LK TEKNIKK	**MANUFACTURING RECORD BOOK (MRB)**	
SUPPLIER/LEVERANDØR: **CLIENT/KUNDE:** **PROJECT/PROSJEKT:** **JOB TITLE/BESKRIVELSE:** **CLIENT REF/KUNDE REF:** **DOC NO/DOK NR:**	**LK TEKNIKK AS** **Brann – og redningsetaten/Oslo Kommune** **23131** **Sveis og beregning av slepekrok** **IUA Indre Oslofjord / Aluminiumsbåt** **23131MRB001**	
LK TEKNIKK ENGINEER/QA/QC:	**LK TEKNIKK MANAGEMENT:**	**REV.NO:**
Name/Navn: Carsten Båserud Lunde **Sign:** Carsten B. Lunde **Date/Dato:** 30.10.2023	**Name/Navn:** Jonas Båserud Lunde **Sign:** Jonas B. Lunde LK TEKNIKK SVEIS OG MEKANISK KONSTRUKSJON LK TEKNIKK AS NO 923 239 189 MVA Hasle Trafo 35 1734 Hafslundsøy **Date/Dato:** 30.10.2023	**1**

1 MRB index

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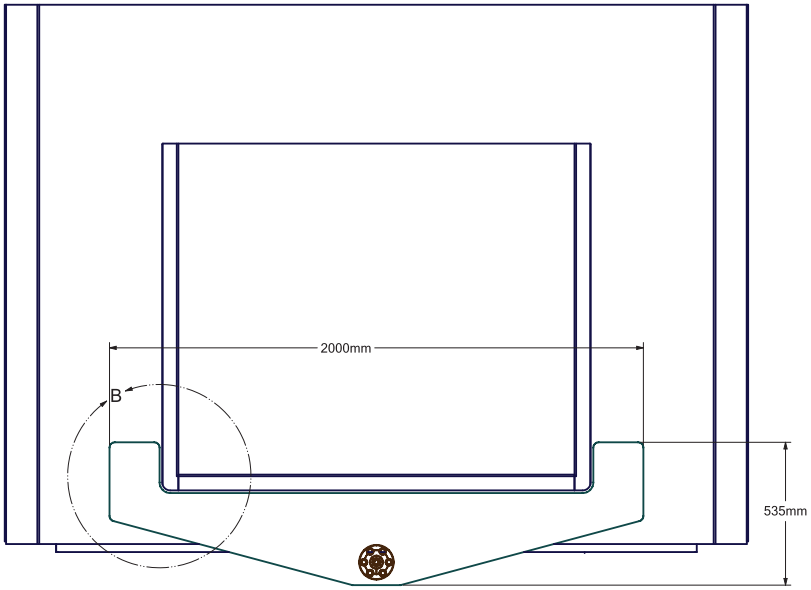
3 As built drawings

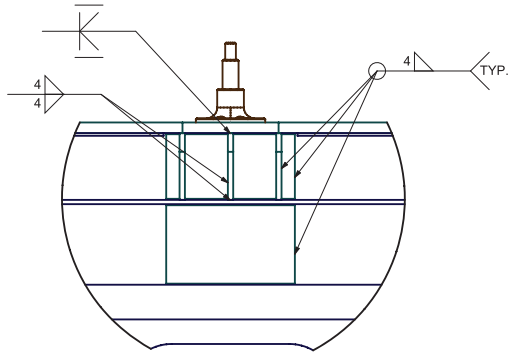

A
110
0-76

AS BUILT

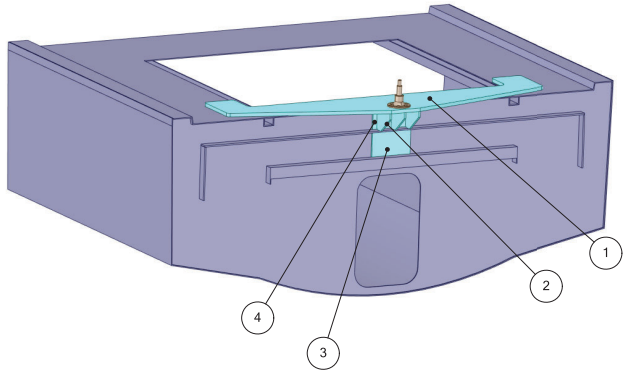
AS BUILT

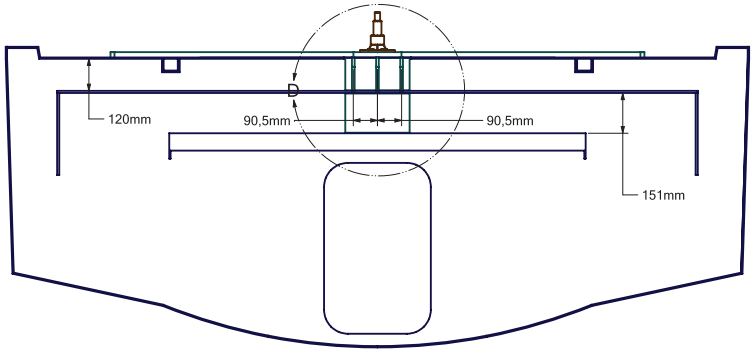
Punkt	Beskrivelse	Material	Vekt (kg)	Ant.
1	Forankringsplate, t=20mm	AW-5083 H111	28,62 kg	1
2	Plate, t=10mm	AW-5083 H111	0,39 kg	3
3	Doblingsplate, t=10mm	AW-5083 H111	0,94 kg	1
4	Doblingsplate, t=10mm	AW-5083 H111	0,78 kg	1





DETALJ D
SKALA 1:5





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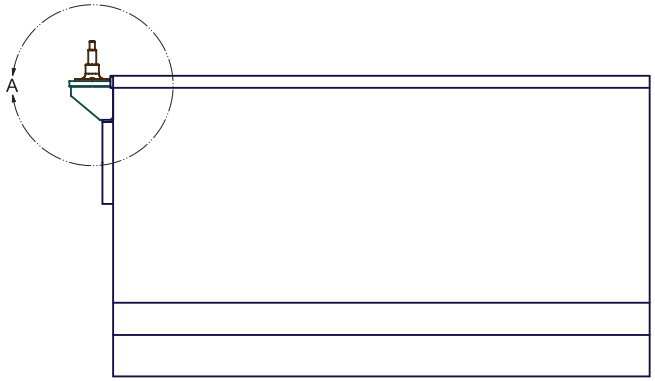

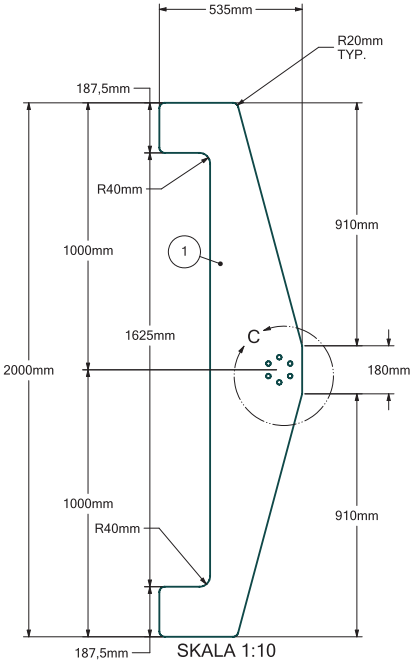

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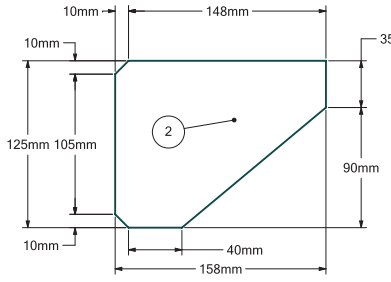

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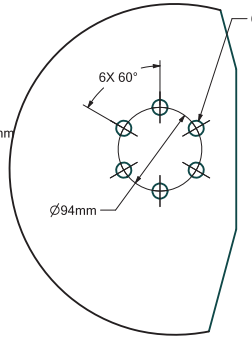
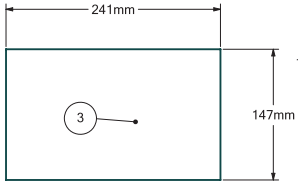


DETALJ C
SKALA 1:3



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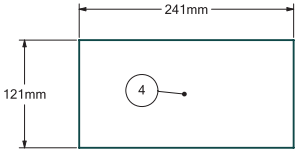

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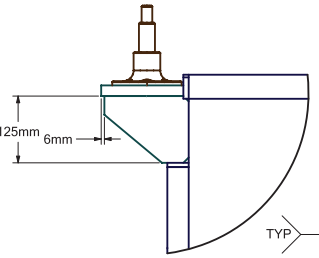

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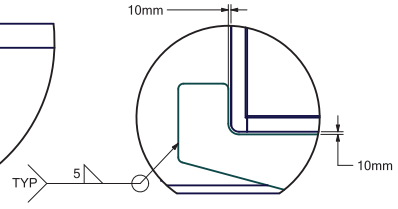

DETALJ B
SKALA 1:10

Rev	Revision kommentar	Rev.Av	Sjekk Av	Godkj.Av	Godkj.Dato
0	FØRSTE UTGAVE	SAP			21.10.2023

Prosjekt	Slepekrok innfestning
Kunde	LK Teknikk
Prosjektnummer	9010
Modell Av:	
Dato:	20.09.2023
Størrelse:	A1
Generell tegnings-regler ISO.	
Skala:	1:20
Ikke skaler tegning	
Tegn.no:	9010-001-A
Rev.:	0
Ark	1 / 1

Arrangement Tegning
Slepekrok Innfesting

5 Material Certification

INSPECTION CERTIFICATE	No: 3462 Date: 9/7/2023	CERTIFIED SRAC-IQNet ISO 9001/2015 No.10/valid 2026	vimetco alro SLATINA

CUSTOMER : ALUMECO ApS

CONTRACT/ORDER : 120632839
BILL OF DELIVERY : 80559015
TRUCK/CONTAINER : IF 37 CXF/ IF 73 CXF

MATERIAL : ALUMINIUM PLATES
ALLOY : EN AW-5083 **TEMPER:** H111
DIMENSIONS (mm) : 70337968 -. 10X1020X2020
. - .
. - .

