COMPARATIVE STUDY ON NON-DESTRUCTIVE TESTING OF VENTURIMETER

Atul Mishra*1, Piyush Acharya*2, Rupesh Kumar*3

*1,2 M.TECH Student, Department of Mechanical Engineering, Faridabad College Of Engineering & Management, Faridabad Haryana India.

*3 Asst. Professor, Department of Mechanical Engineering, Faridabad College Of Engineering & Management, Faridabad Haryana India.

Corresponding author:- atulmishra1424@gmail.com

ABSTRACT

Non-destructive testing methods and techniques are used to identify the defects and discontinuities in materials. NDT is the process of inspecting, checking of materials, components as well as assemblies for interruption or difference in characteristics without damaging the serviceability of the component or system. In other words, while the inspection or test is performed, the part can still be used. Non-destructive testing may also be conducted to measure other test objects characteristics, such as size, dimensions, configuration, or structure, including alloy content, hardness, grain size etc.

In this Research Paper, the objective of the present study is to get the inspection performed before during commissioning of the system to collect data on initial conditions, and it also provides the vital inputs for assessment of the integrity of components.

Inspection is done by using LPT, UT & R.T. methods all results have come according to ASME standards earlier visual inspection was done, so the performance was not much good failure chances were more but due to this new technology all inspection is done appropriately and practical inspection done before they are put into service.

Keywords: Venturimeter, Non-Destructive Testing.

I. INTRODUCTION

A standard definition of Non-destructive Testing (NDT) is an examination, test, or evaluation performed on any type of test object without changing or altering that object in any way, to determine the absence or presence of conditions or discontinuities that may affect the usefulness or serviceability of that object.

Non-destructive tests may additionally be carried out to measure other test object characteristics, such as size, dimension, configuration, or structure, including alloy content, hardness, grain size etc. The simplest of all definitions is an examination that is performed on an object of any type of size, shape or material to determine the presence or absence of discontinuities, or to evaluate other materials characteristics.
II. WHY WE CHOOSE THIS RESEARCH TOPIC

The part tested using destructive testing methods no longer maintains its integrity, original shape or surface texture. Thus, the mechanical testing methods like a tensile test, hardness, bending, compression etc. are all destructive, in that specimen has to be removed from the part to test it. Hardness test that leaves significant impressions (such as Brinell) also regarded as destructive testing.

These destructive tests are usually used to determine the physical properties of materials like impact resistance, flexibility, yield and ultimate tensile strength, fracture toughness and fatigue strength, but discontinuities and variations in material characteristics are more effectively found by NDT. Today modern non-destructive tests are applied in manufacturing, fabrication and in-service inspections to ensure product integrity and reliability, to control manufacturing processes, weaker production costs and maintain a uniform quality level.

III. LITERATURE REVIEW

During the time after World War II, the emerging modern industry required more and more testing equipment for the generation of flawless components. Therefore, instruments for NDT were developed, assembled in quantities and continuously improved. Most of those persons working in this new industrial field not only in Germany but also in other parts of the world.

The first NDT-method coming into industrial employment was the X-Ray Technique.

X-Ray Technique

Already 1895 Wilhelm Conrad Röntgen found "An Unknown Kind of Radiation" which were named in all German-speaking countries after him. In his first publication, he explained all effects, including potential flaw detection. At that point, the industry did not yet need this invention, but the medicine did. So medical equipment was developed, managed and produced in quantities. The only outcome Röntgen could not foresee was that X-rays harm human health. Before radiation protection was originated, many people lost their life. Early technical X-ray uses in Germany were realized by Richard Seifert around 1930. He improved medical equipment.
Magnetic particle crack detection

Magnetic particle crack detection was done even earlier than X-ray testing. The Englishman S.M. Saxby had already in 1868, and the American William Hoke in 1917 attempted to find cracks in gun barrels by magnetic indications.

**Penetrant Testing** also started in the second half of the 19th century. The first people who used the "Oil and Whiting"-process for crack detection to railway-components are unknown. The upcoming MP-technique replaced the method.

**Ultrasonic Testing**

Came latest into industrial use. The techniques of exciting ultrasound were discovered already in 1847 by James Prescott Joule and in 1880 by Pierre Curie and Paul Jacques. Not before 1912, a first application was submitted after the "Titanic" had sunk. The Englishman Richardson declared the identification of icebergs by ultrasound in his patent employment.

