Base Load Power Hub (BLPH)

WELDING BOOK - PIPING

Document Number: 123A90-PML-WEL-PRO-05003

Document Class: 2

Rev.	Date	Description	Prepared	Reviewed	Approved
02	26/06/2024	Accepted for Construction (AFC)	D.CENACCHI	A.KHALIFA	M.BRUNELLI
01	24/05/2024	Accepted for Construction (AFC)	D.CENACCHI	A.KHALIFA	M.BRUNELLI
00	05/04/2024	Issue for Review (IFR)	D.CENACCHI	A.KHALIFA	M.BRUNELLI

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Accepted for Construction (AFC)
02	Accepted for Construction (AFC) Added new scope for Electolyzer package lines

HOLDS LIST

No.	Description
1	
2	
3	
4	

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Table of contents

1 INTRODUCTION 5

1.1 PROJECT OVERVIEW 5

1.2 Project Location 5

1.3 Project Concept 6

2 DOCUMENT SCOPE 8

3 REFERENCES 8

4 DEFINITIONS AND ABBREVIATIONS 9

5 WELDING REQUIREMENTS FOR CROSSWIND PROJECT 10

5.1 FIT UP 10

5.2 Welding materials to be used 10

5.3 WPSs & PQRs 10

5.4 WPSs 10

5.5 PQRs 11

5.6 WELDERS AND/OR WELDING OPERATORS IDENTIFICATION 11

5.7 WELDS IDENTIFICATION 11

5.8 WELDING RECORDS/TRACEABILITY 11

6 WPS CODING 11

7 LIST OF APPLICABLE WPSS 12

8 WPSs 13

List of Figures

Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map 5

Figure 2 - Wind Park Details 6

Figure 3 – BLPH Concept 6

List of tables

Table 1 - Reference Documents 8

Table 2 - Definitions and Abbreviations 9

Table 3 - Consumables selected for this project 10

Table 4 – list of applicable WPSs 12

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

1 INTRODUCTION

1.1 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.

1.2 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.

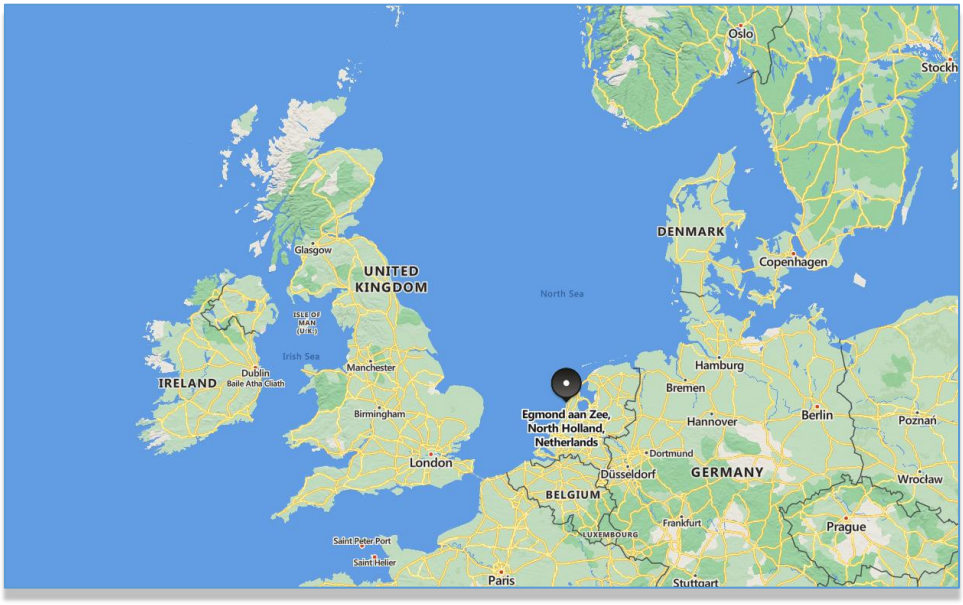


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

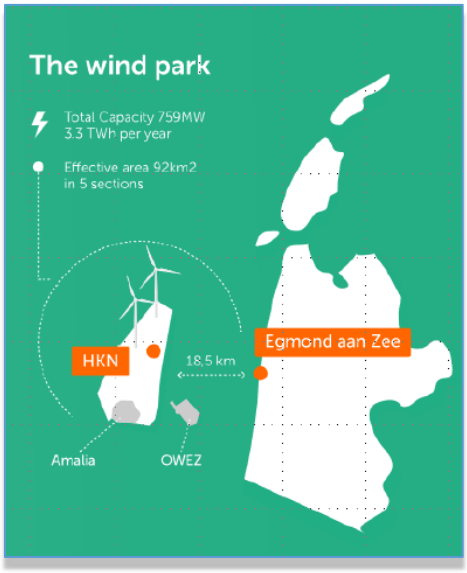


Figure 2 - Wind Park Details

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.

1.3 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.

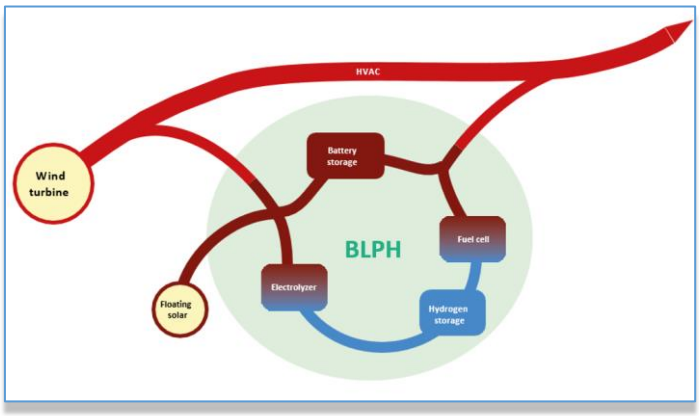


Figure 3 – BLPH Concept

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.

2 DOCUMENT SCOPE

The scope of this procedure is to define the Welding Procedure Specifications to be used on pipework lines and Electrolyser Package WP1 – WP2 – WP3 – WP4 interconnections of Base Load Power Hub (BLPH).

3 REFERENCES

Doc. No.	Rev.	Date	Description - Title
K559-2254-PM-PLN-003	2	06/07/23	Basic Design Engineering Package
K559-2254-MT-REP-0001	1	03/03/2023	Material Selection Report
123A90-DDL-PP-SP-70029 TSS	02	08/01/2024	Piping Materials Narrative
123A90-DDL-PP-SP-70000	02	17/11/2023	Piping Material Classes
EN ISO 15614-1	Ed.2017	08/2017	Specification and qualification of welding procedures for metallic materials-Welding procedure test-Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
123A90-DDL-PP-MTO-70062	01	14/03/2024	MTO - Piping Bulk
ASME B31.3			PROCESS PIPING
ASME B31.12	2019	20/12/2019	Hydrogen Piping and Pipelines
PED 2014/68/EU	2014		Pressure Equipment Directive

Table 1 - Reference Documents

4 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

5 WELDING REQUIREMENTS FOR CROSSWIND PROJECT

5.1 FIT UP

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

5.2 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.

SUPPLIER	CLASS	NAME	PROCESS	NOTES	NOTES
ESAB	ER 70S-3	OK TIGROD 12.60	GTAW	WIRE	
ESAB	E81T1Ni1	FILARC PZ6138	FCAW	WIRE	
LINCOLN	E7018-1H4R	PH 35S DRY	SMAW	ELECTRODE	
SANDVIK	ER 2509	25.4.10L	GTAW	WIRE	
ESAB	ER 2509	OK Tigrod 2509	GTAW	WIRE	
ESAB	E7018-1H4R	OK 55.00	SMAW	ELECTRODE	
ESAB	ER 316L	OK 316L	GTAW	WIRE	
ESAB	E 316L-15	OK 63.35	SMAW	ELECTRODE	
ESAB	ER 309L	OK 309L	GTAW	WIRE	

Table 3 - Consumables selected for this project

5.3 WPSS & PQRS

5.4 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 4).
All WPSs are developed following the essential variables specified by ASME B31.3/ASME B31.12 (IP part), 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.

