

Guide for the Certification of Metal Products Inspectors



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CERTIFIED METAL PRODUCTS INSPECTOR COMMITTEE

The Canadian Welding Bureau *Guide for the Certification of Metal Products Inspectors* was developed with the assistance of the industry representatives named below, who met as a committee to contribute their ideas and opinions to this new certification program.

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**GUIDE FOR THE
CERTIFICATION OF
METAL PRODUCTS INSPECTORS**

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GUIDE FOR THE

CERTIFICATION OF METAL PRODUCTS INSPECTORS

1. SCOPE

- 1.1 This Guide is for the certification of Metal Products Inspectors who have fulfilled the qualification requirements described herein and who carry out inspection activities in metal fabrication, metal manufacturing and on in-service metal products.
- 1.2 The education and training requirements are described in Appendix A.
- 1.3 This certification is voluntary on the part of the inspector.
- 1.4 The Canadian Welding Bureau is the Certifying Authority for this Guide.

2. EDUCATION AND TRAINING

- 2.1 Training and education that fulfils the requirements of Appendix A shall be provided through recognized organizations such as the technical schools and colleges, educational institutes, private companies and other organizations.
- 2.2 Candidates for certification shall submit documentary evidence from the recognized organizations that they have met the training and education requirements stipulated in Appendix A.
- 2.3 Candidates with a minimum of eighteen (18) years experience pertinent to the content of this Guide, may apply for exemption from the mandatory educational and training requirements outlined in Appendix "A", however all applicants shall be required to write the CWB certification examination.
 - 2.3.1 Candidates for exemption to the educational and training requirements identified in Clauses 2.1 and 2.2 shall have worked for at least six (6) years of the eighteen years in the product endorsement for which they are applying for certification.
 - 2.3.2 Eligibility for exemption to the educational and training requirements shall be determined by the Canadian Welding Bureau.

2.4 All candidates for certification must have their education, training and work experience validated by a professional person (see Clause 3, Definitions).

3. **DEFINITIONS**

Bureau - The Canadian Welding Bureau

Certification - Written testimony of successful completion of the qualification and examination to the requirements of the Guide.

CWB - The Canadian Welding Bureau

Experience - The period of time spent in performing work that contributes to a candidate's qualification and thereby eligibility for certification examination.

Metal Products Inspector - A person who has fulfilled the qualification requirements of this Guide and who has passed the CWB certification examinations.

Product Endorsement - Demonstration by the Metal Products Inspector through work experience and examination of detailed knowledge in the inspection requirements of a specific product.

Professional Person - A professional person shall be any one of the following:

- a) Professional Engineer
- b) Person occupying a senior university administrative position or teaching appointment in a university
- c) Person occupying a senior administrative position in a community college
- d) Principal of secondary or primary school
- e) Judge, Magistrate, Police Officer (RCMP, Provincial or Municipal)
- f) Lawyer (member of a provincial bar association)

- g) Mayor
- h) Medical Doctor, Dentist
- i) Minister of Religion authorized under provincial law to perform marriages
- j) Notary Public
- k) Optometrist
- l) Chiropractor

Qualification - Training, education, knowledge and experience required by individuals to perform the job functions of the Metal Products Inspector.

4. VISION REQUIREMENTS

4.1 Vision acuity shall be in accordance with CSA Standard W178.2, Certification of Welding Inspectors, as follows: Applicants for certification shall provide evidence of satisfactory vision as determined by an oculist, optometrist, or other professionally recognized person in accordance with the following requirements:

- a) distant vision shall equal 20/30 or better in at least one eye, either uncorrected or corrected
- b) near vision acuity shall permit reading 0.5 m continuous text (N-4) at a 40 cm test distance with either his/her habitual correction (one or both eyes). The following are considered equivalent to the 0.5 m performance:

TIMES ROMAN		N-4 @ 40 cm
REDUCED SNELLEN		40/50
Jaeger		J2 @ 40 cm
0.5M @ 40 cm	=	0.37M @ 30 cm

4.2 Where corrective lenses are needed to meet the requirements of Clause 4.1 of this Guide, such corrective lenses shall be worn by the certified inspector when carrying out inspection work.

5. CERTIFICATION REQUIREMENTS

5.1 Eligibility for Certification

5.1.1 There are three levels of certification with Level 3 being the most senior. Eligibility for certification examination at any one of these three levels is based on a combination of the candidate's education and training and the number of years of practical work experience (see Appendix A and Table 1 in this Guide).

5.1.2 Eligibility to enter the Metal Products Inspector certification program requires at least one of the following:

- i) Secondary School graduation
- ii) Certification to at least Level 2 in W178.2
- iii) Certification to at least Level II in three (3) nondestructive test methods per CGSB Standards.
- iv) Successful completion of a CWB entrance examination

5.1.3 A candidate who is refused admission to the Metal Products Inspector program may appeal to the Chairman of the Board of the Canadian Welding Bureau (see Clause 9.1 also).

5.2 Certification Levels

5.2.1 LEVEL 1

This level is achieved after the inspector has completed:

- a) the educational and training requirements stipulated for Level 1 in Appendix "A" and Table 1;
- b) the practical experience requirement as defined in Table 1;
- c) the CWB Level 1 examination.

5.2.1.1 Level 1 is considered a training level during which the inspector must work under the supervision of a Level 2 or Level 3 inspector or a CWB approved person. Level 1 does not require a product endorsement (Appendix C).

5.2.2 **LEVEL 2**

This Level is achieved after the Inspector has completed:

- a) the educational and training requirements stipulated for Level 2 in Appendix "A" and Table 1;
- b) the practical experience requirement as defined in Table 1;
- c) the CWB Level 2 examination which shall include at least one product endorsement as specified in Appendix C.

5.2.2.1 The inspectors at Level 2 are trained and experienced and able to work independently and without direct supervision. The Level 2 inspector would consult with a Level 3 inspector or a professional engineer where the inspector's knowledge and/or authority are insufficient to resolve inspection requirements.

5.2.3 **LEVEL 3**

This is considered the advanced level of inspection competence. This Level is achieved after the inspector has completed:

- a) the educational and training requirements stipulated for Level 3 in Appendix A and Table 1;
- b) the practical experience requirements as defined in Table 1;
- c) certification requirements for at least Level 2 welding inspector to CSA Standard W178.2;
- d) the CWB Level 3 examination which shall include at least one product endorsement as specified in Appendix C.

5.2.3.1 The inspectors at Level 3 may additionally be considered for roles in such areas as technical supervisors of inspection staffs, educators, and as a resource for consultation on inspection matters.

5.2.4 Certification at each Level will be granted by the Canadian Welding Bureau based on the conditions contained in Appendix "B".

- 5.3 Inspectors may be certified at two different levels at the same time. For example, an inspector could be at Level 2 for the bridge product endorsement and Level 3 for the pipeline product endorsement.
- 5.4 Applications of candidates who are applying for certification in a product endorsement in which they have not worked for a number of years, or whose practical experience in that product endorsement is limited, shall be subject to review by the CWB to determine whether or not they are acceptable within the intent of the Guide.
- 5.5 Upon initial certification at Level 2 or Level 3 the years of practical experience required for subsequent product endorsements in which the inspector may wish to be certified, may be reduced depending on the inspector's activities related to that product endorsement.
- 5.6 The CWB reserves the right to revoke the product endorsement(s) of a certified inspector.

6. COMPETENCY REQUIREMENTS FOR THE METAL PRODUCTS INSPECTOR

6.1 General

Metal Products Inspectors at any level shall be capable of:

- a) reviewing inspection procedures in conjunction with the related standards, codes, specifications and drawings to a degree consistent with the metal products inspector level held.
- b) monitoring, examining and judging the work performed by manufacturing, fabricating and erection personnel in accordance with the applicable codes, standards, specifications and drawings.
- c) providing accurate and appropriate identification of inspection results.
- d) recognizing the safety hazards associated with the inspection work they undertake.
- e) preparing clear and accurate reports.

