CERTIFICATION OF ROBOTIC ARC WELDING
-Operators and Technicians

Prepared for the
AWS 8th Robotic Arc Welding Conference & Exhibition

Presented by:
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D16 Committee on Robotics

- D16.2 *Guide for Components of Robotic and Automatic Welding Installations*

- D16.3 *Risk Assessment Guide for Robotic Arc Welding*

- D16.4 *Specification for Qualification of Robotic Arc Welding Personnel*

"Form Must Follow Function"

D16.4 *Specification for Qualification of Robotic Arc Welding Personnel*

- This Specification sets the requirement for the certification
- D16.4 Describes four levels of qualification which have been handled in QC19 in the following manner:
  - **Level one to be handled by employer and not to be construed as official AWS recognition**
  - **Level two and three have been combined into one certification for the operator**
  - **Level four is the certification for the technician**

FOR OPERATOR CERTIFICATION

- **EXPERIENCE AND EDUCATIONAL REQUIREMENTS**
  - Have minimum 4000 hours welding experience
  - Have good mechanical aptitude
  - Have one year diploma in welding or robotic instruction
  - Have good written and oral communication skills

FOR OPERATOR CERTIFICATION

- **TRAINING RECOMMENDATIONS**
    - Completion of original equipment manufacturer or equivalent Robotic Programming course
    - Understand the use of the teach pendant
    - Have instruction in the proper operation of cross sectioning related tools and hardware such as plasma cutting and band saws
    - Have instruction in the applicable destructive testing methods, such as macroetch test or bend test
    - Have continuing education in robotic arc welding related disciplines
    - Have basic instruction in workings of all of the robotic peripheral equipment
    - Have basic instruction covering the safe and proper operation of the robot mechanical arm and control circuitry
    - Visual inspection course for the applicable product

FOR TECHNICIAN CERTIFICATION

- **EXPERIENCE AND EDUCATIONAL REQUIREMENTS**
  - Meet all of the level 1, 2, and 3 requirements
  - Have minimum 5 years welding experience with all relevant processes
  - Have a two year Associates Degree in Welding/Robotics/Electrical or equivalent
  - Hold current AWS CWI certification (Certified Welding Inspector).

FOR TECHNICIAN CERTIFICATION

- **TRAINING RECOMMENDATIONS**
  - Meet levels 1, 2, and 3 with the addition of:
  - Receive instruction in the operation of quality measuring tools including applicable computer software for measuring the weld cross section
  - Be familiar with personal computers

AWS QC19 *Standard for AWS Certification of Robotic Arc Welding-Operators and Technicians*

Certification Sub-Committee

E. R. Bohnart, Chairman	Welding Education and Consulting
J. S. Noruk	Servo Robot Corporation
L. K. Gross	Milwaukee Area Technical College
W. R. Polanin	Illinois Central College
R. F. Noch	Johnson Controls Inc.
V. Mangold, Jr.	ISS
M. P. Vandenberg	Miller Electric
L. Barley	AP Automotive Systems
J. Lisell	Northland Community and Technical College
L. Nielson	ABB

In QC19 The Term Certified <u>Operator</u> Is Much More Than Just A Button Pusher!

"Operator. In the context of an AWS Certified Robotic Arc Welding-Operator it is a person capable of dealing with all aspects of an arc welding robot cell. These aspects are as detailed in the D 16.4 qualifications for a level 2 and 3 person."

AWS QC19 *Standard for AWS Certification of Robotic Arc Welding-Operators and Technicians*

- Testing will determine if the candidates meet the D16.4 Performance and Demonstration Requirements
- Performance Test
- Written Closed Book Examination

AWS QC19 *Standard for AWS Certification of Robotic Arc Welding-Operators and Technicians*

- Performance Test
  - will cover the practical demonstration of knowledge and ability involving a robotic system
  - This performance test is to consist of a series of tasks which will include a GMA welding test plate made to a Welding Procedure Specification (WPS)
  - The performance test must be completed and passed **three months prior to or after** taking the written examination.
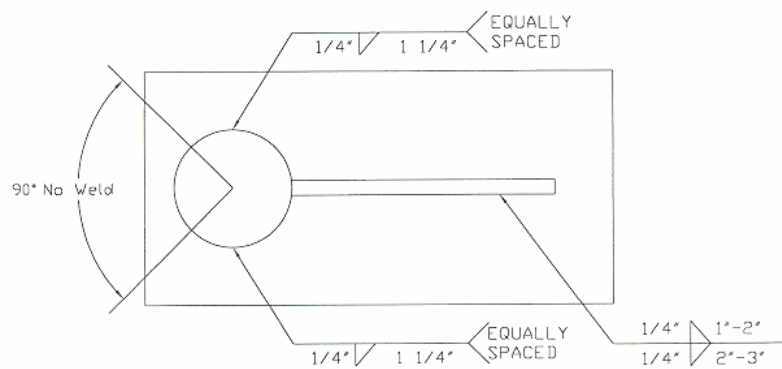
Performance Test
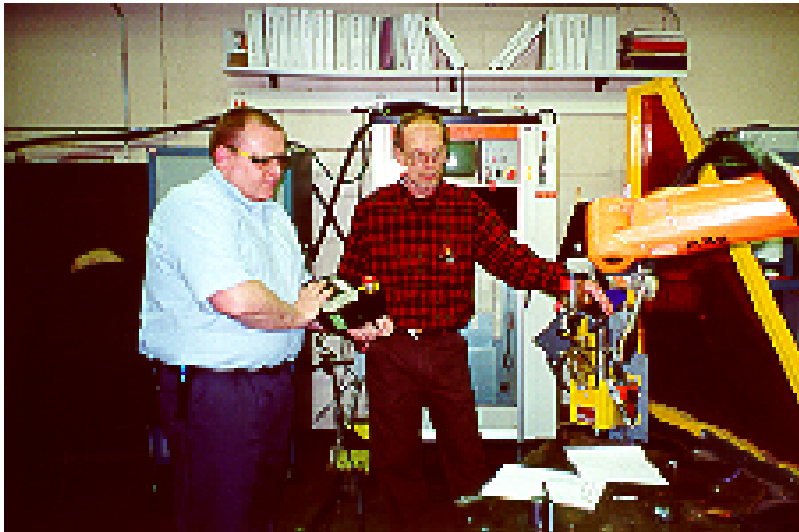
- Test Supervisor must be a CRAW-T
- Test can be administered at work location, School, Robot Mfg. Training Facility etc…
- Test must be done within three months of the closed book examination