5.5 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.

5.6 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 EN 9606-1 or ASME IX code unless otherwise agreed in bidding stage.

5.7 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 free chlorides type , and it 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 - FCAW processes) as per Rosetti Marino procedure.

5.8 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.

6 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:

- **A**: Carbon steel , line class: 01CS (ASME B31.3 Code)
- **B**: Super duplex stainless steel , line class 01SD (ASME B31.3 Code)
- C : Stainless Steel 316l , line classes 01HSS-03HSS / PA22S/ PB22S/PA20W (ASME B31.12 IP part PED 2004/68/EU)
- **D**: Stainless Steel 316L , line class 01SS /PA22S/ PA20W /TK22 (ASME B31.3 Code)**E**: Dissimilar welds

7 LIST OF APPLICABLE WPSS

WPS	Material/ Reference code	Bevel Type	Description and range of application	MAT. Grades	Process	LINE CLASS	range of qualified Thk (mm)	range of qualified diam. (Inch)	PQR
A1A	Carbon Steel/ ASME B31.3	BW-FW	Butt / Fillet welds for pipes and fittings/ pad supports	SA333 Gr.6-SA350 Gr.LF2-SA420 Gr.WPL6	GTAW	**01CS**	1.5÷11.8	ALL	01/18
A1B	Carbon Steel/ ASME B31.3	BW-FW	Butt / Fillet welds for pipes and fittings/pad supports	SA333 Gr.6-SA350 Gr.LF2-SA420 Gr.WPL6	GTAW + FCAW	**01CS**	5÷24	ALL	45/05
A1C	Carbon Steel/ ASME B31.3	BW-FW	Butt / Fillet welds for pipes and fittings/pad supports	SA333 Gr.6-SA350 Gr.LF2-SA420 Gr.WPL6	GTAW +SMAW	**01CS**	1.5÷11.8	ALL	02/18
B1A	Super Duplex Stainless Steel	BW-FW	Butt / Fillet welds for pipes and fittings/pad supports	ASTM A790 UNS S32760-A815 UNS S32760	GTAW	**01SD**	1,5÷9.1	ALL	36/16
C1A	Stainless Steel/ ASME B31.12+ PED 2014/68/EU	BW-FW	Butt / Fillet welds for pipes and fittings/pad supports	ASTM A312 Gr.TP316/316L	141 (GTAW)	**01HSS-03HSS PA22S/ PB22S**	1,4 ÷ 9,56	≥ ¼	45/06+39/06
C1B	Stainless Steel/ ASME B31.12+ PED 2014/68/EU	BW-FW	Butt / Fillet welds for pipes and fittings/pad supports	ASTM A312 Gr.TP316/316L	141+111 (GTAW+SMAW)	**01HSS-03HSS / PA22S/ PB22S/PA20W**	1,4 ÷ 22,1	≥ 1	40/06+26/06
D1A	Stainless Steel B31.3	BW-FW	Butt / Fillet welds for pipes and fittings/pad supports	ASTM A312 Gr.TP316/316L	141 (GTAW)	**01SS /PA22S/ PA20W /TK22**	1,4 ÷ 9,56	≥ 1/2	45/06+39/06
WPS for 316L & dissimilar CS/316L alloy attachments									
WPS	**Material/ Reference code**	**Bevel Type**	**Description and range of application**	**MAT. Grades**	**Process**	**CONSUMABLES***	**range of qualified Thk (mm)**	**range of qualified diam. (mm)**	**PQR**
E1A	Carbon steel to 316L	Fillet	Fillet welds for dissimilar material earthing lugs	CS-316L	141(GTAW)	ESAB OK TIGROD 309L	3-7.4 mm	ALL	49/06+03/03

Table 4 – list of applicable WPSs

8 WPSS

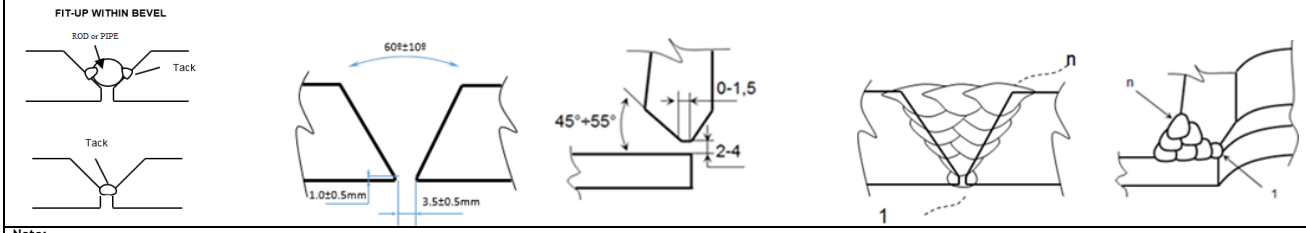
Welding Spc				**STD**	**ASME IX:2019+ASME B31.3:2022**		
PQR ref.:	**01/18**	**WPS N°**	**A1A**	**REV.:**	**2**	**Data /date**	**24/05/2024**

Procedimento di saldatura / Welding process: **GTAW (141)** Tipo / Type: **MANUAL**

GIUNTO – JOINT (QW-402)

Tipo di giunto / Joint Design: **V – ½ V-FW**	Supporto / Backing: ☐ Si / Yes ☒ No	Joint Type	PIPING CLASSES
Materiale di supporto (tipo) / Backing material (type): ☐ Metallico / Metal ☐ Non metallico / No metal. ☐ Metallo non fondente / Non Fusing metal ☐ Altro / Other		**Butt / Fillet Welds**	**01CS**

BEVEL SHALL BE DONE BY MACHINING OR GRINDING



Note:

1. **Surfaces cleaned from moisture, oil, grease, paint, before welding** / *Pulire le superfici da liquidi, oli, grasso e vernici prima di saldare;*
2. **Tack weld should be of a minimum lenghts of 4 times the base metal thickness or 50 mm, whichever is less** / *La puntatura deve essere minimo 4 volte lo spessore o 50 mm, quale dei due è più piccolo;*
3. **Weld should not be discontinued before 25 % of the weld thickness or 3 passes are completed, whichever gives adequate cross section to prevent cracking/** *La saldatura non deve essere interrotta prima di aver saldato il 25% dello spessore o minimo 3 passate, quale dei due valori garantisce un'adeguata resistenza del giunto;*
4. **Preheat method: heating mats or propane torch. Temperature shoul be measured by contact thermometer or temperature indicating sticks. Preheat shall be measured at 75 mm from bevel edge on parent material/** *Il preriscaldo può essere applicator con propano o resistenze elettriche. La temperature deve essere misurata a 75 mm dal bordo del cianfrino;*
5. **Interpass temperature should be checked on weld before weld start/** *La temperatura fra le passate deve essere misurata sulla saldatura prima di partire con la saldatura;*
6. **Repair welding: Maximum 2 repair in the same area is allowed. The removal of defective areas shall be by machining, grinding, or arc/air gouging followed by grinding. Area of defect removal shall be assured by Magnetic Particle Testing or Liquid Penetrant Test. The min. preheat temperature shall be min. 50°C above the preheat temperature used for the original weld/** *Sono possibili massimo 2 riparazioni nella stessa area. La rimozione del difetto deve essere eseguita tramite molatura o scriccatura seguita da molatura. L'area del difetto dev'essere controlalta con particelle magnetiche o liquidi penetranti. La temperatura di preriscaldo per la riparazione deve essere al minimo 50 °C superiore a quella del giunto originale.*