6.2 **Level 1 - Metal Products Inspector**

In addition to the requirements identified in Clause 6.1, the Level 1 Metal Products Inspector shall be capable of carrying out the duties assigned by Appendix A1 to the Product Endorsement for which the Inspector has applied for certification (see Appendix A1).

6.3 **Level 2 - Metal Products Inspector**

In addition to the requirements identified in Clauses 6.1 and 6.2 for the Level 1 Metal Products Inspector, the Level 2 Metal Products Inspector shall be capable of carrying out the duties assigned by Appendix A1 to the Product Endorsement for which the Inspector has applied for certification (see Appendix A1).

6.4 **Level 3 - Metal Products Inspector**

In addition to the requirements identified in Clauses 6.1, 6.2 and 6.3 for the Level 1 and Level 2 Metal Products Inspector, the Level 3 Metal Products Inspector shall be capable of carrying out the duties assigned by Appendix A1 to the Product Endorsement for which the Inspector has applied for certification (see Appendix A1).

7. **EXAMINATIONS**

7.1 The preparation and evaluation of all theoretical and practical examinations required for certification shall be the responsibility of the Canadian Welding Bureau.

8. **CERTIFICATION DOCUMENTS, RENEWAL AND WITHDRAWAL**

8.1 Documentation attesting to the individual's certification to this Guide will be provided by the Canadian Welding Bureau in the form of a wall certificate suitable for framing and a wallet size card.

8.2 Certification will be valid for three years and renewable upon submission of evidence that the inspector:

- a) has been engaged in continuing employment in inspection work during the preceding certification period;

- b) meets the vision requirements as stated in this Guide;
- c) has paid the applicable renewal fees.

8.3 Six (6) years from the date a Metal Products Inspector is certified for a given endorsement and every six years thereafter, the inspector shall be required to rewrite the open book examination based on those codes and standards applicable to that endorsement. This requirement is mandatory for each endorsement in which the inspector is certified.

8.4 A list of inspectors certified to the requirements of this Guide will be published on the CWB website (www.cwbweb.org) and current listing information shall be available at any time from the offices of the Bureau.

8.5 The certificate, card and listing will include the level of certification and endorsements received.

8.6 The certification of an inspector may be withdrawn by the Canadian Welding Bureau when such action is deemed justified.

8.6.1 The Bureau reserves the right to revoke an endorsement of an inspector when such action is deemed justified.

8.7 The certification of a Level 3 inspector will be withdrawn if the inspector is no longer certified in the necessary level as a CSA Standard W178.2 Welding Inspector.

9. APPEALS

9.1 When the staff of the Bureau is unable to resolve a complaint to the satisfaction of an inspector regarding certification the inspector may appeal the matter to the Chairman of the Board of the Canadian Welding Bureau. The chairman's decision shall be final and binding.

10. UNACCEPTABLE PRACTICE

10.1 Violation by a certified inspector of the requirements of this Guide shall constitute unacceptable practice. Such practice shall be reviewed and may be subject to sanctions as outlined in Appendix E, Unacceptable Practice.

TABLE 1

EXPERIENCE REQUIREMENTS BASED ON EDUCATIONAL BACKGROUND
FOR
METAL PRODUCTS INSPECTORS

* EDUCATIONAL BACKGROUND (Table 1 & Appendix A)	REQUIRED YEARS OF EXPERIENCE FOR:		
	LEVEL 1	+LEVEL 2	+LEVEL 3
PART A: SECONDARY SCHOOL <u>OR</u> CLAUSE 5.1.2(IV) OF THIS GUIDE	5	6	8
PART B: 2 YEARS COLLEGE IN ENGINEERING TECHNOLOGY <u>OR</u> CERTIFICATION TO AT LEAST LEVEL 2 TO CSA STANDARD W178.2 <u>OR</u> CERTIFICATION TO AT LEAST LEVEL 2 IN THREE OR MORE NON-DESTRUCTIVE TEST METHODS PER CGSB STANDARDS	3	4	6
PART C: 3 YEARS COLLEGE IN ENGINEERING TECHNOLOGY <u>OR</u> 2 YEARS COLLEGE IN WELDING TECHNOLOGY	2	3	5
PART D: 4 YEARS SCIENCE OR ENGINEERING <u>OR</u> 3 YEARS COLLEGE IN WELDING TECHNOLOGY	1	2	4

* Note: Educational background must include the educational and training requirements of Appendix "A" at the level of certification desired.

+ The practical experience requirement for candidates for initial certification as Metal Products Inspectors at Level 2 and Level 3 must be in the Endorsement for which they are applying.

APPENDIX A

EDUCATIONAL AND TRAINING REQUIREMENTS

APPENDIX "A"

CORE REQUIREMENTS FOR ALL INSPECTORS

The Inspector must possess a general core knowledge as described below:

- A) **Material:**
 - 1.0) Iron and steel making and associated subjects
 - 2.0) Metallurgy of steel
 - 3.0) Welding metallurgy of steel
 - 4.0) General knowledge of stainless steels
 - 5.0) Introduction to non-ferrous metals
- B) **Common Industry Tests Encountered**
- C) **General Knowledge of NDE**
- D) **Codes and Standards** (Associated with steel fabrication) (The purpose of Standards and Specifications, and a synopsis of each)
- E) **General Knowledge of Codes and Standards (Technical)**
- F) **Preparation of Materials**
- G) **Joining and Cutting**
- H) **Fabrication and Manufacturing Techniques**
- I) **Erection / Construction**
- J) **Health and Safety**
- K) **Workplace Knowledge**
- L) **Quality Programs - Philosophy, Management**
- M) **Inspection:**
 - 1.0) Quality control
 - 2.0) Possess working knowledge
 - 3.0) Special knowledge
 - 4.0) Inspection tools

Following are samples of typical subject matter for core knowledge requirements. The Inspector need not be a specialist, but have a working knowledge sufficient to understand the significant aspects of each subject.

CERTIFICATION OF METAL PRODUCTS INSPECTORS

Knowledge and Experience Requirements

A) Material:

		Level		
		1	2	3
1.0)	<u>Iron and steel making and associated subjects:</u>			
1.1	! Blast furnace produces iron.....	X	X	X
1.2	! Refining iron into steel (rimmed; semi-killed; and killed steels), and explain importance of carbon content.....	X	X	X
1.3	! Alloyed steels and alloy influence.....	-	X	X
1.4	! Q & T steels.....	X	X	X
1.5	! Characteristics of steels (CMn, HSLA, CrMo, Q & T, stainless, etc.)	-	X	X
1.6	! Cast iron and cast steels	X	X	X
1.7	! Common terms associated with steels (see also Item 8):			
	- <u>Published Specification</u> specified minimum values of yield and tensile strengths	X	X	X
	- Hardness values 6 Vickers, Rockwell, Brinell	-	X	X
	- Toughness.....	-	X	X
	- Fatigue	-	X	X
	- Brittle fracture	-	X	X
1.8	! Mill test certificates (Ladle analysis)	X	X	X
1.9	! Common metric units (and imperial)	X	X	X
1.10	! Modified steels are not usually a published specification steel.....	X	X	X
1.11	! Defects in steel products, laminations, blisters, cracks, etc.....	X	X	X
1.12	! Finishing processes:			
	- Casting	-	X	X
	- Forging	-	X	X
	- Hot rolling	X	X	X
	- Cold rolling	X	X	X
	- Spinning	-	-	X
	- Clad plate	-	-	X
	- Hot dipped galvanizing	X	X	X
1.13	! Corrosion.....	X	X	X
1.14	! Strength of materials and mechanical properties	X	X	X

