Base Load Power Hub (BLPH)

NDT PROCEDURE (INCL. PMI) – BALL, DBB & SBB, MONOFLANGE

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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.

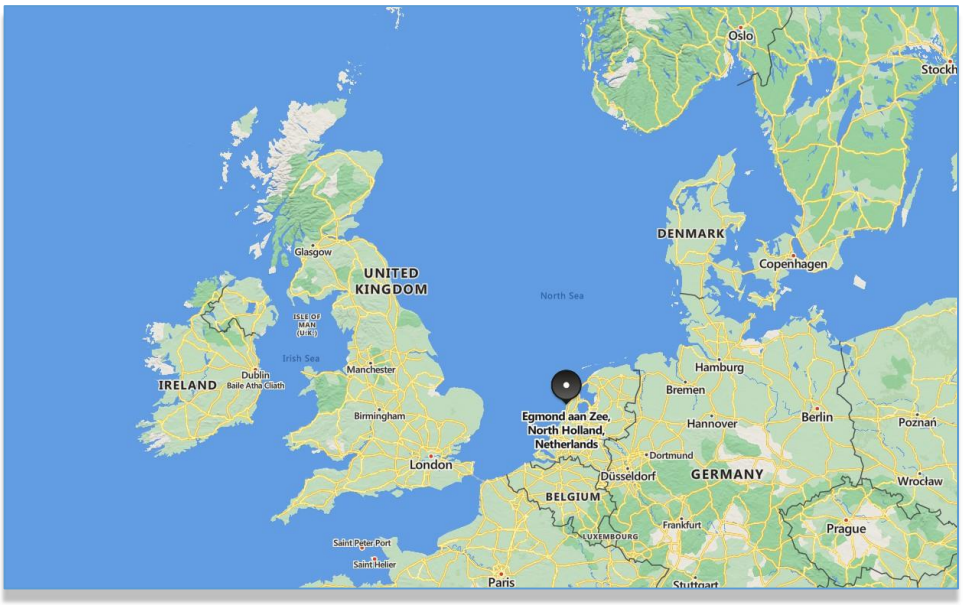


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

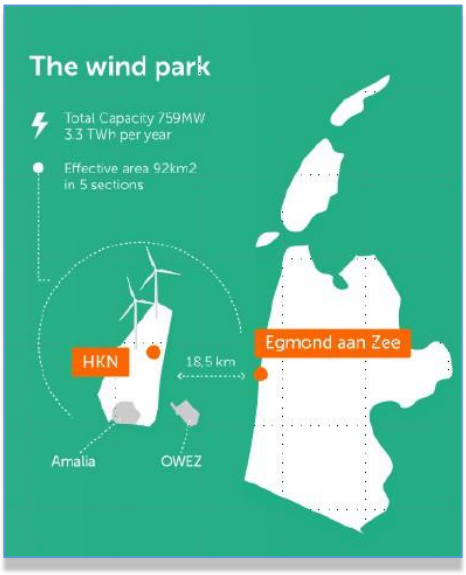


Figure 2 - Wind Park Details

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.

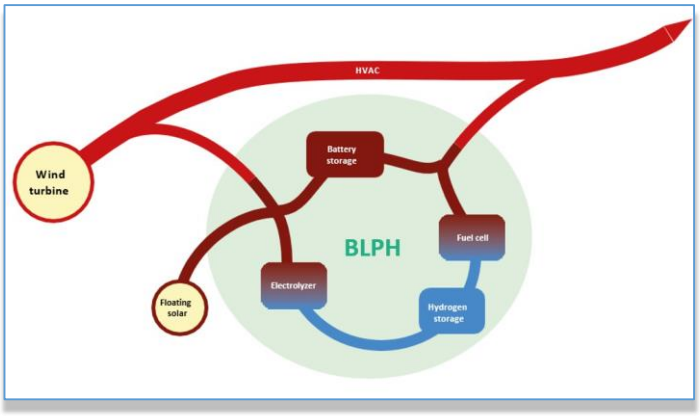


Figure 3 – BLPH Concept

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

2.1 PROCEDURE OF TEST DYE PENETRANT

SCOPE AND FIELD OF APPLICATION

This procedure describes the performance method and acceptance criteria of colour contrast dye penetrant examination of forgings, welding and overlay. If the performance is enforced by third party, the latter must issue their own procedure, according to the indications reported in this document, and submit it in advance for approval. This procedure has been issued in accordance with the minimum contents required by: ASME V table T 621.

In agreement with table T 621 there is a distinction between the essential variables and not essential variables. Any change of value or value range, requires a requalification of the written procedure. Any change of essential and not essential variables requires the revision of the written procedure.

2.1 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project

Table 2 - Definitions and Abbreviations

GENERAL PROCEDURE FOR HARDNESS TEST

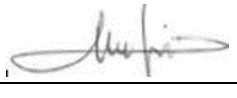
PROCEDURA DI PROVA DI DUREZZA

QUESTE ISTRUZIONI SONO DI PROPRIETA' DELLA INDRA S.R.L.

OGNI DIVULGAZIONE, RIPRODUZIONE O CESSIONE DI CONTENUTI A TERZI DEVE ESSERE AUTORIZZATA DALLA STESSA SOCIETA'.

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Revisione: 0 *Revision: 0*	Redazione *Created*	Approvazione *Approved*
Data: *Date:*	09/09/2024	09/09/2024
Nome: *Name:*	Chiara Poni	Aurelio Giunta
Firma: *Signature:*		

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1. SCOPO E CAMPO DI APPLICAZIONE

Lo scopo della presente procedura è quello di stabilire le modalità per l'esecuzione di prove di durezza, mediante apparecchiature portatili, su componenti finiti.

2. DOCUMENTI DI RIFERIMENTO

I documenti di riferimento sono:
- Manuale della qualità, ultima edizione.
- Procedura di gestione strumentazione (PG-07) ultima edizione.
- ASME Sez. II, ultima edizione.

3. APPARECCHIATURA

Per effettuare le prove di durezza verrà utilizzato un durometro a rimbalzo (Modello TH-110 Portable Hardness Tester 1600HV, S.N. 32159000013), con la possibilità di convertire i risultati nelle varie scale di durezza.

