Base Load Power Hub (BLPH)

WELDING BOOK - STRUCTURE

Document Number: 123A90-PML-WEL-PRO-05002

Document Class: 2

04	21/06/2024	Accepted for Construction (AFC)	D.CENACCHI	A.KHALIFA	M.BRUNELLI
03	13/03/2024	Accepted for Construction (AFC)	D.CENACCHI	A.KHALIFA	M.BRUNELLI
02	12/02/2024	Accepted for Construction (AFC)	D.CENACCHI	A.KHALIFA	M.BRUNELLI
01	06/10/2023	Accepted for Construction (AFC)	D.CENACCHI	A.KHALIFA	M.BRUNELLI
00	06/10/2023	Issue for Review (IFR)	D.CENACCHI	A.KHALIFA	M.BRUNELLI
Rev.	Date	Description	Prepared	Reviewed	Approved

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Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Accepted for Construction (AFC) Revised where indicated by implementing the comments received with the Crosswind Comment Response Sheet
02	Accepted for Construction (AFC) Added new WPSs for Buttering and dissimilar and non structural welds
03	Accepted for Construction (AFC) Added new WPS TKY for branch connections and Non Structural Members
04	Accepted for Construction (AFC) comments received implemented + CTOD WPQRs added
04	Accepted for Construction (AFC) Added new WPS FCAW+SAW for transition piece site connection assembly

HOLDS LIST

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1	
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INTRODUCTION

PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

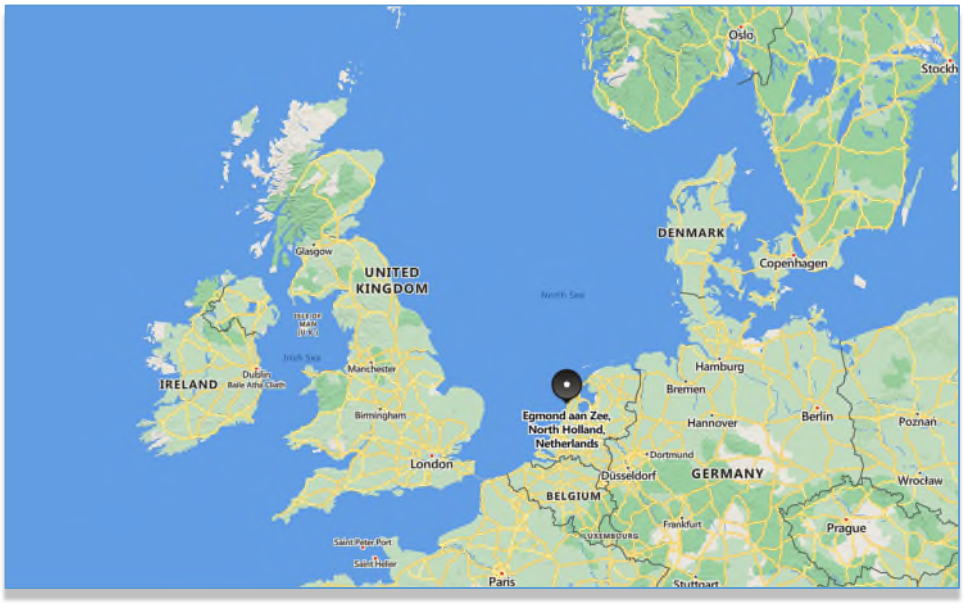


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

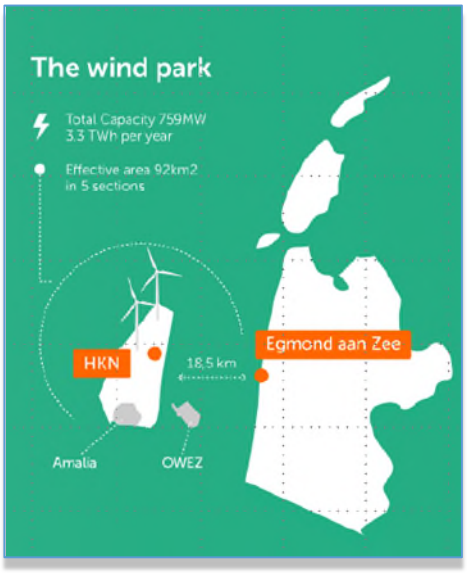


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

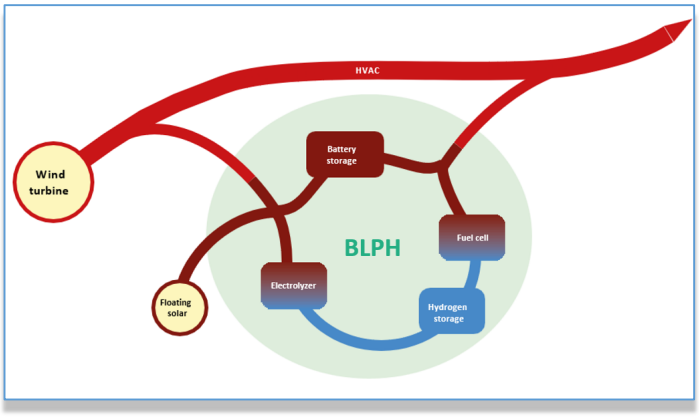


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

DOCUMENT SCOPE

The scope of this procedure is to define the Welding Procedure Specifications to be used on structural steelworks of Base Load Power Hub (BLPH).

REFERENCES

Doc. No.	Rev.	Date	Description - Title
K559-2254-MT-SPE-001	01	06/03/2023	Structural Fabrication Specification
EEMUA 158	Third ededition	2014	Construction Specification for Fixed Offshore Structures.
ISO 19902	Second edition	2020-11	Petroleum and Natural Gas Industries - Fixed Steel Offshore Structures.
ISO 19901-3	Dec-2014	Dec-2014	Petroleum and Natural Gas Industries - Specific Requirements for Offshore Structures - Topsides Structure.

Table 1 - Reference Documents

DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
CA	Certifying Authority
DP	Dye Penetrant
ITP	Inspection and Test Plan
MPI	Magnetic Particle Inspection
NDT	Non-Destructive Testing
QA	Quality Assurance
QC	Quality Control
RT	Radiographic Testing
UT	Ultrasonic Testing
WPQ	Welder Performance Qualification
WPQR (aka PQR)	Welding Procedure Qualification Record
WPS	Welding Procedure Specification
CJP	Complete Joint Penetration
PJP	Partial Joint Peneteration
FW	Fillet weld joint
WI	Welding Inspector
WS	Welding Supervisor
WT	Wall Thickness

Table 2 - Definitions and Abbreviations

WELDING REQUIREMENTS FOR CROSSWIND PROJECT

FIT UP

Dimensional characteristics are indicated in the WPSs attached and on shop drawings.

WELDING MATERIALS TO BE USED

Welding materials shall be those indicated in the applicable WPSs.
Welding consumables treatment shall be in accordance to project procedure.
Base metals are all included in EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1

SUPPLIER	CLASS	NAME	PROCESS	NOTES	NOTES
ESAB	EH12K / F7A8-EH12K	OK AUTROD 12.32	SAW	WIRE	
ESAB	EH12K / F7A8-EH12K	OK AUTROD 12.32	SAW	FLUX	
ESAB	E81T1-Ni1	FILARC PZ6138	GS FCAW	WIRE	
ESAB	E81T1-Ni1	OK TUBORDO 15.17	GS FCAW	WIRE	
BOHLER	E81T1-Ni1	Diamond Spark Ni1RC	GS FCAW	WIRE	
LINCOLN	ER70S-6	SUPRAMIG	GMAW	WIRE	
ESAB	E8016-G	FILARC 88S	SMAW	ELECTRODE	
ESAB	E81T1-Ni1	OK 15.17	GS FCAW	WIRE	
HYUNDAI	E309LT1-4	SW309L	GS FCAW	WIRE	
ESAB	E309L-17	OK 67.60	SMAW	ELECTRODE	
ESAB	ER 309L	OK TIGROD 309L	GTAW	WIRE	
LINCOLN	ER 316LSi	LMN 316LSi	GMAW	WIRE	
ESAB	ER70S-6	OK AUTROD 12.64	GMAW	WIRE	

Table 3 - Consumables selected for this project

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WPSS & PQRS

WPSS

WPSs are the instruments needed to define the techniques which shall be adopted for each kind of joint to be executed and which detail all the associated essential variables.
A table that lists all WPSs employed for the various items and/or pro-jects is attached (table 5).
All WPSs are developed following the essential variables specified by K559-2254-MT-SPE-001 unless otherwise agreed in bidding stage.
Each welder shall have access to the applicable WPSs which shall be kept well visible near each welding station in order to can easily verify the welding parameters used.

PQRS

PQRs supporting WPSs issued for the project are included in the table 5.
The pages of the PQR include the essential variables used during procedure qualification and the documents such as certificate report of base materials, mechanical test, NDE and/or other, shall be included only in the document which is forwarded to COMPANY for comments, review and/or approval.

WELDERS AND/OR WELDING OPERATORS IDENTIFICATION

The RM Welding Engineer shall prepare a list of qualified welders and/or welding operators. Welding personnel certifications (WPQs) shall be in accordance with K559-2254-MT-SPE-001 unless otherwise agreed in bidding stage.

WELDS IDENTIFICATION

At the start of the weld, Welder shall apply his proper identification number as per applicable IDL (of course ID info on sticker/or by marker can be added also by WI/WS).
A welding joint which has been executed by several welders shall show the identification numbers of all the welders employed, respecting welding sequences (for instance: GTAW – SMAW - SAW processes) as per Rosetti Marino procedure.

WELDING RECORDS/TRACEABILITY

This operation allows traceability of welds and welders involved in the activities related to the project.This system is developed by means of a computerized procedure and it also allows to check

the welder's working continuity and therefore his qualification validity.

WPS CODING

Each WPS has been assigned a code according to essential variables, materials and specifications, consumables by name and specification. The WPS coding is as follows:

- 1, 2, 3, 4: butt welds, tee welds, CJP welds, and any other type of weld covered by variables listed.
- 5: Fillet welds (used also for fit-up);
- 7: buttering
- 8: repair on a filler metal different from original weld (usually SMAW or GS FCAW on SAW)
- 10: weld beads & cladding

A letter may be adopted to shift the WPS between different disciplines (architectural, non-structural etc)

- "M" for Welds of 2nd cat and NS items with weld thickness up to 1" (25mm)
- "E" for welds involving stainless steel elements (earthing lugs etc..)

WELDING MAP

Each one of the shop drawings provides weld numbers and all details necessary to select the proper WPS between those introduced in section 3 and attachment 1. Moreover each shop drawing lists:

- Material type and grade and Structural category;
- Thickness and dimensions of the members to be welded;
- Weld details with indication of bevel and where required with supplementary indications.

Therefore shop drawings are to be considered as a complete welding map with weld location plan.

TEMPORARY ATTACHMENTS

Temporary attachments made directly to primary structure shall be removed by flame cutting or gouging at least 5 mm from base metal surface, then grinding flush and inspection by VT+MPI.

For all temporary attachment preheat shall be 100°C.

Removal of temporary attachment shall never be made by hammering or any other method that can lead to mechanical damage of the receiving members.

Tack welds shall be 4 times smaller thickness or 50mm (the smaller applies) or sufficiently frequent to prevent item collapse during welding and handling.

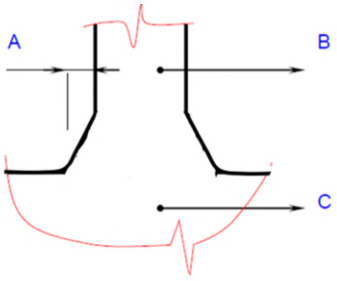
LEG SIZE FOR TEE JOINTS CJP & PJP (NON MANDATORY NOTE)

This point is applicable only where in drawings for CJP & PJP the leg is not indicated and where item may suffer joint stress concentration.

When Weld is CJP or PJP leg size is not required by design calculation, but where feasible and where installation do not require straight edge at the end of weld it is preferred to perform with capping passes with a minimum leg size for the purpose of contouring weld face or to reduce stress concentrations by giving the Weld a smooth profile transition into base metal.

The fillet-like reinforcement on the surface of T- and corner joint groove welds that naturally occurs shall not be cause for rejection nor need it be removed provided it does not interfere with other elements of the construction. No minimum contour radius needs to be provided.