MATERIALE BASE – BASE MATERIAL (QW-403)

Da / from P-N°: **1**	Group N°: **1-2**	Da / from P-N°: **1**	Group N°: **1-2**

Tipo e Grado / Type and Grade: **SA333 Gr.6-SA350 Gr.LF2-SA420 Gr.WPL6**

DIMENSIONI-DIMENSION (QW-403)		**POSIZIONE DI SALDATURA - WELDING POSITION (QW 405)**	
► Materiale base / Base material:	**1.5 to 11.8**	Welding Position	**ALL**
► Gamma diametri / Pipe dia. Range:	**ALL**	Progression	**UP-HILL**

METALLO D'APPORTO – FILLER METAL (QW-404)

	GTAW (141)		
Spec. N° (SFA)	**A5.18**		
AWS N° (CLASS)	**ER 70S-3**		
F-N°	**6**		
A-N°	**10**		
Diametro mat. D'apporto / Size of filler metal	**2,4**		
Deposit Weld metal	**Up to filling**		
Accoppiamento filo-flusso / Electrode-flux (CLASS)	**NA**		
Denom. Comm. Flusso / FLUX trade name	**NA**		
Inserto consumabile / Consumable insert	**NA**		
Altro / other	**ESAB OK TIGROD 12.60**		

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20 °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(QW 407)

N.A.

GAS DI PROTEZIONE – GAS (QW 408)

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	**Ar**	**99,99%**	**11-13 LPM**
Protezione al seguito / Trailing:	**N.A.**	**N.A.**	**N.A.**
Prot. Al rovescio / Backing:	**N.A.**	**N.A.**	**N.A.**

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS (QW –409)

Corrente / Current: **DC**	Polarità / Polarity **SP**		
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type: **AWS 5.12 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 (QW-410)

Passata / Bead: **Tirata/String, max 12 mm**	Dimensione bocchello gas / Orifice of gas cup size: **3/8"**	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 tra 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: **K-Factor of 0.6 applied on HI calculation**

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-3**	**2,4**	**DC/SP**	**87-100**	**11-13**	**40-45**	**0.63-0,98**
Hot pass	**GTAW**	**ER 70S-3**	**2,4**	**DC/SP**	**100-115**	**12-14**	**65-91**	**0,47-0,89**
Filler pass	**GTAW**	**ER 70S-3**	**2,4**	**DC/SP**	**100-116**	**12-14**	**49-51**	**1,68-1,98**
Cap pass/Fillet	**GTAW**	**ER 70S-3**	**2,4**	**DC/SP**	**140-145**	**11-12**	**66-71**	**1,30-1,58**

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

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

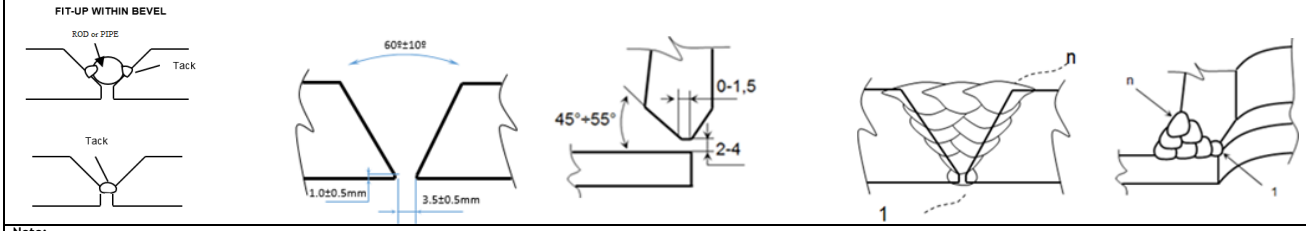
Welding Spc				**STD**	**ASME IX:2017+ASME B31.3:2017**		
PQR ref.:	**45/05**	**WPS N°**	**A1B**	**REV.:**	**1**	**Data /date**	**24/05/2024**

Procedimento di saldatura / Welding process: **GTAW (141)+FCAW(136)** Tipo / Type: **MANUAL+SEMIAUTOMATIC**

GIUNTO – JOINT (QW-402)

Tipo di giunto / Joint Design: **V – ½ V-FW**	Supporto / Backing: ☐ Si / Yes ☒ No	Joint Type	PIPING CLASSES
Materiale di supporto (tipo) / Backing material (type): ☐ Metallico / Metal ☐ Non metallico / No metal. ☐ Metallo non fondente / Non Fusing metal ☐ Altro / Other		**Butt /Fillet Welds**	**01CS**

BEVEL SHALL BE DONE BY MACHINING OR GRINDING



Note:

7. **Surfaces cleaned from moisture, oil, grease, paint, before welding** / *Pulire le superfici da liquidi, oli, grasso e vernici prima di saldare;*
8. **Tack weld should be of a minimum lenghts of 4 times the base metal thickness or 50 mm, whichever is less** / *La puntatura deve essere minimo 4 volte lo spessore o 50 mm, quale dei due è più piccolo;*
9. **Weld should not be discontinued before 25 % of the weld thickness or 3 passes are completed, whichever gives adequate cross section to prevent cracking**/ *La saldatura non deve essere interrotta prima di aver saldato il 25% dello spessore o minimo 3 passate, quale dei due valori garantisce un'adeguata resistenza del giunto;*
10. **Preheat method: heating mats or propane torch. Temperature shoul be measured by contact thermometer or temperature indicating sticks. Preheat shall be measured at 75 mm from bevel edge on parent material**/ *Il preriscaldo può essere applicator con propano o resistenze elettriche. La temperature deve essere misurata a 75 mm dal bordo del cianfrino;*
11. **Interpass temperature should be checked on weld before weld start**/ *La temperatura fra le passate deve essere misurata sulla saldatura prima di partire con la saldatura;*
12. **Repair welding: Maximum 2 repair in the same area is allowed. The removal of defective areas shall be by machining, grinding, or arc/air gouging followed by grinding. Area of defect removal shall be assured by Magnetic Particle Testing or Liquid Penetrant Test. The min. preheat temperature shall be min. 50°C above the preheat temperature used for the original weld**/ *Sono possibili massimo 2 riparazioni nella stessa area. La rimozione del difetto deve essere eseguita tramite molatura o scricattura seguita da molatura. L'area del difetto dev'essere controlalta con particelle magnetiche o liquidi penetranti. La temperatura di preriscaldo per la riparazione deve essere al minimo 50 °C superiore a quella del giunto originale.*

MATERIALE BASE – BASE MATERIAL (QW-403)

Da / from P-N°: **1**	Group N°: **1-2**	Da / from P-N°: **1**	Group N°: **1-2**

Tipo e Grado / Type and Grade: **SA333 Gr.6-SA350 Gr.LF2-SA420 Gr.WPL6**

DIMENSIONI-DIMENSION (QW-403)		**POSIZIONE DI SALDATURA - WELDING POSITION (QW 405)**	
► Materiale base / Base material:	**5 to 24 mm**	Welding Position	**ALL**
► Gamma diametri / Pipe dia. Range:	**ALL**	Progression	**UP-HILL**

METALLO D'APPORTO – FILLER METAL (QW-404)

	GTAW (141)	GS-FCAW (136)
Spec. N° (SFA)	A5.18	A5.29
AWS N° (CLASS)	ER 70S-3	E81T1Ni1
F-N°	6	6
A-N°	1	10
Diametro mat. D'apporto / Size of filler metal	2,4	1,2
Deposit Weld metal	2 mm	Up to fill
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	NA
Denom. Comm. Flusso / FLUX trade name	NA	NA
Inserto consumabile / Consumable insert	NA	NA
Altro / other	ESAB OK TIGROD 12.60	FILARC PZ 6138

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20 °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(QW 407)

N.A.

