



ASPC Project



END CUSTOMER	: Arya Sasol Polymer Company
CONTRACTOR	: DYPNF Co., Ltd.
VENDOR NAME	: Airpack Netherlands BV
EQUIPMENT DESCRIPTION	: Screw Compressor & Roots Blower : Package
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MAGNETIC TESTING PROCEDURE

Client : Airpack Nederland B.V.

Purpose of the examination : Magnetic particle inspection of welds.

Method : According to AWS D1.1 / D1.1M: 2015 (ASTM E709)

Issued by : Applus RTD BUA NL

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1 Scope

This procedure describes the method and acceptance criteria to be used for magnetic testing on structural steel skids with AC yoke magnetisation. To be performed in conformity with the requirements of;

- AWS D1.1/D1.1M:2015 (ASTM E709)

2 Referenced documents

2.1 *Applus+ RTD documents*

NL-10	Written practice for the Training, Qualification, Certification and Authorization of NDT Personnel
CP 31201	Verification procedure for electric magnetic yokes
CP 31203	Verification procedure for magnetic particle suspensions
CP 31210	Verification procedure of light intensity meters

2.2 *Codes and standards*

ISO 9712	Qualification and certification of NDT personnel
SNT TC 1A: 2016	Personnel qualification and certification in NDT
AWS D1.1/D1.1M:2015 (ASTM E709)	Magnetic particle Examination
AWS D1.1/D1.1M:2015	Acceptance standard for magnetic particle examination

2.3 *Abbreviations*

AC	Alternating Current
HSE	Health Safety and Environment
kg	kilogram
MT	Magnetic Testing
NDE	Non Destructive Examination
CJP	Complete Joint Penetration
°C	Temperature in degree Celsius
mm	Millimetre
<	Less than
≥	Greater than or equal to
CJP	Complete joint penetration
NA	Not applicable

3 General requirements

3.1 Personnel qualifications

NDE - personnel shall be qualified and certified in accordance with the valid version of Applus+ RTD written practice, which is in conformity with the recommended practice SNT-TC-1A and ISO 9712, level MT 2 as minimum.

Shall have passed an eyesight examination within the past 12 months, according the ISO 9712 section 7.4 or equivalent.

3.2 Safety precautions

All applicable HSE laws and regulations and the HSE rules of our customers shall be observed at all times. Furthermore Applus+ RTD develops its own HSE rules.

In case of conflict between rules and regulations, the strictest will prevail.
Special consideration shall be given to:

- inflammable and/or volatile materials;
- contrast paint and aerosols as used in magnetic testing;
- Extra attention at magnetic testing on hot objects > 50°C.

Use of safety gloves and eye protection is recommended.

Note:

The vapors from the consumables may be hazardous. Proper ventilation shall be provided in the case of testing being performed in a confined space. At no time during examination, shall there be exposure to any naked flames or sparks due to the flammable nature of the materials.

The use of aerosol containers and dry powders in confined spaces is dangerous and therefore it is only permitted in accordance with the Applus+ RTD safety pocketbook "working in confined spaces".

3.3 Surface preparation

Prior to the magnetic examination the surface or weld surface plus at least 25 mm on both sides of the weld, shall be dry and free of dirt, grease, coating, preserving, scale, welding flux, weld spatter, oil and other matter, that could obscure surface openings or otherwise interfere with the examination.

Typical cleaning agents which may be used are detergents, organic solvents, de-scaling solutions, and paint removers. Degreasing and ultrasonic cleaning methods may also be used.

Surface preparation by grinding or machining may be necessary where surface irregularities could mask indications or produce false indications.

3.4 Surface temperature

The surface temperature of the part to be examined (only for the "wet method") shall be within the temperature range limitations set by the manufacturer of the particles.

3.4.1 High temperature

If the (surface) temperature is > 50°C suitable consumables shall be used.

3.5 Identification and datum position

The welds shall be identified in accordance with the client's requirements.

The marking of flaw indications on the tested component shall be considered necessary as the resultant indications found at the time of inspection cannot be considered permanent. The position of flaws shall be marked on the tested component by a method that will not affect the use of the component or prejudice any subsequent testing.

3.6 Viewing conditions

At all times during the examination with the non-fluorescent method, the light intensity at the surface to be examined shall be 1000 lux. as a minimum.

4 Equipment and consumables

4.1 Yokes

An AC magnet Yoke shall be used.