When T joints are welded, the leg "A" must be ¼ thickness of the thinner between the members welded, but it never need to be more than 4 mm.



For example:

C = 28mm
B = 20mm
A = 20:4 = 5mm, but 4mm is sufficient,
A= no need to be more than 4mm.

C > B → A = ¼ B (max 4mm)

Figure 4 – leg size on CJP Tee

CONTRACT NO. CW-I-WP4-2023-05 – 07 SECTION V

PREHEAT

Preheat temperature is function of base material CEV and related combined thickness.
On WPS temperature of preheat is indicated related to the minimum thickness between members to be joined.
Reference is made to Contract No. CW-I-WP4-2023-05 – clause 07 SECTION V (Scope Description)
Referring to EEMUA 158 ED.3 - sec 5.3.3 – PREHEAT METHOD: CONTRACTOR shall use CONTRACTOR's preheating procedure standard, based on: product, position, thickness, category, preheat temperature, and execution timing, accommodating propane use, limiting the use of electric heating mats where this is necessary and feasible provided that this complies with STANDARDS OF PRACTICE.
Preheat application verification shall be included in the ITP, as a Witness Point for COMPANY, during the First Article Inspection.

NDE DELAY AFTER WELDING

Reference is made to Contract No. CW-I-WP4-2023-05 – clause 07 SECTION V (Scope Description)
Referring to K559-2254-MT-SPE-001 SEC. 7.2.2 DELAYED NDE: The CONTRACTOR shall apply NDE 24h after weld completion to mitigate from the requirements of K559-2254-MT-SPE-001 (48h), CONTRACTOR shall apply a spot verification checks, using MPI, with a 48h delay for the first month at each production site. The selection of the spot checks shall be agreed between the PARTIES.

CTOD TESTING (WHERE APPLICABLE)

Reference is made to Contract No. CW-I-WP4-2023-05 – clause 07 SECTION V (Scope Description)
Referring to EEMUA 158 ED.3 - SEC 5.4: CTOD shall be supplied at -10°C . ECA will not be provided.

LIST OF APPLICABLE WPSS

WPS	DELIVERY CONDITION	TYPE	Description and range of application	MAT. Grades	Process	NOTES	range of qualified Thk (mm)	range of qualified diam. (mm)	PQR
1A	+N	CJP, BW	CIRC. TUBULARS AND SINGLE SIDE NODES WELDS	S420 AND LOWER GRADE	GTAW+GS FCAW 141+136	NONE	3 ÷ 50	≥ 100	22/16+24/16+26/16 45A/10+45B/10
1C	TM	CJP, BW	LONG.CIRC. TUBULARS	S460 AND LOWER GRADE	GS FCAW+SAW 136+121	NONE	15 ÷ 45	≥ 600	06/21+07/21+54/18+40/18
1D	TM	CJP, BW	LONG.CIRC. TUBULARS	S460 AND LOWER GRADE	GMAW+SAW 135+121	NONE	15 ÷ 45	≥ 600	54/18
2A	TM/+N	CJP	PLATE, BEAMS,TUBOLARS COLUMNS / NODES	S460 AND LOWER GRADE	GS FCAW 136	NONE	3 ÷ 80	≥ 300	06/21+07/21+13/21+40/18+ +23/10
2B	TM	CJP, BW	PLATES CONNECTIONS	S460 AND LOWER GRADE	GS FCAW+SAW 136+121	NONE	15 ÷ 80	≥ 600	06/21+07/21+54/18+40/18+13/21
2T	+N/AR	CJP	PLATE, BEAMS,TUBOLARS COLUMNS / NODES	S460 AND LOWER GRADE	GTAW 141	NONE	3 ÷ 19	16,5 ÷ 485	01/21 + 02/21
4A	TM/TM+N	TKY	TUBOLARS/TUBOLARS-PLATES BRACINGS SINGLE SIDE	S460 AND LOWER GRADE	GS FCAW 136	NONE	3-51	≥ 100	6/21+7A/21+7B/21+13/21+27/19+ 30/22+31/22
4B	TM/TM+N	TKY	TUBOLARS/TUBOLARS-PLATES BRACINGS SINGLE SIDE	S460 AND LOWER GRADE	SMAW + GS FCAW 111+136	NONE	9-28	≥ 255	49/18+42/18+47/18 45/18
7A	TM/TM+N	BUTTERING	TUBOLARS/TUBOLARS-PLATES BRACINGS SINGLE SIDE	S460 AND LOWER GRADE	GS FCAW 136	NONE	3 mm – 80 mm (Incoming member on TEE joint Weld)	≥ 110 mm	06/21-07/21-13/21-27/19+21/22+22/22+23/22+40/18 +23/10

WPS for 316L & dissimilar CS/316L alloy attachments

WPS	DELIVERY CONDITION (2nd , NS)	Bevel Type	Description and range of application	MAT. Grades	Process	CONSUMABLES*	range of qualified Thk (mm)	range of qualified diam. (mm)	PQR
E6A	ALL	ALL	Welds dissimilar	316L to CS	FCAW	E309LT1-4	3-25	≥ 75mm	42/19 +44/19+ 46/19
E6B	ALL	ALL	Fillet welds dissimilar	316L to S460 AND LOWER GRADE	SMAW	E309L-17	3-25	≥ 60mm	03/19+25/98
E6C	ALL	ALL	Earthing lugs	316L to C.S.	GTAW	ER 309L	3-7	≥ 12mm	49/06+03/03
E6D	ALL	ALL	Stainless steel details	316L	GMAW	ER 316LSi	3-22,22	≥8”	76/98
E6E	ALL	ALL	Handrails-Stairs-Ladders	CS	GMAW	OK AUTROD 12.64	3-24	≥30,15	13/98
E6F	ALL	ALL	Handrails-Stairs-Ladders	CS	FCAW	OK TUBROD 15.17	3-14.28	≥30,15	02/19

Table 4 – list of applicable WPSs

WPSS

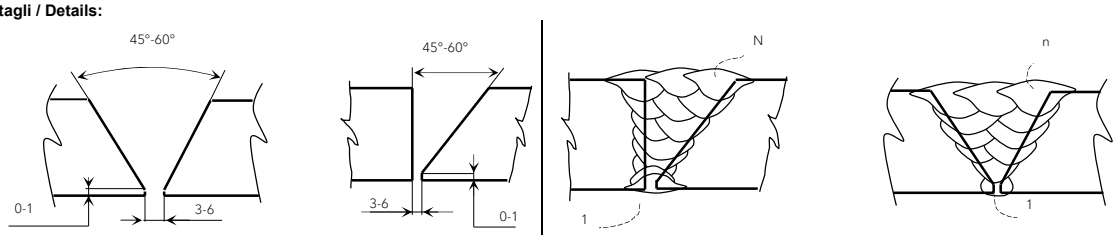
PQR:	22/16+24/16+26/16+45A/10+45B/10	code	ISO+EEMUA 158	WPS	1A	REV.:	0	Data /date	04/09/2023

Procedimento di sald. Welding process:	141 GTAW + 136 GS FCAW	Tipo : Type:	MANUAL + PARTLY MECHANIZED	scopo : scope:	CJP, BW, FW

GIUNTO – JOINT

Tipo di giunto: Joint Design:	½ V -V	☐ DOUBLE SIDED WELD	☒ SINGLE SIDED WELD (no backing on root)

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1	Stato di Fornitura: +N	Limits max: Cev/Ceq 0.43, Pcm = 0.20

Gamma spessori / Thickness range:	► Materiale base / Base material:	Piena penetrazione / Groove	3-50 mm (+N 3÷38mm, +TMCP 20-50mm)
	► Gamma diametri / Pipe dia. Range:	Piena penetrazione / Groove	≥100 mm (+N ≥ 100, +TMCP ≥ 600 mm)

METALLO D'APPORTO – FILLER METAL

	GTAW	GS FCAW	
Spec. N° (SFA)	5.18	5.29	
AWS N° (CLASS)	ER 70S-6	E81T1-Ni1M	
F-N°	6	6	
A-N°	1	10	
Diametro mat. d'apporto / Size of filler metal	2,4	1,2	
Gamma spessori /Thick. range	up to 4mm	up to completion	
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	NA	
Denom. Comm. flusso / FLUX trade name	NA	NA	
Inserto consumabile / Consumable insert	NA	NA	*ESAB Filarc PZ6138
Altro / other	ESAB OK TIGROD 12.64	WIRE: ESAB OK Tubrod 15.17*	*Diamond Spark Ni1 RC

giunto / Joint	Cianfrino / groove	Posizione / position	ALL	Progressione / weld progression:	Uphill

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: Min. pre-heat temp:	25°C [2] (based on WT 50°C, 100°C)	Max temp. Di interpass : Max interpass temp.:	220°C	Preheat Method Metodo preriscaldo	Propane Or Electric Heating Mats

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento Heating rate (°C/Hrs):	N.A.	Temperatura di stasi : Holding temperature °C:	N.A.	Tempo di stasi : Holding time (min.):	N.A.	Velocità di raffreddamento: Cooling rate (°C/Hrs):	N.A.

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar	99,99	10-15lt/1'
Protezione / Shielding:	Ar+CO2	80-20	13-19lt/1'
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC - CV	Polarità / Polarity	SP - RP
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			EWTh2 dia.2,4mm
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:			Spray arc
Velocità alimentazione filo / Electr. Wire feed speed range:			self regulatd

TECNICA – TECHNIQUE

Passata : Bead:	tirata o lavorata	Dimensione bocchello gas: Orifice of gas cup size:	½" – ¾"	Pulizia iniziale e fra le passate: Initial and interpass cleaning:	Spazzolatura e Molatura/Brushing Grinding
Metodo di solcatura a rovescio: Method of back gouging:	N.A.			Distanza tra zona di contatto e pezzo: Contact tube to work distance:	FCAW 12-18mm
N°Passate : Passes nr.:	Singola-Multiple/Single-Multiple	Elettrodo multiplo o singolo: Multiple or single electrodes:	Singolo/Single	Martellatura: Peening:	N.A.

Altro / Other: **Max width of passes 18mm, Minimum thickness to be complete before to cool down and move the item is 1/3 thickness. [2] for WT >20 mm, PREHEAT SHALL BE 50°C, WT ≥30mm 100°C.**

N° Passate Weld layers nr.	Processo Process	Materiale d'apporto Filler metal		Corrente Current		Voltaggio Volt range	Vel. avanzamento Travel speed range (mm/min)	Apporto termico Heat input (KJ/mm)
		Classe / Class	Dia. (mm.)	Polarità / Polarity	Amp. range			
root	GTAW	ER 70S-6	2,4	DC/SP	100-127	11-12	45-60	1.1 - 2.0
Hot	GTAW	ER 70S-6	2,4	DC/SP	130-165	13-14	80-100	1.0 - 1.7
fill	GS FCAW	E81T1-Ni1M	1,2	DC/RP	170-190	24-26	210-290	0.8 - 1.4
fill	GS FCAW	E81T1-Ni1M	1,2	DC/RP	230-270	24-26	290-400	0.8 - 1.4
cap	GS FCAW	E81T1-Ni1M	1,2	DC/RP	170-190	24-26	250-340	0.7 - 1.2
cap	GS FCAW	E81T1-Ni1M	1,2	DC/RP	180-270	24-26	330-380	0.7 - 1.2

Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	A. KHALIFA		

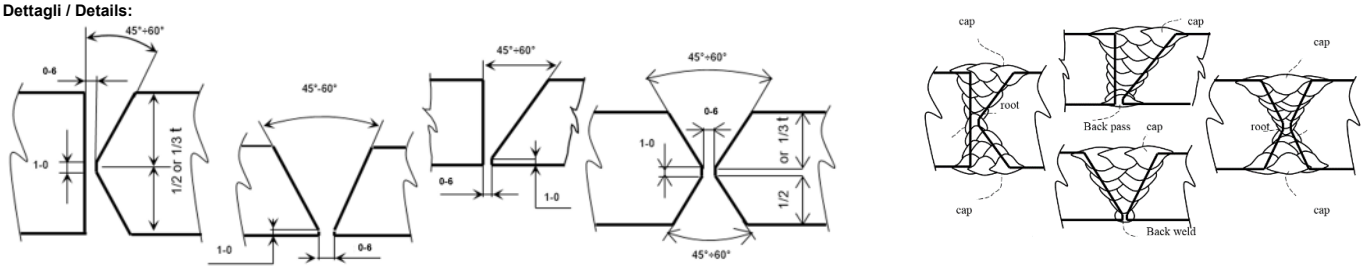
PQR:	06/21+07/21+54/18+40/18	code	ISO+EEMUA 158	WPS	1C	REV.:	2	Data /date	03/08/2023

