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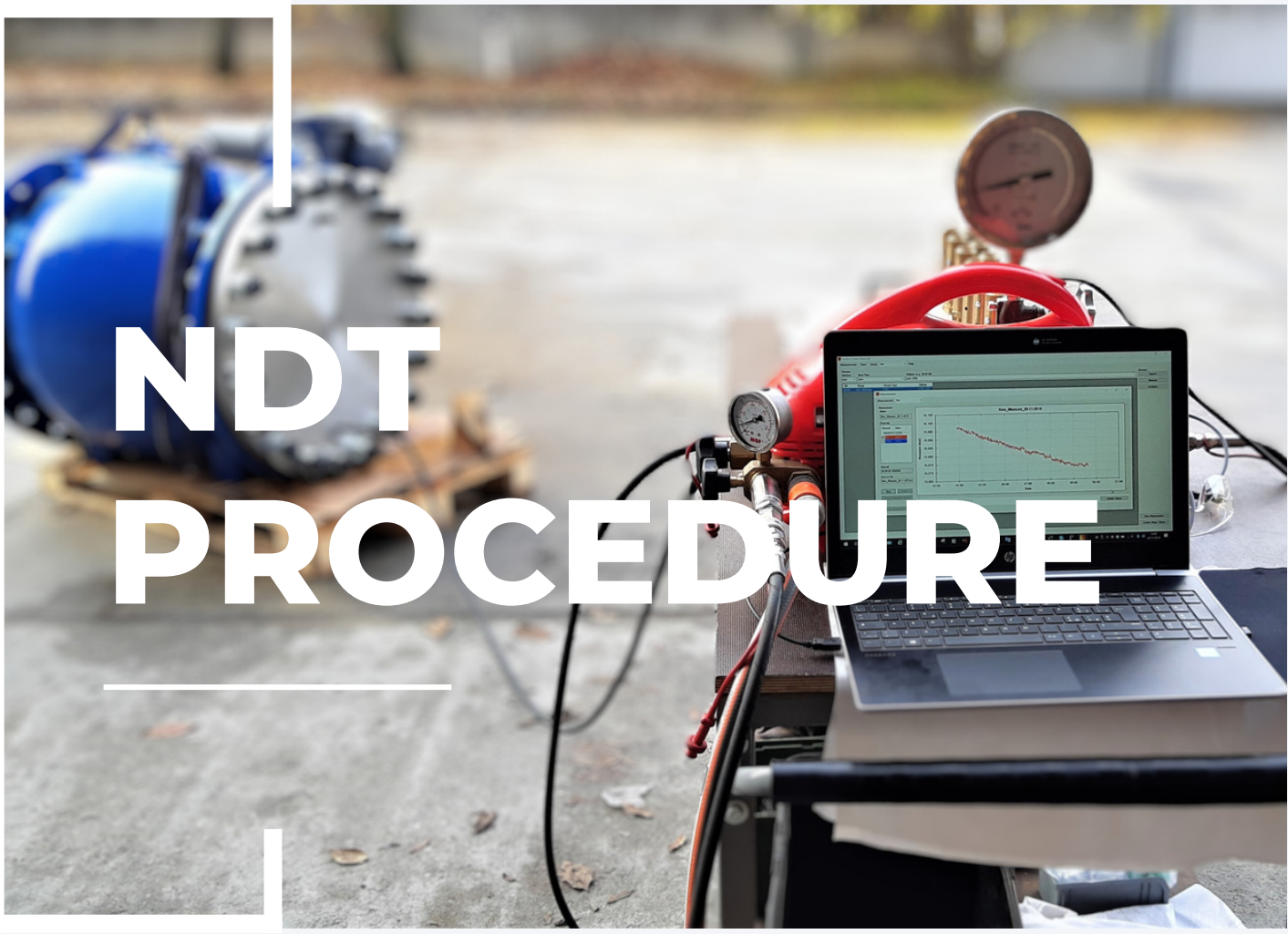

NDT PROCEDURE

PRO AT FLUID CONTROL

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1) ULTRASONIC TEST

- **Scope**

This procedure establishes the requirement for pulse echo ultrasonic examination to evaluate full penetration welds in valves. The general requirement will be conditional to examination of all welds whilst specific changes may be deemed necessary to suit particular dimension, geometry and material of specific welds. Amendments may be made to this general procedure to meet special requirements specifically.

