Base Load Power Hub (BLPH)

Magnetic Particle Examination Procedure – Piping

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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.

1.1.1 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.

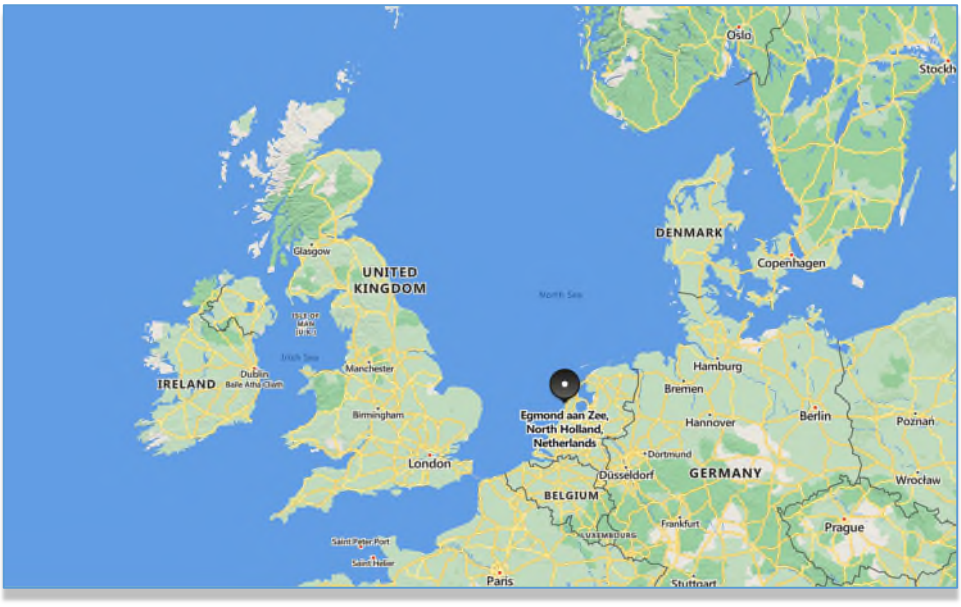


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

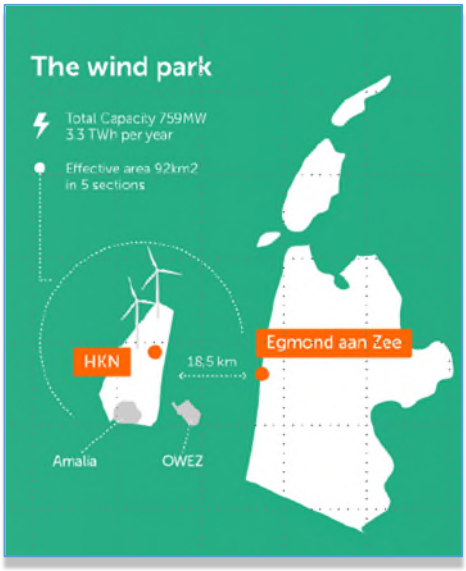


Figure 2 - Wind Park Details

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.

1.1.2 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.

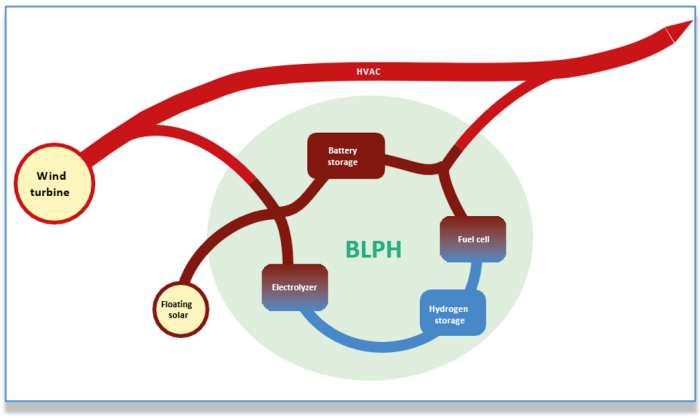


Figure 3 – BLPH Concept

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

This procedure establishes the method for the execution, examination, and evaluation of magnetic particle inspection to detect discontinuities on surface on structural and piping ferromagnetic materials.

This method involves magnetizing an area to be examined and applying ferromagnetic particles to the surface with Alternative current (AC).

This procedure applies also to qualification of welders and welding procedures.

