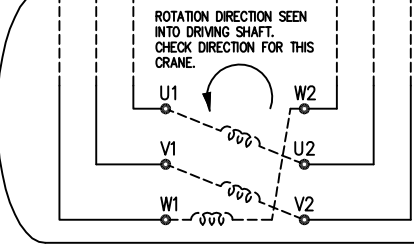
Designed 02.12.09	Approved 24.02.10 MMN	Projection 1:1	Scale A1
Drawn 02.12.09 MMN			

EL. CONTROL SYSTEM
-A902 MAIN STARTER 2
EL. CIRCUIT DIAGRAM

Replaces: Replaced by:
 AutoCAD file: 11857ES3
 11857ES3
 Rev. 3

For motor data and component types ref. Project documents.

CABLE SUPPLIED AND LAYOUT BY CUSTOMER

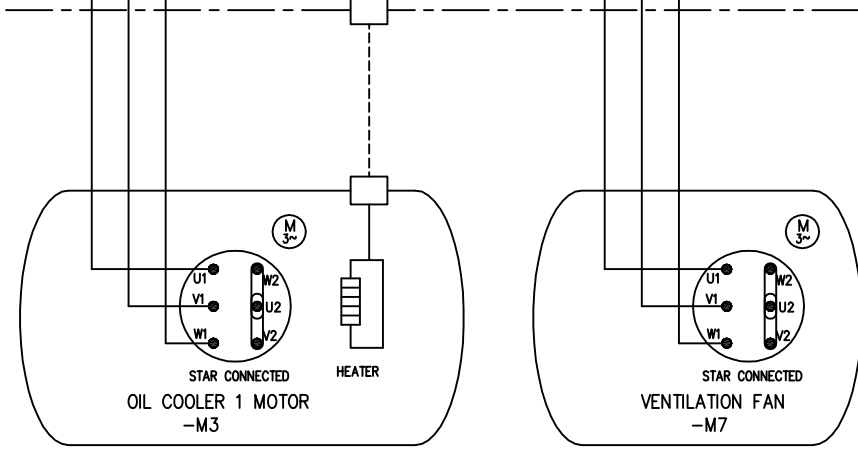
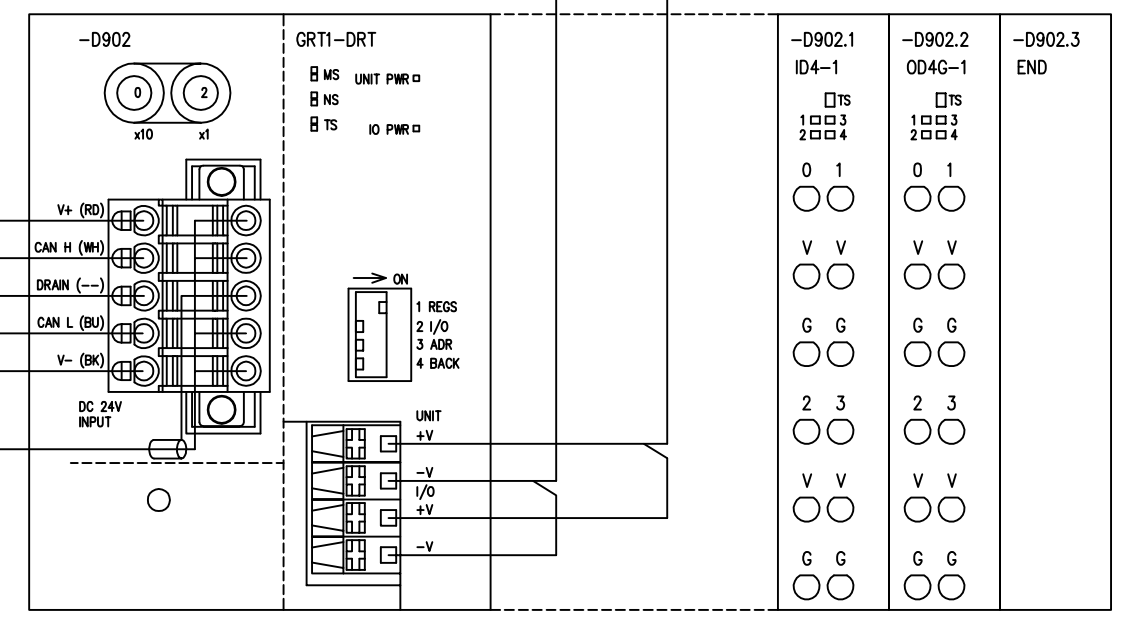
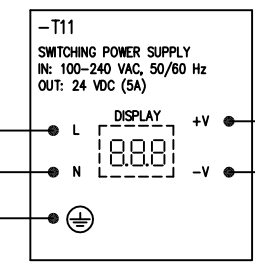
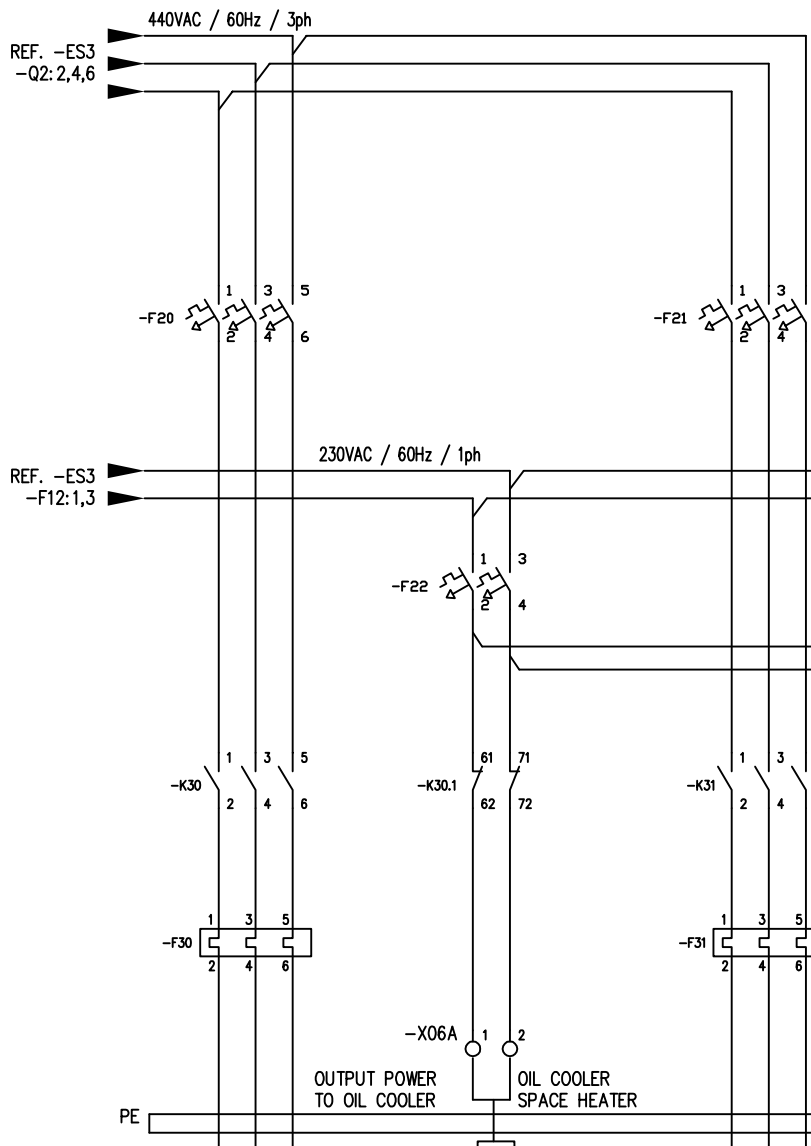
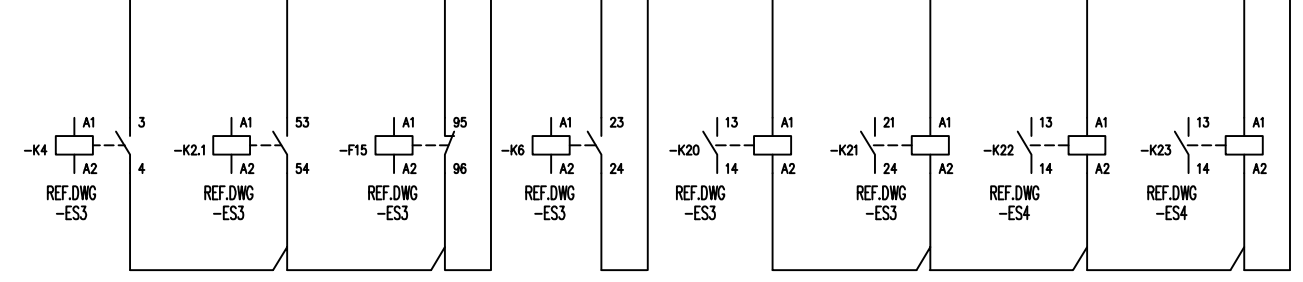


MAIN MOTOR 2
 -M2

-A902 STARTER CABINET

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	24.02.10	MMN		
1	-K21 NORMALLY OPEN	16.05.10	MMN		
2	MODIFICATION 861185	11.04.12	ARB		

DESCRIPTION	MOTOR STARTER -A902 SOURCE	MAIN MOTOR 2 -M2 RUNNING	SPARE	EMERGENCY STOP ACTIVATION FEEDBACK	MAIN MOTOR 2 -M2 START	MAIN MOTOR 2 -M2 STOP	OIL COOLER 1 -M3 START	VENTILATION FAN START
CONTROLLER	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE
I/O CARD	-D902.1 / DI	-D902.1 / DI	-D902.1 / DI	-D902.1 / DI	-D902.2 / DO	-D902.2 / DO	-D902.2 / DO	-D902.2 / DO
SIGN./ADD.	3231.00	3231.01	3231.02	3231.03	3530.00	3530.01	3530.02	3530.03
TERM.SIGN.								
TERMINAL	0 V	1 V	2 V	3 V	0 G	1 G	2 G	3 G



VENDORS CABLE / TERMINAL-LIST CODING: Ver.2/2001

WnnY XnY[n]

n=0: 0V potential
n=1: +V potential

A: 220 - 240 VAC
B: 24 VDC unregulated
C: 24 VDC regulated
D: 12 VDC
E: Analog signals
F: mixed, low voltage
G: 380 / 415 VAC
H: 220 / 230 VDC
I: EX(X) circuits
J: 110 / 120 VAC
K: 24 VAC
L: Special
M: 440 / 450 VAC

EXAMPLES:
W14G
Cable no.14 w.380 VAC
X03C1
Terminal list no.3 w. +24 VDC terminas

For motor data and component types ref. Project documents.

CABLE SUPPLIED AND LAYOUT BY CUSTOMER

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Designed 02.12.09	Approved 24.02.10 MMN	Projection 1:1	Scale A1
Drawn 02.12.09 MMN			

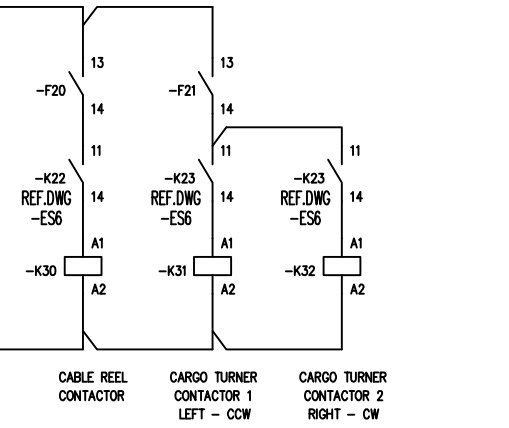
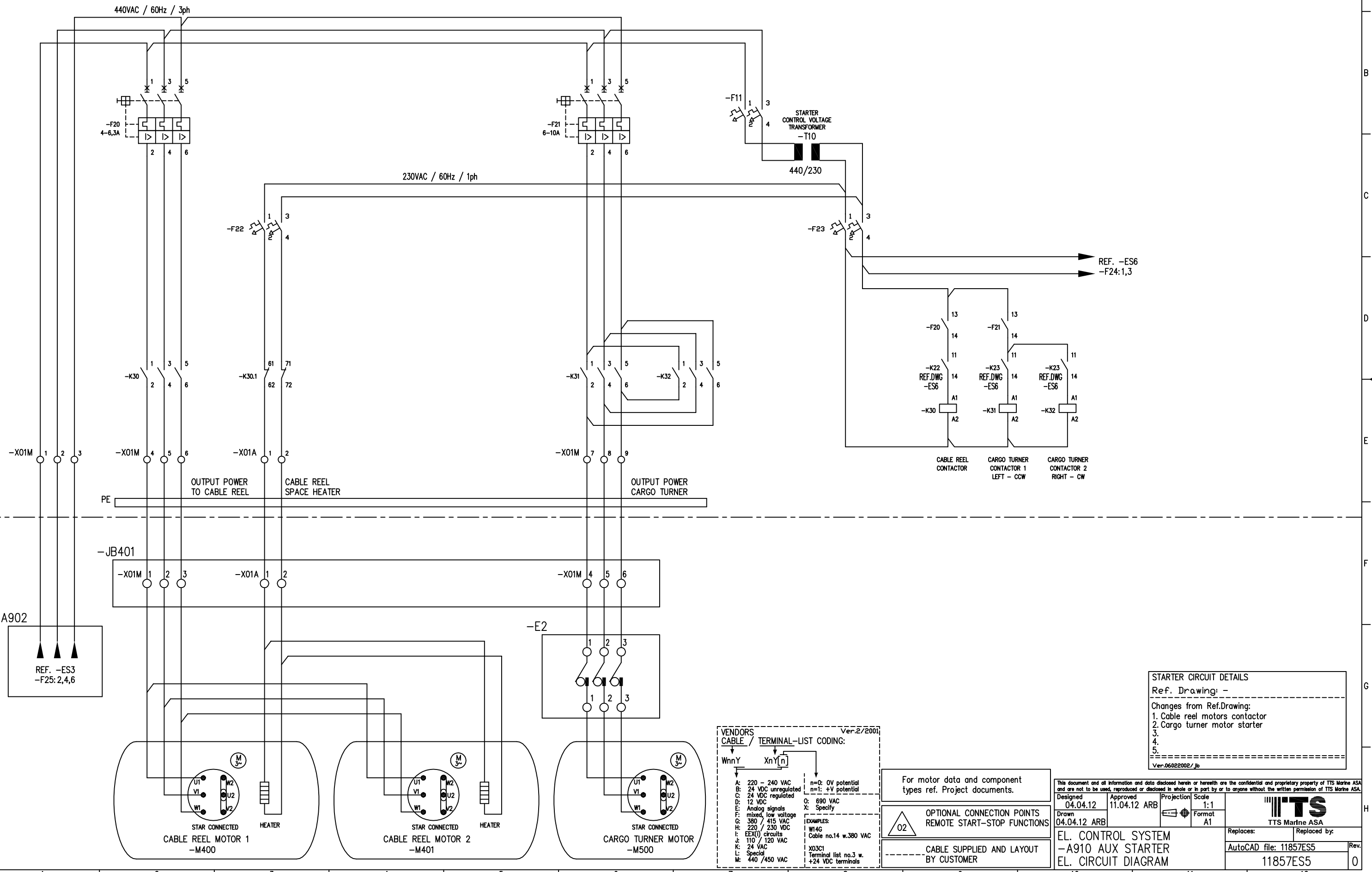
EL. CONTROL SYSTEM
-A902 MAIN STARTER 2
EL. CIRCUIT DIAGRAM

Replaces: 11857ES4
Replaced by: 11857ES4

AutoCAD file: 11857ES4

Rev. 2

-A910
STARTER
CABINET



STARTER CIRCUIT DETAILS
 Ref. Drawing: -
 Changes from Ref.Drawing:
 1. Cable reel motors contactor
 2. Cargo turner motor starter
 3.
 4.
 5.
 Ver:06022002/jb

VENDORS CABLE / TERMINAL-LIST CODING: Ver:2/2001

WnnY	XnY[n]
A: 220 - 240 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	
E: Analog signals	
F: mixed, low voltage	
G: 380 / 415 VAC	
H: 220 / 230 VDC	
I: EX(X) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
 W14G Cable no.14 w.380 VAC
 X03C1 Terminal list no.3 w. +24 VDC terminals

For motor data and component types ref. Project documents.

OPTIONAL CONNECTION POINTS
 REMOTE START-STOP FUNCTIONS

CABLE SUPPLIED AND LAYOUT
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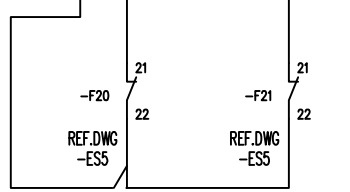
Designed 04.04.12	Approved 11.04.12 ARB	Projection 1:1	Scale Format A1
Drawn 04.04.12 ARB			

EL. CONTROL SYSTEM
 -A910 AUX STARTER
 EL. CIRCUIT DIAGRAM

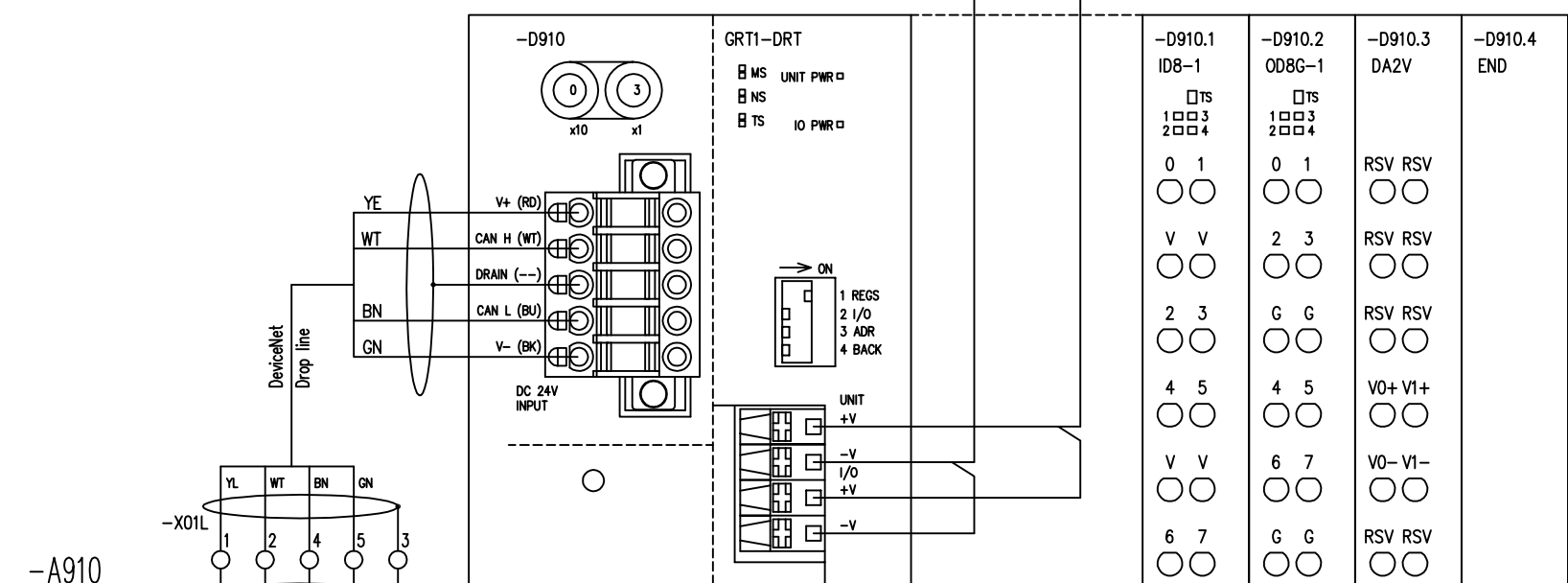
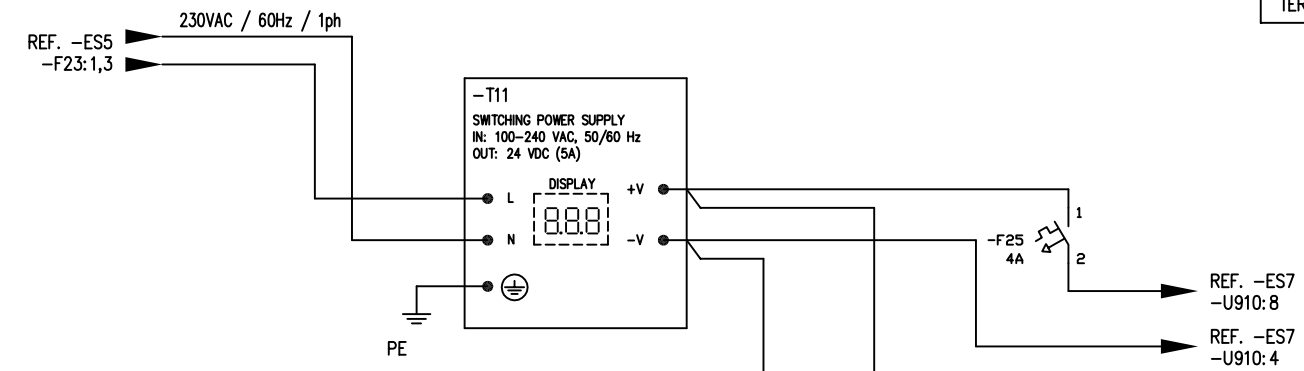
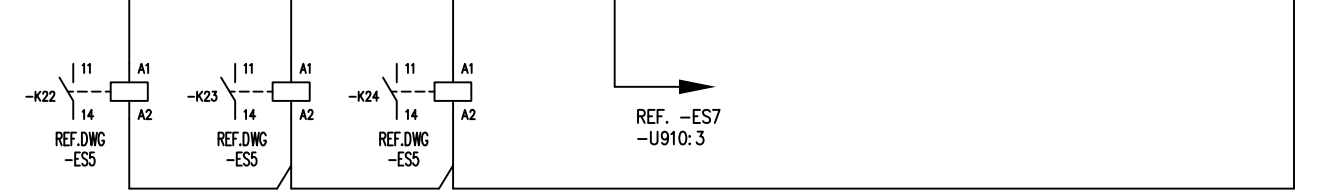
Replaces: 11857ES5
 Replaced by: 11857ES5

AutoCAD file: 11857ES5
 Rev: 0

DESCRIPTION	CABLE REEL MOTOR TRIP/OVERLOAD	CARGO TURNER MOTOR TRIP/OVERLOAD	SPARE	SPARE	SPARE	SPARE	SPARE	SPARE
CONTROLLER	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE
I/O CARD	-D910.1 / DI	-D910.1 / DI	-D910.1 / DI	-D910.1 / DI	-D910.1 / DI	-D910.1 / DI	-D910.1 / DI	-D910.1 / DI
SIGN./ADD.	3321.00	3321.01	3321.02	3321.03	3321.04	3321.05	3321.06	3321.07
TERM.SIGN.	V 0	V 1	2	3	4	5	V 6	V 7
TERMINAL	A2 A1	B2 B1	A3	B3	A4	B4	A5 A6	B5 B6



DESCRIPTION	CABLE REEL MOTORS START/STOP	CARGO TURNER MOTOR LEFT START/STOP	CARGO TURNER MOTOR RIGHT START/STOP	PROP. VALVES ENABLE	SPARE	SPARE	SPARE	SPARE
CONTROLLER	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE
I/O CARD	-D910.2 / DO	-D910.2 / DO	-D910.2 / DO	-D910.2 / DO	-D910.2 / DO	-D910.2 / DO	-D910.2 / DO	-D910.2 / DO
SIGN./ADD.	3540.00	3540.01	3540.02	3540.03	3540.04	3540.05	3540.06	3540.07
TERM.SIGN.	0	1	2	3	4 G	5 G	6 G	7 G
TERMINAL	A1	B1	A2	B2	A4 A3	B4 B3	A5 A6	B5 B6



-A910 STARTER CABINET

REF. DWG.:
-ES4/-C03
-D902

VENDORS CABLE / TERMINAL-LIST CODING: Ver.2/2001

WnnY	XnY[n]
A: 220 - 240 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	
E: Analog signals	
F: mixed, low voltage	
G: 380 / 415 VAC	
H: 220 / 230 VDC	
I: EEX(D) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
W14G Cable no.14 w.380 VAC
X03C1 Terminal list no.3 w. +24 VDC terminations

For motor data and component types ref. Project documents.

CABLE SUPPLIED AND LAYOUT BY CUSTOMER

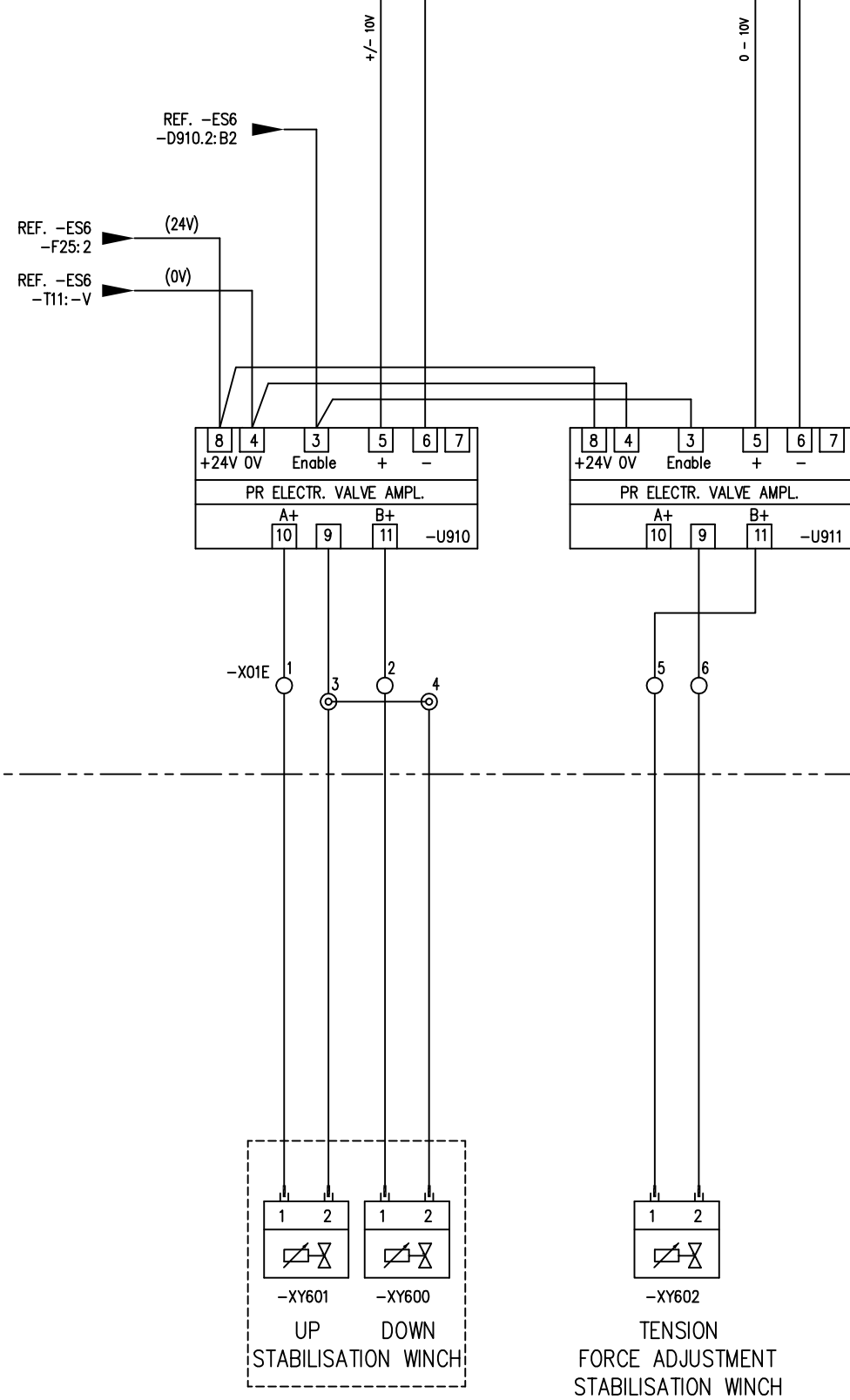
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Designed 04.04.12	Approved 11.04.12 ARB	Projection 1:1	Scale A1
Drawn 04.04.12 ARB			
Replaces: Replaced by:			
EL. CONTROL SYSTEM -A910 AUX STARTER EL. CIRCUIT DIAGRAM			Rev. 0

AutoCAD file: 11857ES6
11857ES6

DESCRIPTION	PROP. VALVE STABILISATION WINCH	PROP. VALVE STABILISAT. WINCH TENSION FORCE
CONTROLLER	SMART SLICE	SMART SLICE
I/O CARD	-D910.3	-D910.3
SIGN./ADD.	CIO 3541	CIO 3542
TERM.SIGN.	v0+ v0-	vi+ vi-
TERMINAL	A4 A5	B4 B5