Procedimento di sald. / Welding process: **136 FCAW + 121 SAW** — Tipo : / Type: **Partially Mechanized + MACHINE** — scopo : / scope: **CJP, BW, FW**

GIUNTO – JOINT

Tipo di giunto / Joint Design: **X+K+V +1/2V** — ☒ **DOUBLE SIDED WELD** (back welded, weld metal as backing on second side) — ☒ **Single sided weld**

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1 — **Stato di Fornitura: TMC** — **Limits max: Cev/Ceq 0.43, Pcm = 0.20**

Gamma spessori / Thickness range: ► Materiale base / Base material: Piena penetrazione / Groove **15-45 mm**

► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **≥ 24" (600 mm)**

METALLO D'APPORTO – FILLER METAL

	136 GS FCAW	121 SAW	
Spec. N° (SFA)	5.29	5.17	
AWS N° (CLASS)	E81T1-Ni1M	EH12K	
F-N°	6	6	
A-N°	10	1	
Diametro mat. d'apporto / Size of filler metal	1,2	3,2 / 3,2+4,0	
Gamma spessori /Thick.	Up to required thickness	balance	
Accoppiamento filo-flusso / Electrode-flux	NA	EH12K / F7A8-EH12K	
Denom. Comm. flusso / FLUX trade name	NA	OK FLUX 10.62	
Inserto consumabile / Consumable insert	NA	NA	
Altro / other	WIRE: ESAB OK Tubrod 15.17*	WIRE:OK AUTROD 12.32	*PZ 6138 / Diamond Spark Ni 1 RC

giunto / Joint **Cianfrino / groove** — Posizione / position **GS FCAW: ALL SAW: 1G-PA-FLAT** — Progressione / weld progression: **UP-HILL**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **50°C [2]** — Max temp. Di interpass / Max interpass temp.: **250°C** — Preheat Method / Metodo preriscaldo **fixed Propane torch or Heating mats**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento / Heating rate (°C/Hrs): **N.A.** — Temperatura di stasi / Holding temperature °C: **N.A.** — Tempo di stasi / Holding time (min.): **N.A.** — Velocità di raffreddamento / Cooling rate (°C/Hrs): **N.A.**

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+CO2	80-20	12-20lt/1'
Protezione al seguito / Trailing:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC ///AC	Polarità / Polarity	RP for DC
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			N.A.
Metodo di trasferimento per FCAW / FCAW metal tranfer mode:			Spray arc
Velocità alimentazione filo / Electr. Wire feed speed range:			self regulatd

TECNICA – TECHNIQUE

Passata / Bead: **tirata o lavorata** — Dimensione bocchello gas / Orifice of gas cup size: **½" – ¾"** — Pulizia iniziale e fra le passate / Initial and interpass cleaning: **Spazzolatura e Molatura/Brushing Grinding**

Metodo di solcatura a rovescio / Method of back gouging: **Scriccatura + molatura/ Arcair + grinding** — Distanza tra zona di contatto e pezzo / Contact tube to work distance: **GMAW/FCAW 12-18mm / SAW: 20-25mm**

Altro / Other: **Maximum weld bead width FCAW 18mm, single SAW 25mm, and tandem SAW 38mm. Do not stop welding before reaching 1/3 of the thickness or 25mm (whichever is less). [2] Preheat before SAW 100°C. HEAT INPUT WITH K FACTOR (0.8 for FCAW, SAW=1). This WPS also covers the execution of partial penetration joints and corner joints with SAW. Current (A) Voltage (V) shall be checked with 5% of tolerances during inspection**

N° Passate Weld layers nr.	Processo Process	Materiale d'apporto Filler metal		Corrente Current		Voltaggio Volt range	Vel. avanzamento Travel speed range (mm/min)	Apporto termico Heat input (KJ/mm)
		Classe / Class	Dia. (mm.)	Polarità / Polarity	Amp. range			
Root / tack	136 GS FCAW	E81T1-Ni1M	1,2	DC/RP	175 - 250	24-27	150-240	0.8 - 2.1
Hot-fill	121 SAW	EH12K	3,2 / 4,0	DC/RP	465 - 610	26-30	410-620	1.1 - 2.5
Back-cap	121 SAW	EH12K	3,2 / 4,0	DC/RP	500 - 600	27-29	410-510	1.6 - 2.5
Fill/cap	121 SAW	EH12K	3,2+4,0	DC/RP /// AC	500-600// 550-650	27-29/36-38	780-1000	2,0 - 3,2

Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	**A. KHALIFA**		

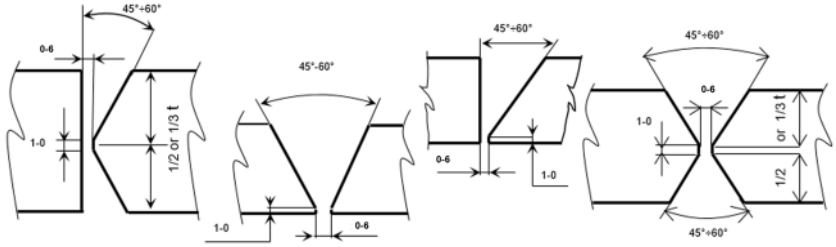
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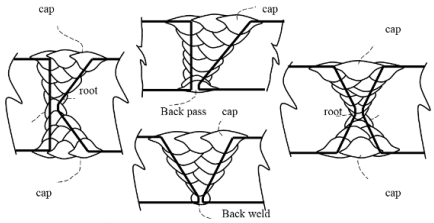
Procedimento di sald. / Welding process: **135 GMAW + 121 SAW** — Tipo : / Type: **Partially Mechanized + MACHINE** — scopo : / scope: **CJP, BW, FW**

GIUNTO – JOINT

Tipo di giunto: / Joint Design: **X+K+V+1/2V** — ☒ **DOUBLE SIDED WELD** (back welded, weld metal as backing on second side) — ☐ **Single sided weld**

Dettagli / Details:





MATERIALE BASE – BASE MATERIAL

EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1 — **Stato di Fornitura: TMC** — **Limits max: Cev/Ceq 0.43, Pcm = 0.20**

Gamma spessori / Thickness range: ► Materiale base / Base material: Piena penetrazione / Groove **15-45 mm**

► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **≥ 24" (600 mm)**

METALLO D'APPORTO – FILLER METAL

	135 GMAW	121 SAW	
Spec. N° (SFA)	5.18	5.17	
AWS N° (CLASS)	ER70-S6	EH12K	
F-N°	6	6	
A-N°	1	1	
Diametro mat. d'apporto / Size of filler metal	1,2	3,2 / 3,2+4,0	
Gamma spessori /Thick.	Up to 8mm	Remaining	
Accoppiamento filo-flusso / Electrode-flux	NA	EH12K / F7A8-EH12K	
Denom. Comm. flusso / FLUX trade name	NA	OK FLUX 10.62	
Inserto consumabile / Consumable insert	NA	NA	
Altro / other	Lincoln Supramig*	WIRE:OK AUTROD 12.32	*or same classification

giunto / Joint **Cianfrino / groove** — Posizione / position **GMAW/ GS FCAW: ALL SAW: 1G-PA-FLAT** — Progressione / weld progression: **UP-HILL**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: / Min. pre-heat temp: **50°C** [2] — Max temp. Di interpass : / Max interpass temp.: **250°C** — Preheat Method / Metodo preriscaldo **fixed Propane torch or Heating mats**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento / Heating rate (°C/Hrs): **N.A.** — Temperatura di stasi : / Holding temperature °C: **N.A.** — Tempo di stasi : / Holding time (min.): **N.A.** — Velocità di raffreddamento: / Cooling rate (°C/Hrs): **N.A.**

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+CO2	80-20	12-20lt/1'
Protezione al seguito / Trailing:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC ///AC	Polarità / Polarity	RP for DC
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			N.A.
Metodo di trasferimento per FCAW / FCAW metal tranfer mode:			Spray arc
Velocità alimentazione filo / Electr. Wire feed speed range:			self regulatd

TECNICA – TECHNIQUE

Passata : / Bead: **string &/or wave** — Dimensione bocchello gas: / Orifice of gas cup size: **½" – ¾"** — Pulizia iniziale e fra le passate: / Initial and interpass cleaning: **Spazzolatura e Molatura/Brushing Grinding**

Metodo di solcatura a rovescio: / Method of back gouging: **Scriccatura + molatura/ Arcair + grinding** — Distanza tra zona di contatto e pezzo: / Contact tube to work distance: **GMAW 12-18mm / SAW: 20-25mm**

Altro / Other: **Maximum weld bead width GMAW 18mm, single SAW 25mm, and tandem SAW 38mm. Do not stop welding before reaching 1/3 of the thickness or 25mm (whichever is less). [2] Preheat before SAW 100°C. HEAT INPUT WITH K FACTOR (0.8 for GMAW, SAW=1). This WPS also covers the execution of partial penetration joints and corner joints with SAW. Current (A) Voltage (V) shall be checked with 5% of tolerances during inspection**

N° Passate / Weld layers nr.	Processo / Process	Materiale d'apporto / Filler metal		Corrente / Current		Voltaggio / Volt range	Vel. avanzamento / Travel speed range (mm/min)	Apporto termico / Heat input (KJ/mm)
		Classe / Class	Dia. (mm.)	Polarità / Polarity	Amp. range			
Root / tack	135 GMAW	ER70-S6	1,2	DC/RP	165 - 200	23-25	190-240	0.8 - 1.2
Hot-fill	121 SAW	EH12K	3,2 / 4,0	DC/RP	465 - 610	26-30	410-620	1.1 - 2.5
Back-cap	121 SAW	EH12K	3,2 / 4,0	DC/RP	500 - 600	27-29	410-510	1.6 - 2.5
Fill/cap	121 SAW	EH12K	3,2+4,0	DC/RP /// AC	500-600// 550-640	27-29/36-38	780-1000	2,0 - 3,1

Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	**A. KHALIFA**		

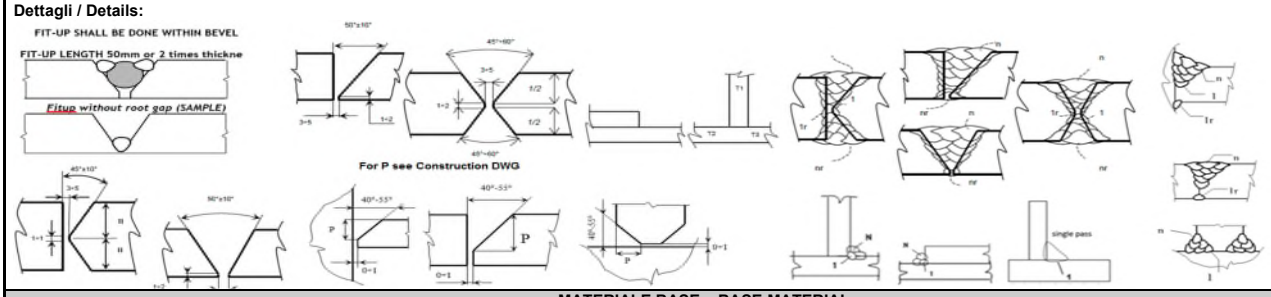
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Procedimento di sald. / Welding process:	136 FCAW	Tipo : / Type:	Partially Mechanized	scopo : / scope:	CJP, BW, FW,PJP

GIUNTO – JOINT

Tipo di giunto: / Joint Design:	1/2V BW & TEE	☒	DOUBLE SIDED WELD	☒	SINGLE SIDED WELD (no backing on root)
PQR SAMPLE	SINGLE SIDE NO BACKING	☒	QUALIFIED WITH AND WITHOUT BACKING &/OR BACKGOUGING	☒	CERAMIC BACKING SEE NOTE

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

GRADO S460 e inferiori — **Delivery cond: +N / +TM, N to TM** — **Max CEV N=0.44 / Pcm=0,23**

Gamma spessori / Thickness range:	► Materiale base / Base material:	Piena penetrazione / Groove	3-80 mm
	► Gamma diametri / Pipe dia. Range:	Piena penetrazione / Groove	≥300 mm

METALLO D'APPORTO – FILLER METAL

	136 GS FCAW		
Spec. N° (SFA)	5.29		
AWS N° (CLASS)	E81T1-Ni1M		
F-N°	6		
A-N°	10		*PZ 6138 only for thickness ≤50 mm
Diametro mat. d'apporto / Size of filler metal	1,2		*DIAMONDSPARK Ni1
Gamma spessori /Thick. range	up to completion		
Inserto consumabile / Consumable insert	NA		
Altro / other	WIRE: ESAB OK Tubrod 15.17*		

giunto / Joint	ALL	Posizione / position	ALL	Progressione / weld progression:	Uphill

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: / Min. pre-heat temp:	50°C [2]	Max temp. Di interpass : / Max interpass temp.:	250°C	Preheat Method / Metodo preriscaldo	Propane Or Electric Heating Mats

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento / Heating rate (°C/Hrs):	N.A.	Temperatura di stasi : / Holding temperature °C:	N.A.	Tempo di stasi : / Holding time (min.):	N.A.	Velocità di raffreddamento: / Cooling rate (°C/Hrs):	N.A.