The welds shall be tested at 100% of external surface and internal surface if accessible.

2.1 REFERENCES DOCUMENT (Latest edition applicable)

Doc. No.	Description
123A90-DDL-PP-SP-70029_2	TSS-Piping materials narrative
ASME V Art.7	Asme Boiler and Pressure Vessel Code – Nondestructive Examination
ASME VIII Div.1	Asme Boiler and Pressure Vessel Code – An International code – Division 1
ISO 9712	Non-destructive testing – Qualification and certification of NDT personnel

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
NDT:	Non Destructive test
MT	Magnetic Test

Table 2 - Definitions and Abbreviations

3 PERSONNEL QUALIFICATION

The examiner who carries out magnetic particle test and evaluates indication on all the other welds shall be qualified as a Level 2 or 3 in the applicable method and on the relevant product sector in accordance with the requirements of ISO9712.

The operator shall have a valid near vision acuity test, which permits reading, a minimum of Times Roman N°4.5 or equivalent letters Jaeger 1 at not less than 30 cm with one or both eyes, either corrected or uncorrected.

Colour vision shall be sufficient that the candidate can distinguish contrast between the colours used in NDT method.

4 SURFACE PREPARATION

Prior to magnetic particle examination, the surface to be examined and all adjacent areas within at least 1" (25,4 mm) shall be free of all dirty, grease, scale or other extraneous matter that could interfere with the examination.

If and when necessary, surfaces to be examined can be cleaned by grit or metal blasting.

The weld shall be prepared by grinding, if necessary, to assure that the examination shall be performed properly and that the surface condition of the weld is not causing misleading interpretations of the results.

For butt weld requiring cap to be ground flush for inspection purposes final MT examination shall be performed after cap removal.

The status of the weld shall be reported in MT inspection report.

5 CONSUMABLES

In all cases the magnetic detection media shall be of a wet suspension type, a contrast white lacquer shall be applied to surfaces to be inspected after cleaning and prior to magnetization, in order to improve the contrast and to facilitate the mobility of the magnetic particles.

Lacquer is to be applied by spraying (also from spray cans).

Black magnetic powder shall be used as an examination medium.

The following materials shall be used:

a) wet particles:

CGM LK 35 BLACK COLOUR

ELITE – BLACK MAGNETIC INK BW2

MAGNAFLUX – 7HF – Oil-Based Visible Magnetic Particle.

Or equivalent

b) white lacquer:

CGM VECOPLAST

WHITE BACKGROUND LACQUER WBL5

MAGNAFLUX WCP-2

Or equivalent.

Particles shall be used within the temperature range limitations set by the manufacturer of the particles.

6 EXAMINATION

The technique shall be carried out in the continuous mode and test shall be performed at least in two perpendicular directions to detect any discontinuities regardless their position and orientation (see Appendix 1).

Magnetization shall be made using sufficient overlap to assure 100% coverage at the required sensitivity of the controlled areas.
To ensure detection of imperfections in all orientations, the welds shall be magnetized in two directions.

approximately perpendicular to each other with a maximum deviation of 30°.

Electromagnetic yoke (A.C. alternative current) shall be used.

Each alternative current electromagnetic yokes shall be verified prior to every use, establishing their lifting force equal or more than 4,5 kg at the maximum pole spacing that will be used.

The equipment shall be calibrated once per year.

Magnetic field adequacy and direction indicator shall be used to check magnetic field adequacy (see Appendix 2).

7 PARTICLES APPPLICATIONS

Magnetic suspension solution shall be applied, during application of magnetic force (continuous method), by means of a sprayer to provide a homogeneous distribution.

The magnetizing current shall be turned on after the particles have been applied.

Flow of particles shall stop with the application of current.

Wet particles applied from aerosol spray cans may be applied before and/or after magnetizing current is applied.

Wet particles may be applied during the application of magnetizing current if they are not applied directly to the examination area and are allowed to flow over the examination area or are applied directly to the examination area with low velocities insufficient to remove accumulated particles.

8 VIEWING CONDITION

All the testing area shall be easily accessible in safety condition; if necessary, the part shall be moved, to avoid that limited access could interfere with the test results.

The area under test shall be evenly illuminated at a level of not less than 1076 lux daylight or artificial light.

The light intensity shall be measured with a light meter prior to the evaluation of indications.

Light meters shall be calibrated at least once a year or whenever a meter has been repaired.

