Welding Procedure Guide

An easy to follow guide covering the preparation of welding procedure data sheets

cwbcertification

CWB Group
1-800-844-6790
www.cwbgroup.org

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1.0 Introduction

This guide has been prepared to assist welding personnel with the preparation of welding procedures required as part of their company certification to CSA Standards W47.1, W47.2 and W186.

The following two documents will be described:

(a) Welding Procedure Specifications

(b) Welding Procedure Data Sheets

There will be a brief description of these documents; however, this guide will focus on the preparation of welding procedure data sheets. Each item on the welding procedure data sheet will be described and guidance will be provided to complete each section.

2.0 Welding Procedure Specification (WPS)

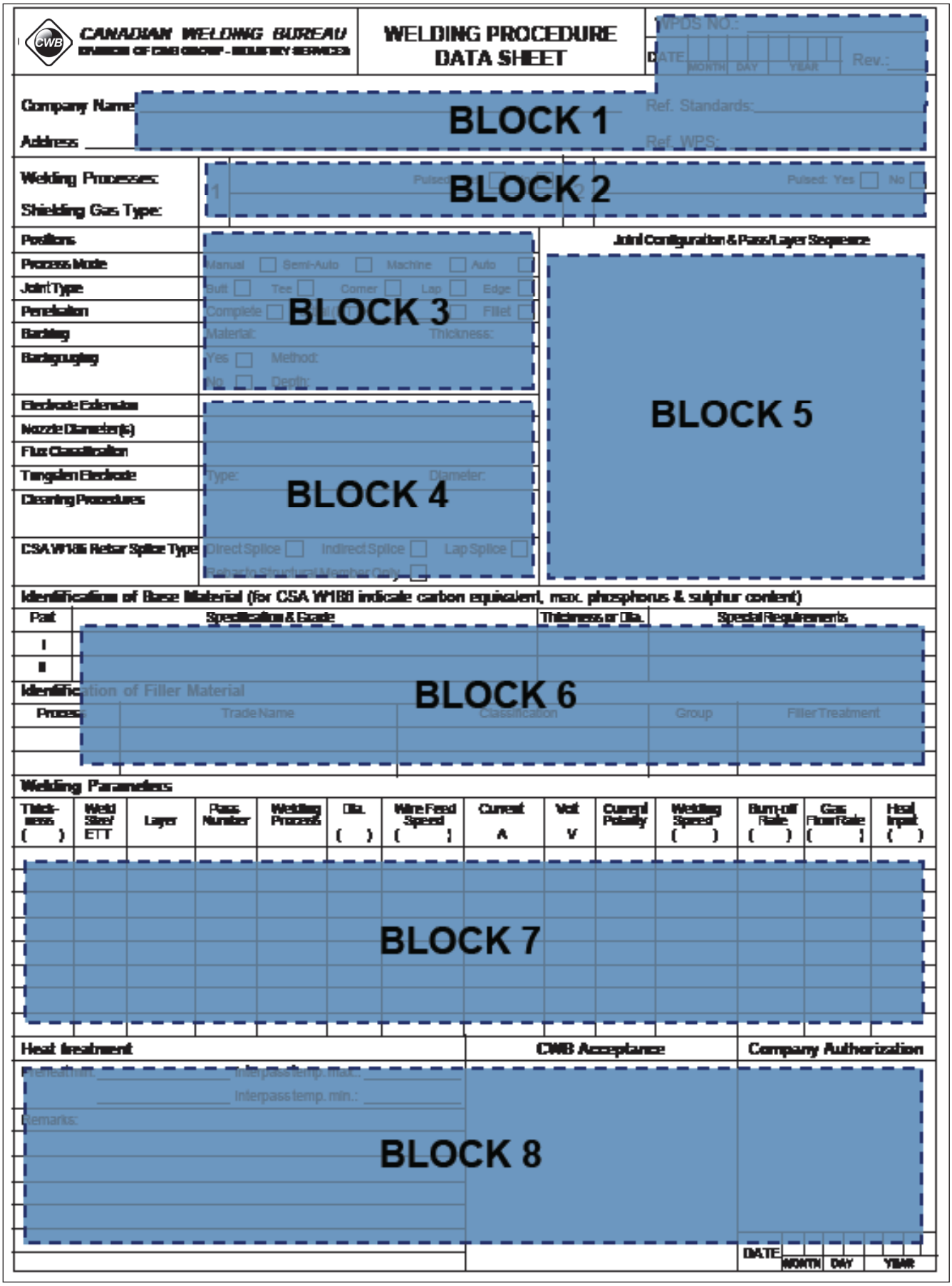
All companies applying or certified to CSA Standards W47.1, W47.2 or W186 are required to prepare and submit welding procedure specifications to the CWB for acceptance.

A welding procedure specification (WPS) sets broad guidelines for the shop and field welding practice of the fabricator for each anticipated combination of essential variables. Welding parameters and ranges are specified and used to prepare the associated welding procedure data sheets.The company shall have welding procedure specifications for each welding process in use, outlining the general welding procedure to be followed in the construction of weldments built in accordance with the governing design or manufacturing standard, or both. Welding procedure specifications submitted for acceptance should cover as a minimum the items specified in Annex D of CSA Standard W47.1 or Appendix A of CSA Standard W47.2, as applicable. Each welding procedure specification shall include applicable essential variables. All welding procedure specifications shall be submitted to the Bureau for acceptance and when stamped as accepted shall be considered as registered with the Bureau.

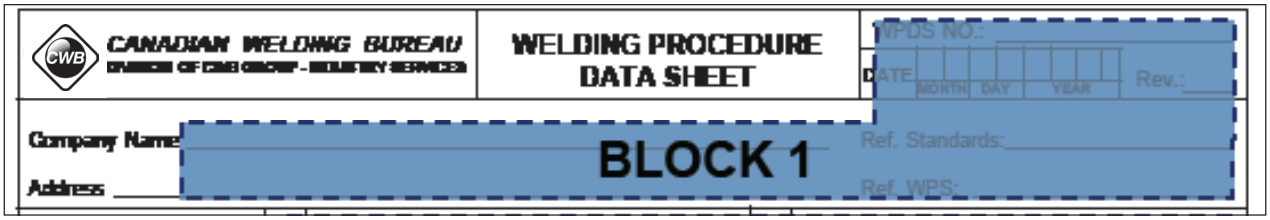
Sample welding procedure specifications are available on our website www.cwbgroup.org

3.0 Welding Procedure Data Sheet (WPDS)

A welding procedure data sheet (WPDS) is a document, used in conjunction with a WPS, detailing the welding parameters and ranges for welding a specific joint, over a range of thicknesses and weld sizes, as illustrated on the data sheet. The following is the standard welding procedure data sheet form suggested by the CWB, however, other welding procedure data sheet formats may be used. Each item on the data sheet will be described and guidance on the completion of the form will be given. Common errors in completing the form will be identified.