GAS DI PROTEZIONE – GAS (QW 408)

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar	99,99%	11-13 LPM
Protezione al seguito / Trailing:	Ar+Co2	80%-20%	16-18 LPM
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS (QW –409)

Corrente / Current: **DC**	Polarità / Polarity: **SP/RP**
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type:	**AWS 5.12 EWTh2 dia.2,4mm**
Metodo di trasferimento per GMAW / GMAW metal tranfer mode:	**N.A.**
Velocità alimentazione filo / Electr. Wire feed speed range:	**Self regulated**

TECNICA – TECHNIQUE (QW-410)

Passata / Bead: **Tirata/String**	Dimensione bocchello gas / Orifice of gas cup size: **½"-3/8"**	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 tra 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: **K-Factor of 0.6 applied on HI calculation**

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-3**	**2,4**	**DC/SP**	**110-160**	**14-16**	**46-60**	**0.92-2.00**
Hot pass	**GS-FCAW**	**E81T1Ni1**	**1,2**	**DC/RP**	**190-200**	**23-24**	**160-190**	**1.10-1.44**
Filler pass	**GS-FCAW**	**E81T1Ni1**	**1,2**	**DC/RP**	**220-235**	**22-24**	**200-250**	**0.93-1.35**
Cap pass/Fillet	**GS-FCAW**	**E81T1Ni1**	**1,2**	**DC/RP**	**195-210**	**24-26**	**235-255**	**0.88-1.13**

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

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Welding Spc				**STD**	**ASME IX:2017+ASME B31.3:2017**		
PQR ref.:	**02/18**	**WPS N°**	**A1C**	**REV.:**	**1**	**Data /date**	**24/05/2024**

Procedimento di saldatura / Welding process: **GTAW (141)+SMAW(111)** — Tipo / Type: **MANUAL**

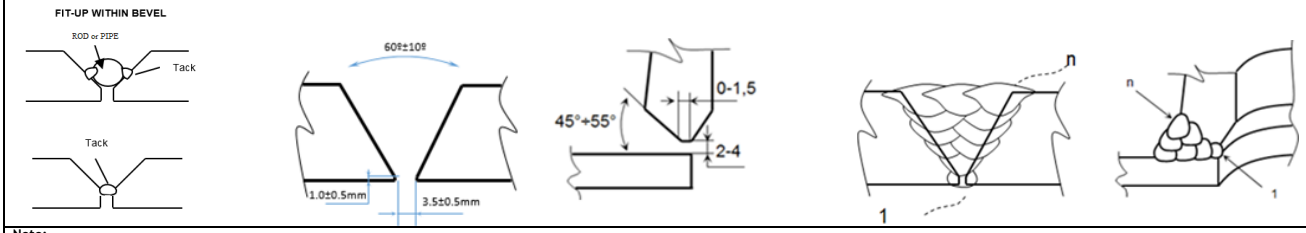
GIUNTO – JOINT (QW-402)

Tipo di giunto / Joint Design: **V – ½ V-FW** — Supporto / Backing: ☐ Si / Yes ☒ No

Joint Type: **Butt /Fillet Welds** — PIPING CLASSES: **01CS**

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

BEVEL SHALL BE DONE BY MACHINING OR GRINDING



Note:

13. **Surfaces cleaned from moisture, oil, grease, paint, before welding** / *Pulire le superfici da liquidi, oli, grasso e vernici prima di saldare;*
14. **Tack weld should be of a minimum lenghts of 4 times the base metal thickness or 50 mm, whichever is less** / *La puntatura deve essere minimo 4 volte lo spessore o 50 mm, quale dei due è più piccolo;*
15. **Weld should not be discontinued before 25 % of the weld thickness or 3 passes are completed, whichever gives adequate cross section to prevent cracking/** *La saldatura non deve essere interrotta prima di aver saldato il 25% dello spessore o minimo 3 passate, quale dei due valori garantisce un'adeguata resistenza del giunto;*
16. **Preheat method: heating mats or propane torch. Temperature shoul be measured by contact thermometer or temperature indicating sticks. Preheat shall be measured at 75 mm from bevel edge on parent material/** *Il preriscaldo può essere applicator con propano o resistenze elettriche. La temperature deve essere misurata a 75 mm dal bordo del cianfrino;*
17. **Interpass temperature should be checked on weld before weld start/** *La temperatura fra le passate deve essere misurata sulla saldatura prima di partire con la saldatura;*
18. **Repair welding: Maximum 2 repair in the same area is allowed. The removal of defective areas shall be by machining, grinding, or arc/air gouging followed by grinding. Area of defect removal shall be assured by Magnetic Particle Testing or Liquid Penetrant Test. The min. preheat temperature shall be min. 50°C above the preheat temperature used for the original weld/** *Sono possibili massimo 2 riparazioni nella stessa area. La rimozione del difetto deve essere eseguita tramite molatura o scriccatura seguita da molatura. L'area del difetto dev'essere controlalta con particelle magnetiche o liquidi penetranti. La temperatura di preriscaldo per la riparazione deve essere al minimo 50 °C superiore a quella del giunto originale.*

MATERIALE BASE – BASE MATERIAL (QW-403)

Da / from P-N°: **1**	Group N°: **1-2**	Da / from P-N°: **1**	Group N°: **1-2**

Tipo e Grado / Type and Grade: **SA333 Gr.6-SA350 Gr.LF2-SA420 Gr.WPL6**

DIMENSIONI-DIMENSION (QW-403)

- Materiale base / Base material: **1.5 to 11.8 mm**
- Gamma diametri / Pipe dia. Range: **ALL**

POSIZIONE DI SALDATURA - WELDING POSITION (QW 405)

Welding Position: **ALL**

Progression: **UP-HILL**

METALLO D'APPORTO – FILLER METAL (QW-404)

	GTAW (141)	SMAW (111)	*ESAB OK 55.00
Spec. N° (SFA)	A5.18	A5.1	
AWS N° (CLASS)	ER 70S-3	E7018-1H4R	
F-N°	6	4	
A-N°	1	1	
Diametro mat. D'apporto / Size of filler metal	2,4	2,5	
Deposit Weld metal	2 mm	Up to fill	
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	NA	
Denom. Comm. Flusso / FLUX trade name	NA	NA	
Inserto consumabile / Consumable insert	NA	NA	
Altro / other	ESAB OK TIGROD 12.60	PH35 S DRY*	

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp:	**20 °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(QW 407)

N.A.

GAS DI PROTEZIONE – GAS (QW 408)

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	**Ar**	**99,99%**	**11-13 LPM**
Protezione al seguito / Trailing:	**N.A.**	**N.A.**	**N.A.**
Prot. Al rovescio / Backing:	**N.A.**	**N.A.**	**N.A.**

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS (QW –409)

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

Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type: **AWS 5.12 EWTh2 dia.2,4mm**

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

Velocità alimentazione filo / Electr. Wire feed speed range: **Self regulated**

TECNICA – TECHNIQUE (QW-410)

Passata / Bead: **Tirata/String**	Dimensione bocchello gas / Orifice of gas cup size: **3/8"**	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 tra 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: **K-Factor of 0.6 applied on HI calculation**

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-3**	**2,4**	**DC/SP**	**90-100**	**11-13**	**46-50**	**0.71-1.03**
Hot pass	**SMAW**	**E7018-1H4R**	**2,5**	**DC/RP**	**65-75**	**21-22**	**80-85**	**0.77-0.99**
Filler pass	**SMAW**	**E7018-1H4R**	**2,5**	**DC/RP**	**65-80**	**21-22**	**90-95**	**0.69-0.94**
Cap pass/Fillet	**SMAW**	**E7018-1H4R**	**2,5**	**DC/RP**	**65-75**	**21-23**	**90-105**	**0.62-0.92**

