The Impact Testing Enigma

A Review of ASME Section VIII, Division 1, Subsection C, Part UCS, Impact Testing Requirements

AB-511

Edition 4, Revision 0 – Issued 2026-06-23

1.0 INTRODUCTION 1
2.0 DEFINITIONS 2
3.0 IMPACT TESTING DECISION CHARTS 4
3.1 Impact Testing Requirements (Materials) 4
3.2 Impact Testing Requirements of Welding Procedures with Filler Metal 5
3.3 Impact Testing Requirements of Welding Procedures without Filler Metal 6
3.4 Impact Testing Requirements Vessel [Production] Impact Tests (Page 1) 7
3.5 Impact Testing Requirements Vessel [Production] Impact Tests (Page 2) 8
4.0 MATERIALS & DESIGN 9
4.1 General 9
4.2 CSA B51, Clause 7.1.3 9
4.3 UG-20(f)(1) 9
4.4 UCS-66 (c) and Figure UCS-66: SA-105 Flange Materials 9
4.5 Table UCS-67.2-1 10
4.6 UCS-68.1 11
4.7 Exemption Combinations 11
4.8.1 Interpretation VIII-1-89-138R 11
4.8.2 Interpretation VIII-1-95-15 11
4.8.3 Interpretation VIII-1-95-160 11
4.8.4 UG-20(f) + UCS-66(b) 12
4.8.5 UG-20(f) + UCS-68.2(a) 12
4.8.6 Table UCS-56-1 Note (b)(2) + UCS-68.2(a) 12
5.0 WELDING PROCEDURES 12
5.1 QW-407.2 12
5.2 QW-403.6 12
5.3 UG-84.8(a), (a)(1), (2), & (3) Impact Testing of Welds and Heat Affected Zones 12
5.4 UG-84.8(b), (b)(1), (2) & (3) 13
5.5 UG-84.8(c), (c)(1), (2), & (3) 14
5.6 UG-84.8(d), (d)(1), & (2) 15
5.7 UG-84.8(e) 16
6.0 FABRICATION 16
6.1 UCS-67.2 16
6.2 UG-84.9(a) & (b) Production Impact Testing 17
6.2.1 Interpretation VIII-1-21-12 18
6.3 UG-84.9(d)(1) Number of Vessel Impact Test Plates Required 18
6.4 UG-84.9(d)(3) Number of Vessel Impact Test Plates Required 18
6.5 UG-84.3 Test Specimens 19
7.0 TESTING 20
7.1 UG-84.9(e) Rejection 20
8.0 REVISION LOG 20

1.0 INTRODUCTION

Manufacturers continuously face the challenge of complying with the impact testing provisions of ASME Section VIII, Division 1. This guideline document has been developed to assist Manufacturers working through the impact test requirements set forth in ASME Section VIII, Division 1.

As Code impact testing rules are quite complex, instances of misconception and/or oversight are not unusual, hence the enigma. The material provided in this document is not intended to replace the Code rules. The intent of this review of impact testing rules and the decision charts provided is to help manufacturers meet Code requirements. The presentation material consists of a series of impact testing decision charts, and a selection of the **most common** problems, misconceptions and oversights with regard to impact testing as it applies to pressure vessel construction to the ASME Code, Section VIII, Division 1, CSA B51, and the Alberta Safety Codes Act and Pressure Equipment Safety Regulation. The primary focus of the document is on Subsection C, Part UCS impact testing requirements.

To ensure this document remains relevant and of value to Alberta stakeholders, it shall be reviewed periodically to confirm that it is aligned with current industry best practices and policies. Additionally it shall be revised whenever an urgent need is identified. Any suggestions for improvement are welcome. Please provide comments to:

Mike Prefumo
Manager of Inspections
prefumo@absa.ca

This document has been revised to include revisions to ASME Section VIII, Division 1, Subsections A and C, up until and including the 2025 Edition and CSA-B51, 2019 Edition.

The next scheduled revision for AB-511 is in 2031.

2.0 DEFINITIONS

Enigma – Something hard to understand or explain (Webster's Ninth New Collegiate Dictionary).

Fined Grain Practice – The procedure necessary to obtain a fine austenitic grain size as described in SA-20.

GMAW – Gas Metal Arc Welding

HAZ – Heat Affected Zone

Heat (Steal Manufacturing) – The material obtained from one furnace melt, where slag-metal or gas-metal reactions occur in producing the specified alloy (e.g. open hearth, electric arc, basic oxygen, argon-oxygen processes). Mill splicing of coils from different heats is not permitted, and coils containing transition heats may not be classified in this manner.

Impact Test – A Charpy V-notch impact test is a dynamic test in which a notched specimen is struck and broken by a single blow in a specially designed testing machine. The measured test values may be the energy absorbed, the percentage shear fracture, the lateral expansion opposite the notch, or a combination thereof.

Impact Test Coupon – A coupon attached to a production weld that, once completed, is prepared so the required impact tests can be performed with the test results used to represent actual production welding. For the purpose of this document the term impact test coupon can also be known as, impact coupon, run-off tab, impact test plate and weld test coupon.

Lot (Welding Consumables) – A unique identifying designation for a specific type and quantity of welding consumable, usually beginning with the word "lot" and followed by a series of numbers and/or letters.

MDMT – Minimum Design Metal Temperature - means the minimum design metal temperature for which a pressure vessel was registered.

NPS – Nominal Pipe Size

PQR - Production Qualification Record – Means documents of what occurred during the production of a procedure qualification test coupon and the results of that coupon.