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+CO2	80-20	13-19lt/1'
Protezione / Shielding:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC - CV	Polarità / Polarity	RP
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:	N.A.		
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:	Spray arc		
Velocità alimentazione filo / Electr. Wire feed speed range:	self regulatd		

TECNICA – TECHNIQUE

Passata : / Bead:	Tirata-Larga/String-Wave	Dimensione bocchello gas: / Orifice of gas cup size:	½"-3/8"	Pulizia iniziale e fra le passate: / Initial and interpass cleaning:	Spazzolatura e Molatura/Brushing Grinding
Metodo di solcatura a rovescio: / Method of back gouging:	Scriccatura + molatura/ Arcair + grinding	Oscillazione: / Oscillation:	N.A.	Distanza tra zona di contatto e pezzo: / Contact tube to work distance:	12-18mm
N°Passate : / Passes nr.:	Singola-Multiple/Single-Multiple	Elettrodo multiplo o singolo: / Multiple or single electrodes:	Singolo/Single	Martellatura: / Peening:	N.A.

Altro / Other: **Maximum weld bead width 18mm. [2] Preheat 100°C for weld thickness >25mm. HEAT INPUT WITH K FACTOR (0.8 for GMAW). This WPS also covers the execution of partial penetration and corner joints. Current (A) Voltage (V) shall be checked with 5% of tolerance during inspection**

Weld Layers	Process	Filler metal		Current		Volt range		Travel speed range (mm/min)		Heat input (KJ/mm)	
		Class	Dia. (mm.)	Polarity	AMP						
root	GS FCAW	E81T1-Ni1M	1,2	DC/RP	155 - 170	24	27	126	240	0,74	1,75
root	GS FCAW	E81T1-Ni1M	1,2	DC/RP	170 - 200	24	27	148	265	0,74	1,75
hot	GS FCAW	E81T1-Ni1M	1,2	DC/RP	180 - 220	25	28	170	290	0,74	1,74
fill-cap	GS FCAW	E81T1-Ni1M	1,2	DC/RP	180 - 220	25	28	170	290	0,74	1,74
fill-cap	GS FCAW	E81T1-Ni1M	1,2	DC/RP	230 - 280	25	28	215	375	0,74	1,75

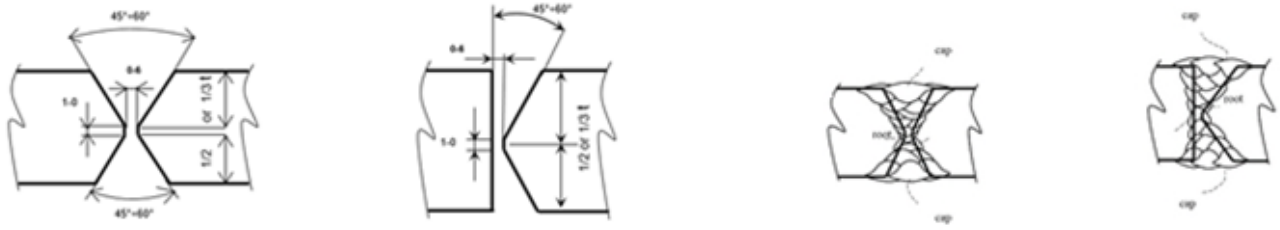
Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	A. KHALIFA		

PQR:	06/21+07/21+54/18+13/21	code	ISO+EEMUA 158	WPS	2B	REV.:	0	Data /date	21/06/2024
Procedimento di sald. Welding process:	136 FCAW + 121 SAW	Tipo : Type:	Partially Mechanized + MACHINE	scopo : scope:	CJP, BW,FW				

GIUNTO – JOINT

Tipo di giunto: Joint Design: **X+K** ☒ **DOUBLE SIDED WELD** (back welded, weld metal as backing on second side) ☐ **Single sided weld**

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1 — **Stato di Fornitura: TMC** — **Limits max: Cev/Ceq 0.43, Pcm = 0.20**

Gamma spessori / Thickness range:

► Materiale base / Base material: Piena penetrazione / Groove **15-65 mm**

► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **≥ 24" (600 mm)**

METALLO D'APPORTO – FILLER METAL

	136 GS FCAW	121 SAW	
Spec. N° (SFA)	5.29	5.17	
AWS N° (CLASS)	E81T1-Ni1M	EH12K	
F-N°	6	6	
A-N°	10	1	
Diametro mat. d'apporto / Size of filler metal	1,2	3,2 / 3,2+4,0	
Gamma spessori /Thick.	Up to required thickness	balance	
Accoppiamento filo-flusso / Electrode-flux	NA	EH12K / F7A8-EH12K	
Denom. Comm. flusso / FLUX trade name	NA	OK FLUX 10.62	
Inserto consumabile / Consumable insert	NA	NA	
Altro / other	WIRE: Diamond Spark Ni 1 RC	WIRE:OK AUTROD 12.32	

giunto / Joint	Cianfrino / groove	Posizione / position	GS FCAW: 4G-PE SAW: 1G-PA-FLAT	Progressione / weld progression:	UP-HILL

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: Min. pre-heat temp:	100°C	Max temp. Di interpass : Max interpass temp.:	250°C	Preheat Method Metodo preriscaldo	fixed Propane torch or Heating mats

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento Heating rate (°C/Hrs):	N.A.	Temperatura di stasi : Holding temperature °C:	N.A.	Tempo di stasi : Holding time (min.):	N.A.	Velocità di raffreddamento: Cooling rate (°C/Hrs):	N.A.

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+CO2	80-20	12-20lt/1'
Protezione al seguito / Trailing:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC ///AC	Polarità / Polarity	RP for DC
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			N.A.
Metodo di trasferimento per FCAW / FCAW metal tranfer mode:			Spray arc
Velocità alimentazione filo / Electr. Wire feed speed range:			self regulatd

TECNICA – TECHNIQUE

Passata : Bead:	tirata o lavorata	Dimensione bocchello gas: Orifice of gas cup size:	½" – ¾"	Pulizia iniziale e fra le passate: Initial and interpass cleaning:	Spazzolatura e Molatura/Brushing Grinding
Metodo di solcatura a rovescio: Method of back gouging:	Scriccatura + molatura/ Arcair + grinding			Distanza tra zona di contatto e pezzo: Contact tube to work distance:	FCAW 12-18mm / SAW: 20-25mm

Altro / Other: **Maximum weld bead width FCAW 18mm, single SAW 25mm, and tandem SAW 38mm. Do not stop welding before reaching 1/3 of the thickness or 25mm (whichever is less). HEAT INPUT WITH K FACTOR (0.8 for FCAW, SAW=1). Current (A) Voltage (V) shall be checked with 5% of tolerances during inspection**

N° Passate Weld layers nr.	Processo Process	Materiale d'apporto Filler metal		Corrente Current		Voltaggio Volt range	Vel. avanzamento Travel speed range (mm/min)	Apporto termico Heat input (KJ/mm)
		Classe / Class	Dia. (mm.)	Polarità / Polarity	Amp. range			
Root / tack	136 GS FCAW	E81T1-Ni1M	1,2	DC/RP	155 - 170	24-27	126-240	0.74 - 1.75
Hot	136 GS FCAW	E81T1-Ni1M	1,2	DC/RP	180-220	25-28	170-290	1.30 - 0.50
FILL/CAP	136 GS FCAW	E81T1-Ni1M	1,2	DC/RP	180-220	25-28	170-290	1.30 - 0.50
BACK GOUGE / GRIND TO BRIGHT METAL								
1-reverse	121 SAW	EH12K	3,2 / 4,0	DC/RP	465 - 610	26-30	410-620	1.1 - 2.5
Back-cap	121 SAW	EH12K	3,2 / 4,0	DC/RP	500 - 600	27-29	410-510	1.6 - 2.5
Fill/cap	121 SAW	EH12K	3,2+4,0	DC/RP /// AC	500-600// 550-650	27-29/36-38	780-1000	2,0 - 3,2

Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	A. KHALIFA		

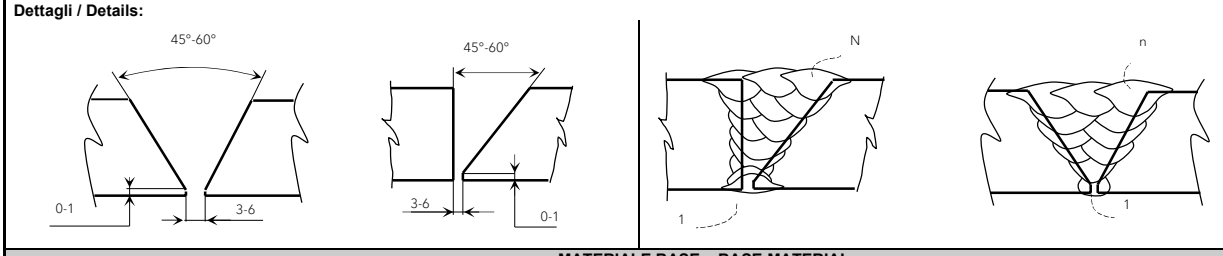
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Procedimento di sald. / Welding process: **141 GTAW** — Tipo : / Type: **MANUAL** — scopo : / scope: **CJP, BW, FW**

GIUNTO – JOINT

Tipo di giunto: / Joint Design: **½ V -V** — ☐ **DOUBLE SIDED WELD** — ☒ **SINGLE SIDED WELD (no backing on root)**

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1 — **Stato di Fornitura: +N / AR** — **Limits max: Cev/Ceq 0.43, Pcm = 0.20**

Gamma spessori / Thickness range: ► Materiale base / Base material: Piena penetrazione / Groove **3-19 mm**

► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **16,5 – 485 mm**

METALLO D'APPORTO – FILLER METAL

	141 GTAW		
Spec. N° (SFA)	5.18		
AWS N° (CLASS)	ER 70S-6		
F-N°	6		
A-N°	1		
Diametro mat. d'apporto / Size of filler metal	2,4		
Gamma spessori /Thick. range	up to completion		
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA		
Denom. Comm. flusso / FLUX trade name	NA		
Inserto consumabile / Consumable insert	NA		
Altro / other	ESAB OK TIGROD 12.64		

giunto / Joint: **Cianfrino / groove** — Posizione / position: **ALL** — Progressione / weld progression: **Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: / Min. pre-heat temp: **25°C** — Max temp. Di interpass : / Max interpass temp.: **250°C** — Preheat Method / Metodo preriscaldo: **Propane Or Electric Heating Mats**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento / Heating rate (°C/Hrs): **N.A.** — Temperatura di stasi : / Holding temperature °C: **N.A.** — Tempo di stasi : / Holding time (min.): **N.A.** — Velocità di raffreddamento: / Cooling rate (°C/Hrs): **N.A.**

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar	99,99	8-20lt/1'
Protezione / Shielding:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current : **DC** — Polarità / Polarity **SP**

Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type: **EWTh2 dia.2,4mm**

Metodo di trasferimento per GMAW / GMAW metal tranfer mode: **N.A.**

Velocità alimentazione filo / Electr. Wire feed speed range: **N.A.**

TECNICA – TECHNIQUE

Passata : / Bead: **string &/or wave** — Dimensione bocchello gas: / Orifice of gas cup size: **½" – ¾"** — Pulizia iniziale e fra le passate: / Initial and interpass cleaning: **Spazzolatura e Molatura/Brushing Grinding**

Metodo di solcatura a rovescio: / Method of back gouging: **N.A.** — Distanza tra zona di contatto e pezzo: / Contact tube to work distance: **N.A.**

N°Passate : / Passes nr.: **Singola-Multiple/Single-Multiple** — Elettrodo multiplo o singolo: / Multiple or single electrodes: **Singolo/Single** — Martellatura: / Peening: **N.A.**

Altro / Other: **Max width of passes 18mm,**

Weld Layers	Process	Filler metal		Current		Volt range	Travel Speed range (mm/min)	Heat input (KJ/mm)
		Class	Dia. (mm.)	Polarity	AMP			
root	141 GTAW	ER70S-6	2,0-2,4	DC/SP	90 - 120	9 - 11	35 - 70	1,4 - 0,4
root	141 GTAW	ER70S-6	2,0-2,4	DC/SP	110 - 140	10 - 12	40 - 70	1,5 - 0,6
hot	141 GTAW	ER70S-6	2,0-2,4	DC/SP	100 - 140	10 - 13	50 - 80	1,3 - 0,5
hot	141 GTAW	ER70S-6	2,0-2,4	DC/SP	120 - 160	11 - 14	60 - 90	1,3 - 0,5
fill-cap	141 GTAW	ER70S-6	2,0-2,4	DC/SP	100 - 150	11 - 15	55 - 100	1,5 - 0,4
fill-cap	141 GTAW	ER70S-6	2,0-2,4	DC/SP	120 - 170	12 - 16	65 - 100	1,5 - 0,5

PQR:	06/21 +07/21 +13/21 +27/19 + Mock-ups[2]	code	ISO+EEMUA 158	WPS	4A	REV.:	0	Data /date	17/01/2024

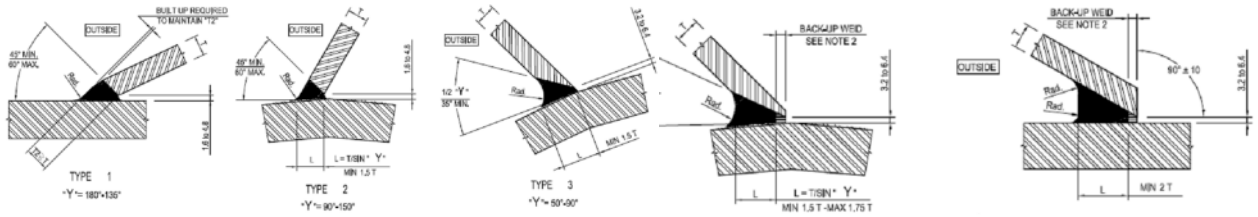
Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	A. KHALIFA		

Procedimento di saldatura: Welding process:	**GS FCAW**	Tipo : Type:	**SEMIAUTOMATIC**	scopo : scope:	**CJP, TKY**

GIUNTO – JOINT

Tipo di giunto: Joint Design:	**1/2V BW & TEE**	☐ **DOUBLE SIDED WELD**	☒ **SINGLE SIDED WELD (no backing on root)**
PQR SAMPLE	**SINGLE SIDE NO BACKING**	☐ **QUALIFIED WITH AND WITHOUT BACKING &/OR BACKGOUGING**	☐ **CERAMIC BACKING SEE NOTE(4)**

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1 **Delivery cond: +N / +TM, N to TM** **Max CEV N=0.42 / TM=0,37, Max C N=0.17 / TM=0,09**

Gamma spessori / Thickness range:	► Materiale base / Base material:	Piena penetrazione / Groove	**3-50 mm (thickness incoming member)**
	► Gamma diametri / Pipe dia. Range:	Piena penetrazione / Groove	**≥110 mm (diameter incoming member)**

METALLO D'APPORTO – FILLER METAL

	GS FCAW		
Spec. N° (SFA)	**5.29**		
AWS N° (CLASS)	**E81T1-Ni1M**		
F-N°	**6**		
A-N°	**10**		
Diametro mat. d'apporto / Size of filler metal	**1,2**		
Gamma spessori /Thick. range	**up to completion**		
Accoppiamento filo-flusso / Electrode-flux (CLASS)	**NA**		
Denom. Comm. flusso / FLUX trade name	**NA**		
Inserto consumabile / Consumable insert	**NA**		
Altro / other	**WIRE: ESAB OK Tubrod 15.17***	***ESAB Filarc PZ6138**	***Diamond Spark Ni1 RC**

giunto / Joint	**Cianfrino / groove**	Posizione / position	**ALL**	Progressione / weld progression:	**Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: Min. pre-heat temp:	**50°C [3]**	Max temp. Di interpass : Max interpass temp.:	**200°C**	Preheat Method Metodo preriscaldo	**PROPANE TORCH OR HEATING MAT**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento Heating rate (°C/Hrs):	**N.A.**	Temperatura di stasi : Holding temperature °C:	**N.A.**	Tempo di stasi : Holding time (min.):	**N.A.**	Velocità di raffreddamento: Cooling rate (°C/Hrs):	**N.A.**

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	**Ar+ CO2**	**80-20**	**13-19lt/1'**
Protezione / Shielding:	**N.A.**	**N.A.**	**N.A.**
Prot. Al rovescio / Backing:	**N.A.**	**N.A.**	**N.A.**

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	**DC - CV**	Polarità / Polarity	**RP**
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			**N.A.**
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:			**Spray arc**
Velocità alimentazione filo / Electr. Wire feed speed range:			**self regulatd**

TECNICA – TECHNIQUE

Passata : Bead:	**Tirata-Larga/String-Wave**	Dimensione bocchello gas: Orifice of gas cup size:	**½"-3/8"**	Pulizia iniziale e fra le passate: Initial and interpass cleaning:	**Spazzolatura e Molatura/Brushing Grinding**
Metodo di solcatura a rovescio: Method of back gouging:	**N.A.**			Oscillazione: Oscillation:	**N.A.**
				Distanza tra zona di contatto e pezzo: Contact tube to work distance:	**12-18mm**
N°Passate : Passes nr.:	**Singola-Multiple/Single-Multiple**	Elettrodo multiplo o singolo: Multiple or single electrodes:	**Singolo/Single**	Martellatura: Peening:	**N.A.**

Altro / Other: **Max. width of weld bead 18mm. [2] Mock-ups PQRs 29/22+30/22+31/22**
[3] incoming members thickness 30mm and above 100°C

N° Passate Weld layers nr.	Processo Process	Materiale d'apporto Filler metal		Corrente Current		Voltaggio Volt range	Vel. avanzamento Travel speed range (mm/min)	Apporto termico Heat input (KJ/mm)
		Classe / Class	Dia. (mm.)	Polarità / Polarity	Amp. range			
root	**GS FCAW**	**E81T1-Ni1M**	**1,2**	**DC/RP**	**140-175**	**21-22**	**90-100**	**1.4 - 2.0**
hot	**GS FCAW**	**E81T1-Ni1M**	**1,2**	**DC/RP**	**200-220**	**24-26**	**150-210**	**1.1 - 1.8**
fill	**GS FCAW**	**E81T1-Ni1M**	**1,2**	**DC/RP**	**200-230**	**24-26**	**150-210**	**1.1 - 1.9**
cap	**GS FCAW**	**E81T1-Ni1M**	**1,2**	**DC/RP**	**215-240**	**25-27**	**190-260**	**1.0 - 1.6**

PQR:	**06/21-07/21-13/21-27/19+40/18+23/10 (mock up)****	**code**	**ISO+EEMUA 158**	**WPS**	**7A**	**REV.:**	**0**	**Data /date**	**12/02/2024**

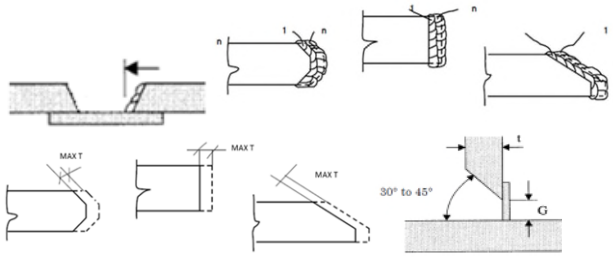
Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	**A. KHALIFA**		

Procedimento di saldatura: Welding process:	136-FCAW	Tipo : Type:	SEMIAUTOMATIC

GIUNTO - JOINT

Tipo di giunto: Joint Design: **BUTTERING** | Supporto: Backing: ☒ Si / Yes DOUBLE SIDED WELD ☐ No

Materiale di supporto (tipo): Backing material (type). ☐ Metallico / Metal ☐ Non metallico / No metal. ☒ Metallo non fondente / Non Fusing metal ☐ Altro / Other



Max T in total 12.7 mm of buttering thickness
Buttering area shall be marked , in order to incorporate to the final NDE inspection.
Buttering do not require dedicated NDE inspection.

Note:

MATERIALE BASE - BASE MATERIAL

EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1 — **Delivery cond: +N / +TM, N to TM (CEV max 0,42; Pcm max 0,21)**

Gamma spessori / Thickness range: ► Materiale base / Base material: Piena penetrazione / Groove **3 mm to 80 mm (Incoming member on TEE Weld**

► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **≥ 110 mm**

METALLO D'APPORTO - FILLER METAL

	GS FCAW		
Spec. N° (SFA)	5.29		
AWS N° (CLASS)	E81T1-Ni1M		
F-N°	6		
A-N°	10		
Diametro mat. D'apporto / Size of filler metal	1,2		
Gamma spessori /Thick. Range (mm)	up to completion		
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA		
Denom. Comm. Flusso / FLUX trade name	NA		
Inserto consumabile / Consumable insert	NA		
Altro / other	WIRE: ESAB OK Tubrod 15.17*	*ESAB Filarc PZ6138 only for thickness ≤50 mm	*Diamond Spark Ni1 RC

POSIZIONI - POSITION

giunto / Joint: **Cianfrino / groove** | Posizione / position **All** | Progressione / weld progression: **Ascendente / UP hill**

PRERISCALDO - PRE-HEAT

Temp.preriscaldo minima: Min. pre-heat temp:	50 °C	Max temp. Di interpass : Max interpass temp.:	250 °C	Mantenimento interpass : Interpass maintenance :	N.A.	Tempo di mantenimento prerisc.: Maintenance timing:	N.A.

TRATTAMENTO TERMICO DOPO SALDATURA - POST WELD HEAT TREATMENT

Riscaldamento Heating rate (°C/Hrs):	N.A.	Temperatura di stasi : Holding temperature °C:	N.A.	Tempo di stasi : Holding time (min.):	N.A.	Velocità di raffreddamento: Cooling rate (°C/Hrs):	N.A.

GAS DI PROTEZIONE - GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+CO2	80%+20%	16-24 lt/min
Protezione al seguito / Trailing:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC	Polarità / Polarity	RP
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			N.A.
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:			N.A.
Velocità alimentazione filo / Electr. Wire feed speed range:			Self regulated

TECNICA - TECHNIQUE

Passata : Bead:	Tirata/String	Dimensione bocchello gas: Orifice of gas cup size:	1/2"	Pulizia iniziale e fra le passate: Initial and interpass cleaning:	Spazzolatura/Brushing
Metodo di solcatura a rovescio: Method of back gouging:	N.A.			Oscillazione: Oscillation:	N.A.
Distanza zona di contatto e pezzo: Contact zone to work distance:	N.A.				
N°Passate : Passes nr.:	Multipla/Multiple	Elettrodo multiplo o singolo: Multiple or single electrodes:	Singolo/Single	Martellatura: Peening:	N.A.