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

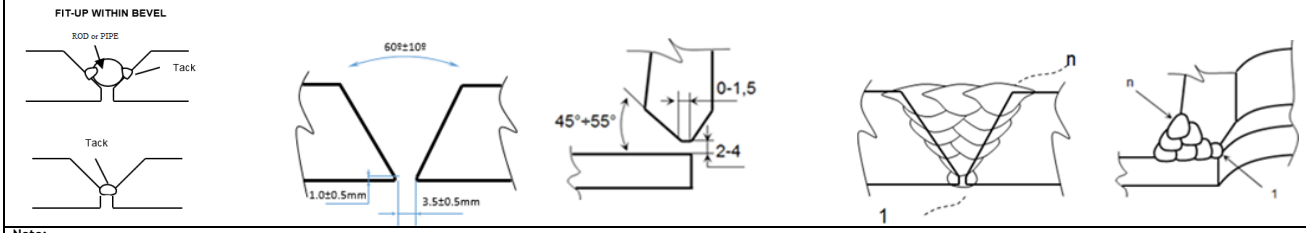
Welding Spc				**STD**	**ASME IX:2017+ASME B31.3:2017**		
PQR ref.:	**36/16**	**WPS N°**	**B1A**	**REV.:**	**0**	**Data /date**	**05/04/2024**

Procedimento di saldatura / Welding process: **GTAW (141)** Tipo / Type: **MANUAL**

GIUNTO – JOINT (QW-402)

Tipo di giunto / Joint Design: **V – ½ V-FW**	Supporto / Backing: ☐ Si / Yes ☒ No	Joint Type	PIPING CLASSES
Materiale di supporto (tipo) / Backing material (type): ☐ Metallico / Metal ☐ Non metallico / No metal. ☐ Metallo non fondente / Non Fusing metal ☐ Altro / Other		**Butt /Fillet Welds**	**01SD**

BEVEL SHALL BE DONE BY MACHINING OR GRINDING



Note:

19. **Surfaces cleaned from moisture, oil, grease, paint, before welding** / *Pulire le superfici da liquidi, oli, grasso e vernici prima di saldare;*
20. **Tack weld should be of a minimum lenghts of 4 times the base metal thickness or 50 mm, whichever is less** / *La puntatura deve essere minimo 4 volte lo spessore o 50 mm, quale dei due è più piccolo;*
21. **Weld should not be discontinued before 25 % of the weld thickness or 3 passes are completed, whichever gives adequate cross section to prevent cracking**/ *La saldatura non deve essere interrotta prima di aver saldato il 25% dello spessore o minimo 3 passate, quale dei due valori garantisce un'adeguata resistenza del giunto;*
22. **Preheat method: heating mats or propane torch. Temperature shoul be measured by contact thermometer or temperature indicating sticks. Preheat shall be measured at 75 mm from bevel edge on parent material**/ *Il preriscaldo può essere applicator con propano o resistenze elettriche. La temperature deve essere misurata a 75 mm dal bordo del cianfrino;*
23. **Interpass temperature should be checked on weld before weld start**/ *La temperatura fra le passate deve essere misurata sulla saldatura prima di partire con la saldatura;*
24. **Repair welding: Maximum 2 repair in the same area is allowed. The removal of defective areas shall be by machining, grinding, or arc/air gouging followed by grinding. Area of defect removal shall be assured by Magnetic Particle Testing or Liquid Penetrant Test. The min. preheat temperature shall be min. 50°C above the preheat temperature used for the original weld**/ *Sono possibili massimo 2 riparazioni nella stessa area. La rimozione del difetto deve essere eseguita tramite molatura o scricattura seguita da molatura. L'area del difetto dev'essere controlalta con particelle magnetiche o liquidi penetranti. La temperatura di preriscaldo per la riparazione deve essere al minimo 50 °C superiore a quella del giunto originale.*

MATERIALE BASE – BASE MATERIAL (QW-403)

Da / from P-N°: **8**	Group N°: **8**	Da / from P-N°: **8**	Group N°: **8**

Tipo e Grado / Type and Grade: **A815 UNS S32760-A790 UNS S32760**

DIMENSIONI-DIMENSION (QW-403)		**POSIZIONE DI SALDATURA - WELDING POSITION (QW 405)**	
► Materiale base / Base material:	**1,5÷9.1 mm**	Welding Position	**ALL**
► Gamma diametri / Pipe dia. Range:	**ALL**	Progression	**UP-HILL**

METALLO D'APPORTO – FILLER METAL (QW-404)

	GTAW (141)	ESAB OK Tigrod 2509
Spec. N° (SFA)	A5.9	
AWS N° (CLASS)	ER 2509	
F-N°	6	
A-N°	1	
Diametro mat. D'apporto / Size of filler metal	2-2,4 mm	
Deposit Weld metal	2 mm	
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	
Denom. Comm. Flusso / FLUX trade name	NA	
Inserto consumabile / Consumable insert	NA	
Altro / other	SANDVIK 25.4.10L*	

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20 °C**	Max temp. Di interpass / Max interpass temp.: **110 °C**	Mantenimento interpass / Interpass maintenance: **N.A.**	Tempo di mantenimento prerisc. / Maintenance timing: **N.A.**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT(QW 407)

N.A.

GAS DI PROTEZIONE – GAS (QW 408)

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar	99,99%	11-13 LPM
Protezione al seguito / Trailing:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	Ar	99,99%	9-11 LPM

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS (QW –409)

Corrente / Current: **DC**	Polarità / Polarity **SP**		
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type: **AWS 5.12 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 (QW-410)

Passata / Bead: **Tirata/String**	Dimensione bocchello gas / Orifice of gas cup size: **3/8"**	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 tra 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: **K-Factor of 0.6 applied on HI calculation**

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 2509	2,4	DC/SP	65-75	10-15	45-55	0.43-0.90
Hot pass	GTAW	ER 2509	2,4	DC/SP	65-78	10-13	45-60	0.52-0.81
Filler pass	GTAW	ER 2509	2,4	DC/SP	70-79	10-12	42-60	0.56-0.81
Cap pass/Fillet	GTAW	ER 2509	2,4	DC/SP	70-79	10-13	42-65	0.52-0.88

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

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

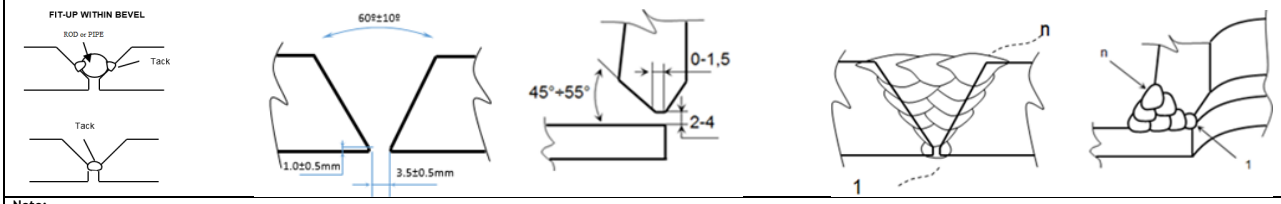
Welding Spc				**STD**	**ASME IX:2017+ASME B31.3:2017+ PED 2014/68/EU**		
PQR ref.:	**45/06+39/06**	**WPS N°**	**C1A**	**REV.:**	**1**	**Data /date**	**26/06/2024**

Procedimento di saldatura / Welding process: **GTAW (141)** Tipo / Type: **MANUAL**

GIUNTO – JOINT (QW-402)