		Level		
		1	2	3
2.0)	<u>Metallurgy of Steel:</u>			
2.1	! Knowledge of iron / carbon diagram (simplified)			
	- Crystal structure; grain growth and retirement; BCC & FCC			
	- Definitions of the various phases	-	x	x
	- Cooling rate effects	-	x	x
	- Alloying effects	-	x	x
2.2	! Steels - annealed, normalized; Q & T	x	x	x
2.3	! Heat treatment:			
	- Stress relieving, tempering	-	x	x
3.0)	<u>Welding Metallurgy of Steel:</u>			
3.1	! Weld zones	x	x	x
3.2	! Hydrogen cracking.....	x	x	x
3.3	! Metallurgical transformations.....	-	-	x
3.4	! Effects of heat inputs from welding	-	x	x
3.5	! Effects of cooling rates	-	x	x
3.6	! Solidification cracking	-	x	x
3.7	! Lamellar tearing.....	-	x	x
3.8	! Preheat temperature effects.....	-	x	x
3.9	! Welding consumable compatibility	-	x	x
3.10	! Distortion and residual stresses	-	x	x
3.11	! Include knowledge of weld faults.....	x	x	x
3.12	! Macro etch examination	-	x	x
3.13	! Micro examination	-	-	x
3.14	! Weldability - carbon equivalent (C.E.)	x	x	x
4.0)	<u>General knowledge of stainless steels</u>	-	x	x
5.0)	<u>Introduction to Non-Ferrous Metals</u>	x	x	x
B) <u>Common Industry Tests Encountered:</u>				
1.0	! Yield strength	x	x	x
2.0	! Ultimate tensile strength.....	x	x	x
3.0	! Bend test (specimens).....	x	x	x

		Level			
		1	2	3	
4.0	!	Nick break test.....	-	-	X
5.0	!	Charpy test (specimens).....	X	X	X
6.0	!	Izod test (specimens)	-	-	X
7.0	!	Hardness tests (Vickers, Rockwell, Brinell)	-	X	X
8.0	!	CTOD test	-	-	X
9.0	!	Pressure test	-	X	X
10.0	!	Load test.....	-	X	X
11.0	!	Chemistry analysis	X	X	X
12.0	!	Paint thickness	-	X	X

C) General Knowledge of NDE:

1.0	!	Visual inspection	X	X	X
2.0	!	Knowledgeable in use of dye penetrant	X	X	X
3.0	!	Knowledge of magnetic particle inspection	X	X	X
4.0	!	Knowledgeable on viewing radiographs	-	X	X
5.0	!	Principle of UT inspection and radiography	-	X	X
6.0	!	UT vs radiography	-	X	X
7.0	!	Safety in X-Ray and Gamma ray vicinities	X	X	X

D) Codes and Standards (Steel - Purpose and Synopsis):

1.0	!	CSA W59	X	X	X
2.0	!	CSA W47.1	X	X	X
3.0	!	AWS D1.1 & AWS D1.5	-	X	X
4.0	!	CSA G40.20, ASTM A 6 & A 20, and location of mechanical tests.....	-	-	X
5.0	!	G40.21.....	X	X	X
6.0	!	Specific clauses of CSA S16 & CSA S6.....	-	X	X
7.0	!	Certification of company (CSA W47.1).....	X	X	X
8.0	!	Welder/Operator qualifications (CSA W47.1).....	X	X	X
9.0	!	ASME Code, Section IX	-	-	X
10.0	!	AASHTO bridge code	-	-	X
11.0	!	ISO 9000 Quality systems	-	-	X
12.0	!	CSA A660 - Certification of Manufacturers of Steel Building Systems	X	X	X

		Level			
		1	2	3	
13.0	!	B31.3.....	-	X	X
14.0	!	CSA Z662.....	-	X	X
15.0	!	Others such as API 1104, Lloyd's, ABS, DNV, AWWA, AAR, etc.	X	X	X
E) <u>General knowledge of Codes and Standards (Technical):</u>					
(Examples)					
1.0	!	Fabrication tolerances (CSA S16, S136, A660)	X	X	X
2.0	!	Awareness of edge distances (pin holes and bolt holes)	X	X	X
3.0	!	Design considerations re statically and dynamically loaded structures.....	-	-	X
		- Notch effects	X	X	X
		- Backing Bars	X	X	X
		- Prohibited joints and welds.....	-	X	X
		- Fatigue/brittle fracture detail concerns	-	-	X
		- Knowledge of stress range category vs structural details	-	-	X
F) <u>Preparation of Materials:</u>					
1.0	!	Roll (Hot/Cold).....	X	X	X
2.0	!	Punch	X	X	X
3.0	!	Drill/Ream.....	X	X	X
4.0	!	Shear.....	X	X	X
5.0	!	Flame cutting.....	X	X	X
6.0	!	Plasma cutting.....	X	X	X
7.0	!	Machining	X	X	X
8.0	!	Mechanical straightening.....	X	X	X
9.0	!	Flame straightening	X	X	X
10.0	!	Bend (Break) (Hot/Cold).....	X	X	X
11.0	!	Arc gouging	X	X	X
12.0	!	Blast cleaning, wire brush cleaning, degreasing.....	X	X	X
G) <u>Joining and Cutting:</u>					

		Level			
		1	2	3	
1.0	!	Gas welding.....	-	-	X
2.0	!	Brazing	-	-	X
3.0	!	Resistance welding including flash butt.....	-	-	X
4.0	!	Laser beam cutting.....	-	-	X
5.0	!	Water jet cutting	-	-	X
6.0	!	Shielding gases			
		- Argon.....	X	X	X
		- Carbon dioxide	X	X	X
		- Helium	X	X	X
		- Hydrogen.....	X	X	X
		- Nitrogen.....	X	X	X
		- Oxygen	X	X	X
7.0	!	Consumable storage			
		- Coated electrodes	X	X	X
		- Flux cored wire	X	X	X
		- SAW flux	X	X	X
		- Solid wires	X	X	X
		- Mixed gases	X	X	X

H) Fabrication and Manufacturing Techniques:

1.0	!	Arc welding.....	X	X	X
2.0	!	Stud welding.....	X	X	X
3.0	!	Arc spot welds	X	X	X
4.0	!	Resistance welding.....	-	X	X
5.0	!	Bolting etc.....	X	X	X
6.0	!	Pinning	X	X	X
7.0	!	Trial assembly including splice criteria	X	X	X
8.0	!	Machining	X	X	X
9.0	!	Stress relief	-	X	X
10.0	!	Paint - including common types of paint	X	X	X
11.0	!	Galvanizing.....	X	X	X
12.0	!	Metallizing	X	X	X
13.0	!	Roll forming	X	X	X
14.0	!	Press forming	X	X	X

		Level			
		1	2	3	
I) <u>Erection/Construction:</u>					
1.0	!	General surveying knowledge	-	X	X
2.0	!	Storage of materials	X	X	X
3.0	!	Site inspection / survey.....	-	X	X
4.0	!	Knowledge of survey of foundations	-	X	X
5.0	!	Aligning and levelling (base plates, etc.)	-	X	X
6.0	!	Plumbing of structure	X	X	X
7.0	!	Bracing	X	X	X
8.0	!	Grouting.....	-	X	X
9.0	!	Erection/Construction diagrams	X	X	X
10.0	!	Bolting	X	X	X
11.0	!	Field modifications - burning, drilling, field welding, sawing, nibbling, shearing	X	X	X
12.0	!	Site safety rules and lines of communication	X	X	X
13.0	!	Falsework	-	-	X
J) <u>Health and Safety:</u>					
1.0	!	WHMIS - Construction & Industrial Safety Acts	X	X	X
2.0	!	Plant / Site awareness.....	X	X	X
3.0	!	Personal protection:			
		- Clothing	X	X	X
		- Shoes / Boots	X	X	X
		- Glasses	X	X	X
		- Respirator	X	X	X
		- Ear protection	X	X	X
		- Gloves	X	X	X
4.0	!	Fume hazards, including galvanizing.....	X	X	X
5.0	!	Explosion hazards	X	X	X
6.0	!	Electrical hazards	X	X	X
7.0	!	Oxy / Acetylene	X	X	X
8.0	!	Working in closed areas	X	X	X
		- Environment and explosion hazards	X	X	X
9.0	!	Safety around welding operations	X	X	X