CANADIAN WELDING BUREAU
DIVISION OF CWB GROUP - INDUSTRY SERVICES
WELDING PROCEDURE DATA SHEET
WPDS NO.:
DATE MONTH DAY YEAR
Rev.:
Company Name:
Address:
Ref. Standards:
Ref. WPS:
BLOCK 1
Welding Processes:
Shielding Gas Type:
Pulsed: Yes No
BLOCK 2
Position:
Process Mode:
Joint Type:
Penetration:
Backing:
Backgouging:
Manual Semi-Auto Machine Auto
Butt Tee Corner Lap Edge
Complete Fillet
Material:
Thickness:
Yes Method:
No Depth:
BLOCK 3
Joint Configuration & Pass/Layer Sequence
BLOCK 5
Electrode Extension:
Nozzle Diameter(s):
Flux Classification:
Tungsten Electrode:
Cleaning Procedures:
CSA W186 Rebar Splice Type:
Type:
Diameter:
Direct Splice Indirect Splice Lap Splice
Rebar-to-Structural Member Only
BLOCK 4
Identification of Base Material (for CSA W186 indicate carbon equivalent, max. phosphorus & sulphur content)
Part
Specification & Grade
Thickness or Dia.
Special Requirements
I
II
BLOCK 6
Identification of Filler Material
Process
Trade Name
Classification
Group
Filler Treatment
Welding Parameters
Thickness ( )
Weld Size/ ETT
Layer
Pass Number
Welding Process
Dia. ( )
Wire Feed Speed ( )
Current A
Volt V
Current Polarity
Welding Speed ( )
Burn-off Rate ( )
Gas Flow Rate ( )
Heat Input ( )
BLOCK 7
Heat treatment
Preheat min.:
Interpass temp. max.:
Interpass temp. min.:
Remarks:
CWB Acceptance
Company Authorization
BLOCK 8
DATE MONTH DAY YEAR

3.1 BLOCK 1 (General Information)



Company Name and Address

Enter the complete company name and address in this section. If the data sheets are to be used by two or more certified plants within the same company, the applicable plants need to be identified in the documentation submitted.

WPDS Number

Each company should have its own method of numbering welding procedure data sheets. This can range from a relatively simple consecutive number system to one that identifies the process, position, groove type and electrode. Each welding procedure data sheet number should be unique so that the WPDS can be easily referenced on production schedules, work orders, shop drawings etc.

Date and Revision

Enter the date the welding procedure data sheet was prepared and the revision number.

Reference Standards

Some welding standards that may be referenced are:

CSA W47.1 – *Certification of Companies for Fusion Welding of Steel*

CSA W59 – *Welded Steel Construction (Metal Arc Welding)*

CSA W186 – *Welding of Reinforcing Bars in Reinforced Concrete Construction*

CSA W47.2 – *Certification of Companies for Fusion Welding of Aluminum*

CSA W59.2 – *Welded Aluminum Construction*

AWS D1.1 – *Structural Welding Code - Steel*

AWS D1.3 – *Structural Welding Code – Sheet Steel*

AWS D1.6 – *Structural Welding Code – Stainless Steel*

A common combination is W47.1 and W59. For certified companies, there must always be a certification standard stated (eg. W47.1, W47.2, W186) plus a “Construction” standard (e.g. W59, W59.2, D1.3, D1.6).

Reference WPS

Record the welding procedure specification number that applies to this data sheet.

Some common mistakes with Block 1:

- The company name and address are not completed.
- More than one data sheet has the same identification number.
- No reference code is specified.
- Reference codes are specified that have different qualification rules and essential variables. For example, W59 and D1.3.

3.2 BLOCK 2 (Process information)

Welding Processes

The welding process to be used should be specified in this section. If two welding processes are used to weld the joint they can each be entered in the areas identified “1” and “2”. Some of the common processes used are listed below with their corresponding letter designations:

Process	Letter Designation
Shielded Metal Arc Welding	SMAW
Gas Metal Arc Welding	GMAW
Flux Cored Arc Welding	FCAW
Metal Cored Arc Welding	MCAW
Gas Tungsten Arc Welding	GTAW
Submerged Arc Welding	SAW
Plasma Arc Welding	PAW
Electroslag Welding	ESW
Electrogas Welding	EGW
Stud Welding	SW

The letter designation may be used to identify the process.

Full details about the various welding processes can be found in the CWB modules.

Pulsed

If pulsed current is used, check this box. Enter the root mean square (RMS) current in Block 7 and the peak and background current in the remarks section of Block 8. The pulsed power source brand, model name and the applicable program number should also be noted in the remarks section (Block 8).

Shielding Gas Type

Record the complete generic composition or gas trade name as shown on the label on the gas cylinder.

Use of the generic composition is advantageous as it allows the user to change brands of shielding gas with the same composition with no required changes to the WPDS.

Note: If the trade name is used, a change to another brand name, even if it is of identical composition, will require revised data sheets.

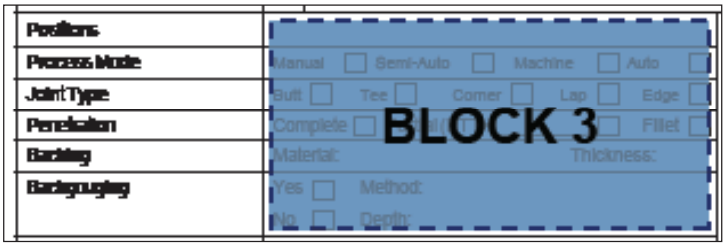
The gas manufacturer/supplier may be able to provide you with the generic composition. For gas metal arc welding, the wire is classified using 100% CO_2; however, argon-oxygen-carbon dioxide combinations may be used based on the oxygen equivalent.

For full details of gas combinations refer to CSA Standard W48.

Some common mistakes with Block 2:

- No welding process specified
- No gas composition specified
- Gas not certified with the filler material

3.3 BLOCK 3 (Joint information)



Positions

Positions shown on the data sheet should be the production position classified as Flat (F), Horizontal (H), Vertical-Up (V-U), Vertical Down (V-D) or Overhead.