Altro / Other: ****Mock up PQRs 21/22+22/22+23/22 (+N Tubular +TM Plate)**

N° Passate Weld layers nr.	Processo Process	Materiale d'apporto Filler metal		Corrente Current		Voltaggio Volt range	Vel. Avanzamento Travel speed range (mm/min)	Apporto termico Heat input (KJ/mm)
		Classe / Class	Dia. (mm.)	Polarità / Polarity	Amp. Range			
1-n	GS FCAW	E81T1-Ni1M	1.2	DC/RP	190 250	24 27	110 270	0,81 2,94

PQR:	49/18+42/18+47/18 45/18	code	ISO+EEMUA 158	WPS	4B	REV.:	0	Data /date	05/03/2024

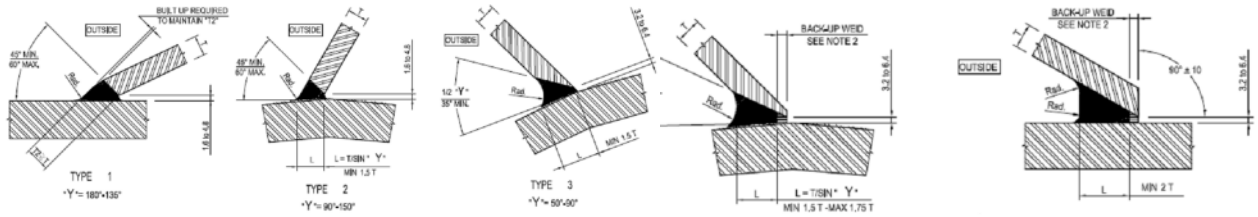
Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	A. KHALIFA		

Procedimento di saldatura: Welding process:	**SMAW+GS FCAW**	Tipo : Type:	**MANUAL+SEMIAUTOMATIC**	scopo : scope:	**CJP, TKY**

GIUNTO – JOINT

Tipo di giunto: Joint Design: **1/2V BW & TEE**	☐ **DOUBLE SIDED WELD**	☒ **SINGLE SIDED WELD (no backing on root)**	
PQR SAMPLE **SINGLE SIDE NO BACKING**	☐ **QUALIFIED WITH AND WITHOUT BACKING &/OR BACKGOUGING**	☐ **CERAMIC BACKING SEE NOTE(4)**	

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

EN ISO 15608 GR.1 & 2 / ISO TR 10272 Gr. 1.1/1.2/2.1 **Delivery cond: +N / +TM, N to TM** **Max CEV N=0.43 / TM=0,37, Max C N=0.17 / TM=0,09**

Gamma spessori / Thickness range:	► Materiale base / Base material:	Piena penetrazione / Groove	**9-28 mm (thickness incoming member)**
	► Gamma diametri / Pipe dia. Range:	Piena penetrazione / Groove	**≥255 mm (diameter incoming member)**

METALLO D'APPORTO – FILLER METAL

	SMAW	GS FCAW	
Spec. N° (SFA)	5.5	5.29/5.36	
AWS N° (CLASS)	E8016-G	E81T1-1/E81T1-Ni1	
F-N°	4	6	
A-N°	10	1	
Diametro mat. d'apporto / Size of filler metal	2,5/3,2	1,2	
Gamma spessori /Thick. range	Up to 4 mm	Up to filling	
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	NA	
Denom. Comm. flusso / FLUX trade name	NA	NA	
Inserto consumabile / Consumable insert	NA	NA	
Altro / other	FILARC 88S	OK TUBROD 15.17	

giunto / Joint	**Cianfrino / groove**	Posizione / position	**ALL**	Progressione / weld progression:	**Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: Min. pre-heat temp:	**50°C [3]**	Max temp. Di interpass : Max interpass temp.:	**200°C**	Preheat Method Metodo preriscaldo	**PROPANE TORCH OR HEATING MAT**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento Heating rate (°C/Hrs):	**N.A.**	Temperatura di stasi : Holding temperature °C:	**N.A.**	Tempo di stasi : Holding time (min.):	**N.A.**	Velocità di raffreddamento: Cooling rate (°C/Hrs):	**N.A.**

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+ CO2	80-20	13-19lt/1'
Protezione / Shielding:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	**DC - CV**	Polarità / Polarity	**RP**
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			**N.A.**
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:			**Spray arc**
Velocità alimentazione filo / Electr. Wire feed speed range:			**self regulatd**

TECNICA – TECHNIQUE

Passata : Bead:	**Tirata-Larga/String-Wave**	Dimensione bocchello gas: Orifice of gas cup size:	**½"-3/8"**	Pulizia iniziale e fra le passate: Initial and interpass cleaning:	**Spazzolatura e Molatura/Brushing Grinding**
Metodo di solcatura a rovescio: Method of back gouging:	**N.A.**	Oscillazione: Oscillation:	**N.A.**	Distanza tra zona di contatto e pezzo: Contact tube to work distance:	**12-18mm**
N°Passate : Passes nr.:	**Singola-Multiple/Single-Multiple**	Elettrodo multiplo o singolo: Multiple or single electrodes:	**Singolo/Single**	Martellatura: Peening:	**N.A.**

Altro / Other: **[3] incoming members thickness 30mm and above 100°C**

N° Passate Weld layers nr.	Processo Process	Materiale d'apporto Filler metal		Corrente Current		Voltaggio Volt range	Vel. avanzamento Travel speed range (mm/min)	Apporto termico Heat input (KJ/mm)
		Classe / Class	Dia. (mm.)	Polarità / Polarity	Amp. range			
Tack-root	SMAW	E8016-G	2.5-3.2	DC/RP	82-100	21-23	67-90	0.92 - 1.65
hot	SMAW	E8016-G	3.2	DC/RP	91-110	21-23	86-112	0.82 - 1.40
fill	GS FCAW	E81T1-Ni1	1,2	DC/RP	190-260	25-28	209-358	0.63 - 1.67
cap	GS FCAW	E81T1-Ni1	1,2	DC/RP	175-200	25-28	282-410	0.51 - 1.18

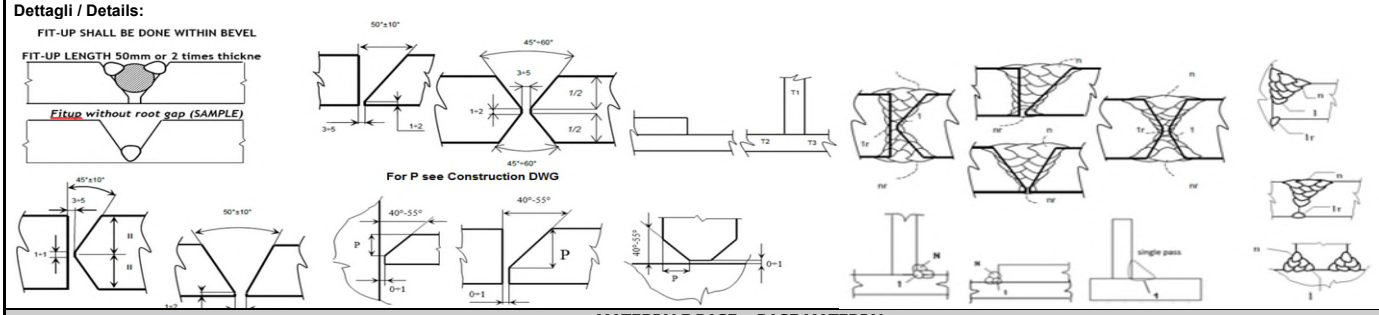
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Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	**A. KHALIFA**		

Procedimento di saldatura: Welding process:	**GS FCAW**	Tipo : Type:	**MANUAL**	scopo : scope:	**FW, PJP, CJP**

GIUNTO – JOINT

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

Dissimilar Joints AISI 316L to Carbon Steel **2nd category and non structural welds**

Gamma spessori / Thickness range:	► Materiale base / Base material:	Piena penetrazione / Groove	**3-25.4 mm (incoming member on tee welds)**
	► Gamma diametri / Pipe dia. Range:	Piena penetrazione / Groove	**≥ 75 mm for rolled positions, 500mm others**

METALLO D'APPORTO – FILLER METAL

		136 - GS FCAW	
Spec. N° (SFA)		A5.22	
AWS N° (CLASS)		E309LT1-4	
F-N°		6	
A-N°		10	
Diametro mat. d'apporto / Size of filler metal		1,2	
Gamma spessori /Thick. range		up to completion	
Accoppiamento filo-flusso / Electrode-flux (CLASS)		N.A.	
Denom. Comm. flusso / FLUX trade name		N.A.	
Inserto consumabile / Consumable insert		N.A.	
Altro / other		HYUNDAI SW309L* or same class	*Shield Britght 309L

giunto / Joint	**FW / CJP / PJP**	Posizione / position	**ALL**	Progressione / weld progression:	**Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: Min. pre-heat temp:	**20°C**	Max temp. Di interpass : Max interpass temp.:	**150°C**	Preheat Method Metodo preriscaldo	**PROPANE TORCH**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	**Ar+CO2**	**80-20**	**13-19lt/1'**
Protezione / Shielding:	**N.A.**	**N.A.**	**N.A.**
Prot. Al rovescio / Backing:	**N.A.**	**N.A.**	**N.A.**

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current : **DC-CV**	Polarità / Polarity	**RP**
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:		**N.A.**
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:		**Spray, Glob, Pulsed**
Velocità alimentazione filo / Electr. Wire feed speed range:		**N.A.**

TECNICA – TECHNIQUE

Passata : Bead:	**Tirata-Larga/String-Wave**	Dimensione bocchello gas: Orifice of gas cup size:	**N.A.**	Pulizia iniziale e fra le passate: Initial and interpass cleaning:	**Spazzolatura e Molatura/Brushing Gri**
Metodo di solcatura a rovescio: Method of back gouging:	**Molatura/Grinding**	Oscillazione: Oscillation:	**N.A.**	Distanza tra zona di contatto e pezzo: Contact tube to work distance:	**N.A.**
N°Passate : Passes nr.:	**Singola-Multiple/Single-Multiple**	Elettrodo multiplo o singolo: Multiple or single electrodes:	**Singolo/Single**	Martellatura: Peening:	**N.A.**

Altro / Other: Max. width of weld bead 18 mm ±2mm. Heat input is including K factor to allow quick check with PQR values.

Weld Layers	Process	Filler metal		Current			Volt range			Travel Speed range (mm/min)			Heat input (KJ/mm)		
		Class	Dia. (mm.)	Polarity	AMP										
root	GS FCAW	E309LT1-4	1,2	DC/RP	150	- 180	23	-	25	125	-	150	1,7	-	1,1
root	GS FCAW	E309LT1-4	1,2	DC/RP	190	- 230	24	-	25	160	-	200	1,7	-	1,1
hot	GS FCAW	E309LT1-4	1,2	DC/RP	180	- 200	24	-	26	140	-	200	1,8	-	1,0
hot	GS FCAW	E309LT1-4	1,2	DC/RP	210	- 260	24	-	27	190	-	240	1,8	-	1,0
fill	GS FCAW	E309LT1-4	1,2	DC/RP	180	- 220	24	-	27	175	-	220	1,6	-	0,9
fill	GS FCAW	E309LT1-4	1,2	DC/RP	220	- 285	24	-	27	230	-	265	1,6	-	1,0
cap	GS FCAW	E309LT1-4	1,2	DC/RP	180	- 200	24	-	27	200	-	270	1,3	-	0,8
cap	GS FCAW	E309LT1-4	1,2	DC/RP	210	- 270	24	-	27	270	-	320	1,3	-	0,8

PQR ref.:	**03/19+25/98**	**code**	**ISO 15614-1 EEMUA 197**	**WPS**	**E6B**	**REV.:**	**0**	**Data /date**	**19/01/2024**