ACCORDING TO : EN 485 - 515 - 573

MECHANICAL PROPERTIES **1 MPa = 1 N/mm2 = 0.145 ksi = 0.102 kgf/mm2**

			1 lbs = 0.4536 kg	Rm MPa		Rp0.2 MPa		Elong. % 50mm
				min.	max.	min.	max.	min.
			Specified values:	270	345	115		16
LOT / BATCH	CASE	NET WEIGHT kg		Measured values:				
70337968 . S23075559	1102637;1102661	2022		299		171		32.0

CHEMICAL COMPOSITION %

	BATCH	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ga	V	Al
	S23075559 . .	0.33	0,30	0.08	0.53	4.7	0.09	0.01	0.13	0.04	0.01	0.01	REM.
Acc. Standard	Min.				0,40	4,0	0,05						REM.
	Max.	0,40	0,40	0,10	1,0	4,9	0,25	0,05	0,25	0,15	0,05	0,05	
	Remarks:						Other- Each- Max.: 0.05			OthersTotal- Max.: 0.15			

REMARKS:

ACCORDING TO: EN485-2:2016+A1:2018 EN 515:2017 EN 573-3:2019+A1:2022

We hereby certify that the material detailed hereon has been produced and tested according to the requirements of the relevant standards, specification and/or order. Keep in dry conditions, without large temperature variations. The difference between metal and air must not exceed 11 °C.
Please follow the recommendations of the American Aluminium Association Guidelines for minimizing water staining of aluminium, latest edition, for the unloading and storage of the material in your premises before usage. Also, we certify that Alro products comply with REACH legislation no. 1907/2006 concerning Registration, Evaluation, Authorization and Restriction of Chemicals and CLP legislation no. 1272/2008 on classification, labeling and packaging of substances and mixtures and RoHS Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

According to **EN 10204:2004 3.1**

Marius Olteanu, Eng.
SC ALRO SA SLATINA
Punct de lucru Slatina
Str.Milcov Nr.1, Jud.Olt
Serv. Inspecţia Calităţii

ALRO S.A. No.116, Pitesti Street Phone: +(40) 0249 435 117; 0249 432 956 alro@alro.ro
230048-Slatina-ROMANIA Fax: (40) 0249 411 487; 0249 415 992 www.alro.ro

QUALITY CONTROL DEPT.

INSPECTION CERTIFICATE	No: 3668 Date: 09/20/2023	CERTIFIED SRAC-IQNet ISO 9001/2015 No.10/valid 2026	vimetco alro SLATINA

CUSTOMER : ALUMECO ApS

CONTRACT/ORDER : 120636971
BILL OF DELIVERY : 80560419
TRUCK/CONTAINER : GJ 08 AWD/ GJ 72 AWD

MATERIAL : ALUMINIUM PLATES
ALLOY : EN AW-5083 **TEMPER:** H111
DIMENSIONS (mm) : 70341400 -. 20X1020X2020
. - .
. - .
ACCORDING TO : EN 485 - 515 - 573

MECHANICAL PROPERTIES **1 MPa = 1 N/mm2 = 0.145 ksi = 0.102 kgf/mm2**

			1 lbs = 0.4536 kg	Rm MPa		Rp0.2 MPa		Elong. % 50mm
				min.	max.	min.	max.	min.
			Specified values:	270	345	115		15
LOT / BATCH	CASE	NET WEIGHT kg		Measured values:				
70341400 . S23085713	1105537;1105539	2928		272		174		26.5

CHEMICAL COMPOSITION %

	BATCH	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ga	V	Al
	S23085713 . .	0.33	0,40	0.07	0.48	4.4	0.08	0.01	0.17	0.04	0.01	0.01	REM.
Acc. Standard	Min.				0,40	4,0	0,05						REM.
	Max.	0,40	0,40	0,10	1,0	4,9	0,25	0,05	0,25	0,15	0,05	0,05	
	Remarks:						Other- Each- Max.: 0.05			OthersTotal- Max.: 0.15			

REMARKS:

ACCORDING TO: EN485-2:2016+A1:2018 EN 515:2017 EN 573-3:2019+A1:2022

We hereby certify that the material detailed hereon has been produced and tested according to the requirements of the relevant standards, specification and/or order. Keep in dry conditions, without large temperature variations. The difference between metal and air must not exceed 11 °C.
Please follow the recommendations of the American Aluminium Association Guidelines for minimizing water staining of aluminium, latest edition, for the unloading and storage of the material in your premises before usage. Also, we certify that Alro products comply with REACH legislation no. 1907/2006 concerning Registration, Evaluation, Authorization and Restriction of Chemicals and CLP legislation no. 1272/2008 on classification, labeling and packaging of substances and mixtures and RoHS Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

According to **EN 10204:2004 3.1**

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QUALITY CONTROL DEPT.

8 Weld procedure qualification record (WPQR)

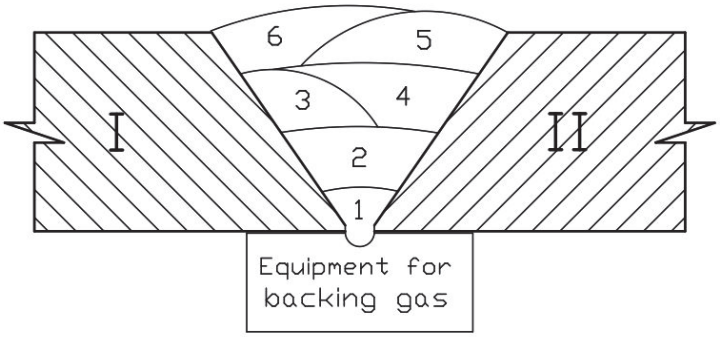
WELDING PROCEDURE QUALIFICATION (WPQR)

WPQR no: 02-2023
Ref.: PAS Int.class.: 10180500
Date: 2023-10-18 Rev.: 0

Prod. by:	LK Teknikk AS	Contact:	-	Ref.stand.:	NS-EN ISO 15614-2
Project:	General	Ref.spec.:	Norsok M-102 Ed.2/*	Exam.body:	DNV
Location:	Hasle 2023-10-09	Ref. pWPS:	BW-141-ML-05 Rev.-	Notified body No:	-

	1	2	3
Welding processes	141 AC		
Shielding gas types	Estate 30 (I3)		
Weaving (width of run)	Achieved max: 10mm	max:	max:

Purging gas type	Estate 30 (I3) 12 l/min
Welding positions	PA
Joint type	Buttweld
Joint preparation	Cutting/milling
Cleaning method	Brushing
Backing	N/A
Single/Double	Single side
Back gouging	N/A
Flux designation	N/A
Flux handling	N/A
Tungsten electrode	WP Green 3.2 mm
Torch angle	75-90 °
Stickout	N/A mm
Gascup	13mm
Puls details	N/A
Tack welding proc.	N/A Rev.:



Groove angle: 35+35=70° Root gap: 3-3.5mm Nose: 0-0.5mm

Identification of parent metal

I C: 0 CE: 0 PCM: 0 II C: 0 CE: 0 PCM: 0

Part	Name	Standard	Group	Lot/Heat no	Delivery condition	Thickness [mm]	Dia [mm] / Dim
I	Al plate 6082 T651	EN 573-3	23.1	MSK2202W60080	T6	10	0
II	Al plate 6082 T651	EN 573-3	23.1	MSK2202W60080	T6	10	0

Identification of filler metal

Index	Name	Classification	Lot / Heat No / Group	Filler handling
A	Böhler UNION ALMG 5 (2.4mm)	ISO 18273-S Al 5356 (AlMg5Cr(A))	5377233110	Suppliers recommendation
B	Böhler UNION ALMG 5 (3.2mm)	ISO 18273-S Al 5356 (AlMg5Cr(A))	5308233200	Suppliers recommendation

Welding parameters

Equipment: Fronius Magicwave 3000

Pass no.	Side	Index	Diameter [mm]	Welding process	Wire feed speed [m/min]	k	Current [A]	Voltage [V]	Current/ Polarity	Welding Speed [mm/min]	Run out length [mm]	Gas [l/min]	Heat input [kJ/mm]
1	1	A	2.40	141 AC	-	0.6	177 - 177	12.4 - 12.4	AC	82 - 82		13	0.96 - 0.96
2	1	B	3.20	141 AC	-	0.6	212 - 212	13.2 - 13.2	AC	136 - 136		13	0.74 - 0.74
3	1	B	3.20	141 AC	-	0.6	203 - 203	13.2 - 13.2	AC	185 - 185		13	0.52 - 0.52
4	1	B	3.20	141 AC	-	0.6	206 - 206	12.5 - 12.5	AC	147 - 147		13	0.63 - 0.63
5	1	B	3.20	141 AC	-	0.6	206 - 206	13.4 - 13.4	AC	180 - 180		13	0.55 - 0.55
6	1	B	3.20	141 AC	-	0.6	207 - 207	13.5 - 13.5	AC	242 - 242		13	0.42 - 0.42

Heat treatment

Method:

Preheat min.: 20 °C Interpass temp. max.: 137 °C Heat treatment proc.: Temp. control: Digital thermometer

PWHT min: °C max.: °C Soaking: Heating rate: °C/h Cooling rate: °C/h

Post Weld cleaning:

We certify that the statement in this record are correct and that the test piece was prepared, welded and heat treated in accordance with above specified Code/Standard and/or Purchasers requirement.

Remarks:

*DNV-OS-C401 Ed.July 2023
Welding parameters logged with ALX III datalogger,serial 112.
DT report: Kiwa 23NO-00241OR02 Rev.-
NDT report:VT/PT/RT Kiwa 23NO-00241OR02-NDT Rev.-

Date/signature
2023-10-18
Pål Arve Solberg

Approved
2023-10-19
Tor Arne Hjemås

Dette dokumentet er godkjent av DNV som tredjepartsorgan iht direktiv 2014/68/EU, vedlegg 1, 3.1.2 (PED).This document is approved by DNV as third-party org. acc. directive 2014/68/EU, Annex 1, ch. 3.1.2 (PED).

9 Weld procedure (WPS)

LK TEKNIKK	WELDING PROCEDYRE SPECIFICATION **WPS**	WPS NO.: AL-BW/FW-141-ML-05 Ref.: WI.P-016 CBL Date: 23.10.2023 Rev.: 01

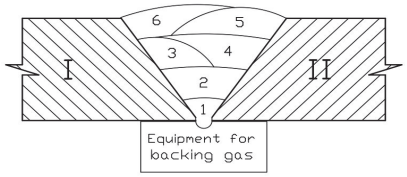
Prod.by: LK-Teknikk AS | Client: All | Ref. stand.: NS-EN ISO 15609/15614-2

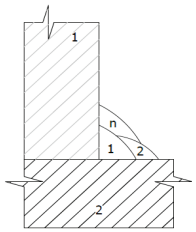
Project: General | Ref.spec.: Norsok M-102 Ed.2/* | Exam. Body: DNV

Location: Hasle

Welding processes	1	141	2		3		
Shielding gas types		Estate 30 (I3)					

Backing gas type	Estate 30 (I3)	10-14 l/min	
Weaving	Width of weld run	max: 8-12	mm
Welding postions	All		
Joint type	BW/FW		
Joint preparation	Cutting/Grinding		
Cleaning method	Steel brushing & Cleaner		
Backing	N/A		
Single/double	Single/ duble side		
Back gouing	If necessary		
Flux designation	N/A		
Flux handling	N/A		
Tungsten electrode	WP Green	3	mm
Torch angle	75-90		°
Stand off distanse	N/A		mm
Nozzle diameter(s)	Ø13		mm
Tack welding proc.	N/A	rev.	