The lifting power shall be checked prior to examination, and shall be 4.5 kg as minimum at the maximum pole spacing that will be used.

The verification of the yoke shall be done once a year or whenever the yoke has been damaged or repaired, in accordance with procedure Applus+ RTD CP 31201.

A field indicator (e.g. Berthold field indicator) may be used, if necessary, to determine the field direction.

4.2 Light meters

Light meters shall be calibrated at least once a year (12 month period +/- 2 weeks) or whenever the meter has been repaired. If meters have not been in use for one year or more, calibration shall be done before being used.

The light meters have to be verified, according to Applus+ RTD verification procedure CP 31210.

4.3 Examination consumables

The examination consumables to be used must provide sufficient contrast with the surface to be examined. The examination medium shall be supplied by Applus+ RTD.

The preferred examination consumables are given on page 6; other products may be used after approval by Applus+ RTD level 3 specialist.

4.3.1 Black particles (wet method)

The magnetic particles, black and fluorescent, to be used in the examination shall meet the following requirements:

- Are oil or water suspended;
- The colour of the particles shall be such as to provide an adequate contrast with the surface being examined;
- The examination consumables shall be agitated (shaken) properly, as per manufacturers' recommendation, to ensure that the dispersion of particles is equal throughout the entire use of the containers contents.
- The test medium shall be applied by either flowing or spraying over the surface. The force of the application shall be such that weakly formed indications are not disturbed or removed.

Wet particles: MR Chemie:

<u>Type</u>	<u>Product</u>	<u>Temp. range</u>	<u>Suspension</u>
• MR 76 SAS	Magnetic testink (black)	+5° to +50°C	Oil based
• MR 221 GF	Magnetic testink (black)	+5° to +50°C	Water based

These wet particles have been tested by the manufacturer for conformity. Where necessary the examination medium will be tested in accordance with verification procedure Applus+ RTD CP 31203.

4.3.2 Contrast paint

If the contrast between the surface and the examination medium is too low, a very thin contrast paint layer shall be applied to the surface.

The preferred contrast paint is given below; other contrast paint may be used after approval by Applus+ RTD level 3 specialist.

<u>Type</u>	<u>Product</u>	<u>Temp. range</u>	<u>Suspension</u>
• MR 72	White contrast paint	+5° to +50°C	
• MR 721	White contrast paint	+5° to +50°C	Water based

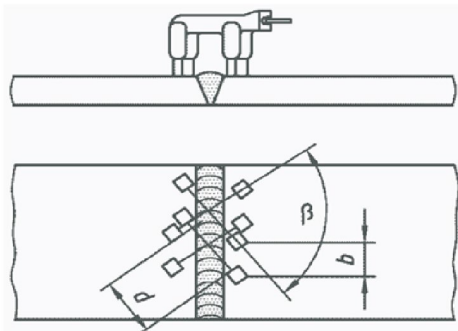
5 Examination

5.1 Examination method

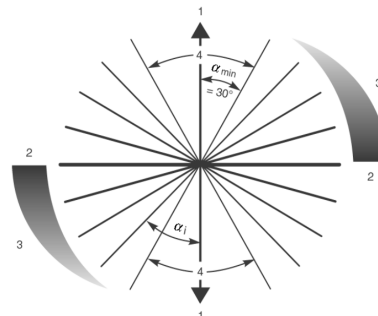
The magnetic particles used in an examination (wet or dry) shall be applied by the continuous method: The magnetizing current shall remain on while the examination medium is being applied and while excess of the examination medium will flow away, or the dry powder will be softly blown away. Following this, time shall be allowed for indications to form before removal of the magnetic field.

5.2 Direction of magnetization

To ensure detection of imperfections in all orientations, the area shall be magnetized in two directions approximately perpendicular to each other.



$$d \geq 75, b \leq 2d \text{ and } \beta = 90^\circ$$



α = is the angle between the magnetic field and the direction of the imperfection
 α_{min} = is the minimum angle for imperfection detection.
 α_i = is an example of imperfection orientation.

1 = magnetic field direction, 2 = optimum sensitivity,
3 = reducing sensitivity and 4 = insufficient sensitivity

5.3 Extent of examination

The examination has to be executed in such a manner that there is sufficient overlap to ensure that 100% examination has been executed.

5.4 Demagnetization

The examined areas shall not be demagnetized after examination.