		Level			
		1	2	3	
K) <u>Workplace knowledge:</u>					
1.0	!	Reading and Interpretation of detail drawings	X	X	X
2.0	!	Welding processes	X	X	X
3.0	!	Welding consumables (common types)	X	X	X
4.0	!	Preheat and post heat control	X	X	X
5.0	!	Markings for bolt grades	X	X	X
6.0	!	High tensile bolts and tightening methods	X	X	X
7.0	!	Capacity of cables and chains	X	X	X
8.0	!	Proper slinging methods	X	X	X
9.0	!	Installation of cable clamps	X	X	X
10.0	!	Welding symbols	X	X	X
11.0	!	Non-destructive testing symbols	X	X	X
12.0	!	Temperature coefficient	X	X	X
L) <u>Quality Programs - Philosophy, Management</u>			X	X	X
M) <u>Inspection:</u>					
1.0) <u>Quality Control:</u>					
1.1	!	Verify material conformance with drawings	X	X	X
1.2	!	Verify dimensions, surface finishes, detail and assembly in accordance with drawings	X	X	X
1.3	!	Verify work carried out in accordance with process procedures; i.e.,	X	X	X
		- machining vs burning or grinding	X	X	X
		- joint preparation	X	X	X
		- assembly sequence	X	X	X
		- specific welding procedures for joints	X	X	X
		- qualified personnel and fabricator	X	X	X
1.4	!	Acceptance of fabricator's product	X	X	X
1.5	!	Maintain inspection records	X	X	X
1.6	!	Write any required reports	X	X	X
1.7	!	"Hold" any items in non-compliance for rework / repair / replacement	X	X	X
1.8	!	Maintenance of records on work inspected	X	X	X

		Level		
		1	2	3
2.0)	<u>Possess working knowledge:</u>			
2.1	! Print reading	X	X	X
2.2	! Layout.....	X	X	X
2.3	! Check bevels (simple and compound)	X	X	X
2.4	! Quality of machine and surfaces and notations (<i>f</i>)	X	X	X
2.5	! Dimension measuring and detail checking	X	X	X
2.6	! Measure camber/sweep	X	X	X
2.7	! Imperial / metric conversion.....	X	X	X
2.8	! Dry and wet paint thicknesses	X	X	X
2.9	! Surface preparation for painting	X	X	X
2.10	! Checking weld dimensions	X	X	X
2.11	! Weld gauges	X	X	X
2.12	! Galvanizing (See H - 11.0)	-	X	X
2.13	! Flame spraying (See H - 12.0)	-	-	X
3.0)	<u>Special Knowledge (Qualification):</u>			
3.1	! Layout of equipment components in machining operations.....	-	X	X
3.2	! General layout skills	X	X	X
3.3	! Angles by Tangent method	X	X	X
4.0)	<u>Inspection Tools:</u>			
4.1	! Imperial / Metric scales.....	X	X	X
4.2	! Imperial / Metric tapes	X	X	X
4.3	! Inside / Outside micrometers.....	X	X	X
4.4	! Squares and adjustable squares	X	X	X
4.5	! Flashlight	X	X	X
4.6	! Magnifying glass.....	X	X	X
4.7	! Clamps (C-Type)	X	X	X
4.8	! System to carry and to work on drawings and reports and records	X	X	X

		Level			
		1	2	3	
4.9	!	Weld gauges, amp and volt meters, wire feed speed meter	x	x	x
4.10	!	Protractor.....	x	x	x
4.11	!	Dividers and inside callipers	x	x	x
4.12	!	Drawings and pertinent specifications	x	x	x
4.13	!	Access to welding procedures	x	x	x
4.14	!	Dry and wet paint gauges	x	x	x
4.15	!	"Hold" tags.....	x	x	x
4.16	!	Appropriate markers, pens and pencils	x	x	x
4.17	!	Hand calculator (scientific type).....	x	x	x
4.18	!	Pit Gauges.....	x	x	x
4.19	!	Go / No Go Gauges.....	x	x	x
4.20	!	Plug gauges	x	x	x

CERTIFICATION OF METAL PRODUCTS INSPECTORS

SUBJECT OUTLINE FOR EDUCATION / TRAINING

A) MATERIAL:

1.0) Iron and steel making and associated subjects:

! Items 1.1 to 1.3:

Process description for extracting pig-iron from iron ore in the blast furnace and the subsequent refining pig-iron into steel in the various types of refining furnaces. Describe the ladle process for alloying steels prior to pouring into ingots or being used for a continuous casting line. Describe the process for killed, semi-killed and rimmed steels, either in the ingot or ladle. What is direct reduction? Explain the importance of the carbon element.

! Items 1.3 to 1.6 and 1.8:

Interpretation of mill test certificates, the chemical analysis of the "heat" or "ladle", and the corresponding mechanical and physical properties. Have knowledge of carbon steels, low alloy steels and alloy steels, as well as recognizing the alloy element symbol and the alloy's effect on the steel. Introduce the major classes of steels as categorized by the SAE/AISI system. What are the characteristics of steels such as CMn, HSLA, CrMo, Q & T, Stainless, etc.? Explain cast steel and cast iron.

! Item 1.12:

Define terms - Slab; Bloom; Billet; Casting; Continuous Casting; Forging; Hot rolling; Cold rolling; Spinning; Clad plate.

! Items 1.7, 1.9 and 1.10:

Properties of steel identified by "Published Specifications" as opposed to the term "modified steel", which is not a recognized specification. Definitions and descriptions of tests for common terms such as specified minimum yield and tensile strengths; Vickers, Rockwell and Brinell hardness tests; toughness, fatigue and brittle fracture. Include imperial and metric type units for yield and tensile stresses.

! Items 1.11 and 1.13:

Understand and identify common defects in steel products, such as laminations; blisters; cracks; corrosion; ingot defects; secondary piping, segregation; etc. (Note: Continuous casting technique will help to diminish or eliminate ingot type defects.)

! Item 1.14

Strength and other mechanical properties of material influence the elastic and inelastic behaviour of the materials, and is a means of evaluating the material for suitability in application (examples):

- Tensile Strength
- Yield Strength
- Elongation
- Hardness
- Fatigue limit
- Impact properties
- Modulus of elasticity

2.0) Metallurgy of steel Items 2.1 to 2.3:

! Understanding of iron/carbon equilibrium diagram, definitions of the various phases such as austenite, ferrite, cementite, pearlite, martensite, etc. Define and explain temperature ranges for annealing, normalizing, stress relieving and tempering, and the associated grain growth (or refinement) and crystalline structure.

! Explain effect of cooling rates have on the steel product, and how steels are quenched and tempered.

! How do alloys affect the steel composition?

3.0) Welding Metallurgy of steel:

! Items 3.1, 3.3, 3.4 and 3.5:

Description of weld zones from molten filler metal, through the H.A.Z., to the base metal. Metallurgically, with respect to the Fe/C constitution diagram, explain the effect of heat input and cooling rate transformations which take place.

! Item 3.2:

Hydrogen cracking is an important subject - What is it? How does it occur? When does the crack occur? Welding precautions to avoid cracking? Inspection.

! Item 3.6 and 3.7:

Define and explain solidification cracking and lamellar tearing defects.
Explain techniques to minimize these defects.

! Item 3.8:

What is preheating? How is preheat controlled? How does it affect the quality of weld zone? Develop overview of required preheats for welding of steels with respect to thickness and composition, including C.E. (Carbon equivalent) calculations.