4. CALIBRAZIONE

4.1 Prima effettuare il controllo sul componente in questione lo strumento verrà verificato attraverso il suo blocco di riferimento S.N. 57061.

4.2 Le differenze tra il valore di lettura della media di N° 5 misurazioni effettuate sul blocco di riferimento S.N. 57061 e il valore riportato sul certificato del blocco saranno sottratte dalla media delle misurazioni effettuate sul componente in esame.

5. CONDIZIONI SUPERFICIALI

5.1 L'area di prova deve essere sufficientemente liscia per consentire la corretta esecuzione della prova.

5.2 La rugosità deve essere massimo 1.6 µm (ottenibile con mola a grana fine) e deve essere sufficientemente ampia da consentire il corretto appoggio del corpo di battuta (circa 20 x 20 mm).

5.3 Lo spessore del campione da testare non deve essere inferiore a 5 mm.

1. SCOPE AND FIELD OF APPLICATION

The purpose of this procedure is to establish the procedures for the execution of hardness testing on finished components using portable equipment.

2. REFERENCE DOCUMENTS

The reference documents are:
- Quality Manual, latest edition.
- Equipment management procedure (PG-07) latest edition.
- ASME Section II, latest edition.

3. EQUIPMENT

To carry out the tests a rebound hardness testing device will be used (Model TH-110 Portable Hardness Tester 1600HV, S.N. 32159000013), with the possibility of converting the results on the various hardness scale.

4. CALIBRATION

4.1 First carry out the check on the component in question, the instrument will be checked through its reference block S.N. 57061.

4.2 The differences between the value of the average of N° 5 measurements made on the reference block S.N. 57061 and the value shown on the certificate of the block will be subtracted from the average of the measurements made on the component in question.

5. SURFACE CONDITIONS

5.1 The test area must be smooth enough to allow the test to be carried out correctly.

5.2 The surface must have a maximum roughness of 1.6 µm (obtainable using a fine-grained wheel) and must be large enough to allow the impact body to rest correctly (about 20 x 20 mm).

5.3 The thickness of the sample to be tested should not be less than 5 mm.

5.4 I pezzi campione che hanno peso inferiore a 5 Kg. necessitano di appropriato sostegno per eseguire la prova.

5.5 I componenti che non soddisfano i requisiti 5.2 e 5.3 non possono essere testati in quanto il risultato di durezza non sarebbe attendibile.

6. ESECUZIONE DELLA PROVA

Come concordato con il cliente, la modalità di esecuzione del test prevede che, per ogni punto, dovrà essere registrato il valore medio di N. 5 prove.

7. CRITERI DI ACCETTABILITA'

Se non diversamente concordato con il cliente, i valori riscontrati dal controllo devono rispettare le normative di riferimento presenti nella ASME Sez. II in base al tipo di materiale.

8. DOCUMENTAZIONE

Se richiesto, l'operatore deve firmare e datare un certificato in grado di identificare ogni test effettuato. I valori delle durezze effettuate saranno registrati su un certificato INDRA od uno proposto dal cliente ed approvato dal RSQ (Responsabile del Sistema Qualità).

9. RESPONSABILITA' DEL PERSONALE

L'operatore ha ricevuto un'adeguata istruzione ed è responsabile per l'uso dello strumento, la manutenzione e la conduzione dei test. Il responsabile del sistema qualità (RSQ) è responsabile della corretta applicazione di questa procedura.

10. INDICE REVISIONI

Rev.0 Prima emissione

5.4 Sample pieces weighing less than 5 Kg. require appropriate support to carry out the test.

5.5 Components not compliant to requirements 5.2 and 5.3 shall not be tested since the obtained hardness would not be reliable.

6. TEST EXECUTION

As agreed with the costumer, the test execution method provides that, for each point, the average value of 5 tests must be recorded.

7. ACCEPTANCE CRITERIA

Unless otherwise agreed with the customer, values based on the control must comply with the relevant regulations of the ASME Sec. II according to the type of material.

8. DOCUMENTATION

If requested, the operator has to sign and date a report to identify each test. The values of hardness made will be recorded on a INDRA certificate or one proposed by the customer and approved by the QAM (Quality Assurance Management).

9. PERSONNEL RESPONSABILITY

The operators have to be suitably trained and are responsible for the instrument use and direction. Quality Assurance Manager (QAM) is responsible for the correct application of this procedure.

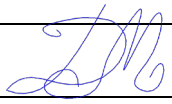
10. REVISIONS INDEX

Rev.0 First emission

Antistatic Test Procedure

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Revision: 0	Created	Checked
Date	15/11/2019	15/11/2019
Name	Merlo Damiano	Giunta Aurelio
Signature		

Purpose

The test shall confirm the electrical conductivity between the obturator and the valve body, according to standard BS EN 12266-2.

Test procedure

General

After carrying out the required pressure test and drying out the valve, the valve shall be operated at least five times and the electrical resistance of the obturator shall be determined for several intermediate positions in accordance to following point.

Test

The electrical resistance between the metal parts of the obturator and the valve body shall be measured using a power source not exceeding 12 V DC.

Acceptance criteria

All-metal construction

The electrical resistance shall not exceed 10 Ω

Composite construction (plastics/metal)

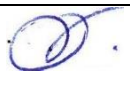
The electrical resistance shall not exceed 10^6 Ω

GENERAL PROCEDURE FOR LIQUID PENETRANT EXAMINATION BY COLOR CONTRAST WATER WASHABLE PENETRANT

PROCEDURA DI ESAME CON LIQUIDI PENETRANTI A CONTRASTO DI COLORE LAVABILI CON ACQUA

QUESTE ISTRUZIONI SONO DI PROPRIETA' DELLA INDRA S.R.L.
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Date	06/09/2024	06/09/2024	06/09/2024
Name	C. Poni	N. Sacchetti	L. Nosotti
Signature			

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1. SCOPE AND FIELD OF APPLICATION

This procedure describes the performance method and acceptance criteria of colour contrast dye penetrant examination of forgings, welding and overlay. If the performance is enforced by third party, the latter must issue their own procedure, according to the indications reported in this document, and submit it in advance for approval. This procedure has been issued in accordance with the minimum contents required by: ASME V table T 621.
In agreement with table T 621 there is a distinction between the essential variables and not essential variables. Any change of value or value range, requires a requalification of the written procedure. Any change of essential and not essential variables requires the revision of the written procedure.

