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ABSTRACT

This document is intended to help education and training institutions deliver the Machine Tool Advanced Skills Technology (MAST) curriculum to a variety of individuals and organizations. MAST consists of industry-specific skill standards and model curricula for 15 occupational specialty areas within the U.S. machine tool and metals-related industries. This volume provides the MAST standards and curriculum for the sheet metal and composites specialty area. (A sheet metal and composites technician is a person who plans, lays out, cuts, fabricates, and joins sheet metal to produce a work piece to referenced engineering standards.) This volume is organized in the following sections: (1) a profile of Texas State Technical College, the development center that produced these standards and curriculum; (2) a sheet metal and composites technician competency profile of job duties and tasks; (3) a sheet metal and composites technician duty, task, and subtask outline; (4) a course curriculum outline and course descriptions; (5) a technical workplace competencies and course crosswalk; and (6) a Secretary's Commission on Achieving Necessary Skills (SCANS) proficiencies course crosswalk. Individual syllabi for the following courses are provided: Bench Work and Layout; Precision Tools and Measurements; Industrial Specifications and Safety; Introduction to Metal Working Processes; Introduction to Plastics; Survey of Welding Processes and Applications; Sheet Metal Processing I; Plastic Materials and Testing; Manufacturing Processes; Computer Assisted Design/Manufacturing (CAD/CAM) I; Sheet Metal Processing II; Composites; and Sheet Metal Structures. Each course syllabus includes the following: course hours, course descriptions, prerequisites, required course materials, teaching and evaluation methods, lecture and laboratory outlines, course objectives for technical and SCANS competencies, and suggested references. An appendix contains industry competency profiles. (KC)

Machine Tool Advanced Skills Technology

COMMON GROUND: TOWARD A STANDARDS-BASED TRAINING SYSTEM FOR THE U.S. MACHINE TOOL AND METAL RELATED INDUSTRIES

VOLUME 8

SHEET METAL & COMPOSITES

of
a 15 volume set of Skills Standards
and
Curriculum Training Materials for the
PRECISION MANUFACTURING INDUSTRY

Supported by
the Office of Vocational & Adult Education
U.S. Department of Education

AUGUSTA TECHNICAL INSTITUTE

CACT CENTER FOR APPLIED COMPETITIVE TECHNOLOGIES
San Diego City College

ITAWAMBA COMMUNITY COLLEGE · 1948 ·

Moraine Valley Community College

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

Texas State Technical College Waco

Machine Tool Advanced Skills Technology Program

MAST

VOLUME 8

SHEET METAL & COMPOSITES

Supported by
The Office of Vocational and Adult Education
U.S. Department of Education

September, 1996

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Discrimination:	Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance." Title IX of the Education Amendments of 1972 states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal financial assistance." Therefore, the Machine Tool Advanced Skills Technology (MAST) project, like every program or activity receiving financial assistance from the U.S. Department of Education, operated in compliance with these laws.

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This project was made possible by the cooperation and direct support of the following organizations:

- U.S. Department of Education, Office of Vocational & Adult Education
- MAST Consortia of Employers and Educators

MAST DEVELOPMENT CENTERS

Augusta Technical Institute - Itawamba Community College - Moraine Valley Community College - San Diego City College (CACT) - Springfield Technical Community College - Texas State Technical College

INDUSTRIES

AB Lasers - AIRCAP/MTD - ALCOA - American Saw - AMOCO Performance Products - Automatic Switch Company - Bell Helicopter - Bowen Tool - Brunner - Chrysler Corp. - Chrysler Technologies - Conveyor Plus - Darr Caterpillar - Davis Technologies - Delta International - Devon - D. J. Plastics - Eaton Leonard - EBTEC - Electro-Motive - Emergency One - Eureka - Foster Mold - GeoDiamond/Smith International - Greenfield Industries - Hunter Douglas - Industrial Laser - ITT Engineered Valve - Kaiser Aluminum - Krueger International. - Laser Fare - Laser Services - Lockheed Martin - McDonnell Douglas - Mercury Tool - NASSCO - NutraSweet - Rapistan DEMAG - Reed Tool - ROHR, International - Searle - Solar Turbine - Southwest Fabricators - Smith & Wesson - Standard Refrigeration - Super Sagless - Taylor Guitars - Tecumseh - Teledyne Ryan - Thermal Ceramics - Thomas Lighting - FMC, United Defense - United Technologies Hamilton Standard

COLLEGE AFFILIATES

Aiken Technical College - Bevil Center for Advanced Manufacturing Technology - Central Florida Community College - Chicago Manufacturing Technology Extension Center - Great Lakes Manufacturing Technology Center - Indiana Vocational Technical College - Milwaukee Area Technical College - Okaloosa-Walton Community College - Piedmont Technical College - Pueblo Community College - Salt Lake Community College - Spokane Community College - Texas State Technical Colleges at Harlington, Marshall, Sweetwater