If meters have not been in use for one year or more, calibration shall be done before being used.

9 DEMAGNETIZATION

After testing with alternating current, residual magnetization will normally be low for low carbon steels, and there will generally be no need for demagnetization of the object.

10 ACCEPTANCE CRITERIA

The acceptance criteria shall be in accordance with ASME VIII Div.1 Appendix 6.

All surfaces to be examinaed shall be free of:

- Relevant linear indications
- Relevant rounded indications greater than 5mm
- Four or more relevant rounded indications in a line separated by 1,5mm or less, edge to edge

10.1 Linear Indication

Is one having a length greater than three times the width

10.2 Rounded Indication

Is one of circular or elliptical shape with a length equal to or less than three times its width

Any questionable or doubtful indications shall be re-examined (after cleaning of the surface) to determine whether or not they are relevant;

11 WELD REPAIR

All defects after repair with a new magnetic particle examination, shall be carried out all over the interested area including 50 mm on either side of defects.
The examination after repair shall be performed not earlier than 48 hours after completion weld.
Welding repairs (or replaced welds) shall be examined with the methods prescribed for the original WPS.

12 EXAMINATION REPORT

All NDT shall be documented, and all reports shall be generate by database (See attachment 3)
The documentation shall include as minimum the following information, where appropriate:

- contract number;
- applicable procedure specification;
- weld identification;
- material type and dimensions;
- welding process used;
- surface conditions;
- post weld heat treatment (if required)
- temperature of the object;
- type of magnetization equipment
- testing technique
- type of current
- detection media
- viewing conditions
- date of testing;
- approval signature of responsible inspector.
- magnetic field strength verification

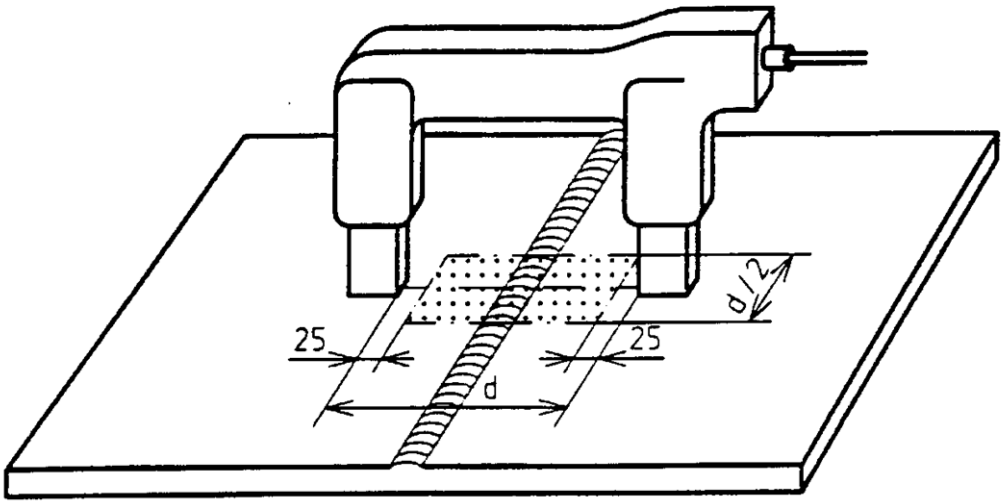
13 ATTACHMENT

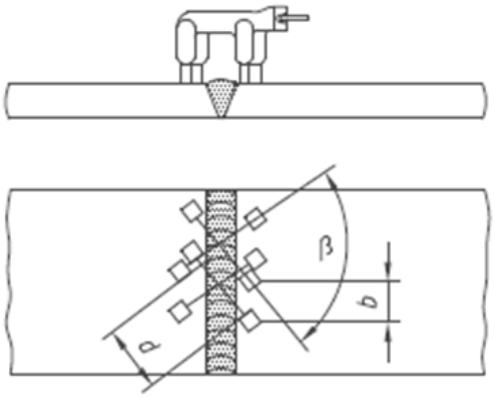
Appendix 1 – Example of area to be examined by yoke technique

Appendix 2 – Magnetic particle field indicator

Appendix 3 – Examination report

Attachment 1 - Example of an area to be examined by yoke magnetization technique.