1. SCOPO E CAMPO DI APPLICAZIONE

La presente procedura descrive le modalità di esecuzione e i criteri di accettabilità del controllo con liquidi penetranti a contrasto di colore di fucinati, saldature e riporti. Se l'esecuzione è effettuata da terzi, questi ultimi devono emettere la propria procedura, secondo i criteri indicati in questo document, e sottoporla preventivamente per approvazione.
Questa procedura è stata redatta secondo i contenuti minimi richiesti da: ASME V, tabella T 621. Secondo la tabella T 621, viene effettuata una distinzione tra le variabili essenziali e variabili non essenziali. Ogni cambiamento di valori o range di valori richiede la riqualificazione della procedura scritta.

2. REFERENCE DOCUMENTS

2. DOCUMENTI DI RIFERIMENTO

ASME V Div.6: 2021	Liquid Penetrant Examination
ASME VIII Div.1 App.8: 2021	Methods for Liquid Penetrant Examination
ASTM E1417: 2021	Standard Practice for Liquid Penetrant Testing
ASTM E165: 2018	Standard Practice for Liquid Penetrant Testing for General Industry
ASME B16.34: 2020	Standard for Valves Flanged, Threaded and Welding End
R.P. SNT-TC-1A: 2020	Personnel Qualification and Certification in Non-destructive Testing.

3. PERSONNEL

Personnel performing this examination shall be qualified minimum as Level II in this method according to SNT-TC 1A.

4. PENETRANT TESTING PRODUCT

Penetrant, Cleaner and Developers
For the control shall be used products qualified in accordance with ASM 2644-QPL (MIL-I-25135), ASTM E165, ASTM E1417. Unless otherwise specified, it shall be used water or solvent removable penetrant. All used products shall not contain contaminating elements more 1% in weight of the dry residual. Contaminants are: Chlorine, Fluorine, Sulphur.
For above elements, producer shall be required a certificate statingthe presence and quantity of contaminating elements in the products.
The certificate should be containing the name of the product, the producer's name, the number of job of production, the results gotten by chemical analisys, the year of manufacturing and the expiry date.

The products used listed in the following table, they belong to the groups indicated according to the, ASTM E165, ASTM E1417 and ASME V classification and are certified by the manufacturer as approved after many years of experience and the supplier qualification.
It is not possible to use, for the same test, products of different groups/suppliers.
Fluorescent penetrant examination shall not follow a color contrast examination.
The batch number, the year of production and expiry date are shown on the product certificate of conformity.
The product certificates are stored in paper and digital form.

3. PERSONALE

I controlli effettuati secondo questa procedura sono eseguiti da personale qualificato in accordo al Livello II SNT-TC 1A.

4. PRODOTTI PER I LIQUIDI PENETRANTI

Penetrante, Pulitori e Rivelatori
Per il controllo verranno usati prodotti qualificati in accordo alla ASM 2644-QPL (MIL-I-25135), ASTM E165, ASTM E1417. Se non diversamente specificato, dovranno essere utilizzati penetranti rimovibili con acqua o con solvente.
Tutti i prodotti utilizzati non devono contenere contaminanti più del 1% residuo secco. I contaminanti sono: Cloro, Fluoro, Zolfo.
Per quanto sopra citato, deve essere richiesto al produttore un certificato sulla presenza e la quantità di contaminanti nei prodotti.
Il certificato deve indicare il nome del prodotto, il nome del produttore, il lotto di produzione, i risultati ottenuti dall'analisi chimica, l'anno di produzione e la data di scadenza.

I prodotti utilizzati elencati in tabella, sono appartenenti ai gruppi indicati secondo la classificazione, ASTM E165, ASTM E1417 ed ASME V e sono certificati dal produttore come approvati a seguito di pluriennale esperienza e qualifica del fornitore.
Non è possibile utilizzare per lo stesso test, prodotti di gruppi differenti o di diversi fornitori.
L'esame con liquidi penetranti fluorescenti non deve seguire un esame con contrasto di colore.
Sul certificato di conformità del prodotto è riportato il numero di lotto, l'anno di produzione e la data di scadenza.
I certificati sono archiviati in formato cartaceo e digitale.

		ELITE
TIPO II *Type II*	PULITORE *Cleaner*	BC1
Metodo A(1) *Method A(1)*	PENETRANTE *Penetrant*	08.122 K71B2
Forma d, e, f ***Form d, e, f***	RIVELATORE *Developer*	D112A
Sensibilità: *Sensitivity:*	ASTM E1417	Level: 2
	QPL-AMS2644-4	Level: 2
	EN ISO 3452-2	Level: 2

NOTE: Tipo I = penetrante fluorescente
Note: Type I = fluorescent penetrant

Tipo II = a contrasto di colore
Type II = visible penetrants

Forma d = a base solvente per tipo I
Form d = solvent-based for type I

Forma e = a base solvente per tipo II
Form e = solvent-based for type II

Forma f = applicazione speciale
Form f = special application

Metodo A = lavabile ad acqua
Method A = water washable

Metodo C = lavabile con solvente
Method C = solvent removable

(1) Doppio uso A e C
(1) Double use A and C

5. EQUIPMENT

Lighting means
It is necessary to periodically calibrate all white light lamp as black light lamp (PDT-074), operators should ensure that the luminous intensity of the parts being examined is adequate.

Digital Luxmeter
Other
- Bristle brushes and in good condition, if the dye penetranti s not applied using aerosol or immersion tanks.
- Clean, dry, lint-free clothes or paper.
- Metal brush or lamellar disc grinding wheel if required for surface preparation.

6. ENVIRONMENTAL CONDITIONS

The ambient where the examination is performed should be well aerated, a safe position for the sample and adequate light intensity according to the requirements of the following paragraphs shall be granted.
Minimum light intensity requested on the examination surface is ≥ 1076 lux (in accordance with ASME V Art.6 or ASTM E165, ASTM E1417).

