

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ON

COURSE OUTLINE

COURSE TITLE: MATERIAL SCIENCES - WELDING

CODE NO. WLD120 **SEMESTER:** Winter

PROGRAM: WELDING and FABRICATING-Techniques
AVIATION WELDING

AUTHOR: D. SOCCffIA

DATE: March 1997 **PREVIOUS OUTLINE DATED:** August 1995

APPROV[^]Sr^{^^^}Z[^]  **/4^{^^}rc. ^{^^}fy**
DEAN **DATE**

TOTAL CREDITS 1

PREREQUISITE(S): A secondary school diploma with grade 10 general mathematics.

LENGTH OF COURSE: 24 Hours... comprised of
18 Classroom/Shop Contact Hours with Professor
6 Lab Non-Contact Hours

TOTAL CREDIT HOURS 24

COURSE DESCRIPTION: This course deals with the concepts and calculations related to the weldability of carbon steels. In doing so, it will make students aware of the increasing demand placed upon them by the many welding codes and / or material specifications in use by the fabrication industry.

- n. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:**
(Generic Skills Learning Outcomes placement on the course outline will be determined and communicated at a later date.)

Upon successful completion of this course the student will demonstrate the ability to:

- 1) *Demonstrate by means of a written theory test a sound working knowledge of the concepts related to "Basic Heat Treatments" and "Heat Affected Zone (HAZ)" .*

Potential Elements of the Performance:

- identify and describe the various crystalline structures that exist in both 'hot rolled' and 'normalized' plain carbon steels at room temperature.
- perform independent research into the topic of 'Basic Heat Treatments' to determine:
 - a) general procedures / temperatures required for each specified process
 - b) the net effect that each specified process has upon crystalline structure and mechanical properties
- identify and describe the individual 'zones' within the HAZ of a completed weldment that includes the following major items:
 - a) the origins, heat inputs and mechanics of the HAZ
 - b) the (potential) final structures of a normalized weld
 - c) the (potential) final structures of a quenched weld.
 - d) the major factors affecting the extent of change in the crystalline structure for a given HAZ.
- perform independent research into the topic of 'Heat Affected Zones'

NOTE: This learning outcome will constitute 45% of the course grade

**n. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE
(Continued)**

2) *Demonstrate by means of a written theory test a sound working knowledge of the concepts related to the topic of "Cold Cracking" as it relates to the process of; "Hardness vs Hydrogen Control".*

Potential Elements of the Performance.

- identify and describe both the 'mechanism of hydrogen absorption and retention' as well as the 'elimination of hydrogen from the complete weldment.'
- identify and describe the typical location of weld and base metal cracks
- identify and describe the properties of hydrogen which are considered detrimental to carbon steels
- list potential sources of hydrogen contamination
- state the conditions that are considered necessary for hydrogen cracking to occur
- define the term 'carbon equivalent' and explain its usefulness to welding of carbon and alloy based steels
- perform calculations of 'carbon equivalent' for a variety of steels
- explain the use of pre-heat, weld size and post-heat to control final hardness
- explain the use of pre-heat, weld size and post-heat to control hydrogen content
- define the terms 'energy input / heat input' and explain their usefulness to the welding of carbon and alloy based steels

NOTE: This learning outcome will constitute 45% of the course grade.

3. *Demonstrate by means of regular attendance, punctuality, respect for fellow students as well as lab /shop equipment, a willingness to assume the responsibilities of employment.*

Potential Elements of the Performance:

- be present for all scheduled classes
- be in the lab/shop or classroom within 5 minutes of the scheduled starting time
- be present for the taking of attendance
- provide a satisfactory reason to the professor for having to leave class early
- provide a reasonable excuse to the professor for being absent from class
- provide a written statement to the professor explaining the reason(s) for being

Material Science - Welding
COURSE NAME

WLD120
CODE NO.

absent on an assignment due date or the day of a scheduled test

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE
(Continued)

- demonstrate behaviour that does not interfere with or obstruct the over-all learning environment
- actively participate in all course assignments and projects
- operate any and all lab / shop equipment according to guidelines prescribed by the college and / or course professor

NOTE: This learning outcome will constitute 10% of the course grade

in. TOPICS:

Note 1: These topics sometimes overlap several areas of skill development and are not necessarily intended to be explored in isolated learning units or in the order below.

- 1) Understanding the basics of Heat Treatment
- 2) The production and over-all effect of Heat Affected Zones
- 3) The Cold Cracking of Carbon and Alloy Steels
- 4) Employment Readiness

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

CSA Approved (Impact Resistant) Safety Glasses
CSA Approved (8 inch High Cut) Safety Work Boots
CSA Approved (Gauntlet Type) Welding Gloves
Module: 'Steel Welding Metallurgy'
Texts: 'The Metal Trades Handbook'
'Modem Welding'

V. EVALUATION PROCESS/GRADING SYSTEM

The evaluation for Learning Outcomes # 1 and # 2 will each consist of '*closed book*' theory test using WLD120 course notes and identified resources / texts. They will constitute 90% of the mark for *Material Sciences-Welding*.

While all tests and assignments are designed to be completed with the specified time limit (or less), students MUST report to the classroom fully prepared. Your professor will supply only the assignment or test instructions.

The evaluation for Learning Outcome # 3 will consist of a day to day recording of the Elements of Performance listed. Each infraction will constitute the loss of one percentage point from the total number of points allocated to this outcome.

Course Grading Scheme

A+	90 - 100%	Outstanding Achievement
A	80 - 89%	Above Average Achievement
B	70 - 79%	Average Achievement
C	60 - 69%	Satisfactory Achievement
U		Unsatisfactory, only given on the midterm report
S		Satisfactory, only given on the midterm report
R		Repeat, signifies a failing grade
X		A temporary grade that is limited to instances where special circumstances have prevented the student from demonstrating the required elements of performance by the end of the course semester. An 'X' grade must have the Dean's approval and has a maximum time limit of 120 days after which it becomes an 'R' grade.

VI. SPECIAL NOTES:

1. Special Needs

If you are a student with special needs (eg. physical limitations, visual impairments, hearing impairments, learning disabilities), you are encouraged to discuss required accommodations with the instructor and/or contact the Special Needs Office, Room E1204, Ext. 493, 717, 491 so that support services can be arranged for you.

2. Retention of Course Outlines

It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other post-secondary institutions.

3. Course materials that are discussed and / or explained during any and all lab or shop demonstrations are subject to evaluation. Students are therefore responsible for the content of all lab / shop demonstrations.

4. Your Professor reserves the right to modify the course as he/she deems necessary to meet the needs of students.

5. Substitute Course Information is available at the Registrar's Office.

6. Any person caught cheating or substituting another person's work in place of their own for the purpose of grading or evaluation will automatically fail the said assignment or test. College policy* also dictates that such persons may be subject to immediate dismissal.

* Students should refer to the definition of "academic dishonesty" provided in the Sauk College "Statement of Student Rights and Responsibilities" .

Material Science - Welding
COURSE NAME

WLD120
CODE NO.

Vn. PRIOR LEARNING ASSESSMENT

Students who wish to apply for advanced credit in the course should consult the instructor. Credit for prior learning will be given upon successful completion of the following;

1. The successful completion of a course in Welding Metallurgy having Learning Outcomes and Elements of Performance that are at least 80% compatible with this course outline...

AND

2. The successful challenge of all lab tests identified by this course outline.

<OR>

3. Documented proof of at least three (3) years of competent shop experience involving the welding and heat treating of base metals that are compatible with Learning Outcomes described in WDL120.

AND

4. The successful challenge of all theory tests identified by this course outline.