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ABSTRACT

This curriculum guide contains learning module outlines for teaching a series of courses in sheet metal working in high schools in Alberta. Each module provides learning experiences selected to develop basic competence in the sheet metal trades. Each module consists of an introduction, objectives, learning resources list, content summary, and a number of topics, each with a generalization and concepts/subconcepts related to learning tasks. The modules cover the following topics: a general introductory course, pattern development, welding and joining, sheet metal work, heating and air conditioning, cabinets, and special topics, on three levels. An introductory section explains the industrial education program and the sheet metal courses in Alberta. (KC)

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SHEET METAL

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NOTE: This Curriculum Guide is a service publication only. The Senior High School Program of Studies contains the official statement concerning Senior High School courses. The information contained in the guide is prescriptive insofar as it duplicates that contained in the Program of Studies. There are in the Guide, however, as well as content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

TABLE OF CONTENTS

INDUSTRIAL EDUCATION

RATIONALE

Industrial Education is a program consisting of courses which provide a continuum of experiences, starting with exploratory activities in the junior high school and expanding in the high school to the development of skills related to career fields. This development of the student's skills is planned for through courses in industrial and vocational education culminating in on-the-job work experience, or entry into a job or post-high school institution for further education.

The program consists of courses ranging from those designed for an exploration of the technologies and trade areas to units of practical preparation for a career. In the process the courses develop the student's self-knowledge, talents and skills.

For information on sequencing and course description, refer to the "Industrial Education Manual for Guidance to Teachers, Counsellors and Administrators".

PROGRAMS

There are two parts to the Industrial Education program. The first part consists of the I.E. 10, 20, 30 series of courses and is designed for career orientation. These courses were developed primarily for students in laboratories that utilize the multiple activity approach as found in most smaller schools, but they can be taught in unit shops as well.

The second part consists of the I.E. 12, 22, 32 series of courses and is intended for career development. The courses are planned for use in schools where facilities are available to teach specific occupational areas.

Students may progress from the I.E. 10, 20, 30 series to the 22 level courses upon meeting specified basic prerequisites or upon recommendation of their principal.

Both sections of the program focus on six career fields. These are:

Graphic Communications
Mechanics
Construction and Fabrication
Electricity-Electronics
Personal Services
Horticulture

The I.E. 10, 20, 30 courses consist of a number of one credit modules related to the career fields while the I.E. 12, 22, 32 courses consist of a number of five credit modules of specific occupational content. Completion of seven five credit modules qualifies the student for recognition by the Apprenticeship Branch for credit towards a journeyman's certificate.

It is left to the administrators of the school to offer the courses or combination of courses best suited to the needs and interests of the students and the financial resources of the district.

Two modules taught for a total of 65 hours will serve as a pre-requisite for the appropriate 22 level courses. Courses offered at the 22 and 32 level have to meet special criteria for staff and facilities. The Industrial Education Consultant must authorize these in order to qualify the students for vocational grants.

OBJECTIVES OF INDUSTRIAL EDUCATION

The Industrial Education Program can help achieve the Goals of Schooling and Education. The course objectives are more focused and give direction to the teacher.

The objectives of Industrial Education are classified in three areas with the following purposes:

A. Personal Growth:

To provide opportunities for the individual growth of the student through the development of acceptable personal and social values necessary in a productive society.

1. To provide a technical environment which motivates and stimulates individuals to discover their interests and develop personal and social responsibilities.

2. To assist in the development of positive attitudes toward safety.

3. To assist in the development of positive attitudes toward conservation and environment.

4. To assist in the development of consumer literacy.

B. Career Exploration:

To provide students with experiences which will assist them in making realistic career choices.

1. To provide students an opportunity, within a technical environment to become acquainted with the general occupational characteristics of a variety of career fields.

2. To relate their own interests, abilities, likes, dislikes and values to several career fields.

C. Occupational Skills:

To develop basic competencies, integrating cognitive and psychomotor skills related to families of occupations.

