

# Improvement to Welding Seam Breakage Rate at TCM of CSC

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The welding machine of CSC TCM was upgraded to a laser beam welder (LBW) in 2018, consequently the welding seam breakage rate at the mill increased to 0.63% during commissioning.

Keywords: laser beam welder, solid state laser, welding seam breakage rate

## 1. INTRODUCTION

The previous welding machine (flash butt welder) had been in use for more than 20 years, and the weld seam failure rate had started to increase especially for grades of silicon and high carbon steels.

The welder was upgraded to a solid state laser welding machine in 2018, and according to the specification, a filler wire is 100% used for the entire welding process.

The reasons for welding seam breakage were as follows:

1. The filler wire problems, 2. Laser path correction was difficult, 3. The welding seam judgement system was inadequate.

## 2. EXPERIMENTAL METHOD

### 2.1 The filler wire problems

(1) The filler wire was not straight enough, and parts of the welding seam were under filled. This problem arose from the lock screw (fig.1.) of the filler wire unit being worn, and after changing it, the filler wire was more stable.



Fig.1. The lock screw of the filler wire unit.

(2) It was difficult to correctly adjust the filler wire intermesh unit after changing the filler wire. After the addition of a scale (fig.2.) on the adjusting screw of the intermesh unit, the operator can now adjust and recover the intermesh quickly and accurately.

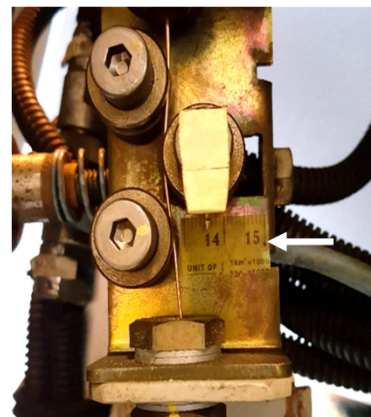


Fig.2. The scale on the intermesh unit.

(3) The filler wire speed was not suitable for each thickness and steel grade. The parameter table (fig.3.) of the wire speed was modified based on the experience of practical operation in CSC.

FILLER WIRE UNIT HEIGHT	2.30 mm	0.00 mm
FILLER WIRE	NO USE	USE
FILLER WIRE SPEED	4.2 m/min	10 %
FILLER WIRE SPEED CONTROL	NO USE	USE
FILLER WIRE SPEED CONTROL START POSITION	500 mm	
FILLER WIRE SPEED CONTROL CONTROL FACTOR	10 %/sec	
FILLER WIRE SPEED CONTROL UPPER LIMIT	6.0 m/min	
FILLER WIRE SPEED CONTROL LOWER LIMIT	-0.04 mm	

Fig.3. The setting value of filler wire speed on the HMI

- (4) The wire position was unstable due to the filler wire nozzle (fig.4.) being worn, and it was improved by changing this nozzle according to the welding times.

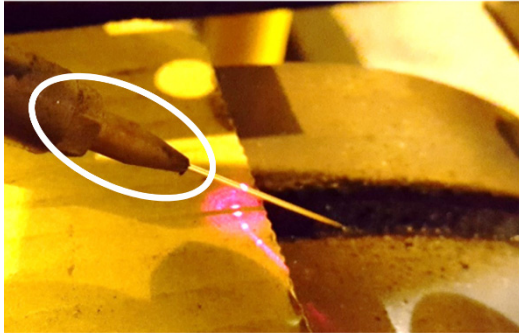


Fig.4. filler wire nozzle

- (5) The product mix of common quality (CQ) is about 33% , and based on the 80/20 rule (Pareto Principle) , it was a good countermeasure to cancel the filler wire used for CQ products. After modification of the welding parameters, it was considered successful for welding a material thickness under 2.6mm without using filler wire. We applied a patent for this Know-How: “the welding parameter without filler wire of solid state laser welding machine”.

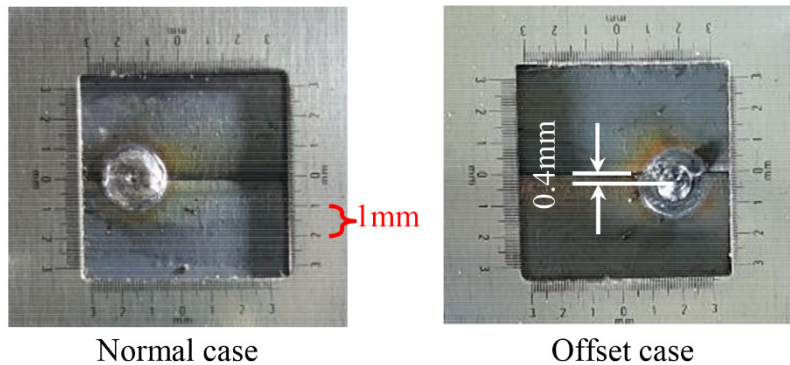


Fig.5. Magnifying glass with 0.1mm scale



Fig.6. The curve is very close the upper limit (dark line) , but this welding seam quality was judged “okay” by the judgement system.

### 2.2 Laser path correction is difficult

The offset of laser spark in the “Laser path correction process” is about 0.1~0.3mm , so it is very difficult for the operator to check visually. A magnifying glass with a 0.1mm scale (fig.5.) is used , so the laser path correction process will be faster and more accurate.

### 2.3 The welding seam judgement system was inadequate

According to some serious welding seam breakages, the curve of the welding seam judgement system was close to its limit, although still within the limits, this system can’t warn the operator effectively. (fig.6.) After reducing the limit of the judgement system, a poor welding seam was warning successfully.

## 3. RESULTS AND DISCUSSION

After applying all the countermeasure, the welding seam breakage rate at the mill was down to 0.34%.

## REFERENCES

Toshiba Mitsubishi-Electric Industrial Systems (Comp.), Laser Beam Welder type LBW-C10C-64-2H1PR for 1TCM Operation and Maintenance Manual, 2017, Tokyo, Japan.