FEDERAL LABS

Jet Propulsion Lab - Lawrence Livermore National Laboratory - L.B.J. Space Center (NASA) - Los Alamos Laboratory - Oak Ridge National Laboratory - Sandia National Laboratory - Several National Institute of Standards and Technology Centers (NIST) - Tank Automotive Research and Development Center (TARDEC) - Wright Laboratories

SECONDARY SCHOOLS

Aiken Career Center - Chicopee Comprehensive High School - Community High School (Moraine, IL) - Connally ISD - Consolidated High School - Evans High - Greenwood Vocational School - Hoover Sr. High - Killeen ISD - LaVega ISD - Lincoln Sr. High - Marlin ISD - Midway ISD - Moraine Area Career Center - Morse Sr. High - Point Lamar Sr. High - Pontotoc Ridge Area Vocational Center - Putnam Vocational High School - San Diego Sr. High - Tupelo-Lee Vocational Center - Waco ISD - Westfield Vocational High School

ASSOCIATIONS

American Vocational Association (AVA) - Center for Occupational Research and Development (CORD) - CIM in Higher Education (CIMHE) - Heart of Texas Tech-Prep - Midwest (Michigan) Manufacturing Technology Center (MMTC) - National Coalition For Advanced Manufacturing (NACFAM) - National Coalition of Advanced Technology Centers (NCATC) - National Skills Standards Pilot Programs - National Tooling and Machining Association (NTMA) - New York Manufacturing Extension Partnership (NYMEP) - Precision Metalforming Association (PMA) - Society of Manufacturing Engineers (SME) - Southeast Manufacturing Technology Center (SMTC)

MAST PROJECT EVALUATORS

Dr. James Hales, East Tennessee State University and William Ruxton, National Tooling and Machine Association (NTMA)

SPECIAL RECOGNITION

Dr. Hugh Rogers recognized the need for this project, developed the baseline concepts and methodology, and pulled together industrial and academic partners from across the nation into a solid consortium. Special thanks and singular congratulations go to Dr. Rogers for his extraordinary efforts in this endeavor.

This report is primarily based upon information provided by the above companies, schools and labs. We sincerely thank key personnel within these organizations for their commitment and dedication to this project. Including the national survey, more than 3,000 other companies and organizations participated in this project. We commend their efforts in our combined attempt to reach some common ground in precision manufacturing skills standards and curriculum development.

This material may be found on the Internet at **http://machinetool.tstc.edu**

CATALOG OF 15 VOLUMES

VOLUME 8
SHEET METAL/COMPOSITES TECHNOLOGY

Table of Contents

FOREWORD

In years past, the sheet metal industry employed workers who worked solely with metal that had been rolled into thin sheets. Two classifications of workers were prominent: Sheet Metal joiners, akin to automotive body workers, who specialized in the joining of sheet metal without the use of rivets, and sheet metal fabricators, who included air conditioning and heating duct workers and possessed the skills to make just about anything out of a piece of sheet metal. Their work required flat layout, fit-up, three-dimensional drawing, use of hand tools ranging from snips and punches to brakes and shears, use of powered tools such as power hammers, old English wheels, and knowledge of anodizing and polishing. Versatile in its applications, the sheet metal industry nevertheless remained an industry that used sheet metal and few other materials.

The industry changed forever with the advent of modern aviation and the increasing use of advanced materials in addition to sheet metal. Routinely working with materials ranging from resins to hard plastics, modern sheet metal workers are now more accurately described as **Sheet Metal/Composites Technicians**. Within the aircraft industry, their work involves a staggering diversity of skills and materials and greater precision than ever before (aircraft production is governed by nearly 20 thick volumes of Federal aviation standards). The modern Sheet Metal/Composites Technician must still be adept at layout, fit-up and use of traditional hand tools, but he now requires education and training in modern processes such as honeycomb work, boron patching, vacuum processes, and even computer assisted design/computer assisted manufacturing (CAD/CAM).

Recognizing the need to increase the supply of new skilled workers in this and other occupations for the metal and metals-related industries, the U.S. Department of Education launched the Cooperative Demonstration Program (Manufacturing Technologies) as part of the National Skills Standards Act of 1994. The goal of the Department initiative was to foster the development and implementation of national skill standards and a training model for certificate and Associate of Science degree programs. In July 1994, a multi-state consortium of community colleges led by Texas State Technical College received a grant awarded by the Department under the initiative. The Machine Tool Advanced Skills Technology (MAST) consortium, which includes six of the nation's leading Advanced Technology Centers (ATCs), was formed to develop, test and disseminate industry-specific skill standards and model curricula for the U.S. machine tool industry over a two year period. As part of the MAST consortium, Texas State Technical College was tasked with developing and piloting skill standards and model curricula in the technical area of Sheet Metal/Composites Technician.