Groove angle:65-70	Root gap: 2-4	Nose: 0-0.5

Identification of parent metal

	I C max:	CE max:	PCM max:	II C max:	CE max:	PCM max:

Part	Name/Grade	Standard	Group	Delivery cond.	Thicness range (mm)		Diameter (mm)
I	Aluminium Gr. 22 & 23	EN 573-3	23.1*	H111	3-20		>150 rotating
II	Aluminium Gr. 22 & 23	EN 573-3	23.1*	H111	3-20		>150 rotating

Identification of filler metal

Index	Trade name	Classification		Heat no/ Lot
A	Böhler UNION ALMG 5 (2.4mm)	ISO 18273-S Al 5356 (AlMg5Cr(A))		
B	Böhler UNION ALMG 5 (3.2mm)	ISO 18273-S Al 5356 (AlMg5Cr(A))		
C				

Welding parameters Equipment:

Pass no.	Filler Index	Dia (mm)	Welding process	Wire feed speed (mm/min)	Current (A)	Voltage (V)	Current/ Polarity	Welding speed (mm/min)	Gas (l/min)	Heat input (kJ/mm)
1	A	2,4	141	-	150-190	11.5-13.5	AC	70-95	12-14	0,8-1,2
2n	B	3,2	141	-	175-235	12-14	AC	115-260	12-14	0,4-0.85

Heat treatment

Preheat min: 20° C Interpass temp. max.: 150 °C Heat treatment proc.: Temp. control: Digital/temp stift

PWHT min: max.: Soacing: min. Heating rate: Cooling rate:

Remarks:

*Material group range: 22.1/22.2/22.3/22.4 according to table 4.

Thermal efficiency factor set to 0,7

Fillet weld throat thicknes range: a7,5 to a16. Diamter >150 rotating PA/PC. >500 all position.

Heat input i calculated +-15% from WPQR.

Additional info enclosed (Y/N):

Date/signature: 23.10.2023

Verified: HSPInspection Hans-Petter Jakobsen IWT-NO700129

10 Welder qualification certificate (WATC)

NORSK AKKREDITERING PERS 016

DET NORSKE VERITAS

DNV

GODKJENNINGSBEVIS FOR SVEISERE EN ISO 9606-2:2004/
WELDER APPROVAL TEST CERTIFICATE EN ISO 9606-2:2004

Sertifikatnummer/Certificate no.

162645-07-9606-2-FKS-23

Betegnelse/Designation	**9606-2 141(AC) P FW 23 S t6,0 PB ml**
Prosedyrespes./WPS	**01-2023**
Sveiser/Welder	**Lunde Oscar**
Identifikasjon/Identification	**Førerkort / Drivers Licence**
Fødselsdato, -sted/Date of Birth, Place	**1996-08-03, Norge**
Arbeidsgiver/Employer	**LK TEKNIKK AS**
Fagkunnskap/Job knowledge	**Ikke prøvet / Not tested**
Referanse nr/Reference no	**OL**

Variabler/Variables	Sveiseprøve/Weld test details	Godkjenningsområde/Range of approval
Sveisemetode/Welding process	**141(AC)**	**141(AC)**
Plate eller rør/Plate or pipe	**P**	**P, (T)**
Fugetype/Joint type	**FW**	**FW**
Grunnmaterialgrupp(er)/Parent metal	**23**	**21, 22, 23**
Tillsettmateriale/Filler metal	**S (AlMg)** (Union AlMg5)	**S (Al, AlMg, AlSi), nm**
Beskyttelsegass/Shielding gas(es)	**I1 (Ar)**	**Inert**
Annet/Auxiliaries	**-**	
Godstykkelse/Thickness (mm)	**6,0**	**≥ 3,0**
Utvendig rørdiam./Outside diameter (mm)	**-**	**≥ 150,0**
Sveisestilling/Welding position	**PB**	**PA, PB**
Sveisedetaljer/Welding details	**ml**	**sl, ml**
Tilleggsinfo./Others		

Prøvingsmetode/Type of test	Utført og akseptert/ Performed and accepted	Ikke nødvendig/ Not required
Visuell/Visual	X	
Radiografi/Radiography		X
Makroprøving/Macro, micro	X	
Bruddprøving/Fracture		X
Bøyeprøving/Bend		X
Ultralyd/Ultrasonic		X
Annet/Additional tests		

Påtegning for 6 måneder/ Prolongation for 6 months. Kun elektronisk oppdatering er gyldig/ Only electronic prolongation is valid.

Sveising utført/ Test performed	**2022-01-03, Hasle**
Eksaminator/Examiner	**Hans-Petter Jakobsen**
Utstedt/Issued	**2023-01-09, Stavanger**
Anm/Note	
Gyldighet til/Valid to	**2024-01-03**
Sertifiseringsorgan/ Examining body	**DNV**
Godkjent av/Issued by	**Tor Arne Hjemås**

Dette sertifikatet er laget elektronisk. Tor Arne Hjemås
This certificate is produced electronically.
Please refer any queries to: Tor Arne Hjemås (tor.arne.hjemas@dnv.com).

Dato/Date	Bekreftet/Confirmed
2022-07-03	**Marius Arnesen**
2023-01-03	**Marius Arnesen**

Dette dokumentet er godkjent av DNV som tredjepartsorgan iht direktiv 2014/68/EU, vedlegg 1. 3.1.2 (PED).
This document is approved by DNV as an Recognized third-party organization accordance to directive 2014/68/EU Annex 1, ch. 3.1.2 (PED).

I samsvar med NS-EN ISO 17024 er dette sertifikatet DNV sin eiendom.
According to ISO/IEC 17024 DNV shall maintain the sole ownership of the certificate.

NORSK AKKREDITERING PERS 016

DET NORSKE VERITAS

DNV

RODKVENNINRSWEj IS FO: Sj EISE: E EN ISO 8m0m-2E2004/

6 ELDE: APP: Oj AL TEST CE: TIFICATE EN ISO 8m0m-2E2004

Sertifikatnummer/Certificate no.

1m2m45-0m-8m0m-2-FKS-23

Betegnelse/Designation	**8m0m-2 141(AC) T W6 23 S t5,0 Dm0,3 I -L045 ss nH, J b**
Prosedyrespes./WPS	**01-2023**
Sveiser/Welder	**Lunde Oscar**
Identifikasjon/Identification	**Førerkort / Drivers Licence**
Fødselsdato, -sted/Date of Birth, Place	**188m-07-03, NorXe**
Arbeidsgiver/Employer	**LK TEKNIKK AS**
Fagkunnskap/Job knowledge	**Ikke prøvet / Not tested**
Referanse nr/Reference no	**OL**

Variabler/Variables	Sveiseprøve/Weld test details	Godkjenningsområde/Range of approval
Sveisemetode/Welding process	**141(AC)**	**141(AC)**
Plate eller rør/Plate or pipe	**T**	**P, T**
Fugetype/Joint type	**W6**	**W6 , F6**
Grunnmaterialgrupp(er)/Parent metal	**23**	**21, 22, 23**
Tillsettmateriale/Filler metal	**S (Alg X)** (Union AlMg5)	**S (Al, Alg X, AlSi), nJ**
Beskyttelsegass/Shielding gas(es)	**I1 (Ar)**	**Inert**
Annet/Auxiliaries	-	
Godstykkelse/Thickness (mm)	**5,0**	**2,5 - 10,0 (F6 B≥ 3,0)**
Utvendig rørdiam./Outside diameter (mm)	**m0,3**	**≥ 30,2**
Sveisestilling/Welding position	**I -L045**	**PA, PW, PC, PD, PE, PF, I -L045**
Sveisedetaljer/Welding details	**ss nH, J b**	**ss nH, ss J H, Hs (F6 Bsb, J b)**
Tilleggsinfo./Others		

Prøvingsmetode/Type of test	Utført og akseptert/ Performed and accepted	Ikke nødvendig/ Not required
Visuell/Visual	**9**	
Radiografi/Radiography	**9**	
Makroprøving/Macro, micro		**9**
Bruddprøving/Fracture		**9**
Bøyeprøving/Bend		**9**
Ultralyd/Ultrasonic		**9**
Annet/Additional tests		

Påtegning for 6 måneder/ Prolongation for 6 months. Kun elektronisk oppdatering er gyldig/ Only electronic prolongation is valid.

Sveising utført/ Test performed	**2022-01-03, I asle**
Eksaminator/Examiner	**I ans-Petter VakoHsen**
Utstedt/Issued	**2023-01-08, StavanXer**
Anm/Note	
Gyldighet til/Valid to	**2024-01-03**
Sertifiseringsorgan/ Examining body	**DNj**
Godkjent av/Issued by	**Tor Arne I åJ Ms**

Dette sertifikatet er laget elektronisk. Tor Arne Hjemås
This certificate is produced electronically.
Please refer any queries to: Tor Arne Hjemås (tor.arne.hjemas@dnv.com).

