UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A Study on Welding Defects of Pressure Vessel

This report submitted in accordance with requirements of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management) with Honours.

By

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2009

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PSM

JUDUL: **A STUDY ON WELDING DEFECTS OF PRESSURE VESSEL**

SESI PENGAJIAN: **2008/2009**

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I hereby, declare this thesis entitled "A Study on Welding Defects of Pressure Vessel." is the result of my own research except as cited in references.

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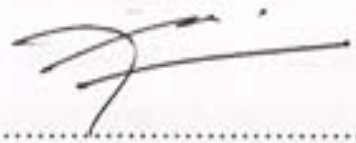
Author's Name : Mohd Shah Fahmi Bin Zainuddin

Date : 21/5/2009

APPROVAL

This Bachelor's report submitted to the senate of UTeM and has been accepted as fulfillment of the requirement for the Degree of Bachelor of Manufacturing Engineering major in Manufacturing Management with honors. The member of the supervisory committee is as follow:



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Mr. Nik Mohd Farid Bin Che Zainal Abidin

Project Supervisor

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ABSTRACT

A pressure vessel is a closed container designed to hold gases or liquids at a pressure different from the ambient pressure. During the fabrication of pressure vessels, it has been discovered that a common problem that always occurs is at the welding joint. This problem occurs because the correct welding process is not used, and this then leads to welding defects. This project was carried out at UMW Advantech Sdn. Bhd as they are the fabricators of pressure vessels. It aims to identify the types of welding defects that occur during the welding process, to determine the type of welding inspection that should be conducted with regards to the fabrication of pressure vessels, and finally, to suggest counter measures and improvements to solve the welding defects of pressure vessels. The types of welding defects will be determined by conducting a welding inspection which consists of non destructive tests such as using a dye penetrant, magnetic particle inspection, ultrasonic testing, and radiographic testing.

ABSTRAK

Tangki tekanan adalah sebuah kontena yang tertutup direka untuk menampung gas atau cecair di satu tekanan berbeza daripada tekanan persekitaran. Semasa proses pembuatan tangki tekanan, ia telah meneemui beberapa masalah biasa yang sering berlaku adalah pada sendi kimpalan. Masalah ini berlaku kerana proses kimpalan yang digunakan adalah tidak betul dan tidak sesuai. Ini menyebabkan membawa kepada kecacatan pada bahagian kimpalan. Projek ini telah dijalankan di UMW Advantech Sdn Bhd dimana mereka sebagai pembuat tangki tekanan. Ia bertujuan untuk mengkaji jenis-jenis kecacatan kimpalan yang berlaku semasa proses kimpalan diajalankan, untuk menentukan jenis pemeriksaan keatas kecacatan kimpalan, dan akhir sekali mencari jalan penyelesaian kepada masalah kecacatan kimpalan pada tangki tekanan. Setiap jenis kecacatan kimpalan akan dikaji mengunakan ujian tanpa musnah iaitu seperti penyembur penetrant, ujian zarah magnetik, ujian ultrasonik, dan ujian radiografik.

DEDICATION

For my beloved parents:

Mr. Hj. Zainuddin Bin Mohd Arshad

Mrs Hjh. Fuziah Bte Hj. Tahir

For my cherished sibling

Mohd Shukran Bin Hj. Zainuddin

And my treasured friends

UTeM's students

ACKNOWLEDGEMENT

All Praise to Allah, the Lord of the Worlds, and prayers and peace be upon Muhammad Rasulullah S.A.W, His servant and Messenger. Alhamdulillah, with Allah blessings and guidance, I have completed this project successfully even though along the way, there are many hardship and obstacles.

First of all, I would like to thank to our Faculty of Manufacturing Engineering Dean, Dr. Mohd Rizal Bin Salleh. I am grateful to my punctilious and highly devoted supervisor Mr Nik Mohd Farid Bin Che Zainal Abidin for excellent supervision and for providing for vision, knowledge and guidance throughout this work. Secondly, not to forget both my parents who always pray for my success all the time particularly during difficult times while carrying out this project.

Finally, I would like to thank all individuals who had given me both technical and spiritual support to make this project a success. May all our good deeds and tranquil be worth for our self development, society and the country.