! Item 3.9:

Compatibility of consumables entails many areas:

- study of electrode classification and intended use for electrode as per the CSA W48 standard
- knowledge on SAW electrode/flux combinations as certified by CWB, and recognize that some fluxes are used to alloy the weld metal
- if SAW fused flux is recrushed for recycling, then a quality assurance program must be in place relating to collection of fused flux, recrushing flux, and for recycling the crushed flux
- chemically compatible
- the affects of shielding gas or flux on weld metal
- dilution affect on weld metal (from base metal), and that some electrodes designated for single pass only depend upon this dilution
- care and storage of electrodes to prevent them from being a carrier of diffusible hydrogen into the weld metal
- care and storage of SAW fluxes, and ES fluxes and consumable guides.

! Item 3.10:

Explain distortion caused by welding, and the residual stress conditions resulting from welding due to distortion or restraint against distortion.

! Item 3.11:

Identify and describe weld faults and possible causes of these faults.

! Item 3.12 and 3.13:

Physically carry out macro examination of welds. Learn polish and etch technique, and learn about safety of all usual etchants. Recognize the meaning of macro examination.

! Item 3.14:

Determine weldability by the Carbon Equivalent (CE).

4.0) General knowledge of stainless steels:

- ! Become familiar with common types of austenetic and ferretic stainless steels, and note Cr/Ni contents, and that austenetic stainless steels are non-magnetic. Should understand that care in welding is to be exercised so as not to cause excessive distortion and to choose stabilized electrodes. Discuss Cr/Ni constitution diagram re welding stainless steels to carbon steels. Welding procedures are important, especially if base metal dilution is desirable or not desirable.

5.0) Introduction to Non-Ferrous Metals:

- ! Must be familiar with the common non-ferrous metals including their properties and composition (example):
- Aluminum and aluminum alloys
 - Nickel and nickel alloys
 - Copper and copper alloys
 - Titanium and titanium alloys
 - Typical solders such as tin-zinc, and silver, etc.

! Be able to recognize common trade names and compositions such as:

- Incoloy
- Inconel
- Hastelloy
- Monel
- Bronze

B) COMMON INDUSTRY TESTS ENCOUNTERED:

! The inspector should recognize the various tests listed in Section 8 of the Core Requirements.

! Should have a good understanding of:

- yield strength
- ultimate tensile strength
- bend tests
- pressure tests
- load tests

C) GENERAL KNOWLEDGE OF NDE:

The inspector should be able to use dye penetrant for inspection, but must understand that it is for "on the spot" information only, unless he/she is qualified (certified). A basic understanding of other NDE methods is a requirement; i.e., magnetic particle, ultrasonic, x-ray and gamma-ray operations are important topics. The inspector should have a basic knowledge of radiograph interpretation.

D) CODES AND STANDARDS (FOR STEEL - PURPOSE AND SYNOPSIS):

Inspections are carried out in accordance with codes, standards, and other specification requirements. Therefore, the inspector should have a working knowledge of those sections pertinent to his/her work, of the various standards. The more common standards are listed in this section of the "Core Requirements". For structural welding, attention must be given to the CSA W47.1 certification requirements.

E) GENERAL KNOWLEDGE OF CODES AND STANDARDS (TECHNICAL):

! Items 1.0 and 2.0:

Candidates should review the following standards** for an understanding that tolerances* are specified for mill products, and for designing, detailing, and fabricating steel components. Other codes and standards can be reviewed in a similar manner by the individual as required by the client's project.

* **Examples:**

- Mill tolerances of rolled products
- Misalignment of compression members
- Camber and sweep
- Twist
- Minimum edge and hole spacings
- Bolt hole punching
- Joint geometry and fitup

** - And many other specified criteria as found in:

CAN/CSA G40.21, "Structural Quality Steels"

CAN/CSA G40.20, "General Requirements for Rolled or Welded Structural Quality Steel"

CAN/CSA S16, "Limit States Design of Steel Structures"

CAN/CSA S136, "Cold Formed Steel Structural Members"

CSA W59, "Welded Steel Construction"

CSA S6, "Design of Highway Bridges"

AASHTO Bridge Code

CAN/CSA A660 "Certification of Manufacturers of Steel Building Systems".

! Item 3.0:

Understanding of terms "statically loaded" and "dynamically loaded"; and that dynamically loaded structure detail often require special consideration by the designer, and therefore, deserve special attention from the steel inspector. Dynamic loads are fluctuating loads, so the steel inspector should be aware of subjects such as:

- notch effects
- backing bar removal
- prohibited joints and welds
- fatigue / brittle fracture detail concerns
- careful interpretation of detail drawings

F) PREPARATION OF MATERIALS:

As per Core Requirements for this section, the inspector is required to recognize the various methods of material preparation, and if there are limitations or advantages and disadvantages of each method. Heating procedure for flame straightening is important, and when used, must minimize the possibility of any adverse change in the steel properties.

G) JOINING AND CUTTING:

- ! Recognize the features of arc welding, electroslag and electrogas welding, gas welding, brazing, resistance welding (including flash butt welding), laser beam cutting, waterjet cutting, plasma cutting, nibbling and shearing.
- ! Some welding processes require shielding gases, as do many plasma welding and burning processes. Characteristics of the various shielding gases should be known, including oxygen. (Ventilation always required when used in enclosed areas.)
- ! Electric arc consumable filler materials should be stored and maintained in accordance with CSA W59. Cylinders of gases should be stored as recommended by various safety regulations and/or supplier's recommendation.

H) **FABRICATION AND MANUFACTURING TECHNIQUES:**

1.0) Arc Welding:

Recognize welding processes and welding symbols. Welding symbols and joint preparation to be in agreement. Tolerances to be observed.

2.0) Stud Welding:

Material preparation is important. Procedural control to be in place and followed, as per CSA W59, or other applicable standard.

3.0) Arc Spot Welds:

Define arc spot welds. Successful arc spot welds require approved welding procedures and welders qualified for arc spot welding.

4.0) Resistance Welding:

There are many types of resistance welding, and weld integrity is largely dependent upon good equipment and procedure for operating the equipment with respect to the application. Proper cleaning of the steel and condition of the welding electrodes are extremely important. All welding operations should be automatically controlled, in accordance with an approved procedure. Resistance welding can be spot welding, seam welding, projection welding, and flash butt welding.

5.0 & Bolting and Pinning:

6.0)

These are common fabrication techniques. It is important to recognize the various types of bolts and their grades. Also the material specification of pins and their surface treatment must be observed. Pin and bolt holes must be within tolerance. Alignment of pin and bolt holes to be as per specification. Check to see whether drift pinning is allowed.

7.0) Trial assembly:

Translate information such as dimensions, angles, etc. from drawing to assembly. Make all necessary checks on fit-up as per specification and drawings. Any surface preparations required before final assembly, such as milled cross-section for bearing splices, etc.

8.0) Machining:

Inspector should be able to recognize the common types of machining, and identify surface qualities. Define machine shop terminology. Must be able to perform normal inspection functions such as reading vernier scales, take micrometer readings, check shaft run-out, accurately translate detail drawing information, check for parallel surfaces, etc.

9.0) Stress Relief:

A stress relief procedure must be followed. The procedure must be for the pertinent fabrication. Discussion on stress relieving and temperature observations during the process, and the metallurgical effects on steels and Q & T steels. Emphasize that improper stress relieving can possibly destroy the desired properties of the steel. CSA Standard W59 demonstrates stress relief procedure and control. Verify calibration of all temperature and time indicating devices prior to stress relieving.

10.0) Painting:

Painting is a broad subject. Type of paint usually controlled by specification. Some paints require a hardener. Paint is applied by various means. The inspector should be able to measure wet and dry paint films, and recognize the significance that the covering dry film thickness is relative to the percentage of solids in the paint. The inspector should be familiar with surface preparation specifications SP2; ... SP7; or SP10, of the Steel Structures Paint Council.