Tipo di giunto / Joint Design: **V – ½ V-FW**	Supporto / Backing: ☐ Si / Yes ☒ No	Joint Type	PIPING CLASSES
Materiale di supporto (tipo) / Backing material (type). ☐ Metallico / Metal ☐ Non metallico / No metal. ☐ Metallo non fondente / Non Fusing metal ☐ Altro / Other		**Butt /Fillet Welds**	**01HSS-03HSS PA22S/ PB22S**

BEVEL SHALL BE DONE BY MACHINING OR GRINDING



Note:

25. **Surfaces cleaned from moisture, oil, grease, paint, before welding /** *Pulire le superfici da liquidi, oli, grasso e vernici prima di saldare;*
26. **Tack weld should be of a minimum lenghts of 4 times the base metal thickness or 50 mm, whichever is less /** *La puntatura deve essere minimo 4 volte lo spessore o 50 mm, quale dei due è più piccolo;*
27. **Weld should not be discontinued before 25 % of the weld thickness or 3 passes are completed, whichever gives adequate cross section to prevent cracking/** *La saldatura non deve essere interrotta prima di aver saldato il 25% dello spessore o minimo 3 passate, quale dei due valori garantisce un'adeguata resistenza del giunto;*
28. **Preheat method: heating mats or propane torch. Temperature shoul be measured by contact thermometer or temperature indicating sticks. Preheat shall be measured at 75 mm from bevel edge on parent material/** *Il preriscaldo può essere applicator con propano o resistenze elettriche. La temperature deve essere misurata a 75 mm dal bordo del cianfrino;*
29. **Interpass temperature should be checked on weld before weld start/** *La temperatura fra le passate deve essere misurata sulla saldatura prima di partire con la saldatura;*
30. **Repair welding: Maximum 2 repair in the same area is allowed. The removal of defective areas shall be by machining, grinding, or arc/air gouging followed by grinding. Area of defect removal shall be assured by Magnetic Particle Testing or Liquid Penetrant Test. The min. preheat temperature shall be min. 50°C above the preheat temperature used for the original weld/** *Sono possibili massimo 2 riparazioni nella stessa area. La rimozione del difetto deve essere eseguita tramite molatura o scriccatura seguita da molatura. L'area del difetto dev'essere controlalta con particelle magnetiche o liquidi penetranti. La temperatura di preriscaldo per la riparazione deve essere al minimo 50 °C superiore a quella del giunto originale.*

MATERIALE BASE – BASE MATERIAL (QW-403)

Da / from P-N°: **8.1**	Group N°: **8.1**	Da / from P-N°: **8.1**	Group N°: **8.1**
Tipo e Grado / Type and Grade	**A403 Gr.WP316/316L / A312 Gr.TP316/316L**		

DIMENSIONI-DIMENSION (QW-403)		**POSIZIONE DI SALDATURA - WELDING POSITION (QW 405)**	
► Materiale base / Base material:	**1,5÷9.56 mm**	Welding Position	**ALL**
► Gamma diametri / Pipe dia. Range:	**≥ 1/4"**	Progression	**UP-HILL**

METALLO D'APPORTO – FILLER METAL (QW-404)

	GTAW (141)	
Spec. N° (SFA)	A5.9	
AWS N° (CLASS)	ER 316L / W 19 12 3 L	
F-N°	6	
A-N°	8	
Diametro mat. D'apporto / Size of filler metal	2,4	
Deposit Weld metal	UP TO 9,56 mm	
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	
Denom. Comm. Flusso / FLUX trade name	NA	
Inserto consumabile / Consumable insert	NA	
Altro / other	Esab OK 316L	

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20 °C**	Max temp. Di interpass / Max interpass temp.: **150 °C**	Mantenimento interpass / Interpass maintenance: **N.A.**	Tempo di mantenimento prerisc. / Maintenance timing: **N.A.**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT(QW 407)

N.A.

GAS DI PROTEZIONE – GAS (QW 408)

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	**Ar**	**99,99%**	**11-13 LPM**
Protezione al seguito / Trailing:	**N.A.**	**N.A.**	**N.A.**
Prot. Al rovescio / Backing:	**Ar**	**99,99%**	**10-13 LPM**

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS (QW –409)

Corrente / Current: **DC**	Polarità / Polarity **SP**		
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type: **AWS 5.12 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 (QW-410)

Passata / Bead: **Tirata/String**	Dimensione bocchello gas / Orifice of gas cup size: **3/8"**	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 tra 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: **K-Factor of 0.6 applied on HI calculation**

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 316L / W 19 12 3L	2,4	DC/SP	75-91	10-11	46-64	0.42-0.78
Hot pass	**GTAW**	ER 316L / W 19 12 3L	2,4	DC/SP	88-102	10-11	36-50	0.63-1.12
Filler pass	**GTAW**	ER 316L / W 19 12 3L	2,4	DC/SP	88-102	10-11	36-50	0.63-1.12
Cap pass/Fillet	**GTAW**	ER 316L / W 19 12 3L	2,4	DC/SP	80-90	10-11	56-93	0.30-0.63

Welding Spc		**STD**	**ASME IX:2017+ASME B31.3:2017+ PED 2014/68/EU**

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

CROSSWIND	HOLLANDSE KUST NOORD WIND PARK PROJECT **Contract No. CW-I-WP4-2023-05** **WELDING BOOK - PIPING-123A90-PML-WEL-PRO-05003**	ROSETTI MARINO

PQR ref.:	40/06+26/06	WPS N°	C1B	REV.:	1	Data /date	26/06/2024

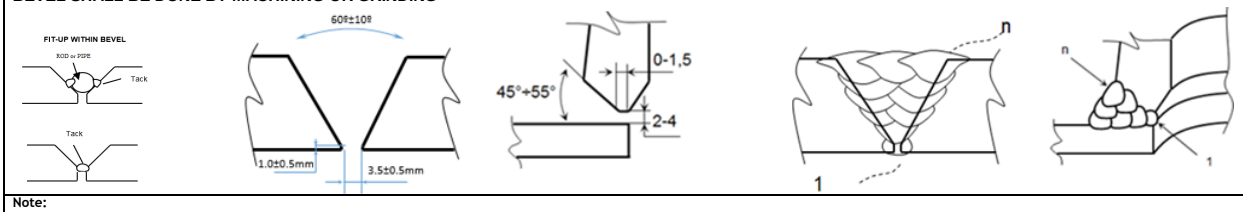
Procedimento di saldatura / Welding process: **GTAW (141)+SMAW (111)** Tipo / Type: **MANUAL**

GIUNTO – JOINT (QW-402)

Tipo di giunto / Joint Design: **V – ½ V-FW** | Supporto / Backing: ☐ Si / Yes ☒ No | Joint Type: **Butt /Fillet Welds** | PIPING CLASSES: **01HSS-03HSS / PA22S/ PB22S/PA20W**

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

BEVEL SHALL BE DONE BY MACHINING OR GRINDING



Note:

31. **Surfaces cleaned from moisture, oil, grease, paint, before welding /** *Pulire le superfici da liquidi, oli, grasso e vernici prima di saldare;*
32. **Tack weld should be of a minimum lenghts of 4 times the base metal thickness or 50 mm, whichever is less /** *La puntatura deve essere minimo 4 volte lo spessore o 50 mm, quale dei due è più piccolo;*
33. **Weld should not be discontinued before 25 % of the weld thickness or 3 passes are completed, whichever gives adequate cross section to prevent cracking/** *La saldatura non deve essere interrotta prima di aver saldato il 25% dello spessore o minimo 3 passate, quale dei due valori garantisce un'adeguata resistenza del giunto;*
34. **Preheat method: heating mats or propane torch. Temperature shoul be measured by contact thermometer or temperature indicating sticks. Preheat shall be measured at 75 mm from bevel edge on parent material/** *Il preriscaldo può essere applicator con propano o resistenze elettriche. La temperature deve essere misurata a 75 mm dal bordo del cianfrino;*
35. **Interpass temperature should be checked on weld before weld start/** *La temperatura fra le passate deve essere misurata sulla saldatura prima di partire con la saldatura;*
36. **Repair welding: Maximum 2 repair in the same area is allowed. The removal of defective areas shall be by machining, grinding, or arc/air gouging followed by grinding. Area of defect removal shall be assured by Magnetic Particle Testing or Liquid Penetrant Test. The min. preheat temperature shall be min. 50°C above the preheat temperature used for the original weld/** *Sono possibili massimo 2 riparazioni nella stessa area. La rimozione del difetto deve essere eseguita tramite molatura o scriccatura seguita da molatura. L'area del difetto dev'essere controlalta con particelle magnetiche o liquidi penetranti. La temperatura di preriscaldo per la riparazione deve essere al minimo 50 °C superiore a quella del giunto originale.*