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	MODIFICATION 861185	10.04.12 ARB			



-A910
STARTER
CABINET

ITEM -U910							ITEM -U911							
UAL	CUA	CUB	RAN	PAR	PRO		UAL	CUA	CUB	RAN	PAR	PRO		
PAS: 030	LOA: 41.7	LOB: 41.7	ON: 000	REU: 000	PF: 0.15		PAS: 030	LOA: 22.0	LOB: 22.0	ON: 000	REU: 000	PF: 0.15		
1A1: 99.9	1B1: 99.0	UP: 0.00	DOD: 01.0	IF: 0.50		1A1: 99.9	1B1: 99.0	UP: 0.00	DOD: 01.0	IF: 0.50				
1A2: 99.9	1B2: 99.0	DO: 0.00	FRQ: 100			1A2: 99.9	1B2: 99.0	DO: 0.00	FRQ: 130					
			GA: 0.72							GA: 0.68				
DP1-ON: 1,2,6,8	DP1-OFF: 3,4,5,7						DP1-ON: 6	DP1-OFF: 1,2,3,4,5,7,8						
JUMPER-JP1: 2-3							JUMPER-JP1: 2-3							

VENDORS CABLE / TERMINAL-LIST CODING:	Ver. I/2000
WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	0: 680 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VAC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w. +24 VDC terminals
L: Special	
M: 440 / 450 VAC	

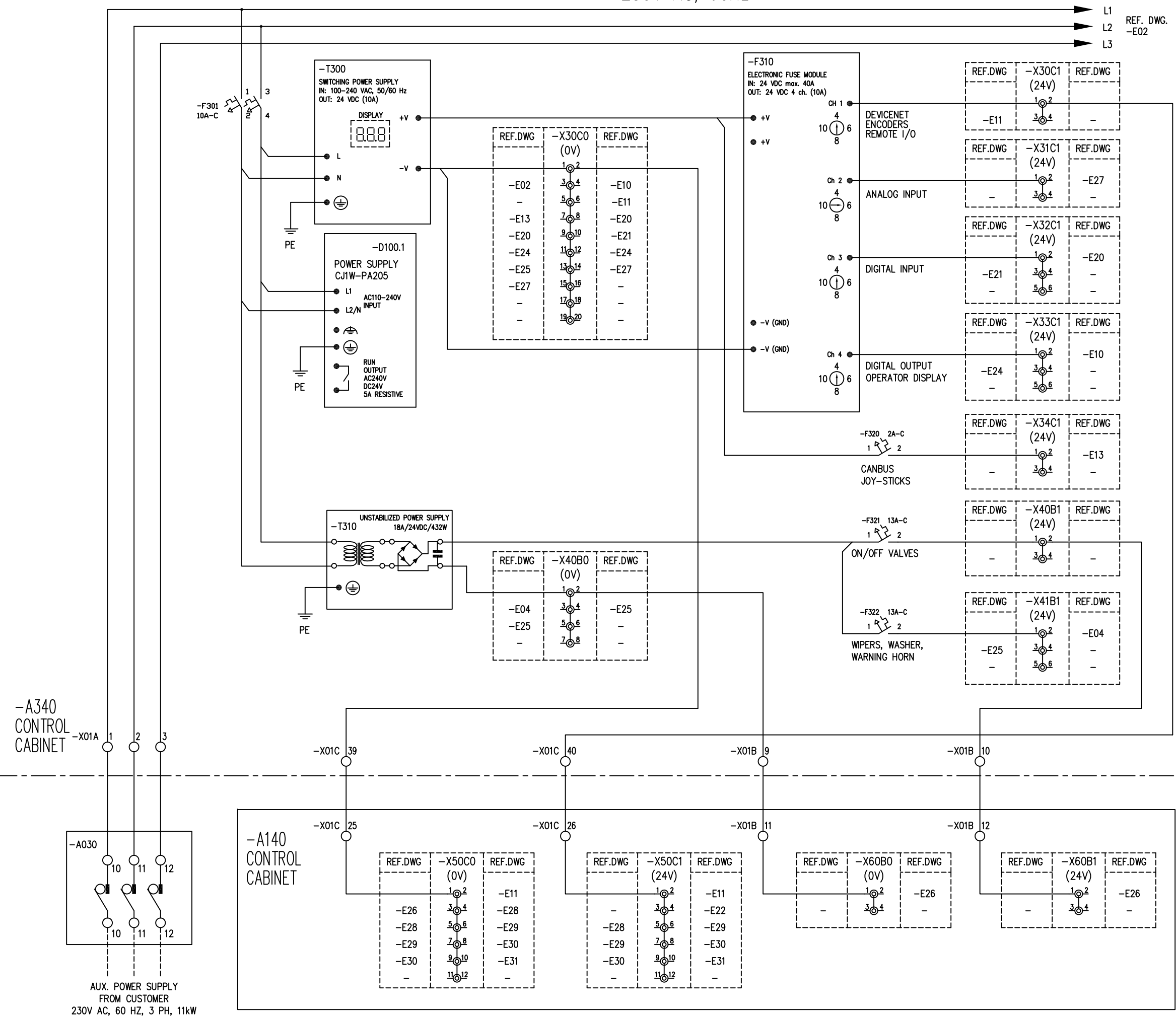
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Designed 04.04.12	Approved 10.04.12 ARB	Projection 1:1	Scale A1	
Drawn 04.04.12 ARB				
EL. CONTROL SYSTEM -A910 AUX STARTER EL. CIRCUIT DIAGRAM				Replaces: AutoCAD file: 11857ES7 11857ES7
				Replaced by: Rev. 0

REF.DWG : -C10

230V AC, 60Hz

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		
1	GENERAL UPD.	30.04.10	MMN		



VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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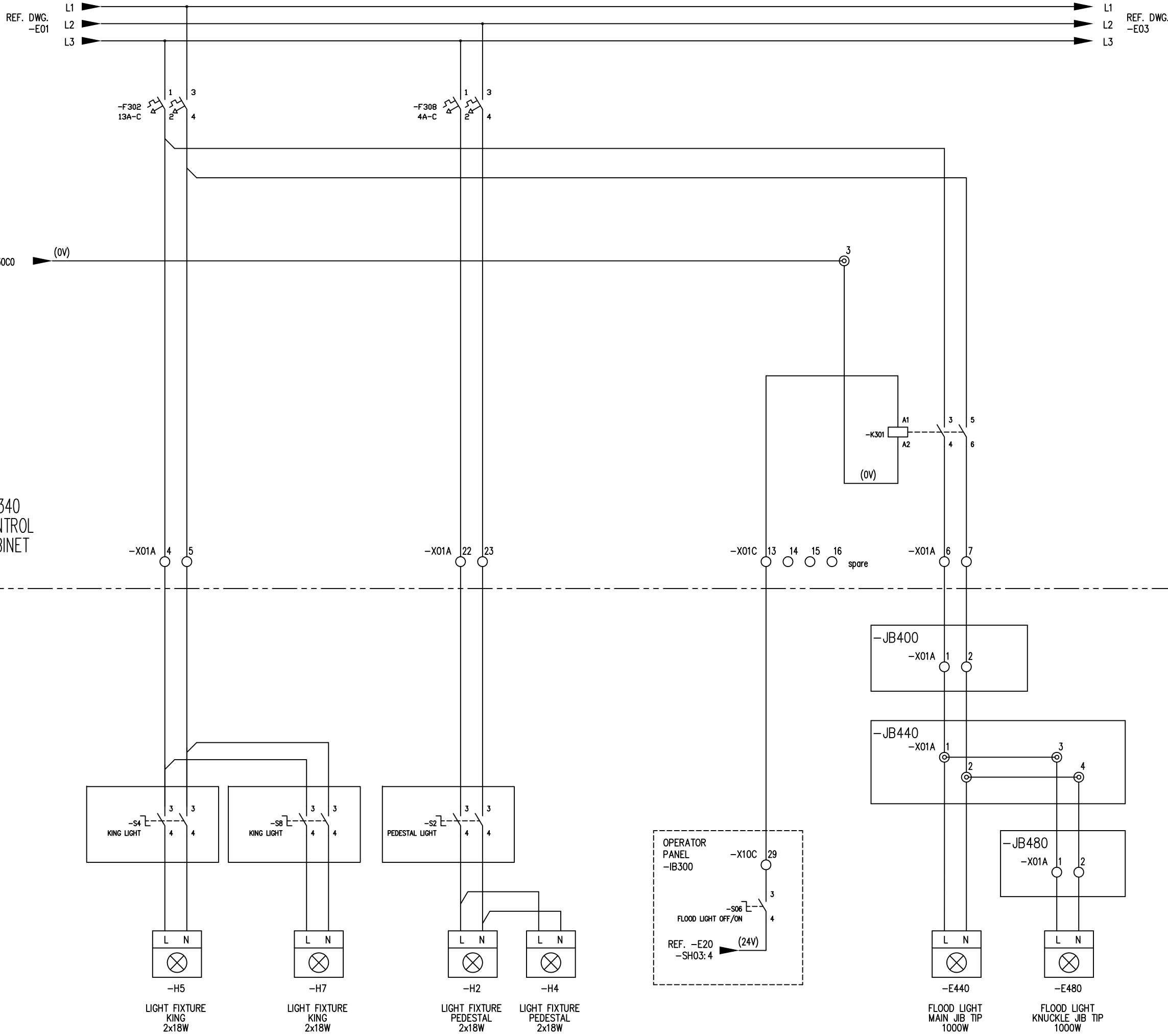
Designed 23.11.09	Approved 30.03.10 MMN	Projection Scale 1:1	 TTS Marine ASA
Drawn 23.11.09 MMN	Format A1	Replaces: Replaced by:	

EL. CONTROL SYSTEM
230 VAC / 24 VDC SYSTEM
EL. CIRCUIT DIAGRAM

AutoCAD file: 11857E01
11857E01

REF.DWG :	-C03	-C16
-----------	------	------

230V AC, 60Hz



Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	29.03.10	MMN		
1	TERM. NO. -X01A UPD.	16.04.10	MMN		

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	O: 690 VAC
E: Analog signals	X: Specify
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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Designed 23.11.09	Approved 29.03.10 MMN	Projection 1:1	Scale A1
Drawn 23.11.09 MMN			



REF.DWG :	-C04	-C13	-C04
-----------	------	------	------

EL. CONTROL SYSTEM	Replaces:	Replaced by:
230 VAC / 24 VDC SYSTEM	AutoCAD file: 11857E02	
EL. CIRCUIT DIAGRAM	11857E02	Rev. 1

TTS MARINE AS

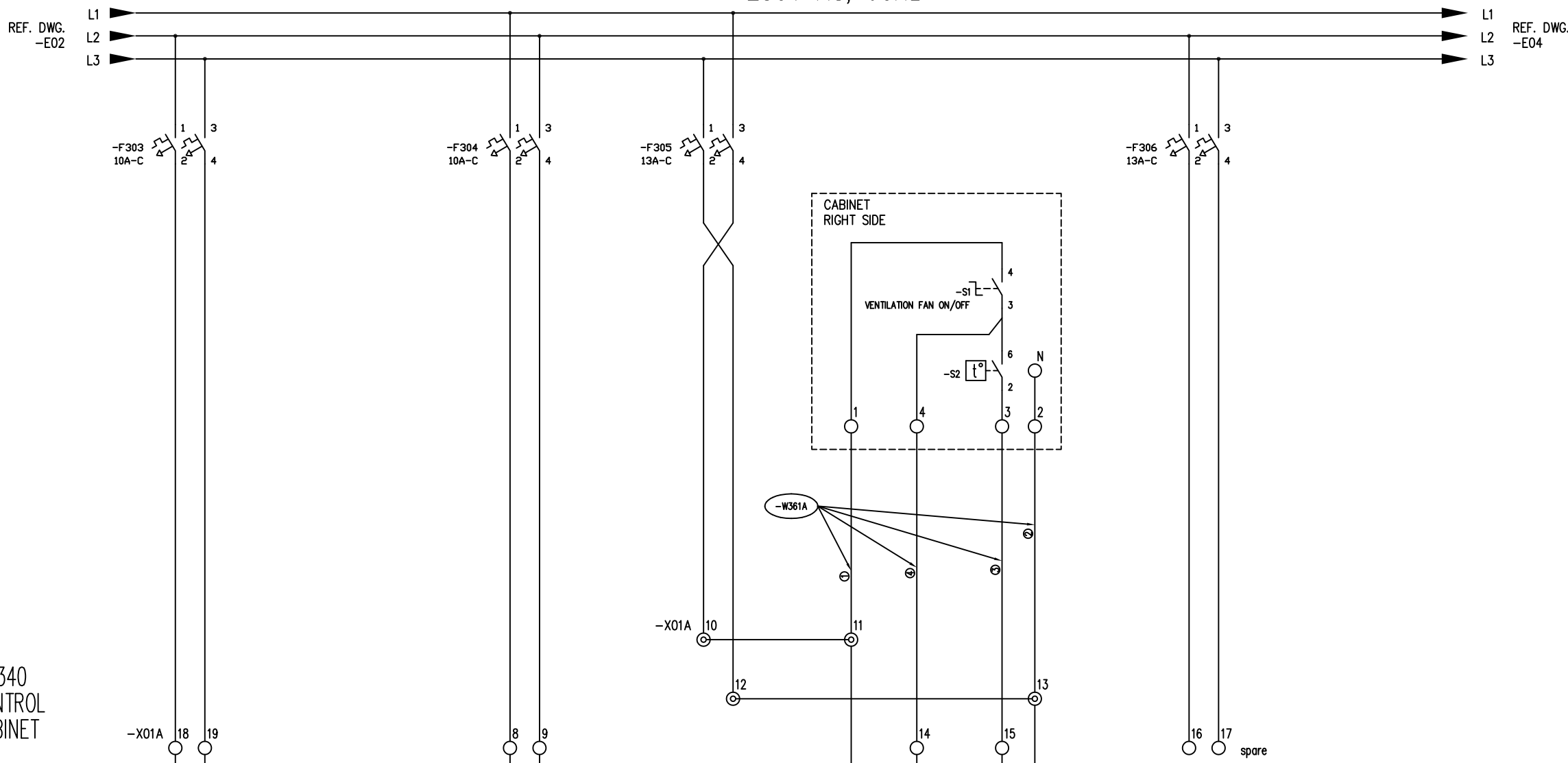
CUSTOMER PARTLIST

Project: 11857 ShipsEquipment-Ray Shipping
 Debtor: 66236 TTS SHIPS EQUIPMENT AS
 Hull Number:
 Machine Number: 11857

Draw number: 11857E02 Drawing revision: 1
 Item No.: X11857E02 EL CONTROL SYSTEM
 Item group: DRAW DRAWING
 CustDocNo

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-E440	1,00		REF	11857EB2
	-E480	1,00		REF	11857EB2
	-F302	1,00	CIRCUIT BREAKER 10A	114270	
	-K301	1,00	CONTACTOR RELAY 24VDC	114354	
	-S06	1,00	SWITCH 2 POS.90deg	58140	
	-S06.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-S06.2	1,00	CONTACT ELEMENT 1xNO	58147	
	-S06.3	1,00	SIGNHOLDER 50mm	58145	

230V AC, 60Hz

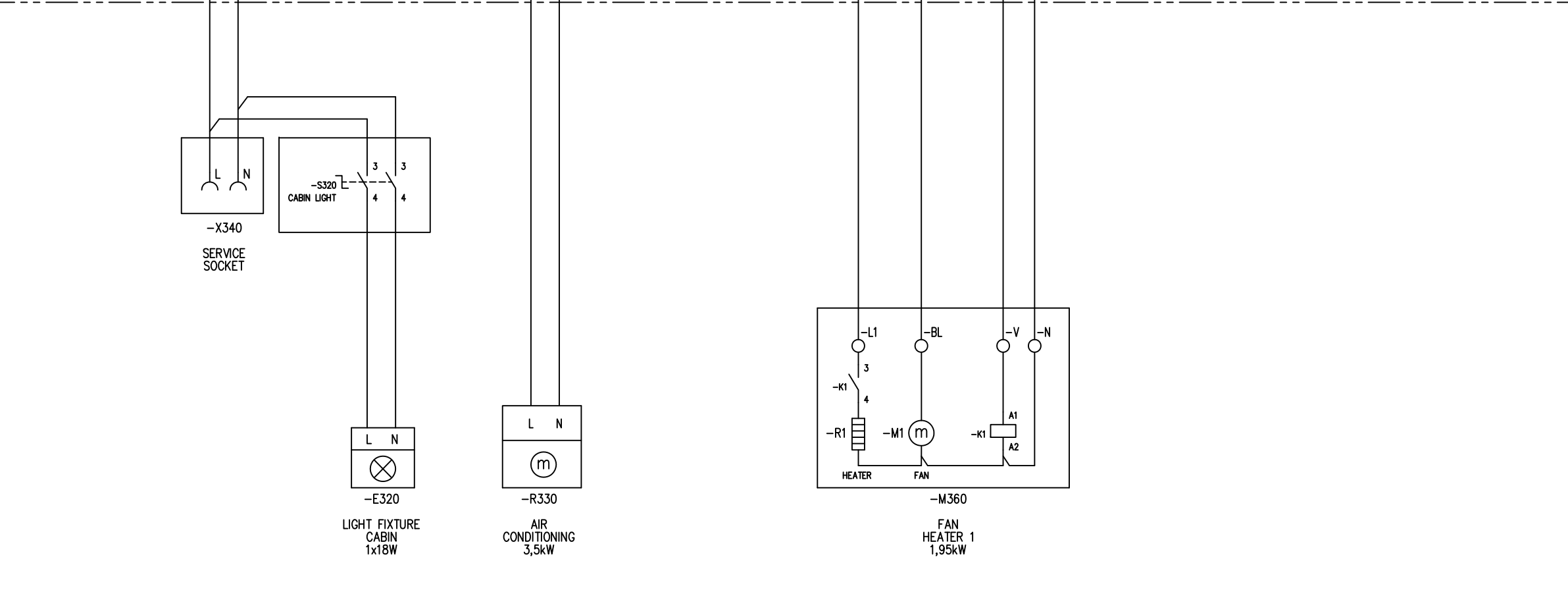


-A340
CONTROL
CABINET

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	O: 690 VAC
E: Analog signals	X: Specify
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	



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Designed 20.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1
Drawn 20.11.09 MMN	Format A1		

REF.DWG :

-C04

EL. CONTROL SYSTEM	Replaces:	Replaced by:
230 VAC / 24 VDC SYSTEM	AutoCAD file: 11857E03	Rev.
EL. CIRCUIT DIAGRAM	11857E03	0

TTS MARINE AS

CUSTOMER PARTLIST

Project: 11857 ShipsEquipment-Ray Shipping
Debtor: 66236 TTS SHIPS EQUIPMENT AS
Hull Number:
Machine Number: 11857

Draw number: 11857E03 Drawing revision: 0
Item No.: X11857E03 EL CONTROL SYSTEM
Item group: DRAW DRAWING
CustDocNo

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-F303	1,00	CIRCUIT BREAKER 10A	114270	
	-F304	1,00	CIRCUIT BREAKER 10A	114270	
	-F305	1,00	CIRCUIT BREAKER 13A	114271	
	-F306	1,00	CIRCUIT BREAKER 13A	114271	
	-K1	1,00	RELAY	REF	Cabin Partlist
	-S1	1,00	SWITCH 2 POS	REF	Cabin Partlist
	-S2	1,00	THERMOSTAT	REF	Cabin Partlist

230V AC, 60Hz

REF. DWG.
-E03



-A340
CONTROL
CABINET

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

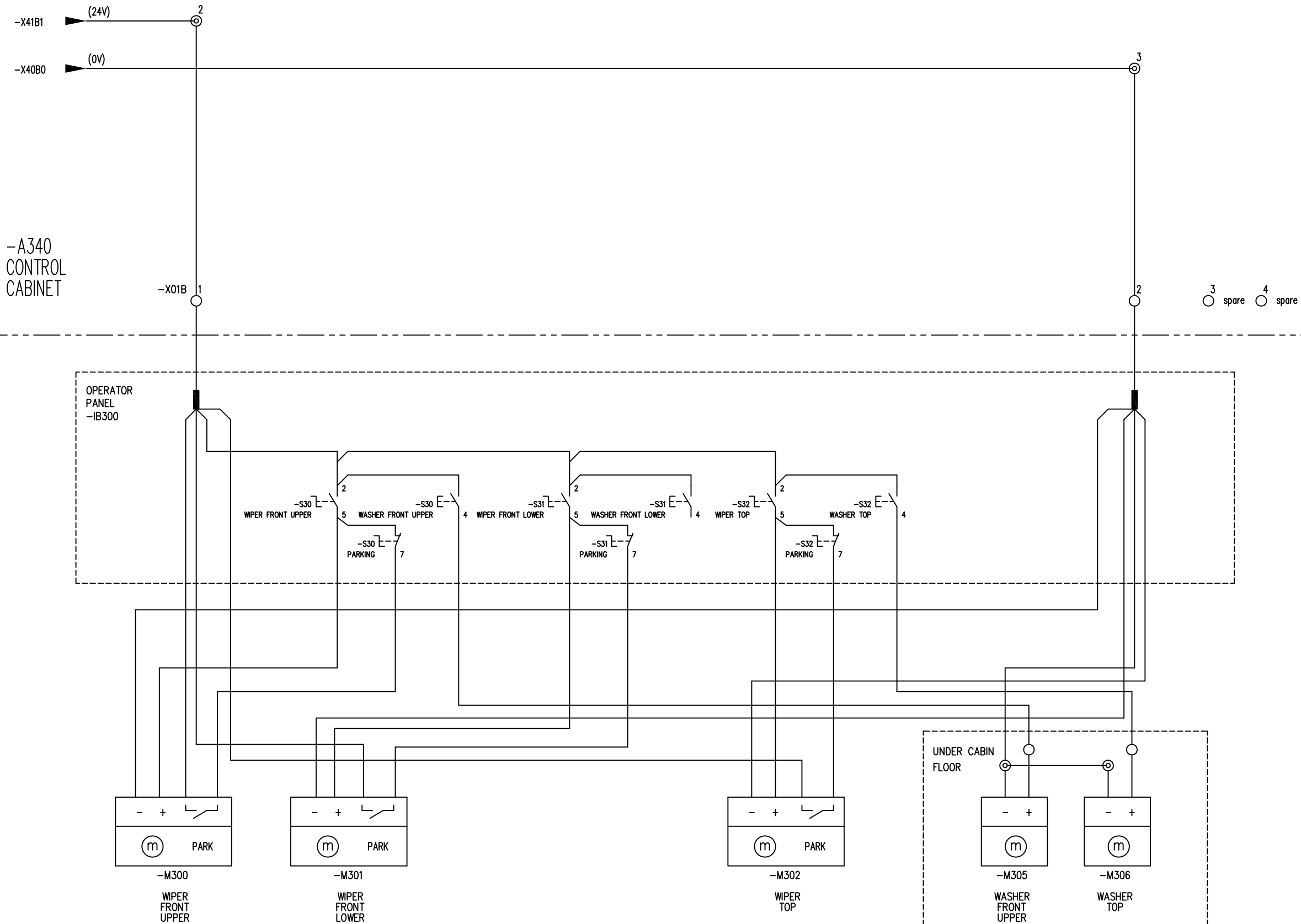
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Designed 20.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1	
Drawn 20.11.09 MMN	Format A1	Replaces: Replaced by:		

REF.DWG : _____ -C04

EL. CONTROL SYSTEM	AutoCAD file: 11857E04	Rev.
230 VAC / 24 VDC SYSTEM	11857E04	0
EL. CIRCUIT DIAGRAM		

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		



VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	
I: EEX(I) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
 W14G Cable no.14 w.380 VAC
 X03C1 Terminal list no.3 w. +24 VDC terminals

INSIDE CRANE CABIN

REF.DWG :

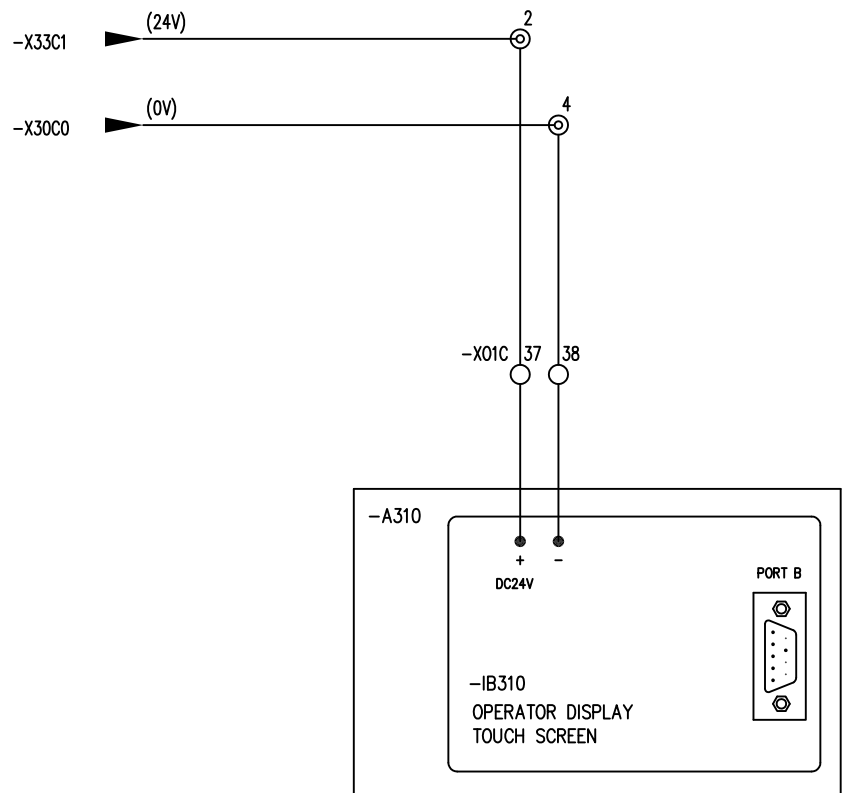
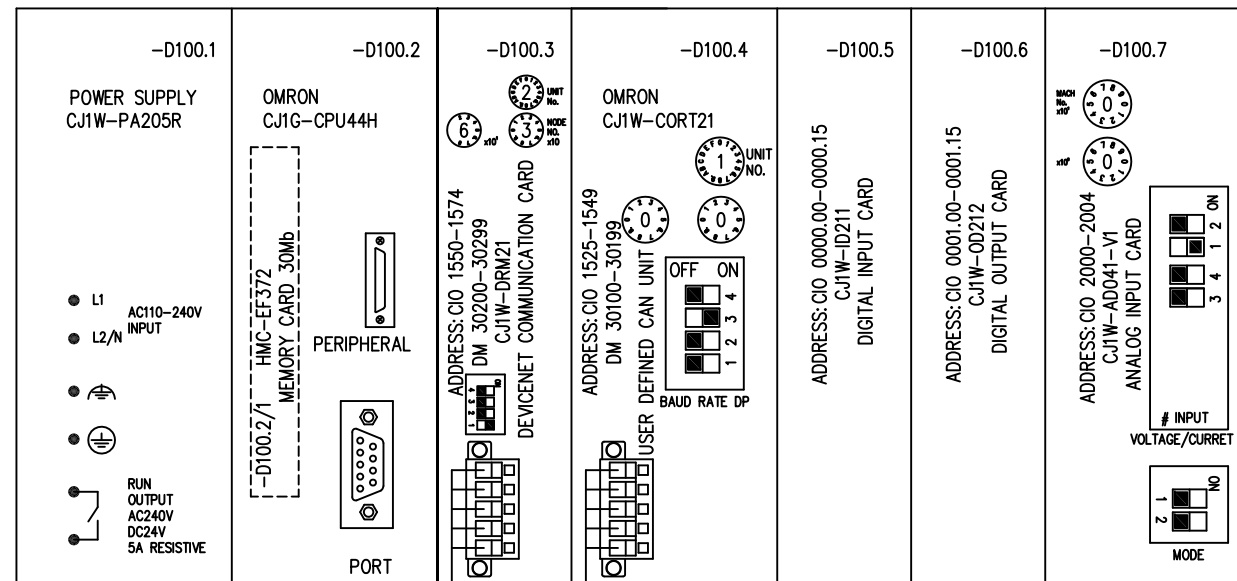
-C14

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Designed 20.11.09	Approved	Projection 1:1	Scale 1:1	
Drawn 20.11.09 MMN		Format A1		

Replaces:	Replaced by:
EL. CONTROL SYSTEM 230 VAC / 24 VDC SYSTEM EL. CIRCUIT DIAGRAM	AutoCAD file: 11857E05 11857E05
Rev. 0	Rev. 0

-A340
CONTROL
CABINET



REF.DWG E11
-X01L

REF.DWG E13
-HC300

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		

-D100.7
ANALOG INPUT CARD

SETTING OF VOLTAGE/CURRENT SWITCH:

OFF: VOLTAGE INPUT
ON: CURRENT INPUT

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	O: 690 VAC
E: Analog signals	X: Specify
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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Designed 24.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1	
Drawn 24.11.09 MMN	Format A1	Replaces:	Replaced by:	

REF.DWG : -C14

EL. CONTROL SYSTEM
PLC CONFIGURATION
EL. CIRCUIT DIAGRAM

AutoCAD file: 11857E10
11857E10

Rev. 0

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10 MMN			
1	GENERAL UPD.	30.05.10 MMN			

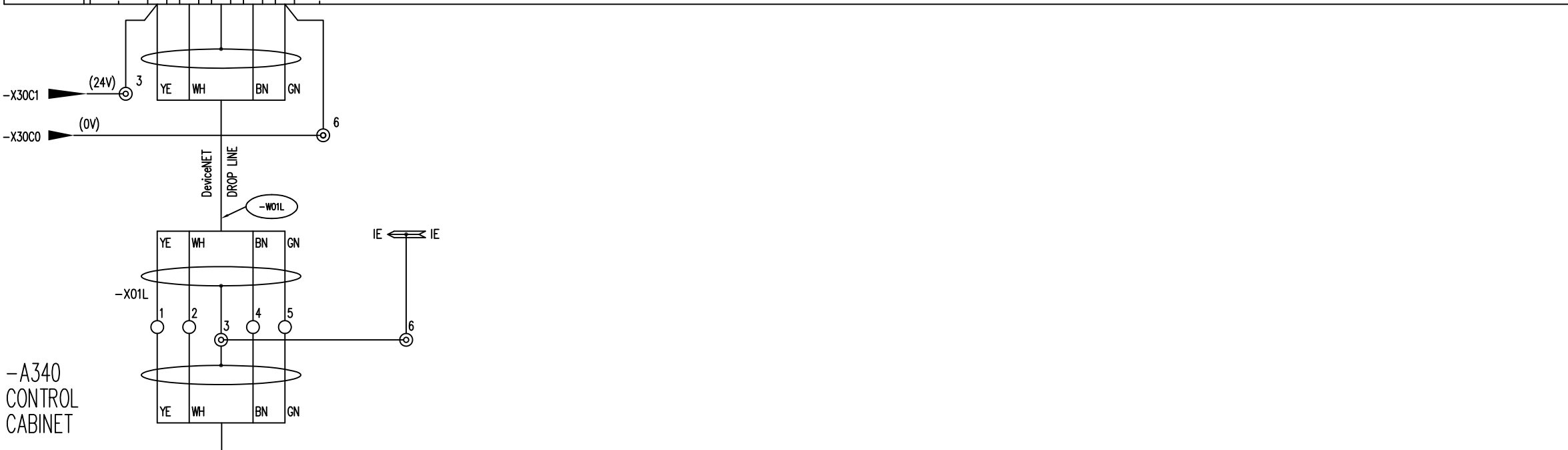
DESCRIPTION	DeviceNet
CONTROLLER	OMRON
I/O CARD	-D100.3
SIGN./ADD.	CIO
TERM.SIGN.	V+ CAN H SHIELD CAN L V-
TERMINAL	RD WH -- BU BK

-D100.3 connector color assignment

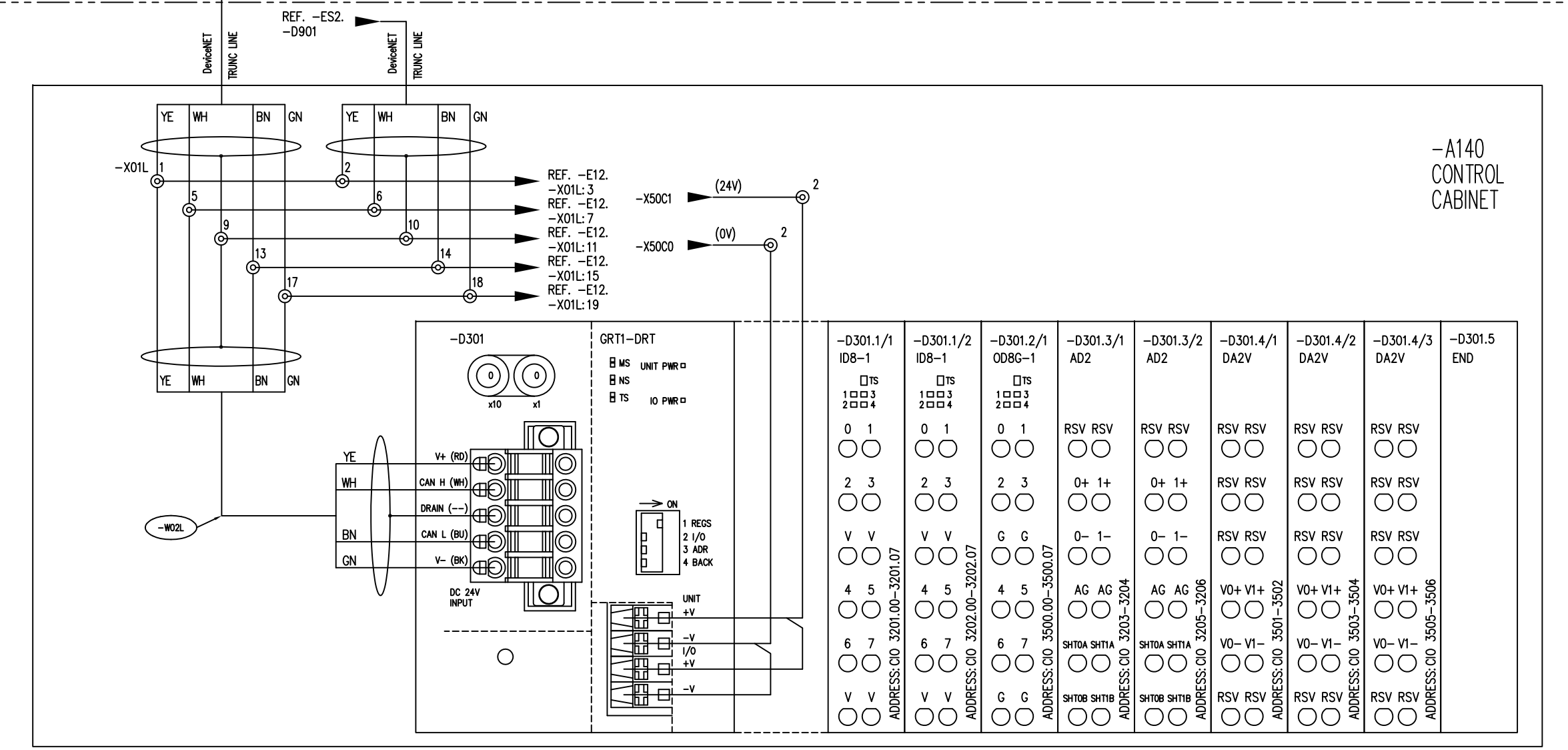
+24V: RED
 0V: BLACK
 CAN+: WHITE
 CAN-: BLUE

DeviceNet cable color assignment

+24V: YELLOW
 0V: GREEN
 CAN+: WHITE
 CAN-: BROWN



-A340 CONTROL CABINET



-A140 CONTROL CABINET

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY XnY[n]

A: 220 / 230 VAC
 B: 24 VDC unregulated
 C: 24 VDC regulated
 D: 12 VDC regulated
 E: Analog signals mixed, low voltage
 F: 380 / 400 VAC
 G: 220 / 230 VDC
 H: EE(X) circuits
 I: 110 / 120 VAC
 K: 24 VAC
 L: Special
 M: 440 / 450 VAC

n=0: 0V potential
 n=1: +V potential
 o: 690 VAC
 X: Specify

EXAMPLES:
 W14G Cable no.14 w.380 VAC
 X03C1 Terminal list no.3 w. +24 VDC terminals

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Designed 24.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1
Drawn 24.11.09 MMN			

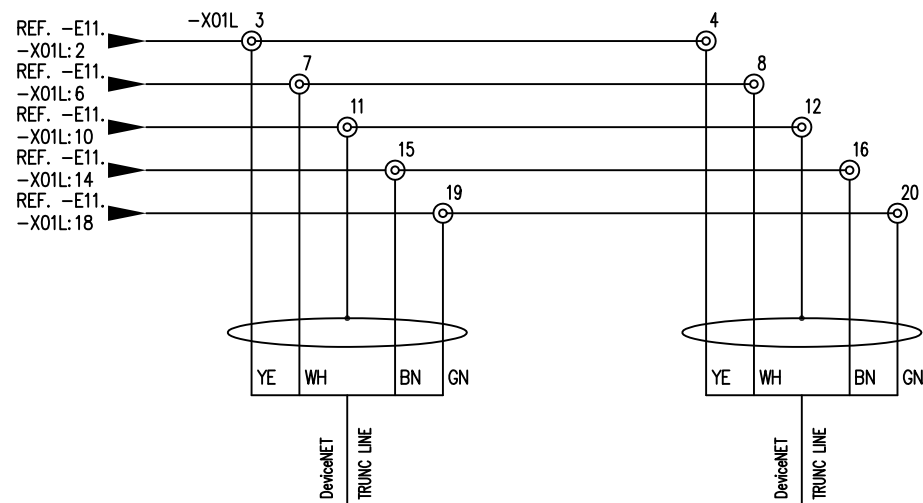


REF.DWG : -C03

EL. CONTROL SYSTEM
 DEVICENET
 EL. CIRCUIT DIAGRAM

Replaces: Replaced by:
 AutoCAD file: 11857E11
 11857E11

-A140
CONTROL
CABINET



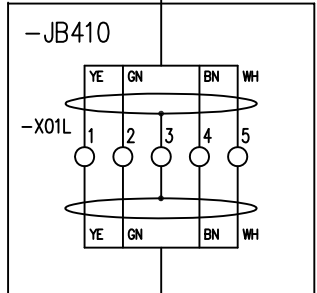
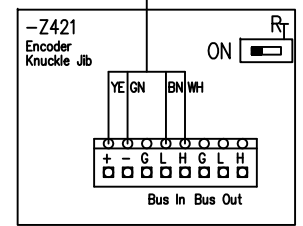
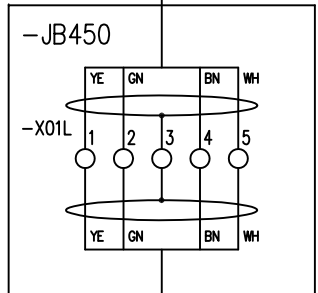
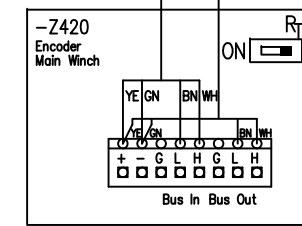
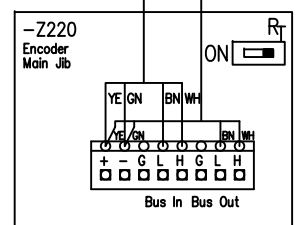
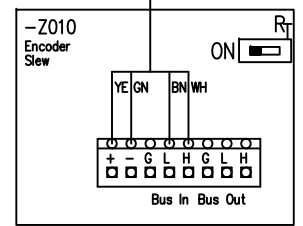
INSIDE PEDESTAL

MAIN JIB

MAIN JIB TIP

MAIN WINCH

KNUCKLE JIB



DeviceNET Node Config.
Baudrate= 250kbit/s

Encoder settings:

Baudrate	Node No.	
1	2	6
Bd	x10	x1
1	2	7
Bd	x10	x1
1	2	2
Bd	x10	x1
1	2	8
Bd	x10	x1

-Z010 SLEW ENCODER
-Z220 MJIB ENCODER
-Z420 MWINCH ENCODER
-Z421 KNJIB ENCODER

DeviceNet cable color assignment

+24V: YELLOW
0V: GREEN
CAN+: WHITE
CAN-: BROWN

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Designed 24.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1
Drawn 24.11.09 MMN			



EL. CONTROL SYSTEM
DEVICENET
EL. CIRCUIT DIAGRAM

Replaces: Replaced by:
AutoCAD file: 11857E12
11857E12

REF.DWG :

DESCRIPTION	CANopen	
CONTROLLER	OMRON	
I/O CARD	-D100.4	
SIGN./ADD.	CIO	
TERM.SIGN.	V- CAN L SHIELD CAN H V+	
TERMINAL	BK BU -- WH RD	

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10 MMN			
1	MODIFICATION 861185	11.04.12 ARB			



-D100.4 connector color assignment

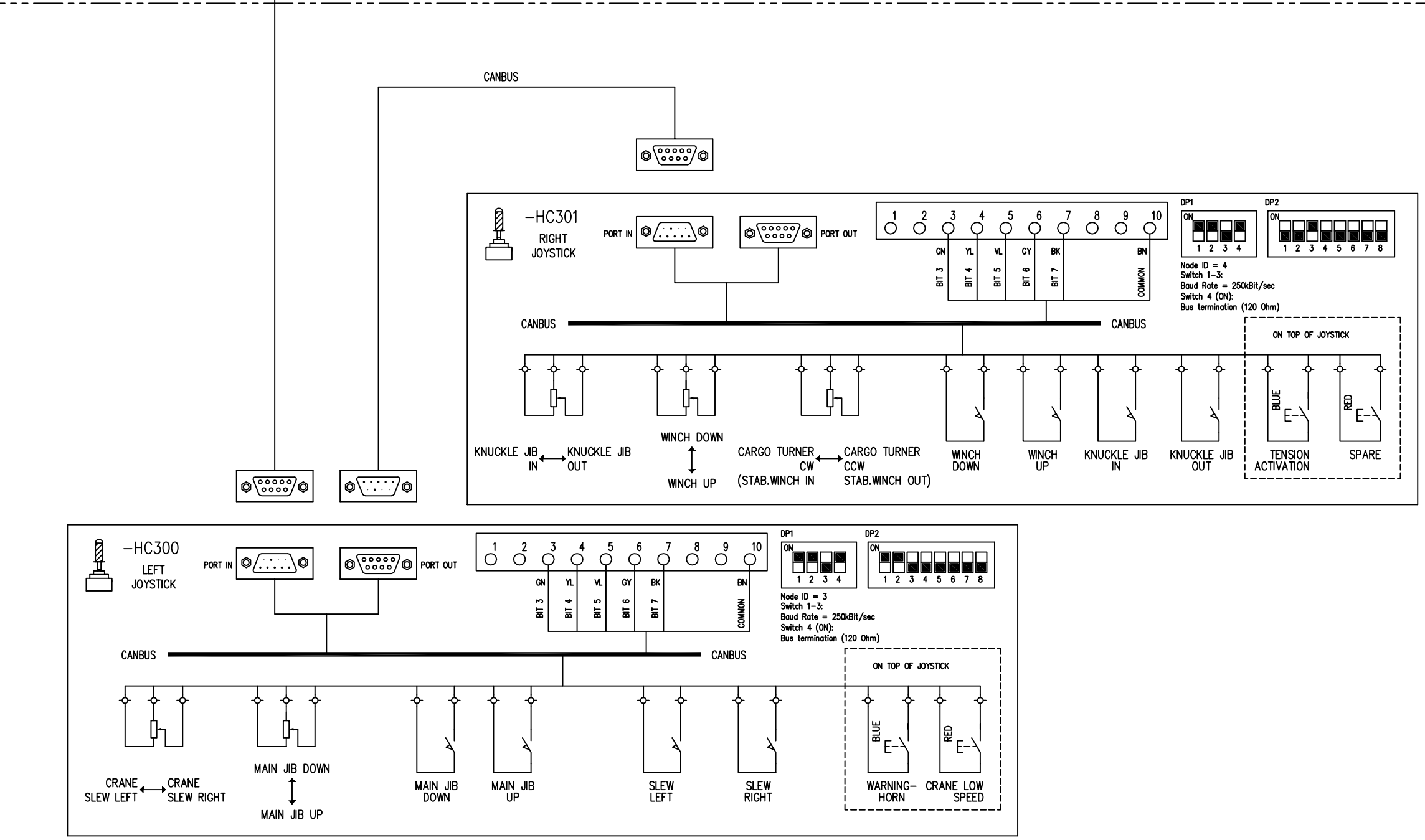
+24V: RED
 0V: BLACK
 CAN+: WHITE
 CAN-: BLUE

CANbus cable color assignment and pin assignment for 9 pin D-SUB

Pin 9: +24V: YELLOW
 Pin 6: 0V: GREEN
 Pin 7: CAN+: WHITE
 Pin 2: CAN-: BROWN

CANopen Node Config.
 Baudrate= 250kbit/s

Node No.
 03 -HC300 LEFT JOYSTICK
 04 -HC301 RIGHT JOYSTICK



VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	
D: 12 VDC	O: 690 VAC
E: Analog signals	X: Specify
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EX(1) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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Designed 24.11.09	Approved 30.03.10 MMN	Projection Scale 1:1	
Drawn 24.11.09 MMN	Format A1	Replaces: Replaced by:	
EL. CONTROL SYSTEM CANBUS EL. CIRCUIT DIAGRAM			AutoCAD file: 11857E13 11857E13 Rev. 1

REF.DWG : -C15

TTS MARINE AS

CUSTOMER PARTLIST

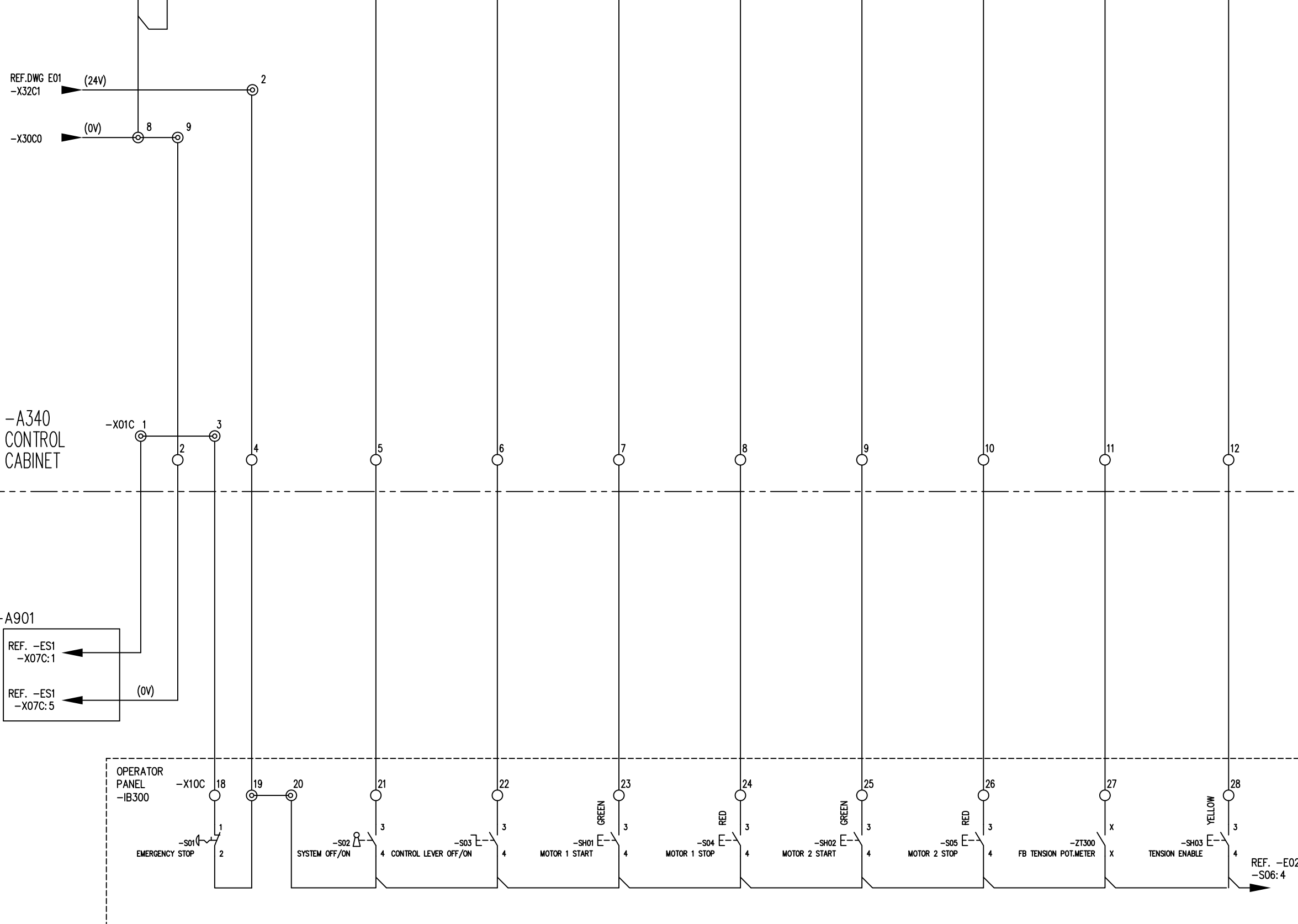
Project: 11857 ShipsEquipment-Ray Shipping
Debtor: 66236 TTS SHIPS EQUIPMENT AS
Hull Number:
Machine Number: 11857

Draw number: 11857E13 Drawing revision: 0
Item No.: X11857E13 EL CONTROL SYSTEM
Item group: DRAW DRAWING
CustDocNo

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
-HC30		1,00	LEFT JOYSTICK	REF	
-HC30		1,00	RIGHT JOYSTICK	REF	

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10			MMN

DESCRIPTION	SUPPLY	CONTROL SYSTEM OFF/ON	CONTROL LEVER OFF / ON	MOTOR 1 START / RUNNING	MOTOR 1 STOP	MOTOR 2 START / RUNNING	MOTOR 2 STOP	FEEDBACK TENSION POT.METER	WINCH TENSION ENABLE
CONTROLLER	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON
I/O CARD	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI
SIGN./ADD.		CIO 0000.00	CIO 0000.01	CIO 0000.02	CIO 0000.03	CIO 0000.04	CIO 0000.05	CIO 0000.06	CIO 0000.07
TERM.SIGN.	COM COM	0	1	2	3	4	5	6	7
TERMINAL	A8 B8	A0	B0	A1	B1	A2	B2	A3	B3



VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 400 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	X03C1
J: 110 / 120 VAC	Terminal list no.3 w.
K: 24 VAC	+24 VDC terminals
L: Special	
M: 440 / 450 VAC	

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Designed 25.11.09	Approved 30.03.10 MMN	Projection Scale 1:1	
Drawn 25.11.09 MMN	Format A1	Replaced by:	

REF.DWG :	-C03	-C13
-----------	------	------

EL. CONTROL SYSTEM	Replaces:	Replaced by:
DIGITAL INPUT	AutoCAD file: 11857E20	
EL. CIRCUIT DIAGRAM	11857E20	Rev. 0

TTS MARINE AS

CUSTOMER PARTLIST

Project: 11857 ShipsEquipment-Ray Shipping
Debtor: 66236 TTS SHIPS EQUIPMENT AS
Hull Number:
Machine Number: 11857

Draw number: 11857E20 Drawing revision: 0
Item No.: X11857E20 EL CONTROL SYSTEM
Item group: DRAW DRAWING
CustDocNo

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-S01	1,00	EMERGENCY STOP 38mm	58144	
	-S01.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-S01.2	1,00	CONTACT ELEMENT 1xNC	58148	
	-S01.3	1,00	SIGN: EMERGENCY STOP 33x50mm	58349	
	-S02	1,00	SWITCH w/key 2.POS.	58142	
	-S02.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-S02.2	1,00	CONTACT ELEMENT 1xNO	58147	
	-S02.3	1,00	SIGNHOLDER 50mm	58145	
	-S03	1,00	SWITCH 2 POS.90deg	58140	
	-S03.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-S03.2	1,00	CONTACT ELEMENT 1xNO	58147	
	-S03.3	1,00	SIGNHOLDER 50mm	58145	
	-S04	1,00	PUSHBUTTON Red (0)	58130	
	-S04.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-S04.2	1,00	CONTACT ELEMENT 1xNO	58147	

TTS MARINE AS

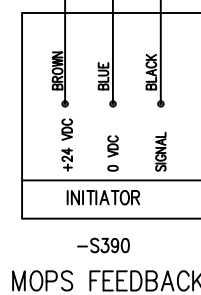
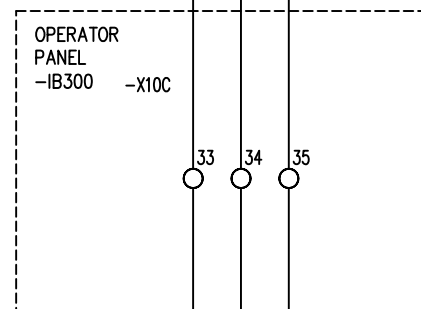
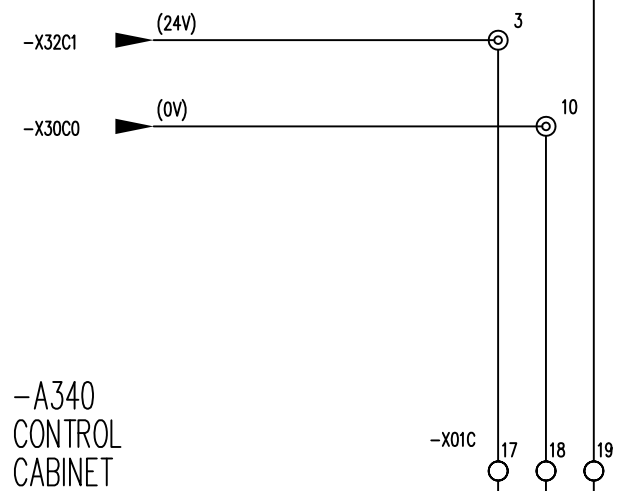
CUSTOMER PARTLIST

Draw number	11857E20	Drawing revision	0
Item No.	X11857E20	EL CONTROL SYSTEM	
Item group	DRAW	DRAWING	
CustDocNo			

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-S04.3	1,00	SIGNHOLDER 50mm	58145	
	-S05	1,00	PUSHBUTTON Red (0)	58130	
	-S05.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-S05.2	1,00	CONTACT ELEMENT 1xNO	58147	
	-S05.3	1,00	SIGNHOLDER 50mm	58145	
	-SH01	1,00	PUSHBUTTON ILLUM.Green	58138	
	-SH01.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-SH01.2	1,00	CONTACT ELEMENT 1xNO	58147	
	-SH01.3	1,00	LAMP SOCKET ELEM.DIODE Green	58151	
	-SH01.4	1,00	SIGNHOLDER 50mm	58145	
	-SH02	1,00	PUSHBUTTON ILLUM.Green	58138	
	-SH02.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-SH02.2	1,00	CONTACT ELEMENT 1xNO	58147	
	-SH02.3	1,00	LAMP SOCKET ELEM.DIODE Green	58151	
	-SH02.4	1,00	SIGNHOLDER 50mm	58145	

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		

DESCRIPTION	MOPS FEEDBACK SIGNAL	SPARE	SPARE	SPARE	SPARE	SPARE	SPARE	SOR
CONTROLLER	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON
I/O CARD	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI	-D100.5 DI
SIGN./ADD.	CIO 0000.08	CIO 0000.9	CIO 0000.10	CIO 0000.11	CIO 0000.12	CIO 0000.13	CIO 0000.14	CIO 0000.15
TERM.SIGN.	8	9	10	11	12	13	14	15
TERMINAL	A4	B4	A5	B5	A6	B6	A7	B7



VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY XnY[n]

A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	
I: EEX(I) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
W14G Cable no.14 w.380 VAC
X03C1 Terminal list no.3 w. +24 VDC terminals

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Designed 25.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1
Drawn 25.11.09 MMN			