11.0) Galvanizing:

Study the principles of hot galvanizing, including the preparation of material, and the final treatment of the galvanized surface following removal from the galvanizing vat.

12.0) Study the principles of spray metallizing.

I) ERECTION / CONSTRUCTION:

This section considers on site work, where the inspector must have a working knowledge of listed subjects in Core Requirements. Prior to verifying that assembly, fitup and connection requirements are met, the inspector may verify that site dimensions and elevations are in accordance with plans. Overall knowledge requirements are:

- Good understanding of survey techniques re foundation alignment and elevations.
- Recognize importance of erection sequence when specified on drawings and specifications.
- Understand requirements for proper storage of materials on site to prevent damage.
- Have an understanding of rigging and lifting.
- Understand the importance of bracing in the erection sequence.
- An understanding of grouting base plates.
- Understand bolt tightening procedures (turn-of-nut versus torque inspection).
- Knowledge on plumbing structure prior to bolting or welding connections.
- Must be able to interpret erection and assembly drawings with respect to welding symbols, bolt sizes and grades, joint preparations and fit-up, etc.
- Observe lines of communication on entry to site and while on site. Appropriate safety equipment and personal protection wear is an all-time necessity. Must have evidence of WHMIS training and where required, the necessary certification for construction site entry.
- When tying-off at workstation, a "full body harness" must be used incorporating lanyard and shock absorber.

J) HEALTH AND SAFETY:

- ! Personal health and Safety while in a plant or on a field site begins before authorized entry is obtained:
 - WHMIS training.
 - Have available all personal protection items.
 - Know your job, and what you intend to do on site.

- Check into work environment.
- Be aware of all activities in the immediate work area.
- Material from Provincial Construction Safety Associations.
- Be familiar with Construction and Industrial Health and Safety Acts.

! While at workstation, job awareness and immediate environment are prime concerns:

- Do not by-pass area supervisor.
- Check for hazardous fumes or explosive environments.
- Know safety when around electrical panels, equipment or when using extension chords.
- Learn about electrical panel lock-outs and explosion proof lights.
- Learn proper safety measures for entering confined spaces or vessels.
- Observe the hazards of the electric welding arc and arc air operations.
- If working with cleaners, etc., beware of possible exposure to flames, electric sparks, or persons smoking.
- An intensive study on safety in transporting and operating an oxygen/acetylene torch system.
- Safety practices for ladders, and for openings in floors.

! Special safety re clothing, hair, eyes, etc. when near moving or rotating equipment, or in thermal cutting and welding areas.

K) WORKPLACE KNOWLEDGE:

! Items 1.0, 10.0 and 11.0:

Required to have working knowledge of mechanical and structural detail drawings, assembly drawings and erection diagrams. Knowledge of imperial and metric measurements is essential. Must be able to understand typical symbols for machining, welding and non-destructive inspection, and recognize all tolerance indicators.

! Items 2.0, 3.0 and 4.0:

The inspector should possess knowledge in the following areas:

- Physically recognize the various welding processes. (There are many welding processes, however, the most common are: SMAW; GMAW; FCAW; SAW & ESW.) Welding processes are either manual, semi-automatic or automatic.
- Have knowledge about the various types of electrodes and their classifications.
- Should be able to interpret pertinent welding procedures.
- Be able to check preheat and interpass temperatures for welding.

! Items 5.0 and 6.0:

Recognize markings for various grades of bolts and nuts, both imperial and metric, including the common structural bolts A325 and A490. Bolts are also supplied in materials other than carbon steels, and also can be coated such as galvanized or cadmium plated. The individual must be able to use a torque wrench, and also understand the various methods used to torque structural bolts. Inspectors should be aware that without verification, bolts may not in fact meet specifications (see Section I - Erection/Construction of this Guide).

! Items 7.0 and 8.0:

Cables, cable slings nylon slings, and chains are common in the workplace, or can be a client's product. The candidate must have a good working knowledge of these products and recognize the safe way to use slings. It is essential that cable clamps be installed correctly.

! Items 12.0 and 13.0:

A study of weights, measures and temperature coefficients of steel and other metals must be undertaken, both metric and imperial.

L) QUALITY PROGRAMS - PHILOSOPHY, MANAGEMENT

A Quality Assurance System is a quality program. It consists of all planned and systematic actions recommended to provide adequate confidence that a product or service will satisfy given requirements for quality.

! ISO 9001 is a typical example of a Quality Program in which policies and procedures are formulated and implemented. CSA A660 for Steel Building Systems is another example.

! A Quality Program is only effective when all aspects of the policies are implemented and enforced throughout continuously 100% of the time.

! Other quality programs, such as CWB company certification for welding, become part of an overall Quality Assurance program.

! A Quality Control program is one that aims to **detect** non-conformities (such as inspection during and following fabrication)

whereas

A Quality Assurance program is one that aims to **prevent** non-conformities.

M) INSPECTION:

1.0) Quality Control:

! Interpretation of detail drawings and all sectional views, including all possible symbols which convey pertinent information. Inspection of components to be carried out prior to assembly.

! Thorough knowledge of mill test reports and related specifications required to check validity of steel used in components.

! Follow through with any special process procedures for work performance.

- ! Acceptance of fabricator's product means that it conforms in all respects to specifications and drawings.
- ! Proficiency in report writing, maintaining inspection reports, maintaining records of work inspected, "holding" non-compliance work or items, and documenting release or replacement of non-compliance items.
- ! Recognize the importance of functions such as co-ordinating and supervising if working as a team.

2.0) Possess Working Knowledge:

- ! Prime areas where working knowledge is applied:
 - Checking fabrications against detail requirements, incorporating checking dimensions, bevels, and developing layout work. Should be able to develop bevel geometry, both two and three dimensional. Being able to take off-set measurements for cambers and sweeps is important.
 - Know the various surface preparations, e.g. SP-6.
 - Knowledge on measuring paint thickness, both wet and dry.
 - An understanding of weld sizes, and understanding of use of weld size gauges is essential. It should be noted that in some countries, the weld size is the effective throat size.
 - The inspector should have knowledge on galvanizing and flame spraying procedures and techniques.

3.0) Special Knowledge (Qualification):

- ! Requires sound knowledge of mathematics relating to drafting and layout of components. Good understanding of trigonometry and ability to use a hand calculator is necessary. Special machine shop knowledge is helpful.

4.0) Inspection Tools:

- ! The inspector is required to have an inventory of common inspection tools and any necessary reference material, such as conversion tables, steel handbook, relevant codes or standards, etc.

APPENDIX A1

TYPICAL DUTIES OF THE

METAL PRODUCTS INSPECTOR

APPENDIX A1

Typical Duties of the Metal Products Inspector

The duties of the Metal Products Inspector in each product endorsement shall include but not be limited to those which are identified in this Appendix A1. Product Endorsements apply only to Level 2 and Level 3.

STRUCTURES

The structures product endorsement includes Buildings, Industrial Structures, Bridges and Culverts from Appendix C. Duties of the Metal Products Inspector in the Structures product endorsement include:

Level 2

In addition to the general requirements of Clause 6.1 of the Guide, the Level 2 Metal Products Inspector for the structures product endorsements shall be capable of

- a) following the inspection plan.
- b) taking accurate shop measurements using tapes, squares and templates and other measuring devices.
- c) ensuring that preheat requirements have been employed and that welding consumables are properly stored.
- d) checking the camber of girders and their shop alignment for splicing.
- e) checking for transfer of heat numbers and piece mark numbers.
- f) ensuring shipping ties and general arrangement of material are in accordance with requirements.
- g) arranging for access to the inspection site and establishing contacts.
- h) cooperating fully with the client and avoid undue delay in fabrication and erection.
- i) confirming shop approval and welders qualifications under the Canadian Welding Bureau.