Dato/Date	Bekreftet/Confirmed
2022-0G-03	**g arius Arnesen**
2023-01-03	**g arius Arnesen**

11 NDT inspection report (Non destructive testing)

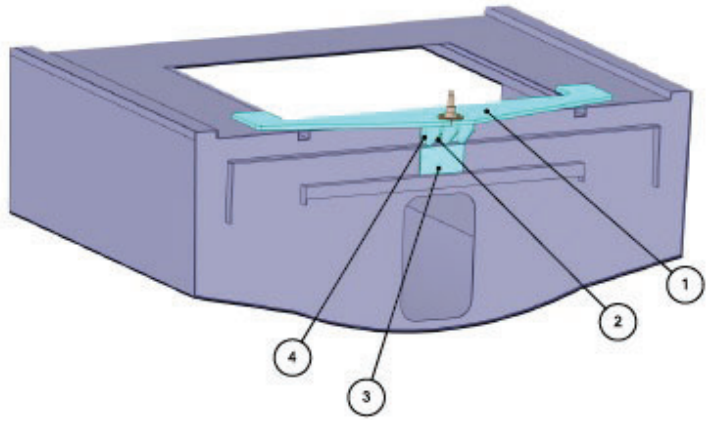
IKM Inspection AS

Report: **GT-23-3414 Rev. 0**

VISUAL INSPECTION REPORT

Client	LK Teknikk			Date	25-10-2023
Project	Slepekrok innfesting			Work Order	LK best.: 23131 - IKM nr: 501990
Part	-			Location	Ytre Enebakk
Part No.	Slepekrok innfesting			Trace	-
Serial No.	-			Lighting & Equip.	1500 lux
Drawing No.	9010-001-A			Thickness	-
Procedure	BPI-01 Visual examination - EN ISO 17637 Rev.03			Material	Aluminium
Acceptance	NS-EN ISO 10042:2018 Level.B			Surface	Som sveist
Geometry	-	Weld Process	141	Welder ID	OL
N/A	N/A	Extent	100%	Joint Type	FW
Heat Treat.	-	Weld ID	-	N/A	N/A

Vi har utført 100% Visuel Inspeksjon av alle nye sveis til slepekrok innfesting.



ACCEPTABLE TO SPECIFICATION.

Technician	Document Approved By	Client / 3rd Party / Level 3 By Request
Vidar Johansen ISO 9712 VT Level 2 2780	Vidar Johansen	
		SIGNATURE

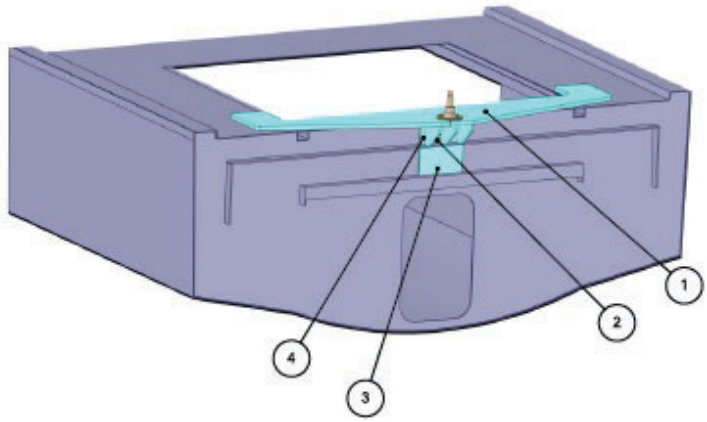
IKM Inspection AS

Report: **PT-23-2206 Rev. 0**

LIQUID PENETRANT INSPECTION REPORT

Client	LK Teknikk			Date	25-10-2023
Project	Slepekrok innfesting			Work Order	LK best.: 23131 - IKM nr: 501990
Part	-			Location	Ytre Enebakk
Part No.	Slepekrok innfesting			Trace	-
Serial No.	-			Lighting & Equip.	1500 lux
Drawing No.	9010-001-A			Thickness	-
Procedure	BPI-01.Penetrant Testing ISO 3452 Rev.02			Material	Aluminium
Acceptance	EN ISO 23277			Surface	Som sveist
Geometry	-	Weld Process	141	Welder ID	OL
N/A	N/A	Extent	100%	Joint Type	FW
Heat Treat.	-	Weld ID	-	N/A	N/A
Light	+1500 lux	UV Light	-	Pre Clean	Yes
Dwell Time	20 min	Dev Time	20 min	Dye Product	Magnaflux
Dev Product	Magnaflux	Clean Product	Magnaflux		
Surface Temp & Equipment			+10		

Vi har utført 100% Penetrant Testing av alle nye sveis til slepekrok innfesting.



ACCEPTABLE TO SPECIFICATION.

Technician	Document Approved By	Client / 3rd Party / Level 3 By Request
Vidar Johansen ISO 9712 PT Level 2 2780	Vidar Johansen	
		SIGNATURE

23 Calculations

Prosjektnummer:	Dokument Type:	Prosjekt tittel:
9010	**Beregningsrapport**	**Beregning Innfestning Slepekrok**

Kontraktnummer:	Tag no./modell/type:	Filnavn:
NA	**Innfestning slepekrok**	**9010-SP-N-CA-0001_Rev_A**

A	01.11.2023	Første revisjon	SAP		
Rev:	Utg. dato:	Beskrivelse:	Laget av:	Kontroll:	Godkjent:

Dokument Tittel:

Beregning Innfestning Slepekrok

SP Engineering dokumentnummer:	Rev:	Side:
9010-SP-N-CA-0001_Rev_A	**A**	1 av 19

Innholdsfortegnelse

1 Introduksjon

1.1 Generelt

Det ble gjort en henvendelse på en slepeløsning på eksisterende skrog på Brann- og Redningsbåt. Selve slepekroken er presertifisert og skal leveres av Henriksen AS. Den har en sikker arbeidslast (SWL) på 2500kg.

Det må beregnes kapasitet for innfestning til båt for å verifisere sikker bruk av slepekrok og utførelse av slepeoppdrag. Denne rapporten vurderer om forsterkning på båten er strukturelt egnet for de gjeldende laster.

Beregninger av konstruksjonselementer er utført ved bruk av dataprogram ANSYS. Håndberegninger er utført i Mathcad.

Figur 1 – Båt sett fra siden.

Figur 2 – Båt sett bakfra.

2 Materialer

Konstruksjonselementer i forsterkningen er av materialkvalitet aluminium AW-5083/H111. Verdier er vist i Tabell 1 under og er benyttet i analysene. Materialfaktor er ihht. ref. /1/ og vist i Tabell 2 under.

Tabell 1 – Materialdata for stål.

Konstruksjonselement	Material	Densitet (g/cm³)	Flytegrense (Rp0.2, MPa)	Bruddgrense(Rm, MPa)	Bruddforlengelse (%)
Forsterkningsplater	AW-5083/H111	2,66	125	275	16

Tabell 2 – Materialfaktorer og tillatt spenning, bruddgrensetilstand.

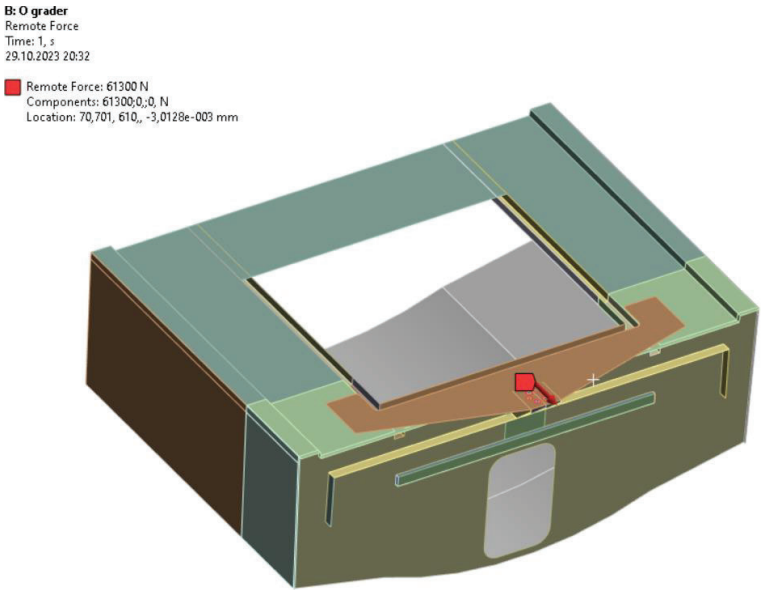
Konstruksjonselement	Materialfaktor	Tillatt spenning [MPa]
Forsterkningsplater	1,1	113,6

3 Laster

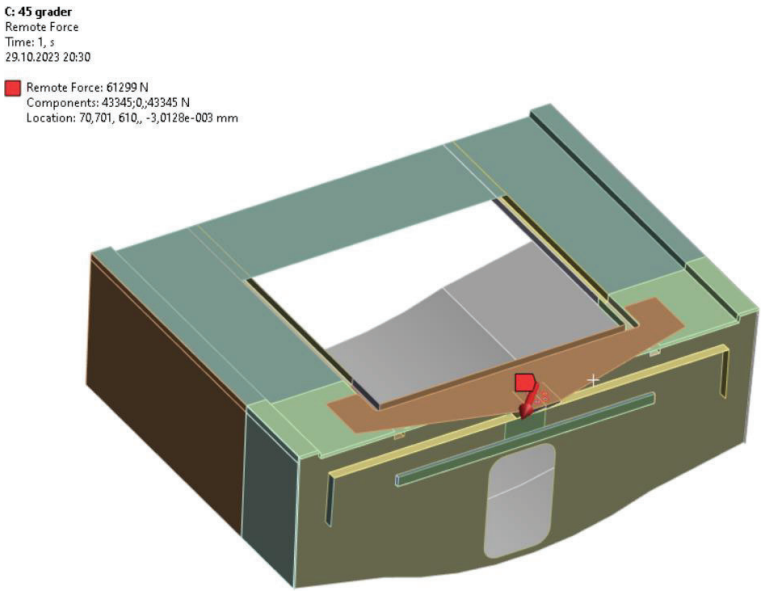
Den dominerende lasten er slepelasten som blir etablert ved trekking. Det anses at egenvekt utgjør så lite spenningsmessig at denne neglisjeres. Det benyttes lastfaktor basert på ref. /2/ der det står oppført 2,5 ved trekkelaster under 200 kN. Dermed blir den dimensjonerende lasten med lastfaktor følgende:

SWL Slepekrok	$SWL := 2500\ kg \cdot g = 24517\ N$
Lastfaktor ihht. ISO 7365:2012	$k := 2.5$ (tabell 1)
Dimensjonerende last	$F_D := SWL \cdot k = 61.3\ kN$

Det utføres også lastkombinasjon i 0 grader (i linje med kjøreretning) og 45 grader.



Figur 3 – Last påført i 0 grader.



Figur 4 – Last påført i 45 grader.