MATERIALE BASE – BASE MATERIAL (QW-403)

Da / from P-N°:	**8.1**	Group N°:	**8.1**	Da / from P-N°:	**8.1**	Group N°:	**8.1**

Tipo e Grado / Type and Grade: **A403 Gr.WP316/316L / A312 Gr.TP316/316L**

DIMENSIONI-DIMENSION (QW-403)		POSIZIONE DI SALDATURA - WELDING POSITION (QW 405)	
► Materiale base / Base material:	**1,5÷9.56 mm**	Welding Position	**ALL**
► Gamma diametri / Pipe dia. Range:	**≥ 1"**	Progression	**UP-HILL**

METALLO D'APPORTO – FILLER METAL (QW-404)

	GTAW (141)	111 (SMAW)
Spec. N° (SFA)	A5.9	A5.4
AWS N° (CLASS)	ER 316L / W 19 12 3 L	E316L-15 / E 19 12 3 L B 2 2
F-N°	6	5
A-N°	8	8
Diametro mat. D'apporto / Size of filler metal	2,4	3,2
Deposit Weld metal	UP TO 9,56 mm	balance
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	NA
Denom. Comm. Flusso / FLUX trade name	NA	NA
Inserto consumabile / Consumable insert	NA	NA
Altro / other	Esab OK 316L	Esab OK 63.35

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp:	**20 °C**	Max temp. Di interpass / Max interpass temp.:	**150 °C**	Mantenimento interpass / Interpass maintenance:	**N.A.**	Tempo di mantenimento prerisc.: / Maintenance timing:	**N.A.**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT(QW 407)

N.A.

GAS DI PROTEZIONE – GAS (QW 408)

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar	99,99%	11-13 LPM
Protezione al seguito / Trailing:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	Ar	99,99%	10-13 LPM

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS (QW –409)

Corrente / Current: **DC** | Polarità / Polarity: **SP/RP**

Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type: **AWS 5.12 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 (QW-410)

Passata / Bead:	**Tirata/String**	Dimensione bocchello gas / Orifice of gas cup size:	**3/8"**	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 tra 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: **K-Factor of 0.6 applied on HI calculation**

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	E316L-15	2,4	DC/SP	88-131	10-12	41-67	0.47-1.38
Hot pass	SMAW	E316L-15	3.2	DC/RP	65-95	22-23	165-188	0.36-0.63
Filler pass	SMAW	E316L-15	3.2	DC/RP	60-101	22-24	183-210	0.30-0.63
Cap pass/Fillet	SMAW	E316L-15	3.2	DC/RP	65-91	22-23	158-218	0.31-0.63

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

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Welding Spc				STD	ASME IX:2017+ASME B31.3:2017		
PQR ref.:	45/06+39/06	WPS N°	D1A	REV.:	1	Data /date	26/06/2024

Procedimento di saldatura / Welding process: **GTAW (141)** Tipo / Type: **MANUAL**

GIUNTO – JOINT (QW-402)

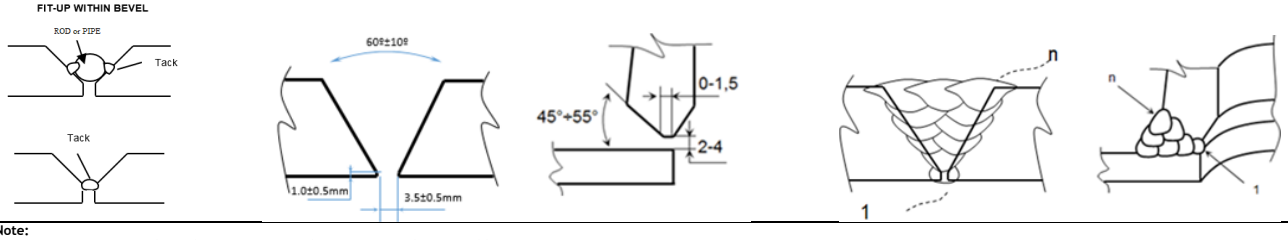
Tipo di giunto / Joint Design: **V – ½ V-FW** Supporto / Backing: ☐ Si / Yes ☒ No

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

Joint Type: **Butt /Fillet Welds**

PIPING CLASSES: **01SS /PA22S/ PA20W /TK22**

BEVEL SHALL BE DONE BY MACHINING OR GRINDING



Note:

37. **Surfaces cleaned from moisture, oil, grease, paint, before welding /** *Pulire le superfici da liquidi, oli, grasso e vernici prima di saldare;*
38. **Tack weld should be of a minimum lenghts of 4 times the base metal thickness or 50 mm, whichever is less /** *La puntatura deve essere minimo 4 volte lo spessore o 50 mm, quale dei due è più piccolo;*
39. **Weld should not be discontinued before 25 % of the weld thickness or 3 passes are completed, whichever gives adequate cross section to prevent cracking/** *La saldatura non deve essere interrotta prima di aver saldato il 25% dello spessore o minimo 3 passate, quale dei due valori garantisce un'adeguata resistenza del giunto;*
40. **Preheat method: heating mats or propane torch. Temperature shoul be measured by contact thermometer or temperature indicating sticks. Preheat shall be measured at 75 mm from bevel edge on parent material/** *Il preriscaldo può essere applicator con propano o resistenze elettriche. La temperature deve essere misurata a 75 mm dal bordo del cianfrino;*
41. **Interpass temperature should be checked on weld before weld start/** *La temperatura fra le passate deve essere misurata sulla saldatura prima di partire con la saldatura;*
42. **Repair welding: Maximum 2 repair in the same area is allowed. The removal of defective areas shall be by machining, grinding, or arc/air gouging followed by grinding. Area of defect removal shall be assured by Magnetic Particle Testing or Liquid Penetrant Test. The min. preheat temperature shall be min. 50°C above the preheat temperature used for the original weld/** *Sono possibili massimo 2 riparazioni nella stessa area. La rimozione del difetto deve essere eseguita tramite molatura o scricatura seguita da molatura. L'area del difetto dev'essere controlalta con particelle magnetiche o liquidi penetranti. La temperatura di preriscaldo per la riparazione deve essere al minimo 50 °C superiore a quella del giunto originale.*

MATERIALE BASE – BASE MATERIAL (QW-403)

Da / from P-N°:	8.1	Group N°:	8.1	Da / from P-N°:	8.1	Group N°:	8.1

Tipo e Grado / Type and Grade: **A403 Gr.WP316/316L / A312 Gr.TP316/316L**

DIMENSIONI-DIMENSION (QW-403)

- Materiale base / Base material: **1,5÷9.56 mm**
- Gamma diametri / Pipe dia. Range: **≥ 1/2"**

POSIZIONE DI SALDATURA - WELDING POSITION (QW 405)

Welding Position: **ALL**

Progression: **UP-HILL**

METALLO D'APPORTO – FILLER METAL (QW-404)

	GTAW (141)	
Spec. N° (SFA)	A5.9	
AWS N° (CLASS)	ER 316L / W 19 12 3 L	
F-N°	6	
A-N°	8	
Diametro mat. D'apporto / Size of filler metal	2,4	
Deposit Weld metal	UP TO 9,56 mm	
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	
Denom. Comm. Flusso / FLUX trade name	NA	
Inserto consumabile / Consumable insert	NA	
Altro / other	Esab OK 316L	

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp:	20 °C	Max temp. Di interpass / Max interpass temp.:	150 °C	Mantenimento interpass / Interpass maintenance:	N.A.	Tempo di mantenimento prerisc. / Maintenance timing:	N.A.