- j) arranging in conjunction with the fabricator suitable times for nondestructive testing.
- k) checking for plate defects and weld preparation and fit up.
- l) approving and accepting flame cambering or other methods of correcting girder shape problems.
- m) inspecting bridge railings, bearings and expansion assemblies.
- n) investigating and reporting on high load or other field damage to bridge structures.
- o) determining type and location of temporary supports.
- p) checking of girder sweep and proper installation of bracing to hold shape and torqued joints.
- q) evaluating secondary members such as diaphragms and lateral bracing.

Level 3

In addition to the general requirements of Clause 6.1 of the Guide and Level 2 duties, the Level 3 Metal Products Inspector for the structures product endorsements shall be capable of:

- a) reviewing contract documents and drawings and fabricator's quality assurance plan.
- b) determining what are the applicable codes and specifications.
- c) preparing an inspection plan.
- d) determining items for discussion at a prefabrication meeting.
- e) checking that bearing elevations and layout are correct.
- f) determining amount and method of preassembly when required.
- g) determining heating patterns and supervising heating and cooling cycles.
- h) measuring hardness, sag and twist in steel quenched during fire fighting operations.

PIPELINES

The pipelines product endorsement includes Oil and Gas transmission pipelines. Duties of the Metal Products Inspector in the pipelines product endorsement include:

Level 2

In addition of the general requirements of Clause 6.1 of the Guide for Certification of Metal Products Inspectors, the Level 2 Metal Products Inspector for the pipelines product endorsement shall be capable of:

- a) following an inspection plan and accompanying work instructions.
- b) understanding the specifications and codes used on the project.
- c) arranging for access to work sites without impeding progress of the fabricator or constructor.
- d) monitoring and inspecting the manufacturing and/or fabrication function and objectively report on same.
- e) understanding the applications of the common mechanical and electronic measuring instruments utilized for dimensional assessment in the pipeline industry.
- f) identifying the methods for heat and lot traceability during manufacture or construction of material.
- g) interfacing with both the client and the contractor in order to allow for uninterrupted work progress.
- h) confirming qualification of procedures and personnel associated with welding and nondestructive testing.
- i) determining any hold points in the fabricator=s/contractor=s inspection plans.
- j) making assessments of dimensions and material by comparing to those listed on approved construction drawings.
- k) interpreting data commonly presented on material test certificates and reporting of any non-specification properties.
- l) becoming familiar with manufacturing and fabrication practices associated with pipe and pipeline appurtenances.

- m) checking for steel defects and verifying the extent of same as measured by common mechanical or electronic dimensional assessment methods.
- n) assessing for adequacy of test methods determining mechanical properties of metals.
- o) assessing for specification compliance of NDT methods.

Level 3

In addition to the general requirements of Clause 6.1 of the Guide and the Level 2 duties above, the Level 3 Metal Products Inspector for the pipelines product endorsement shall be capable of:

- a) reviewing and assessing contract documents, drawings, specifications, and quality plans related to the project.
- b) recognizing the essential elements of common industry-related quality programs.
- c) providing technical input at pre-production/pre-construction meetings.
- d) determining the reason for any hold points noted in fabricator=s/constructor=s inspection plans.
- e) preparing plans and work instructions for project inspection personnel.
- f) recognizing the corrosion mechanisms common to metals in pipeline applications.
- g) recognizing the adequacy of alternate materials in standards proposed for utilization.
- h) verifying the qualifications and certifications of inspection personnel.
- i) indoctrinating and training personnel in the aspects of inspection involvement.
- j) interfacing with senior designated representatives of the fabricator/constructor regarding situations of a technical nature.
- k) determining trends in fabricator/contractor performance which could reflect on overall product or installation quality.

PRESSURE VESSELS

Duties of the Metal Products Inspector in the pressure vessel product endorsement include:

Level 2

In addition to the general requirements of Clause 6.1 of the Guide, the Level 2 metal products inspector for the pressure vessel endorsement shall be capable of:

- a) reviewing the Manufacturer=s QC Manual which will identify the QC process and responsibilities of the manufacturer/fabricator personnel when manufacturing a pressure vessel.
- b) initiating travel sheet and/or Inspection Test Plan, reviewing all code and customer specifications.
- c) establishing communications with the AI and the customer=s inspector (when applicable).
- d) verifying all aspects of welding, which can exceed the basic WPS, PQR and WPQR by getting into calibration of welding machines and Production Impact Charpy requirements.
- e) carrying out in-process verifications and inspections of incoming materials (checking CE, chemistry to code, select chemistry to customer specs., dimensions and MTRs. Low temp materials and Charpy requirements are and issue with the manufacturing of pressure vessels.
- f) carrying out in-process inspections of workmanship and maintenance of tolerances and procedures for both code and the customer requirements during fabrication/ repair of pressure vessels.
- g) participating in corrective actions when Non-Conformances occur which affect Code requirements applicable to the pressure vessel.
- h) preparing and reviewing documentation for Post Weld Heat Treatment when required by the applicable code or customer specifications.
- i) carrying out in-process inspections for hydro testing of pressure vessels including code and customer requirements. Chart recording and water temperatures may be stipulated by the customer, which exceed code requirements.

- j) verifying sandblasting profiles and paint thicknesses.
- k) completing all documents applicable to each phase of fabrication including Manufacturer=s Data Reports.
- l) signing off all documentation with the Authorized Inspector and customer inspector (when applicable).
- m) affixing nameplates to completed vessels.
- n) witnessing the loading/shipping arrangements for the pressure vessel.

Level 3

In addition to the general requirements of Clause 6.1 of the Guide and the Level 2 duties, the Level 3 Metal Products Inspector for pressure vessel endorsements shall be capable of:

- a) revising the Quality Control Manual to reflect code and other changes found necessary within the Quality Control System.
- b) reviewing all codes and standards and ensure that they are up-to-date and all departments are aware of revisions made to new codes and addendas.
- c) auditing existing inspection procedures and techniques and establish new ones for the inspection of pressure vessels when required.
- d) reviewing and identifying conflicts and differences within customer/fabricator quotes and specifications.
- e) attending prefabrication meetings to establish design, fabrication, inspection and scheduling concerns and expectations when fabricating a pressure vessel.
- f) establishing applicable codes and standards through the use of customer specifications when applicable and identifying areas where customer specifications exceed the applicable codes. It is very important that all departments are made aware of these exceptions, otherwise they will be missed.
- g) ensuring the engineering department is clear and concise on all documentation when requesting materials and giving directions to various departments. They must fully understand and meet all code and customer requirements and relay these requirements to Aall@ departments.

- h) reviewing drawings to ensure they are accurate and relay all relevant information required by the applicable code and the Authorized Inspection Agency. This information must be clear and concise so that trades people can use the information and not miss key information. A prompt system of drawing and calculations transferral for CRN applications is important.
- i) auditing the QC process to establish that all requirements are being met.
- j) logging all Non-Conformances and auditing them to ensure they are dealt with in a timely manner and not re-occurring.
- k) attending completion meetings to review all aspects for the fabrication of a pressure vessel.
- l) reviewing all completed data compiled by the fabricator when all work is completed and all data is put into a data book.
- m) conducting training sessions to inform all departmental personnel of existing procedure requirements and new requirements when they are approved.

APPENDIX B

CONDITIONS OF CERTIFICATION

APPENDIX "B"

CONDITIONS OF CERTIFICATION

LEVEL 1

1. Completion of the training and education required for Level 1.
2. Successful completion of all examinations based on the above training and education.
3. Proof of required practical experience.
4. Identification of approved supervisor (mentor).

LEVEL 2

1. Completion of all training and education required for Level 2.
2. Successful completion of all examinations based on the above training and education.
3. Completion of education and training, and the satisfactory examination in at least one "endorsement" subject.
4. Proof of required practical experience.
5. Signed agreement to the Code of Ethics contained in Appendix "D".