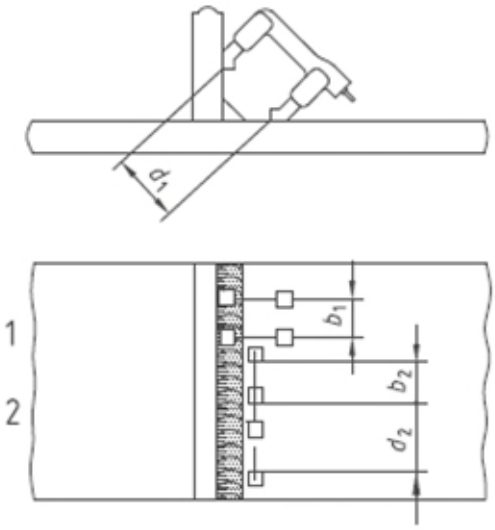




$d \geqslant 75$

$b \leqslant d/2$

$\beta \approx 90°$

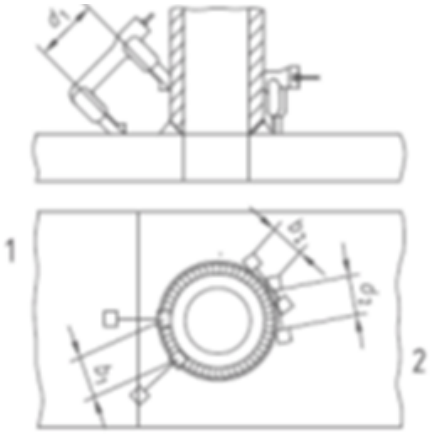


$d_1 \geqslant 75$

$b_1 \leqslant d_1/2$

$b_2 \leqslant d_2 - 50$

$d_2 \geqslant 75$

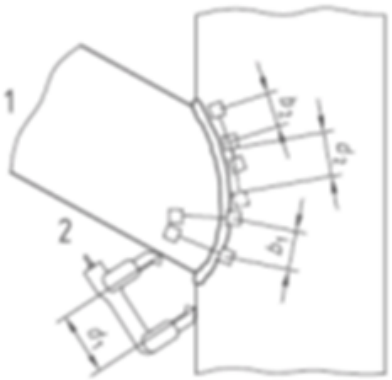


$d_1 \geq 75$

$d_2 \geq 75$

$b_1 \leq d_1/2$

$b_2 \leq d_2 - 50$



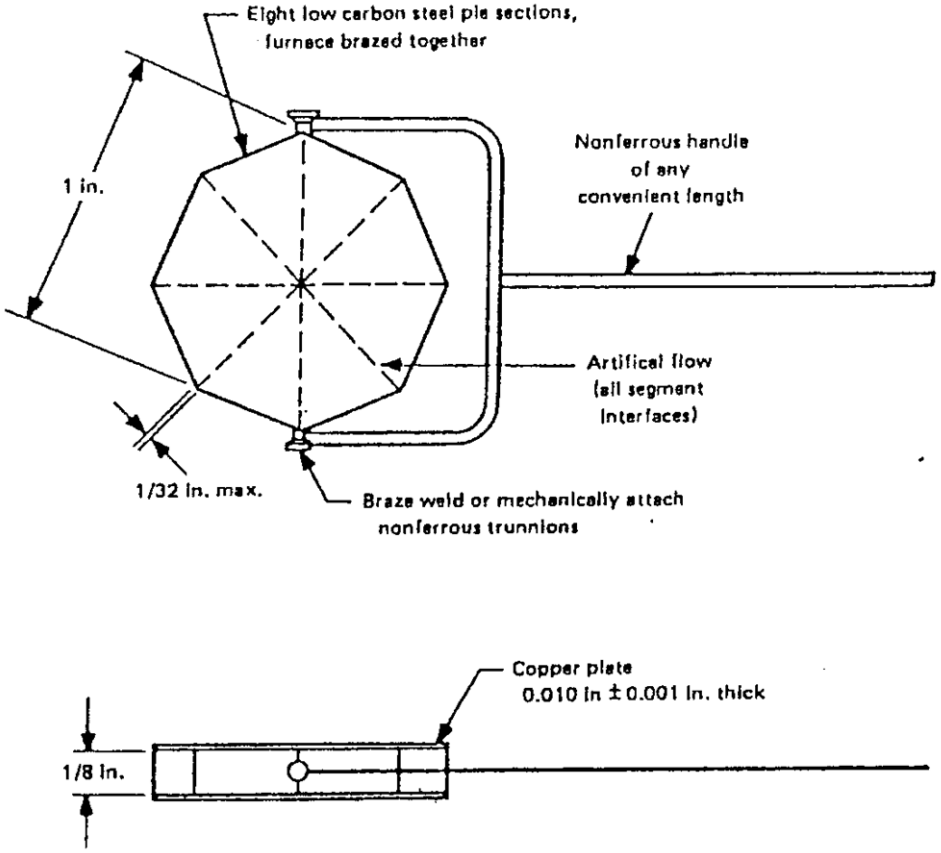
$d_1 \geq 75$

$d_2 > 75$

$b_1 \leq d_1/2$

$b_2 \leq d_2 - 50$

Attachment 2 – Magnetic particle field indicator



MAGNETIC PARTICLE FIELD INDICATOR

Attachment 3 – Examination Report

ROSETTI MARINO

NDT ACTIVITIES - TEST REPORT

RAPPORTO DI ESAME MAGNETOSCOPICO

MAGNETIC PARTICLE TEST REPORT

REPORT N°

DATA DELL'ESAME / Examination Date

FOGLIO / Sheet n° 1 DI / of

CLIENTE / Client	COMMESSA N°/Job No	DISCIPLINA / Discipline	ORDINE N°/ Order N°	PROGETTO/Project

CODICE - PROCEDURA Code - Procedure Rev.	SPECIFICA Specification	ACCETTABILITA' Acceptance levels	INSPECTION TEST PLAN ITP No Rev.	FASE ITP Phase ITP

TECNICA DI SALDATURA Welding process	PROC. di SALDATURA WPS	FASE DEL CONTROLLO Examination phase	TRATTAMENTO TERMICO / PWHT
			☐ PRIMA DEL TT / Before PWHT ☐ DOPO IL TT / After PWHT ☐ NON APPLICABILE / Not Applicable

OGGETTO Object	MATERIALE Material	TEMPERATURA PEZZO Piece temperature	ISTRUZIONE DI LAVORO MT MT Work Instruction