**IV. METHODOLOGY**

All data and information's has been collected from different sources and research papers and thesis how I will do all that work different from work which has been already done for proper inspection I have choose this NDT method to do work because as now days quality of inspection improves productivity. More time is available to produce defect free output because products do not have to be reworked and extra time to replace scrap do not have to be produced.

An improvement in quality can lead to increased market shares, improved competitive positions and increased probability. Contact to the Company who help me for the completion of my thesis practice because I need some equipment to do that practice work so I have decided to do work on this project then I have taken some major helps from code and standards.

**Codes**

Codes are generally the top-tier documents, giving a set of rules that specify the minimum admissible level of safety for fabricated, manufactured, or constructed objects. Examples of some usually used Codes are the AWS D1.1 Structural Welding Code – Steel, ASME Boiler and Pressure Vessel Code (B&PVC). The B&PVC carpets pressure-related equipment from refineries and unfired pressure vessels to nuclear power formation, and the AWS D1.1 Code includes welded structures of all kinds.

**Standards**

Standards are documents that set engineering or technical requirements for stocks, practices, methods or operations. Of particular interest to NDT personnel are the standards that provide personnel certification requirements and those that give requirements for performing NDT tasks. Instances of certification standards are the ANSI/ASNT CP-189, ASNT Standard for

**Specifications**

Specifications give specific requirements for materials, components or services and are often made by private companies to address additional requirements relevant to a specific product or application. Specifications are at times listed in procurement agreements or contract documents as additional requirements above and beyond code or standard requirements.

**V. PROCEDURE TO TEST VENTURI METER WELD JOINTS BY NDT METHODS**

After assembly of venturimeter all welding process has been done then now we had take test of that welding that the material having any defect or not by three processes firstly we had gone through Liquid penetrant test ultrasonic testing then we had gone through radiographic testing.
LIQUID PENETRANT TESTING:
1. Precleaning
2. Penetrant Application
3. Penetrant Dwell Time - 12 Minutes
4. Excess Penetrant Removal
5. Developer Application
6. Development Time
7. Interpretation And Evaluation

Figure-2: Liquid Penetrant Testing On Venturimeter

Figure-3: LPT Test On Welding Joint

ULTRASONIC TESTING OF WELD JOINTS
Welds that are being examined by ultrasound shall be prepared to provide a sufficiently smooth and regular area for scanning. The area shall extend at least the full skip distance needed, and shall be free of any irregularities like spatter, chipping marks scale, grinding etc., which may hinder the scanning pattern or create confusion in the interpretation of the resultant display, i.e. excessive surface noise.
Figure-4: UT Testing Of Venturimeter

Figure-5: Flaw Detector

RADIOGRAPHIC TESTING OF WELD JOINTS

Single wall technique Radiography shall be performed using this technique in which radiation passes through only one wall.

Double-wall technique This technique in which the radiation penetrates through both walls and both the walls are seen for acceptance on the same film.
VI. RESULT

I. LIQUID DYE PENETRANT TEST REPORT

Report No.1

Product Name - Venturimeter

Test Standard / Procedure - Asme Sec.V Article -6 Latest Edition

Acceptance Level - Asme B31.3

Test Method - Solvent Removable Method

Liquid Penetrant Type - Visible

Type Of Each Penetrant, Cleaner, Developer Batch No. & Mfg. Date:-

<table>
<thead>
<tr>
<th>PENETRANT (MAGNAFLUX)</th>
<th>CLEANER (MAGNAFLUX)</th>
<th>DEVELOPER (MAGNAFLUX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 D16</td>
<td>19K02</td>
<td>20B09</td>
</tr>
<tr>
<td>APR.19</td>
<td>OCT.19</td>
<td>FEB.20</td>
</tr>
</tbody>
</table>

