

**VISOKA ŠOLA ZA PROIZVODNO INŽENIRSTVO**

## **DIPLOMSKO DELO**

**ANALIZA ROČNEGA IN ROBOTSKEGA MAG-VARJENJA  
ZALOGOVNIKA TOPLE SANITARNE VODE**

**ANALYSIS OF APPLIED MANUAL AND ROBOTIC MAG-  
WELDING SANITARY HOT WATER STORAGE TANK**

**Študent: DRAGO KEŠE**

**Mentor: pred. Matej Veber, univ. dipl. inž.**

**Somentor: pred. mag. Andro Glamnik, univ. dipl. inž.**

**Študijski program: Sodobno proizvodno inženirstvo**

**CELJE, 2014**

# **ANALIZA ROČNEGA IN ROBOTSKEGA MAG-VARJENJA ZALOGOVNIKA TOPLE SANITARNE VODE**

## **POVZETEK**

V diplomskem delu je predstavljeno ročno in robotsko varjenje v zaščitnem plinu po MAG-postopku. Predmet obravnave diplomskega dela je zalogovnik tople sanitarne vode ZSV-20. Diplomsko delo je razdeljeno na dva dela. V prvem delu so na podlagi kompilacije predstavljena teoretična izhodišča za analiziranje tipičnih zvarov zalogovnika. Podrobno smo predstavili robotsko varilno celico, ki sestoji iz varilnega aparata FroniusTransPulsSynergic 4000, robota KUKA KR 5-2 ARC HW in dvoosne varilne mize KUKA DKP-400, na kateri na Šolskem centru Celje izvajamo izobraževanje dijakov in študentov. Drugi, praktični del diplomskega dela, je usmerjen v izdelavo varilnih vzorcev oziroma tipičnih zvarov zalogovnika, pa tudi zalogovnika samega, v robotskem načinu in ročno po MAG-postopku. Diplomsko delo temelji na praktični metodi izdelave vzorcev in zalogovnika in njeni analizi. Na podlagi varilnih vzorcev smo iskali odgovore na raziskovalna vprašanja, ki so osnova diplomskega dela in temeljijo na analizi kakovosti, produktivnosti, ponovljivosti, in optimizaciji varilnega procesa ter s tem prispevajo k znatnemu izboljšanju kakovosti zvarov z uporabo dvoosne vrtljive mize ter k ekonomičnosti, kar smo dokazali z matematično metodo.

**Ključne besede:** varjenje, zaščitni plin, varilna robotska celica, preiskave zvarov

# **ANALYSIS OF APPLIED MANUAL AND ROBOTIC MAG-WELDING SANITARY HOT WATER STORAGE TANK**

## **SUMMARY**

This thesis presents manual and robotic welding with protective gas in the MAG-process. The subject of the thesis is a buffer tank for hot sanitary water ZSV-20. The thesis is divided into two parts. The first part is based on the compilation of the theoretical basis for analyzing typical welds of the buffer tank and the buffer tank itself. We made a detailed presentation of the robotic welding cell, which consists of a welding machine, FroniusTransPulsSynergic 4000, a robot KUKA KR 5-2 ARC HW and the biaxial welding table KUKA DKP-400 in the premises of School Centre Celje. The second practical part of the thesis is focused on the manufacture of welding samples and typical welds of the buffer tank as well as the buffer tank itself, both in Robotic mode and manually by MAG process. The thesis is therefore based on a practical method of modeling and water tank analysis. On the basis of the welding samples we were looking for answers to research questions that are the basis of this thesis and are based on the analysis of quality, productivity, repeatability, optimization of the welding process. Consequentially, significant improvement of the quality of the welds using a biaxial rotary table which is economical what has been proved by mathematical methods.

**Keywords:** welding, protective gas , welding robot cell, examination of welds