The Sheet Metal/Composites industry continues to evolve as a result of advances in technology and the introduction of new industrial materials. Minimum training for Sheet Metal/Composites Technician must continue to evolve as well to keep up with emerging industry standards. The skill

standards and curriculum presented here are the result of numerous interviews with practitioners from industry (see Appendix A) and discussions with educators, managers, supervisors, and others involved in the field of Sheet Metal/Composites. Based on discussion with the other MAST consortium partners, the project presents the following definition of the new occupation:

SHEET METAL/COMPOSITES TECHNICIAN: *The Sheet Metal/Composites Technician will plan, layout, cut, fabricate and join sheet metal to produce a work piece to referenced engineering standards. Competencies included in sheet metal/composites work include layout, fit-up, and shaping, either by hand or machine, non-metallic and composite materials to include resins, hard plastics, fiberglass, and ceramics.*

The MAST Consortium's 63-hour training curriculum requires one year and emphasizes manufacturing methods, as well as laboratory work with standard equipment and materials used across a variety of industries. Comprising a greater diversity of courses than is usually offered for workers in the sheet metal industry, these courses range from the basics of occupational mathematics, precision tools and measurements, welding processes, and sheet metal processing to plastics materials and testing, manufacturing processes, and composite structures.

The present volume provides the occupational skill standards, project documentation, and course syllabi for education and training recommended as minimum preparation for an individual desiring to enter the occupational field of Sheet Metal/Composites Technician.

PARTNER OCCUPATIONAL SPECIALITY ASSIGNMENTS

Although each of the six partner college development centers possessed detailed expertise in each of the MAST 15 occupational specialities, a division of work was still very necessary to ensure completion of the project due to the enormity associated with industrial assessment and complete curriculum revision for each of the areas of investigation.

Each Collegiate Partner was responsible for development of a specialization component of the overall model. Information for the future direction of this specialization area was obtained from NIST Manufacturing Centers and/or national consortia, professional societies, and industrial support groups addressing national manufacturing needs. Each Collegiate Partner tested its specialization model utilizing local campus resources and local industry. Information gained from the local experience was utilized to make model corrections. After testing and modification, components were consolidated into a national model. These events occurred during the first year of the Program. During the second year of the Program, the national model was piloted at each of the Collegiate Partner institutions. Experience gained from the individual pilot programs was consolidated into the final national model.

What follows is a profile of the MAST development center which had primary responsibility for the compilation and preparation of the materials for this occupational specialty area. This college also had the responsibility for conducting the pilot program which was used as one of the means of validation for this program.

MAST DEVELOPMENT CENTER
Texas State Technical College
Center for Contemporary Technology

Dr. Cecil L. Groves
Texas State Technical College System
Dr. Fred Williams, President
Texas State Technical College, Waco
Joe K. Penick, MAST Grant Director
Texas State Technical College, Waco

3801 Campus Drive
Waco, TX 76705
College phone: 817/799-3611 or 800-792-8784
fax:817-867-3380
Center phone: 817/867-4849, fax: 817/867-3380
e-mail: jpenick@tstc.edu

Manufacturing in Texas

Economic trends have led Texas officials to recognize the need to better prepare workers for a changing labor market. The downturn in the oil, natural gas, ranching and farming industries during the last decade diminished the supply of high-paying, low-skill jobs. Growth in Texas is occurring in the low paying, low skills service industry and in the high skills, high paying precision manufacturing industry. In Texas, projected increases by the year 2000 include 4,050 jobs for machine mechanics (24% growth rate); 4,700 jobs for machinists (18% growth rate); 3,850 numeric control operators (20% growth rate); and 107,150 general maintenance repair technicians (23% growth rate). The National Center for Manufacturing Sciences (NCMS) identified that of the top twenty manufacturing states, Texas experienced the largest increase in manufacturing employment. Manufacturing will add over 70,000 additional jobs in Texas by the year 2000 with increases in both durable and non-durable goods.

Texas State Technical College (TSTC)

Texas State Technical College System (TSTC) is authorized to serve the State of Texas through excellence in instruction, public service, research, and economic development. The system's efforts to improve the competitiveness of Texas business and industry include centers of excellence in technical program clusters on the system's campuses and support of educational research commercialization initiatives. Through close collaboration with business, industry, governmental agencies, and communities, including public and private secondary and postsecondary educational institutions, the system provides an articulated and responsive technical education system.

In developing and offering highly specialized technical programs and related courses, the TSTC system emphasizes the industrial and technological manpower needs of the state. Texas State Technical College is known for its advanced or emerging technical programs not commonly offered by community colleges.

New, high performance manufacturing firms in areas such as plastics, semiconductors and aerospace have driven dynamic change in TSTC's curriculum. Conventional metal fabrication to support oil and heavy manufacturing remains a cornerstone of the Waco campus and is a primary reason TSTC took the lead in developing new curricula for machining and manufacturing engineering technology in the MAST program.

Development Team

- **Project Director**: Joe K. Penick, Grant Director for Machine Tool Advanced Skills Technology Program (MAST); served as the primary administrator and academic coordinator for the MAST project.
- **Subject Matter Expert**: Wallace Pelton, Site Coordinator, was responsible for developing skill standards and course/program materials for the conventional machining, mold making and manufacturing engineering technology components of the MAST project.