After testing with AC current, residual magnetization will normally be low and generally there is no need for demagnetization of the tested object.

5.5 Post examination cleaning

The examined areas shall not be cleaned after examination.

6 Evaluation of indications

The evaluation of indications shall be done during the magnetization.

An indication of an imperfection may be larger than the real imperfection. However the size of the indication will be the basis for the evaluation.

A linear indication is an indication (piping porosity), of which the length is larger than 3 times the width.

A rounded (non-linear) indication (porosity) is an indication of circular- and/or elliptical shape with a length equal to or less than 3 times its width.

Note:

Not all of the indications are relevant, because excessive surface roughness, etc. may cause similar indications. Any questionable indications shall be re-examined, possibly after surface improvement, to determine whether or not it is relevant.

7 Acceptance standard

7.1 Choice of acceptance criteria

The client shall provide the load condition and load direction before examination.

Required info:

Statically loaded or cyclically loaded.

Tensile stress during any load condition: Yes or No.

When the load condition is unknown the used acceptance shall be cyclically loaded with tensile stress.

7.2 Acceptance criteria

Acceptance according AWS D1.1: 2015 Claus 6. Table 6.1 and Clause 9, Table 9.6.

Discontinuity Category and Inspection Criteria	Table 6.1		Table 9.6
	Statically Loaded Nontubular Connections	Cyclically Loaded Nontubular Connections	Tubular Connections (All Loads)
1) Crack Prohibition <i>Any crack shall be unacceptable, regardless of size or location.</i>	x	x	x
(2) Weld/Base Metal Fusion <i>Complete fusion shall exist between adjacent layers of weld metal and between weld metal and base metal.</i>	x	x	x
(7) Undercut <i>A) For material less than 1 in [25 mm] thick, undercut shall not exceed 1/32 in [1 mm], with the following exception: undercut shall not exceed 1/16 in [2 mm] for any accumulated length up to 2 in [50 mm] in any 12 in [300 mm]. For material equal to or greater than 1 in [25 mm] thick, undercut shall not exceed 1/16 in [2 mm] for any length of weld.</i>	x	NA	NA
<i>(B) In primary members, undercut shall be no more than 0.01 in [0.25 mm] deep when the weld is transverse to tensile stress under any design loading condition. Undercut shall be no more than 1/32 in [1 mm] deep for all other cases.</i>	NA	x	x
(8) Porosity <i>(A) CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no visible piping porosity. For all other groove welds and for fillet welds, the sum of the visible piping porosity 1/32 in [1 mm] or greater in diameter shall not exceed 3/8 in [10 mm] in any linear inch of weld and shall not exceed 3/4 in [20 mm] in any 12 in [300 mm] length of weld.</i>	x	NA	NA
<i>(B) The frequency of piping porosity in fillet welds shall not exceed one in each 4 in [100 mm] of weld length and the maximum diameter shall not exceed 3/32 in [2.5 mm]. Exception: for fillet welds connecting stiffeners to web, the sum of the diameters of piping porosity shall not exceed 3/8 in [10 mm] in any linear inch of weld and shall not exceed 3/4 in [20 mm] in any 12 in [300 mm] length of weld.</i>	NA	x	x
<i>(C) CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the frequency of piping porosity shall not exceed one in 4 in [100 mm] of length and the maximum diameter shall not exceed 3/32 in [2.5 mm].</i>	NA	x	x

Discontinuities 3, 4, 5 and 6 shall only be subject to visual inspection.

Discontinuities 2, 7 and 8 shall only be evaluated on length in case of an MPI indication and shall not be evaluated on other dimensions.

X shall be evaluated

NA shall not be evaluated

8 Report

For each magnetic examination carried out a report shall be written. Each report shall contain the following information as minimum:

- Procedure number and revision;
- Examination standard, acceptance standard;
- Client;
- Date of examination;
- Equipment used and type of current;
- Magnetic particles used incl. batch numbers (wet or dry);
- Object data and examined parts;
 - base material;
 - extent of examination
 - in case of welds type of weld, welding process and filler material;
 - heat treatment (if applicable);
 - thickness;
 - temperature of the object;
- Viewing conditions(light intensity);
- Drawing or record of all indications exceeding the acceptance standard;
 - All relevant indications shall be reported with as minimum the type, location and extent (length, diameter or aligned);
- Name operator(s) qualification and signature operator(s) who performed examination.