Number and letter combinations are also used to designate each welding position for quick reference. The letter G stands for groove weld, letter F for fillet weld. The numbers 1, 2, 3 and 4 correspond to flat, horizontal, vertical and overhead positions respectively. For the vertical position, indicate if the progression is vertical up or vertical down.

In actual shop fabrication, welding can be in any intermediate position. For detailed information on the definition of the various welding positions please consult Appendix E of CSA Standard W59, Welded Steel Construction (Metal Arc Welding) or AWS A3.0, Standard Welding Terms and Definitions.

Process Mode (manual, semi-automatic, machine and auto)

One of the four process modes should be checked in this section based on the following definitions. Do not enter more than one process mode unless multiple processes are used.

Manual welding. Welding with the torch, gun or electrode holder held and manipulated by hand. Accessory equipment, such as part motion devices and manually controlled filler material feeders may be used. An example is SMAW or GTAW.

Semi-automatic welding. Manual welding with equipment that automatically controls one or more of the welding conditions. Examples are FCAW and GMAW.

Machine welding (mechanized welding). Welding with equipment that requires manual adjustment of the equipment controls in response to visual observation of the welding, with the torch, gun or electrode holder held by a mechanized device. SAW is an example.

Automatic welding. Welding with equipment that requires only occasional or no observation of the welding and with no manual adjustment of the equipment controls. An example is a robotic application.

Joint Type

Check the box(es) to indicate the joint type. The five basic types are butt, tee, corner, lap and edge.

For definitions and details of joint type, please consult CWB Module 2, Engineering Drawings, Basic Joints and Preparation for Welding.

Penetration (complete, partial, ETT)

The depth of penetration of a groove weld needs to be identified.

A complete joint penetration groove weld is defined as one in which the weld metal extends through the joint thickness. This can be achieved with or without backing. If complete joint penetration is achieved, the box marked “Complete” should be checked.

A partial joint penetration groove weld is one in which incomplete joint penetration exists. If this is the case, the box marked “Partial” should be checked and the effective throat thickness (ETT) should be dimensioned in the space provided. The ETT may be specified as a percentage of T, e.g. ETT = 0.75T.

Table 4.3 of CSA Standard W59 shows minimum groove depths for partial joint penetration groove welds based on the thickness of the parts and the groove angle at the root. Verify that these requirements are met.

Fillet

The box marked “fillet” should be checked if the weld is of approximately triangular cross section joining two surfaces approximately at right angles to each other in a lap-joint, T-joint or corner joint. Joints with a groove angle greater than 135 degrees or less than 30 degrees require greater detail in the sketch (defined as skewed joints). Refer to W59, Clause 4.5 for more detail.

Backing (material and thickness)

Backing is a material or device placed against the back side of the joint adjacent to the joint root to support and shield molten weld metal.

Permanent backing is designed to remain in place as part of the finished weld.

Backings used for the welding of steels up to and including 480 MPa (70 ksi) minimum specified tensile strength may be any of the steels listed in Clauses 11.2.1 and 12.2.1 of CSA Standard W59.

W59 requires that backings used for the welding of steels of over 480 MPa (70 ksi) minimum specified tensile strength be of the same material as the base material.

If steel backing is used, enter the material and thickness of backing in the space provided

Non-permanent backings can be made from materials such as ceramic, copper or flux. If they are used, enter the material, type and form of the backing in the space provided.

Back Gouging (Yes/ No, Method, Depth)

Back gouging is the removal of weld metal and base metal from the weld root side of a welded joint to facilitate complete fusion and complete joint penetration upon subsequent welding from that side. Methods include grinding to sound metal (GTSM), air carbon arc and plasma.

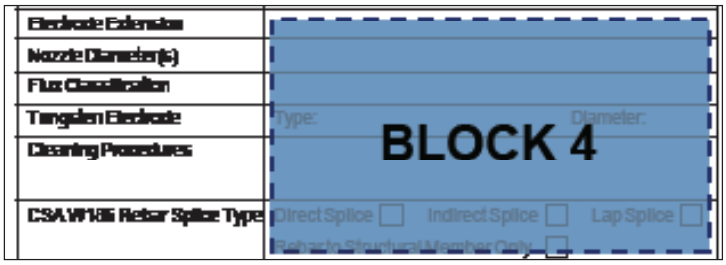
Back gouging should produce a groove contour substantially conforming to the appropriate prequalified single U-joint in Clause 10 of CSA Standard W59, and its depth should be adequate to ensure complete penetration into the previously deposited weld metal for the welding process to be used.

If back gouging is used, the back gouging box should be checked. The method used and the depth should be identified.

Some common mistakes with Block 3:

- No welding position specified.
- Incorrect welding position specified. For example, the drawing shows horizontal (2F or 2G) but position says “Flat”.
- Progression of welding not shown for Vertical.
- Partial joint penetration specified with ETT = T
- No ETT specified for partial joint penetration
- Both fillet and partial boxes are checked (Complete or partial joint penetration only apply to groove welds)

3.4 BLOCK 4 (Technical data)



Electrode Extension

The electrode extension for the gas metal arc welding, flux cored arc welding, submerged arc welding processes is the length of electrode extending beyond the end of the contact tip.

The electrode extension for the gas tungsten arc welding and plasma arc welding processes is the length of electrode extending beyond the end of the collett.

Enter the electrode extension in this section. Do not leave it blank. If the information requested does not pertain to the welding process used, insert N/A (Not Applicable) e.g. SMAW.

Nozzle Diameter

The gas nozzle is the device at the exit end of the torch or gun that directs shielding gas in gas shielded processes. Enter the diameter of this nozzle in the space provided. If it does not apply (e.g. non-gas shielded processes), enter N/A.

Flux classification

For the submerged arc welding (SAW) process, the flux classification or flux trade name should be entered e.g. EM12K or the flux trade name. This information can be obtained from the label on the bag of flux. If you enter the flux trade name and decide later to change the flux, the data sheet will need to be revised. The generic classification is preferred.

Tungsten Electrodes (type, diameter)

The tungsten type and diameter used should be specified for the GTAW process. For other processes, enter N/A. The choice of the type and size of tungsten electrode for a particular application depends on the operating current and current type.

Common tungsten types are listed below.