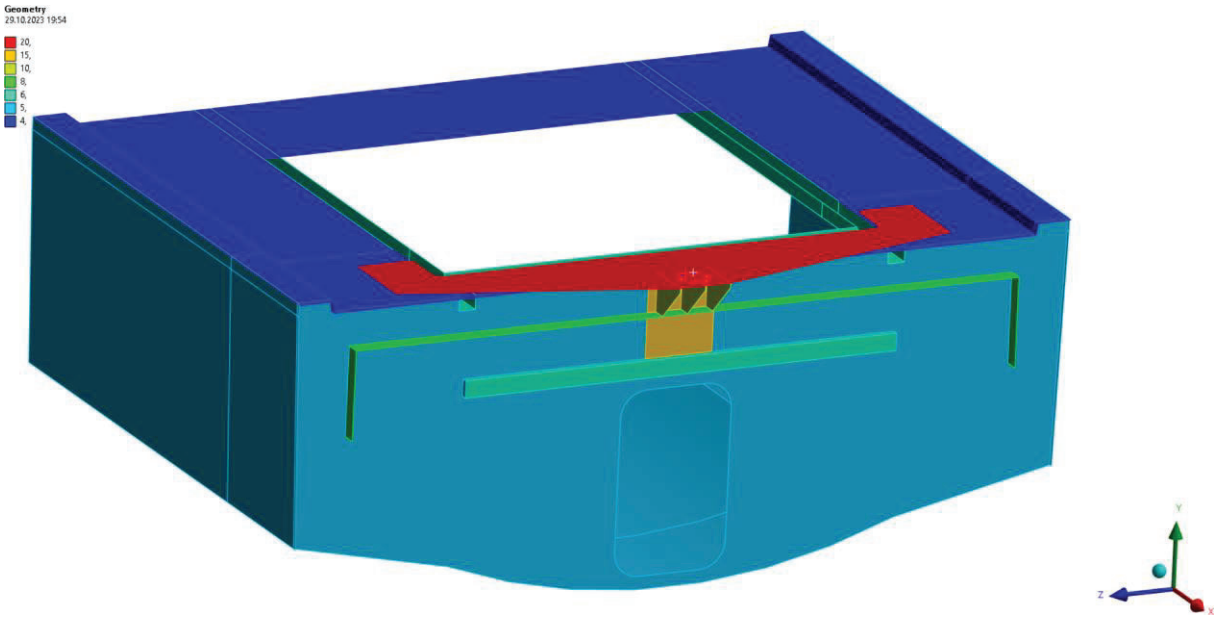
4 Fe-analyse

Det er utført en FEM analyse der man kontrollerer lokale spenninger i konstruksjonen. Det er også kjørt en lineær buklingsanalyse for kontrollere stabilitet. Analysegeometri er vist i Figur 5 og består primært av båtskrog og forsterkningsplater. Alt er av materialkvalitet AW-5083/H111 som har en flytegrense på 125 MPa.

Løsning er en 20 mm tykk plate som vil bli sveist på topp av skrog og med hullmønster som sammenfaller slepekrok. Det vil være stiverplater under denne platen for å redusere bøyespenninger i platen og fordele det påførte momentet bedre.

Konstruksjonen vil bli opplagret (alle frihetsgrader) en god avstand fra aktuelle område av interesse og dermed vil denne ikke påvirke resultater.

Geometri er modellert ihht. mottatte mål, men er forenklet noe for å lette analysetid. Det er benyttet skallelementer som analysegeometri.



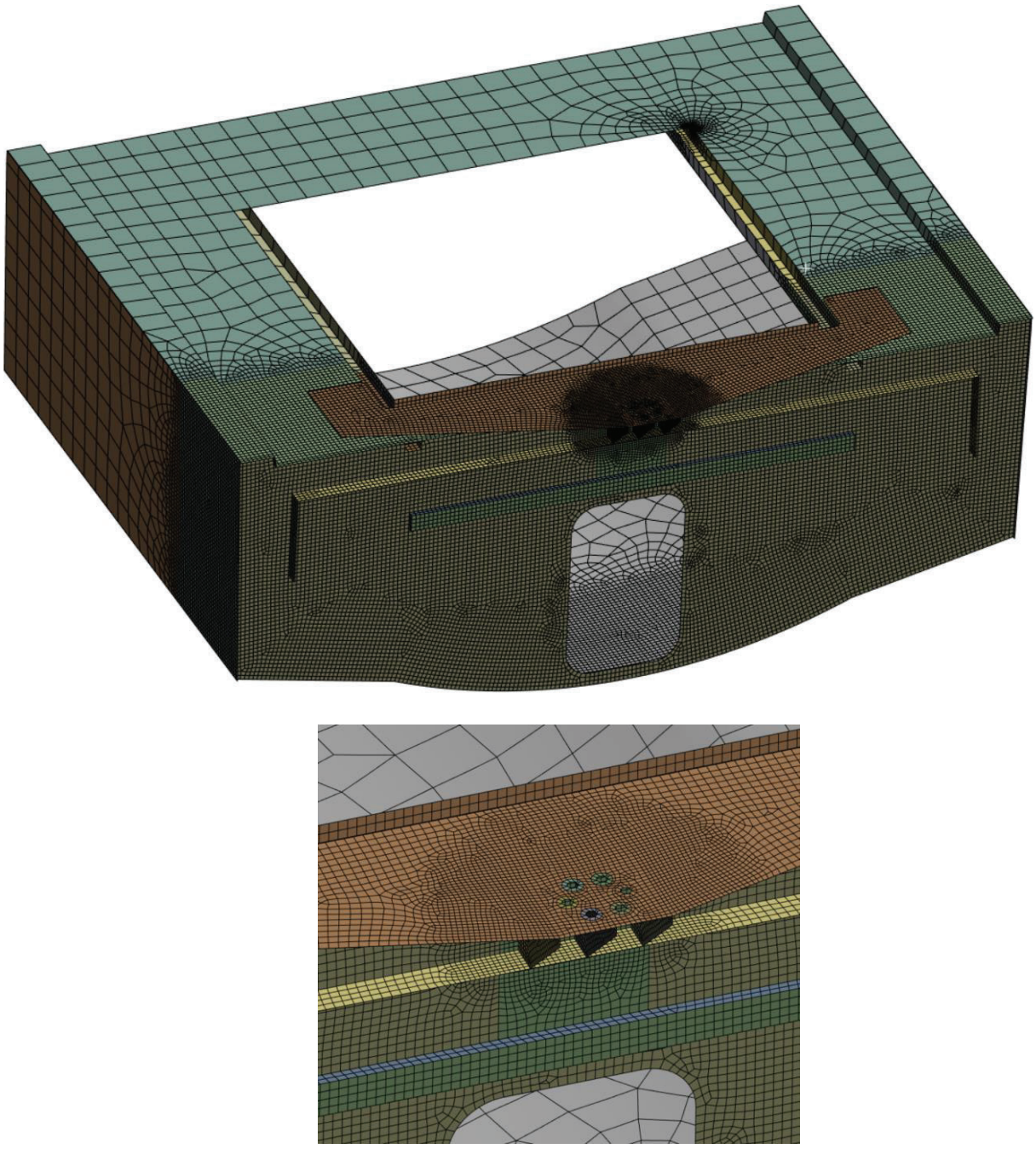
Figur 5 – Geometri analysemodell med tilhørende globalt koordinatsystem og skalltykkelser benyttet.

4.1 Oppsett

4.1.1 Elementinndeling

Det er benyttet høyere ordens SHELL281 skallelementer i analysen og den har totalt 120027 noder og 39973 elementer. Deler av elementinndelingen er vist på Figur 6 under. Hele analysemodell er koblet sammen med felles elementnett samt også med noen

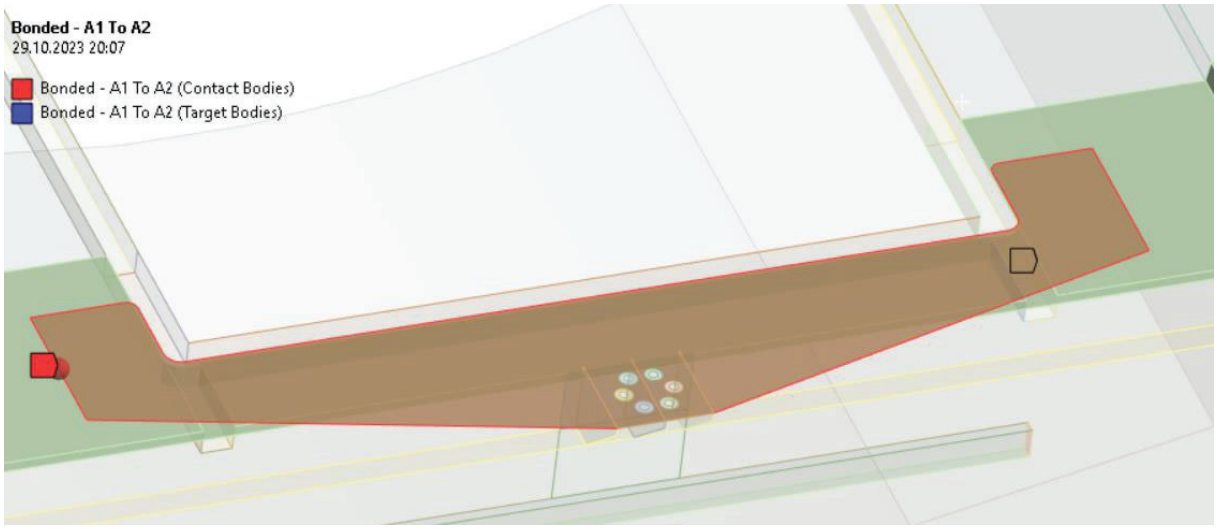
kontaktformulering som beskrives i neste kapittel. Det er benyttet elementer av størrelse 100 mm generelt for skall, 15mm for bakre del og 8 mm der det er forventet å få høyere spenning.