- **Reference**

ASME Section V : 2004 Edition.
ASME B31.3: 2004 Edition , 2003 Addendum.
ASTM A 435: Lamination Check – 2002 Edition.

- **Equipment**

The examination shall be conducted with an ultrasonic pulse reflection system generating frequencies covering the nominal range of 1 MHz to 5 MHz with a rectified 'A' scan display. Frequency of straight beam probes shall be between 1 MHz to 5 MHz, with diameters 10mm to 25mm size.

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- **Examination Coverage**

The area to be tested shall be examined by moving the search unit over the examination surface so as to scan the entire examination volume. As a minimum, each pass of search unit shall overlapa minimum of 10% the transducer dimension perpendicular to the direction of the scan.

- **Rate of Search Unit Movement**

The rate of search unit movement shall not exceed6 in/sec (153mm/sec) unless calibration is verified at scanning speed.

- **Scanning Sensitivity Level**

Scanning shall be performed at a gain setting at least two times the reference level. During scanning, only the gain or attenuator controls will be adjusted.

- **Transducer Scanning Pattern**

The examination volume shall be scanned with angle beam probes directed both at right angles to the weld axis and along the weld axis. In order to detect all possible defects, the following scanning pattern shall be utilized as much as weld and test specimen configuration would permit.

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- **Transverse Motion**

This movement is necessary to examine the complete cross section of the weld and heat affected zone. The extent of such movement is normally equalto the skip distance.

- **Lateral Motion**

This movement should be made to scan the specified length of the welded joint. This is combined with the traversing motion so that each successive probe displacement has an overlap dimension not less than that stated above.

- **Swiveling Motion**

During the movement both towards and away from the welded joint the probe shall be done at an angle not exceeding 15 degrees from the weld axis from both directions and sides of the weld. obtained from the edge of the calibration block and from the edge of the component with similarthickness.

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- **Transverse Scanning**

On cases where transverse defects in the weld is to be detected, scanning shall be done at an angle not exceeding 15 degrees from the weld axis from both directions and sides of the weld.
Alternatively, the weld surface may be dressed flush with the parent metal and a transverse scan be performed overthe weld surfacealong the weld axis.

- **Transfer Correction**

In the event calibration is not performed on an off-cut of the component to be tested, it will be deemed necessary to determine the difference in gain setting necessary to compensate for transfer loss. This can be obtained from the amplitude difference between the signals obtained from the edge of the calibration block and from the edge of the component with similar thickness.

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Weld Examination

- **Surface Preparation**

The base metal on each side of the weld shall be free of weld spatter,surface irregularities or foreign matter that might interfere with the examination.

- **Straight Beam Scanning**

Straight beam scanning of the adjacent base metal shall be performed to detect reflectors that may lie in the horizontal plane parallel to the scanning surface. Locations and area of such reflectors shall be recorded and evaluated for acceptance and rejection accordingly.

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- **Angle Beam Scanning**

Angle beam scanning shall be directed at approximate right angles to the weld axis from two directions where possible. The search unit shall be manipulated so that the ultrasonic energy passes through the required volumes of weld and adjacent base metal.
Scanning shall be performed at a gain setting at least two times the primary reference level. Evaluation shall be performed with respect to the primary reference level. Transducers angle include 45, 60, 70 degrees. A minimum of three angle probes are to be used for each examination in addition to the zero degree probe on parent metal. (where specimen thickness allows).

- **Butt Welds**

Scanning of butt welds should be done within half skip and full distance. In the case of curve surfaces, the effect of curvature should be taken into consideration in locating echo origin.

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- **Nozzle Welds (Full Penetration)**

Nozzle orientation and weld configuration should be studied to understand the shift in echoes due to change on geometry . Test should be performed from more than one scanning face if possible. In the case of large diameter nozzles, scan should be performed also from the nozzle internal.

- **Evaluation**

Any imperfection which causes an indication in excess of 20% DAC shall be investigated to the extent that it can be evaluated in terms of the acceptance rejection standard of the relevant code section.