☐ MAT. BASE / Parent Material ☐ SALDATURA / Weld Metal			

CONDIZIONI DI VISIONE / Viewing conditions

☐ NATURALE / Natural light ☐ ARTIFICIALE / Artificial light — TIPO ILLUMINATORE / Lighting equipment

☐ LAMPADA DI WOOD / Wood Lamp ☐ ALTRO / Other — ILLUMINAZIONE / Lighting intensity

STATO DELLA SUPERFICIE / Surface condition

☐ COME SALDATO / As welded ☐ SPAZZOLATO / As brushed ☐ LAVORATO DI MACCHINA / As machined ☐ COME CALANDRATO / As formed

☐ MOLATO / As ground ☐ COME LAMINATO / As rolled ☐ GREZZO / As forged ☐ ALTRO / Other

TECNICA DI MAGNETIZZAZIONE / Magnetization technique

☐ PUNTALI / Prods ☐ GIOGO / Yoke ☐ BOBINA / Coil ☐ CONDUTTORE CENTRALE / Neutral Wire ☐ ALTRO / Other

SMAGNETIZZAZIONE FINALE/ Final Demagnetization	CORRENTE/ Current	INTENSITA'/ Intensity

DISTANZA PUNTALI / Pole Spacing (mm)	TIPO APPARECCHIO/ Magnetic Equipment	NUMERO DI SERIE / Serial number

PARTICELLE MAGNETICHE UTILIZZATE PER L'ISPEZIONE / Magnetic particles used for inspection

TIPOLOGIA CONTROLLO / Examination kind ☐ SECCO / Dry ☐ UMIDO / Wet ☐ FLUORESCENTE/Fluorescent

COLORE / Color ☐ BLU / Blue ☐ ROSSA / Red ☐ NERA / Black ☐ ALTRO / Other

MARCA / Trade	TIPO / Type	Batch N.

VERNICE DI CONTRASTO / Surface contrast paint	MARCA / Trade	TIPO / Type	Batch N.