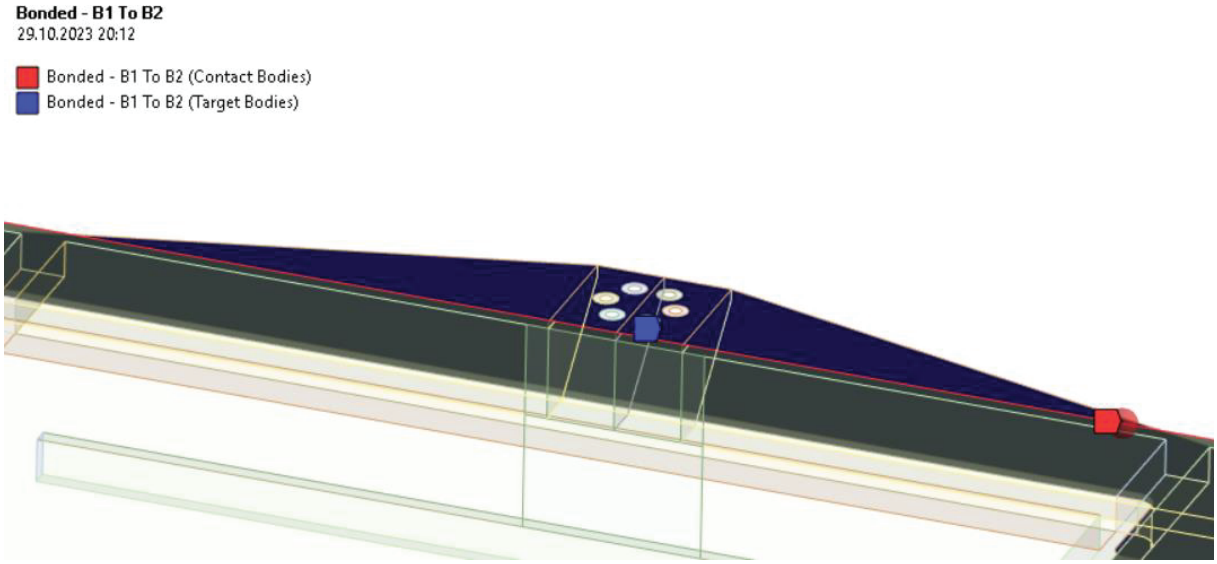
Figur 6 – Elementinndeling av konstruksjonen.

4.1.2 Kontakter

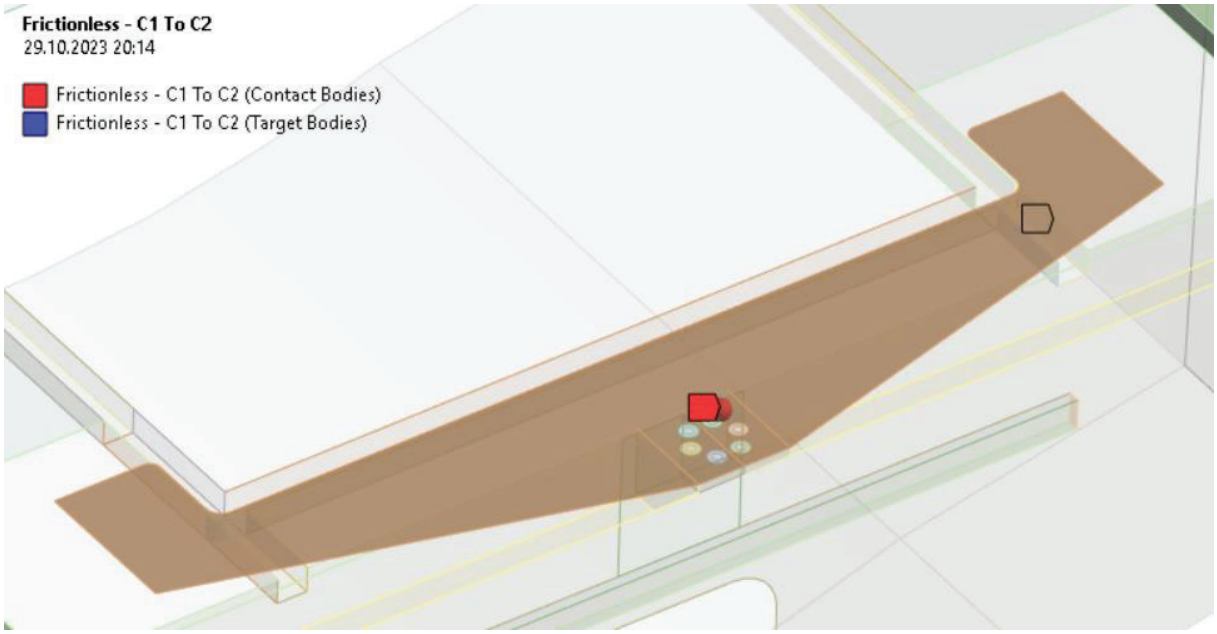
For å knytte noen deler sammen som ikke kan dele elementnett så benyttes det kontakter i ANSYS. Det er benyttet «bonded» kontakt som overfører krefter i alle frihetsgrader og flater kan ikke separeres og glide. Det er også benyttet «frictionless kontakt», denne kan glide i planet og kan separeres fra flate. Denne kontaktformulering er ikke-lineær.



Figur 7 – «Bonded» kontakt mellom 20mm forsterkningsplate (ytre kant) og topp skrog (nærliggende flate).



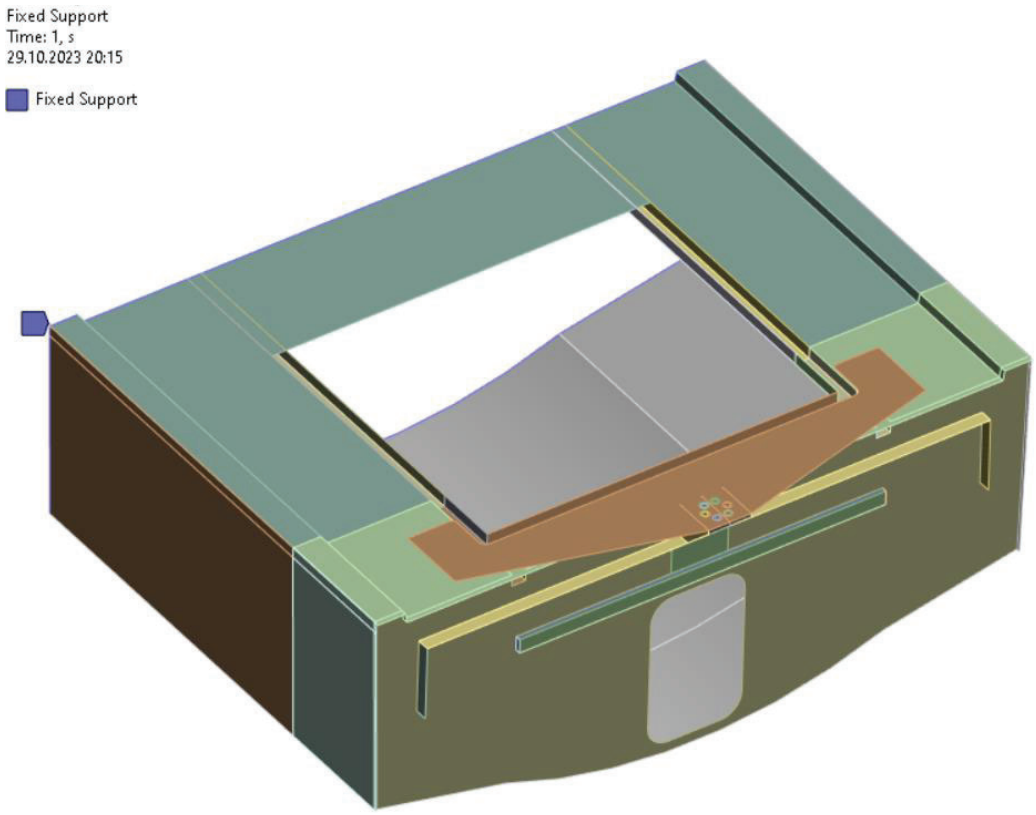
Figur 8 – «Bonded» kontakt mellom 20mm forsterkningsplate (flate under) og topp skrog (ytre linje).



Figur 9 – «Frictionless» kontakt mellom 20mm forsterkningsplate (flate under) og topp skrog (flate).

4.1.3 Opplagerbetingelser

Båtskroget er opplagret en god avstand fra det aktuelle interesseområde. Definisjonen er fullt fiksert i alle frihetsgrader.



Figur 10 – Opplagerbetingelse for analyse.

4.2 Resultater/Konklusjon

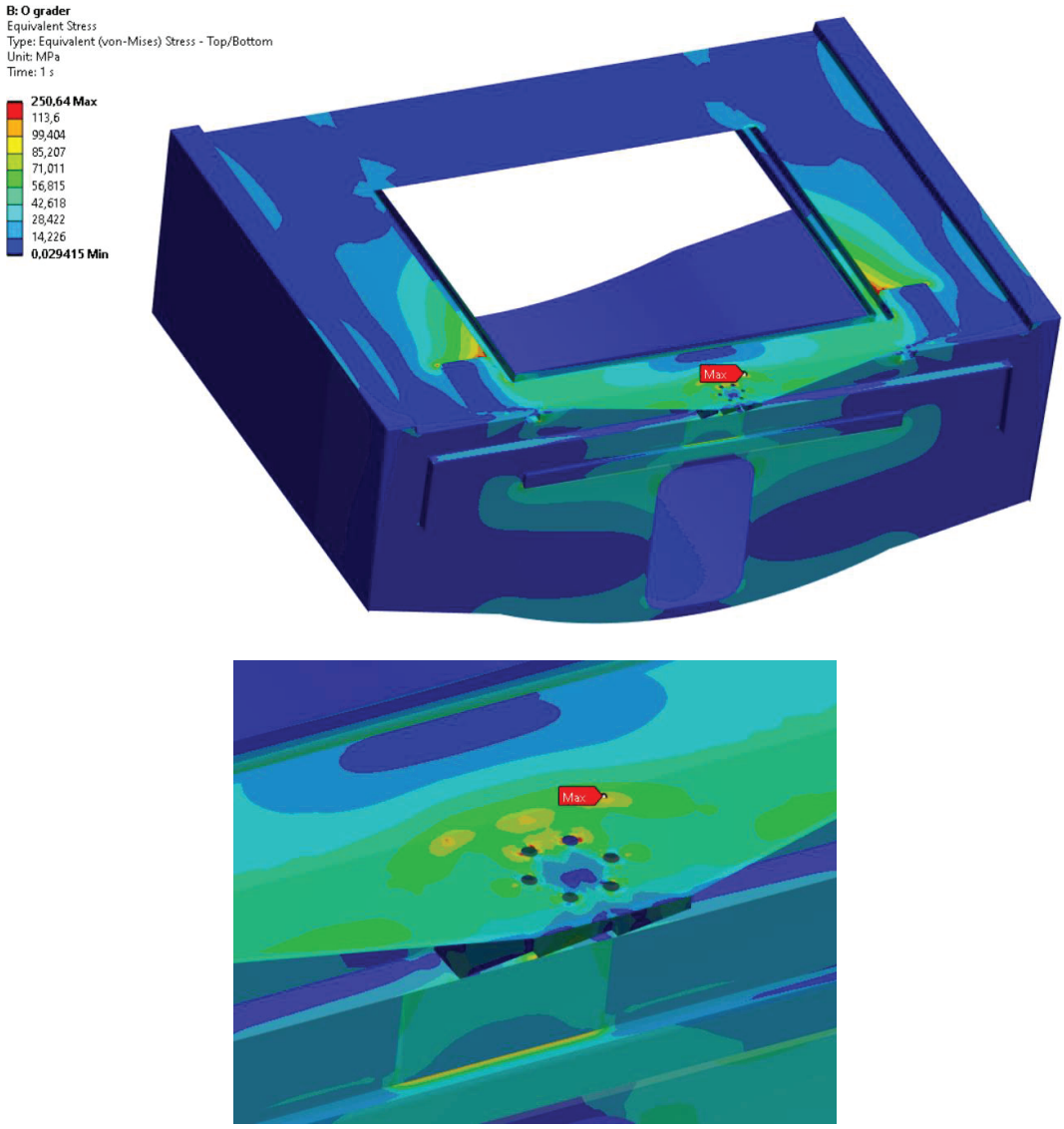
Det er utført analyse for forsterkningen med aktuelle laster og kombinasjoner. Det er kontrollert for spenning med gitte tillatte verdier definert i kapittel 2.