1. To provide safe exploratory experiences in the use of tools, energy, equipment and materials appropriate to various technologies prevalent in a productive society.

2. To develop an understanding of the interrelationships of various technologies.

3. To provide a technical environment which permits students to synthesize their accumulated knowledge in the solution of practical problems, and to assist students to develop habits that will be conducive to the establishment of a safe environment.

INDUSTRIAL EDUCATION 12, 22, 32 PROGRAM

INTRODUCTION

The Industrial Education 12, 22, 32 program is a series of courses which develop competencies leading to six different career fields.

Entry into a career field may be gained by taking one of several related introductory courses. These are:

1. the "12" course designated for each major, or

2. two modules from the Industrial Education "10, 20, 30" series related to the anticipated major, or

3. one half of a "12" course. The other half would be another half "12" or a module from the "10" program. The course would be recorded as Industrial Education "10".

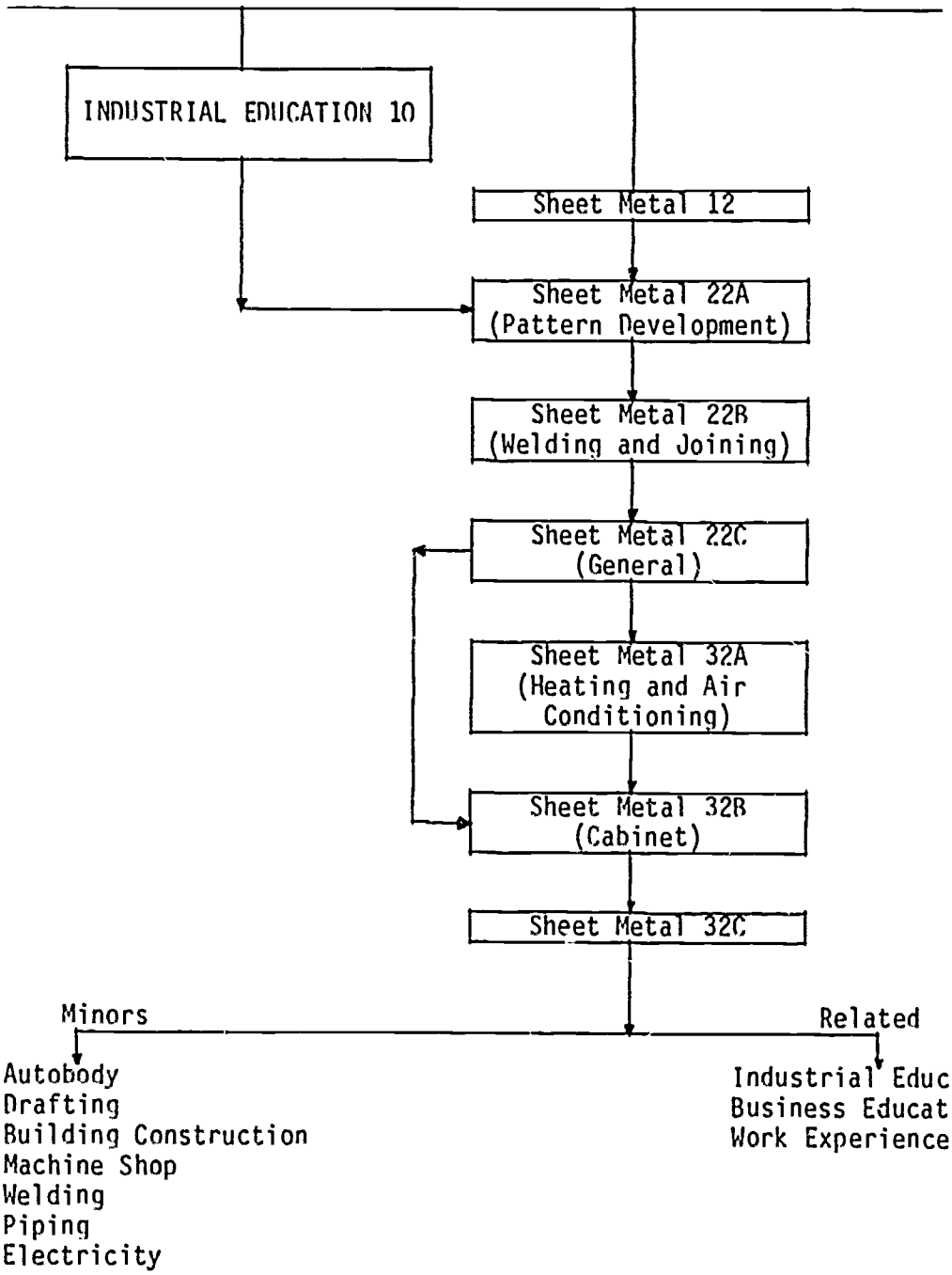
Following the introductory course the student may advance to the major area of study by selecting any number of five credit modules from the courses designated as "22" or "32". The scheduling and sequencing of the modules is the responsibility of the local school personnel but must be in accordance with the regulations pertaining to prerequisites.