7. PREPARATION OF SURFACES

The entire surface of the piece to be examined shall be cleaned from dirt, oil, grease, flakes, oxides, humidity, welding slivers, or other elements that could mask defects and absorb or contaminate the penetrant.
Cleaning operations could be carried out using cloths or paper soaked in an appropriate solvent.
The drying of the pieces may be done per normal evaporation, or with hot/cold air. Generally, the surface can be as welded, forged, swaged or cast. Grinding, machining, and any other preparation shall be applied on surface that show irregular conditions which can disturb the examination.
The cleaning of the preparation after final mechanical processing, must be carried out at 100% of the zones accessible with the use of a dedicated solvent.

8. APPLICATION OF PENETRANT

It is particularly important to verify that the temperature of components, of the liquid penetrant, of the compressed air and of the environment are within the range 10°C / 50°C.
If this doesn't occur, the whole process needs to be qualified as special procedure.

8.1 Penetrant application
The penetrant liquid can be applied with a brush, sprayed or by immersion.
Penetration time varies according to the material under examination and to the type of penetrant used.

5. APPARECCHIATURA

Mezzi di illuminazione (lampade)
È richiesta una taratura periodica sia delle lampade a luce bianca che di quelle a luce nera (PDT-074), e l'operatore deve assicurarsi che sulle parti da esaminare l'intensità luminosa sia adeguata.

Luxmetro digitale
Altro
- *Pennelli in setola e in buono stato, qualora il liquido penetrante non sia applicato usando bombolette spray o per immersione.*
- *Panni o carta puliti, asciutti e senza sfilacciature.*
- *Spazzola metallica o mola a disco lamellare, se necessarie, per la preparazione superficiale.*

6. CONDIZIONI AMBIENTALI

La postazione di lavoro dove vengono effettuati i controlli, deve essere ben aerata, deve garantire un posizionamento sicuro del pezzo da controllare e deve garantire una luminosità adeguata sulla superficie controllata.
L'illuminamento richiesto sulla superficie da controllare è ≥ 1076 lux (in accordo ad ASME V Art.6 o ASTM E165, ASTM E1417).

7. PREPARAZIONE DELLE SUPERFICI

L'intera superficie del pezzo da esaminare deve essere ripulita da sporcizia, olio, grasso, ossido, scaglie, umidità, residui di saldatura e spruzzi o altri elementi che possano occludere i difetti, assorbire o contaminare il penetrante.
La pulizia può essere effettuata mediante stracci o carta imbevuti del solvente idoneo.
L'asciugatura del pezzo può essere effettuata tramite normale evaporazione o con aria forzata calda/fredda.
In generale, le superfici possono essere saldate, forgiate, stampate, fuse. La molatura, la lavorazione di macchina e qualsiasi altra preparazione, devono essere applicate su superfici che presentano condizioni irregolari che possono disturbare l'esame.
La pulizia di preparazione dopo lavorazione meccanica finale deve essere eseguita al 100% delle zone accessibili, con l'utilizzo di solvente dedicato.

8. APPLICAZIONE DEL PENETRANTE

È particolarmente importante verificare che la temperatura dei pezzi, dei liquidi penetranti, dell'aria compressa e dell'ambiente, siano comprese tra 10°C e 50°C.
In caso diverso, l'intero processo è da qualificare specificatamente.

8.1 Applicazione del penetrante
Il liquido penetrante può essere applicato a pennello, a spruzzo o per immersione del pezzo.
Il tempo di penetrazione è in funzione del materiale da controllare e del tipo di penetrante usato.

The minimum time is 10 minutes (5 minutes for casts, welds and non-metal materials) both for liquids that can be removed with water and for those removable with solvents.

For special cases and for information on maximum penetration time, refer to the quoted standard and to the instructions provided by the supplier of the liquid.
In any case, max penetration time is 60 minutes.
During penetration, the surface under examination should be maintained "wet" in order to prevent the penetrating liquid from drying inside the discontinuities.

Il tempo minimo di penetrazione è 10 minuti (5 minuti per fusioni, saldature e materiali non metallici) sia per i liquidi asportabili con acqua che per quelli asportabili con solvente.

Per casi particolari, così come per i tempi massimi di penetrazione, riferirsi alla norma citata ed alle istruzioni del fornitore dei liquidi.
In ogni caso, il tempo massimo di penetrazione è 60 minuti.
Durante il tempo di penetrazione, la superficie in esame dovrà essere mantenuta "bagnata" in modo da evitare che il liquido penetrante si asciughi dentro le eventuali discontinuità.

8.2 Excess penetrant removal

8.2.1 Water washable penetrants

a) after the expire of the penetrating time, the penetrating liquid in excess should be removed from the surfacebeing examined using one or more of the systems listed here below:
   - by immersing the component in current/circulating water
   - by spraying the component with water at a low pressure (p ≤ 200 kPa).
     The water jet is showered and the minimum distance of the nozzle from the surface of the component should not be below 30 cm.

     The temperature of water should be within the range 10°C ÷ 43°C
b) Washing should be continued only until all the penetrant is removed from the surface under examination to avoid removing also the liquid that has penetrated in discontinuous areas.

8.2 Asportazione dell'eccesso di penetrante

8.2.1 Liquidi penetranti lavabili con acqua

a) Trascorso il tempo di penetrazione, il liquido penetrante in eccesso viene asportato dalla superficie di esame usando uno o più dei sistemi elencati di seguito:
   - immersione del pezzo in acqua corrente/agitata
   - spruzzatura con acqua a bassa pressione (p ≤ 200 kPa).
   Il getto d'acqua viene spruzzato e la distanza minima dell'ugello, dalla superficie del componente, non deve essere inferiore a 30 cm.

   La temperatura dell'acqua deve essere compresa tra 10°C ÷ 43°C
b) Il lavaggio dura il tempo strettamente necessario ad asportare il penetrante dalla superficie in esame per evitare che possa venir asportato anche quello penetrato nelle eventuali discontinuità.