THE MAST COMPETENCY PROFILE

Development of Competency Profiles at each of the MAST sites began with visits to representative companies for the purpose of surveying expert workers within the industry and occupational areas under investigation. Each site began the survey process by asking a subject matter expert in the targeted technical area, generally a member of their faculty, to employ a modified version of the generally-accepted DACUM (Developing A Curriculum) method to categorize the major skills needed to work in the selected occupation. As source materials, the college instructors drew on their professional knowledge and experience of current and future industry requirements. The initial skill standards developed by the subject matter experts underwent numerous internal reviews and revisions within each site, assuming final form as a series of structured survey and interview statements designed to elicit a simple yes or no response.

To determine an appropriate survey sample, each site compiled a database of their region's small and medium-sized manufacturers and searched for companies likely to employ workers in the targeted occupational area. The resulting cross-industry samples were sorted further to achieve a balance of technological capability and workforce size; the sample companies within each region were then asked to participate in the project. Willing respondents were scheduled for interviews.

During the company interviews, MAST staff asked expert workers to identify the primary duties and tasks performed by a typical worker and to consider the special skills and knowledge, traits and attitudes, and industry trends that will have an impact on worker training, employability, and performance both now and in the future. The interview results were analyzed to create individual profiles identifying the most common duties and skills required of workers at each company. Copies of individual company competency profiles are provided in Appendix A of this volume. These individual company Competency Profiles served two purposes. First, they showed, in a format that could be easily understood by both industry and educators, a picture of the occupational specialty at a given company at that particular time. Second, these individual company Competency Profiles furnished the company with a document for which they could claim ownership. This, in effect, made them "real" partners in the work of MAST.

Data for all companies were then aggregated to develop a composite Competency Profile of industry skill standards within the selected occupational specialty area of, as shown in the following pages.

These same duties and tasks were then included in both the Texas and National Surveys for further validation (see Volume 1). As a result of the surveys, additional refinements were made to the Competency Profiles. These changes were then incorporated into the individual course syllabi which were used for the pilot program.

The MAST Competency Profile for this occupational specialty area has been included on the following pages.

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Knowledge of Cutting Fluids/Lubricants
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

JOE PENICK
Project Director

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

TOM REYNOLDS
Department Chair
Aviation Maintenance Technology

Texas State Technical College Waco

CURRENT TRENDS/CONCERNS

Hot Bonds
Cold Bonds
Composite on Metal Repair
Composite on Composite
Honeycomb
Distributing Loads
Different Laminates and Honeycombs
New Corrosion Preventative Measures
Strict Environmental Requirements
Taper Lock Fasteners
Hard Tooling

COMPETENCY PROFILE

Sheet Metal/Composites Technician

Conducted By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortium Partners
(V.199J40008)

***M**achine Tool **A**dvanced **S**kills*
***T**echnology Program*

MAST

SHEET METAL/COMPOSITES STRUCTURAL TECHNICIAN .... plan, layout, cut, fabricate and join sheet metal and/or composite material to produce a work piece to referenced engineering standards. Includes lay up and shaping, either by hand or machine, metallic, non-metallic and composite materials to include metals, resins, hard plastics, fiberglass, and ceramics.

Duties		Tasks											
A	Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross first aid and CPR procedures	A-7 Recommend hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace				
B	Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Interconvert fractions/ decimals	B-3 Interconvert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Extract roots and raise numbers to a given power	B-7 Determine areas and volumes of various geometric shapes	B-8 Solve ratio, proportion and percentage problems				
C	Interpret Blueprints and Sheet Metal Drawings	C-1 Review blueprint notes and dimensions	C-2 Identify basic layout of drawings	C-3 Identify basic types of drawings	C-4 List the purpose of each type of drawing	C-5 Verify drawing elements	C-6 Practice geometric dimensioning and tolerancing (GD&T) methodology	C-7 Describe the relationship of engineering drawings to planning	C-8 Use standards to verify requirements	C-9 Analyze Bill of Materials (BOM)	C-10 Understand and use quality systems	C-11 Draw sketches of repairs and alterations	C-12 Use blueprint information
D	Identify Materials and Processes	D-1 Identify and select appropriate non-destructive testing methods	D-2 Perform chemical etching	D-3 Understand basic heat-treating processes	D-4 Inspect and check welds	D-5 Perform precision measurements							
E	Perform Cleaning and Corrosion Control	E-1 Identify and select cleaning materials	E-2 Perform aircraft cleaning and corrosion control										
F	Work With Sheet Metal Structures	F-1 Inspect bonded structures	F-2 Inspect and repair sheet metal structures	F-3 Inspect and repair plastics, honeycomb and laminated structures	F-4 Install special rivets and fasteners	F-5 Remove and install conventional rivets	F-6 Hand form, layout and bend sheet metal						
G	Work With Composite Structures	G-1 Identify method of repair	G-2 Identify bill of materials (BOM)	G-3 Repair per technical order/ engineering specifications or disposition	G-4 Perform resin transfer molding	G-5 Lay up a fiberglass mold	G-6 Build honeycomb structure to specifications						

THE MAST TECHNICAL WORKPLACE COMPETENCY OUTLINE

The Competency Profiles derived from the industry survey process were returned to industry and faculty members at each MAST partner college for review. Reviewers were asked to identify specific sub-tasks within each block of Duties and Tasks in the Profile; MAST staff at each college broke the sub-tasks down further into the detailed steps required to actually perform the duties and tasks of the manufacturing process. It is these detailed skill standards that were then incorporated into development of the curriculum and piloted as a training program by each of the MAST colleges. All results for the specific occupational specialty area have been organized as an outline of the duties, tasks, and sub-tasks required to demonstrate technical competency in the workplace, as shown in the following pages.