AWS CLASSIFICATION	COMMON NAME	COLOUR CODE
EWCe-2	2% Ceriated Tungsten	Orange
EWLa-1	1% Lanthanated Tungsten	Black
EWTh-1	1% Thoriated Tungsten	Yellow
EWTh-2	2% Thoriated Tungsten	Red
EWZr-1	1% Zirconiated Tungsten	Brown
EWG	Other - Needs to be Specified	Gray

Cleaning procedures

Enter the cleaning procedures used. This is particularly important for the welding of aluminum alloys because a change in cleaning method is considered an essential variable. Full details of the cleaning procedure used should be included in the corresponding welding procedure specification.

CSA W186 Rebar Splice Type.

This section is only used for welding procedure data sheets for CSA Standard W186, *Welding of Reinforcing Bars in Reinforced Concrete Construction*.

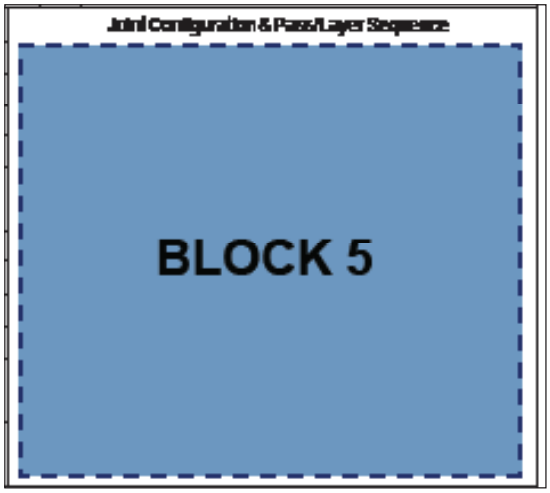
The types identified in CSA Standard W186 are:

- direct splice
- indirect splice
- lap splice
- rebar to structural member

Some common mistakes with Block 4:

- Electrode stickout not specified
- Incomplete or no cleaning procedures specified

3.5 BLOCK 5 (Joint Preparation)



Joint Configuration and Pass/Layer sequence

A sketch of the joint configuration with the welding symbol and a typical sequence of the layers and passes should be included in this section of the form. It is recommended that the sketch be drawn in the correct welding postion.

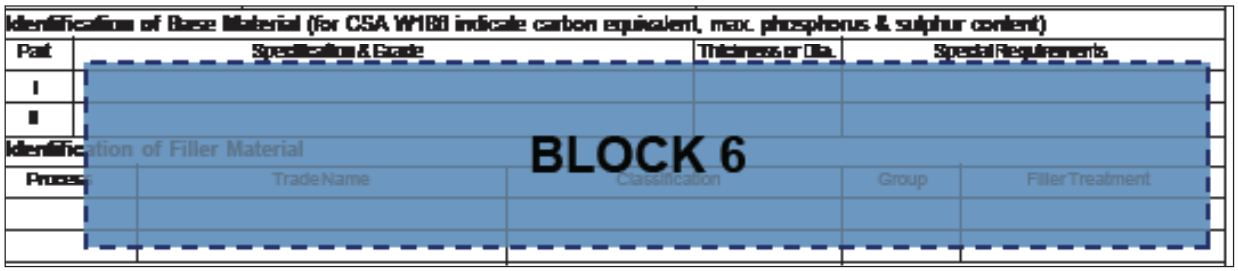
The joint configuration should include the following information:

- thickness of parts
- root opening
- root face
- bevel angle
- groove angle
- depth of preparation
- radius (for HSS)
- diameter (for solid bars/tubing/pipe)
- effective throat thickness (ETT)

Some common mistakes with Block 5:

- Missing details such as root face (Rf), root opening (G), groove angle (Θ), radius (for HSS)
- Non pre-qualified material thickness. Ex: 0.9 mm GMAW wire is not prequalified for groove welds with a material thickness greater than 12 mm.

3.6 BLOCK 6 (Base and Filler Material)



Identification of Base Material (specification and grade, thickness or diameter, special requirements)

Obtain a copy of the mill test certificate or any other document from the material supplier that shows the specification and grade of the base materials. Record the complete material specifications and grades on the welding procedure data sheets. Check with your purchasing agent.

The following are some examples of correct and incorrect material designations:

Incorrect	Correct
44W	CSA Standard G40.21 Grade 300W
A572	ASTM A572 Grade 50
Gr. 400 Rebar	CSA Standard G30.18 Grade 400W

Note that many materials, especially ASTM materials, have a grade designation which must be included.

Another common method to designate materials on data sheets is to use steel groups such as Steels in groups 1, 2 and 3 of Table 11-1/ 12-1 of CSA Standard W59. This is advantageous as it ensures a wide range of materials are covered.

Identification of Filler Material (process, trade name, classification, group, filler treatment)

Filler material classifications can be found in CSA Standard W48, *Filler metals and Allied Materials for Metal Arc Welding* or AWS Specification.

Check the label on the filler material box or spool to obtain the full filler material classification. This information can also be verified on our website www.cwbgroup.org.

Please note there is a new designation system for wire electrodes and deposits for GMAW of non alloy and fine grained steels as specified in ISO CAN/CSA-ISO 14341.

Full details can be found in CSA Standard W48.

The electrode or electrode-flux combination for butt joints using complete joint penetration groove welds shall be in accordance with Table 11.1 or 12.1 of CSA Standard W59.

The electrode or electrode-flux combination for:

- complete joint penetration groove welds in joints other than butt joints;
- partial joint penetration groove welds; or
- fillet welds may be of lower or higher strength than required by Table 11.1 or 12.1 in CSA Standard W59, provided that the conditions of Table 11.2(a), 11.2(b), 12.2(a), or 12.2(b), as applicable, are fully satisfied.

Remember that only steels in Column 2 of Table 5.3 of CSA Standard may be welded with SMAW with other than low-hydrogen electrodes and FCAW and MCAW without diffusible hydrogen designators.