Mohd Shah Fahmi Bin Zainuddin

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LIST OF ABBREVIATIONS

A	-	Ampere
AC	-	Alternating Current
API	-	American Petroleum Institute
ASME	-	American Society of Mechanical Engineers
CW	-	Cold Welding
DC	-	Directing Current
DT	-	Destructive Test
FCAW	-	Fluxed-Core Arc-Welding
FW	-	Flash Welding
GMAW	-	Gas Metal-Arc Welding
GTAW	-	Gas Tungsten-Arc Welding
JIS	-	Japanese Industrial Standard
kPa	-	Kilo Pascal
MMA	-	Manual Metal Arc Welding
MPa	-	Mega Pascal
MT	-	Magnetic Particle Test
NDT	-	Non Destructive Test
PED	-	Pressure Equipment Directive
Psig	-	Pounds per square inch gage
PT	-	Liquid Penetrant
PW	-	Pressure Welding
RT	-	Radiography Test
RW	-	Resistance Welding
SAW	-	Submerged Arc Welding
SMAW	-	Shielded-Metal Arc Welding
TIG	-	Tungsten Inert Gas
UT	-	Ultrasonic Test
V	-	Volt

CHAPTER 1
INTRODUCTION

This project aims to provide some improvements and suggestions on how to solve problems related to pressure vessel fabrication. This chapter defines the pressure vessel specifications and tests followed by the objectives and scope of study of the thesis. Furthermore, the methodology used will also be explained.

1.1 Pressure Vessel Background

A pressure vessel is a closed container designed to hold gases or liquids at a pressure different from the ambient pressure. This vessel is categorized as Unfired Pressure Vessel. The end caps fitted to the cylindrical body are called heads. In addition to industrial compressed air receivers and domestic hot water storage tanks, other examples of pressure vessels are diving cylinders, distillation towers, other vessels in mining or oil refineries and petrochemical plants, nuclear reactor vessels, pneumatic reservoirs, hydraulic reservoirs under pressure, storage vessels for liquefied gases such as ammonia, chlorine, propane, butane and LPG

In the industrial sector, pressure vessels are designed to operate safely at a specific pressure and temperature technically referred to as the 'Design Pressure' and 'Design Temperature'. A vessel that is inadequately designed to handle high pressures constitutes a very significant safety hazard. Because of that, the design and certification of pressure vessels is governed by design codes such as the ASME Boiler and Pressure Vessel Code in North America, the Pressure Equipment Directive of the EU (PED), and the Japanese Industrial Standard (JIS). From here, we can make comparisons between pressure vessel, boiler and tank. A boiler is a

closed vessel in which water or other fluids are heated. The heated or vaporised fluid exits the boiler for use in various processes or heating applications. This vessel is categorised as Fired Pressure Vessel. A boiler has:

1. Safety valve: used to relieve pressure and prevent possible explosion of a boiler.
2. Water level indicators: a water gauge or water column to show the operator the level of fluid in the boiler.
3. Bottom blow down valves.
4. Surface blow down line.
5. Feed water check valve or clack valve: a non-return stop valve in the feed water line.

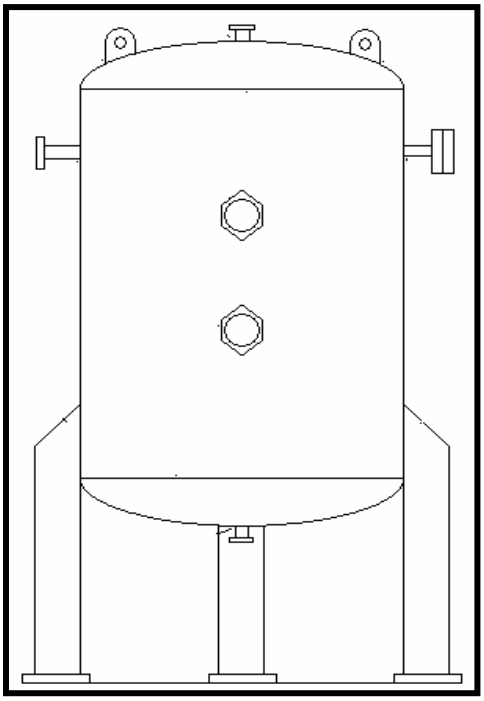

Figure 1.1: Shows a schematic diagram of a pressure vessel

1.2 Company background

The case study was conducted at UMW Advantech Sdn Bhd. It was incorporated in 1917 by Chia Yee Soh who is the founder of UMW Group. UMW Group's main business activity ranges from automotive, heavy and industrial equipment,

manufacturing and engineering, automotive parts, and oil & gas. UMW Advantech Sdn Bhd is a wholly owned subsidiary of UMW Holdings Berhad. The company has two divisions, Auto Component and Specialty Equipment. Equipped with talents, state of the art design and comprehensive facilities and system, they provide innovative engineering solutions for Automotive, Oil & Gas, Petrochemical, Oleochemical, Environment Control and Transportation.