PWHT – Post Weld Heat Treatment

SAW – Submerged Arc welding

SMAW – Shielded Metal Arc Welding

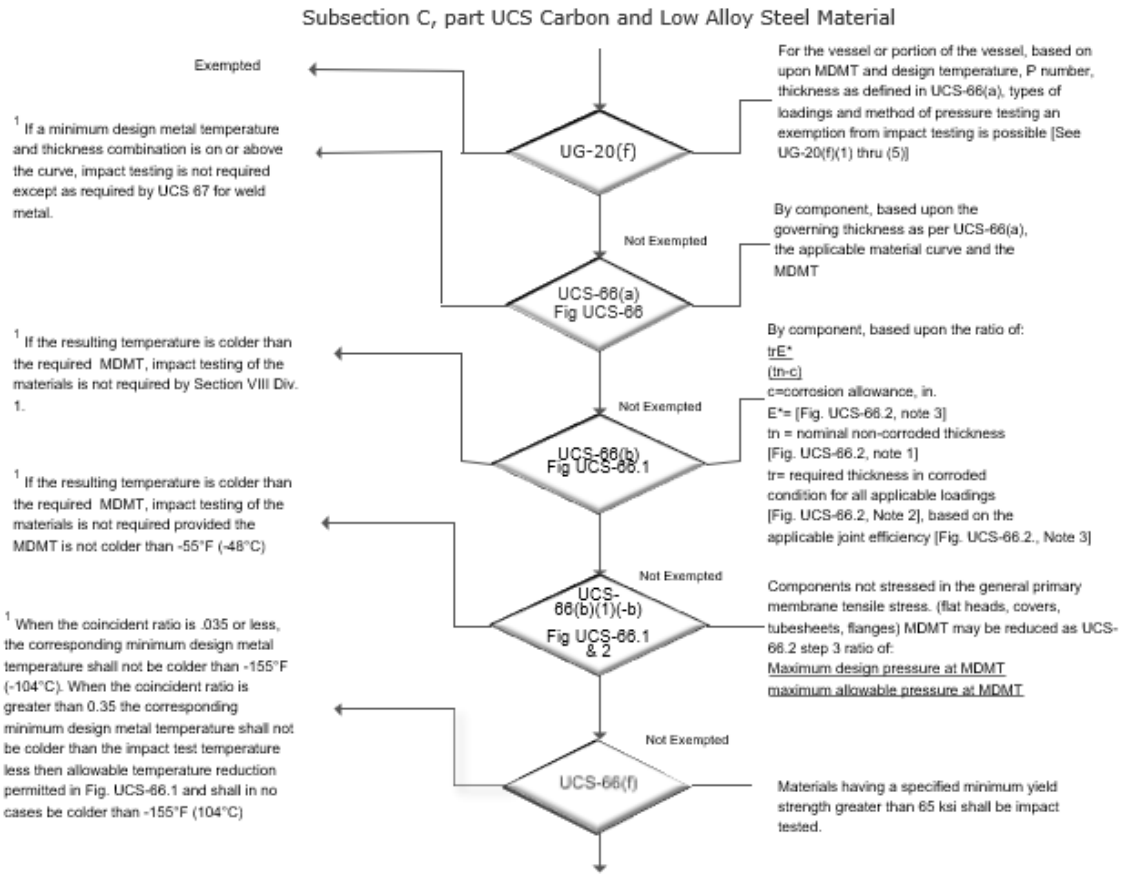
SFA – Universal classification system for welding filler materials.

Specimen – A sample of a weld test coupon for a specific test.

WPS – Means a Welding Procedure Specification meeting the requirements of ASME Section IX Code.

3.0 IMPACT TESTING DECISION CHARTS

3.1 Impact Testing Requirements (Materials)



UCS-66 (c) Exemption for impact testing of the following types of ferritic steel flanges: (ASME B16.5, ASME B16.47, and long weld neck forged flanges as defined in UCS-66(c) Also refer to IB-20-008: Justification of SA-105 Flanges for Low Temperature Service in ASME Section VIII-1 2019 Edition.
UCS-66(d) Exemption for thin UCS materials and thin P-1 materials in pipe and tubes less than NPS 4 NPS (Refer to UCS-66(d) for thickness limitations).
UCS-66(g) Exemption for Figure UG-84.5-1/UG-84.5-1M), General Note (c), materials (at MDMT's not colder than 5°F (3°C) colder than the test temperature required by the specification).
UCS-66(h) Exemption for metal backing strips of materials assigned to Curve A of Figure UCS-66/ UCS-66M) and 1/4 in. or less in thickness which remain in place with MDMT no colder than -20°F (-29°C).
UCD-66(i) Reduction of MDMT for impact tested components based upon coincident ratio (Fig UCS-66.1)
UCS-66(j) When base metal is exempt from impact testing by UCS-66(g) or by Fig. UCS-66 Curves C or D, -20°F (-29°C) is the coldest MDMT to be assigned for welded components that do not meet UCS-67.