Spenningsmessig så er generelt verdier under tillatt spenning definert i kapittel 2. Det finnes små soner som har noe overskridende verdier for spenning (rundt boltehull og overføring forsterkningsplate og skrog), men disse relateres til singulære verdier som oppstår hyppig i FE analyser. Disse punktene får forhøyede verdier på grunn av geometri og bratte geometriske overganger.

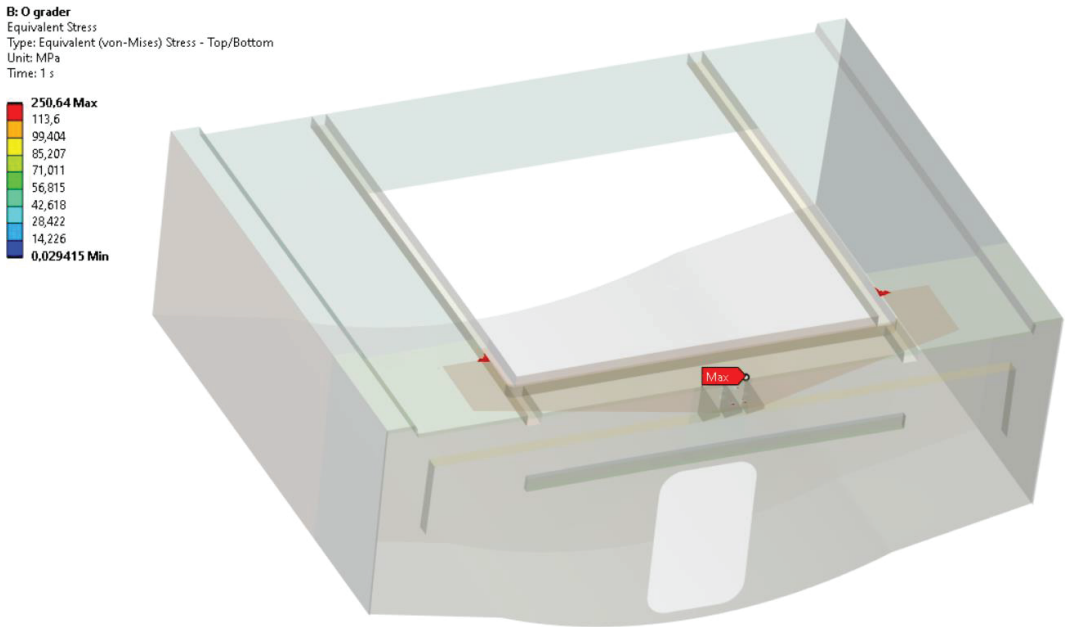
Resultater for analysen vurderes dermed som tilfredstillende.

4.2.1 Bruddgrense

Tillatt grense for spenning er definert i kapittel 2 og er 113,6 MPa i bruddgrensetilstand. Spenninger er vist på Figur 12 og **Feil! Fant ikke referansekilden.**. Som forventet så er kombinasjon med last i kjøreretning som er dominerende. Dermed føres kun disse resultatene opp.



Figur 11 – Kombinert spenning (von-mises), 0 grader lastretning.

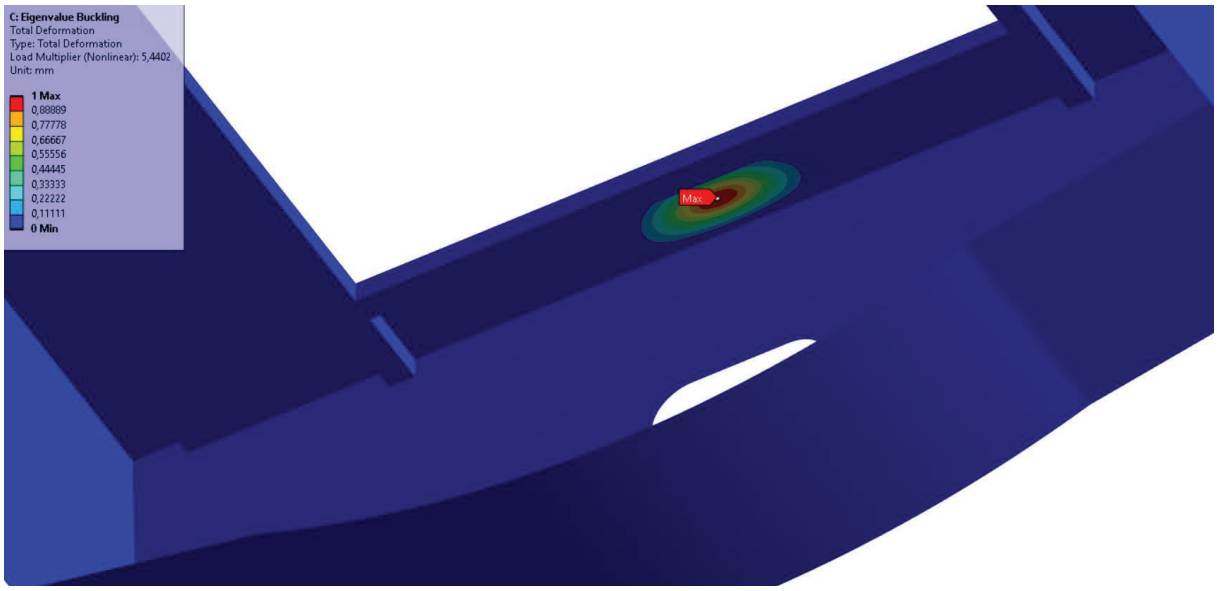


Figur 12 – Kombinert spenning (von-mises), 0 grader lastretning. Rød farge indikerer soner over tillatt spenning.

4.2.2 Bukling

Det er utført en lineær elastisk buklingsanalyse. Resultatet er multiplikasjonsfaktorer, altså den verdien som må multipliseres for å oppnå instabilitet.

Selv om lineær elastisk buklingsanalyse ikke er konservativt så er verdier så høye at det ikke er fare for instabilitet for plateseksjoner i konstruksjonen.



	Mode	Load Multiplier
1	1,	5,4402
2	2,	6,3768
3	3,	7,8563
4	4,	8,3659
5	5,	8,5778

Figur 13 – Lineær bukling globalt, underside forsterkning.

5 Referanser

/1/ NS-EN 1999-1-1, Eurocode 9; Prosjektering av aluminiumkonstruksjoner, Del 1-1 Allmenne regler.

/2/ ISO-7365-2012, Shipbuilding and Marine Structures Deck Machinery, Towing winches for deep sea use.

6 Appendiks

6.1 Material Sertifikater

INSPECTION CERTIFICATE	No: 3462 Date: 9/7/2023	CERTIFIED SRAC-IQNet ISO 9001/2015 No.10/valid 2026	vimetco alro SLATINA

CUSTOMER : ALUMECO ApS

CONTRACT/ORDER : 120632839
BILL OF DELIVERY : 80559015
TRUCK/CONTAINER : IF 37 CXF/ IF 73 CXF

MATERIAL : ALUMINIUM PLATES
ALLOY : EN AW-5083 TEMPER: H111
DIMENSIONS (mm) : 70337966 - 10X1020X2020

ACCORDING TO : EN 485 - 515 - 573

MECHANICAL PROPERTIES 1 MPa = 1 N/mm2 = 0.145 ksi = 0.102 kgf/mm2

1 lbs = 0.4536 kg			Rm MPa		Rp0.2 MPa		Elong. % 50mm
			min.	max.	min.	max.	min.
Specified values:			270	345	115		16
LOT / BATCH	CASE	NET WEIGHT kg	Measured values:				
70337966 S23075559	1102637;1102661	2022	299		171		32.0

CHEMICAL COMPOSITION %

	BATCH	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ga	V	Al
	S23075559	0.33	0,30	0.05	0.53	4.7	0.09	0.01	0.13	0.04	0.01	0.01	REM.
Acc. Standard	Min.				0,40	4,0	0,05						REM.
	Max.	0,40	0,40	0,10	1,0	4,9	0,25	0,05	0,25	0,15	0,05	0,05	
	Remarks:						Other- Each- Max.: 0.05			OthersTotal- Max.: 0.15			

REMARKS:

ACCORDING TO: EN485-2:2016+A1:2016 EN 515:2017 EN 573-3:2019+A1:2022

We hereby certify that the material detailed hereon has been produced and tested according to the requirements of the relevant standards, specification and/or order. Keep in dry conditions, without large temperature variations. The difference between metal and air must not exceed 11 °C.
Please follow the recommendations of the American Aluminium Association Guidelines for minimizing water staining of aluminium, latest edition, for the unloading and storage of the material in your premises before usage. Also, we certify that Alro products comply with REACH legislation no. 1907/2006 concerning Registration, Evaluation, Authorization and Restriction of Chemicals and CLP legislation no. 1272/2008 on classification, labeling and packaging of substances and mixtures and RoHS Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

According to EN 10204:2004 3.1

Marius Olteanu, Eng.
SC ALRO SA SLATINA
Punct de lucru Slatina
Str.Milcov Nr.1, Jud.Olt
Serv. Inspecţia Calităţii

ALRO S.A. No.116, Pitesti Street Phone: +(40) 0249 435 117; 0249 432 956 alro@alro.ro
230048-Slatina-ROMANIA Fax: (40) 0249 411 487; 0249 415 992 www.alro.ro
QUALITY CONTROL DEPT.
cod f1/PO-051/Rev.4/2012
End Of Certificate

INSPECTION CERTIFICATE	No: 3668 Date: 09/20/2023	CERTIFIED SRAC-IQNet ISO 9001/2015 No.10/valid 2026	vimetco alro SLATINA