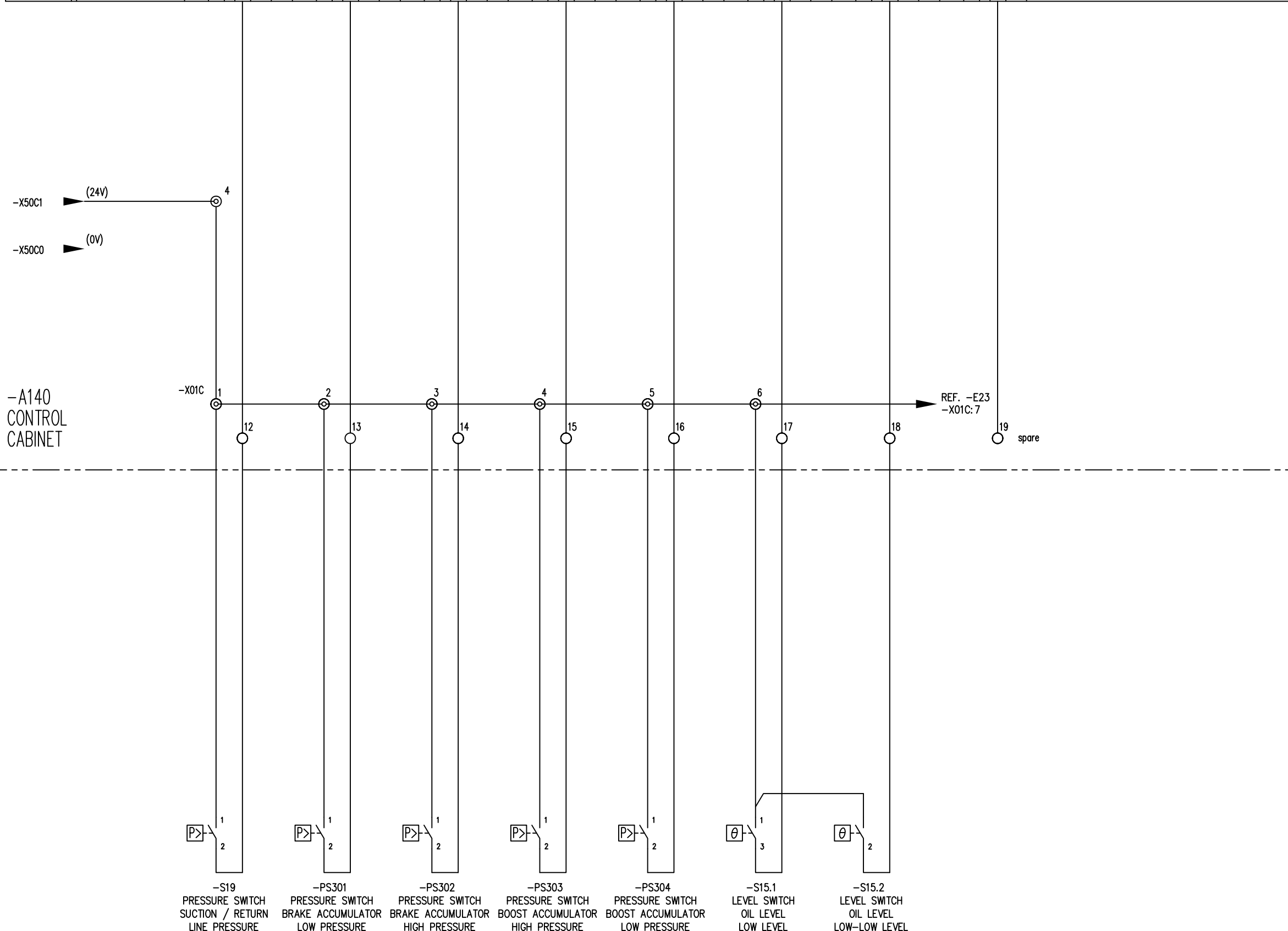
Replaces:	Replaced by:
AutoCAD file: 11857E21	Rev. 0
11857E21	

REF.DWG : -C13

EL. CONTROL SYSTEM
DIGITAL INPUT
EL. CIRCUIT DIAGRAM

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				30.03.10 MMN

DESCRIPTION	PRESSURE SWITCH SUCTION / RETURN LINE PRESSURE	PRESSURE SWITCH BRAKE ACCUM. LOW PRESSURE	PRESSURE SWITCH BRAKE ACCUM. HIGH PRESSURE	PRESSURE SWITCH BOOST ACCUM. HIGH PRESSURE	PRESSURE SWITCH BOOST ACCUM. LOW PRESSURE	LEVEL SWITCH OIL TANK LOW LEVEL	LEVEL SWITCH OIL TANK LOW-LOW LEVEL	SPARE
CONTROLLER	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE
I/O CARD	-D301.1 DI	-D301.1 DI	-D301.1 DI	-D301.1 DI	-D301.1 DI	-D301.1 DI	-D301.1 DI	-D301.1 DI
SIGN./ADD.	CIO 3201.00	CIO 3201.01	CIO 3201.02	CIO 3201.03	CIO 3201.04	CIO 3201.05	CIO 3201.06	CIO 3201.07
TERM.SIGN.	0	1	2	3	4	5	6	7
TERMINAL	A1	B1	A3	B3	A4	B4	A6	B6



-A140
CONTROL
CABINET

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	
I: EEX(I) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
W14G Cable no.14 w.380 VAC
X03C1 Terminal list no.3 w. +24 VDC terminals

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Designed 25.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1
Drawn 25.11.09 MMN	Format A1		

REF.DWG :

-C12

Replaces:
EL. CONTROL SYSTEM
DIGITAL INPUT
EL. CIRCUIT DIAGRAM

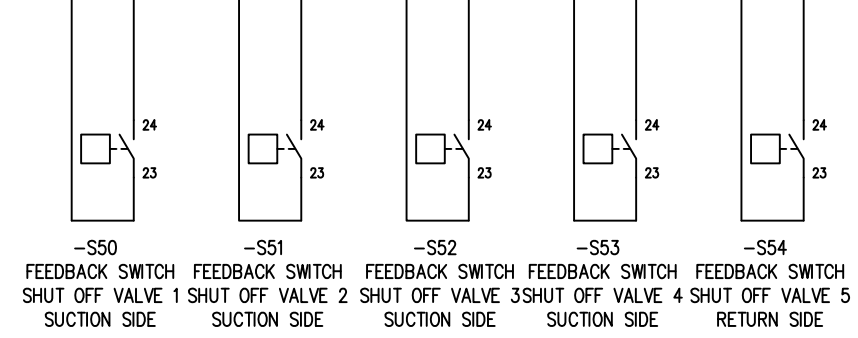
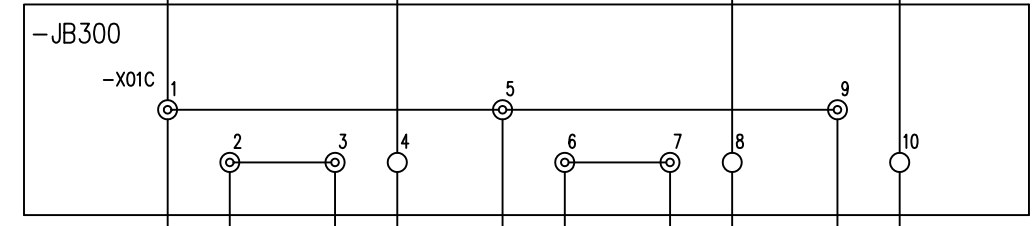
Replaced by:
AutoCAD file: 11857E22
11857E22
Rev. 0

DESCRIPTION	SPARE	FEEDBACK SWITCH SHUT OFF VALVES SUCTION SIDE	FEEDBACK SWITCH SHUT OFF VALVES SUCTION SIDE	SPARE	FEEDBACK SWITCH SHUT OFF VALVES RETURN SIDE	SPARE	SPARE	SPARE
CONTROLLER	SMART SLICE	SMARTSLICE	SMARTSLICE	SMARTSLICE	SMARTSLICE	SMARTSLICE	SMARTSLICE	SMARTSLICE
I/O CARD	-D301.1/2 DI	-D301.1/2 DI	-D301.1/2 DI	-D301.1/2 DI	-D301.1/2 DI	-D301.1/2 DI	-D301.1/2 DI	-D301.1/2 DI
SIGN./ADD.	3202.00	3202.01	3202.02	3202.03	3202.04	3202.05	3202.06	3202.07
TERM.SIGN.	0	1	2	3	4	5	6	7
TERMINAL	A1	B1	A3	B3	A4	B4	A6	B6

Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10 MMN
1	UPD.CONN.FEEDB.SW	23.04.10 MMN

-A140
CONTOL
CABINET

REF. -E22
-X01C:6



VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY XnY[n]

A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	
I: EEX(I) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
W14G Cable no.14 w.380 VAC
X03C1 Terminal list no.3 w. +24 VDC terminals

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Designed 25.11.09	Approved 30.03.10 MMN	Projection Scale 1:1
Drawn 25.11.09 MMN	Format A1	



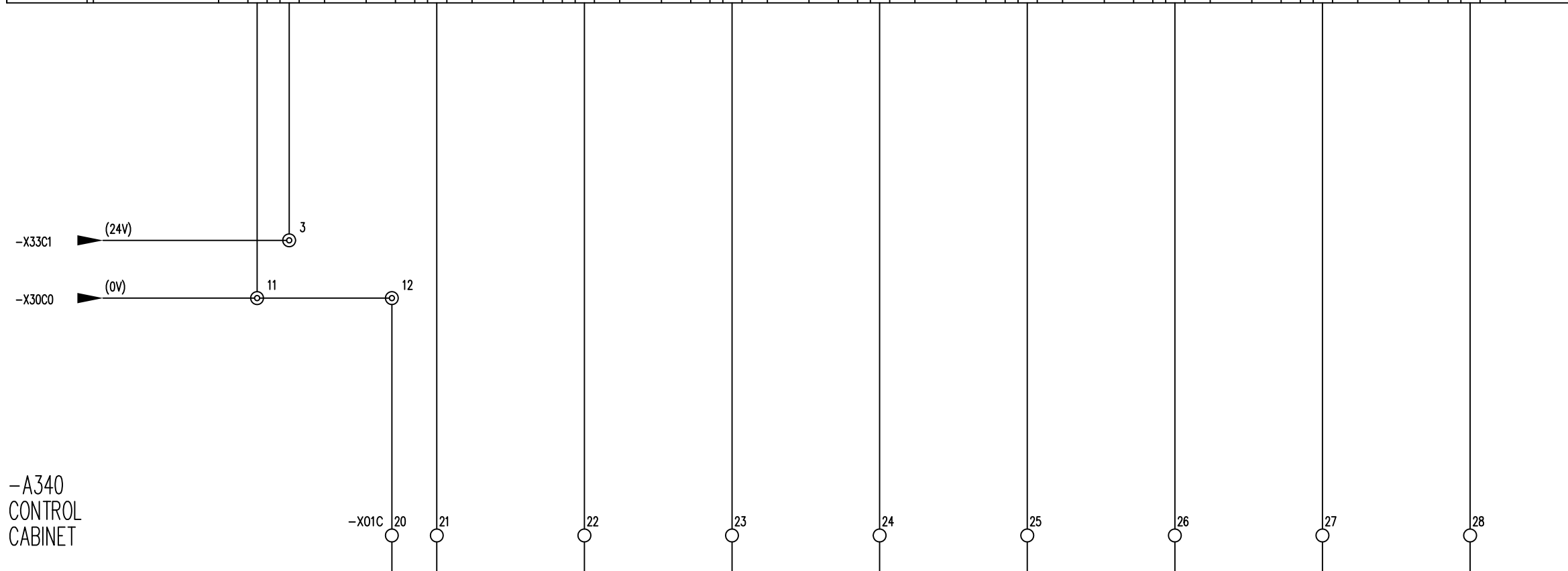
Replaces:	Replaced by:
AutoCAD file: 11857E23	Rev. 1
11857E23	

REF.DWG : _____ -C12

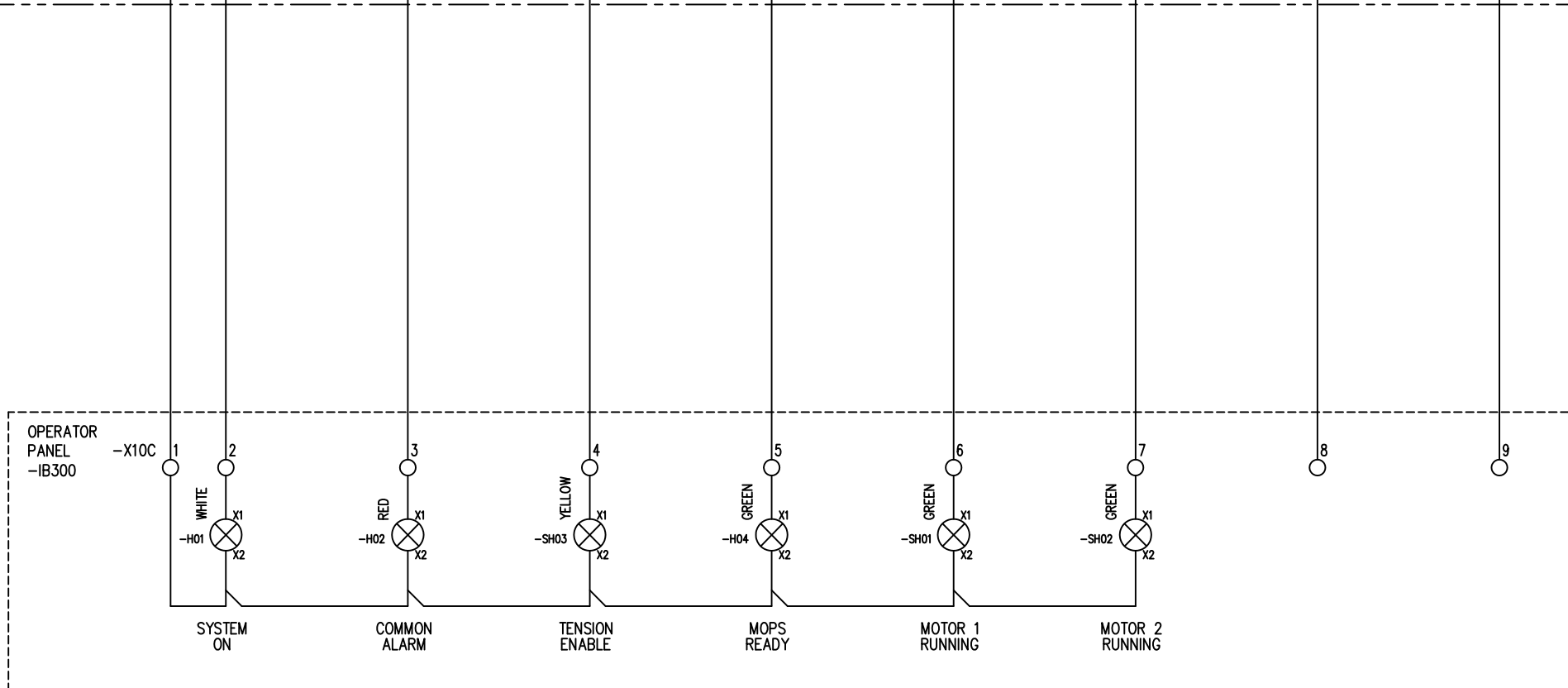
EL. CONTROL SYSTEM
DIGITAL INPUT
EL. CIRCUIT DIAGRAM

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		

DESCRIPTION	SUPPLY	SYSTEM ON	COMMON ALARM	WINCH TENSION ENABLE	MOPS READY	MOTOR 1 RUNNING	MOTOR 2 RUNNING	SPARE	SPARE
CONTROLLER	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON
I/O CARD	-D100.6	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6
SIGN./ADD.		CIO 0001.00	CIO 0001.01	CIO 0001.02	CIO 0001.03	CIO 0001.04	CIO 0001.05	CIO 0001.06	CIO 0001.07
TERM.SIGN.	0V COM	0	1	2	3	4	5	6	7
TERMINAL	A8 B8	A0	B0	A1	B1	A2	B2	A3	B3



-A340
CONTROL
CABINET



VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 400 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	X03C1
J: 110 / 120 VAC	Terminal list no.3 w.
K: 24 VDC	+24 VDC terminals
L: Special	
M: 440 / 450 VAC	

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Designed 25.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale 1:1
Drawn 25.11.09	Format A1	TTS TTS Marine ASA	

Replaces:	Replaced by:
AutoCAD file: 11857E24	Rev. 0
11857E24	0

REF.DWG :

TTS MARINE AS

CUSTOMER PARTLIST

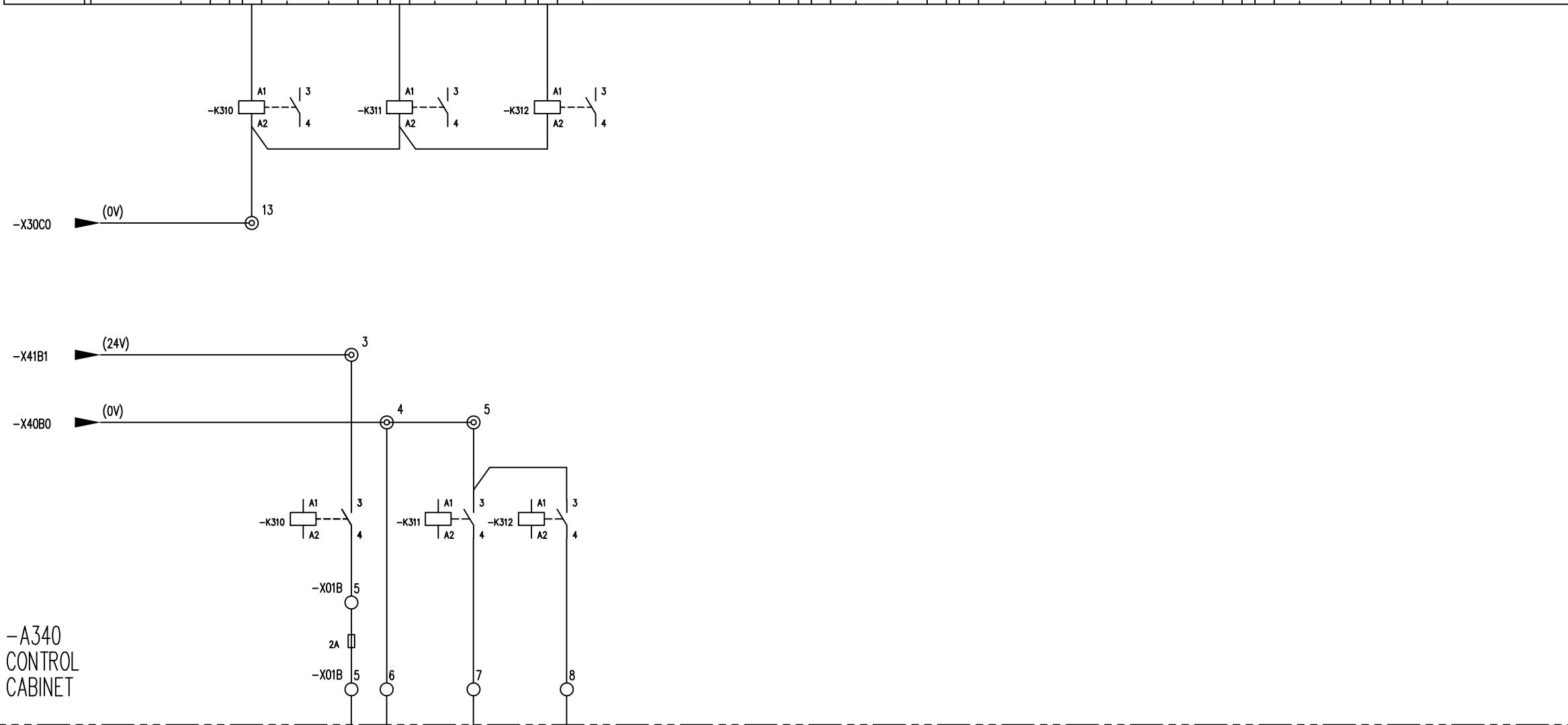
Project: 11857 ShipsEquipment-Ray Shipping
Debtor: 66236 TTS SHIPS EQUIPMENT AS
Hull Number:
Machine Number: 11857

Draw number: 11857E24 Drawing revision: 0
Item No.: X11857E24 EL CONTROL SYSTEM
Item group: DRAW DRAWING
CustDocNo

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-H01	1,00	INDICATOR LENS UNIT White	58136	
	-H01.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-H01.2	1,00	LAMP SOCKET ELEM.DIODE White	58149	
	-H01.3	1,00	SIGNHOLDER 50mm	58145	
	-H02	1,00	INDICATOR LENS UNIT Red	58132	
	-H02.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-H02.2	1,00	LAMP SOCKET ELEM.DIODE Red	58150	
	-H02.3	1,00	SIGNHOLDER 50mm	58145	
	-H03	1,00	INDICATOR LENS UNIT Yellow	58134	
	-H03.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-H03.2	1,00	LAMP SOCKET ELEM.DIODE White	58149	
	-H03.3	1,00	SIGNHOLDER 50mm	58145	
	-H04	1,00	INDICATOR LENS UNIT Green	58133	
	-H04.1	1,00	ADAPTER f/RMQ TITAN BUTTON	58146	
	-H04.2	1,00	LAMP SOCKET ELEM.DIODE Green	58151	

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		

DESCRIPTION	WARNING HORN ACTIVATE	WARNING HORN STAGE 2 TONE	WARNING HORN STAGE 3 TONE	SPARE	SPARE	SPARE	SPARE	SPARE
CONTROLLER	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON	OMRON
I/O CARD	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO	-D100.6 DO
SIGN./ADD.	CIO 0001.08	CIO 0001.09	CIO 0001.10	CIO 0001.11	CIO 0001.12	CIO 0001.13	CIO 0001.14	CIO 0001.15
TERM.SIGN.	8	9	10	11	12	13	14	15
TERMINAL	A4	B4	A5	B5	A6	B6	A7	B7



-A340
CONTROL
CABINET

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	EXAMPLES:
I: EEX(I) circuits	W14G
J: 110 / 120 VAC	Cable no.14 w.380 VAC
K: 24 VAC	X03C1
L: Special	Terminal list no.3 w.
M: 440 / 450 VAC	+24 VDC terminals

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Designed 25.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1
Drawn 25.11.09 MMN			



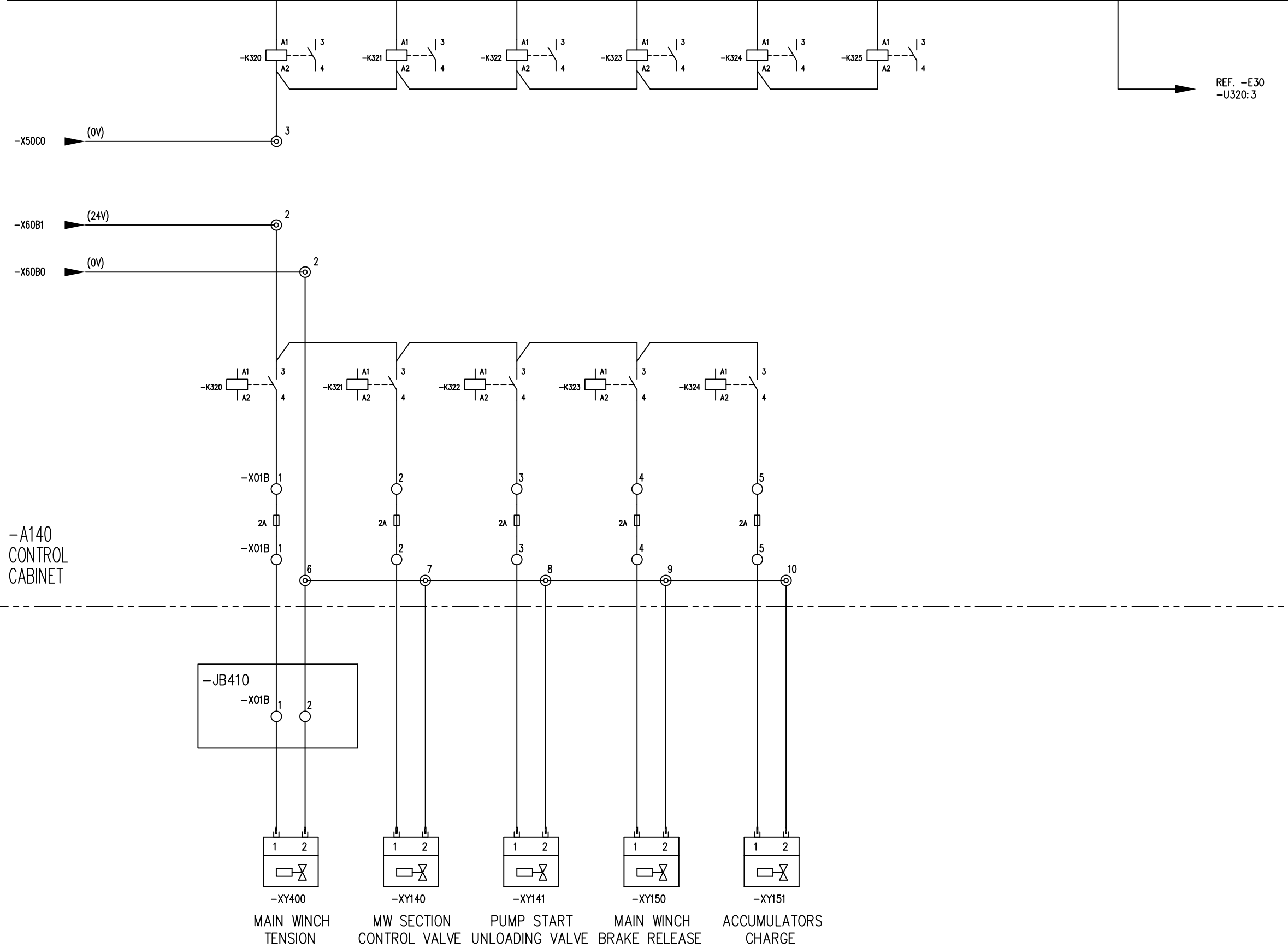
REF.DWG : -C14

Replaces:	Replaced by:
AutoCAD file: 11857E25	Rev. 0
11857E25	

EL. CONTROL SYSTEM
DIGITAL OUTPUT
EL. CIRCUIT DIAGRAM

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		
1	REF. DWG.	16.04.10	MMN		

DESCRIPTION	ON/OFF VALVE MAIN WINCH TENSION	ON/OFF VALVE MW SECTION CONTROL VALVE	ON/OFF VALVE PUMP START UNLOADING VALVE	ON/OFF VALVE MAIN WINCH BRAKE RELEASE	ON/OFF VALVE ACCUMULATORS CHARGE	SPARE	SPARE	PROP. VALVES ENABLE
CONTROLLER	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE
I/O CARD	-D301.2/1 DO	-D301.2/1 DO	-D301.2/1 DO	-D301.2/1 DO	-D301.2/1 DO	-D301.2/1 DO	-D301.2/1 DO	-D301.2/1 DO
SIGN./ADD.	CIO 3500.00	CIO 3500.01	CIO 3500.02	CIO 3500.03	CIO 3500.04	CIO 3500.05	CIO 3500.06	CIO 3500.07
TERM.SIGN.	0	1	2	3	4	5	6	7
TERMINAL	A1	B1	A2	B2	A4	B4	A5	B5



-A140
CONTROL
CABINET

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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Designed 25.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale 1:1
Drawn 25.11.09 MMN	Format A1		



Replaces:	Replaced by:
AutoCAD file: 11857E26	Rev.
11857E26	1

REF.DWG : _____ -C11

EL. CONTROL SYSTEM
DIGITAL OUTPUT
EL. CIRCUIT DIAGRAM

TTS MARINE AS

CUSTOMER PARTLIST

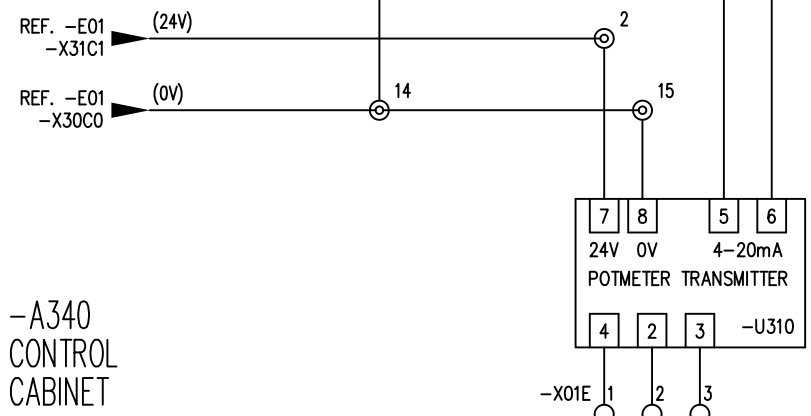
Project: 11857 ShipsEquipment-Ray Shipping
Debtor: 66236 TTS SHIPS EQUIPMENT AS
Hull Number:
Machine Number: 11857

Draw number: 11857E26 Drawing revision: 1
Item No.: X11857E26 EL CONTROL SYSTEM
Item group: DRAW DRAWING
CustDocNo