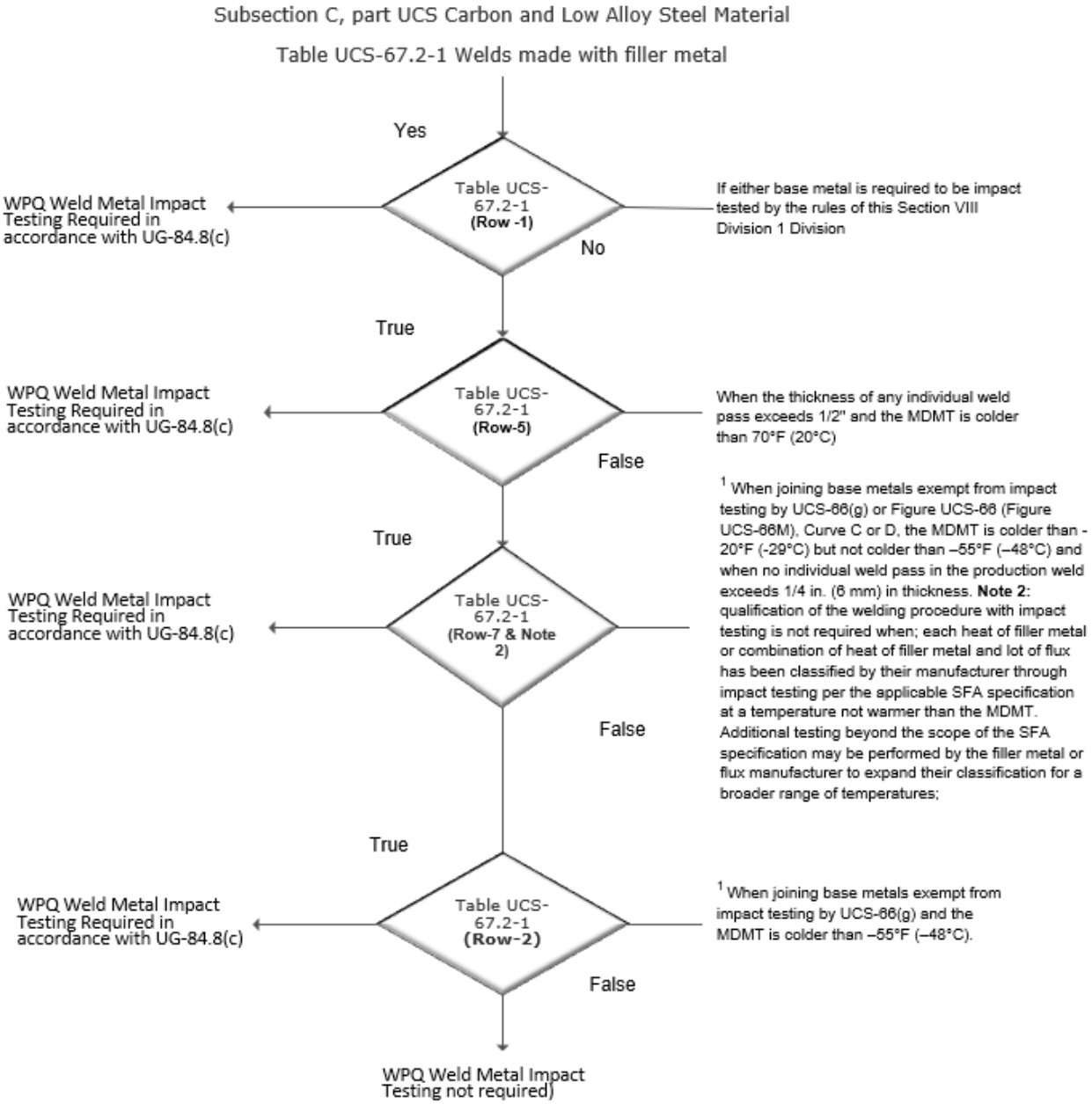
↓

Impact Testing Required in accordance with UG-84

See UCS-68.2(a) for further reduction of 30°F (17°C) in the MDMT exemption when non-mandatory PWHT is performed for P-No.1 Materials.
[1] Note: CSA B51 Clause 7.1.3 requires impact testing at a MDMT below -50°F (-46°C)

Prepared in accordance with ASME Section VIII Division 1-2025 Ed. & CSA 51:19

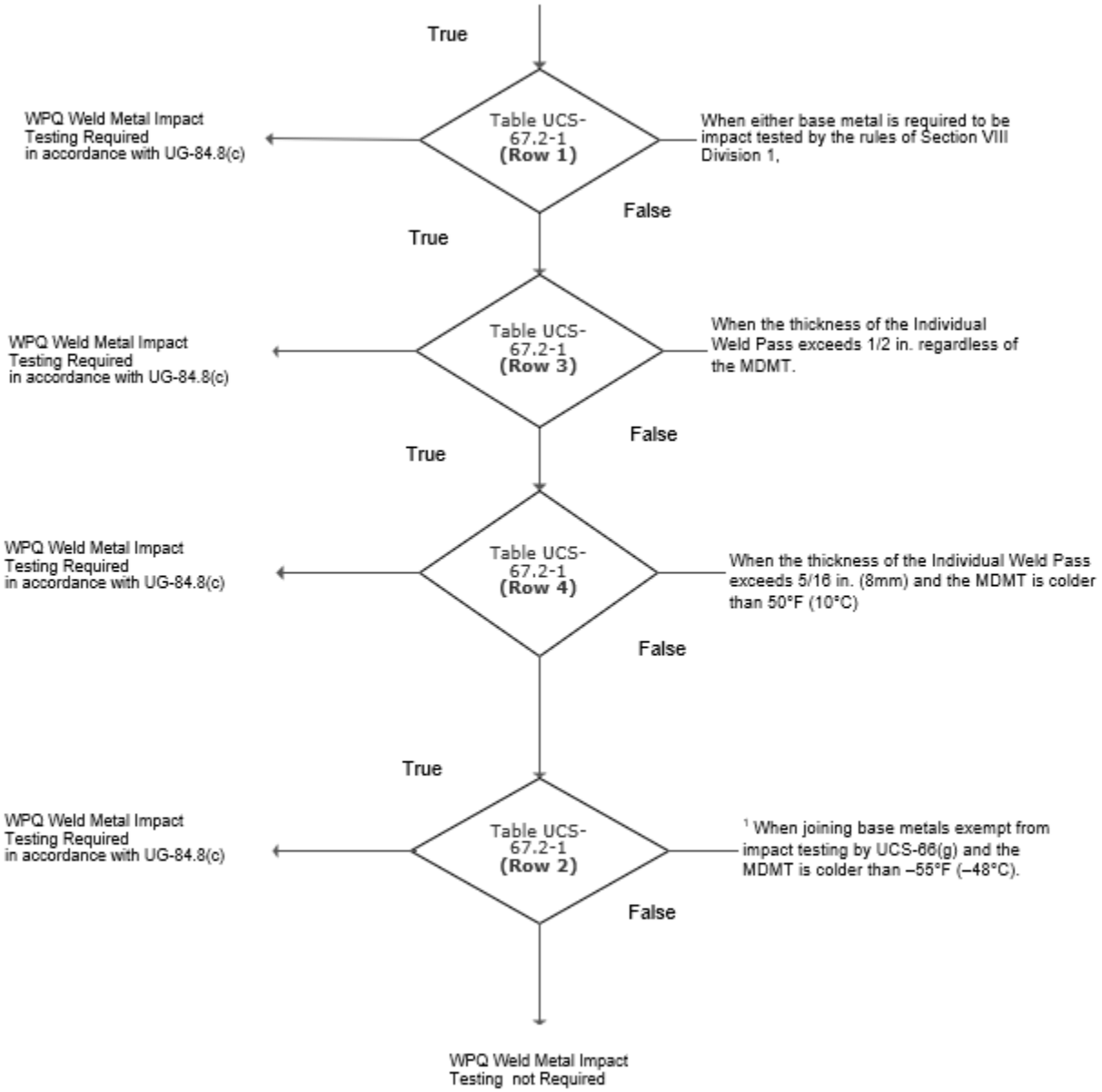
3.2 Impact Testing Requirements of Welding Procedures with Filler Metal



3.3 Impact Testing Requirements of Welding Procedures without Filler Metal

Subsection C, part UCS Carbon and Low Alloy Steel Material

Table UCS-67.2-1 Except for welds made as part of the material specification, welds in UCS materials made without filler metal shall be completed using welding procedures qualified with impact testing when:

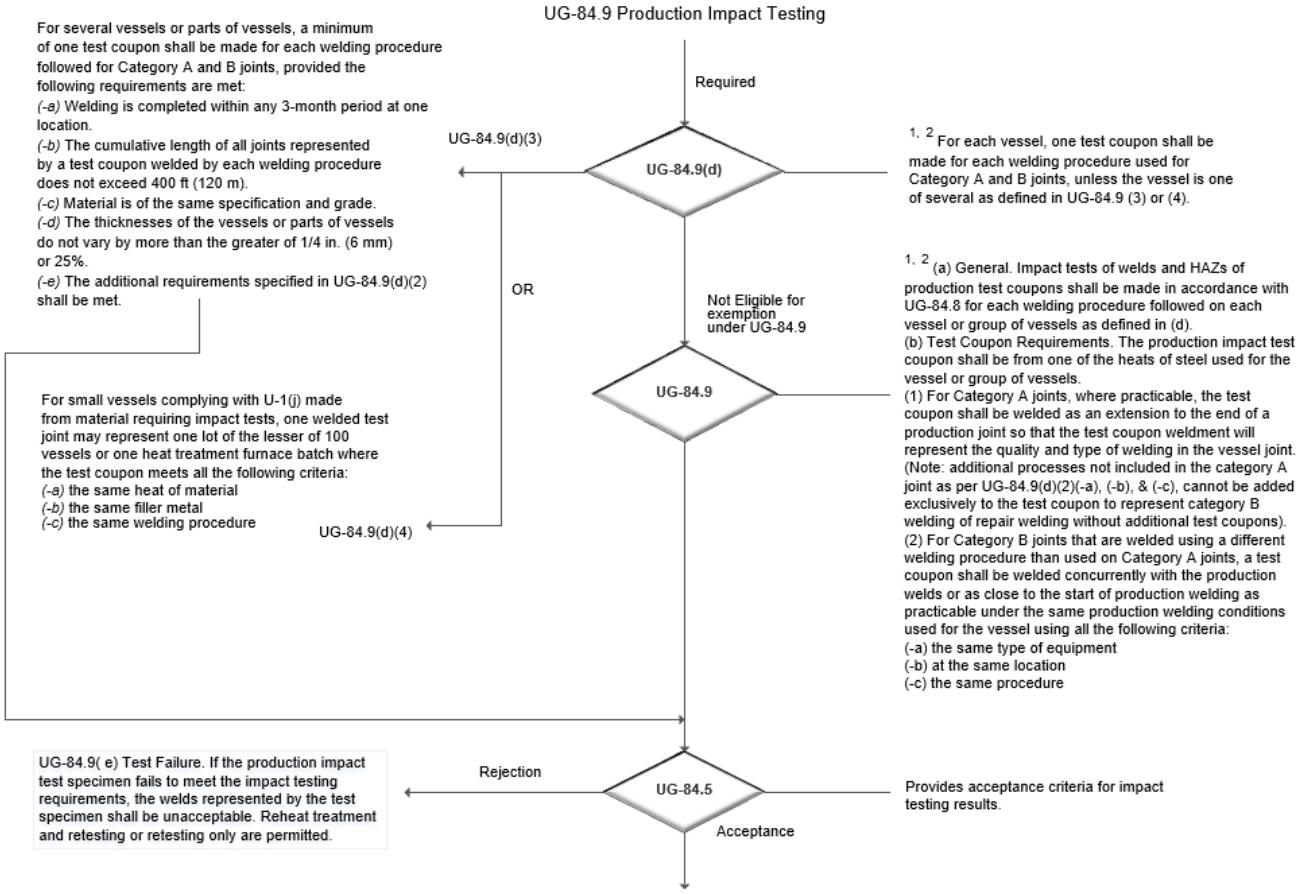


[1] Note: CSA B51Clause 7.1.3 requires impact testing at a MDMT below -50°F (-46°C)

Prepared in accordance with ASME Section VIII Division 1-2025 Ed. & CSA 51:19

See Table UC-67.2-1 in 4.5 for Row designations

3.4 Impact Testing Requirements Vessel [Production] Impact Tests (Page 1)



[1] Note: Clause 7.1.3 requires impact testing at a MDMT below -50 F (-46C)

[2] Note: UG-84.9(d)(2)(-a), (-b), & (-c), Stipulations on test coupon weld positions, and if automatic, machine, semiautomatic manual welding is performed.

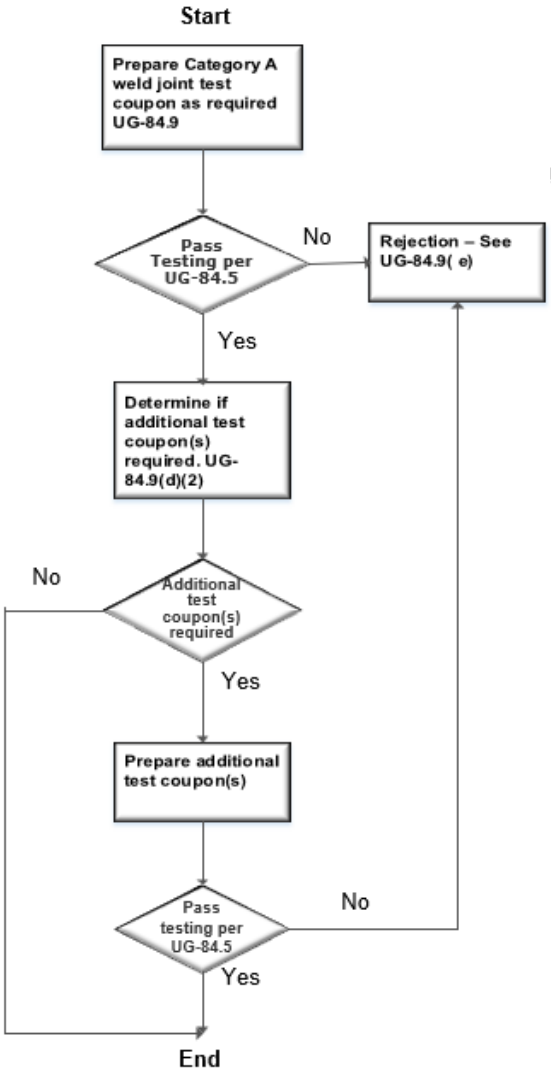
Prepared in accordance with Section VIII Division 1-2025 Ed. & CSA B51:19

3.5 Impact Testing Requirements Vessel [Production] Impact Tests (Page 2)

Impact Testing Requirements Vessel [Production] Impact Tests Page 2

Example 1

a) Vessel contains both category A and category B weld joints.
b) Category A and B joints are welded using the same multi process (GMAW-SMAW-SAW) WPS
c) The vessel is not one of several per UG-84(d)(3) or (4)



UG-84.9(b)(1)
For Category A joints, the test coupon shall, where practicable, be welded as an extension to the end of a production joint so that the test coupon weldment will represent as nearly as practicable the quality and type of welding in the vessel joint.