8.3 Drying

Before the application of the developer, the surface under examination should be perfectly dried with clean cloths and/or absorbent paper and/or air blown at a low pressure with temperature no higher than 50°C.

8.3 Asciugatura delle superfici

Prima dell'applicazione del rivelatore, la superficie in esame deve essere perfettamente asciugata con stracci puliti e/o carta assorbente e/o aria soffiata a bassa pressione con temperatura non maggiore di 50°C.

8.4 Wet developer application

The developer should be applied as soon as possible after the removal of the penetrant (10 minutes max).
The developer should be sprayed in several light layers and not with a single and heavy layer, at a distance from the surface of 20-30 cm, in order to create a thin and consistent film with a thickness suited to create a good contrast with the dye liquid penetrant.

8.4 Applicazione del rivelatore

Il rivelatore va applicato nel più breve tempo possibile, dopo l'asportazione del penetrante (10 minuti max).
Il rivelatore va applicato a spruzzo (prima dell'applicazione il contenitore va agitato in modo da disperdere adeguatamente le particelle in sospensione), in più passate leggere piuttosto che in un'unica passata abbondante, da una distanza dalla superficie del pezzo di 20-30 cm, fino a creare un velo sottile ed uniforme, ma di spessore sufficiente a creare un buon contrasto per i liquidi a contrasto di colore.

8.5 Interpretation/Evaluation

This phase starts as soon as the developer has dried.

8.5.1 Visible liquid penetrants

The surface should be carefully examined after the application of the developer.
The examination must be extended over the whole developing time.

8.5 Ispezione

Il tempo di sviluppo inizia non appena il rivelatore sia asciugato.

8.5.1 Liquidi penetranti a contrasto di colore

La superficie deve essere esaminata attentamente subito dopo l'applicazione del rivelatore.
L'esame verrà poi continuato durane tutto il tempo di sviluppo.

The evaluation of results should be carried out after a minimum of 10 minutes and a maximum of 30 minutes from the completed application of the developer.

a) The surface should be adequately lighted during all the examination.
The minimum lighting intensity should be 1076 lux
For this scope a periodical calibration of the white light lamps is performed in order to obtain the required light intensity.
The light intensity is also verified with a luxmeter positioned on the surface to be tested and reading the obtained value.

b) The indications will appear as dye spots on a white background. Their information should be carefully followed so that it is possible to determine their cause.
In doubtful cases, i twill be necessary to carry out further examinations with other techniques or locally grinding of specific areas (provided that there is sufficient removable thickness) followed by a new re-test.

9. CRITERIA FOR APPROVAL/REFUSAL OF RESULTS

During the development phase, using a color contrast technique, a background tending to pale pink color control indicates that the removal of penetrant has not been performed correctly, for which the repetition of the test is necessary.

If in doubt could be necessary to proceed to further analysis by other techniques or to a local grinding (where the allowance permits), and subsequent re-test.

10. ACCEPTANCE CRITERIA

The following indications are not acceptable (see definitions at para.4):

- Linear indications
- Non-linear indications with a diameter above 5 mm
- Four or more non-linear indications in a line at a distance below 1.5 mm between the edges.

Indications with dimensions below 1.5 mm are not taken into consideration.
The above-described acceptance criteria are in compliance with standard ASME VIII Div.1 App.8 and ASME B16.34.

For information, some criteria more detailed are attached and can be used with client agreement.

See Annex B

La valutazione delle indicazioni non dovrà essere eseguita prima che siano trascorsi 10 minuti e non deve essere protratta oltre 30 minuti dal termine dell'applicazione del rivelatore.

a) È necessario che la superficie sia adeguatamente illuminata durante l'esame.
L'intensità minima di illuminazione deve essere pari a 1076 lux
A tale scopo viene eseguita una taratura periodica delle lampade a luce bianca, al fine di ottenere l'intensità luminosa richiesta.
Le condizioni di illuminamento vengono inoltre verificate con luxmetro, appoggiandolo sulla superficie di prova e leggendo la misura rilevata.
b) Le indicazioni appariranno come macchie di colore sullo sfondo bianco e la loro formazione andrà attentamente seguita, per individuarne la causa.
In casi dubbi, sarà necessario effettuare ulteriori esami con altre tecniche o molare localmente aree specifiche (a condizione che ci sia sovrametallo sufficiente) seguito da un nuovo controllo.

9. CRITERI PER APPROVAZIONE/RIFIUTO DEI RISULTATI

Durante la fase di sviluppo, nel caso di un controllo a contrasto di colore, uno sfondo tendente al colore rosa più o meno pallido, indica che l'asportazione del penetrante non è stata eseguita correttamente, per cui è necessaria la ripetizione del controllo.

In caso di dubbi si dovrà procedere ad ulteriori esami con altre tecniche o alla molatura locale (ove il sovrametallo lo permetta) e successiva ripetizione del controllo.

10. CRITERI DI ACCETTABILITA'

Non sono accettabili difetti che danno le seguenti indicazioni (vedi definizioni al par.4):

- *Indicazioni lineari*
- *Indicazioni tondeggianti superiori a 5 mm di diametro*
- *Quattro o più indicazioni tondeggianti allineate, distanziate meno di 1.5 mm tra i bordi.*

Non vengono prese in considerazione indicazioni di dimensioni inferiori a 1.5 mm.
I criteri di accettabilità sopra indicati, sono conformi all'ASME VIII Div.1 App.8 e ASME B16.34.

A titolo informativo, vengono allegati alcuni criteri più dettagliati e possono essere utilizzati in accordo con il cliente.

Vedi Allegato B

11. REPAIRS

For not finished components in production, it is possible to grind unacceptable defects provided that there is sufficient removable thickness.
Unacceptable defects on laminates and on drawn profiles, can be removed by eliminating the sections of defective material.
Welded additions are not permitted on forged, laminated, hot-drawn and rolled materials or on bolts.
All repaired areas should be re-inspected by qualified personnel following the procedures described above.

12. FINAL CLEANING

Cleaning of the component after examination shall be carried out when the residuals of the developer could impair subsequent operations on the components, for example during painting.
Final cleaning is always necessary for aluminum alloys that could be corroded by the residuals of the developer.
Special instructions shall be indicated when necessary.