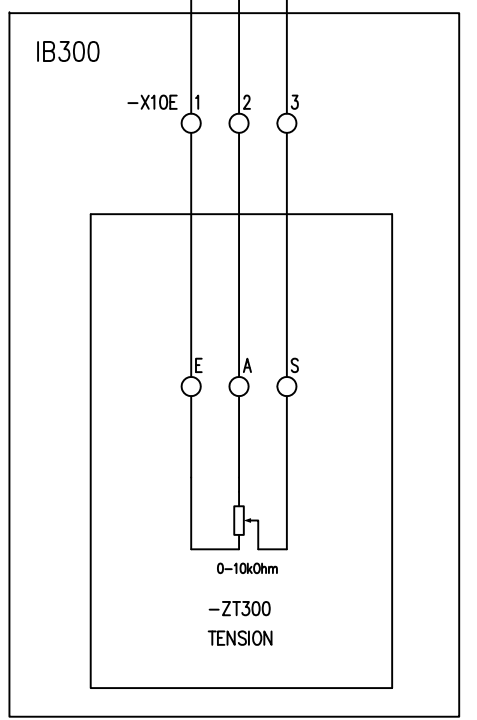
Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-K320	1,00	RELAY MINIATURE 10A/16A 1 POL	57535	
	-K320.1	1,00	SOCKET FOR MINIATURE RELAY 1 P	50198	
	-K321	1,00	RELAY MINIATURE 10A/16A 1 POL	57535	
	-K321.1	1,00	SOCKET FOR MINIATURE RELAY 1 P	50198	
	-K322	1,00	RELAY MINIATURE 10A/16A 1 POL	57535	
	-K322.1	1,00	SOCKET FOR MINIATURE RELAY 1 P	50198	

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		
1					

DESCRIPTION	GROUND	POTMETER TENSION	SPARE	SPARE	SPARE
CONTROLLER	OMRON	OMRON	OMRON	OMRON	OMRON
I/O CARD	-D100.7	-D100.7/ AI	-D100.7/ AI	-D100.7/ AI	-D100.7/ AI
SIGN./ADD.		CIO 2001	CIO 2002	CIO 2003	CIO 2004
TERM.SIGN.	AG AG	1(+) 1(-)	2(+) 2(-)	3(+) 3(-)	4(+) 4(-)
TERMINAL	A5 B5	A1 A2	B1 B2	A3 A4	B3 B4



-A340
CONTROL
CABINET



ANALOG INPUT CARD

SETTING OF VOLTAGE/CURRENT SWITCH:

- OFF: VOLTAGE INPUT
- ON: CURRENT INPUT

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	
I: EEX(I) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
W14G Cable no.14 w.380 VAC
X03C1 Terminal list no.3 w. +24 VDC terminals

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Designed 25.11.09	Approved 30.03.10 MMN	Projection Scale 1:1
Drawn 25.11.09 MMN	Format D/A1	Replaces TTS Marine ASA

EL. CONTROL SYSTEM
ANALOG INPUT
EL. CIRCUIT DIAGRAM

AutocAD file: 11857E27
11857E27

Replaced by:
Rev. 1

REF.DWG :

TTS MARINE AS

CUSTOMER PARTLIST

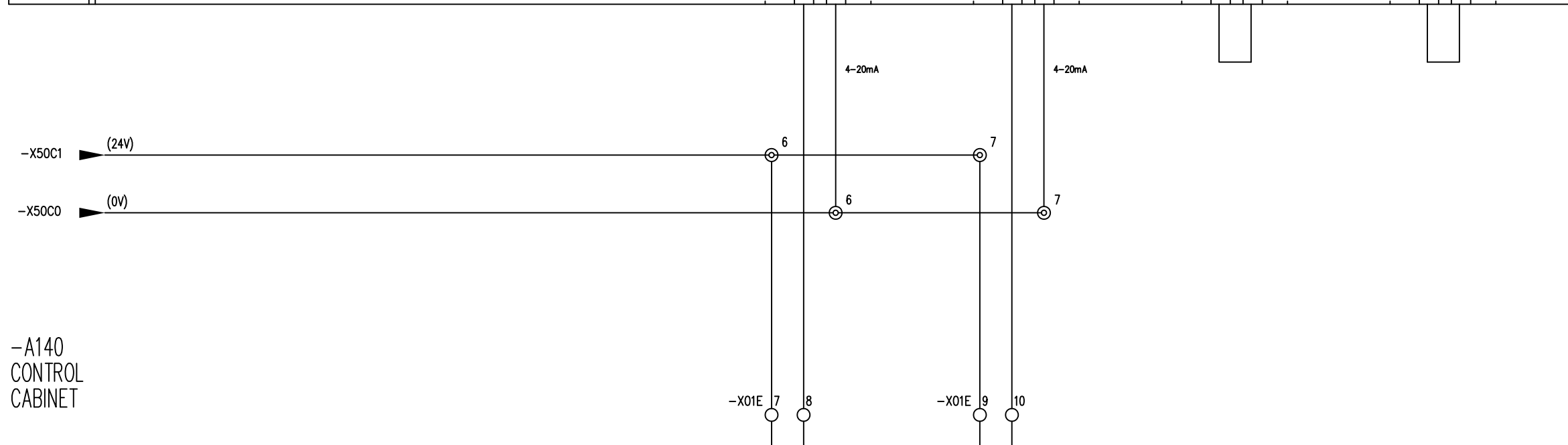
Project: 11857 ShipsEquipment-Ray Shipping
Debtor: 66236 TTS SHIPS EQUIPMENT AS
Hull Number:
Machine Number: 11857

Draw number: 11857E28 Drawing revision: 0
Item No.: X11857E28 EL CONTROL SYSTEM
Item group: DRAW DRAWING
CustDocNo

Pos.	Tag	Qty.	Item name	Item No.	Drawing Reference
	-U320	1,00	VALVE CONTROLLER CARD	50838	
	-U320.1	1,00	SOCKET FOR VALVE CONTROLLER CA	501739	
	-U320.2	1,00	SPRING HOLDER F/VALVE CONTROLL	501740	
	-U321	1,00	VALVE CONTROLLER CARD	50838	
	-U321.1	1,00	SOCKET FOR VALVE CONTROLLER CA	501739	
	-U321.2	1,00	SPRING HOLDER F/VALVE CONTROLL	501740	
	-U322	1,00	VALVE CONTROLLER CARD	50838	
	-U322.1	1,00	SOCKET FOR VALVE CONTROLLER CA	501739	
	-U322.2	1,00	SPRING HOLDER F/VALVE CONTROLL	501740	
	-U323	1,00	VALVE CONTROLLER CARD	50838	
	-U323.1	1,00	SOCKET FOR VALVE CONTROLLER CA	501739	
	-U323.2	1,00	SPRING HOLDER F/VALVE CONTROLL	501740	

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				30.03.10 MMN

DESCRIPTION	PRESSURE TRANSMITTER BOOST ACCUM.	PRESSURE TRANSMITTER BRAKE ACCUM.	CURRENT/VOLTAGE INPUT SELECT	CURRENT/VOLTAGE INPUT SELECT
CONTROLLER	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE
I/O CARD	-D301.3/2 AI	-D301.3/2 AI	-D301.3/2 AI	-D301.3/2 AI
SIGN./ADD.	CIO 3205	CIO 3206		
TERM.SIGN.	0+ 0-	1+ 1-	SHT0A SHT0B	SHT1A SHT1B
TERMINAL	A2 A3	B2 B3	A5 A6	B5 B6



-A140
CONTROL
CABINET

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 400 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	X03C1
J: 110 / 120 VAC	Terminal list no.3 w.
K: 24 VAC	+24 VDC terminals
L: Special	
M: 440 / 450 VAC	

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Designed 25.11.09	Approved	Projection 1:1	Scale 1:1
Drawn 25.11.09 MMN		Format A1	

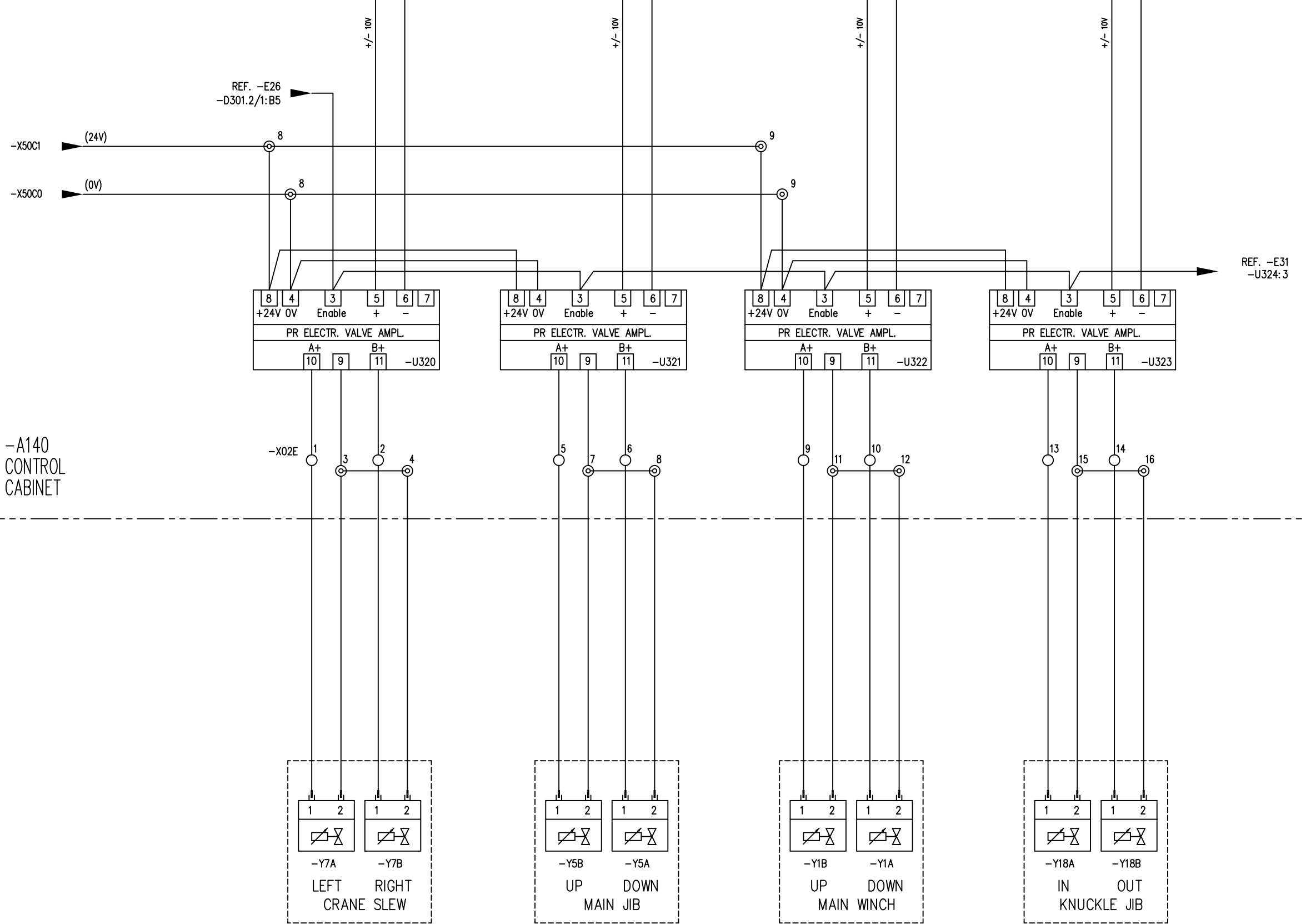


Replaces:	Replaced by:
AutoCAD file: 11857E29	Rev. 0
11857E29	0

REF.DWG : -C12

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10			MMN

DESCRIPTION	PROP. VALVE CRANE SLEW	PROP. VALVE MAIN JIB	PROP. VALVE MAIN WINCH	PROP. VALVE KNUCKLE JIB
CONTROLLER	SMART SLICE	SMART SLICE	SMART SLICE	SMART SLICE
I/O CARD	-D301.4/1	-D301.4/1	-D301.4/2	-D301.4/2
SIGN./ADD.	CIO 3501	CIO 3502	CIO 3503	CIO 3504
TERM.SIGN.	VO+ VO-	VI+ VI-	VO+ VO-	VI+ VI-
TERMINAL	A4 A5	B4 B5	A4 A5	B4 B5



ITEM					
-U320/-U321/-U322/-U323					
UAL	CUA	CUB	RAN	PAR	PRO
PAS: 030	LOA: 41.7	LOB: 41.7	ON: 000	REU: 000	PF: 0.15
	1A1: 99.9	1B1: 99.0	UP: 0.00	DOD: 01.0	IF: 0.50
	1A2: 99.9	1B2: 99.0	DO: 0.00	FRQ: 100	CA: 0.72
DP1-ON			DP1-OFF		
1,2,6,8			3,4,5,7		
JUMPER-JP1					
2-3					

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

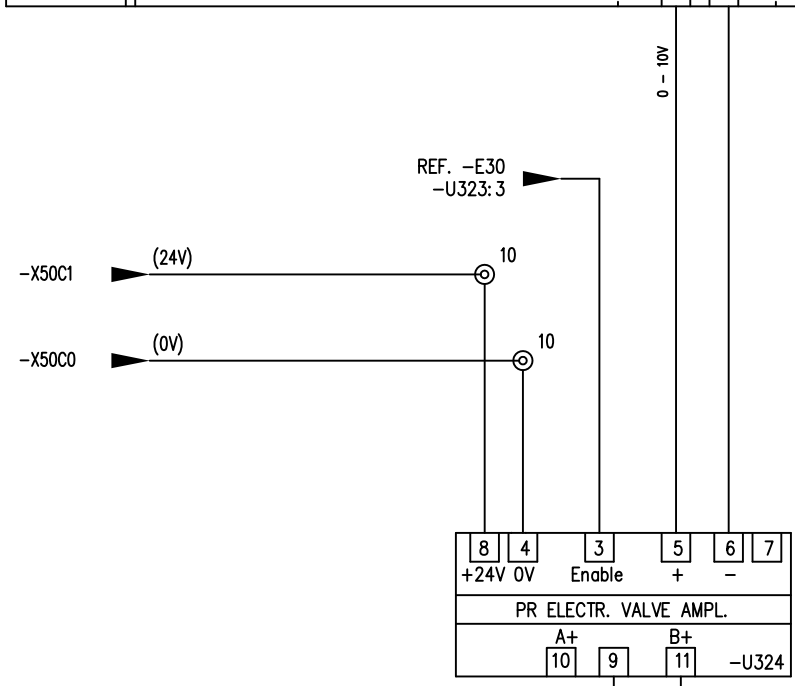
WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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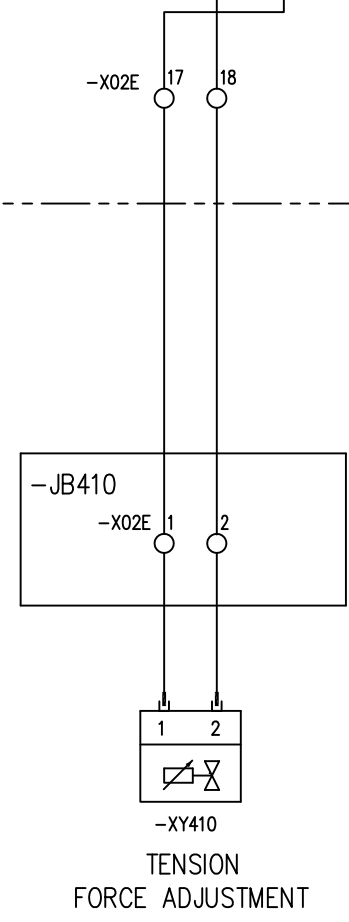
Designed 14.01.10	Approved 30.03.10 MMN	Projection 1:1	Scale A1	
Drawn 14.01.10 MMN	Replaces:	Format A1	Replaced by:	
EL. CONTROL SYSTEM ANALOG OUTPUT EL. CIRCUIT DIAGRAM				AutoCAD file: 11857E30
REF.DWG :				11857E30
-C10				Rev. 0

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				30.03.10 MN

DESCRIPTION		PROP. VALVE TENSION FORCE ADJUSTMENT		SPARE	
CONTROLLER		SMART SLICE		SMART SLICE	
I/O CARD		-D301.4/3		-D301.4/3	
SIGN./ADD.		CIO 3505		CIO 3506	
TERM.SIGN.		v0+ v0-		v1+ v1-	
TERMINAL		A4 A5		B4 B5	



-A140 CONTROL CABINET



ITEM -U324					
UAL	CJA	CUB	RAN	PAR	PRO
PAS: 030	LOA: 22.0	LOB: 22.0	ON: 000	REU: 000	PF: 0.15
	1A1: 99.9	1B1: 99.0	UP: 0.00	DOD: 01.0	IF: 0.50
	1A2: 99.9	1B2: 99.0	DO: 0.00	FRQ: 1.30	
				GA: 0.68	
	DP1-ON: 6		DP1-OFF: 1,2,3,4,5,7,8		
	JUMPER-JP1 2-3				

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 400 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	X03C1
J: 110 / 120 VAC	Terminal list no.3 w. +24 VDC terminals
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

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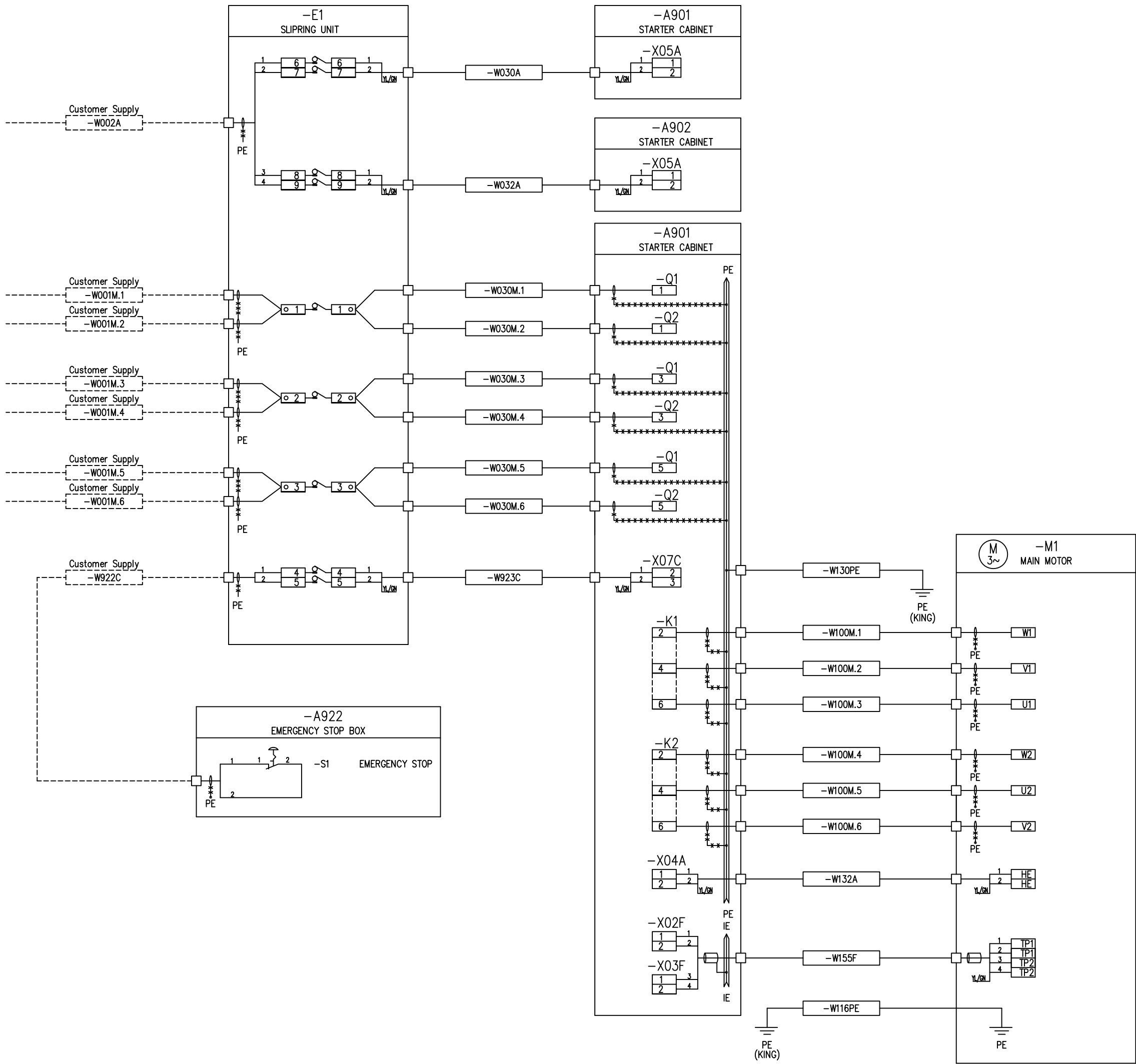
Designed 14.01.10	Approved	Projection 1:1	Scale A1	
Drawn 14.01.10 MN		Format A1		

Replaces:	Replaced by:
AutoCAD file: 11857E30	Rev. 0
11857E31	

REF.DWG : _____ -C10

EL. CONTROL SYSTEM
ANALOG OUTPUT
EL. CIRCUIT DIAGRAM

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	29.03.10	MMN		



REF.DWG :
-ES3
-ES1
-ES2
-ES1

CABLE SUPPLY AND LAY OUT BY CUSTOMER

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	Q: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 400 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	X03C1
J: 110 / 120 VAC	Terminal list no.3 w.
K: 24 VAC	+24 VDC terminals
L: Special	
M: 440 / 450 VAC	

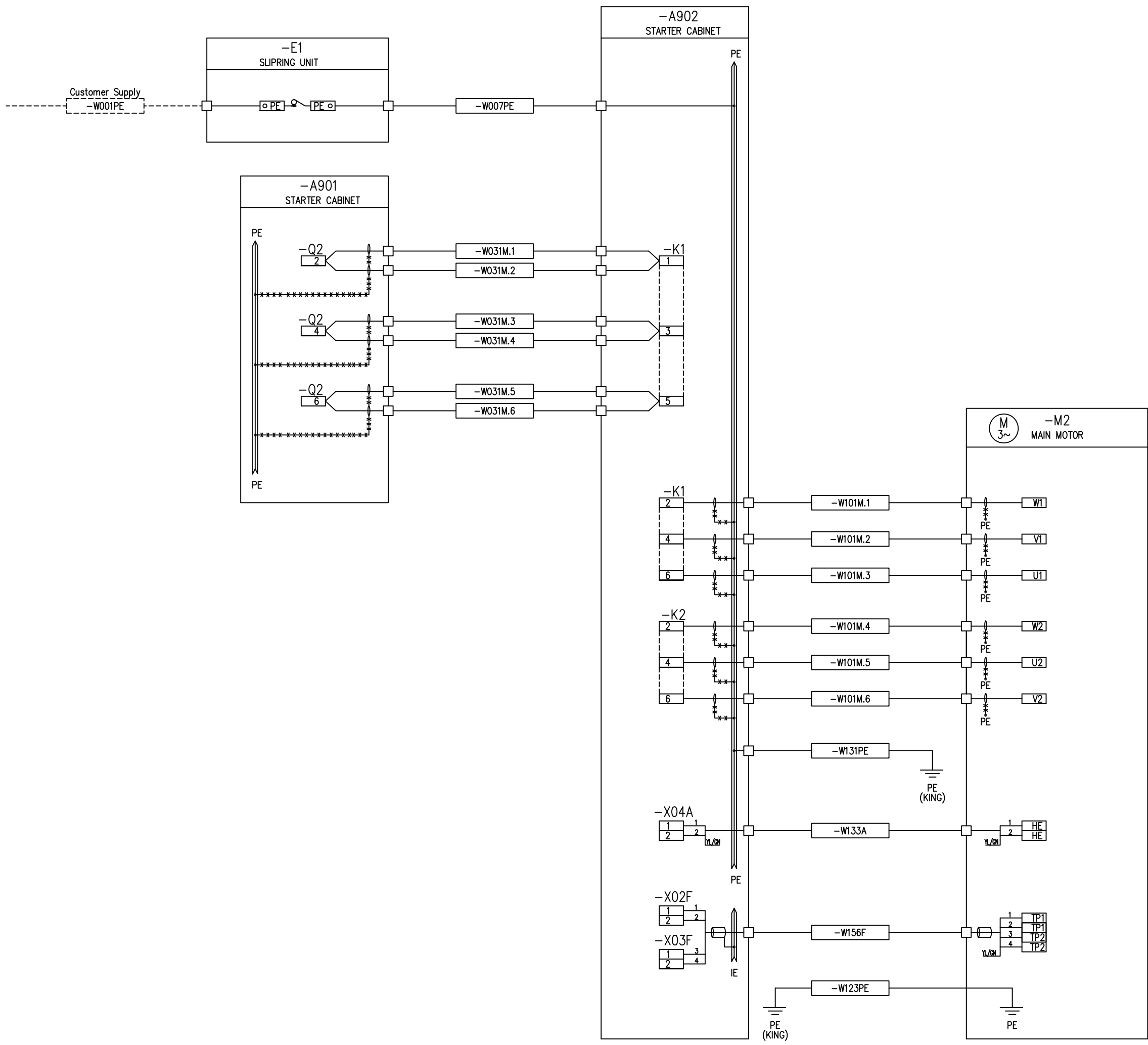
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Designed 09.12.09	Approved 29.03.10	Projection MMN	Scale 1:1	
Drawn 09.12.09	MMN	Format A1	Replaces:	

EL. CONTROL SYSTEM
ELECTRICAL
CABLE WIRING DIAGRAM

AutoCAD file: 11857C01
11857C01

Replaced by:
Rev. 0



REF.DWG :

-ESI/ES3

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				
					29.03.10 MMN

CABLE SUPPLY AND LAY OUT BY CUSTOMER

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

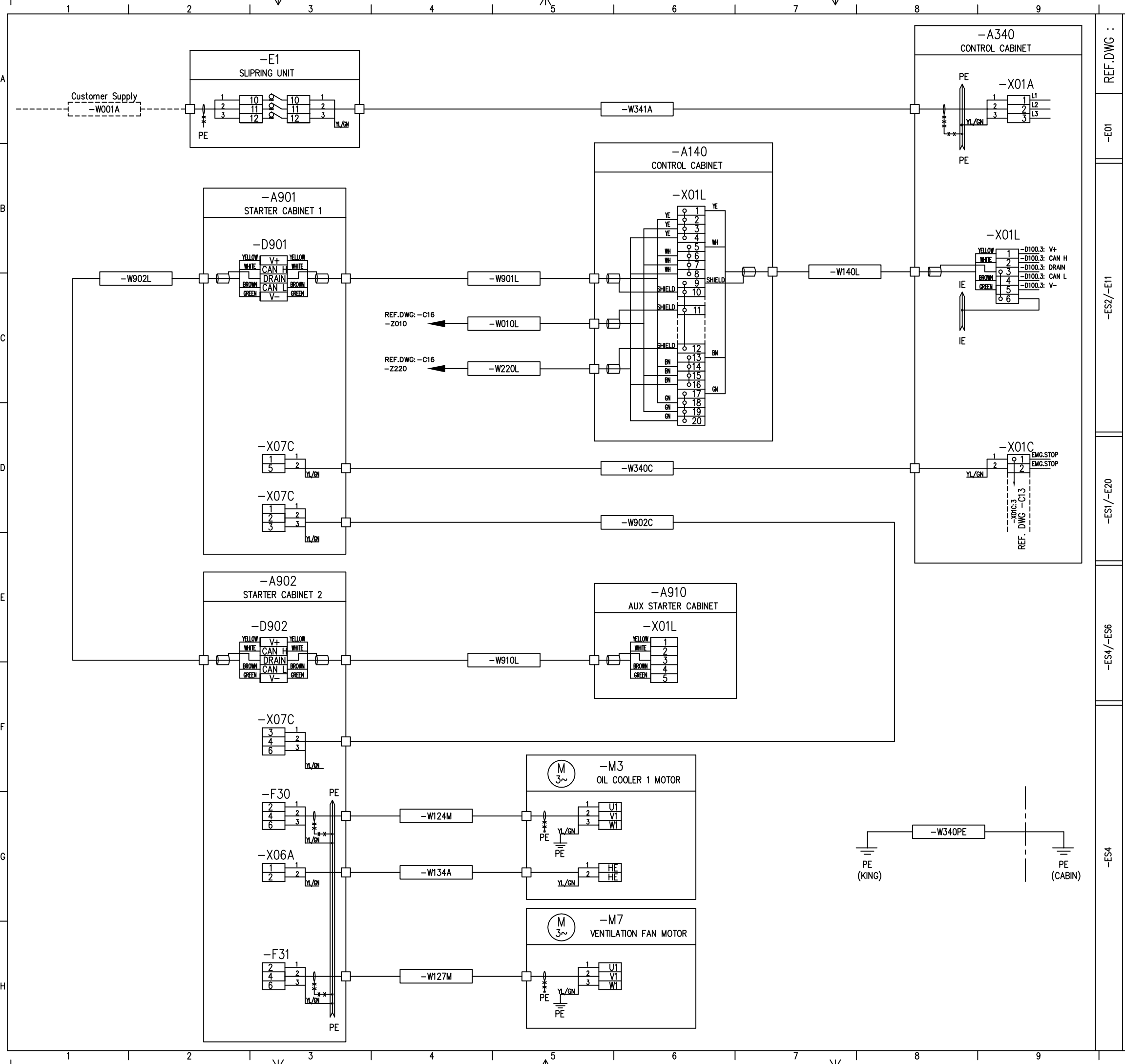
WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	Q: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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Designed 09.12.09	Approved 29.03.10 MMN	Projection A1	Scale 1:1	
Drawn 09.12.09 MMN		Format A1		