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Defect Sizing (Length)

All reflections from weld defects will be maximized from all angles to find the best angle which is compatible to the defect orientation. The defect echo will be adjusted to the screen's graticule. The defect echo will be adjusted to the screen's graticule height and sized in the following manner:

- **Compressional Wave**

The 6 Db drop method shall be used for sizing large defects. Small defects shall be expressed as a percentage amplitude of the back wall echo.

- **Shear wave**

The 6 Db drop method shall be used for sizing large defects lengths whilst the 20 Db drop method may be used for sizing small defects. For sizing defect height, the 20 Db drop method or the maximum amplitude technique may be used.

Acceptance Criteria

The acceptance / rejection criteria shall be as per Appendix 9 of ASME VIII Div. 1 / ASME B31.3 for Piping,2004 Edition, ASTMA 435 for Lamination Check- 2002 Edition.

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2) RADIOGRAPHIC TEST

- **Scope**

This procedure establishes the requirement, techniques and processes for quality radiographic examination on welds of plates, beams, turbulars and pipes. It is applicable to radiographic examination using Ir-192 Isotope on various gradesof steel, cooperand nickel alloy'spiping.
Amendments may be made to this general procedure to meet special requirements specifically.

- **Reference**

ASME Section V : 2004 EditionASME / ANSI 31.3: 2004 Edition

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- **Equipment**

Iridium 192 Gamma isotope will be used. Container for the isotope shall be Tech-Ops 660 or equivalent model with remote control winder. Curie strength of isotope shall normally not exceed 50 curies.
Radiographs shall be made using Type 1 or 2 films or equivalent.
Radiographic film for Duplex Stainless Steel shall be as per ASTM E94, Type I.
All films shall be stored in a cool clean storage area where they will not be exposed to heat, light or radiation. Lead intensifying screens of 0.125mm thickness shall be placed on the front and back of the films in close contact. Screens shall be free of dents, scratches, dirt and other foreign materials.
Standard penetrameter or DIN wire type penetrameter shall be used. The IQI material shall either be the similar material to the component to be radiographer or belonging to a similarmaterial group or belonging to a similarmaterial grouping.

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Radiographic Technique

- **Single Wall Single Image (SWSI)**

This is the preferred method whenever possible. However,it requires that both side of the weld or component be accessible, with the source placed on one side and the film in close contact on the other side. In the case when the inside of a valve is accessible, with the source placed on one side and the film in close contact on the other side.

- **Single Wall Single Image (SWSI)**

This technique is limited to valve weld up to 3" O.D. or less in nominal diameter. The radiation beam will offset from plane or weld in order to separate the images of welds. At least two films must be taken, at 90° to the other, for each joint. Superimpose technique shall be applied if unable to perform elliptical shots.

- **Double Wall single Image (DWSI)**

This method is recommended for valve welds greater than 3" nominal diameter.The radiation passes through two walls but only the image of the wall close to the film is projected. Sufficient number of exposures will be taken to cover the entire weld or component.

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Acceptance Criteria

Accept / Reject Criteria shall be in accordance to Chapter VI, Section 344.5 of ASME / ANSI B31.3, 2004, Table 341.3.2Severe cyclic condition.

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Acceptance Criteria

Accept / Reject Criteria shall be in accordance to Chapter VI, Section 344.5 of ASME / ANSI B31.3, 2004, Table 341.3.2Severe cyclic condition.

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3) MAGNETIC PARTICLE INSPECTION TEST

- **Scope**

This procedure establishes the method and process for magnetic particle inspection using a magnetic yoke for the defection of discontinuities on or near surface of ferromagnetic material.

- **Reference**

ASME Section V (2004) ASME / ANSI 31.3 (2004)

- **Equipment**

An AC Yoke or permanent Magnetic Yoke unit shall be used to produce a magnetic field strength sufficient to reveal all objectionable defects. The AC Yoke shall have a lifting power of not less than 10 lbs (4.5 kg) for a maximum pole spacing of 6.5 ins. (165 mm) or less. The Permanent Yoke shall have a lifting power of not less than 40lbs (18 kg) for a maximum pole spacing of 8 ins (200 mm) or less.
Premix Black Magnetic Ink having a concentration of not less than 0.8% and not more than 3.2% by volume shall beused. The particles shallnot be toxic and shallbe free from substances like rust, greaseand dirt. The wet powder method shall be applicable up to a maximum temperature of 135°F. Dry incon powdermay be used where temperature of parts to be tested is higher than 130°F but lower than 600°F.