13. RECORDING RESULTS

The test report (TR) is prepared in accordance with the attached form.

14. HEALTH AND SAFETY

Dye penetrant solutions have a low flash point and must not be heated or put in contact with a flame or hot surface. Avoid contact between skin and penetrant or developer, because such liquids are irritant of the skin. Workers have to respect regulations for their safety and for the environment.
Residual liquids (including washing water) must be disposed according to environmental regulations in force.

15. ATTACHMENT

15.1 Acceptance criteria ASME VIII App.8

15.2 Test Report

11. RIPARAZIONI

Nei pezzi non finiti di lavorazione, è ammessa l'asportazione di mola dei difetti inaccettabili, compatibilmente con il sovrametallo disponibile.
Difetti inaccettabili su laminati e trafilati possono essere asportati eliminando le porzioni di materiale difettoso.
Su fucinati, laminati, trafilati, rullati e bulloneria, non sono ammesse riparazioni mediante riporti di saldatura.
In ogni caso le zone riparate vanno ricontrollate da personale qualificato con le medesime modalità.

12. PULIZIA FINALE

La pulizia dei componenti dopo l'esame deve essere eseguita quando i residui di rivelatore possono provocare inconvenienti nelle successive operazioni sui pezzi, ad esempio durante la verniciatura.
La pulizia finale è sempre necessaria per i materiali in lega di alluminio, per i quali sussiste il pericolo di corrosione da parte dei residui di rivelatore.
Istruzioni specifiche devono essere indicate quando necessario, per materiali e/o impieghi particolari.

13. REGISTRAZIONE DEI RISULTATI

La stesura del rapporto di prova è eseguita in accordo al formato allegato.

14. PRECAUZIONE DI SICUREZZA

Le soluzioni del penetrante hanno un basso punto di infiammabilità e non devono venire riscaldati o esposti a fiamme libere o a superfici calde. Si deve evitare di esporre la pelle ad un contatto prolungato con il penetrante o il rivelatore, in quanto tali liquidi sono irritanti della pelle.
L'operatore è responsabile per operare in piena conformità a quanto richiesto dalle disposizioni di legge vigenti.
I residui dei liquidi (incluse le acque di lavaggio) devono essere smaltiti secondo le vigenti norme ambientali.

15. ALLEGATI

15.1 Criteri di accettabilità ASME VIII App.8

15.2 Rapporto di Prova

ANNEX 15.1

Acceptance standards to ASME VIII Div.1 Appendix 8

Only indications with majors dimensions greater than 1/16 in (1.5 mm) shall be considered relevant.
All surfaces to be examined shall be free of:

a) Relevant linear indications
b) Relevant rounded indications greater than 3/16 in (5 mm)
c) Four or more relevant rounded indications in a line separated by 1/16 in (1.5 mm) or less (edge to edge).

Indications of any size are not permitted on seal contact surfaces.

Criteri di accettabilità secondo ASME VIII Div.1 Appendice 8

Solo le indicazioni con la dimensione maggiore, superiore a 1/16 in (1.5 mm) sono considerate rilevanti.
Tutte le superfici che devono essere esaminate devono essere esenti da:

a) Indicazioni lineari rilevanti
b) Indicazioni tondeggianti rilevanti più grandi di 3/16 in (5 mm)
c) Quattro o più indicazioni tondeggianti rilevanti allineate, separate da 1/16 in (1.5 mm) o meno.

Nessuna indicazione di nessuna dimensione è permessa o accettabile nelle zone di tenuta.

ANNEX 15.2

indra VALVES ITALY	**PENETRANT TEST REPORT (PT)**	**MD-02-29** rev.02 Date 28-11-2022

Customer:	Internal Indra Order No.:	Batch no.:
Customer Order No.:	Qty:	
Code:	Description:	
Acceptance Standards:	ASME V Art.6 / ASME VIII Div.1 App.8	
Procedure:	Indra Procedure PT-DP-01 Rev.03	
Equipment:		

Test Conditions:			
Test Surface:	EXTERNAL SIDE	INTERNAL SIDE	Surface Condition:
Penetrant Time: 20 min	Drying Time: 10 min	Development Time: 20 min	Cleaner:
Natural Light: > 1100 Lux			
Type of Penetrant			
Type of Developer			
Type of Removal			
Results:			
Note: The inspection was conducted 100% of the surface			

Operator: Nicholas Sacchetti (LEVEL 2 acc. EN 9712:2012)	Signature:	Approved: Lucia Nosotti (RSQ)	Signature:
INDRA Srl via Novara 10/B 20013 - Magenta (MI) ITALY iPhone: +39 97298663 www.indra.it	Approval of Customer:		Date:

TITOLO **Title**	**PROCEDURE OF POSITIVE MATERIAL IDENTIFICATION BY X-RAY FLUORESCENCE AND LIBS (OES)**
DISTRIBUITA A **Distributed to**	Carezzo R. Fagnani P. Giunta A. Petitti T. Rossini C.

REV. rev.	DATA date	NOME/FIRMA name/signature	NOME/FIRMA name/signature
14	20/09/2023	C. PONI	A. GIUNTA
REVISIONI revisions		PREPARATA DA prepared by	APPROVATA DA approved by

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REVISIONS INDEX		
Rev.	**Date**	**Description**
0	December '12	Emission
1	29 October '14	Tables of alloy element in cap.9.0
2	03 April 2015	Rev. tables of alloy element (cap. 9.0) Measurement tolerance (cap. 8.0)
3	04 June 2015	Rev. tables of alloy element (cap. 9.0)
4	02 May 2016	Acceptance criteria (cap. 9.0) Test report (cap. 10.0)
5	31 May 2016	Test report CVH
6	02 May 2019	General revision
7	23/04/2020	Add. SS304/L
8	24/05/2021	Updated material table
9	28/02/2022	Updated material table
10	19/09/2022	Rev. Test report (cap. 10.0)
11	30/11/2022	Rev. Table 1
12	18/05/2023	Rev. Table 1
13	15/09/2023	Rev. Table 1
14	20/09/2023	Rev. cap. 1.0, 3.0, 4.0, Table 1

0.0 SUMMARY

1.0 PURPOSE AND APPLICATION FIELD

2.0 REFERENCE DOCUMENTS

3.0 METHOD PRINCIPLE

4.0 EQUIPMENTS

5.0 PERSONNEL

6.0 SAMPLE SURFACE PREPARATION

7.0 TEST PROCEDURE

8.0 RESULT EXPRESSION

9.0 ACCEPTANCE CRITERIA

10.0 TEST REPORT

1.0 PURPOSE AND APPLICATION FIELD

This procedure describes the operation modalities for the "Non-Destructive Testing" of materials by the "on-site" Positive Material Identification using a portable X-Ray Fluorescence Instrument, and Laser Induced Breakdown Spectroscopy (LIBS), a type of atomic optical emission spectroscopy (OES).