A student registered in a second or third level course ("22" or "32") is regarded as taking a major in that course area. Having established a major the student may select courses designated as minors and in this way broaden his/her practical skill base in a career field or even several career fields. However, students must complete all the preceding modules in a major series (usually six) before taking the 32C module (exception: Beauty Culture).

CAREER FIELD

CONSTRUCTION AND FABRICATION

Sheet Metal



CAREER OPPORTUNITIES

Sheet Metal is a program designed to give students first year proficiency in the Sheet Metal trade and thereby reduce the amount of time required to serve as an apprentice by one year. Students must complete the course and the apprenticeship exams.

Successful students may look foreward to the following career opportunities.

Sheet Metal 12-22-32 (35 credits)

Post High School Studies	Career Entry
N.A.I.T. or S.A.I.T.	Apprenticeship as:
Sheet Metal Mechanic	Sheet Metal Mechanic
Air Conditioning & Refrigeration	
UNIVERSITY	Engineer
Engineering	Teacher - Institutes
Education	Community Colleges
	High School

SHEET METAL 12

COURSE CONTENT

SHEET METAL 12 (5 CREDITS)

INTRODUCTION

The general objective of this course is to offer the student a sampling of the type of work to be found in the career area, and thus, give the student the knowledge necessary to make an informed decision about future studies.

OBJECTIVES

The objectives of the Sheet Metal 12 course are:

1. To give the student an understanding of the Sheet Metal workers role in industrial society.

2. To introduce the student to the safe use of tools and acceptable procedures basic to the Sheet Metal trade.

LEARNING RESOURCES

*Zinngrabe, C.J., and Schumacher, F.W., Practical Layout for the Sheet Metal Shop, Delmar Publishers Latest Edition.
*Zinngrabe, C.J., and Schumacher, F.W., Sheet Metal Hand Processes, Delmar Publishers 1974.
*Zinngrabe, C.J., and Schumacher, F.W., Sheet Metal Machine Processes, Delmar Publishers 1975.
Daugherty, Powell and Foster Sheet Metal Pattern Drafting and Shop Problems, Chas. A. Bennett Co. Inc., 1975.
Ahr, A.F. (Editor) Mathematics for Sheet Metal Fabrication, Delmar Publishers, Latest Edition.
Budzik, R.S. Sheet Metal Technology, 2nd Edition, Robbs-Merrill 1981.
Neundorf, B. and Stevens, C. Sheet Metal Practice, SI Metric, McGraw-Hill Ryerson, 1977.

*Refers to prescribed learning resources.