The following filler material groups may be used for shielded metal arc welding (SMAW):

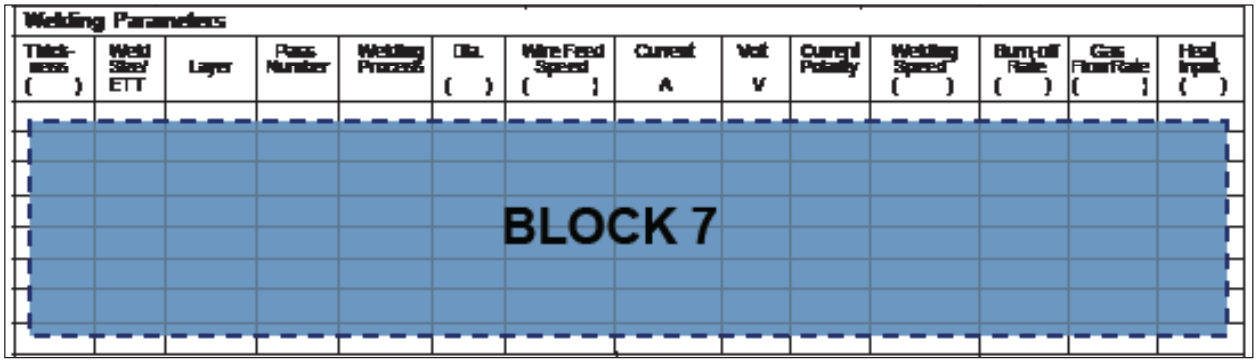
Group	Electrode Classifications
F1	EXX22, EXX24, EXX27, EXX28
F2	EXX12, EXX13, EXX14
F3	EXX10, EXX11
F4	EXX15, EXX16, EXX18, EXX48

Filler material treatment shall be in accordance with manufacturer's recommendations and the requirements of the applicable standard.

Some common mistakes with Block 6:

- The base material is not fully described. For example: 3XX Stainless Steel. A precise description must be given from the reference code such as Group A or B, Table 3.1, AWS D1.6. A precise material specification such as "ASTM A240, Grade 304L" can also be given.
- The filler material classification is incorrect.
- No thickness is specified.

3.7 BLOCK 7 (Welding Details)



Thickness

Record the thickness of material to be welded in the space provided.

Weld size/ ETT

The weld size for a fillet weld or effective throat thickness for a groove weld should be entered in this section.

Layer and pass number

Enter the number of passes and sequence of welding. There are several ways available to determine the number of layers and passes for a WPDS including:

- The Nomograph Method
- The Mathematical Equation Method
- The Weld Calculator Program Method

These methods require you to calculate the area of weld and to select a deposition rate. Deposition rates can be found in some welding textbooks, online or from your electrode supplier.

Steel and aluminum calculators, data sheet preparation courses etc. are available from the CWB to help you calculate the number of layers and passes.

Details can be obtained from our website www.cwbgroup.org.

Welding Processes

Enter the number “1” or “2” identified in Block 2 or the letter designation below.

Welding Process	Letter Designation
Shielded Metal Arc Welding	SMAW
Gas Metal Arc Welding	GMAW
Flux Cored Arc Welding	FCAW
Metal Cored Arc Welding	MCAW
Gas Tungsten Arc Welding	GTAW
Submerged Arc Welding	SAW
Plasma Arc Welding	PAW
Electroslag Welding	ESW
Electrogas Welding	EGW
Stud Welding	SW

Diameter

The standard units of measurement for electrode diameter are mm in SI (metric) and inch (imperial). The following shows common electrode sizes in SI (metric) and Imperial units.

INCH	MM
0.030	0.8
0.035	0.9
0.040	1.0
0.045	1.2
1/16	1.6
5/64	2.0
3/32	2.4
1/8	3.2
5/32	4.0
3/16	5.0
1/4	6.0

Be consistent with the selection of the choice of units.

Wire Feed Speed

The standard units of measurement for wire feed speed are m/min in SI (metric) and inches/ min (imperial).

A calibrated wire feed meter is preferred for measuring wire feed speed when the actual welding is in progress. If a verification of the recorded number is necessary or a wire feed meter is not available, measure the length of wire discharged from the gun for a period of 20 seconds. Multiply the length of discharged wire by 3 to give the wire feed speed in inches/minute or meters/minute. Take care to ensure that these are the real wire feed speeds and not the run in values

Current

Current values can be found in welding textbooks, online or by contacting your electrode supplier for one of their product catalogs. The current to be used depends on many factors including electrode type, size, welding position, joint design.

Measure the amperage using a calibrated clamp type amp meter. Follow the meter manufacturer's directions and measure the amperage as close to the gun/holder as possible without interfering with the operator. This usually is about 3 or 4 feet from the gun/holder.

Voltage

When measuring voltage, different techniques can be used depending on the welding process being used. For the SMAW and GMAW processes the voltage can be taken between the cable terminals on the welding machine.

For the GMAW and FCAW processes, the voltage can be taken between the work lead at the work connection clamp and the electrode lead at the the contractor in the wire feed unit. If not practical, the voltage can also be taken between terminal or between the cable terminals on the welding machine.

For the SAW process, the voltage can be taken between the electrode lead connection at the torch and the work lead clamp.

Warning- Welding parameters should only be measured by properly trained personnel following safe work practices. Follow manufacturer's recommendations.

Current Polarity

Enter the current and polarity for the electrode, electrode-gas or electrode-flux combination being used. This information can be found in welding textbooks (CWB Module 4), electrode standards, online or from electrode catalogues or from your supplier.

Direct current electrode positive (DCEP) is the arrangement of direct current welding leads in which the electrode is the positive pole and the work piece is the negative pole of the welding arc. A non standard term for this is direct current reverse polarity.

Direct current electrode negative (DCEN) is the arrangement of direct current welding leads in which the electrode is the negative pole and the work piece is the positive pole of the welding arc. A non standard term for this is direct current straight polarity.

Alternating current is the current flow in an electrical circuit, usually at a pre-determined frequency.

Arc Travel Speed/ Welding Speed

The arc travel speed can be measured by recording the time taken to weld a specific length of weld, then convert the measured time and length to inches/minute or millimeters/minute. Record the calculated arc travel speed (ATS) value and not just the measured length and time. This can be done using one of the following formulas:

$$\text{ATS (ins/min)} = \frac{\text{Measured Weld Length in inches} \times 60}{\text{Measured Time in Seconds}}$$

or

$$\text{ATS (mm/min)} = \frac{\text{Measured Weld Length in millimeters} \times 60}{\text{Measured Time in Seconds}}$$

Burn-off Rate

The burn off or melting rate is the weight or length of electrode, wire, rod, powder melted in a unit of time. Record this information for arc spot welds.

Gas flow Rate

The shielding gas flow rate should be high enough to maintain adequate shielding for the arc but not so high that it causes turbulence in the weld pool. The gas flow rate to be used depends on a number of factors such as the process, welding position, shielding gas, electrode extension and operating parameters. With GTAW, flow rates are typically in the range of 15 to 20 cubic feet per hour (CFH). With GMAW and FCAW flow rates typically vary between 25 and 45 CFH depending on the factors noted above. Manufacturer's literature should be consulted for more details.