With EDXRF analyzer is possible to verify a wide range of alloys since almost all element with an atomic number higher than 12 (Magnesium).

With LIBS analyzer is possible to verify carbon content too.

The analyzer automatically compensates for reducing many effects that would otherwise bias or distort sample analyses.

These effects include:

- Geometric effects caused by the sample's shape, surface texture, thickness and density.
- Spectroscopic interferences and other sample matrix effects.
- Critical absorption of the characteristic x-rays of one element by other elements in the sample, and secondary and tertiary x-ray excitation of one or more elements by other elements in the sample (only X-Ray instrument).

2.0 REFERENCE DOCUMENTS

- Equipment Operating Manual
- API 578 RP

3.0 METHOD PRINCIPLE

3.1 X-Ray Analyzer

Each of the atomic elements present in a sample produces a unique set of *characteristic x-rays* that is a fingerprint for that specific element. EDXRF analyzers determine the chemistry of a sample by measuring the spectrum of the characteristic x-rays emitted by the different elements in the sample when it is illuminated by high energy photons (x-rays).

Each element present in the sample emits its own unique fluorescent x-ray energy spectrum. By inducing and measuring a wide spectrum of the range of different characteristic fluorescent x-rays emitted by the different elements in the sample, XRF analyzers can determine the elements present in the sample and their relative concentrations, in other words, the elemental chemistry of the sample.

3.2 LIBS Analyzer

For LIBS analyzer, the wavelength (color) of specific lines reveals the elements present, and the intensity of the light at a given wavelength is related to the concentration of each element.

4.0 EQUIPMENT

4.1 X-Ray Analyzer

Main features of the portable X-Ray Fluorescence instrument (**NITON XL2 980 GOLDD**):

- Plays Non-destructive chemical analysis via simultaneous detection and quantification of fluorescent x-rays of multiple elements in test sample.
- X-ray fluorescence (XRF) is induced by miniaturized X-ray tube (35 kV 100 µA miniaturized low- power X-ray tube).
- The Instrument detector is a High-performance, thermo-electrically cooled, solid state detector system.
- Operating temperature range 20° to 122°F (-7° to 50°C).

3.2 LIBS Analyzer

Main features of the portable LIBS instrument (**SciAps HH-LIBS Z-902**):

- Plays Non-destructive chemical analysis with high energy pulsed laser.
- Operating laser temperature range 79° to 95°F (26° to 35°C).

5.0 PERSONNEL

The technicians that perform the analysis are trained and qualified according to the company quality system procedure. They also must observe the applicable safety standards.

6.0 SAMPLE SURFACE PREPARATION

The kind of preparation depends on the material to be examined, usually specific surface preparation could be omitted, even if it is advisable for improving analytical results.

In facts it is sufficient that the surface is free from grease, oil, paint, rust, dust and rough irregularities.

A portable smoothing machine could be used for sample surface preparation. The best paper granulometry should be about 60. The specimens also used for the calibration of the equipment are submitted to the above-mentioned surface preparation.

7.0 TEST PROCEDURE

The operations listed hereinafter are described in the Equipment Operating Manual.

The analysis starts with the "verification procedure" by using the instrument set up sample.

After this operation the equipment is ready for both identification analysis and anti-mixing control.

Calibration of PMI X-Ray Machine is done every 6 months using a verification block IARM 35KN certified 1.25Cr-0.5Mo.

LIBS instrument calibration certificate is Certificate Number: 230725-Z902-00943.

Calibration procedure used is: "Istruzione operativa: taratura pistola PMI Rev.2".

8.0 RESULTS EXPRESSION

On the display is visible the percentage results for each single element aside with direct alloy identification if the alloy is memorized in the instrument library.

PMI Machine limits of detection (only X-Ray) are listed below in ppm (mg/kg):

Time 60s per filter (A/S= Application specific) (N/A=Not Applicable)

Matrix	Al-based Alloys	Ti-based Alloys	Fe-based Alloys	Cu-based Alloys
Sb	30	100	150	175
Sn	30	60	90	120
Pd	20	25	30	35
Ru	20	50	70	100
Mo	N/A	A/S	A/S	A/S
Nb	N/A	200	240	320
Zr	N/A	50	70	100
Bi	20	35	50	65
Pb	20	20	75	50
Se	N/A	20	20	25
W	50	150	200	220
Zn	30	40	60	300
Cu	30	75	110	N/A
Ni	50	150	220	110
Co	50	120	750	50
Fe	75	300	N/A	75
Mn	100	250	220	75
Cr	200	500	110	100
V	500	1300	150	150
Ti	1000	N/A	250	275
S	N/A	N/A	100	N/A
P	N/A	N/A	200	200
Si	700	750	425	425
Al	N/A	4000	3000	3000
Mg	7500	N/A	N/A	N/A

The measurement tolerance is determined with the standard deviation, range $\mu \pm 2\sigma$ (confidence interval 95%).

The instrument errors should eventually be verified and corrected using a different Certified Reference Materials.

9.0 ACCEPTANCE CRITERIA

The acceptance criteria will be per the ASME Boiler & Pressure Vessel Code, Section II, unless otherwise specified by the customer.

10.0 TEST REPORT

All results are given in the follow company docs.:

- MD/PMI-VSF
- MD/PMI-VSP
- MD/PMI-CVH

It shall contain information about the: customer, job number and position, tested samples, place where the test is performed, test specifications.