CONTENT SUMMARY

1. Career field occupations
   - related occupations
   - employment opportunities
   - trade certification

2. Safety

3. Industrial forces
   - social structure of industry
   - collective bargaining
   - apprenticeship

4. Measurement
   - systems; metric, imperial
   - measuring instruments
   - layout instruments

5. Tool processes
   - mechanical removal of metal
   - thermal removal
   - chemical removal
   - combining material; fastening methods
   - forming

6. Elements of pattern development
   - simple pattern development
   - parallel line development
   - radial line development

TOPIC 1: CAREER FIELD STUDY VSM12

GENERALIZATION: There are many occupations within and related to the career field of construction and fabrication.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Career Field Occupations	- list the various occupations available in the career field plus entry requirements - list the courses offered in the school system in the career field	1	Guest speakers from: apprenticeship boards, industry and trade, career counselors
2. Employment Opportunities	- list the various opportunities that exist in the career field: those with and without accredited trade qualifications	1	
3. Trade Certification	- explain journeyman certification requirements	1	

NOTES:

TOPIC 2: SAFETY

VSM12

GENERALIZATION: A knowledge and practice of safety is essential in all shop and laboratory activities.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Safe Acts	- analyze various activities for safe acts	1	Films, Demonstrations, Guest speakers, from: Alberta Construction Association Occupational Health and Safety
2. Safe Conditions	- analyze various tool and machine operations for safe working and operating conditions	2	
	- apply safety practice as it relates to: personal safety - machine safety - shop safety - tool safety - material handling safety		

NOTES:

TOPIC 3: INDUSTRIAL FORCES VSM12

GENERALIZATION: In today's complex industrial society it is necessary for a worker to be aware of some of the forces which often affect him; social structure of industry, collective bargainirg and apprenticeship.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Social Structure of Industry	- describe industrial organization, and the worker's role in production and social relations within this career field	1	
2. Collective Bargaining	- define the meaning of trade unions, and how they relate to the executive and the worker in this career field	1	
3. Apprenticeship	- describe the structure of the apprenticeship board, and its relationship with the employer and the employee within this career field	2	

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TOPIC 4: MEASUREMENT VSM12

GENERALIZATION: Measurement and layout are essential in the manufacture or repair of most products.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Measurement Systems:	- measure and lay out measurements accurately to within 1 mm	1 1/2	
- metric	- use the metric system of measurement in most situations		
- English	- convert to imperial units only as needed		
2. Measuring Instruments	- correctly use the following: - steel rule - circumference rule - steel square - metal thickness gauge - wire gauge - micrometer - combination square	4	
3. Layout Instruments	- correctly use the following layout instruments: - dividers - trammel points - scratch awl - prick punch - centre punch - marking gauge	4	

NOTES:

TOPIC 5: TOOL PROCESSES VSM12

GENERALIZATION: Through the use of tools, materials are shaped by removal, combining and forming.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Mechanical Removal:			
- shearing	- describe the various "shearing" devices used in sheet metal work: - snips (various kinds) - floor shears: - squaring - gap - power - throatless shears - portable power shears: - unishear - nibbler	4	
- fracture	- chisels - drills bits - sanders: - disc - belt - grinder		
2. Thermal removal	- use the oxyacetylene cutting process	1	
3. Chemical removal	- use available chemical removal process, such as: - chemical milling (CHM) - electrochemical machining (ECM)		

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TOPIC 5: TOOL PROCESSES (continued) VSM12

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
4. Combining Material	- identify the various techniques used in combining material in sheet metal industry - seaming - riveting - welding - soldering	15	
5. Forming	- demonstrate the care, use and maintenance of the following sheet metal forming tools: - bending machines - standard hand brake - pan brake - barfolder - cleatbender - power brake - lock former - stakes - slip rollers	8	

NOTES:

TOPIC 6: ELEMENTS OF PATTERN DEVELOPMENT VSM12

GENERALIZATION: All objects have surfaces which can be reduced to flat patterns.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Simple Pattern Development	- lay out and make up objects having simple surfaces: - rectangular pan - round pipe - square elbow	30	
2. Parallel-line Development	- use the parallel line system to lay out and fabricate at least one of the following: - two intersecting cylinders - mitre pipe	40	
3. Radial-line Development	- use radial-line system to layout and fabricate at least one of the following: - funnel - pail - roof jack	11	

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SHEET METAL 22A

COURSE CONTENT

SHEET METAL 22A (5 CREDITS)
(Pattern Development)

INTRODUCTION

Students may advance to Sheet Metal 22A following completion of an introductory course in Industrial Education 10 or Sheet Metal 12. Sheet Metal 22A is pre-requisite for 22B.