EL. CONTROL SYSTEM ELECTRICAL CABLE WIRING DIAGRAM	Replaces:	Replaced by:
	AutoCAD file: 11857C02	Rev. 0
	11857C02	

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	29.03.10	MMN		
1	GENERAL UPD.	28.05.10	MMN		
2	MODIFICATION 861185	11.04.12	ARB		



REF.DWG :

-E01

-ES2/-E11

-ES1/-E20

-ES4/-ES6

-ES4

▽ SPARE CABLE CORE.
TO BE CUTTED AND INSULATED

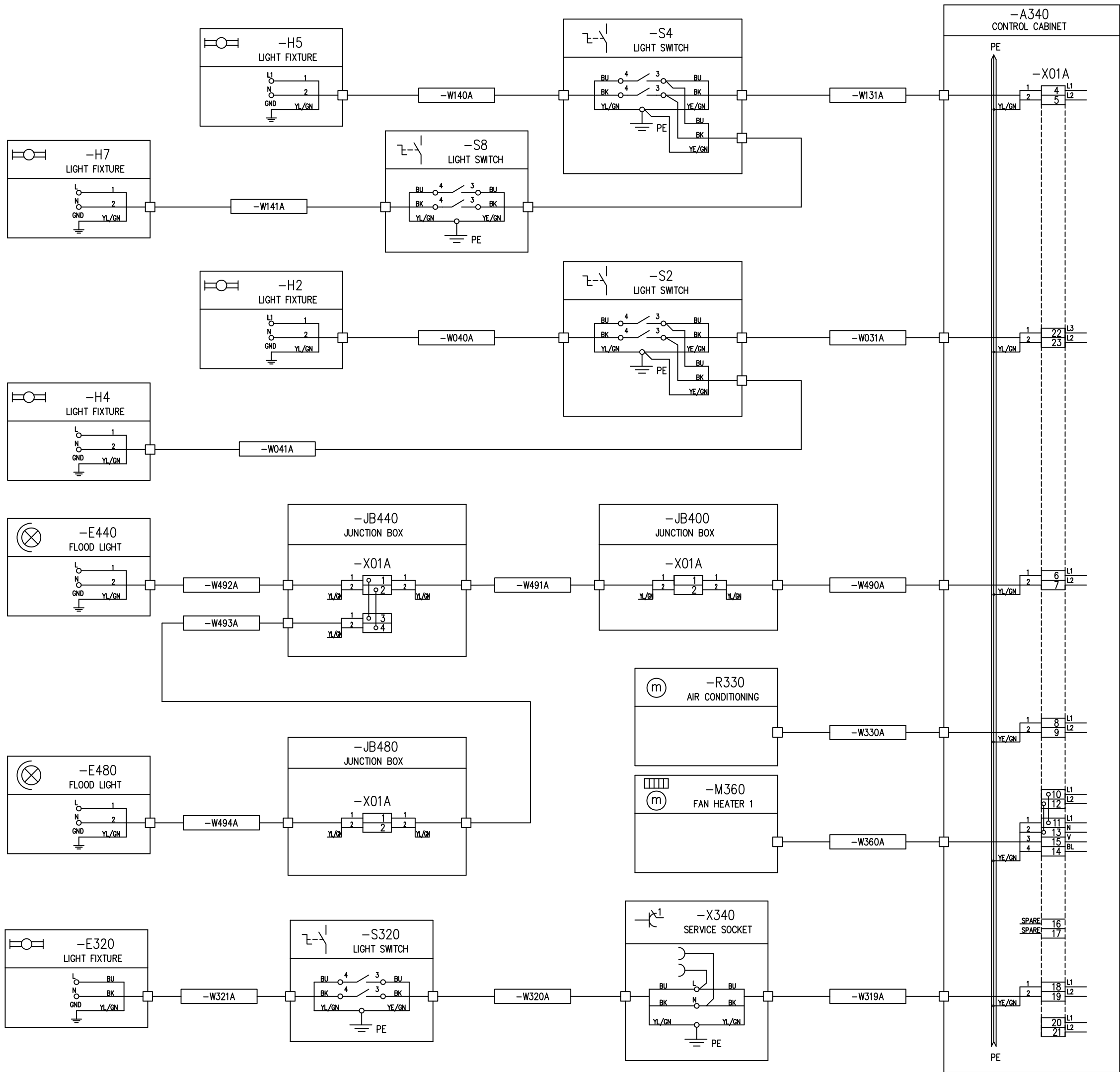
CABLE SUPPLY
AND LAY OUT
BY CUSTOMER

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	0: 680 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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Designed 09.12.09	Approved 29.03.10 MMN	Projection Scale 1:1	
Drawn 09.12.09 MMN	Format A1	Replaces:	
ELECTRICAL CONTROL SYSTEM CABLE WIRING DIAGRAM			Replaced by: AutoCAD file: 11857C03 11857C03
			Rev. 2



REF.DWG :
-E02
-E03, -E04

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	29.03.10	MMN		
1	TERM. NO. -X01A UPD.	16.04.10	MMN		

CABLE SUPPLY
AND LAY OUT
BY CUSTOMER

Ver.1/2000

VENDORS CABLE / TERMINAL-LIST CODING:	
WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	Q: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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Designed 30.11.09	Approved 29.03.10 MMN	Projection Scale 1:1	
Drawn 30.11.09 MMN	Format A1	Replaces: Replaced by:	

EL. CONTROL SYSTEM
ELECTRICAL
CABLE WIRING DIAGRAM

AutoCAD file: 11857C04
11857C04

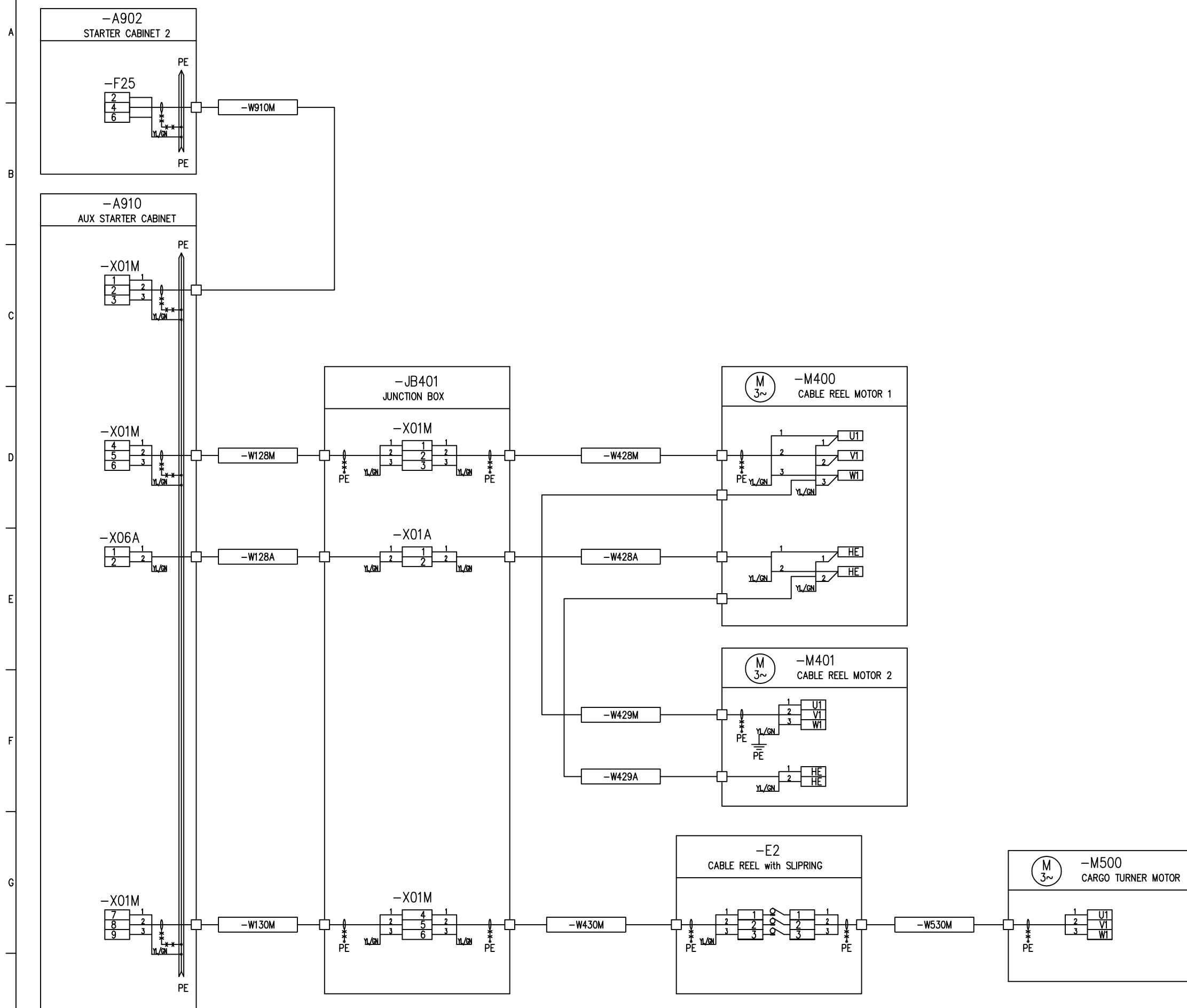
Rev. 1

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	MODIFICATION 861185	13.04.12 ARB			

REF.DWG :

-ES3

-ES5



▽ SPARE CABLE CORE.
TO BE CUTTED AND INSULATED

----- CABLE SUPPLY
AND LAY OUT
BY CUSTOMER

VENDORS CABLE / TERMINAL-LIST CODING: Ver.I/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 680 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w.
L: Special	+24 VDC terminals
M: 440 / 450 VAC	

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Designed 13.04.12	Approved 13.04.12 ARB	Projection Scale 1:1	
Drawn 13.04.12 ARB	Format A1	Replaces:	
EL. CONTROL SYSTEM ELECTRICAL CABLE WIRING DIAGRAM			Replaced by: AutoCAD file: 11857C05 11857C05
			Rev. 0

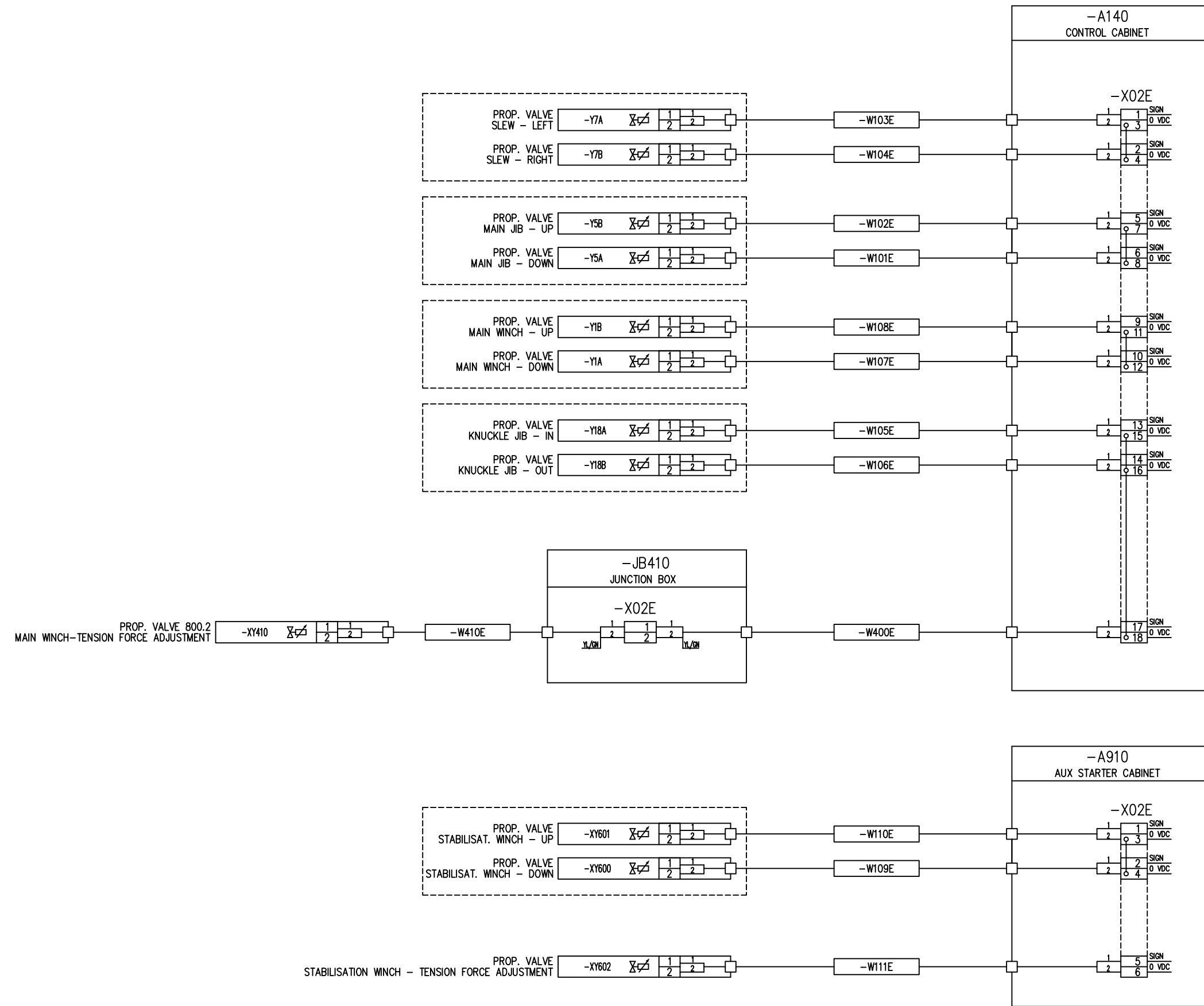
Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10 MMN			
1	MODIFICATION 861185	10.04.12 ARB			

REF.DWG :

-E30

-E31

-E37



CABLE SUPPLY AND LAY OUT BY CUSTOMER

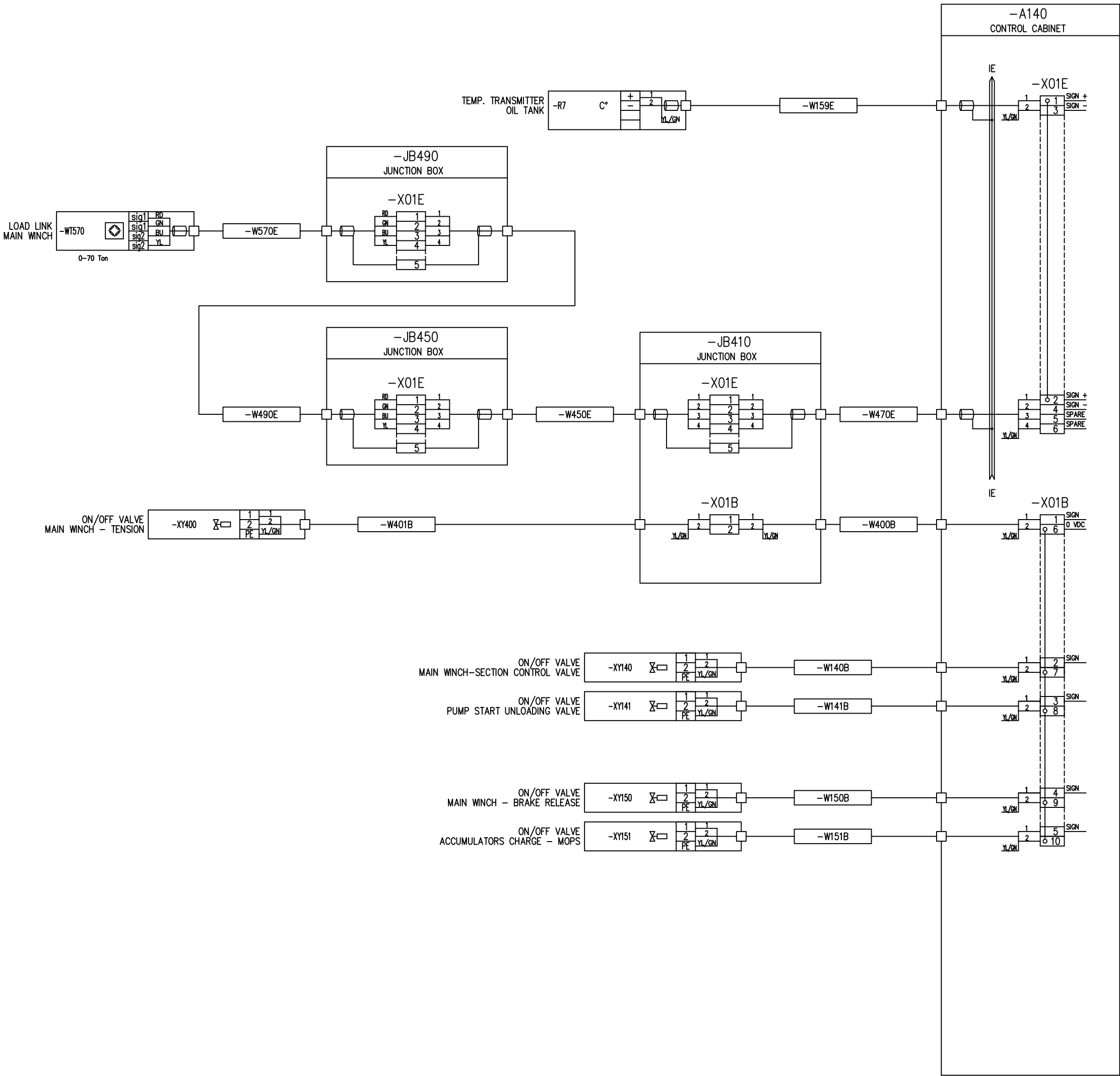
VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	0: 680 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	EXAMPLES:
H: 220 / 230 VDC	W14G
I: EEX(I) circuits	Cable no.14 w.380 VAC
J: 110 / 120 VAC	X03C1
K: 24 VAC	Terminal list no.3 w. +24 VDC terminals
L: Special	
M: 440 / 450 VAC	

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Designed 28.11.09	Approved 30.03.10 MMN	Projection Scale 1:1	
Drawn 28.11.09 MMN	Format A1	Replaces: Replaced by:	
EL. CONTROL SYSTEM INSTRUMENT CABLE WIRING DIAGRAM			AutoCAD file: 11857C10 11857C10 Rev. 1

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				30.03.10 MMN



REF.DWG :

-E28

-E26

CABLE SUPPLY AND LAY OUT BY CUSTOMER

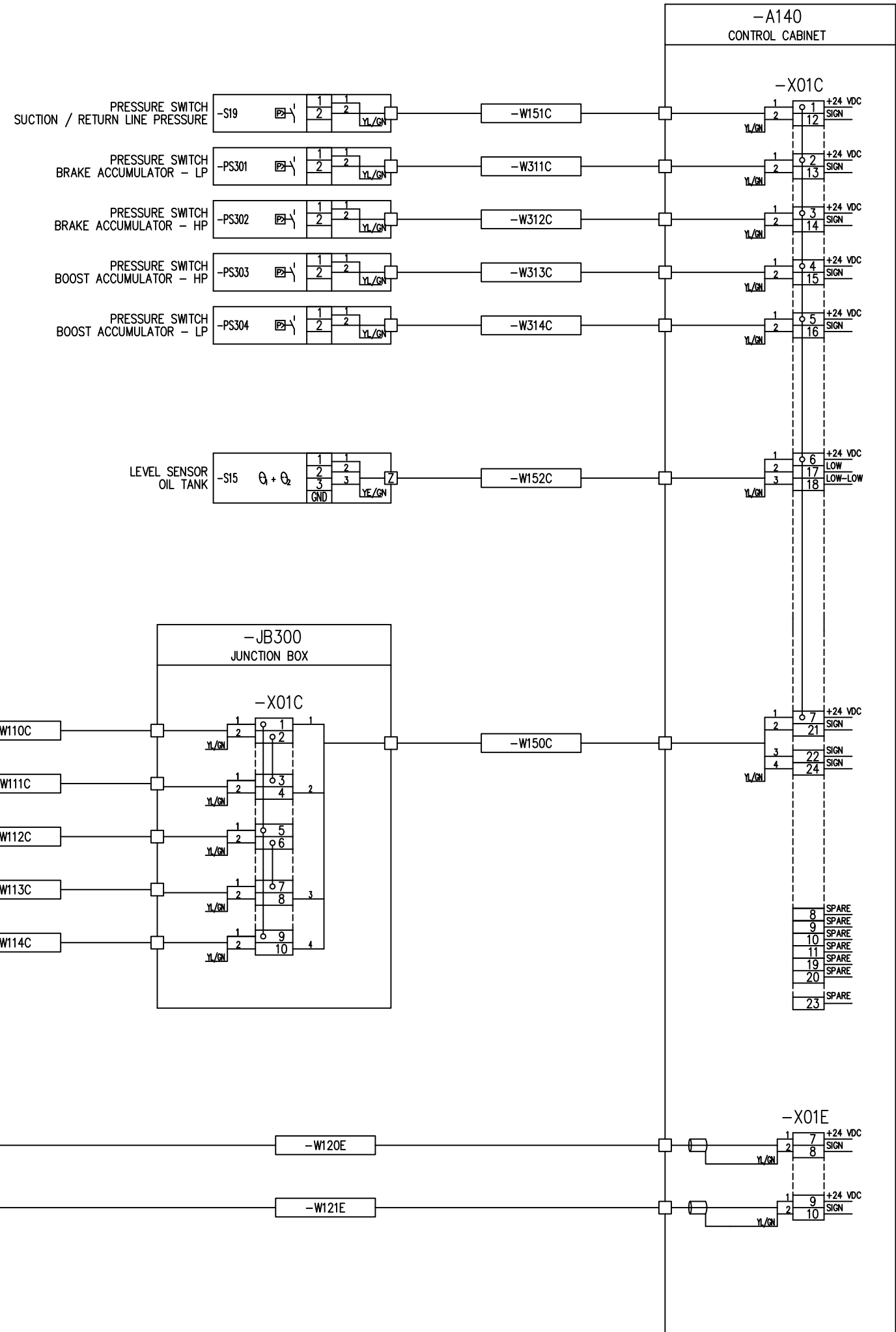
VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	Q: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 400 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	X03C1
J: 110 / 120 VAC	Terminal list no.3 w.
K: 24 VAC	+24 VDC terminals
L: Special	
M: 440 / 450 VAC	

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Designed 28.11.09	Approved 30.03.10 MMN	Projection Scale 1:1	
Drawn 28.11.09 MMN	Format A1	Replaces:	
EL. CONTROL SYSTEM INSTRUMENT CABINET CABLE WIRING DIAGRAM			Replaced by:
AutoCAD file: 11857C11			Rev. 0
11857C11			

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	30.03.10	MMN		
1	UPD.CONN.FEEDB.SW	23.04.10	MMN		



REF.DWG :

-E22

-E23

-E29

CABLE SUPPLY AND LAY OUT BY CUSTOMER

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	Xnn[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	Q: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 400 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	X03C1
J: 110 / 120 VAC	Terminal list no.3 w.
K: 24 VAC	+24 VDC terminals
L: Special	
M: 440 / 450 VAC	

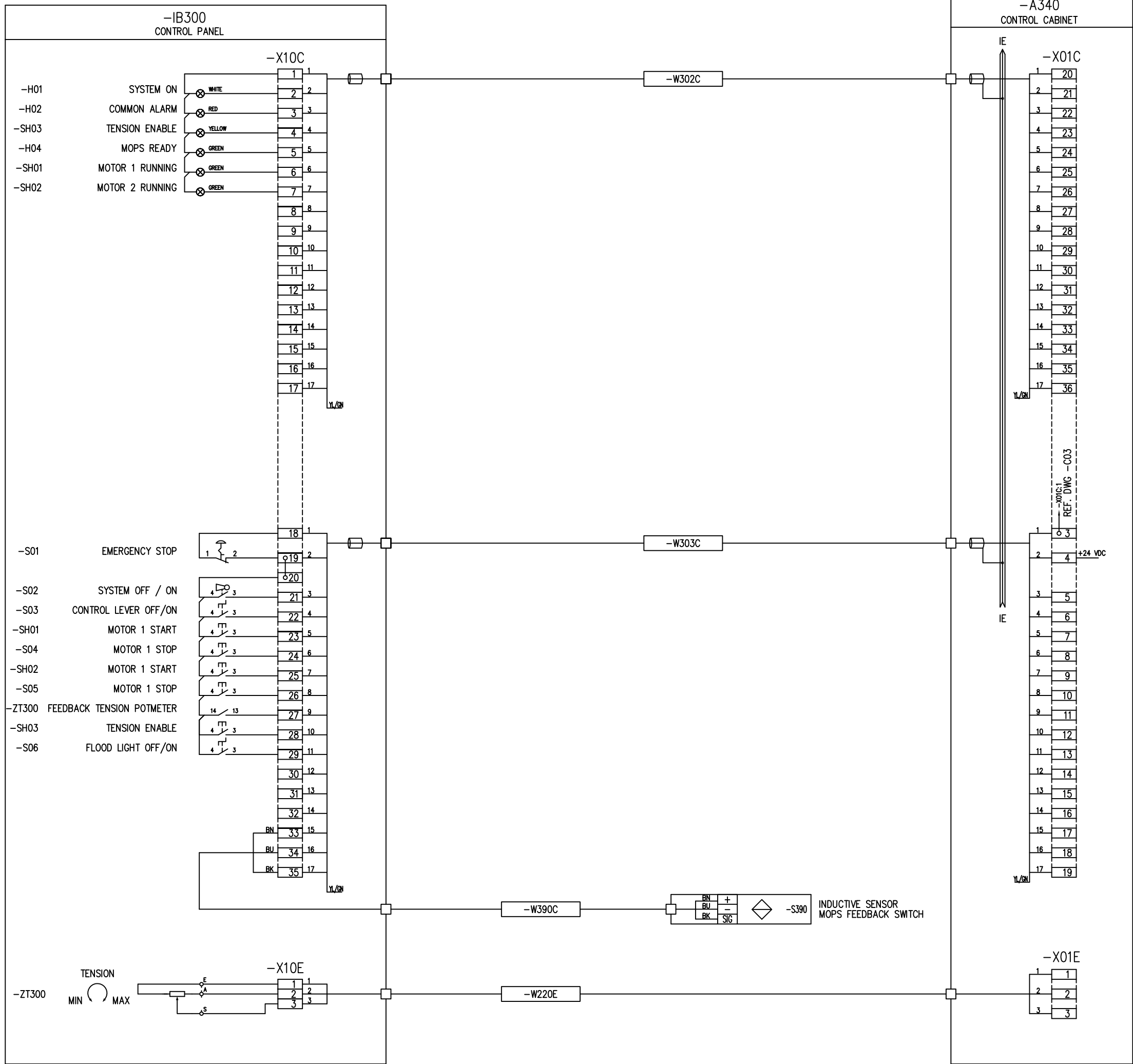
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Designed 28.11.09	Approved 30.03.10 MMN	Projection Scale 1:1		Replaces:	Replaced by:
Drawn 28.11.09 MMN	Format A1	AutoCAD file: 11857C12		Rev. 1	

