

Bermuda National Occupational Certification  
Standard 2017:  
Welder – Levels CSA W47.1 & ASME B31.3

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## National Certification

National Certification in the occupation of Welder is a practical assessment that requires a minimum standard of CSA W47.1 together with the national safety training for all construction related jobs. This is the standard set by the Occupational Advisory Committee (OAC) comprised of industry experts. This standard level of proficiency is applied to Bermudians, spouses of Bermudians and PRC holders.

Persons who anticipate obtaining work opportunities in Bermuda must meet the minimum requirement of the ASME B31.3 or 6G standard.

### *Level CSA W47.1*

This is a practical test administered by a CWB certification representative using a test plate provided and evaluated by the CWB. The Canadian Standards Association sets the criteria for Standard W47.1. This category of welder qualification, includes a practical assessment in the following welding positions:

#### **Flat:**

This type of welding is performed from the upper side of the joint. The face of the weld is approximately horizontal. Flat welding is the preferred term; however, the same position is sometimes called downhand.

#### **Horizontal:**

In horizontal welding, the weld axis is approximately horizontal, but the weld type dictates the complete definition. Welding in the horizontal position is a little more difficult to master than the flat position. This is due to the tendency of molten metal to flow to the lower side of the joint. The heat from the torch rises to the upper side of the joint. The combination of these opposing factors makes it difficult to apply a uniform deposit to this joint.

#### **Vertical:**

In this position, the axis of the weld is approximately vertical. When welding is done on a vertical surface, the molten metal has a tendency to run downward and pile up. The welding rod should be held slightly above the center line of the joint, and the welding flame should sweep the molten metal across the joint to distribute it evenly. Butt joints welded in the vertical position should be prepared for welding in the same manner as that required for welding in the flat position.

#### **Overhead:**

Overhead welding is performed from the underside of a joint.

In overhead welding, the metal deposited tends to drop or sag on the plate, causing the bead to have a high crown. To overcome this difficulty, the molten puddle should be kept small, and enough filler metal should be added to obtain good fusion with some reinforcement at the bead. If the puddle becomes too large, the flame should be removed for an instant to permit the weld metal to freeze. When welding light sheets, the puddle size can be controlled by applying the heat equally to the base metal and filler rod.

## *Welder Test Rules & Regulations*

The CSA Standards provide clear requirements with respect to procedures, as well as workmanship, as verified during an auditing process, that is required.

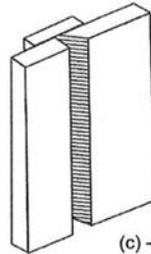
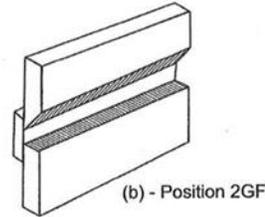
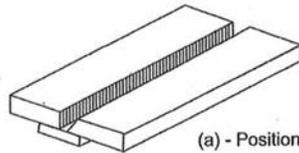
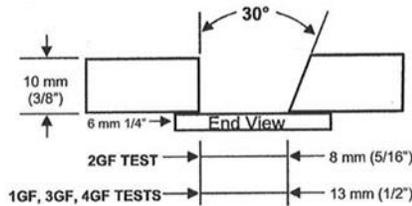
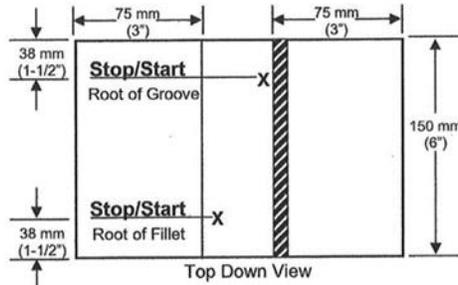
1. All materials including electrodes and coupons are supplied by test center.
2. Electrode size: E7018 – 1/8" (3.2 mm) or larger diameter.
3. NO GRINDERS, SAW BLADES, FILES OR METHODS THAT REMOVE DEPOSITED METAL OR ALTER WELD BEAD PROFILE ARE PERMITTED.
4. Welders have the choice of having their coupons cut and bent or X-rayed. CWB will provide requested x-rays.
5. Test is comprised of four (4) positions: flat, horizontal, vertical & overhead
6. All coupons have a backing strip attached.
7. ¾ hour is allowed per coupon.
8. Upon successful completion of the welder's test, the Canadian Welding Bureau will issue a "Welder Test Record" letter to the test center stating the date of the test, coupons welded and the test results. The test center is responsible for mailing the letter to each welder.
9. If a welder wishes to retest on any failed position(s), he/she should contact DWD (Department of Workforce Development) for applicable information and retest rates.

**ASSEMBLIES/COUPONS FOR "S" CLASSIFICATION  
CSA STANDARD W47.1**

1. Fillet Weld shall be examined by the CWB Representative before welding next passes.
2. Maximum Fillet Weld size is 8 mm (5/16")
3. Fillet Weld Legs shall not differ in length more than 1.5 mm (1/16")
4. Undercut shall not exceed 0.8 mm (1/32")
5. Reinforcement shall not exceed 3 mm (1/8")
6. Stops/Restarts shall be visible in root passes in specified places. The CWB Representative shall examine them.
7. Weld Ends shall be filled in. Do not leave crater ends.

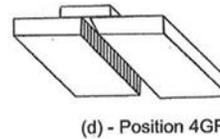
**MATERIAL**  
PLATE OR BAR OF MAXIMUM SPECIFICATION YIELD OF 300 MPa (44 KSI)

**NOTE**  
STOP/START REQUIRED ON ROOT PASSES OF FILLET AND GROOVE WELDS AT 38 mm (1-1/2") FROM THE ENDS OF TEST COUPON.



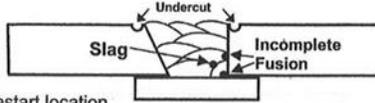
Position of welding for "S" Classification

NOTE: (3-4) GF Assembly is identical to the 4GF Assembly except the fillet weld position is to be welded in the vertical position, and the groove weld portion is to be welded in the overhead position.