OBJECTIVES

The objective of the Sheet Metal 22A module is:

1. To introduce the student to the principles of pattern development.

LEARNING RESOURCES

*Daugherty, Powell, Sheet Metal Pattern Drafting and Shop Problems, Chas. A. Bennett Co. Inc. 1975.

*Refers to prescribed learning resources.

CONTENT SUMMARY

1. Principles of sheet metal layout
   - simple pattern development
   - parallel line development
   - radial line development
   - triangulation

TOPIC 1: PRINCIPLES OF SHEET METAL LAYOUT VSM22A

GENERALIZATION: All objects have surfaces which can be reduced to flat patterns.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Simple Pattern Development	- make patterns of surfaces involving simple shapes: - rectangular - cylinders - hexagonal surfaces - calculate and lay out the necessary seams and hems on patterns developed	20	
2. Parallel-line Development	- make patterns of surfaces of the following typical shapes: - mitered cylinder - round elbow - cylinder to cylinder intersections	45	
3. Radial-line Development	- develop patterns related to the surfaces of the right cone: - roof jacks - funnels - reducers	20	
4. Triangulation	- develop patterns for objects which lend themselves to a triangulation method: - a variety of rectangle to round transitions - the oblique cone	45	

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SHEET METAL 22B

COURSE CONTENT

SHEET METAL 22B (5 CREDITS)
(Joining)

INTRODUCTION

Students may advance to Sheet Metal 22B or take it concurrently with 22A.

OBJECTIVES

The objective of the Sheet Metal 22B module is:

1. To introduce the student to the basic methods of joining and fastening sheet metal products.

LEARNING RESOURCES

*Daugherty, Powell, Sheet Metal Pattern Drafting and Shop Problems, Chas. A. Bennett Co. Inc. 1975.

*Refers to prescribed learning resources.

CONTENT SUMMARY

1. Joining Sheet Metal
   - mechanical methods of joining
   - self locking seams
   - adhesion
   - cohesion

TOPIC 1: JOINING SHEET METAL VSM22B

GENERALIZATION: The main methods of joining sheet materials involve mechanical methods, adhesion, cohesion and forming sheet metal itself into seams.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Mechanical Methods of Joining	- list the theoretical and practical advantages of: - bolts - rivets - seams - produce projects applying mechanical methods of joining	20	
2. Self-locking Seams	- fabricate projects applying formula	20	
3. Adhesion	- correctly solder various metals	20	
4. Cohesion	- demonstrate knowledge of and correctly use the following: - oxy-acetylence welding - A.C. and D.C. welding - TIG and MIG welding - carbon arc welding - resistance welding	70	

NOTES:

SHEET METAL 22C

COURSE CONTENT

SHEET METAL 22C (5 CREDITS)
(General)

INTRODUCTION

Students may advance to Sheet Metal 22C following completion of or concurrently with 22B.

OBJECTIVES

The objective of the Sheet Metal 22C module is:

1. To introduce the student to methods of constructing and fabricating sheet metal products.

LEARNING RESOURCES

*Daugherty, Powell, Sheet Metal Pattern Drafting and Shop Problems, Chas. A. Bennett Co. Inc. 1975.

*Refers to prescribed learning resources.