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT(QW 407)

N.A.

GAS DI PROTEZIONE – GAS (QW 408)

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar	99,99%	11-13 LPM
Protezione al seguito / Trailing:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	Ar	99,99%	10-13 LPM

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS (QW –409)

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

Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type: **AWS 5.12 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 (QW-410)

Passata / Bead:	Tirata/String	Dimensione bocchello gas / Orifice of gas cup size:	3/8"	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.
N°Passate / Passes nr.:	Multipla/Multiple	Elettrodo multiplo o singolo / Multiple or single electrodes:	Singolo/Single	Martellatura / Peening:	N.A.

Distanza tra zona di contatto e pezzo / Contact zone to work distance: **N.A.**

Altro / Other: **K-Factor of 0.6 applied on HI calculation**

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 316L / W 19 12 3L	2,4	DC/SP	75-91	10-11	46-64	0.42-0.78
Hot pass	GTAW	ER 316L / W 19 12 3L	2,4	DC/SP	88-102	10-11	36-50	0.63-1.12
Filler pass	GTAW	ER 316L / W 19 12 3L	2,4	DC/SP	88-102	10-11	36-50	0.63-1.12
Cap pass/Fillet	GTAW	ER 316L / W 19 12 3L	2,4	DC/SP	80-90	10-11	56-93	0.30-0.63

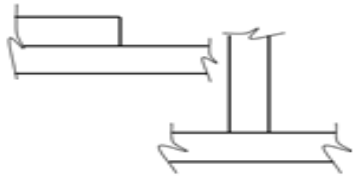
Preparato da / prepared by RM	Approvato da / approved by RM	Approvato da / approved by	Approvato da / approved by
D.CENACCHI	A. KHALIFA		

Welding Spc				STD	ASME IX:2017+ASME B31.3:2017		
PQR ref.:	49/06+03/03	WPS N°	E1A	REV.:	0	Data /date	05/04/2024

Procedimento di saldatura / Welding process: **GTAW (141)** Tipo / Type: **MANUAL**

GIUNTO – JOINT (QW-402)

Tipo di giunto / Joint Design: **FW**	Supporto / Backing: ☐ Si / Yes ☒ No	Joint Type	PIPING CLASSES
Materiale di supporto (tipo) / Backing material (type): ☐ Metallico / Metal ☐ Non metallico / No metal. ☐ Metallo non fondente / Non Fusing metal ☐ Altro / Other		**Fillet Welds DISSIMILAR**	**01CS**



Note:

43. **Surfaces cleaned from moisture, oil, grease, paint, before welding /** *Pulire le superfici da liquidi, oli, grasso e vernici prima di saldare;*
44. **Tack weld should be of a minimum lenghts of 4 times the base metal thickness or 50 mm, whichever is less /** *La puntatura deve essere minimo 4 volte lo spessore o 50 mm, quale dei due è più piccolo;*
45. **Weld should not be discontinued before 25 % of the weld thickness or 3 passes are completed, whichever gives adequate cross section to prevent cracking/** *La saldatura non deve essere interrotta prima di aver saldato il 25% dello spessore o minimo 3 passate, quale dei due valori garantisce un'adeguata resistenza del giunto;*
46. **Preheat method: heating mats or propane torch. Temperature shoul be measured by contact thermometer or temperature indicating sticks. Preheat shall be measured at 75 mm from bevel edge on parent material/** *Il preriscaldo può essere applicator con propano o resistenze elettriche. La temperature deve essere misurata a 75 mm dal bordo del cianfrino;*
47. **Interpass temperature should be checked on weld before weld start/** *La temperatura fra le passate deve essere misurata sulla saldatura prima di partire con la saldatura;*
48. **Repair welding: Maximum 2 repair in the same area is allowed. The removal of defective areas shall be by machining, grinding, or arc/air gouging followed by grinding. Area of defect removal shall be assured by Magnetic Particle Testing or Liquid Penetrant Test. The min. preheat temperature shall be min. 50°C above the preheat temperature used for the original weld/** *Sono possibili massimo 2 riparazioni nella stessa area. La rimozione del difetto deve essere eseguita tramite molatura o scriccatura seguita da molatura. L'area del difetto dev'essere controlalta con particelle magnetiche o liquidi penetranti. La temperatura di preriscaldo per la riparazione deve essere al minimo 50 °C superiore a quella del giunto originale.*

MATERIALE BASE – BASE MATERIAL (QW-403)

Da / from P-N°: **1-2**	Group N°: **8.1**	Da / from P-N°: **1-2**	Group N°: **8.1**

Tipo e Grado / Type and Grade: **SA333 Gr.6-SA350 Gr.LF2-SA420 Gr.WPL6 / A312 Gr.TP316/316L**

DIMENSIONI-DIMENSION (QW-403)

- ► Materiale base / Base material: **3-7.4 mm**
- ► Gamma diametri / Pipe dia. Range: **≥ 1/4"**

POSIZIONE DI SALDATURA - WELDING POSITION (QW 405)

Welding Position: **ALL**

Progression: **UP-HILL**

METALLO D'APPORTO – FILLER METAL (QW-404)

	GTAW (141)	
Spec. N° (SFA)	A5.9	
AWS N° (CLASS)	ER 309L	
F-N°	6	
A-N°	8	
Diametro mat. D'apporto / Size of filler metal	2,4 mm	
Deposit Weld metal	7.4 mm MAX	
Accoppiamento filo-flusso / Electrode-flux (CLASS)	NA	
Denom. Comm. Flusso / FLUX trade name	NA	
Inserto consumabile / Consumable insert	NA	
Altro / other	Esab OK 309L	

PRERISCALDO – PRE-HEAT (QW406)

Temp.preriscaldo minima / Min. pre-heat temp: **20 °C**	Max temp. Di interpass / Max interpass temp.: **150 °C**	Mantenimento interpass / Interpass maintenance: **N.A.**	Tempo di mantenimento prerisc. / Maintenance timing: **N.A.**

TRATTAMENTO TERMICO DOPO SALDATURA – POST WELD HEAT TREATMENT(QW 407)

N.A.

GAS DI PROTEZIONE – GAS (QW 408)

	GAS	Miscela / Mixture	Port. / Flow rate
Protezione / Shielding:	Ar	99,99%	11-13 LPM
Protezione al seguito / Trailing:	N.A.	N.A.	N.A.
Prot. Al rovescio / Backing:	N.A.	N.A.	N.A.

CARATTERISTICHE ELETTRICHE / ELECTRICAL CHARACTERISTICS (QW –409)

Corrente / Current: **DC**	Polarità / Polarity: **SP**
Dia e tipo elettr. Tungsteno / Tungsten elctr. Size & type: **AWS 5.12 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 (QW-410)

Passata / Bead: **Tirata/String**	Dimensione bocchello gas / Orifice of gas cup size: **3/8"**	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 tra 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: **K-Factor of 0.6 applied on HI calculation**

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 / Clas	Dia. (mm.)	Polarità / Polarity	Amp. Range			
1 to n	GTAW	ER 309L	2,0-2,4	SP	90-120	11-13	50-90	0,7-1,7

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