As a result of the Texas and the National Surveys, additional refinements were.made to the Competency Outlines. These changes were then incorporated into the individual course syllabi.

The MAST Technical Workplace Competency Outline for this occupational specialty area has been included on the following pages.

SHEET METAL/COMPOSITES TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES

SHEET METAL/COMPOSITES TECHNICIAN ... plan, layout, cut, fabricate and join sheet metal and/or composite material to produce a work piece to referenced engineering standards. Includes lay up and shaping, either by hand or machine, metallic, non-metallic and composite materials to include metals, resins, hard plastics, fiberglass, and ceramics.

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment
6. Apply American Red Cross First Aid and CPR Procedures
   a. Notify appropriate personnel of injury
   b. Check and evaluate life-endangering conditions
   c. Determine need for CPR
   d. Apply appropriate first aid techniques
   e. Complete accident report as needed
7. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Evaluate and determine hazards
   c. Describe the proper collection for a variety of hazardous wastes
   d. Respond to emergencies in the appropriate manner

8. Apply Ergonomic Principles to the Workplace
   a. Define ergonomics
   b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart
4. Perform Basic Algebraic Operations
   a. Express word statements as algebraic equations
   b. Solve word statements as algebraic equations
   c. Calculate the center of gravity relative to the datum
5. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
6. Extract Roots and Raise Numbers to a Given Power
   a. Determine the square or cube of a number
   b. Determine the square root of a number
7. Determine Areas and Volumes of Various Geometric Shapes
   a. Calculate the area of rectangles, squares, triangles, circles, and trapezoids
   b. Calculate the volume of rectangles, cubes, and cylinders
8. Solve Ratio, Proportion, and Percentage Problems
   a. Determine the ratio of two numbers
   b. Convert decimal numbers to their fractional equivalent

C. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions
   d. Identify general note symbols
   e. Locate notes on a print
   f. Interpret commonly used abbreviations and terminology
   g. Determine the tolerances associated with dimensions on a drawing
   h. Determine the tolerance for a referenced dimension
   i. Determine the surface finish for a given part
   j. List the essential components found in the general drawing notes

2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
   c. Identify the purpose of exploded isometric drawing
   d. Identify the purpose of assembly drawings
5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
9. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed
10. Understand and Use Quality Systems
   a. Use ISO 9000, 9002, and 9003 for external quality assurance
   b. Use ISO 9004 for internal quality management

c. Document paper trails for document revisions

11. Draw Sketches of Repairs and Alterations
    a. Illustrate a major repair or alteration
    b. Use dividers, compass, ruler, T-square, etc., in the development of sketches of repairs and alterations
12. Use Blueprint Information
    a. Identify/interpret information presented in blueprint title blocks
    b. Install and modify component parts by reference to blueprints

D. IDENTIFY MATERIALS AND PROCESSES

1. Identify and Select Appropriate Non-Destructive Testing Methods
    a. Apply the use of ultrasonic inspection methods for detecting cracks
    b. Apply methods for detecting surface cracks in aluminum castings and forgings
    c. Apply techniques for locating cracks in materials when only one side of the material is accessible
2. Perform Chemical Etching
    a. Perform general magnetic particle inspection general procedures
    b. Demagnetize steel parts after magnetic inspection
    c. Clean parts in preparation for penetrant inspection
    d. Identify visual indications of a subsurface flaw or fracture during magnetic particle inspection
    e. Locate cracks and blowholes in welded assemblies
    f. Perform dye penetrant procedures
    g. Distinguish between heat-treated and non-heat-treated aluminum alloys when the identification marks are not on the material
3. Understand Basic Heat-Treating Processes
    a. Identify the types of aluminum alloys considered to be heat-treatable
    b. Identify the steps in the heat-treatment of aluminum alloys
    c. Identify the effect of various forms of heat-treatment
    d. Identify the effect of incorrect heat-treatment on the corrosion-resistant properties of aluminum alloy
    e. Identify the degree of temper for aluminum alloy products from code designators
    f. Identify the effect of heating a metal slightly above its critical temperature, and then rapidly cooling it
    g. Identify the effect of strain hardening on the tensile strength of aluminum alloy
    h. Compare and contrast the relationships between tensile strength and metal hardness
    i. Anneal a welded steel part
4. Inspect and Check Welds
    a. Identify the characteristics of a good weld
    b. Identify the types of stress that welded joints can withstand
    c. Determine the effects of welding over a previously brazed or soldered joint
5. Perform Precision Measurements
    a. Use a micrometer and caliper to make precise measurements

b. Measure a small hole using a micrometer and a hole gage
c. Read and interpret a vernier micrometer scale
d. Use a dial indicator, V-blocks, and a surface plate to check alignment of a shaft