Note: This requires all processes that will be used in the Category A joint to be included in the test coupon

UG-84.9 (e) Test Failure. If the production impact test specimen fails to meet the impact testing requirements, the welds represented by the test specimen shall be unacceptable. Reheat treatment and retesting or retesting only are permitted.

UG-84.9(d)(2)
In addition, for Category A and B joints the requirements shall, apply:
(-a) If automatic, machine, or semiautomatic welding is performed, a test coupon shall be made in each position employed in the vessel welding.
(-b) If manual welding is also employed, a test coupon shall be made in the flat position.
(-c) If welding is to be performed in other positions a test coupon shall be made in the vertical position.
(-c)(-1) The major layers of welds shall be deposited using vertical uphill progression.
(-c)(-2) An acceptable test coupon qualifies.

Note:
A long seam with an attached production test coupon is welded using only the SAW welding process. The circumferential seams are to be welded using a semiautomatic (GMAW) and manual welding (SMAW) process. Now that these processes have been added as per UG-84.9(d)(2) above, this would require as additional test coupon to represent the addition of other processes. It would be acceptable to add these additional processes to the initial longitudinal seam with attached test coupon to cover the manual and semiautomatic processes that will be used in any additional longitudinal and circumferential seams provided the impact test coupon follows the requirements of UG-84.8(d)(2). An impact test coupon using a WPS qualified with multiple weld processes, can still be used to qualify other weld joints when one or more of the weld processes has been omitted. This is supported by interpretation BPV VIII-1-21-12.

4.0 MATERIALS & DESIGN

4.1 General

Code users and pressure equipment owners are reminded that their responsibility for ensuring the safety and suitability of their equipment goes beyond meeting the specific requirements of codes and standards. Owners are responsible to ensure material selected is fit-for-purpose in low temp applications.

4.2 CSA B51, Clause 7.1.3

Carbon and low alloy steel used for the construction of pressure vessels at a minimum design metal temperature below -46ºC (-50 °F) and shall be impact tested at the MDMT or lower temperature with the test results meeting UG-84 of ASME Section VIII Division 1.

4.3 UG-20(f)(1)

To qualify for exemption under UG-20(f) the material shall be limited to P Number 1, Group Number 1 or 2, and **the thickness as defined in UCS-66(a)** [see also, Note(1) in Fig.UCS-66.2] is limited to ½ inch for curve A materials and 1 inch for curve B, C, or D materials of Figure UCS-66.

4.4 UCS-66 (c) and Figure UCS-66: SA-105 Flange Materials

The 2019 edition of ASME VIII-1 introduced more stringent requirements for impact test exemption of SA-105 flange materials. SA-105 forged flanges supplied in the as-forged condition are assigned to Curve A and SA-105 forged flanges produced to fine grain practice and supplied in normalized, normalized and tempered, or quenched and tempered condition after forging are assigned to Curve B in Figure UCS-66. Respectively, Subparagraph UCS-66(c) has been revised to raise the impact test exemption temperature for ferritic steel flanges to 0°F (-18°C) when they are provided in the as-forged condition. An exemption temperature of -20°F (-29°C) is still permitted for such flanges when they are produced to fine-grain practice and either normalized, normalized and tempered, or quenched and tempered after forging. See ABSA Information Bulletin IB20-008 (Justification of SA-105 Flanges for Low Temperature Service in ASME Section VIII-1 2019 Edition) for more details.

4.5 Table UCS-67.2-1

Table UCS-67.2-1
Requirements and Exemption of WPS Impact Testing Qualification

Row	Use of Filler Metal (With/Without)	MDMT (See UCS-67.1)	Individual Weld Pass Thickness	Base Metal Impact Testing Required/Exempt	WPS Qualification with Impact Testing
1	With / without	Any	Any	Required (either component)	Required
2	With / without	Colder than −55°F (−48°C)	Any	Exempt per UCS-66(g)	
3	Without	Any	> 1/2 in. (13 mm)	Regardless of base metal impact testing requirements	
4	Without	Colder than 50°F (10°C)	> 5/16 in. (8 mm)		
5	With	Colder than 70°F (21°C)	> 1/2 in. (13 mm)		
6	With	Colder than −20°F (−29°C) but no colder than −55°F (−48°C)	> 1/4 in. (6 mm) or Any [Note (1)]	Exempt per UCS-66(g); or Figure UCS-66, Curve C or Curve D	
7	With	Colder than −20°F (−29°C) but no colder than −55°F (−48°C)	≤ 1/4 in. (6 mm) when Note 2 is met	Exempt per UCS-66(g); or Figure UCS-66, Curve C or Curve D	Not Required

General Notes:

1. When the filler metal is qualified per Note (2), or when the filler metal is not qualified per Note (2) regardless of any weld pass thickness.
2. Each heat of filler metal, or the combination of a filler metal heat and a flux lot, is classified by its manufacturer with impact testing in accordance with the applicable SFA specification at a test temperature not warmer than the MDMT. Additional impact testing beyond the requirements of the SFA specification may be performed by the filler metal or flux manufacturer to expand their classifications for a broader range of temperatures.

Table UCS-67.2-1 was added as a consolidation of the prior UCS-67 paragraphs. To help understand the new table as it relates to the previous UCS-67(a)(3) text, rows 6 and 7 will precede the commonly used UCS-67(a)(3) text below. Under the provisions of Table UCS-67.2-1, several requirements and exemptions of WPS impact testing qualifications are listed in the table.

Row 6 - MDMTs that are colder than -20°F but not colder than -55°F, when joining **materials exempt from impact testing by UCS-66(g) or Figure UCS-66, Curves C or D,** and weld passes that exceed 1/4 in**.** (6mm) must be made with welding procedures qualified by impact testing.

Row 7- MDMTs that are colder than -20ºF but not colder than -55ºF, **when joining materials exempt from impact testing by UCS-66(g) or Figure UCS-66, Curves C or D**, qualification of welding procedures with impact testing is not required when no individual weld pass in the production weld exceeds ¼ inch in thickness; and each heat of filler metal or combination of filler metal and lot of flux (used to join these base metals) has been classified by the consumable manufacturer through impact testing per the applicable SFA specification at a temperature not warmer than the MDMT. If consumables are not classified by the consumable manufacturer to the vessel MDMT the vessel Manufacturer should provide evidence (i.e., Material Test Report) to the Authorized Inspector that the required impact testing of weld consumables has been completed by the consumable manufacturer. Welding procedure qualifications shall include impact tests of welds and heat affected zones in accordance with UG-84, as specified in paragraph UCS-67.2 when used.