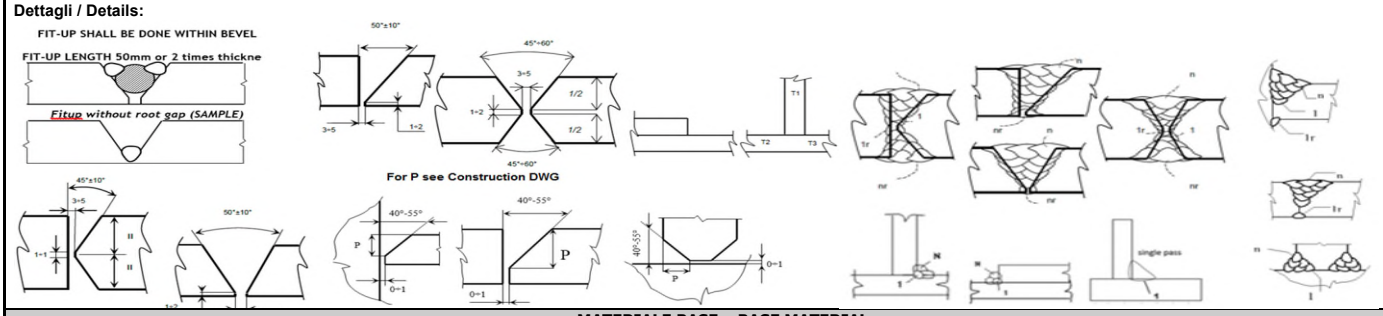
Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	**A. KHALIFA**		

Procedimento di saldatura: Welding process:	**SMAW**	Tipo : Type:	**MANUAL**	scopo : scope:	**FW**

GIUNTO – JOINT

Tipo di giunto: Joint Design:	**ALL**	☒ **DOUBLE SIDED WELD**	☒ ~~**SINGLE SIDED WELD**~~
PQR SAMPLE	**SINGLE SIDE WITH BACKING**	☐	☐

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

Dissimilar Joints AISI 316L to Carbon Steel **2nd category and non structural welds**

Gamma spessori / Thickness range:

► Materiale base / Base material: Piena penetrazione / Groove **ALL**

► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **≥ 60.3 mm**

METALLO D'APPORTO – FILLER METAL

		SMAW	
Spec. N° (SFA)		**5.4**	
AWS N° (CLASS)		**E 309L-17**	
F-N°		**5**	
A-N°		**8**	
Diametro mat. d'apporto / Size of filler metal		**2.5-3.2 mm**	
Metallo depositato / Deposit weld metal			
Gamma spessori /Thick. range		**up to completion**	
Accoppiamento filo-flusso / Electrode-flux (CLASS)		**NA**	
Denom. Comm. flusso / FLUX trade name		**NA**	
Inserto consumabile / Consumable insert		**NA**	
Altro / other		**ESAB OK 67.60* OR EQUIVALENT**	

giunto / Joint	**FW / CJP / PJP**	Posizione / position	**ALL**	Progressione / weld progression:	**Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima: Min. pre-heat temp:	**20°C**	Max temp. Di interpass : Max interpass temp.:	**150°C**	Preheat Method Metodo preriscaldo	**PROPANE TORCH**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

Riscaldamento Heating rate (°C/Hrs):	**N.A.**	Temperatura di stasi : Holding temperature °C:	**N.A.**	Tempo di stasi : Holding time (min.):	**N.A.**	Velocità di raffreddamento: Cooling rate (°C/Hrs):	**N.A.**

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	**N.A.**	**N.A.**	**N.A.**
Protezione / Shielding:	**N.A.**	**N.A.**	**N.A.**
Prot. Al rovescio / Backing:	**N.A.**	**N.A.**	**N.A.**

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	**DC**	Polarità / Polarity	**RP**
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			**N.A.**
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:			**N.A.**
Velocità alimentazione filo / Electr. Wire feed speed range:			**N.A.**

TECNICA – TECHNIQUE

Passata : Bead:	**Tirata-Larga/String-Wave**	Dimensione bocchello gas: Orifice of gas cup size:	**N.A.**	Pulizia iniziale e fra le passate: Initial and interpass cleaning:	**Spazzolatura e Molatura/Brushing Grind**
Metodo di solcatura a rovescio: Method of back gouging:	**N.A.**	Oscillazione: Oscillation:	**N.A.**	Distanza tra zona di contatto e pezzo: Contact tube to work distance:	**N.A.**
N°Passate : Passes nr.:	**Singola-Multiple/Single-Multiple**	Elettrodo multiplo o singolo: Multiple or single electrodes:	**Singolo/Single**	Martellatura: Peening:	**N.A.**

Altro / Other: **Max. width of weld bead x 3 electrode diameter**

Weld Layers	Process	Filler metal		Current		Volt range	Travel speed range (mm/min)	Heat input (KJ/mm)
		Class	Dia. (mm.)	Polarity	AMP			
root	SMAW	E 309L-17	2,5	DC/RP	65 - 85	20 - 23	60 - 90	1,6 - 0,7
root	SMAW	E 309L-17	3,2	DC/RP	75 - 110	21 - 25	85 - 100	1,6 - 0,8
fill cap	SMAW	E 309L-17	2,5	DC/RP	65 - 90	21 - 24	65 - 100	1,6 - 0,7
fill cap	SMAW	E 309L-17	3,2	DC/RP	90 - 130	21 - 25	100 - 125	1,6 - 0,7

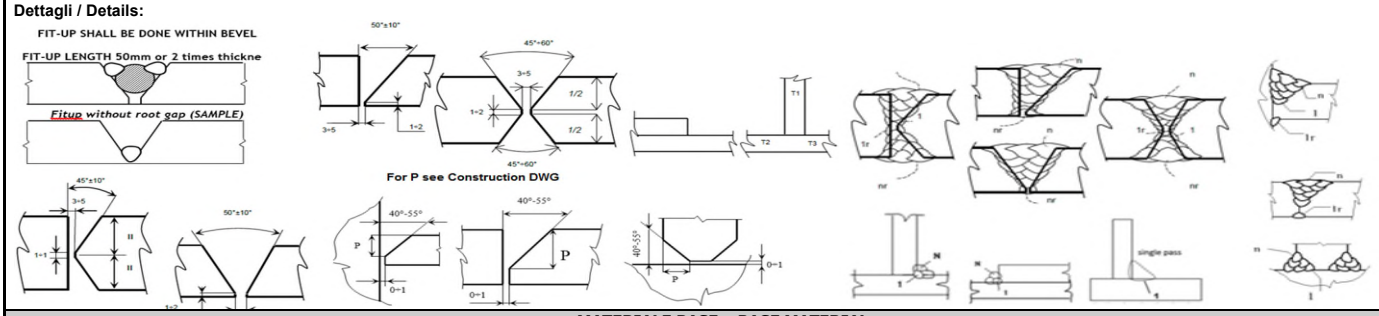
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D.CENACCHI	**A. KHALIFA**		

PQR ref.:	49/06+03/03	code	ISO 15614-1 EEMUA 197	WPS	E6C	REV.:	0	Data /date	19/01/2024

Procedimento di saldatura / Welding process: **GTAW** — Tipo / Type: **MANUAL** — scopo / scope: **FW, PJP, CJP**

GIUNTO – JOINT

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

Dissimilar Joints AISI 316L to Carbon Steel **2nd category and non structural welds**

Gamma spessori / Thickness range:

- ► Materiale base / Base material: Piena penetrazione / Groove **3-7.4 mm (incoming member on tee welds)**
- ► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **≥ 12 mm**

METALLO D'APPORTO – FILLER METAL

		141 GTAW	
Spec. N° (SFA)		A5.9	
AWS N° (CLASS)		ER 309L	
F-N°		6	
A-N°		10	
Diametro mat. d'apporto / Size of filler metal		2,0-2,4	
Gamma spessori /Thick. range		up to completion	
Accoppiamento filo-flusso / Electrode-flux (CLASS)		N.A.	
Denom. Comm. flusso / FLUX trade name		N.A.	
Inserto consumabile / Consumable insert		N.A.	
Altro / other		OK TIGROD 309L or same class	

giunto / Joint: **FW / CJP / PJP** — Posizione / position: **ALL** — Progressione / weld progression: **Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20°C** — Max temp. Di interpass / Max interpass temp.: **150°C** — Preheat Method / Metodo preriscaldo: **PROPANE TORCH**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar	99,9	13-19lt/1'
Protezione / Shielding:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC	Polarità / Polarity	SP
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:	N.A.		
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:	N.A.		
Velocità alimentazione filo / Electr. Wire feed speed range:	N.A.		

TECNICA – TECHNIQUE

Passata / Bead: **Tirata-Larga/String-Wave** — Dimensione bocchello gas / Orifice of gas cup size: **½"-3/8"** — Pulizia iniziale e fra le passate / Initial and interpass cleaning: **Spazzolatura e Molatura/Brushing Grin**

Metodo di solcatura a rovescio / Method of back gouging: **Molatura/Grinding** — Oscillazione / Oscillation: **N.A.** — Distanza tra zona di contatto e pezzo / Contact tube to work distance: **N.A.**

N°Passate / Passes nr.: **Singola-Multiple/Single-Multiple** — Elettrodo multiplo o singolo / Multiple or single electrodes: **Singolo/Single** — Martellatura / Peening: **N.A.**

Altro / Other: Max. width of weld bead 18 mm ±2mm

Weld Layers	Process	Filler metal Class	Filler metal Dia. (mm.)	Current Polarity	Current AMP	Volt range	Travel speed range (mm/min)	Heat input (KJ/mm)
root	GTAW	ER 309L	2,0-2,4	DC/SP	65 - 85	9 - 11	45 - 65	0,7 - 0,3
root	GTAW	ER 309L	2,0-2,4	DC/SP	80 - 100	10 - 12	55 - 70	0,8 - 0,4
hot	GTAW	ER 309L	2,0-2,4	DC/SP	70 - 100	10 - 13	60 - 100	0,8 - 0,3
hot	GTAW	ER 309L	2,0-2,4	DC/SP	90 - 140	10 - 13	85 - 110	0,8 - 0,3
fill cap	GTAW	ER 309L	2,0-2,4	DC/SP	100 - 140	11 - 14	90 - 130	0,8 - 0,3
fill cap	GTAW	ER 309L	2,0-2,4	DC/SP	120 - 160	11 - 14	100 - 140	0,8 - 0,3

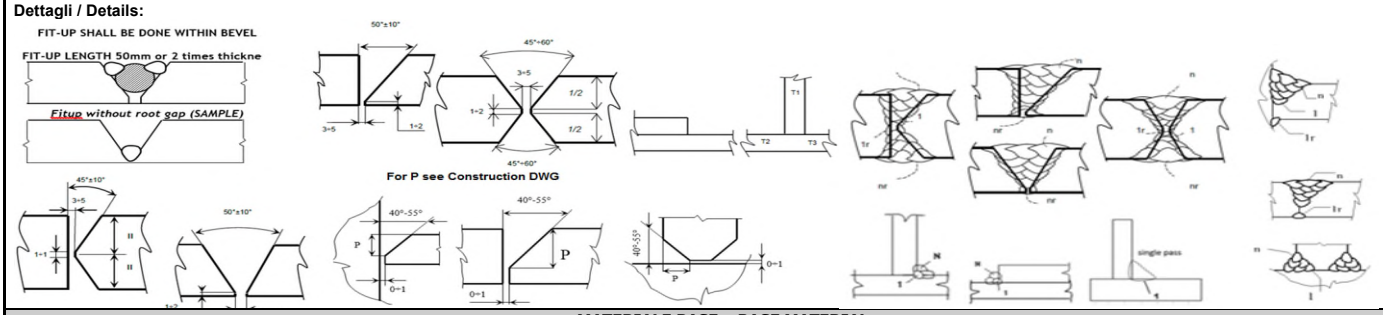
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D.CENACCHI	A. KHALIFA		

PQR ref.:	42/19 +44/19+ 46/19	code	ISO 15614-1 EEMUA 197	WPS	E6D	REV.:	0	Data /date	19/01/2024

Procedimento di saldatura / Welding process: **GMAW 135** — Tipo / Type: **SEMIAUTOMATIC** — scopo / scope: **FW, PJP, CJP**

GIUNTO – JOINT

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

AISI 316 &/or 316L — **NS welds**

Gamma spessori / Thickness range:
- ► Materiale base / Base material: Piena penetrazione / Groove: **3-22.26 mm (incoming member on tee welds)**
- ► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove: **≥ 8”**

METALLO D’APPORTO – FILLER METAL

		135 - GMAW	
Spec. N° (SFA)		5.9	
AWS N° (CLASS)		ER 316LSi*	
F-N°		6	
A-N°		10	
Diametro mat. d’apporto / Size of filler metal		1,2	
Gamma spessori /Thick. range		up to completion	
Denom. Comm. flusso / FLUX trade name		N.A.	
Inserto consumabile / Consumable insert		N.A.	
Altro / other		LINCOLN LMN 316LSi*	*or same classification

giunto / Joint: **FW / CJP / PJP** — Posizione / position: **ALL** — Progressione / weld progression: **Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20°C** — Max temp. Di interpass / Max interpass temp.: **150°C** — Preheat Method / Metodo preriscaldo: **PROPANE TORCH**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+CO2	98-2	10-16 Lt/1’
Protezione / Shielding:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	Ar	99,9	7-10 Lt/1’

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC-CV	Polarità / Polarity	RP
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			N.A.
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:			Spray, Glob, Pulsed
Velocità alimentazione filo / Electr. Wire feed speed range:			N.A.