E. PERFORM CLEANING AND CORROSION CONTROL

1. Identify and Select Cleaning Materials
   a. Determine the effect of caustic cleaning products on aluminum structures
   b. Identify the characteristics and use of chemical cleaners
   c. Determine the type of cleaner for use on high strength metals
2. Perform Aircraft Cleaning and Corrosion Control
   a. Identify the cause and corrective procedures for fretting corrosion
   b. Identify and control intergranular corrosion of heat-treated aluminum alloy
   c. Protect multi-metal and/or composite structure against dissimilar-metal corrosion
   d. Prevent and remove rust
   e. Protect the interior surfaces of closed steel and aluminum tubing against corrosion
   f. Apply methods of protecting aluminum alloy parts against corrosion
   g. Remove corrosion products such as metal flakes, scale powder, and salt deposits from aluminum
   h. Clean corrosion-resistant parts by blast cleaning methods
   i. Use paints and similar organic coatings for corrosion protection purposes

F. WORK WITH SHEET METAL STRUCTURES

1. Inspect Bonded Structures
   a. Identify the reasons for using metal sandwich panels in high-speed aircraft
   b. Use the metallic "ring" test to inspect for delamination damage of bonded structures
   c. Evaluate the extent of damage to a bonded structure and determine the type repair needed
2. Inspect and Repair Sheet Metal Structures
   a. Select and use twist drills
   b. Select and use a hand file for soft metals
   c. Prepare dissimilar metals for assembly
   d. Drill holes in stainless steel
   e. Define shear failure
   f. Construct a water tight joint
   g. Countersink a hole
   h. Perform the dimpling process
   i. Stop drill cracks in sheet metal
   j. Repair a slightly oversize hole
   k. Repair shallow scratches in sheet metal
   l. Use a reamer
3. Inspect and Repair Plastics, Honeycomb, and Laminated Structures
   a. Distinguish between transparent plastic and plate glass
   b. Protect plastics during handling and repair operations

c. Remove scratches and surface crazing from plastic
d. Drill shallow or medium depth holes in plastic materials
e. Identify the effects of moisture trapped in honeycomb structures
f. Use a router to remove damaged area from honeycomb panels
g. Clean honeycomb panels prior to patching
h. Form and shape acrylic plastic
i. Repair shallow surface scratches in transparent plastic

4. Install Special Rivets and Fasteners
   a. Determine correct rivet length and diameter
   b. Install hi-shear rivets
   c. Identify the precautions concerning rivet fit
   d. Identify the stresses that a rivet is designed to resist
5. Remove and Install Conventional Rivets
   a. Prepare Sheet Metal for installation of flush rivets
   b. Identify and select rivets
   c. Determine the correct rivet length and diameter
   d. Select and use the correct rivet set for specified rivet head styles
   e. Select and use bucking bars
   f. Remove rivets
   g. Determine the condition of a driven rivet
   h. Determine the circumstances under which 2117 rivets may be used to replace 2017 and 2024 rivets
   i. Define rivet tipping
   j. Determine the correct number of rivets to be used in making a structural sheet metal repair
   k. Handle and install rivets that require heat treatment prior to use
   l. Adjust and use an air-operated riveting gun
6. Hand Form, Layout and Bend Sheet Metal
   a. Make a joggle or offset bend
   b. Bend Sheet Metal that requires the use of a large radius
   c. Determine the neutral axis of a bend
   d. Determine the amount of material required to make a specific bend
   e. Bend sheet metal to a desired angle
   f. Layout and bend in relationship to metal "grain" to minimize the possibility of cracking
   g. Determine the flat layout dimensions of a component part to be formed by bending
   h. Form metal by bumping

G. WORK WITH COMPOSITE STRUCTURES

1. Identify Method of Repair
   a. Determine extent of damage
   b. Interpret repair order and/or blueprint build sheet
   c. Determine stress requirements
   d. Select materials for repair IAW repair order and Standard Repair Method (SRM)
2. Identify Bill of Materials (BOM)

a. Calculate required materials
b. Compare required materials to the BOM in the repair order
c. Adjust BOM if necessary