The standard units of measurement for gas flow rate are l/min in SI (metric) and cubic feet/ hr CFH (imperial). To convert from CFH to L/min multiply by 0.472. To convert from L/min multiply by 2.119.

CFH	15	20	25	30	35	40	45
L/min.	7	9.5	12	14	16.5	19	21

Check the gas flow rate with a meter and record the rate and the unit of measurement (in brackets).

Heat Input

Enter the heat input and the unit of measurement when the heat input needs to be controlled. Examples are when welding quenched and tempered steels and when specific impact properties need to be achieved.

Heat input is the energy supplied by the welding arc to the work piece. The heat input is calculated using the following formula:

$$H = \frac{V \times A \times 60}{1000 \times T}$$

where:

H = heat input (kJ/in or kJ/mm)

V = arc voltage (volts)

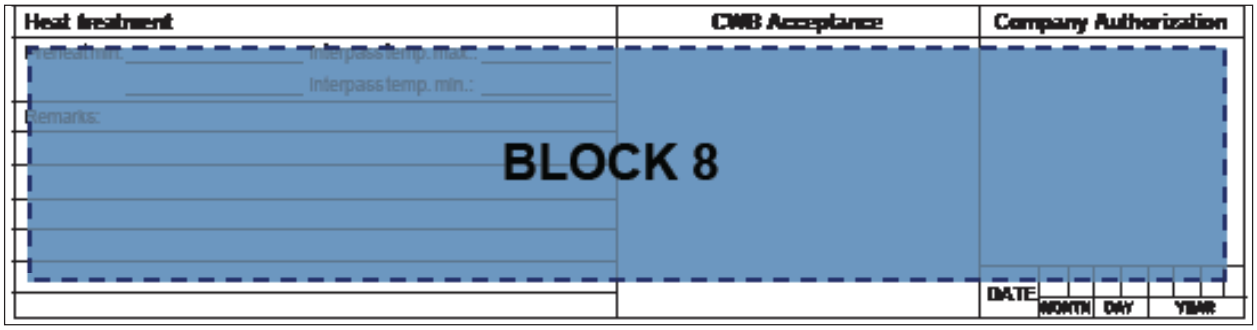
A = current (amps)

T = travel speed (in/min or mm/min)

Some common mistakes with Block 7:

- No wire feed speed with a semi-automatic process. (This is one adjustment the welder needs to make)
- Incorrect voltage or wire feed speed parameters for GMAW spray arc transfer. Charts showing parameters for spray transfer are available from the CWB
- Incomplete range of fillet weld sizes
- Incorrect number of welding passes in flare-bevel or flare-V joints. Ex: 8 welding passes to get an 8mm effective throat
- No flow rate entered
- Flow rate unit written “CFM” instead of “CFH”

3.8 BLOCK 8 (Final Remarks)



Heat Treatment (preheat, interpass temperatures, post weld heat treatment)

For preheat or interpass temperatures, refer to the applicable table in the standard such as Table 5-3, CSA Standard W59. Alternatively, enter the values in Centigrade or Fahrenheit. This box cannot be left empty or marked as ambient or not applicable (N/A).

If a post weld heat treatment is used, the temperature and time should be recorded.

Additional Remarks

Any additional remarks or requirements should be added in this section. It can also be used for notes if there is insufficient space in other sections of the welding procedure data sheet form. Examples are details of pulsed welding or welding techniques such as stringer or weave beads.

Company Authorization

The developed welding procedures need to be accepted by the responsible personnel at the company before submission to the CWB.

For companies involved in certification to CSA Standard W47.1 or CSA Standard W47.2 - Division 1 or 2, their welding procedures must indicate the acceptance by the designated professional welding engineer. Engineers submitting welding procedures to the CWB must, at their option, seal and/or sign each document.

For companies involved in certification to CSA Standard W186, their welding procedures must indicate the acceptance by the designated professional welding engineer responsible for welding procedures and practice. Engineers submitting welding procedures to the CWB must, at their option, seal and/or sign each document.

For companies involved in certification to CSA Standard W47.1 or CSA Standard W47.2 - Division 3, their welding procedures must indicate the acceptance by a qualified welding supervisor. Welding supervisors submitting welding procedures to the CWB must sign each document.

For Division 3 companies, when the welding supervisor changes, the company's approved welding procedures are still considered valid. The company is not required to submit the existing welding procedures for re-approval or provide an acceptance letter. The new welding supervisor is tested on the knowledge and application of the company's welding procedures.

When a company changes its status from Division 3 to Division 1, 2 (W47.1 or W47.2), or when an engineer takes over the responsibilities for previously approved welding procedures, the engineer may, at his or her discretion, use one or more of the following options:

- prepare and submit for approval new welding procedures bearing his or her seal and/or signature;
- issue a dated and signed letter to the CWB listing all welding procedures previously approved by the CWB that have been reviewed and found to be acceptable for the company's operations;
- review, sign and/or seal the existing documents and resubmit the appropriate number of copies for re-approval. If the welding supervisor's or engineer's signature or the engineer's seal has been removed from the document, then the previous approval must also be removed. If the previous approval stamp has not been removed, the documents are returned to the engineer without being reviewed; or
- if the engineer does not submit any documentation to the Bureau regarding the existing procedures, it is presumed that the engineer has reviewed the procedures and found them to be suitable for the company's welding operations. The engineer is not required to advise the Bureau of the action he or she has taken.

When a company changes its status from Division 1 or 2 to Division 3, the company's existing approved welding procedures are still considered valid. The company may submit the existing welding procedures for re-approval or provide an acceptance letter, although this is not a requirement.

Date

The data sheet should have an accepted date.

Some common mistakes with Block 8:

- Welding procedure data sheets are not accepted by the authorized personnel.
- Preheat is entered as "none" or ambient.
- Incorrect Preheat is specified.

4.0 Submission Of Welding Procedures

A certified company is required by the Standard to submit welding procedure data sheets, to the CWB, for the types of welded joints used by the company.

Electronic submissions of welding procedures should be sent to procedures@cwbgroup.org.

Hard copy submissions for Québec companies should be sent to 4321 Autoroute des Laurentides, Laval QC, H7L 5W5. All other hard copy submissions should be sent to the Procedures Department, 8260 Parkhill Drive, Milton ON, L9T 5V7.