Performance Test

- Must be able to identify all of the equipment
- Point out all safety devices and issues
- Do gun, wire feed, and shielding gas maintenance
- Correct for part shifting
- Follow a WPS and Shop Drawing
- Excess number of teach points will deduct from final score
- Test is a timed

Performance Test

- Weld Size
- Weld Location
- Weld Appearance
- WPS must be followed

Performance Test

- Welds are VT'd
- Followed by Macroetching to Determine:
  - Weld Profile
  - Penetration
  - Fusion
- Passing Rate is 75%

Performance Test

- Candidate must locate a CRAW-T to administer the test
  - The AWS will provide a contact list
- Facility must be located
- Test weldment must be procured

Topics Covered In Performance Test

TOPIC	APPROXIMATE %
Identification of components & demonstration of use	
Demonstration of safe use	
Procedure & Welding Process Set-Up	
Cannot lose more than 10 points in above sections	
Robot Programming of Test Piece	20
Welding of test piece	40
Weld Quality Assessment	40
TOTAL	100%

AWS QC19 *Standard for AWS Certification of Robotic Arc Welding-Operators and Technicians*

- Written Closed Book Examination
  - Applicants for certification as CRAW Operator or Technician shall be required to achieve a pass mark of 75%
  - general knowledge test consisting of approximately one hundred and forty (140) multiple choice questions written examination
  - The written examination is the same for both the operator and technician
  - The technician level certification also allows this person to administer the practical demonstration part of the certification test.

Written Closed Book Examination

- A quiet place must be provided

- A timed two hour exam

- Conducted at major sites along with CWI examination activities

- AWS can make arrangements for special examination sites if warranted

Topics Cover In Written Examination

TOPIC	MINIMUM NUMBER	APPROXIMATE PERCENTAGE
Weld Equipment Setup	10	8
Welding Processes	20	15
Weld Examination	10	8
Definitions and Terminology	10	8
Symbols – Welding & Robotics	5	4
Safety	14	12
Destructive Testing	10	8
Conversion and Calculations	5	4
Robot Programming and Logic	25	20
Welding Procedures	10	8
Kinematic Concepts	5	4
Robot Arc Weld Cell Components-ID	5	4
TOTAL	136 questions	100%

Reference Documents for Written Examination

- AWS A3.0, *Standard Welding Terms and Definitions*
- AWS B1.10, *Guide for Nondestructive Inspection of Welds*
- AWS B1.11, *Guide for Visual Welding Inspection*
- AWS B5.1, *Qualification Standard for AWS Welding Inspectors*
- AWS QC1, *Standard for AWS Certification of Welding Inspectors*
- AWS WI, *Welding Inspection*
- AWS CM-00, *Certification Manual for Welding Inspectors*
- AWS B2.1, *Specification for Welding Procedure and Performance Qualification*
- AWS D8.8, *Specification for Automotive and Light Truck Weld Quality: Arc Welding*
- AWS D16.2, *Standard for Components of Robotic and Automatic Welding,*
- AWS D16.3, *Risk Assessment Guide for Robotic Arc Welding*
- AWS D16.4, *Specification for the Qualification of Robotic Arc Welding Personnel*

Reference Documents for Written Examination

- ANSI Z49.1, *Safety in Welding, Cutting and Allied Processes* (published by the American Welding Society)
- NEMA EW-1, *Electric Arc Welding Power Sources*
- AWS Arc Welding with Robots, Do's and Don'ts
- Automating the Welding Process, Jim Berge, Industrial Press
- AWS Welding Handbook, Volume 1, 9th Edition
- AWS Welding Handbook Volume 2, 8th Edition
- Robot Programming Manual (published by robot manufacturer)
- AWS 058, *Arc Welding Automation,* Howard Cary
- AWS A2.4, *Standard Symbols for Welding Brazing, and Nondestructive Examination*
- Jefferson's Welding Encyclopedia 8th Edition (published by the American Welding Society)
- RIA 15.06, *American National Standard of Industrial Robots and Robot Systems - Safety Systems*

Scoring

- Applicants scoring at or above the 75% pass marks shall be considered certified at such time as all other requirements are met, and fees paid.

- Applicants who fail to meet the minimum scores may apply for re-examination for the part failed not less than thirty (30) days following notification of test results by AWS.

- Applicants may apply to be examined for certification as many times as they may choose; however, no applicant may be examined more than three (3) times per calendar year.

- Applicants must complete and pass both written examinations and the performance test within a three (3) month period.

Current Status Of This New Certification Program

- Beta Test Results
  - Number Tested-23
  - Average Performance Test Scores-91%
  - Average Written Test Scores-80%
- Fees and Application Information
  - Fees for Performance Test
  - Fees for Written Test
  - Total Certification Fees

CLOSING COMMENTS

Questions and Comment