3. Repair Per Technical Order/Engineering Specifications or Disposition
   a. Use blueprint information
   b. Remove damaged material IAW the repair order
   c. Perform cleaning (and corrosion control if required)
   d. Perform metal to metal repair
   e. Perform composite to metal repair
   f. Perform composite to composite repair
4. Perform Resin Transfer Molding
   a. Design and fabricate a polymer resin mold with reinforcing elements (fibers) using either a dimensionally correct part or build a casting with slip/plaster from a blueprint
   b. Debur mold base and chamfer edges
   c. Select and use mold cleaners
   d. Select and use mold releases
   e. Use soft tool method with mold cavities
   f. Select and operate drill presses, sanders, saws and ovens
5. Lay Up a Fiberglass Mold
   a. Design a fiberglass mold from a dimensionally correct part or build a slip casting from a blueprint or drawing
   b. Prepare surface for bonding
   c. Lay up by hand the fiberglass mats (for small molds)
   d. Select and use vacuum bags
   e. Operate an autoclave
   f. Operate sanders and saws
   g. Operate dust collecting equipment
   h. Select and operate tape wrap machines
   i. Select and operate obturators
6. Build Honeycomb Structure to Specifications
   a. Design and fabricate sheet metal components
   b. Prepare surfaces for bonding
   c. Select and use hole punches
   d. Apply honeycomb material to specification

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THE MAST PILOT PROGRAM CURRICULUM AND COURSE DESCRIPTIONS

After completing the Competency Profile and Technical Workplace Competency Outline for each occupational specialty area, each MAST partner reviewed their existing curricula against the industry-verified skill standards in order to identify a suitable foundation for new pilot training programs. Because each college had to comply with the requirements of its respective college system and appropriate state agency, the resulting pilot curricula for occupational specialty areas tended to vary in format and academic requirements (e.g., some programs were based on the semester system, others on the quarter system). Despite differences in the curricula developed at the partner colleges, each of the pilot programs was designed to achieve the following two goals mandated in the MAST grant proposal:

- Pilot Program: "Conduct a one year pilot program with 25 or more selected applicants at each college or advanced technology center to evaluate laboratory content and effectiveness, as measured by demonstrated competencies and indicators of each program area."

- Student Assessment: "Identify global skills competencies of program applicants both at point of entrance and point of exit for entry level and already-employed technicians."

(Note: All occupational specialty areas were not pilot tested at all Development Centers; however, all partner colleges conducted one or more pilot programs.)

Included on the following pages is the curriculum listing for the pilot program which was used to validate course syllabi for this occupational specialty area. This curriculum listing included course names and numbers from the college which conducted the pilot program. The curriculum also shows the number of hours assigned to each of the courses (lecture, lab and credit hours). Also included is a description of each of the courses.

MANUFACTURING ENGINEERING TECHNOLOGY
SHEET METAL/COMPOSITE
CURRICULUM

		LEC	LAB	CR
FIRST QUARTER				
PSYC 1100*	College Success Skills	1	0	1
MET 1204	Bench Work and Layout	2	8	4
MET 1103	Precision Tools & Measurements	2	4	3
MET 1603	Industrial Specifications and Safety	2	4	3
MTH 115*	Occupational Mathematics	2	3	4
		9	19	15
SECOND QUARTER				
MET 108	Introduction to Metal Working Processes	2	6	4
MET 201	Introduction to Plastics	2	2	3
ENG 107*	Oral and Written Communications	3	0	3
WLT 105	Survey of Welding Processes and Appl.	3	3	4
PSY 112*	Human Relations	2	2	3
		12	13	17
THIRD QUARTER				
MET 211	Sheet Metal Processing I	3	9	6
MET 209	Plastic Materials and Testing	1	3	2
MET 301	Manufacturing Processes	3	3	4
MET 302	CAD/CAM I	3	3	4
		10	18	16
FOURTH QUARTER				
MET 317	Sheet Metal Processing II	3	9	6
MET 345	Composites	1	3	2
AER 3027	Sheet Metal Structures	4	9	7
		8	21	15
	Program Totals	39	71	63

* Course Syllabi in Volume 2

MANUFACTURING ENGINEERING TECHNOLOGY
SHEET METAL/COMPOSITES
COURSE DESCRIPTIONS

MET 108 **Introduction to Metal Working Processes** (2-6-4) A course designed for the student enrolled in technologies that are associated with metal working processes to become familiar with metal working equipment and processes used in industry. Equipment and processes introduced will include foundry, bench work, drills, grinders, lathe, milling machine, and demonstrations on Computer Numerical Control machining.

MET 201 **Introduction to Plastics** (2-2-3) This is a survey course designed to introduce the student to the field of plastics. This overview will include both thermoplastic and thermoset materials along with the major processing methods being utilized by industry today.

MET 211 **Sheet Metal Processing I** (3-9-6) An introductory sheet metal course. Students will be assigned specifically designed projects that will be fabricated using sheet metal hand tools and manually operated sheet metal brakes and shears, drill presses, and various light industrial saws, rollers, beaders, and punches. Sheet metal drawing and blueprints, hand held precision measuring instruments, and basic layout and fabrication will be stressed.

MET 209 **Plastic Materials and Testing** (1-3-2) This course covers the properties, peculiarities and applications of commercial polymers, including identification techniques and testing methods. Experiments will be conducted to determine various industrial required test results, including strength, thermal, and hardness using appropriate testing equipment. Prerequisite: MET 201, Introduction to Plastics.