CONTENT SUMMARY

1. General sheet metal work
   - tools and equipment
   - rectangular objects
   - conical objects

TOPIC 1: GENERAL SHEET METAL WORK VSM22C

GENERALIZATION: Because of considerations involving design, cost and material properties, certain items required by industry are best realized through sheet metal techniques.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Rectangular Objects	- demonstrate knowledge of the layout and related theory of the following: - several methods for constructing rectangular pans - a variety of rectangular duct fittings with connector cleats - metal clad doors and frames	40	
2. Cylindrical Objects	- demonstrate knowledge of theory by laying out and fabricating the following items: - roof jack - round pipe - chimney hood - round elbow - round offset - intersecting cylinders	70	
3. Conical Objects	- lay out patterns and manufacture articles related to the right cone: - funnel with splash lip - frustum of a cone - truncated cone	20	

NOTES:

SHEET METAL 32A

COURSE CONTENT

SHEET METAL 32A (5 CREDITS)
(Heating and Air Conditioning)

INTRODUCTION

Students must have completed the "22" series before advancing to 32A.

OBJECTIVES

The objectives of the Sheet Metal 32A module are:

1. To introduce the student to the fundamentals of heating.
2. To introduce the student to the fundamentals of air-conditioning.

LEARNING RESOURCES

*Daugherty, Powell, Sheet Metal Pattern Drafting and Shop Problems, Chas. A. Bennett Co. Inc. 1975.

*Refers to prescribed learning resources.

CONTENT SUMMARY

1. Heating and air-conditioning
   - air-conditioning systems; types, installations, controls
   - heating systems; fittings, installations, controls
   - new developments; solar systems, high efficiency furnaces

TOPIC 1: HEATING AND AIR CONDITIONING VSM32A

GENERALIZATION: Environmental comfort within dwellings is obtained through the use of air conditioning and heating systems.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Air Conditioning Systems	- analyze and explain air conditioning systems, including the following areas: - types of fittings - controlled humidity - controls - installations - electronic filters	65	Field trips Films
2. Heating Systems	- analyze gravity and forced air systems, including: - fittings - controls - installations	50	
3. New Developments	- discuss the implications of: - solar systems - high efficiency furnaces and related units	15	Field trips

NOTES:

SHEET METAL 32B

COURSE CONTENT

SHEET METAL 32B (5 CREDITS)
(Cabinet)

INTRODUCTION

Students may advance to Sheet Metal 32B after completion of the "22" series.

OBJECTIVES

The objective of the Sheet Metal 32B module is:

1. To introduce the student to cabinet work related to the sheet metal trade.

LEARNING RESOURCES

*Daugherty, Powell, Sheet Metal Pattern Drafting and Shop Problems, Chas. A. Bennett Co. Inc. 1975.

*Refers to prescribed learning resources.

CONTENT SUMMARY

1. Introduction to sheet metal cabinet work
   - hospital equipment
   - restaurant equipment
   - general cabinet work
   - layout and manufacture one cabinet type project

TOPIC 1: INTRODUCTION OF SHEET METAL CABINET WORK AND RELATED EQUIPMENT VSM32B

GENERALIZATION: Because of the properties of certain metals, there is a demand for sheet metal products by various industries and institutions.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Hospital Equipment	- list the methods of manufacture and the kinds of units and related equipment required in hospitals. Typical items should include: - sinks - table tops - kick plates - portable food carrying equipment - laundry chutes	20	
2. Restaurant Equipment	- identify the kinds of units required and basic methods of construction for the following: - dishtables - sinks - refrigeration units - salad tables - coffee urn stands - tray rails - canopies - store fronts	20	
3. General Cabinet Work	- describe the construction of the following: - metal desk - filing cabinet - metal tables - mechanics's tool box - barbecue	10	
	- layout and manufacture an article of cabinet design	80	

SHEET METAL 32C

COURSE CONTENT

SHEET METAL 32C (5, 10 CREDITS)

The last module of the Sheet Metal sequence is open to students who have completed 30 credits or six modules in the major.

The 125 hours of instruction time available in this module may be used to:

a. Provide greater depth to a module taken previously. An individual student, groups of students or whole classes may elect to study an area in more detail. This in-depth study could be in pattern development, air conditioning, heating or any of the modules named in the Sheet Metal sequence.

b. Engage in actual Sheet Metal work supervised by the Sheet Metal teacher as a coordinator of the student and a Journeyman on the job.