Usually, in addition to a declaration of correspondence / non correspondence to the declared material, the found values are reported for information.

The test report also contains the percentage results for each single element, according to **Table 1**, and refer to the rules stated therein.

Attachment 2 provide sample PMI Test Report.

When components of a valve are PMI tested, Valve nameplate is marked with indication of executed PMI test through stamping the note “AV” (Alloy Verified).

Table 1

Material	304/ 304L	316/ 316L	321	XM-19	Duplex F51	Duplex F55	Duplex F53	F44 (6Mo)	Inconel 625	Hastelloy C276	Incoloy 825	Inconel 718 (API 6A)	Monel K500	Monel 400	Alumin. Bronze C95800	Titanium Gr.2	Stellite 6	Carbon steel A105	Carbon steel LF2	Carbon steel 4130	Carbon steel 4140
ASTM / AMS	A182	A182	A182	A182	A182	A182	A182	A182	B564	B619	N08825	N07718	B865	B564	B148	R50400	-	A105	A350	A29	A29
C %	0.03 max	0.03 max	0.08 max	0.06 max	0.03 max	0.03 max	0.03 max	0.02 max	0.1 max	0.01 max	0.05 max	0.08 max	0.25 max	0.3 max	-	0.08 max	3 - 4	0.35 max	0.3 max	0.28 – 0.33	0.38 - 0.43
Cr %	18 - 20	16 - 18	17 - 19	20.5 – 23.5	21 - 23	24 - 26	24 - 26	19.5 – 20.5	20 - 23	14.5 – 16.5	19.5 - 23.5	17 - 21	-	-	-	-	26 - 32	0.3 max	0.3 max	0.8 – 1.1	0.8 – 1.1
Ni %	8 - 13	10 - 15	9 - 12	11.5 - 13.5	4.5 - 6.5	6 - 8	6 - 8	17.5 - 18.5	58.0 min	(**)	38 - 46	50 - 55	60 min	63 min	4 - 6	-	3 max	0.4 max	0.4 max	-	-
Mo %	-	2 - 3	-	1.5 - 3.0	2.5 - 3.5	3 - 4	3 - 4	6 – 6.5	8 – 10	15 – 17	2.5 - 3.5	2.8 - 3.3	-	-	-	-	1 max	0.12 max	0.12 max	0.15 – 0.25	0.15 –0.25
Mn %	2.00 max	2.00 max	2.00 max	4 - 6	2.00 max	1.00 max	1.20 max	1.00 max	0.50 max	1.00 max	1.00 max	0.35 max	-	2.00 max	0.8 – 1.5	-	-	0.6 - 1.05	0.6 - 1.35	0.4 – 0.6	0.75 - 1
Al %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.5–10-5	-	-	-	-	-	-
W %	-	-	-	-	-	0.5 - 1	-	-	-	3.0 – 4.5	-	< 0.1	-	-	-	-	3 - 6	-	-	-	-
Nb %	-	-	-	-	-	-	-	-	3.15 – 4.15	-	-	-	-	-	-	-	-	-	0.02 max	-	-
Fe %	-	-	-	-	-	-	-	-	5.0 max	4.0 – 7.0	-	-	-	-	-	-	-	-	-	-	-
Ti %	-	-	(***)	-	-	-	-	-	0.4 max	-	0.6 - 1.2	0.8 - 1.15	-	-	-	(**)	-	-	-	-	-
Co %	-	-	-	-	-	-	-	-	-	2.5 max	-	< 1.0	< 2.0	<2.0	-	-	BAL	-	-	-	-
Cu %	-	-	-	-	-	0.5 - 1	0.5 max	0.5 - 1	-	-	1.5 - 3.0	< 0.23	(**)	(**)	(**)	< 0.1	-	0.4 max	0.4 max	-	-
Sn %	-	-	-	-	-	-	-	-	-	-	-	< 0.1	-	-	< 0.1	< 0.1	-	-	-	-	-
Ta %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

(**) The composition shall be determined arithmetically by difference with other detected elements

(***) Titanium content shall be not less than five times the carbon plus nitrogen detected content and not more than 0.70%

Attachment 2

indra VALVES ITALY	**RAPPORTO DI PROVA PMI** **PMI TEST DOCUMENT**	Cert. n° : Data/*Date* :	MD/PMI-VSF Rev.4-Dec/2022

CLIENTE *Customer*		COMMESSA INDRA Indra Job No.		NR. D'ORDINE CLIENTE Customer Order No.		DEL Dated		POSIZIONE D'ORDINE CLIENTE *Customer Item*		POSIZIONE D'ORDINE INDRA *Indra Item*	
Percentuale particolari da testare *Percentage of elements to be tested*		(da arrotondare all' unità superiore) *(to be rounded at higher unit)*		CODICE *Code*		DESCRIZIONE *Description*				Quantità da produrre (pz.) *No. of pieces to be produced*	

TAG TESTATO / *Tag tested* - VALVOLA NR. / *Valve no.* 72765

POS. / *Item*	CODICE DEL COMPONENTE / *Component code*	DESCRIZIONE / *Description*	Q.TA' DA TESTARE / Q.ty to be tested	LOTTO PRELEVATO / *Picking lot*	CERTIFICATO DEI MATERIALI/ *Certificate of material*	MATERIALE/ *Material*	VALORI DEL PMI TEST / *Values of PMI test (%)* Cr	Ni	Mo	W	Co	Ti	Cu	Sn	RISULTATO DEL PMI/ PMI result

NOTE / *Remarks* : PMI on body, wetted parts and plugs		
PMI Procedure:	Data prelievo componenti / *Date of components picking* :	Firma /Signature: ANDREA CHIODINI (ASSEMBLY OPERATOR)
Testing instrument: X-Ray analyzer NITON XL2 980 GOLDD	Data verifica componenti / *Date of components verification* :	Firma /Signature: THOMAS PETITTI (PMI OPERATOR)
Serial number: 85044 **Expiry calibration:** 13-Nov-2022	Data esecuzione PMI TEST / *Date of PMI TEST execution* :	Firma /Signature: (PMI INSPECTOR)