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Test Technique

The use of the magnetic Yoke favours the detection of flaws where the major axis lies transverse to the line joining the pole pieces of the Yoke. As such, two magnetizing application, each beingat right angleto the other, should be applied over the same area. When an indication is found, a third application should be made at an axis where maximum indication is obtained.

- **Wet Method**

Apply thin coat of white contrast paint on area of test. Allow the paint to dry.
Place yoke on the area of test in a direction where a second application at 90° to this first axis is possible. Ensure good contact of yoke to the test piece. Switch on current flow. Apply magnetic ink either through aerosol (wet method) onto area where magnetic field has been induced, with the current still on. Observe for indications formed by the iron powder. Cut off current flow before removing the yoke. Repeat the above mentioned steps at an axis perpendicular to first test.
When an indication is found, perform again the above mentioned steps at an axis perpendicular to the axis of the indication in order to obtain maximum sensitivity.
Repeat the procedure over the entire area of the test. Maintain an overlap of approximately 50mm to ensure 100% coverage of area of test. Remove remaining solvent after test. Record flaw indications, found with respect to their location,size and type.

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- **Dry Method**

Place Yoke on the area of test in a direction where a second application at 90° to this first axis is possible. Ensure good contact of Yoke to the test place. Switch on current flow.
Apply fine magnetic powder onto area where magnetic field has been induced, with the current still on. Observe for indications formed by the iron powder. Mark Off defect location with the magnetic field still induced. Cut off current flow before removing the Yoke. Repeat the above mentioned steps at an axis perpendicular to first test.

Acceptance Criteria

Accept / Reject Criteria shall be in accordance to Appendix 6, ASME VIII Div.1 2001, 2004 Addendum/ ASME B31.3 2004 for Piping.

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4) LIQUID PENETRANT TEST

- **Scope**

This procedure establishes the requirements for liquid penetrant examination of weldment on valves of ferrous and non-ferrous materials using solvent removal dye.

- **Reference**

ASME Section. V (2004) ASME/ ANSI 31.3 (2004)

Test Technique

- **Surface Preparation**

Ensure that surface of interest to be tested is free of paint, grease, oil, dust, lint, scalesa nd spatters. Grinding and machining may be applied only when surface irregularities might mask indication of unacceptable discontinuities.

- **Testing Media**

Solvent removable system consisting of the following shall be used (aerosol spray type)

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- **Penetrant Application**

Apply the penetrant to the entire surface to be inspected. Allow a minimum dwelling time of 5 minutes and to a maximum of 20 minutes.

- **Solvent Application**

Clean lint-free material wets with solvent shall be used to remove the penetrant. Care should be taken not to apply solvent too extensively. Direct spraying of solvent to remove penetrant is not to be practised.

- **Developer Application**

Allow solvent to dry before applying developer. Direct the developer at approximately 12 inches away from the surface to be inspected and apply only a thin and even film. Mark all defect indication.

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- **Inspection**

Inspection shall be done while applying the developer. Final interpretation shall be made after allowing the penetrant to bleed out for 7 minutes to 30 minutes. Longer periods acceptable if the surface to be examined is not altered by the bleed out. If the surface to be examined is so large as to preclude complete examination within the prescribed time, then only portions of the surface shall be examined at any one time.

- **Interpretation**

Interpretation shall be made at intervals during the 'bleed out' process so that the large indication may be viewed before excessive diffusion occurs. Localized surface irregularities such as machining marks or other surface irregularities may also produce indication. Such indications shall not be treated as non-relevant until and unless proven to be one.
Relevant indications are those, which result from mechanical discontinuities. Linear indication is those indications in which the length is more than three timest he width. Only indications with major dimensions greater
Rounded indications or indications, which are circular or elliptical with the length less than three times the width. Any questionable or doubtful indications shall be retested to verify whether or not actual defects are present. Localised surface imperfection, such as may occur from machining marks. Surface conditions, or an incomplete bond between base metal and cladding, may produce similar indications which are nor relevant to the detection of unacceptable discontinuities.

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Acceptance Criteria

The Acceptance / Rejection Criteria shall be in accordance with Appendix 8, ASME VIII Div.1 ASME B31.3 (2004) for Piping.