TECNICA – TECHNIQUE

Passata / Bead:	Tirata-Larga/String-Wave	Dimensione bocchello gas / Orifice of gas cup size:	3/8” – ½”
Pulizia iniziale e fra le passate / Initial and interpass cleaning:	Spazzolatura e Molatura/Brushing Grin		
Metodo di solcatura a rovescio / Method of back gouging:	Molatura/Grinding	Oscillazione / Oscillation:	N.A.
Distanza tra zona di contatto e pezzo / Contact tube to work distance:	N.A.		
N°Passate / Passes nr.:	Singola-Multiple/Single-Multiple	Elettrodo multiplo o singolo / Multiple or single electrodes:	Singolo/Single
Martellatura / Peening:	N.A.		

Altro / Other: Max. width of weld bead 18 mm ±2mm. Heat input is including K factor to allow quick check with PQR values.

Weld Layers	Process	Filler metal Class	Filler metal Dia. (mm.)	Current Polarity	Current AMP	Volt range	Travel speed range (mm/min)	Heat input (KJ/mm)
root	GMAW	ER 316LSi	1,2	DC/RP	150 - 180	23 - 25	125 - 150	1,7 - 1,1
root	GMAW	ER 316LSi	1,2	DC/RP	120 - 150	15 - 18	80 - 140	1,6 - 0,6
hot	GMAW	ER 316LSi	1,2	DC/RP	140 - 180	24 - 26	160 - 200	1,4 - 0,8
hot	GMAW	ER 316LSi	1,2	DC/RP	160 - 240	24 - 27	210 - 240	1,5 - 0,8
fill	GMAW	ER 316LSi	1,2	DC/RP	140 - 220	24 - 27	175 - 220	1,6 - 0,7
fill	GMAW	ER 316LSi	1,2	DC/RP	200 - 240	24 - 27	230 - 265	1,4 - 0,9
cap	GMAW	ER 316LSi	1,2	DC/RP	140 - 180	24 - 27	200 - 270	1,2 - 0,6
cap	GMAW	ER 316LSi	1,2	DC/RP	160 - 240	24 - 27	270 - 320	1,2 - 0,6

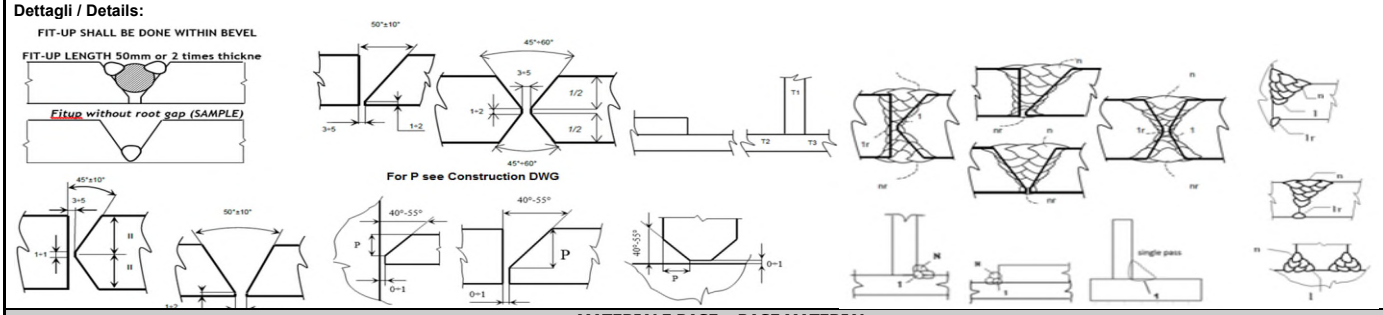
Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	A. KHALIFA		

PQR ref.:	13/98	code	ISO 15614-1 EEMUA 197-ASMEIX	WPS	E6E	REV.:	0	Data /date	16/02/2024

Procedimento di saldatura / Welding process: **GMAW 135** — Tipo / Type: **SEMIAUTOMATIC** — scopo / scope: **FW, PJP, CJP**

GIUNTO – JOINT

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

API 5L Gr.B and lower — **NS welds**

Gamma spessori / Thickness range:
- ► Materiale base / Base material: Piena penetrazione / Groove **3-24 mm**
- ► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **≥ 30,15mm**

METALLO D'APPORTO – FILLER METAL

		135 - GMAW	
Spec. N° (SFA)		5.18	
AWS N° (CLASS)		ER 70S-6 / G3 Si1	
F-N°		6	
A-N°		10	
Diametro mat. d'apporto / Size of filler metal		1,2	
Gamma spessori /Thick. range		up to completion	
Denom. Comm. flusso / FLUX trade name		N.A.	
Inserto consumabile / Consumable insert		N.A.	
Altro / other		OK AUTROD 12.64*	*or same classification

giunto / Joint **FW / CJP / PJP** — Posizione / position **ALL** — Progressione / weld progression: **Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20°C** — Max temp. Di interpass / Max interpass temp.: **200°C** — Preheat Method / Metodo preriscaldo **PROPANE TORCH**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+CO2	80-20	12-20 Lt/1'
Protezione / Shielding:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC-CV	Polarità / Polarity	RP
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			N.A.
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:			Spray, Globular
Velocità alimentazione filo / Electr. Wire feed speed range:			N.A.

TECNICA – TECHNIQUE

Passata / Bead:	Tirata-Larga/String-Wave	Dimensione bocchello gas / Orifice of gas cup size:	3/8" – ½"
Pulizia iniziale e fra le passate / Initial and interpass cleaning:	Spazzolatura e Molatura/Brushing Grin		
Metodo di solcatura a rovescio / Method of back gouging:	Molatura/Grinding	Oscillazione / Oscillation:	N.A.
Distanza tra zona di contatto e pezzo / Contact tube to work distance:	N.A.		
N°Passate / Passes nr.:	Singola-Multiple/Single-Multiple	Elettrodo multiplo o singolo / Multiple or single electrodes:	Singolo/Single
Martellatura / Peening:	N.A.		

Altro / Other: Max. width of weld bead 18 mm ±2mm. Heat input is including K factor to allow quick check with PQR values.

Weld layers nr.	Process	Filler metal		Current		Volt range	Travel speed range (mm/min)	Heat input (KJ/mm)
		Class	Dia. (mm.)	Polarity	Amp. range			
Root - Hot	GMAW	ER 70S-6 / G3 Si1	1,0-1,2	RP	160-220	25-27	140-220	0.87-1.85
FILL- CAP	GMAW	ER 70S-6 / G3 Si1	1,0-1,2	RP	180-230	24-28	160-300	0.60-1.86
FILL- CAP	GMAW	ER 70S-6 / G3 Si1	1,0-1,2	RP	220-265	24-28	180-400	0.60-1.94
FILLET	GMAW	ER 70S-6 / G3 Si1	1,0-1,2	RP	220-265	24-28	180-400	0.60-1.94

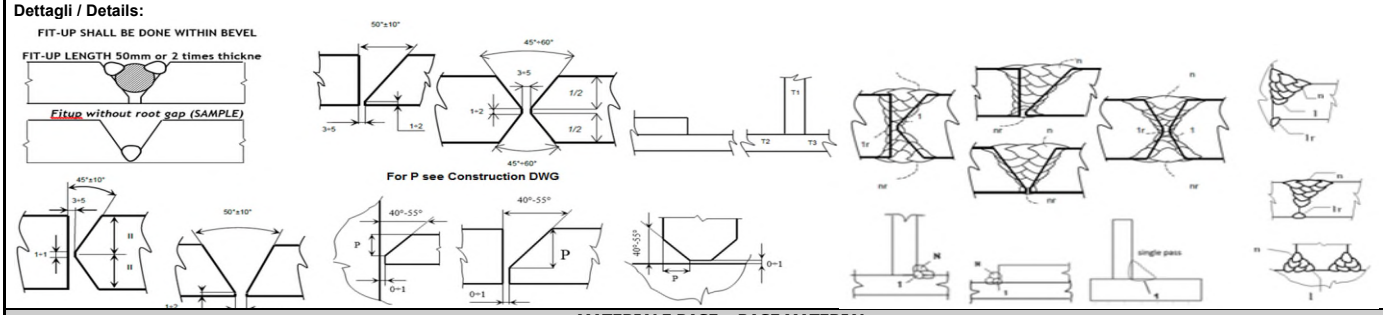
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D.CENACCHI	A. KHALIFA		

PQR ref.:	02/19	code	ISO 15614-1 EEMUA 197	WPS	E6F	REV.:	0	Data /date	07/03/2024

Procedimento di saldatura / Welding process: **GS-FCAW** — Tipo / Type: **SEMIAUTOMATIC** — scopo / scope: **FW, PJP, CJP**

GIUNTO – JOINT

Dettagli / Details:



MATERIALE BASE – BASE MATERIAL

S460 and lower grades — **NS welds**

Gamma spessori / Thickness range:
- ► Materiale base / Base material: Piena penetrazione / Groove **3-24 mm**
- ► Gamma diametri / Pipe dia. Range: Piena penetrazione / Groove **≥ 30,15mm**

METALLO D'APPORTO – FILLER METAL

		136 - GS-FCAW	
Spec. N° (SFA)		5.29/5.36	
AWS N° (CLASS)		E81T1-1/E81T1-Ni1	
F-N°		6	
A-N°		1	
Diametro mat. d'apporto / Size of filler metal		1,2	
Gamma spessori /Thick. range		up to completion	
Denom. Comm. flusso / FLUX trade name		N.A.	
Inserto consumabile / Consumable insert		N.A.	
Altro / other		OK TUBROD 15.17	

giunto / Joint **FW / CJP / PJP** — Posizione / position **ALL** — Progressione / weld progression: **Uphill**

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20°C** — Max temp. Di interpass / Max interpass temp.: **250°C** — Preheat Method / Metodo preriscaldo **PROPANE TORCH**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT

GAS DI PROTEZIONE – GAS

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar+CO2	80-20	12-20 Lt/1'
Protezione / Shielding:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS

Corrente / Current :	DC-CV	Polarità / Polarity	RP
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:			N.A.
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:			N.A.
Velocità alimentazione filo / Electr. Wire feed speed range:			N.A.

TECNICA – TECHNIQUE

Passata / Bead: **Tirata-Larga/String-Wave** — Dimensione bocchello gas / Orifice of gas cup size: **3/8" – ½"** — Pulizia iniziale e fra le passate / Initial and interpass cleaning: **Spazzolatura e Molatura/Brushing Grin**

Metodo di solcatura a rovescio / Method of back gouging: **Molatura/Grinding** — Oscillazione / Oscillation: **N.A.** — Distanza tra zona di contatto e pezzo / Contact tube to work distance: **N.A.**

N°Passate / Passes nr.: **Multipla/Multiple** — Elettrodo multiplo o singolo / Multiple or single electrodes: **Singolo/Single** — Martellatura / Peening: **N.A.**

Altro / Other: Max. width of weld bead 18 mm ±2mm. Heat input is including K factor to allow quick check with PQR values.

Weld layers nr.	Process	Filler metal		Current		Volt range	Travel speed range (mm/min)	Heat input (KJ/mm)
		Class	Dia. (mm.)	Polarity	Amp. range			
Root - Hot	GS-FCAW	E81T1-1/E81T1-Ni1	1,2	RP	165-170	22-26	201-250	0.70-1.05
FILL- CAP	GS-FCAW	E81T1-1/E81T1-Ni1	1,2	RP	150-170	22-26	201-250	0.63-1.05
FILLET	GS-FCAW	E81T1-1/E81T1-Ni1	1,2	RP	150-170	22-26	201-250	0.63-1.05

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D.CENACCHI	A. KHALIFA		