CUSTOMER : ALUMECO ApS

CONTRACT/ORDER : 120636971
BILL OF DELIVERY : 80560419
TRUCK/CONTAINER : GJ 08 AWD/ GJ 72 AWD

MATERIAL : ALUMINIUM PLATES
ALLOY : EN AW-5083 **TEMPER:** H111
DIMENSIONS (mm) : 70341400 - 20X1020X2020

ACCORDING TO : EN 485 - 515 - 573

MECHANICAL PROPERTIES **1 MPa = 1 N/mm2 = 0.145 ksi = 0.102 kgf/mm2**

	1 lbs = 0.4536 kg	Rm MPa		Rp0.2 MPa		Elong. % 50mm
		min.	max.	min.	max.	min.
	Specified values:	270	345	115		15
LOT / BATCH	CASE	NET WEIGHT kg	Measured values:			
70341400 - S23065713	1105537;1105539	2928	272		174	26.5

CHEMICAL COMPOSITION %

	BATCH	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ga	V	Al
	S23065713	0.33	0.40	0.07	0.46	4.4	0.06	0.01	0.17	0.04	0.01	0.01	REM.
Acc. Standard	Min.				0.40	4.0	0.05						REM.
	Max.	0.40	0.40	0.10	1.0	4.9	0.25	0.05	0.25	0.15	0.05	0.05	
	Remarks:						Other- Each- Max.: 0.05			OthersTotal- Max.: 0.15			

REMARKS:

ACCORDING TO: EN485-2:2016+A1:2018 EN 515:2017 EN 573-3:2019+A1:2022

We hereby certify that the material detailed hereon has been produced and tested according to the requirements of the relevant standards, specification and/or order. Keep in dry conditions, without large temperature variations. The difference between metal and air must not exceed 11 °C.
Please follow the recommendations of the American Aluminum Association Guidelines for minimizing water staining of aluminium, latest edition, for the unloading and storage of the material in your premises before usage. Also, we certify that Alro products comply with REACH legislation no. 1907/2006 concerning Registration, Evaluation, Authorization and Restriction of Chemicals and CLP legislation no. 1272/2008 on classification, labeling and packaging of substances and mixtures and RoHS Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

According to **EN 10204:2004 3.1**

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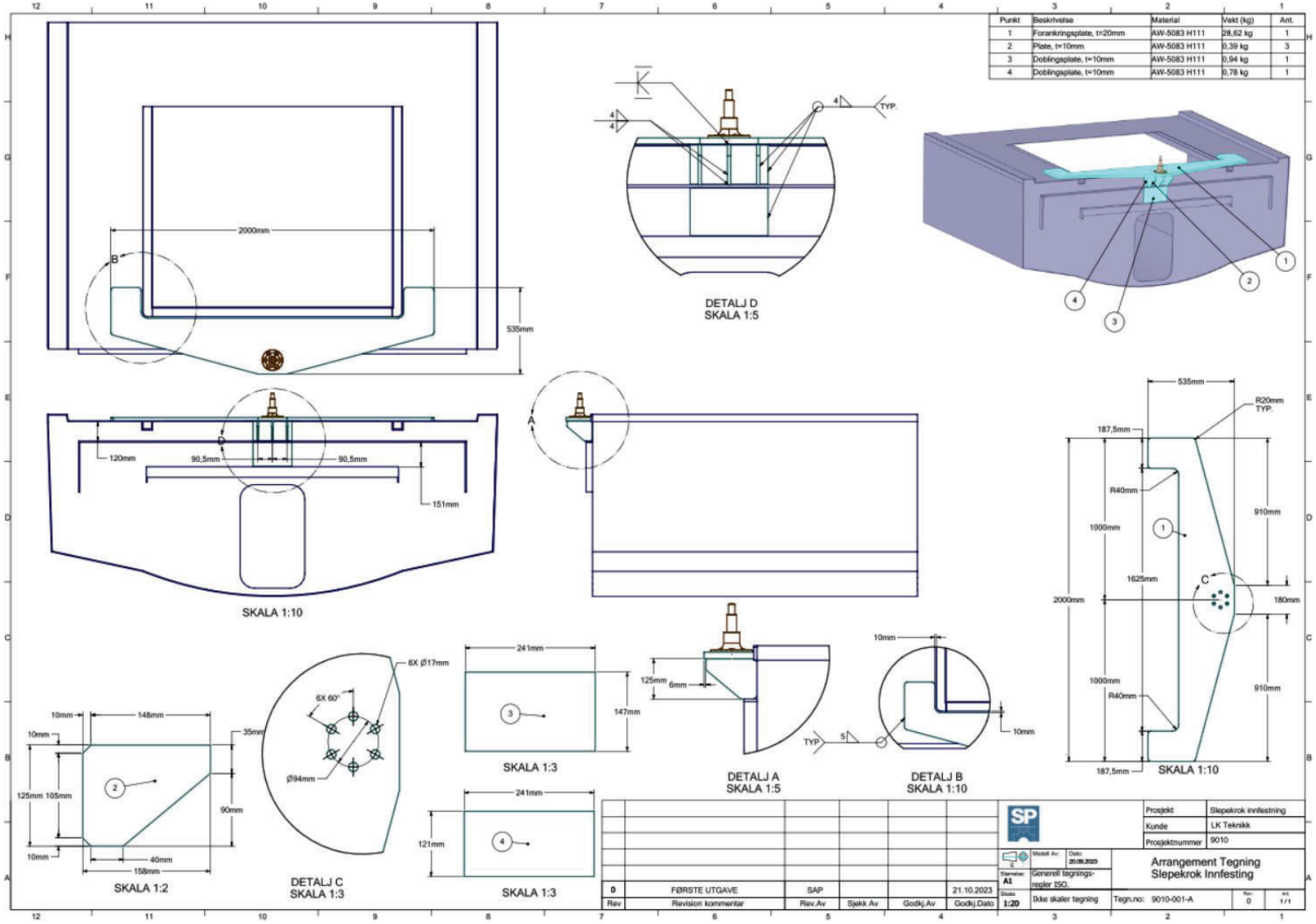
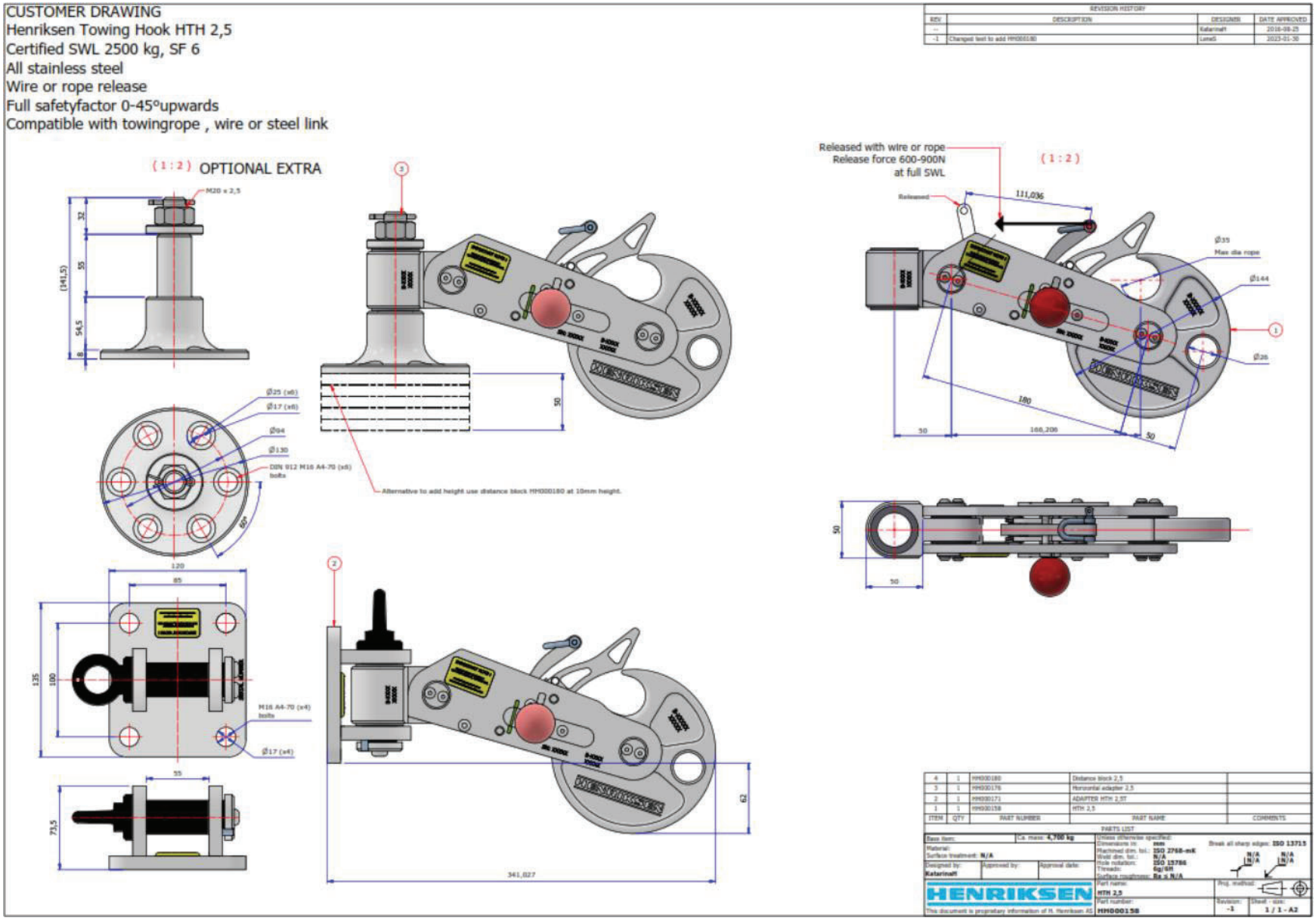
230048-Slatina-ROMANIA Fax: (40) 0249 411 487; 0249 415 992 www.alro.ro

QUALITY CONTROL DEPT.

cod f1/PO-051/Rev.4/2012
End Of Certificate

6.2 Tegninger




CUSTOMER DRAWING
Henriksen Towing Hook HTH 2,5
Certified SWL 2500 kg, SF 6
All stainless steel
Wire or rope release
Full safetyfactor 0-45°upwards
Compatible with towingrope , wire or steel link
(1:2) OPTIONAL EXTRA
Released with wire or rope
Release force 600-900N
at full SWL
(1:2)
Alternative to add height use distance block HH000180 at 10mm height.
HENRIKSEN