## MOST COMMON TYPES OF FAILURE

- Incomplete fusion at the root of the fillet weld.  
Causes: Insufficient heat  
Poor manipulation or technique  
Incorrect electrode angle
- Incomplete fusion or slag inclusion at a Stop/Restart location.  
Causes: Incorrect Restart technique
- Incomplete fusion of the side wall of the square cut plate above the toe of the fillet weld.  
Causes: Allowing the puddle to flow up against the square plate instead of pointing the arc at the square edge of the plate.
- Porosity  
Causes: Holding a long arc/incorrect restart technique

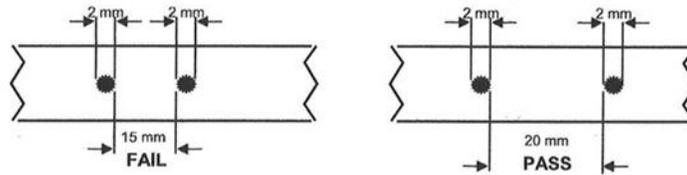


### LIMITS OF FLAWS

Porosity & fusion type defects such as slag, lack of fusion and inadequate penetration

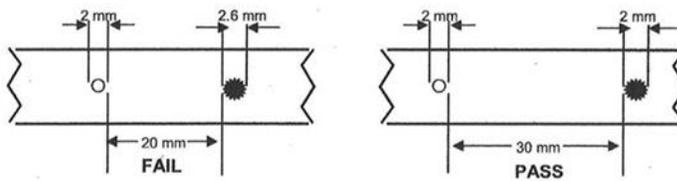
- The maximum dimension of a single flaw must not exceed 2.6 mm
- Flaws of 2 mm to 2.6 mm are evaluated based on how close they are together.

Example 1 - a 2 mm slag inclusion is 15 mm away from another 2 mm slag inclusion. Result: fail—they must be separated by 20 mm of clear metal.



Example 2 - a 2 mm diameter pore is separated from a 2.6 mm long slag inclusion by 20 mm. Result: fail—they must be separated by 26 mm of clear metal.

Example 3 - a 2 mm long lack of fusion is separated from a 2 mm diameter pore by 30 mm. Result: pass—as long as they are separated by 25 mm they are acceptable.



- If you have clusters of porosity, pieces of slag etc. smaller than 2 mm in size, and if their sizes add up to more than 9 mm in any 25 mm length of weld, a failure will result.

## Level ASME B31.3

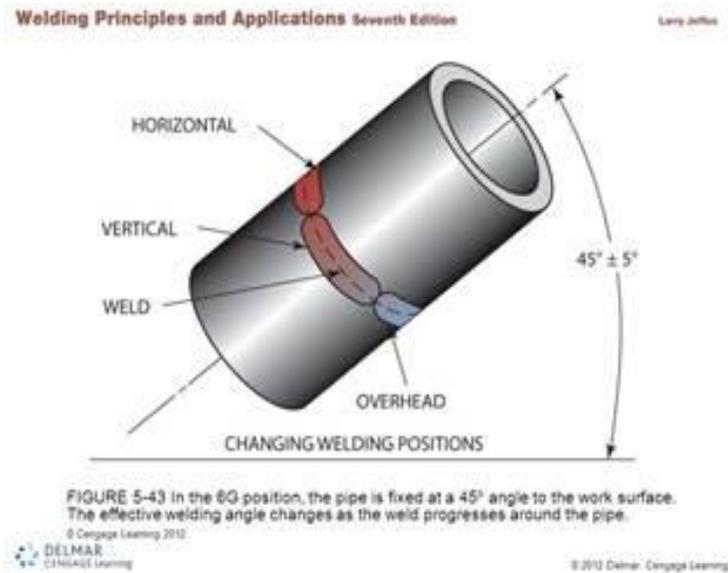
The CWB defers to the ASME B31.3 for high pressure pipe welding and as such accept this standard within Canada. This requires the test taker to weld in the 6G position which is the hardest of all welding positions. This level of testing will be applied to persons who are seeking permission to work and reside in Bermuda on a work permit.

### American Society of Mechanical Engineers ASME B31.3 – Process Piping

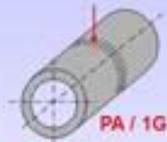
**ASME B31.3** contains requirements for piping typically found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants; and related processing plants and terminals. Requires the test taker to weld in the 6G position.

### The 6G pipe welding certification

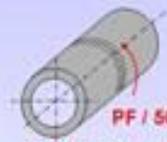
The **6G** Welding Test is a means to identify the skills or lack of them in a welder. This test uses a pipe set at a 45 degree angle and incorporates all of the positions. This one test will qualify the welder to weld pipe and plate in all positions and is the hardest of all welding positions.



## Welding Positions



**PA / 1G**  
Weld: Flat  
Pipe: rotated  
Axis: Horizontal



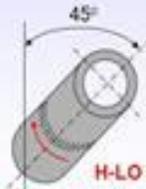
**PF / 5G**  
Weld: Vertical upwards  
Pipe: Fixed  
Axis: Horizontal



**PG / 5G**  
Weld: Vertical Downwards  
Pipe: Fixed  
Axis: Horizontal



**PC / 2G**  
Weld: Horizontal vertical  
Pipe: Fixed  
Axis: Vertical



**H-LO 45 / 6G**  
Weld: Upwards  
Pipe: Fixed  
Axis: Inclined