UMW Advantech Sdn Bhd was formerly known as UMW Engineering Sdn Bhd. The company has been ISO 9001:2000 certified since 2002. The company is also a registered member of ASME, U2 and R, for which R stands for the approval to repair welding works. The main customers of the company are Titan Petchem (M) Sdn Bhd and Calidad Sdn Bhd. The main product that UMW Advantech Sdn Bhd produces for the customer is the pressure vessel.

1.3 Problem statement

Nowadays, a pressure vessel is a closed container designed to hold gases or liquids at a different pressure from the surrounding pressure. Besides that, a pressure vessel is to operate safely at a specific pressure and temperature technically referred to as the 'Design Pressure' and 'Design Temperature'. The problem that always occurs during the fabrication in the welding process for pressure vessel is the occurrence of welding defects at the pressure vessel welding joint. This welding defect occurs after the welding processes have been done at the welding joint of the pressure vessel. This welding defect can be determined using Non Destructive Test (NDT). These NDTs consist of die penetrate inspection, magnetic particles inspection, ultrasonic inspection, and radiography inspection. Welding inspection has been designed to provide a general description of welding specifications for new pressure vessels.

Basically, this project will focus more on determining the welding defects at the pressure vessel after the welding process. This is because; at the UMW Advantech Sdn. Bhd. they never revise, the causes on the welding defects that always occur after the welding inspection has been done of pressure pessel. UMW Advantech Sdn Bhd has been selected as the pressure vessel fabricator in order to reduce the welding

defects of the pressure vessel. Currently, the company faces a problem in preventing the welding defects that always occur after the welding process. Therefore, this project aims to find the best solution to improve the welding process to prevent welding defects by focusing on the factors that cause the welding defects.

1.4 Objective

The objectives of this project are as follows:

a) To identify the welding defects encounter during the welding process using the Non Destructive Test.
b) To suggest counter measures and improvements to solve the welding defects of pressure vessels.

1.5 Scope

This project was conducted at UMW Advantech Sdn Bhd who is a fabricator of the pressure vessel. The scope for the project is to mainly focus on:

1. The defects of welding on the pressure vessel joints.
2. The types of welding inspection and the factors that cause the welding defects.
3. The improvements that could made to avoid welding defects.

1.6 Outline of Report

This report outline illustrates the process flow of completion for this project. This project is divided into four (4) chapters. The chapters are as follows

Chapter 1: Introduction

The first chapter of the report describes the introduction of the project, background, objective and scope. In this chapter, the focus of the study is classified.

Chapter 2: Literature Review

The second chapter is the literature review of the pressure vessel. In this chapter, aspects of the pressure vessel and the various welding processes are discussed. The specifications of the pressure vessel in the ASME code are also discussed. The chapter then goes on to describe the types of welding inspection that are used to detect welding defects.

Chapter 3: Methodology

The third chapter discusses the methodology of the project. It consists of the information from the primary and secondary data sources for analysing the welding defects of pressure vessel. The chapter starts by identifying the company used as the case study. This is followed by understanding the nature of the process, identifying the type and function of pressure vessels and welding process, and studying the fabrication of pressure vessels. Then, it goes on to discuss the welding inspections used to detect the welding defects. This chapter also includes details on the project planning, flowcharts and Gantt charts. Data collection in this project utilises the Non Destructive Test (NDT) method.

Chapter 4: Fabrication of pressure vessel at UMW Advantech Sdn Bhd

This chapter discusses the pressure vessels fabricated by UMW Advantech Sdn Bhd. This includes the welding process and the welding inspection that have been used to detect the welding defects utilised by UMW Advantech Sdn Bhd.

Chapter 5: Result and Analysis

This chapter discusses the result and analysis based from the experiments that have been done. This includes the type welding defects that occur on pressure vessel.

Chapter 6: Discussion

This chapter is about the discussion of the project. It will discuss the advantage and disadvantage of the Non Destructive Test (NDT) in term to identify the welding defect. It also will discuss about the welding ability.

Chapter 7: Recommendation and Improvement

This chapter discusses the recommendation and improvement for the welding defects. It also includes the method to prevent the welding defects.

Chapter 8: Conclusion

This chapter discusses the conclusion overall of the project that a study of welding defects on pressure vessel.