LEVEL 3

1. Completion of all training and education required for Level 3.
2. Successful completion of all examinations based on the above training and education.
3. Completion of all the requirements for a Level 2 Inspector.
4. Proof of required practical experience.
5. Certified as a Level 2 or 3, W178.2 Welding Inspector.
6. Signed agreement to the Code of Ethics contained in Appendix "D".

APPENDIX C

PRODUCT ENDORSEMENTS

APPENDIX "C"

PRODUCT ENDORSEMENTS

On completion of the "core" subjects for Level 2 and 3 inspectors, which is contained in Appendix "A", the Inspector, in order to become certified, must have passed the examinations for at least one Endorsement from the list below:

- 1.1 *Inspection of Buildings and Industrial Structures*
- 1.2 *Inspection of Bridges and Culverts*
- 1.3 *Inspection of Tankage and Silos*
- 1.4 *Inspection of Cranes and Machinery*
- 1.5 *Inspection of Oil and Gas Pipelines*
- 1.6 *Inspection of Pressure Vessels*
- 1.7 *Inspection of Plant for Maintenance Purposes*
- 1.8 *Inspection of Railcars and Other Rolling Stock*
- 1.9 *Inspection of Boat and Ship Hulls*
- 1.10 *Inspection of Castings and Forgings*
- 1.11 *Inspection of Wire Rope*
- 1.12 *Inspection of Farm Equipment*

ENDORSEMENT EXAMINATIONS

Endorsement examinations shall require knowledge of the special features of the products they represent including codes and standards and the particular inspection techniques applicable to the product.

NOTE: Not all of the above Product Endorsements are currently available for the Certification of Metal Products Inspectors. Candidates should contact the Canadian Welding Bureau to determine if certification examinations for the Endorsement of their choice have been prepared. Future Endorsements for this Guide shall be determined by industry needs.

APPENDIX D
CODE OF ETHICS

APPENDIX "D"

CODE OF ETHICS

Certified Metal Products Inspectors recognize that precepts of personal integrity and professional competence are fundamental, and as such shall:

- a) have proper regard for the safety of the public;
- b) undertake only those assignments for which they are competent by virtue of certification, training, and experience and where warranted, advise the engagement of such specialists as are required to complete the assignment;
- c) protect to the fullest extent possible, consistent with the well being of the public, any information given in confidence by an employer or colleague;
- d) indicate to the employer or supervisor any adverse consequence that may result from an overruling of their rejection of work by a non-technical authority;
- e) be objective, thorough, and factual in any written report, statement or testimony of the work and include all relevant or pertinent information in such documents;
- f) sign only for work that they have inspected or for work about which they have personal knowledge through direct technical control, and;
- g) strive to maintain personal proficiency by updating their technical knowledge and skills as required to properly practice metal products inspection.

APPENDIX E
UNACCEPTABLE PRACTICE

APPENDIX E

UNACCEPTABLE PRACTICE

1. SCOPE

1.1 This Appendix describes the procedure to be followed in the handling of complaints against certified Metal Products Inspectors for violations of this Guide.

1.2 This Appendix is intended to protect the public interest, to promote and preserve the individual's integrity and competence, and to ensure that the rights of the Metal Products Inspector against whom a complaint has been made will be respected.

2. PROCEDURE

2.1 Complaints about violations to the requirements of this Guide shall be investigated by the Bureau under the authority of the Registrar. If this investigation shows the complaint to be unfounded, without basis of fact, or outside the scope of the Guide, the Registrar shall thus inform the complainant and furthermore advise the complainant of his/her recourse to appeal.

2.2 If the initial investigation shows that the complaint may be valid, the Registrar shall advise the subject Metal Products Inspector of the nature of the alleged infraction, detailing the potential sanctions that could result and setting a date for review by the Violations Review Committee within ten (10) working days.

2.3 The Violations Review Committee shall be chaired by the Registrar and shall include no less than two additional members selected from the President, Vice-President, and Region Manager. This Committee shall review the complaint; the results of the staff investigation, and any submissions made by the Metal Products Inspector and shall advise the Metal Products Inspector of its ruling within ten (10) working days.

- 2.4 The Violations Review Committee, in its ruling, may dismiss the complaint or impose a sanction, which could range from a warning to withdrawal of certification. The subject Metal Products Inspector and the complainant shall be formally notified of all rulings respecting their interest and the appeal procedure available to them, but decisions shall not be made public unless they include suspension of certification.

3. **APPEALS**

- 3.1 In the event of the failure of this procedure to satisfy both parties, either party may appeal by submitting the matter in writing to the Chairman of the Board of the Canadian Welding Bureau. Appeals must be received within thirty (30) days of the Violations Review Committee ruling.
- 3.2 The ruling of the Chairman of the Board of the Canadian Welding Bureau shall be final and binding.

APPENDIX F

STUDY SOURCES FOR THE CLOSED BOOK EXAMINATIONS

APPENDIX F

STUDY SOURCES FOR THE CLOSED BOOK EXAMINATIONS

Candidates for Metal Products Inspector certification will find the study sources listed below useful in preparing for their closed book examinations.

- < AWS Welding Journal
- < ITP Industrial Fasteners Handbook, by B.M. Basaraba
- < Tools and Manufacturing Engineers Handbook, Pub. By McGraw-Hill
- < Machine Design Fundamentals, by Hindhede, Zimmerman, Hopkins, Evisman, Hull, Lang, Pub. By Wiley
- < Steel Castings Handbook, Pub by American Founders Society of America
- < Engineering Materials Technology, by James A Jacobs & Thomas F. Kilduff, Pub. By Prentice Hall
- < Welding Handbook, Pub. By AWS
- < CWB Learning Centre modules, Pub. By CWB Group - Industry Services
- < Engineering Drawing and Design, by Cecil Jensen & Jay Helsel, Pub. By Glencoe
- < Modern Materials & Manufacturing Processes, by John E. Neely & Richard R. Kibbe, Pub. By John Wiley and Sons
- < ASM Handbooks
- < Engineering Materials by Kenneth C. Budinski, Pub. By Prentice Hall
- < Modern Welding Technology, by Howard Carey, Pub. By Regents Prentice Hall
- < ASNT, Materials and Processes for NDT Technology
- < Fundamentals of Dimensional Metrology, by Ted Busch and Wilkie Brothers Foundation, Pub. By Delmar
- < The Quality Audit, by Charles A. Mills, Pub. By McGraw Hill
- < Quality, by Donna C.S. Summers, Pub. By Prentice Hall
- < Metallurgy, by Johnson, Weeks and Anderson, Pub. By A.T.P
- < The Science and Engineering of Materials, by Donald R. Askeland, Pub. By Chapman & Hall
- < Welding Principles and Applications, by Larry Jeffus, Pub. By Delmar
- < CISC Handbook
- < AISC Shop Training Guide
- < Iron Casting Handbook, Editors Walton & Opar, Pub. By Iron Castings Society
- < Blueprint Reading for Machinists, by David Taylor, Pub. By Delmar
- < AWS Handbooks
- < Technology of Machine Tools, by Krar, Oswald & St. Amand, Pub. By McGraw-Hill Ryerson
- < Steel Structures Painting Manual, Vol.2, SSPC-PA2

The Canadian Welding Bureau (the Bureau), federally incorporated, "not-for-profit" organization is accredited by the Standards Council of Canada as a Certification Body for the administration of CSA Standards W47.1, W47.2, W186, W178.1 and the W48 Series of Standards.

Le Bureau canadien de soudage (le Bureau), une organisation fédéralement incorporée à but non lucratif est accréditée par le conseil Canadien des normes comme une organisation de certification pour l'administration des normes CSA W47.1, W47.2, W186, W178.1 et des normes CSA de la series W48.



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