4.6 UCS-68.1

This paragraph requires that welded joints be postweld heat treated when required by other rules of Section VIII-1 or when the MDMT is colder than -55°F, and the coincident ratio as defined in Fig. UCS-66.1 is 0.35 or greater. Exemptions to UCS-68.1(b) are; for P-No. 1 materials that are impact tested at the specified MDMT or colder in accordance with UG-84, minimum average energy requirements for base metals and weldments specified in UCS-68.1(c)(2), and Category A & B joints plus fillet weld requirements as per UCS-68.1(c)(3) & (4) have been met.

4.7 Exemption Combinations

4.8.1 Interpretation VIII-1-89-138R

If a vessel is constructed of a combination of P-No. 1 Group No. 1 or 2 materials and other materials listed in Subsection C, the rules of UG-20(f) may be applied to the portion constructed of P-No. 1 Group No. 1 or 2.

4.8.2 Interpretation VIII-1-95-15

The allowable temperature reduction determined from Fig. UCS-66.1 (coincident ratio less than 1) and the temperature reduction permitted by UCS-68.2(a), (postweld heat treatment when not otherwise a requirement per Code) may be combined.

4.8.3 Interpretation VIII-1-95-160

The additional temperature reduction provided by UCS-68.2(a) may **not** be applied to the provision of UCS-66(c), which allows ANSI B16.5 and B16.47 flanges and split loose flanges as specified within the Code paragraph, exemption from impact testing when the MDMT is no colder than -20°F.

UCS-68.2(a) specifically requires Figure UCS-66 to be used to determine the temperature to which the reduction is applied, and does not permit UCS-66(c) to be used to determine the starting temperature. Although Interpretation VIII-1-95-160 permits a user to use a temperature determined by UCS-66(c), this interpretation is not acceptable for use in Alberta because this was not supported by subsequent revision to subparagraph UCS-68.2(a) to allow a reduction to be applied to the temperature determined by UCS-66(c).

Note: The paragraph references in the above interpretations have been revised to the 2025 VIII-1 Edition for clarity. Please refer to the published interpretation for the complete wording.

4.8.4 UG-20(f) + UCS-66(b)

A temperature reduction determined from Fig. UCS-66.1(coincident ratio less than 1) **may not** be applied in addition to an exemption from impact testing under UG-20(f).

4.8.5 UG-20(f) + UCS-68.2(a)

A temperature reduction permitted by UCS-68.2(a) **may not** be applied in addition to an exemption from impact testing under UG-20(f).

4.8.6 Table UCS-56-1 Note (b)(2) + UCS-68.2(a)

A temperature reduction permitted by UCS-68.2(a) **may not** be applied when the provisions of table UCS-56-1, General Note (b)(2) is used to avoid the requirement to postweld heat treat (200°F preheat for P-No. 1 materials over 1¼ in. nominal thickness through 1½ in. nominal thickness).

5.0 WELDING PROCEDURES

5.1 QW-407.2

This Supplementary Essential Variable requires that the procedure qualification test be subjected to PWHT essentially equivalent to that encountered in the fabrication of production welds, including **at least 80%** of the aggregate time(s) at temperature(s). For example, to remain within the WPS requirements, the maximum post weld heat treatment time(s) at temperature(s) for the production weld or production test coupons is 1.25 times the time(s) at temperature(s) qualified by the PQR coupon.

5.2 QW-403.6

This Supplementary Essential Variable specifies that the minimum base metal thickness qualified is the thickness of the test coupon T or 5/8 in., whichever is less. However, where T is less than ¼ in., the minimum thickness qualified is ½T.

5.3 UG-84.8(a), (a)(1), (2), & (3) Impact Testing of Welds and Heat Affected Zones

(a) Welding Procedure Specifications (WPSs) shall be qualified with impact testing when required by UCS-67, UHT-82, or UHA-51. When welding procedure qualification with impact testing is required:

(a)(1) The material used for the test coupon shall meet the minimum toughness requirements for the thickest base material thickness of the range qualified by the procedure [see Figure UG-84.5-1 (Figure UG-84.5-1M)].
This paragraph may place an additional limit on the qualification thickness of a WPS. For example, assume a WPS is qualified on a P-No. 1 Group No. 1 base material which has minimum specified yield strength of 55 ksi. If the test is made on a 1½ in. thick plate the test specimen would normally qualify the WPS for thicknesses up to 8 inches. Fig. UG-84.5-1 requires that the impact test results must average 30 ft-lbs. or more to qualify for a thickness of 3 inches or more.
(a)(2) The welding procedures used for fillet welds shall be qualified by groove welded test coupons.
(a)(3) The supplementary essential variables in Section IX, QW-250 shall apply.

5.4 UG-84.8(b), (b)(1), (2) & (3)

(b) Except for P-No. 1, Group Nos. 1 and 2 materials other than SA-737 and SA-841, the weld test coupon material for vessels constructed of Part UCS materials shall be in the same material heat treatment condition before welding (as rolled, normalized, quenched and tempered, etc.) as the material of construction.

(b)(1) The heat-treatment condition shall be recorded on the procedure qualification record (PQR) and specified on the WPS.

(b)(2) The test coupons **(PQR and Production, when not exempted)** shall be subjected to the same postweld heat treatment established by the Manufacturer for production, including the aggregate time at temperature or temperatures.

This paragraph can have significant consequences when an exemption under the referenced paragraphs is not available. For instance P-No. 3, Gr. Numbers 1 and 2 materials, reheat treatment of the vessel could lead to unacceptable WPS and production impact tests. **Material impact test results may also be unacceptable** under reheat treatment as provided for in Subsection C. Particular attention should be paid to this paragraph when dealing with UHT materials.

One must remember that irrespective of the Subsection C exemptions to UG-84.8(b)(2) & (3), the WPS(s) may become unacceptable if the vessel itself, or production impact test coupons are subjected to heat treatments that are outside of QW-407.2 requirements for the welding procedure [at least 80% of aggregate time(s) at temperature(s)].

(b)(3) Heat treatment requirements of UG-85, UCS-85, UHT-81, and UHT-82 shall apply to the test coupons, except the provisions of UCS-85(f) and UCS-85(g) are not applicable.

