

# TECHNICAL NOTES

Following rules can be derived from "knowledge based systems in Robotized Arc Welding" summarised by the author Gunnar Bolmsjö. [Report from : International Journal for the Joining of Materials. Volume 9, Number 4 December 1997.]

It should be noted however that such causal models and corresponding rules are only valid for specified ranges of background parameters which define the working envelope for such knowledge based systems. Please note that "B" are backward and "F" are forward rules. An action to decrease or increase a parameter must also be determined through a quantitative model for the specific case.

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**Rule 1 B** IF the weld defect is incomplete penetration AND the wire feed rate or welding voltage is less than the specified limits THEN the diagnosis is insufficient heat input AND the corrective action is to increase wire feed rate or welding voltage.

**Rule 2B** IF the weld defect is incomplete penetration AND the welding speed is higher than the specified limit THEN the diagnosis is insufficient heat input AND the corrective action is to decrease the welding speed.

**Rule 3B** IF the weld defect is incomplete penetration AND the weld pool runs ahead of the welding arc OR the welding speed is less than the minimum allowable speed THEN the diagnosis is welding pool running ahead of the arc AND the corrective action is to increase the welding speed.

**Rule 4B** IF the weld defect is incomplete penetration AND the variation of joint penetration is excessive THEN diagnosis is improper joint preparation.

Since improper joint preparation can be caused by excessive variation of joint edge preparations, improper jiggling of the work piece, defective fixtures or poor tack welds, the following rules can be generated for the identification of improper joint preparation :

**Rule 4.1 B** IF the variation of joint edge preparation exceeds the specified tolerances THEN the variation of joint preparation is excessive AND the corrective action is to improve consistency of the joint edge preparation to reduce the variation within specified tolerances.

**Rule 4.2 B** IF the work piece is not properly jiggled THEN the variation of joint preparation is excessive AND the corrective action is to properly jig the work pieces before welding.

**Rule 4.3 B** IF the fixture is excessively worn THEN the variation of joint preparation is excessive AND the corrective action is to readjust or replace the fixture.

**Rule 4.4 B** IF the tack welds are not properly done THEN the variation of

joint preparation is excessive AND the corrective action is to improve the quality of the tack welds.

**Rule 5 B** IF the weld defect is incomplete penetration AND the contact nozzle to work piece distance is larger than the maximum allowable distance THEN the diagnosis is excessive contact nozzle to workpiece distance AND the corrective action is to reduce the distance.

**Rule 6 B** IF the weld defect is incomplete penetration AND the location of the resulting weld excessively deviates from the location of the weld joint THEN the diagnosis is excessive deviation of the welding arc. This can be diagnosed by the following rules:

**Rule 6.1 B** IF the torch position deviates excessively from the desired torch position THEN the location of resulting weld excessively deviates from the location of the joint AND the corrective action is to readjust the torch position to the desired position.

**Rule 6.2 B** IF the contact nozzle to work piece distance is larger than the specified one THEN the location of resulting weld excessively deviates from the location of the joint AND the corrective action is to reduce the distance.

**Rule 6.3 B** IF the contact nozzle is excessively worn THEN the location of resulting weld excessively deviates from the location of the joint AND the corrective action is to replace the contact tube with a new one.

**Rule 7 B** IF the weld defect is incomplete penetration AND the welding process is unstable THEN the diagnosis is unstable welding process.

**Rule 7.1 B** IF the welding process is unstable AND the combination of wire feed rate and welding voltage is outside the allowed one THEN the

diagnosis is unsuitable combination of wire feed rate and voltage AND the corrective action is to readjust the wire feed rate and welding voltage.

**Rule 7.2 B** IF the welding process is unstable AND excessive wire fluctuation is observed THEN the cause of the process instability is wire fluctuation. This can be examined through further rules analyzing the wire feed system.

**Rule 7.3 B** IF the welding process is unstable AND the gas shielding is disturbed THEN the cause of the process instability is disturbed gas shielding. This can be further examined through further rules analyzing the gas shielding system.

**Rule 7.4 B** IF the welding process is unstable AND there are contaminating substances on the wire or work piece THEN the cause

of the process instability is contaminating substance on the wire or work piece AND the corrective action is to remove these substances before welding.

**Rule 7.5 B,F** IF the combination of wire feed rate and voltage is correct AND there is no excessive wire fluctuation AND there is no disturbance of gas shielding AND no contaminating substances on both wire and work piece THEN the cause of the process is probably that the voltage variation in the power supply network is excessive AND that corrective action is to reduce the variation of the input voltage to the power source.

**Rule 8 B, F** IF the amount of metal spatter increases OR the regularity of arc sounds decreases OR the regularity of the weld appearance decreases THEN the welding process is unstable.

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