A WPDS can be accepted based on the following:

- The joint geometry and parameters are specified by the governing standard to be prequalified;
- The company has previous procedure qualification test data recorded on a PQR (procedure qualification record);
- There are successful procedure data sheet tests in the CWB database that match the information on your WPDS;
- By successfully passing procedure qualification tests conducted in accordance with the requirements of the applicable standard;
- By successfully passing procedure qualification tests conducted in accordance with other recognized specifications or standards or
- By successfully passing a special procedure qualification test recorded on a PQR (an alternative type test)

The requirements for procedure qualification testing will be identified by the Procedure Engineer in a letter sent to the client.

Checklist: The following checklist can be used for completing welding procedure data sheets.

WELDING PROCEDURE DATA SHEET ITEM	SMAW	GMAW	FCAW	MCAW	GTAW	SAW
General Information						
Company name and address	X	X	X	X	X	X
WPDS No.	X	X	X	X	X	X
Date and Rev	X	X	X	X	X	X
Process Information						
Reference Standards	X	X	X	X	X	X
Welding Process	X	X	X	X	X	X
Pulsed current		X	X	X	X	
Shielding gas type		X	X	X	X	
Joint Information						
Positions	X	X	X	X	X	X
Process mode	X	X	X	X	X	X
Joint type	X	X	X	X	X	X
Penetration	X	X	X	X	X	X
Fillet	X	X	X	X	X	X
Backing material and thickness	X	X	X	X	X	X
Back gouging	X	X	X	X	X	X
Technical information						
Electrode extension		X	X	X		X
Flux classificatio						X
Tungsten electrode					X	
Cleaning	X	X	X	X	X	X
Joint preparation						
Joint configuration joint type	X	X	X	X	X	X
Base and filler material						
Identificatio to standard or group	X	X	X	X	X	X
Identificatio of fille material	X	X	X	X	X	X
Welding details						
Thickness	X	X	X	X	X	X
Weld size	X	X	X	X	X	X
Layers	X	X	X	X	X	X
Pass No.	X	X	X	X	X	X
Welding Process	X	X	X	X	X	X
Diameter	X	X	X	X	X	X
Wire feed speed		X	X	X		X
Voltage	+	X	X	X	+	X
Current, Current Type/ polarity	X	X	X	X	X	X
Arc travel speed	+	X	X	X	+	X
Gas flo rate		X	X	X	X	X
Additional items						
Heat treatment/ preheat/ interpass	X	X	X	X	X	X
Additional remarks						
Company authorization	X	X	X	X	X	X
Charpy V-notch						
Reference standard	X	X	X	X	X	X
Heat input	X	X	X	X	X	X
Stringer or weave bead	X	X	X	X	X	X
Arc Spot welds						
Visible diameter	X				X	
Coating thickness	X				X	

+ If heat input control is required

5.0 Review And Approval Of Welding Procedures

General

Each submission is reviewed by a Procedure Engineer based on the requirements of the applicable standards and/or codes. The applicable standard and/ or code must be referenced on the document submitted.

The Procedure Engineers use their professional discretion when reviewing all documents to ensure that they are feasible and meet the requirements as set out in the certification standards.

When a Welding Procedure Data Sheet meets all prequalified requirements but does not seem feasible, soundness tests are required.

In cases not directly covered by the certification standards, the Procedure Engineers apply the general concepts of the standard combined with the requirements of other relevant standards and codes to complete the review and approval process.

Welding Procedure Specifications

Welding procedure specifications that satisfy the requirements specified in the applicable standard are stamped accepted.

Welding procedure specifications submitted for approval shall include, as a minimum, the applicable essential variables of the governing design or manufacturing standard.

Welding Procedure Data Sheets

Prequalified Joints: Welding procedure data sheets, using joints designated as prequalified in the governing standard, can be accepted by the CWB as prequalified without further testing by the company, provided all other requirements of the governing standard have been met. Examples of governing standards that designate joints as prequalified are CSA Standard W59 and AWS Code D1.1.

Approval using the CWB database: Welding procedure data sheets that are not prequalified in the governing standard can be accepted by the CWB if sufficient relevant testing information has been accumulated by the CWB. The CWB reviews all submitted Welding Procedure Data Sheets that are not prequalified against the information in our database. This database contains procedure qualification tests completed by companies, and if sufficient information is found, acceptance can be granted without procedure testing. Welding Procedure Data Sheets that satisfy these requirements are stamped accepted on the basis of previous tests accumulated by the CWB.

Non Prequalified Joints - Procedure Testing: Welding procedure data sheets that are not prequalified in the governing standard can be accepted by the Bureau if relevant procedure qualification testing is completed by the company and witnessed by the CWB. The requirements for procedure qualification testing are identified by the Procedure Engineer in a letter sent to the client. Welding procedure data sheets that are successfully tested are stamped accepted to the applicable standard on the basis of procedure qualification.

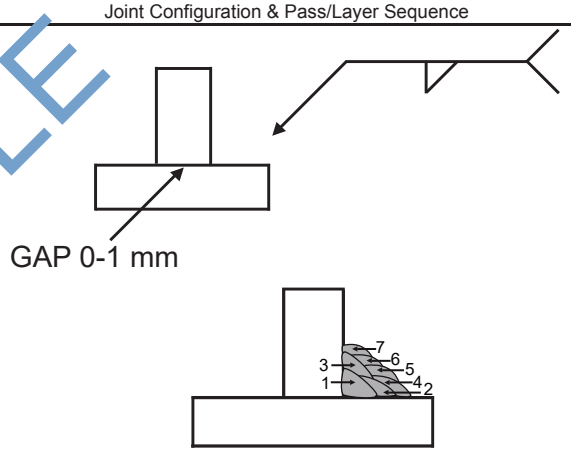
More than one qualification standard/code specified on the Welding Procedure Data Sheet: If there is more than one standard/code, the requirements of all specified standards/codes must be met. For example: A fillet weld Welding Procedure Data Sheet with both CSA W47.1 and AWS D1.6, will required 3 macro-etch tests.