5.5 UG-84.8(c), (c)(1), (2), & (3)

(c) For steel vessels of welded construction, the toughness of welds and heat-affected zones (HAZs) of procedure qualification test coupons and production impact test coupons shall be determined as follows:

(c)(1) Each set of weld metal test specimens shall be taken transverse to the weld axis and prepared with;

(c)(1)(-a) the notch located in the weld metal, perpendicular to the surface of the material

(c)(1)(-b) one face of the specimen within 1/16 in. (1.5 mm) of the surface of the material, except the test specimens may be removed from any depth when the weld has been postweld heat treated.

(c)(2) When impact tests are required for the weld metal but the base material is exempt, both the following requirements shall be met;

(c)(2)(-a) The test coupon shall be made from the same P-Number and Group number material as the vessel.

(c)(2)(-b) impact testing of the weld metal shall be performed but impact testing of the HAZ is not required.

(c)(3) Each set of HAZ test specimens shall be taken transverse to the axis of the weld and of sufficient length to locate the fusion line after etching.

(c)(3)(-a) Use a joint design where only one side of the joint is beveled (i.e, a single-bevel or double-bevel groove weld) is recommended to obtain a specimen containing as much of the HAZ as possible. See Figure UG-84.8-1

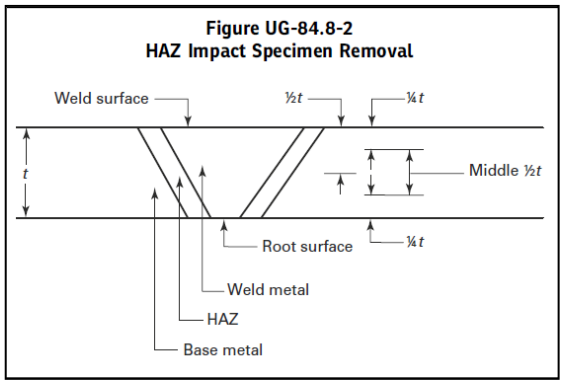
(c)(3)(-b) When the material to be tested is less than 1 in. (25 mm) thick, the HAZ test specimens shall be removed from a depth that maximizes the amount of the HAZ at the notch centerline.

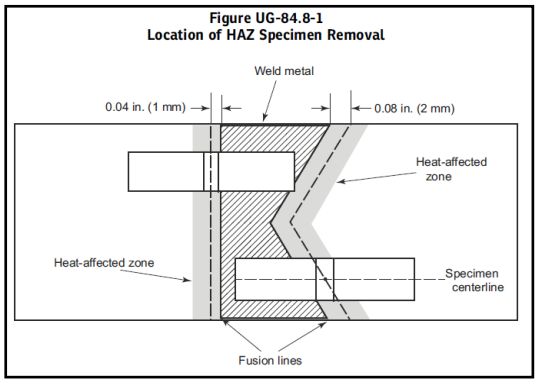
(c)(3)(-c) When the material to be tested is 1 in. (25 mm) thick or greater, test specimens prepared shall be removed from coupons prepared as shown in Figure UG-84.8-2 with their centerlines between 1/2 and 1/4 of the material thickness below the surface.

(c)(3) (-d) The notch shall be normal to the material surface.

(c)(3) (-e) When the angle of the HAZ is approximately normal to the material surface, the middle of the notch centerline shall be approximately 0.04 in. (1 mm) from the fusion line.

(c)(3)(-f) When the HAZ is at an angle to the material surface, the middle of the notch centerline shall be located approximately 0.08 in. (2 mm) from the fusion line as shown in Figure UG-84.8-1.





UG-84.8(c)(3)(-a), (-c), & (-f) illustrates through Figure UG-84.8-1 and Figure UG-84.8-2 the location of where heat-affected zone impact specimens must be taken.

5.6 UG-84.8(d), (d)(1), & (2)

(d) Each welding process may be qualified using single process or multi-process test coupons.

(d)(1) If more than one set of essential or supplementary essential variables for a process is recorded on a PQR (e.g. different filler metal F-numbers, from E6010 to E7018), the requirements below for multi-process testing shall apply for each set of essential or supplementary essential variables as if that set of variables defined a separate welding process.

(d)(2) When more than one welding process is included in a test coupon the following shall apply:

(d)(2)(-a) The test specimens shall be full-sized or the largest obtainable subsize test specimen based on the thickness of the test coupon (when material thickness does not support full size specimens subsize are acceptable).

(d)(2)(-b) The weld metal test specimens shall contain as much of the weld metal from each process as practical.

(d)(2)(-c) When the test coupon contains more than two welding processes, additional weld metal impact test specimens shall be removed from the thickness depth where each process is located.

(-d) HAZ test specimens shall be removed from the thickness depth associated with deposited weld metal from each process and may contain HAZ material from more than one welding process.

(-e) When specimens contain weld metal or HAZs from more than one welding process, the test results apply to all the processes contained in those specimens.
(-f) Procedure qualifications completed using subsize test specimens tested in accordance with the 2017 Code Edition or later Editions remain acceptable.

5.7 UG-84.8(e)

(e) When qualifying a Welding Procedure Specification (WPS) for welding base metals having different impact testing requirements and acceptance criteria, the following shall apply:

(e)(1) The weld metal impact test specimens shall meet the acceptance criteria for either base metal.

(e)(2) When HAZ impact tests are required, separate impact test specimens shall be removed from the HAZ of each base metal requiring impact testing, and each set of test specimens shall meet the acceptance criteria applicable for the base metal from which they were removed.

6.0 FABRICATION

6.1 UCS-67.2

This paragraph references Table UCS-67.2-1 (see 4.5) which stipulates that welds made with or without filler metal shall be deposited using welding procedures qualified with impact testing when any of the following apply:

6.1.1 **Row 1** - When either base metal is required to be impact tested with or without the use of filler metal,

6.1.2 **Row 5** - When the thickness of any individual pass exceeds ½ inch and the MDMT is colder than 70°F, with the use of filler metal,

6.1.3 **Row 7** - When joining base metals exempt from impact testing by UCS-66(g) (typically SA-350 LF2 Class 1, SA-333 Grade 6 materials), or above the curves of Figure UCS-66 C or D, and the MDMT is colder than -20°F but no colder than -55°F. Qualification of the welding procedure with impact testing is not required when no individual pass in the production weld exceeds ¼ in. in thickness and each heat of filler metal or combination of filler metal heat and flux lot is classified by its manufacturer

with impact testing in accordance with the applicable SFA specification at a test temperature not warmer than the MDMT.