EL. CONTROL SYSTEM
INSTRUMENT
CABLE WIRING DIAGRAM

11857C12

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				30.03.10 MMN
1					



REF.DWG :
-E24
-E20
-E02
-E21
-E27

CABLE SUPPLY AND LAY OUT BY CUSTOMER

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

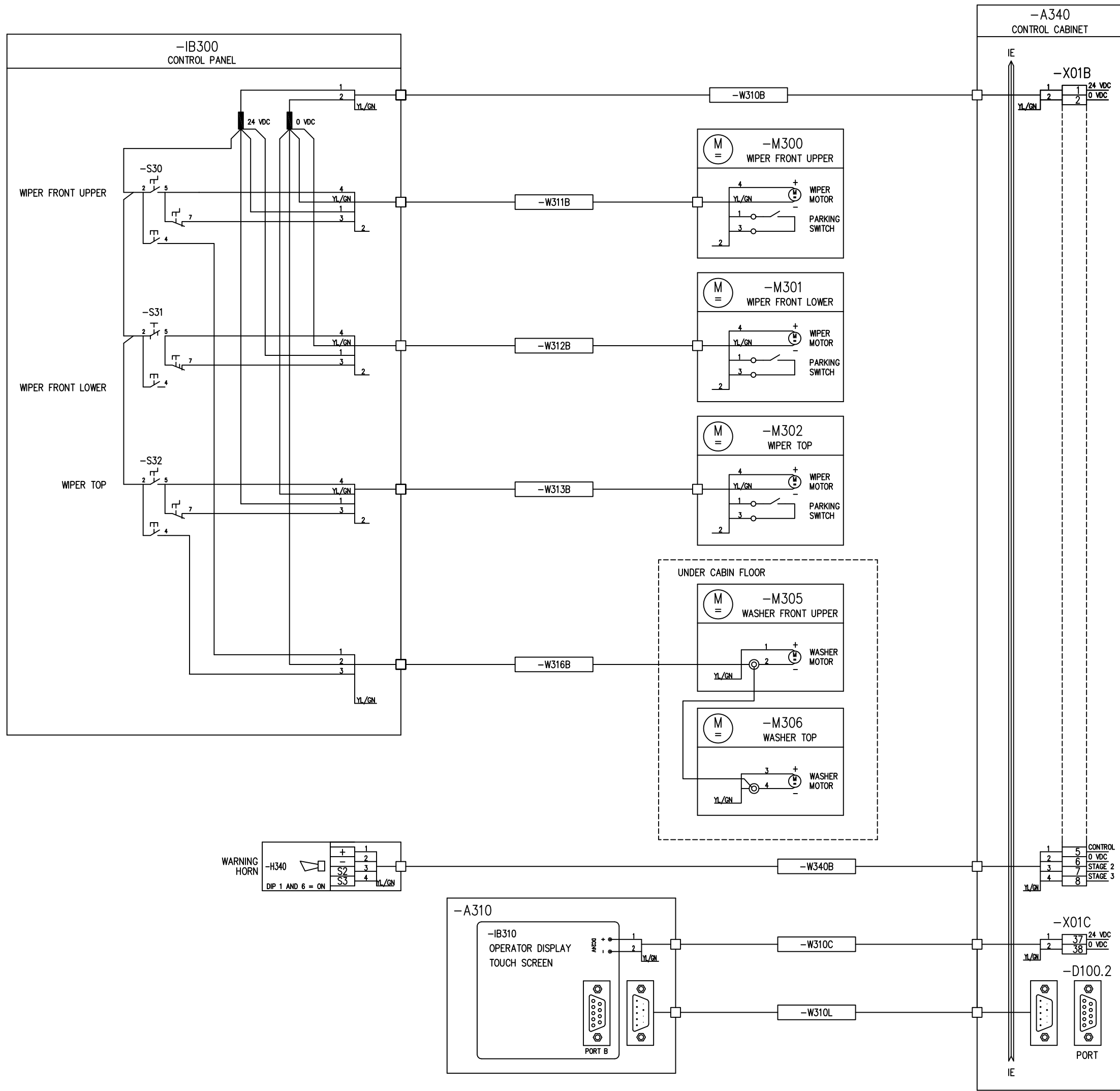
WnnY	Xny[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	Q: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	
I: EEX(I) circuits	
J: 110 / 120 VAC	
K: 24 VAC	
L: Special	
M: 440 / 450 VAC	

EXAMPLES:
W14G
Cable no.14 w.380 VAC
X03C1
Terminal list no.3 w. +24 VDC terminals

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Designed: 28.11.09
Approved: 30.03.10 MMN
Projection: 1:1
Scale: 1:1
Format: A1
Drawn: 28.11.09 MMN
Replaces: TTS Marine ASA
Replaced by:
AutoCAD file: 11857C13
Rev. 11857C13 1

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				30.03.10 MMN



REF.DWG :
-E05
-E25
-E10

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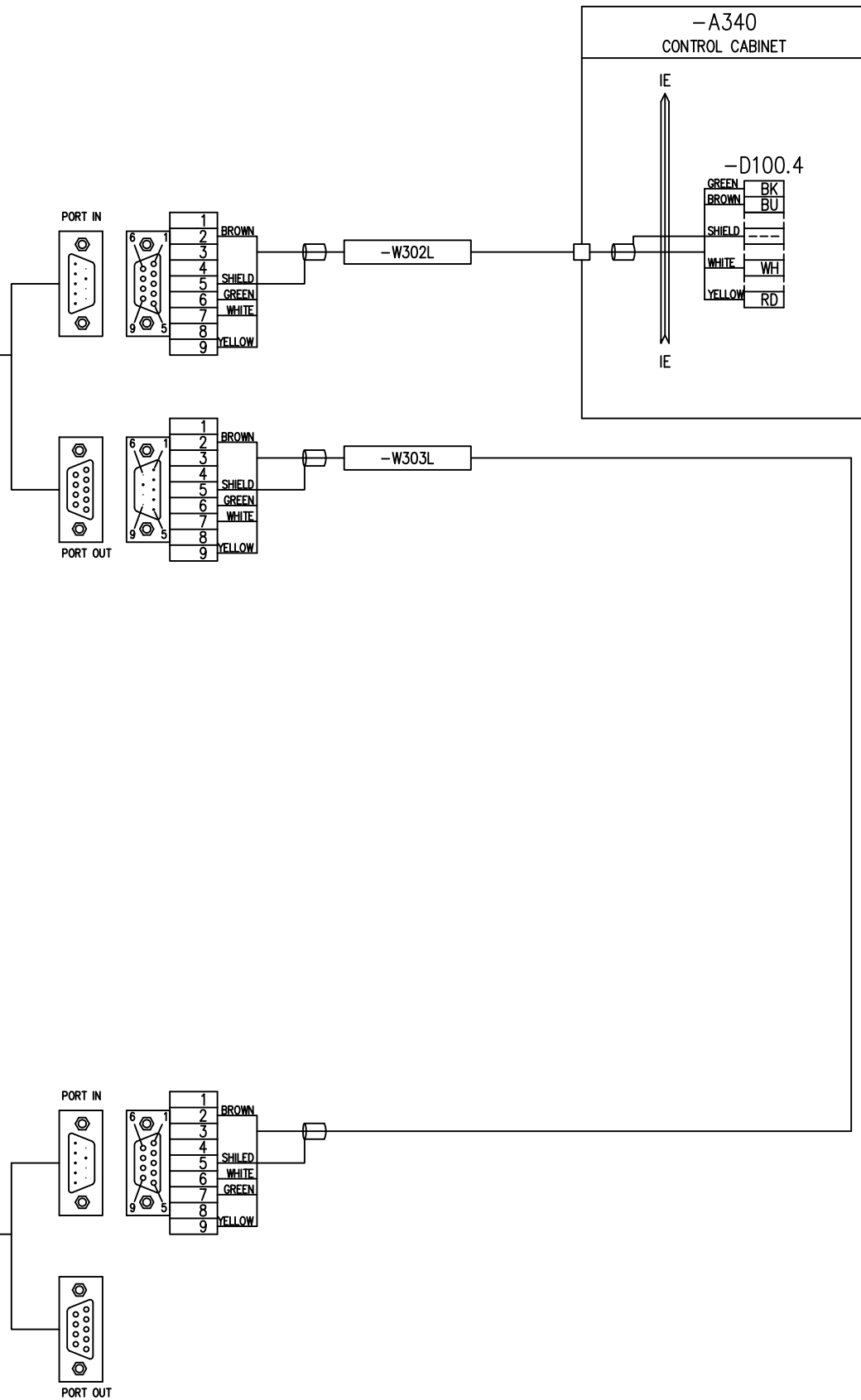
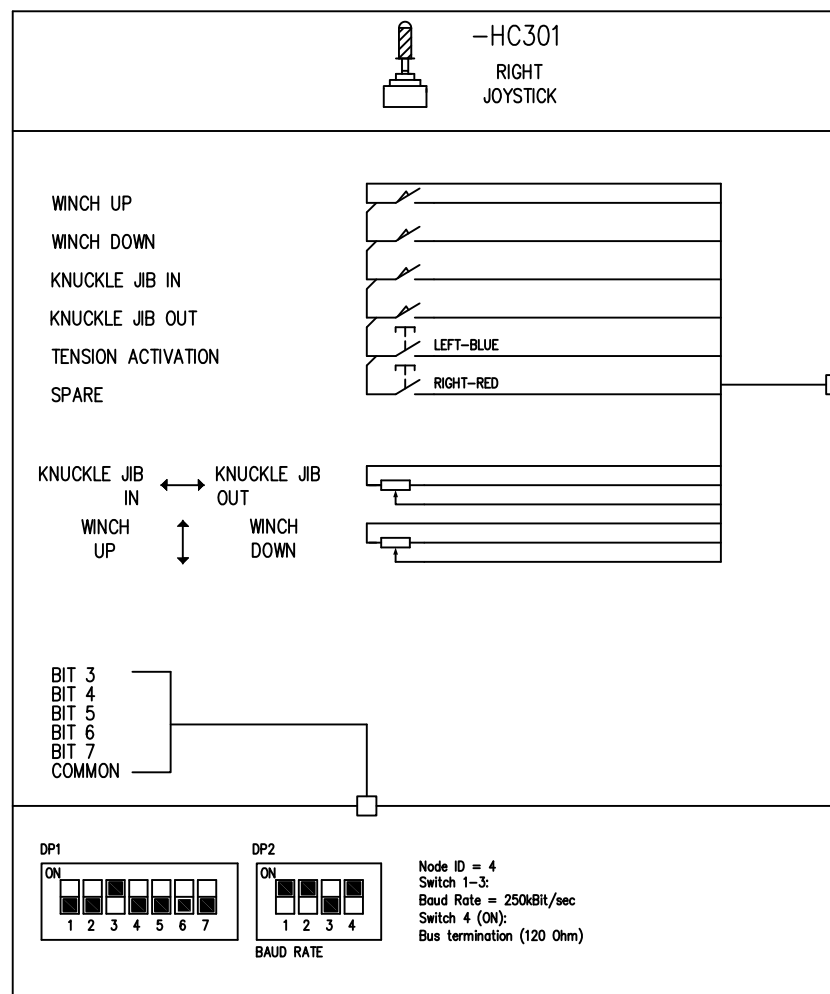
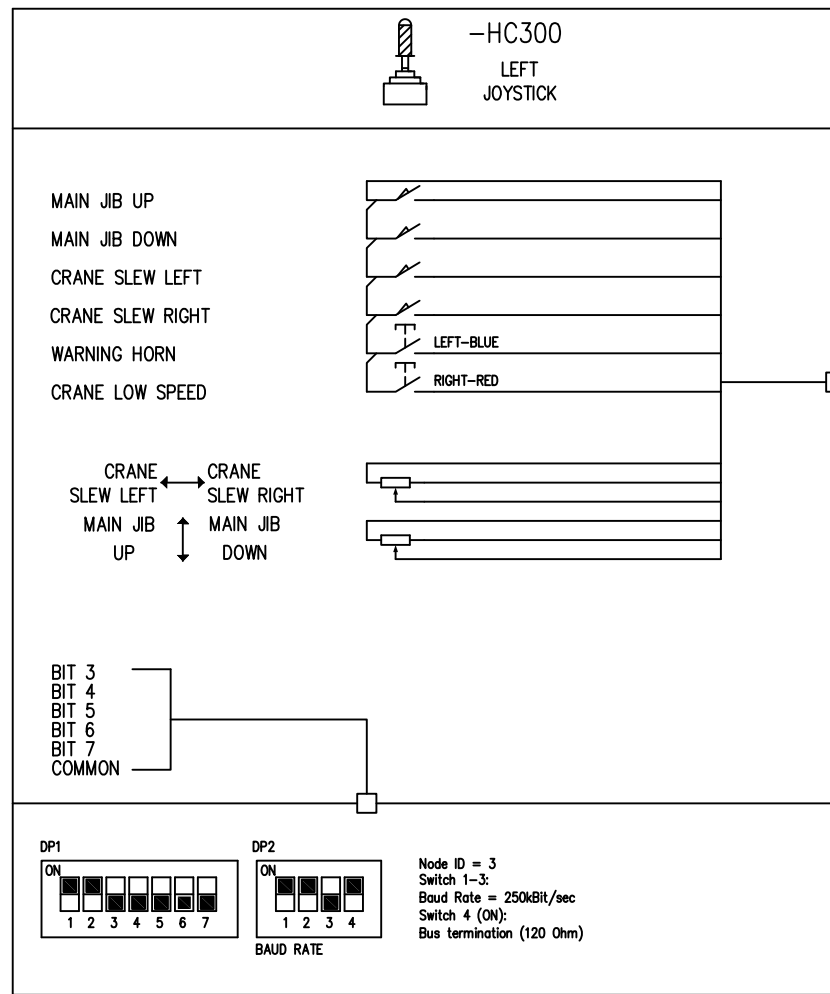
Designed 28.11.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1	
Drawn 28.11.09 MMN	Replaces:	Format	Replaced by:	

EL. CONTROL SYSTEM
INSTRUMENT
CABLE WIRING DIAGRAM

AutoCAD file: 11857C14
11857C14

Rev. 0

Rev.	Description of revision	Date / Sign.	Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION				30.03.10 MMN



REF.DWG :

-E13

-D100.4 connector color assignment
 0V: BLACK
 CAN-: BLUE
 CAN+: WHITE
 +24V: RED

CANbus cable color assignment
 Pin 9: +24V: YELLOW
 Pin 6: 0V: GREEN
 Pin 7: CAN+: WHITE
 Pin 2: CAN-: BROWN

CABLE SUPPLY AND LAY OUT BY CUSTOMER

VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	O: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	
G: 380 / 400 VAC	
H: 220 / 230 VDC	EXAMPLES:
I: EEX(I) circuits	W14G
J: 110 / 120 VAC	Cable no.14 w.380 VAC
K: 24 VAC	X03C1
L: Special	Terminal list no.3 w. +24 VDC terminals
M: 440 / 450 VAC	

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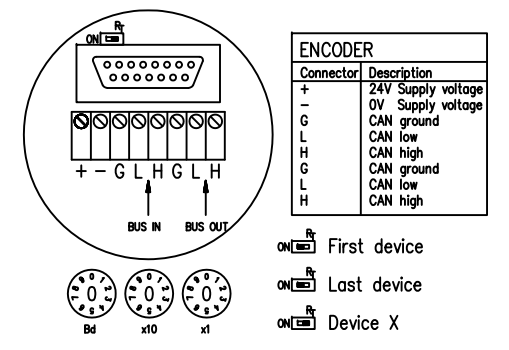
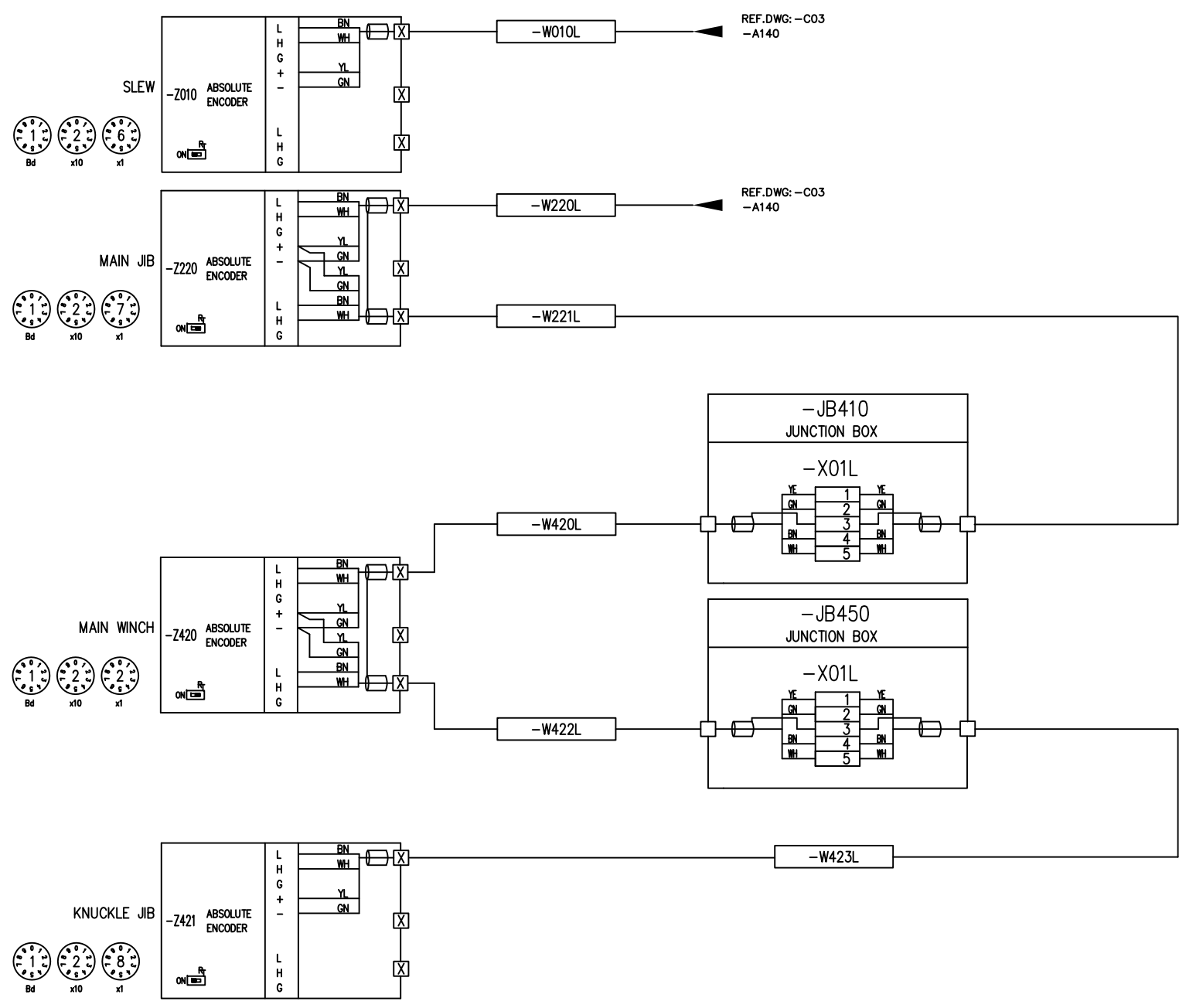
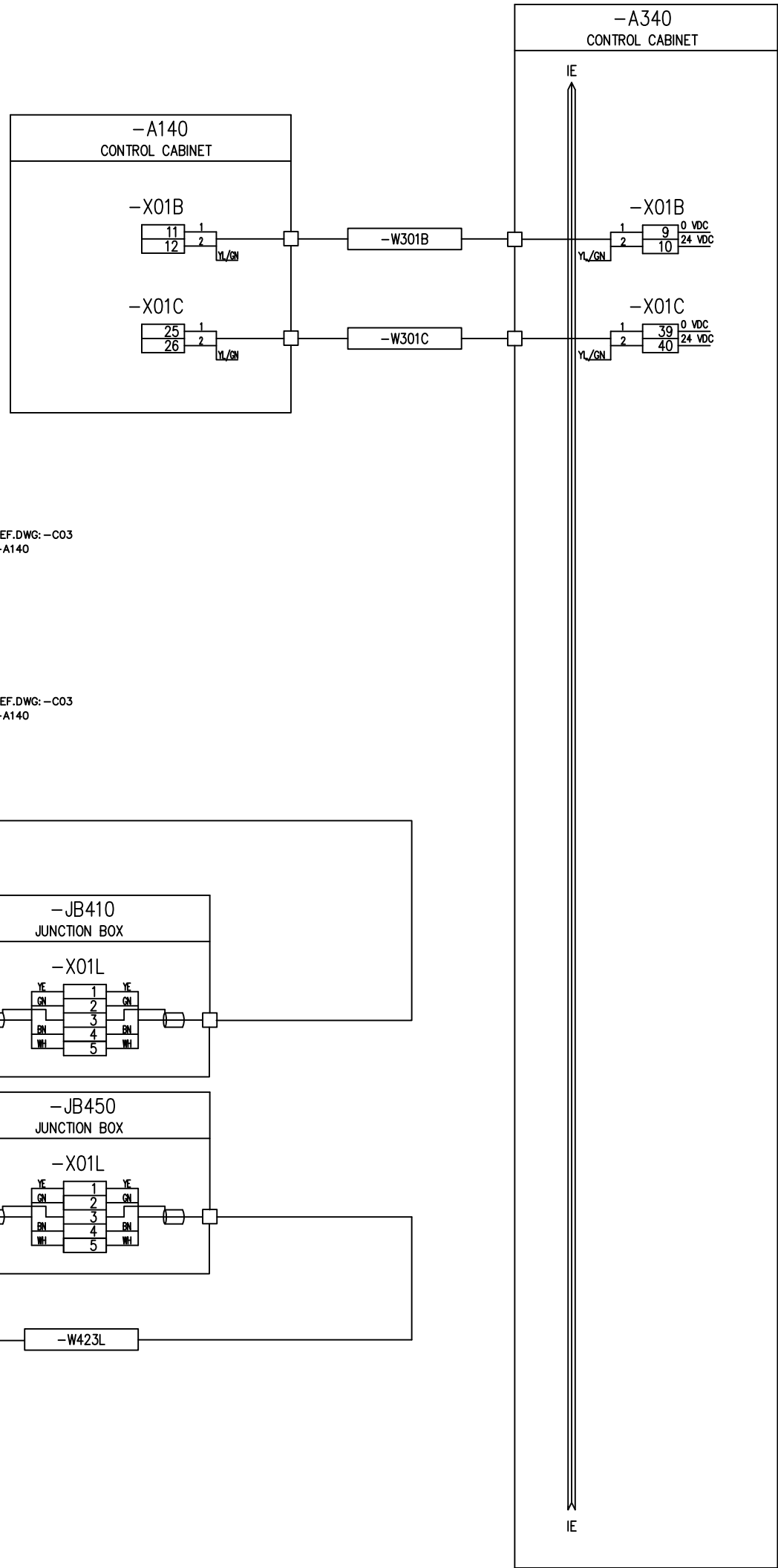
Designed 04.12.09	Approved 30.03.10 MMN	Projection 1:1	Scale A1		Replaces:	Replaced by:
Drawn 04.12.09 MMN					AutoCAD file: 11857C15	Rev. 0

EL. CONTROL SYSTEM
 INSTRUMENT
 CABLE WIRING DIAGRAM

11857C15

REF.DWG :
-E01

-E12



DeviceNet cable color assignment

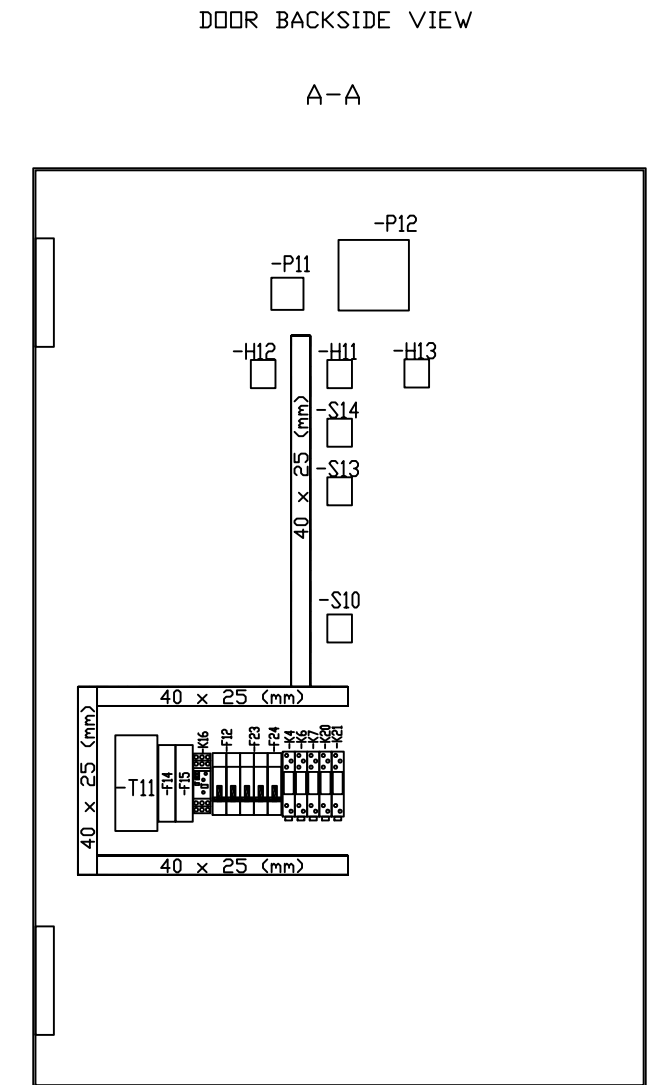
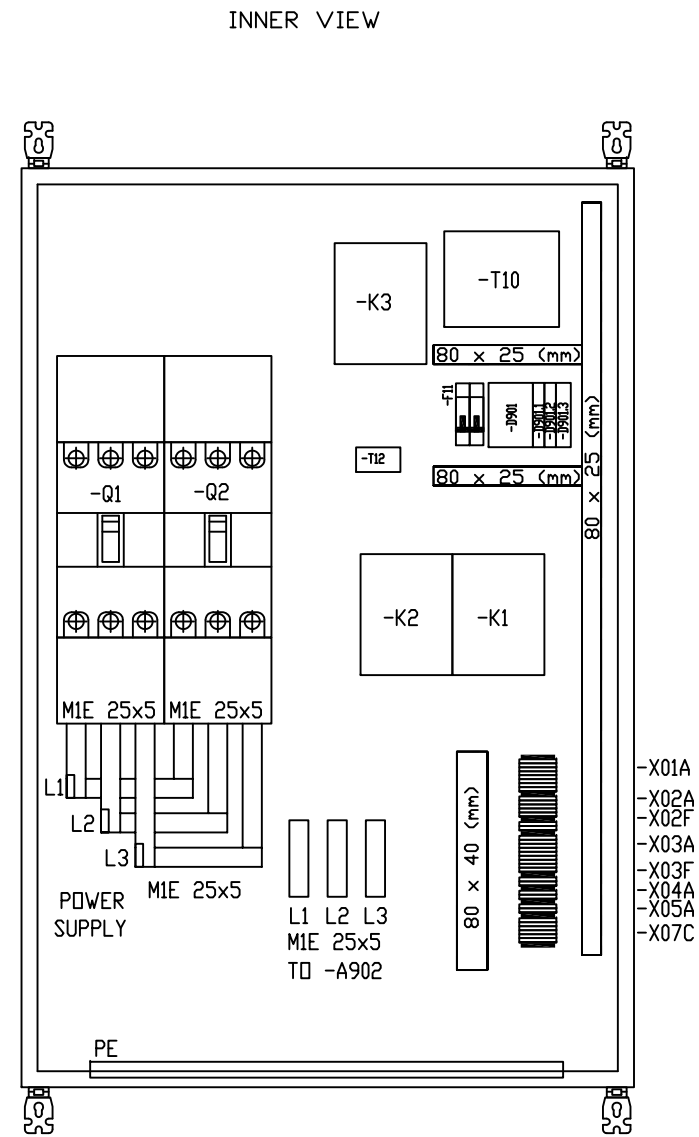
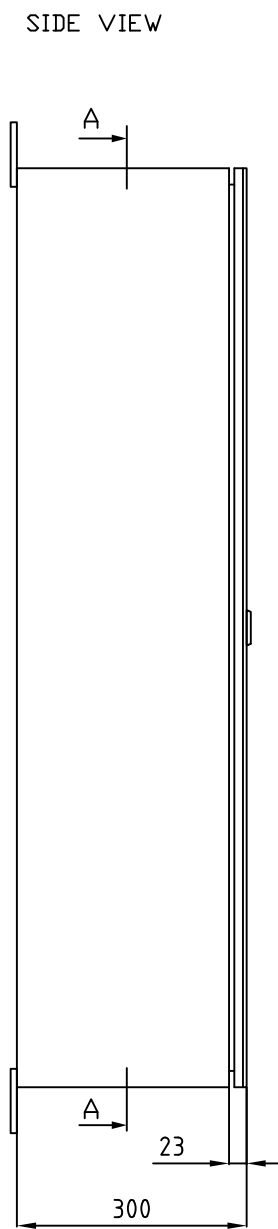
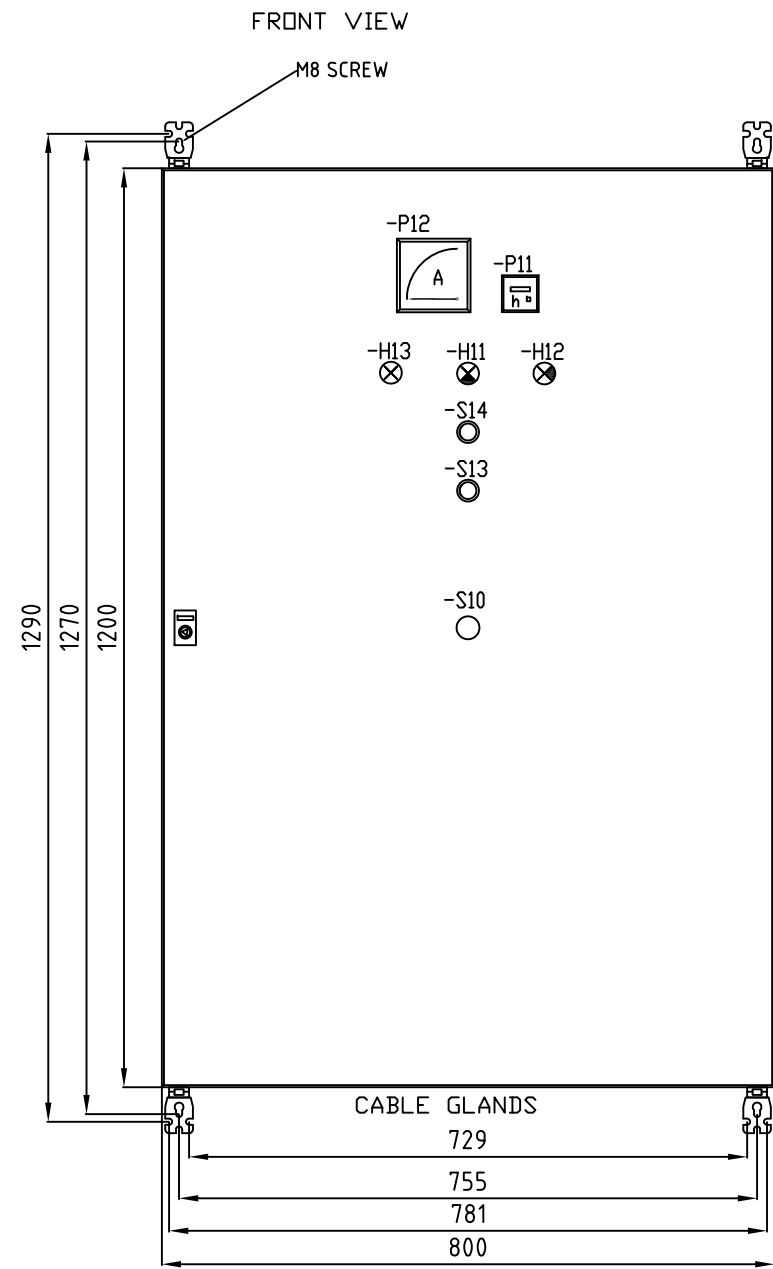
V+: RED
CAN H: WHITE
CAN L: BLUE
V-: BLACK