6.0 Sample Welding Procedure Data Sheets

CANADIAN WELDING BUREAU	**WELDING PROCEDURE DATA SHEET**	WPDS NO.: SMAW-2F-8 DATE: 5/27/2008 Rev.: 0

Company Name:	Canadian Welding Bureau	Ref. Standards:	CSA W47.1/ W59
Address:	7250 West Credit Avenue, Mississauga, ON L5N 5N1	Ref. WPS:	SMAW-1

Welding Processes:	1	SMAW	Pulsed: ☐ Yes ☑ No	2	Pulsed: ☐ Yes ☑ No
Shielding Gas Type:		N/A			
Positions:	Horizontal			Joint Configuration & Pass/Layer Sequence	
Process Mode:	☑ Manual ☐ Semi-Auto ☐ Machine ☐ Auto				
Joint Type:	☐ Butt ☑ Tee ☐ Corner ☐ Lap ☐ Edge				
Penetration:	☐ Complete ☐ Partial ETT=		☑ Fillet		
Backing:	Material: N/A	Thickness: N/A			
Backgouging:	☐ Yes Method:				
	☑ No Depth:				
Electrode Extension:	N/A				
Nozzle Diameter(s):	N/A				
Flux Classification:	N/A				
Tungsten Electrode:	Type: N/A	Dia.:			
Cleaning Procedures	Use a chipping hammer and wire brush. Slag shall be removed from all finished welds and before welding over previously deposited metal.				
CSA W186 Rebar Splice Type:	☐ Direct Splice ☐ Indirect Splice ☐ Lap Splice ☐ Rebar to Structural Member Only				



Identification of Base Material (for CSA W186 indicate carbon equivalent, max. phosphorus & sulphur content)

Part	Specification & Grade	Thickness or Dia.	Special Requirements
I	Steels in Groups 1, 2 and 3 of Table 11-1/ 12-1	5.0 mm - 16.0 mm	
II	Steels in Groups 1, 2 and 3 of Table 11-1/ 12-1	5.0 mm - 16.0 mm	

Identification of Filler Material

Process	Trade Name	Classification	Group	Filler Treatment
SMAW		E4918-H8	F4	Cl. 5.2.2.4, W59

Welding Parameters

Thick-ness ( )	Weld Size/ ETT	Layer	Pass Number	Welding Process	Dia. (mm)	Wire Feed Speed ( )	Current A	Volt V	Current Polarity	Welding Speed ( )	Burn-Off Rate ( )	Gas Flow Rate ( )	Heat Input ( )
	5.0	1	1	SMAW	3.2	N/A	120-140		AC/DC+			N/A	
	6.0	1	1	SMAW	3.2	N/A	120-140		AC/DC+			N/A	
	8.0	1-2	1-3	SMAW	3.2	N/A	120-140		AC/DC+			N/A	
	10.0	1-2	1-4	SMAW	4.0	N/A	160-180		AC/DC+			N/A	
	12.0	1-3	1-6	SMAW	4.0	N/A	160-180		AC/DC+			N/A	
	16.0	1-3	1-7	SMAW	4.0	N/A	160-180		AC/DC+			N/A	

Heat treatment :			**CWB Acceptance**	**Company Authorization**
Preheat min:	10° C	Interpasstemp.max.:		To be signed by the engineer or supervisor before submission to the CWB
		Interpasstemp.min.:	10° C	
Remarks: Preheat in accordance with Table 5-3 of CSA W59				Date: 5/27/2008

CANADIAN WELDING BUREAU

WELDING PROCEDURE DATA SHEET

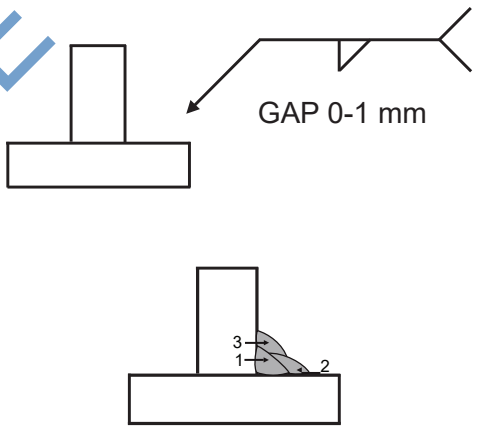
WPDS NO.: GMAW-2F
DATE: 5/27/2008 Rev.: 0

Company Name: Canadian Welding Bureau
Address: 7250 West Credit Avenue, Mississauga, ON L5N 5N1

Ref. Standards: CSA W47.1/ W59
Ref. WPS: GMAW-1

Welding Processes:	1	GMAW Pulsed: ☐ Yes ☑ No	2		Pulsed: ☐ Yes ☐ No
Shielding Gas Type:		90%Ar/ 10% CO2			
Positions:	Horizontal				
Process Mode:	☐ Manual ☑ Semi-Auto ☐ Machine ☐ Auto				
Joint Type:	☐ Butt ☑ Tee ☐ Corner ☐ Lap ☐ Edge				
Penetration:	☐ Complete ☐ Partial ETT=		☑ Fillet		
Backing:	Material: N/A		Thickness:		
Backgouging:	☐ Yes Method:				
	☑ No Depth:				
Electrode Extension:	20 mm				
Nozzle Diameter(s):	16 mm				
Flux Classification:	N/A				
Tungsten Electrode:	Type: N/A		Dia.:		
Cleaning Procedures	Wire brush, clean between passes				
CSA W186 Rebar Splice Type:	☐ Direct Splice ☐ Indirect Splice ☐ Lap Splice ☐ Rebar to Structural Member Only				

Joint Configuration & Pass/Layer Sequence



Identification of Base Material (for CSA W186 indicate carbon equivalent, max. phosphorus & sulphur content)

Part	Specification & Grade	Thickness or Dia.	Special Requirements
I	ASTM A36, A516 Gr. 70 G40.21Gr. 300W, 350 W	6-10 mm	N/A
II	ASTM A36, A516 Gr. 70 G40.21Gr. 300W, 350 W	6-10 mm	N/A

Identification of Filler Material

Process	Trade Name	Classification	Group	Filler Treatment
GMAW	N/A	ER49S-6	N/A	Cl. 5.2.4.5, CSA W59

Welding Parameters

Thick-ness ( )	Weld Size/ ETT	Layer	Pass Number	Welding Process	Dia. (mm)	Wire Feed Speed (m/min)	Current A	Volt V	Current Polarity	Welding Speed (mm/min)	Burn-Off Rate ( )	Gas Flow Rate (l/min	Heat Input ( )
	6	1	1	GMAW	1.2	10.0	260	28	DC+	400-500		20	
	8	1	1	GMAW	1.2	10.0	260	28	DC+	300-400		20	
	10	1	1	GMAW	1.2	10.0	260	28	DC+	400-500		20	
		2	2-3	GMAW	1.2	10.0	260	28	DC+	400-500		20	

Heat treatment :

Preheat min: 10° C
Interpasstemp.max.: 250° C
Interpasstemp.min.: 10° C

In accordance with Table 5-3, CSA Standard W59

CWB Acceptance

Company Authorization

To be signed by the engineer or supervisor before submission to the CWB

Date: 5/27/2008