Dwell Time For Penetrant - 12 Minutes

Dwell Time For Developer - 12 Minutes

Area Covered - All Weld Joints

Test Results - No Relevant Indication Observed Found Satisfactory

Light Intensity - Day Light And 1100 Lux

Remarks - Acceptable
II. ULTRASONIC TESTING REPORT

Report No. 2

Material: Venturimeter
Calibration Block: liw-V1& V2
Weld Thickness: 30 Mm
Reference Block: Set Bw At 80% Height Of Fsh
Procedure No.: Asme V /Ut/Rev-02
Calibration Range: Normal 0-100
Angle 0-100
Surface Condition: Clean And Smooth

<table>
<thead>
<tr>
<th>SEARCH UNIT</th>
<th>NORMAL</th>
<th>ANGLE 70°</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE</td>
<td>10 DIA</td>
<td>8X9 MM</td>
</tr>
<tr>
<td>FREQUENCY</td>
<td>2 MHZ</td>
<td>2 MHZ</td>
</tr>
</tbody>
</table>
SEARCH UNIT CABLE TYPE & LENGTH: Coaxial & 1500mm
COUPLANT: SAE Gr.30 OIL
GAIN NORMAL:

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>SCANNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>52 &amp; 54 DB</td>
<td>+ 6 DB</td>
</tr>
</tbody>
</table>

GAIN ANGLE:

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>SCANNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>48 &amp; 52 DB</td>
<td>+ 6 DB</td>
</tr>
</tbody>
</table>

Type Of Indication: No Recordable Indication Observed
Results: Acceptable

III. RADIOGRAPHIC TESTING REPORT

Report No. 3
Product Name: Venturimeter
Weld Thickness: 30 Mm
Weld Process: Gtaw & Smaw
Standard: Asme - B 31.3
Iqi: Astm 1b
Film Type: Astm Cl ii
Viewing Technology: Single Image
System Of Marking: Lead Letter Film Side
Iqi Placement: Film Side
Lead Screen: Front 0.10 Mm, Back 0.15 Mm
Exposure Time: As Required
Sfd/Ofd: 375mm/ 24mm
Isotope Type: Ir 192
Sensitivity: Wire No. 8
Procedure No: Asme Nde-Rt-01
Source Size: 2.7 Mm

<table>
<thead>
<tr>
<th>SEGMENT</th>
<th>FILM SIZE</th>
<th>TYPE OF DISCONTINUITY</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>12”X4”</td>
<td>NSD</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>BC</td>
<td>12”X4”</td>
<td>NSD</td>
<td>ACCEPTABLE</td>
</tr>
</tbody>
</table>

As Procedure discussed earlier in method logy section here are the results and reports of all project which we have done all inspection report step by step then after we have proceed to the interpretation that whether our result is appropriate or not with the help of Industry MICRO PRECESION PRODUCT PVT. LTD. I am very thankful to them for support of making this result acceptable according to the ASME standards. As per ASTM E
VII. CONCLUSION

Venturimeter assembly has done after welding of three sub-parts convergent cone, throat, divergent cone then after welding inspection has done in all three joints by different methods to get the proper desired value according to the AMERICAN STANDARDS OF MECHANICAL ENGINEERING (ASME)

By using Dye-Penetrant test very high sensitivity for surface defects can detect defects up to 0.01 inch. Penetrant testing is a planer testing method, unlike R.T., UT that are volumetric. All weld joints are covered by this method parts with complex geometries are routinely inspected. Solvent Removal Method is used for inspection of Venturimeter No relevant indication observed found satisfactory lighting intensity - daylight 1100 lux

In Ultrasonic testing in which High-frequency sound waves are introduced into a material, and they are reflected from surfaces or flaws. The distance the sound travelled can be displayed on the flaw detector. Angle beam probe 70°and Normal beam probe are used Internal steel forgings up to 2m (6ft) in diameter.

In digital radiographic testing uses are useable Imaging plates made up of a thin transparent coated with a fine layer of phosphorous on one or both sides of the plastic—the distance of the source from the plate and thickness of the part being inspected. If either of those parameters is not met, another exposure must be made for that area of the part.

Earlier it can only measure defect or weld thickness of manufacturing part up to 20mm, but by increasing exposure time and intensity, we had a measure up to 30 mm.

So conclusion conventional methods are less repeatable, less recordable and have a low probability of detection. But advance technologies such as computer radiography testing Image acquisition is faster than film, Increasing production time, More consistent image quality, Defects measurements can be saved on the image for customer review. High spatial and density resolution

VIII. REFERENCES