CABLE SUPPLY AND LAY OUT BY CUSTOMER

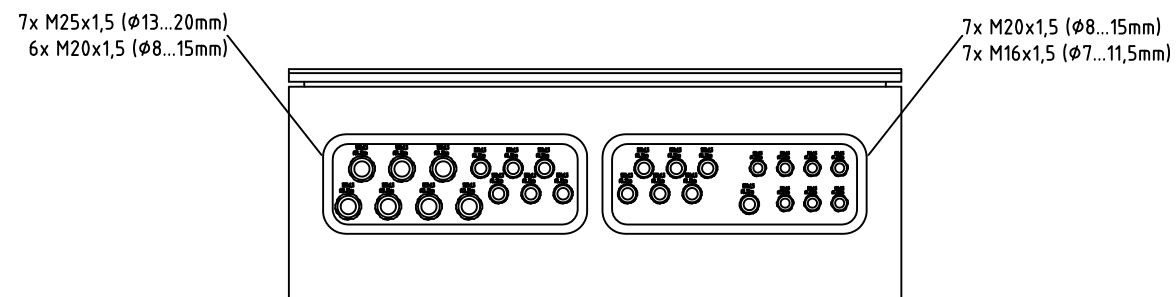
VENDORS CABLE / TERMINAL-LIST CODING: Ver.1/2000

WnnY	XnY[n]
A: 220 / 230 VAC	n=0: 0V potential
B: 24 VDC unregulated	n=1: +V potential
C: 24 VDC regulated	Q: 690 VAC
D: 12 VDC	X: Specify
E: Analog signals	
F: mixed, low voltage	EXAMPLES:
G: 380 / 400 VAC	W14G
H: 220 / 230 VDC	Cable no.14 w.380 VAC
I: EEX(I) circuits	X03C1
J: 110 / 120 VAC	Terminal list no.3 w.
K: 24 VAC	+24 VDC terminals
L: Special	
M: 440 / 450 VAC	

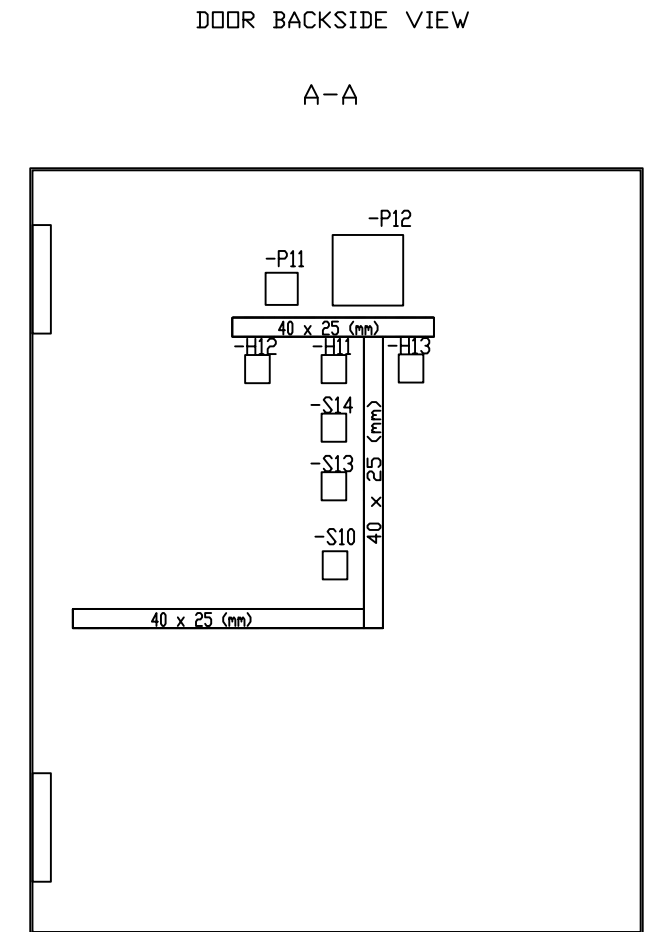
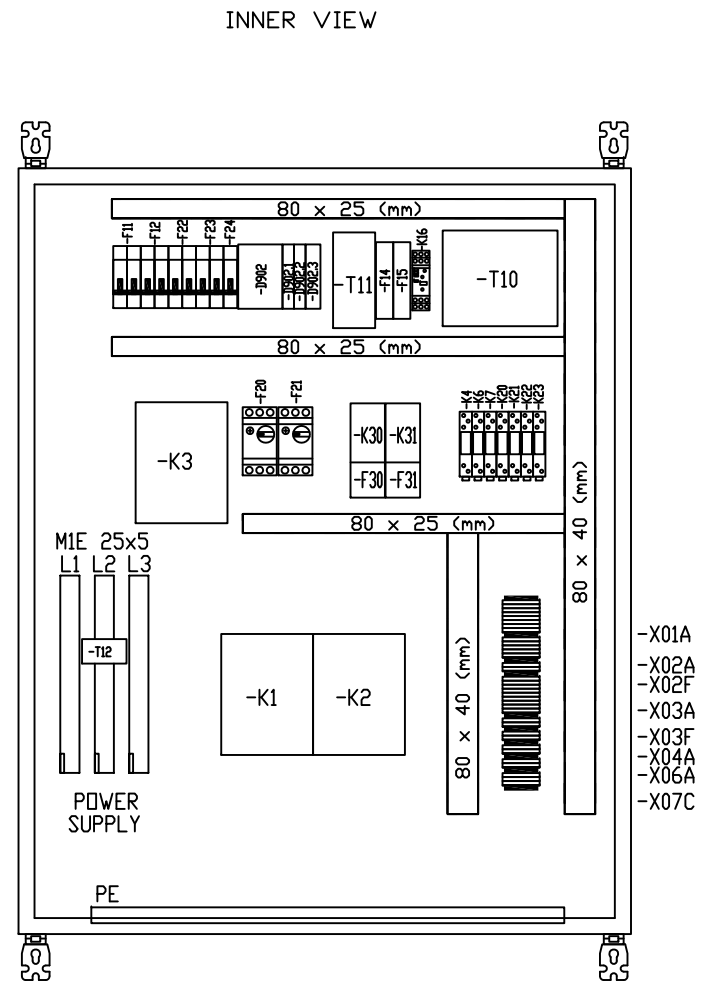
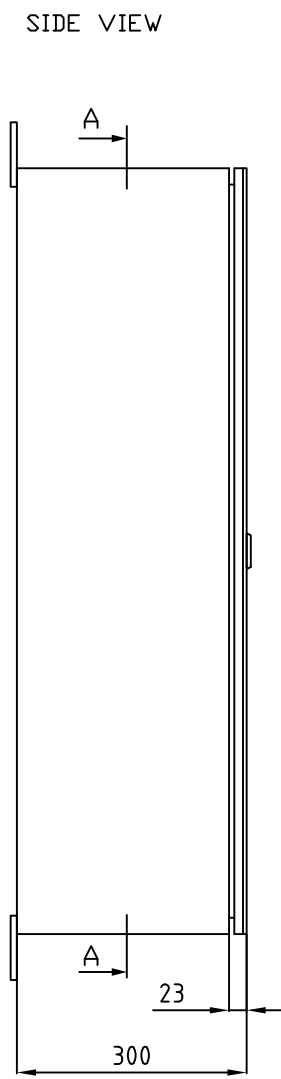
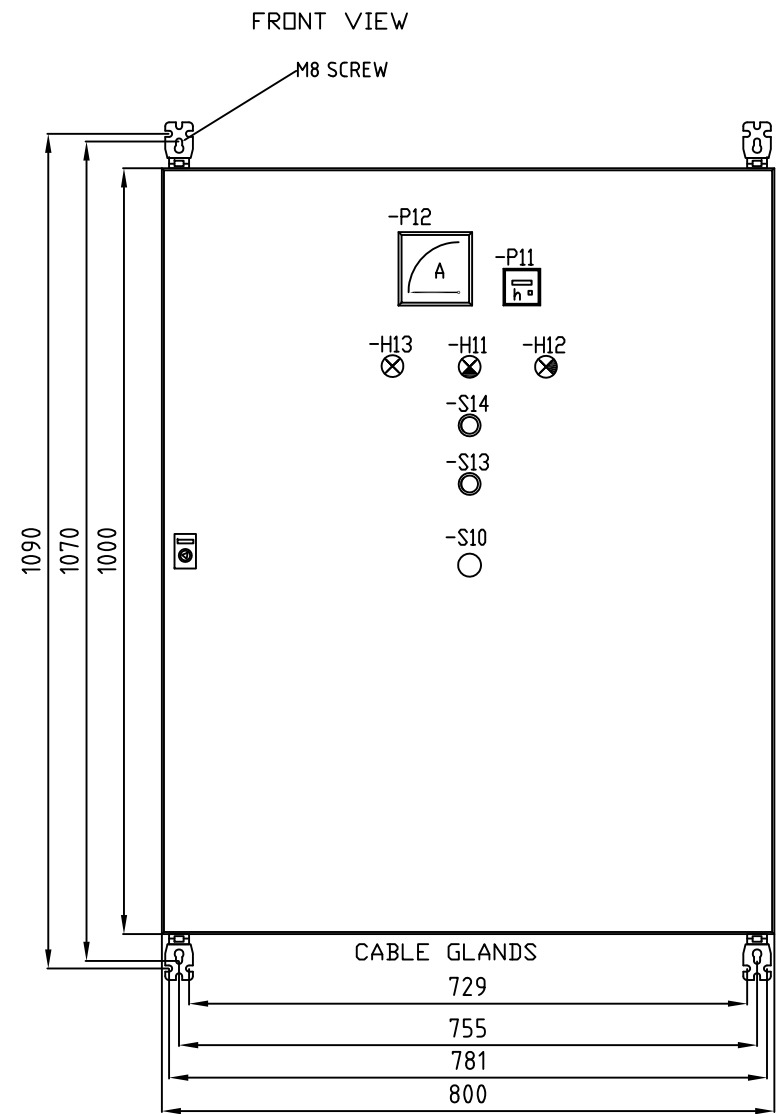
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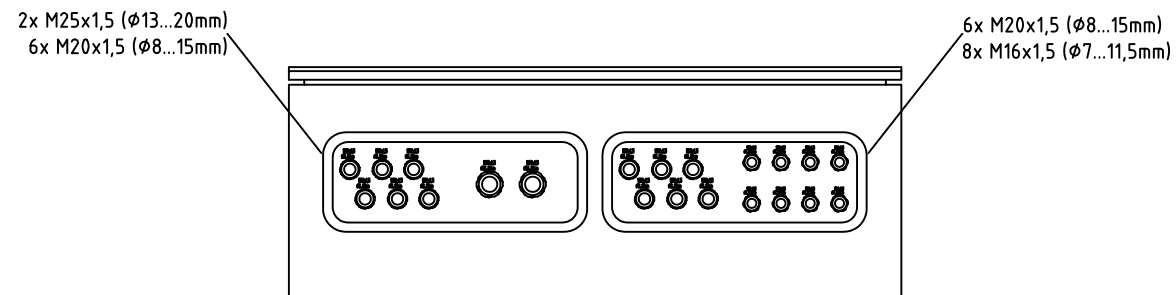
CABLE TRAYS DIMENSIONS - H x W



CABLE GLANDS

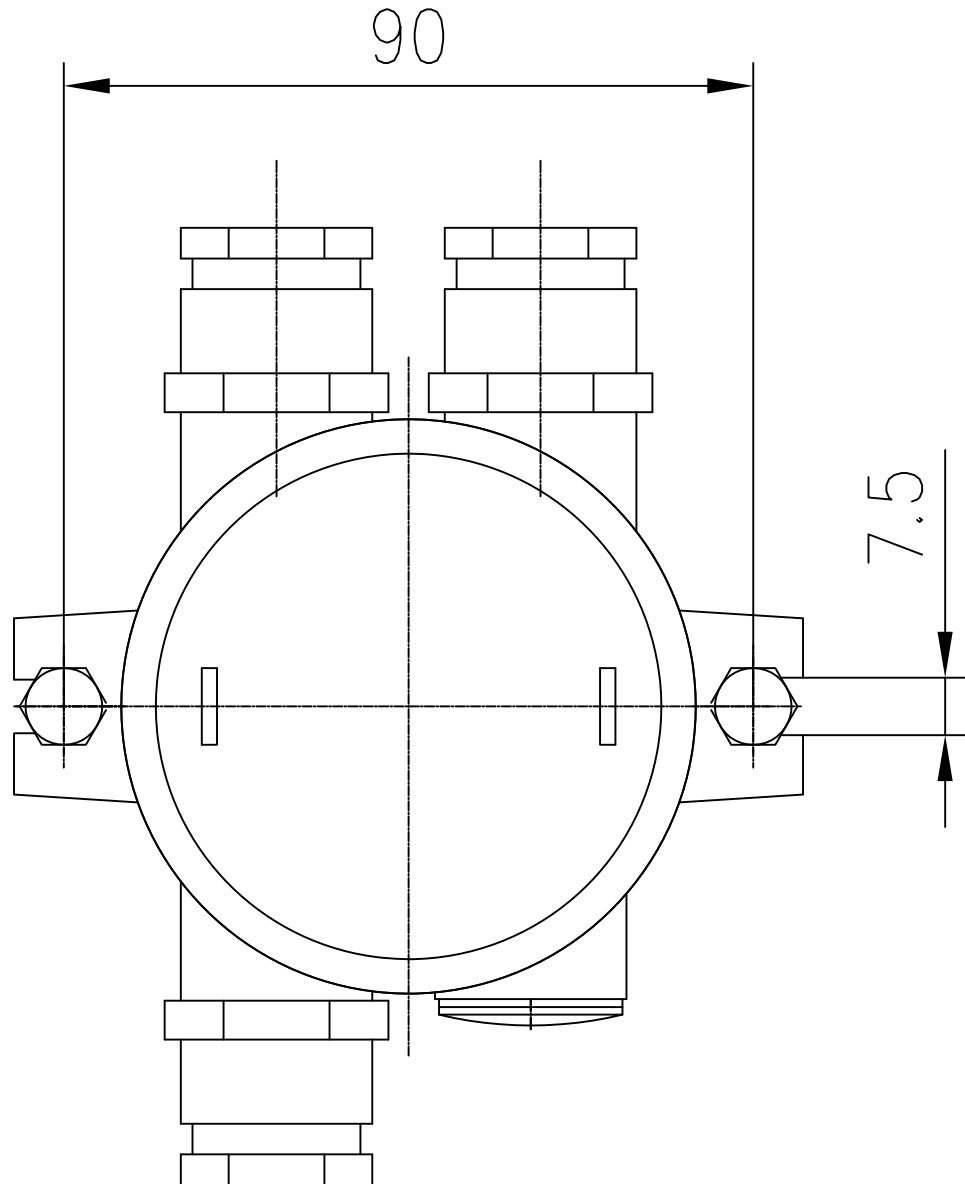


CABLE TRAYS DIMENSIONS - H x W

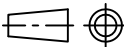


CABLE GLANDS

Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	26.02.10 MMN



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Designed 26.02.10	Approved 26.02.10 MMN	Projection 	Scale 1:1
Drawn 26.02.10 MMN			Format A4

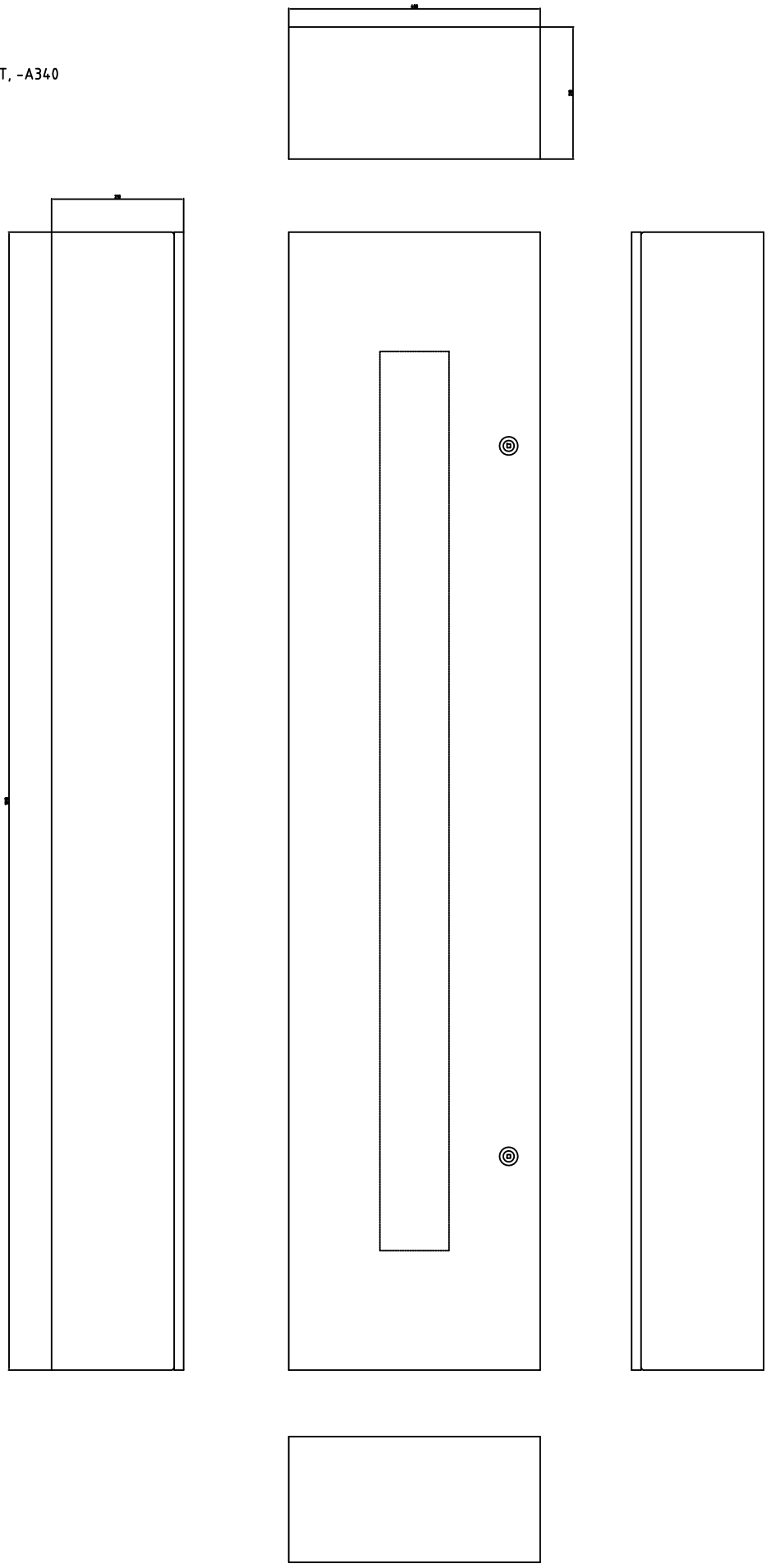


EL. CONTROL SYSTEM
- JB400/440/480 JUNCTION BOX
EL. PANEL LAYOUT

Replaces:	Replaced by:	Rev. 0
AutoCAD file: 11857DP3.dwg		
11857DP3		

Rev.	Description of revision	Date / Sign.
0	INITIAL REVISION	02.03.10 MMN

CONTROL CABINET, -A340
INSIDE CABIN

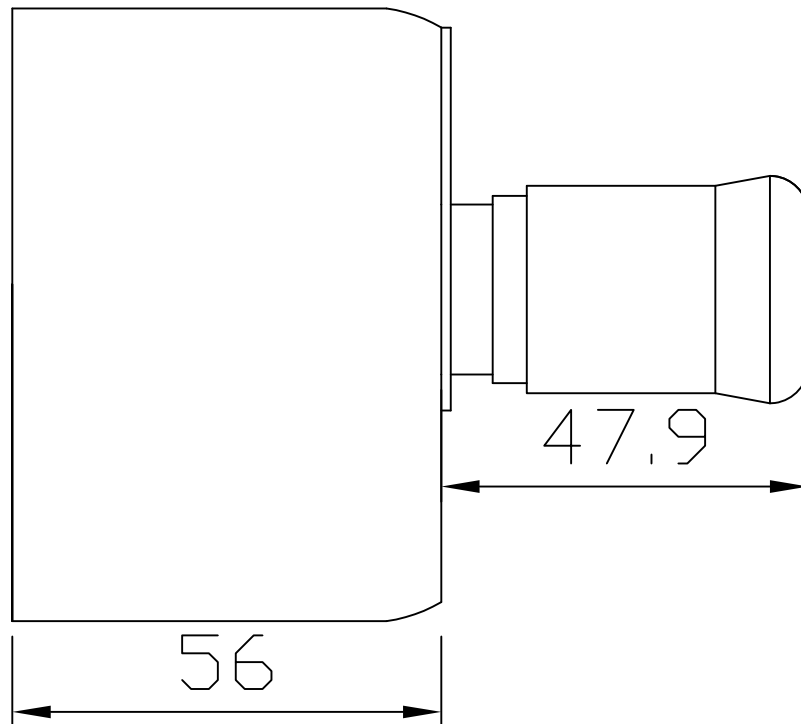
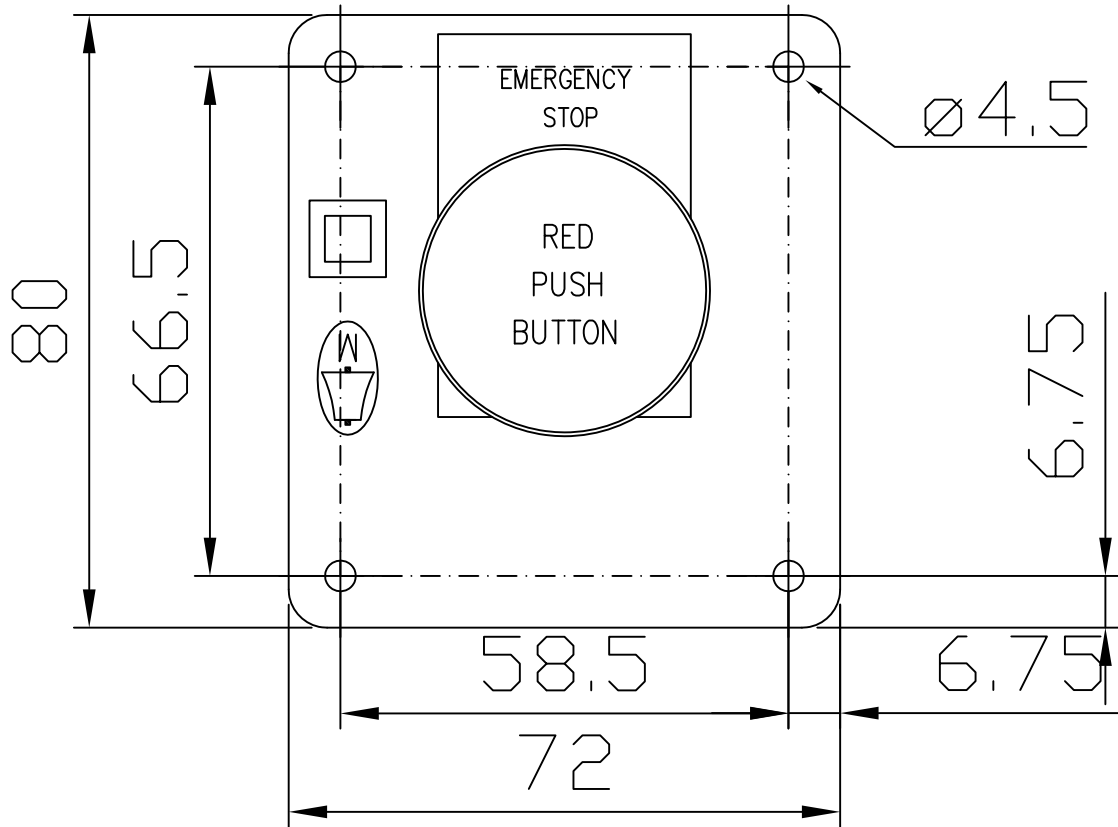


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Designed 02.03.10	Approved 02.03.10 MMN	Projection ↔	Scale 1:5	
Drawn 02.03.10 MMN		Format A1		

EL. CONTROL SYSTEM -A340 CONTROL CABINET EL. PANEL LAYOUT		Replaces:	Replaced by:
		AutoCAD file: 11857DP4.dwg	Rev. 0
		11857DP4	

Rev.	Description of revision	Date / Sign
0	INITIAL REVISION	02.03.10 MMN



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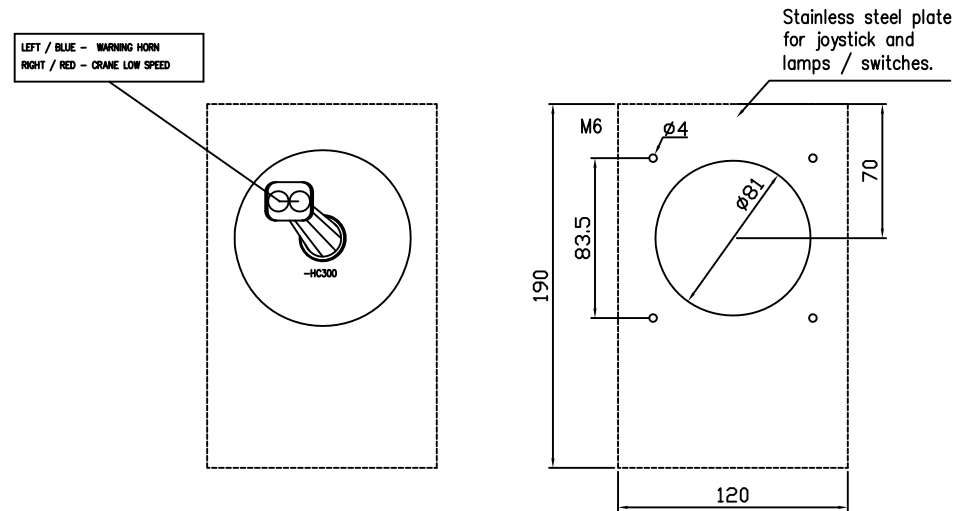
Designed 02.03.10	Approved 02.03.10 MMN	Projection 	Scale 1:1
Drawn 02.03.10 MMN			Format A4



EL. CONTROL SYSTEM
-A922 EMG. STOP BOX
EL. PANEL LAYOUT

Replaces:	Replaced by:
AutoCAD file: 11857DP5	Rev.
11857DP5	0

LEFT SIDE OF CHAIR
 CONTROL LEVER -HC300



RIGHT SIDE OF CHAIR
 OPERATOR PANEL - IB300
 CONTROL LEVER -HC301