The minimum design metal temperature (MDMT) used in UCS-67.1 shall be either the MDMT stamped on the nameplate or the exemption temperature of the welded component before applying the temperature reduction permitted by UCS-66(b) or UCS-68.2.

6.2 UG-84.9(a) & (b) Production Impact Testing

(a) Impact tests of welds and HAZ of production test coupons shall be made in accordance with UG-84.8 for each welding procedure followed on each vessel or group of vessels as defined in UG-84.9(d).

(b) The production impact test coupon shall be from one of the heats of steel used for the vessel or group of vessels.

(b)(1) For Category A joints, where practicable, the test coupon shall be welded as an extension to the end of a production joint so that the test coupon weldment will represent the quality and type of welding in the vessel joint.

The term practicable has been interpreted different ways. For example, a run-off tab would not be practicable for the Category “A” joint in a sphere made from 2 hemispheres or when a seamless shell is used without a long seam. This should not be interpreted so as to avoid the use of the run-off tab due to other problems (such as not attaching the impact coupon to the long seam because it was not practicable at the time) or welding the test coupon after the vessel has been completed because it was forgotten at the start of production and this is considered as close to the start of production as practicable. This is supported by Interpretation VIII-79-16.

In an attempt to meet all of the requirements with only one test coupon, and save on the cost of additional mechanical testing, some Manufacturers have proposed to prepare a test coupon which is attached to the first longitudinal seam to be welded with the type(s) of welding that will be used in production, as required by UG-84.9(d)(2)(-a) and UG-84.9(d)(2)(-b).

This test coupon shall represent the quality and type of welding in the vessel Category A joint(s). The impact test coupon would satisfy UG-84.9(a) provided the welding type used in the Category A joint is present. Interpretation VIII-1-21-12 supports this approach.

A test coupon weldment completed with the first production longitudinal seam that includes two or three welding processes could represent additional Category A joints made with a single welding process. The run-off tab (test coupon) shall be welded as an extension to the end of the first production longitudinal seam so

that the test coupon weldment will represent as nearly as practicable the quality and welding in the vessel joint to meet Code requirements. A test coupon welded with the first longitudinal seam that is a composite of all types of welding that exist in the remaining Category A and Category B joints is allowed based on the interpretation.

6.2.1 Interpretation VIII-1-21-12

Q. For a given vessel, a production impact test plate meeting the requirements of UG-84(i) for a Cat A joint is welded using a WPS containing three welding processes. All three of the welding processes on the WPS were used to make the weld deposit and the test plate follows the requirements of UG-84(h)(5). If another Cat A or Cat B joint exists in this vessel and was welded using the same WPS, but only with one of the welding processes listed, is an additional production impact test plate required?

A. No.

(b)(2) For Category B joints that are welded using a different welding procedure than used on Category A joints, a test coupon shall be welded concurrently with the production welds or as close to the start of production welding as practicable under the same production welding conditions used for the vessel using all the following criteria:

(-a) the same heat of material
(-b) the same filler metal
(-c) the same welding procedure

Under some circumstances when the above requirements have not been met, a test coupon removed from the production weld seam has been accepted as meeting the Code provisions, but a production impact test coupon cannot be welded after the fact.

6.3 UG-84.9(d)(1) Number of Vessel Impact Test Plates Required

(1) For each vessel, one test coupon shall be made for each welding procedure used for joints of Categories A and B, unless the “vessel” is one of several as defined in UG-84.9(d)(3) or UG-84.9(d)(4).

6.4 UG-84.9(d)(3) Number of Vessel Impact Test Plates Required

(d)(3) For several vessels or parts of vessels, a minimum of one test coupon shall be made for each welding procedure followed for Category A and B joints, provided the following requirements are met:

(d)(3)(-a) Welding is completed within any 3-month period at one location (the 3-month period is from when welding has started on the category A & B joints of the first vessel and ends once the last category A & B joints are completed on the last vessel to be represented)

(d)(3)(-b) The cumulative length of all joints represented by a test coupon welded by each welding procedure does not exceed 400 ft (120 m).
(d)(3)(-c) Material is of the same specification and grade.

(d)(3)(-d) The thicknesses of the vessels or parts of vessels do not vary by more than the greater of 1/4 in. (6 mm) or 25%.

(d)(3) (-e) The additional requirements specified in UG-84.9(d)(2) shall be met.

If it is intended to invoke the provisions of this paragraph, accurate records of Category A and B welding footage must be maintained by the manufacturer. The records must be acceptable to the Authorized Inspector.

When reviewing the applicability of production impact tests that have been performed, against the requirements of UG-84.9(d)(3), use the thickness of the impact test coupon for determination of the 25% thickness variation provision not the thickness of the thickest production part welded.

Questions have arisen as to the applicability of the limitations of UG-84.9(d)(3), when a vessel has had impact test coupons prepared in accordance with UG-84.9(d)(1), **What if the production welding extends beyond a three month time period?** The time, thickness and footage limitations do not apply to production impact tests performed in accordance with UG-84.9(d)(1).

6.5 UG-84.3 Test Specimens

As per UG-84.3(a) a set of impact specimens consists of three test specimens removed from each area required to be tested.

Impact specimens shall be full-sized or the largest subsize Charpy V-notch specimens that can be obtained from the material to be tested. Only materials that are less than full size specimens can be subsize. Where the maximum obtainable Charpy specimen has a width along the notch less than 0.099 in. (2.5 mm), impact tests are not required.

7.0 TESTING

7.1 UG-84.9(e) Rejection

If the production impact test specimen fails to meet the impact testing requirements, the welds represented by the test specimen shall be unacceptable. Reheat treatment and retesting or retesting only are permitted.

Under the provision for reheat treatment it is necessary to consider the applicability of the welding procedure under QW-407.2, as well as UG-84.8(2) & (3) implications.

8.0 REVISION LOG

Edition	Revision	Date	Description
1	0	1999-09-20	1st Edition
1	1	1999-10-25	General Updates
2	0	2016-04-08	General Updates
2	1	2017-05-03	Added t=1½ in. row to table in section 5.7 & removed equal to sign in row 4
3	0	2021-11-09	Editorials for clarity and revisions to align with 2021 ASME BPV Code
3	1	2023-10-04	Revisions to align with the 2023 ASME BPV Code
3	2	2024-11-26	Revisions to align with the 2024 CSA B51 edition
4	0	2026-06-23	5-year reaffirmation. Revisions to align with the 2025 ASME BPV Code