OGGETTO CONTROLLATO / Object tested

SALDATURA Weld Number	DISEGNO / Sheet DWG / sheet	MARCA Mark	DIMENSIONI Dimension	SPESSORE Thickness	TIPO DI GIUNTO Type of joint	TIPO DI GIUNTO Type of joint	LUNGHEZZA CONTROLLATA Inspected length	ESITO Result

NOTE / Remarks

TECNICO CND Livello 2 NDT Technician Level 2	CONTROLLO QUALITA' Q.C. Supervisor	ISPETTORE CONTRATTISTA Contractor Repr.	ISPETTORE CLIENTE Company Repr.	ISPETTORE TERZA PARTE Third party inspector
Company: Operator:				

Examination report (issued by operator)

ROSETTI MARINO

NDT ACTIVITIES - TEST REPORT

RAPPORTO DI ESAME MAGNETOSCOPICO

MAGNETIC PARTICLE TEST REPORT

REPORT N°
DATA DELL'ESAME / Examination Date
FOGLIO / Sheet n° 1 DI / of

CLIENTE / Client	COMMESSA N°/Job No	DISCIPLINA / Discipline	ORDINE N°/ Order N°	PROGETTO/Project

CODICE - PROCEDURA / Code - Procedure	SPECIFICA / Specification	ACCETTABILITA' / Acceptance levels	INSPECTION TEST PLAN / ITP No	FASE ITP / Phase ITP
Rev.			Rev.	

TECNICA DI SALDATURA / Welding process	PROC. di SALDATURA / WPS	FASE DEL CONTROLLO / Examination phase	TRATTAMENTO TERMICO / PWHT
			☐ PRIMA DEL TT / Before PWHT ☐ DOPO IL TT / After PWHT ☐ NON APPLICABILE / Not Applicable

OGGETTO / Object	MATERIALE / Material	TEMPERATURA PEZZO / Piece temperature	ISTRUZIONE DI LAVORO MT / MT Work Instruction
☐ MAT. BASE / Parent Material ☐ SALDATURA / Weld Metal			

CONDIZIONI DI VISIONE / Viewing conditions

☐ NATURALE / Naturall light ☐ ARTIFICIALE / Artificial light — TIPO ILLUMINATORE / Lighting equipment

☐ LAMPADA DI WOOD / Wood Lamp ☐ ALTRO / Other — ILLUMINAZIONE / Lighting intensity

STATO DELLA SUPERFICIE / Surface condition

☐ COME SALDATO / As welded ☐ SPAZZOLATO / As brushed ☐ LAVORATO DI MACCHINA / As machined ☐ COME CALANDRATO / As formed

☐ MOLATO / As ground ☐ COME LAMINATO / As rolled ☐ GREZZO / As forged ☐ ALTRO / Other

TECNICA DI MAGNETIZZAZIONE / Magnetization technique

☐ PUNTALI / Prods ☐ GIOGO / Yoke ☐ BOBINA / Coil ☐ CONDUTTORE CENTRALE / Neutral Wire ☐ ALTRO / Other

SMAGNETIZZAZIONE FINALE/ Final Demagnetization	CORRENTE/ Current	INTENSITA'/ Intensity

DISTANZA PUNTALI / Pole Spacing (mm)	TIPO APPARECCHIO/ Magnetic Equipment	NUMERO DI SERIE / Serial number

PARTICELLE MAGNETICHE UTILIZZATE PER L'ISPEZIONE / Magnetic particles used for inspection

TIPOLOGIA CONTROLLO / Examination kind ☐ SECCO / Dry ☐ UMIDO / Wet ☐ FLUORESCENTE/Fluorescent

COLORE / Color ☐ BLU / Blue ☐ ROSSA / Red ☐ NERA / Black ☐ ALTRO / Other

MARCA / Trade	TIPO / Type	Batch N.

VERNICE DI CONTRASTO / Surface contrast paint	MARCA / Trade	TIPO / Type	Batch N.

OGGETTO CONTROLLATO / Object tested

SALDATURA / Weld Number	DISEGNO / Sheet DWG / sheet	MARCA / Mark	DIMENSIONI / Dimension	SPESSORE / Thickness	TIPO DI GIUNTO / Type of joint	TIPO DI GIUNTO / Type of joint	LUNGHEZZA CONTROLLATA / Inspected length	ESITO / Result

NOTE / Remarks

TECNICO CND Livello 2 / NDT Technician Level 2	CONTROLLO QUALITA' / Q.C. Supervisor	ISPETTORE CONTRATTISTA / Contractor Repr.	ISPETTORE CLIENTE / Company Repr.	ISPETTORE TERZA PARTE / Third party inspector
Company: Operator:				