MET 301 **Manufacturing Processes** (3-3-4) Essential studies into the processes and materials for manufacturing, including metal casting, hot and cold forming of steel, powder metallurgy and plastics. Analysis of newer processes such as electrical discharge machining, chemical machining and ultra-sonic machining; with an emphasis on the economical manufacturing of products.

MET 302 **CAD/CAM I** (3-3-4) This course will provide an introduction to "Process Modeling" utilizing the CNC graphics programming systems; "SMARTCAM". Using engineering drawings, students will program various parts for both CNC mills and CNC lathes. Related topics include: job planning, tool selection, construction of a process mode, tool path verification, simulation, quality control, CAD/CAM data transfer, and CNC code generation.

MET 317 **Sheet Metal Processing II** (3-9-6) An advanced metalforming course to assist students in achieving proficiency in the handling and placing tooling and materials into

service; in setup and operation of metal stamping equipment, tools and dies, and power bending and forming ancillary devices. Includes custom roll forming processes, metal spinning, press brake operation, and die setter training.

MET 345 **Composites** (1-3-2) Introductory course showing the benefits of combining various types of reinforcing elements (fibers) with a polymer resin (matrix) to yield specific characteristics and properties not attainable by either constituent acting alone.

MET 1103 **Precision Tools and Measurements** (2-4-3) Introduction to the function and reason for measurements. Relationship between different types of measuring tools that a machinist is required to use. Upon completion, the student will be able to properly handle, use, care and calibrate instruments.

MET 1204 **Bench Work and Layout** (2-8-4) Introduction to bench work and layout. The student will be taught use of common hand tools in the machine shop industry; reading of steel rules and the conversion of fractions to decimals; and how to read a blueprint and successfully layout a work piece to be completed with other machine shop tools.

MET 1603 **Industrial Specifications and Safety** (2-4-3) This course is designed to give the student an opportunity to study the fundamentals of specifications in the form of blueprints, work orders, and associated engineering directives. Safety as pertains to machining and shop operations will be covered.

MANUFACTURING ENGINEERING TECHNOLOGY
SHEET METAL/COMPOSITE
SUPPORT COURSES

PSYC 1100* **College Success Skills** This course acquaints the students with the policies of the college, services available on and off the campus, and study skills along with other issues that will help them through their college studies. Students are required to take this course in their first quarter at TSTC.

ENG 107* **Oral & Written Communications** The oral and written communications most needed by entry level technicians. Emphasis will be on oral communication situations between peers, between technician and supervisor or subordinate, and between technician and groups.

MTH 115* **Occupational Mathematics** This course includes English and Metric systems of measurement, geometric principles, solutions of basic algebraic expressions and solutions of triangular trig problems. Problems from specific occupational areas will be stressed.

PSY 112* **Human Relations** This course presents a study in the interaction of people in the business and industrial complex. Emphasis is placed on the necessity for a cooperative environment to satisfy individual needs as well as to increase production efficiency.

WLT 105 **Survey of Welding Processes and Applications** This course is a survey of shielded metal arc, gas tungsten arc, gas metal arc, flux cored arc, and submerged arc welding processes. Metals weldability and weld symbols are considered. Process safety, electrode selection, and process parameters are emphasized. Hard surfacing using shielded metal arc and oxyacetylene processes and techniques are studied. It is recommended that the student have some knowledge of the welding processes before enrollment in this course.

AER 3027 **Sheet Metal Structures** (4-9-7) The principles and practices used in the inspection, repair, layout, and fabrication of aircraft sheet metal structures. Students will become familiar with fiberglass and honeycomb structures and perform repair procedures.

* Course syllabi in Volume 2

THE MAST TECHNICAL WORKPLACE COMPETENCY/COURSE CROSSWALK

Upon development of appropriate curricula for the pilot programs, each MAST college began to develop individual course outlines for its assigned specialty area. The skill standards identified in the Competency Profile were cross walked against the technical competencies of the courses in the pilot curriculum. The resulting matrix provided a valuable tool for assessing whether current course content was sufficient or needed to be modified to ensure mastery of entry level technical competencies. Exit proficiency levels for each of the technical competencies were further validated through industry wide surveys both in Texas and across the nation.

The Technical Workplace Competency/Course Crosswalk in the following pages presents the match between industry-identified duties and tasks and the pilot curriculum for . Course titles are shown in columns, duties and tasks in rows. The Exit Level Proficiency Scale, an ascending scale with 5 the highest level of proficiency, includes marked boxes indicating whether the task is covered by the instructor during the course; the numbers 1-5 indicate the degree of attention given to the task and the corresponding proficiency expected on the part of the student. The crosswalk is intended to serve as an aide to other instructional designers and faculty in community college programs across the nation.

Included on the following pages is the Technical Workplace Competency/Course Crosswalk for the pilot program curriculum. This crosswalk validates the fact that the duties and tasks which were identified by industry as being necessary for entry level employees have been incorporated into the development of the course syllabi.

Technical Workplace Competencies/Course

CROSSWALK

TECHNICAL COMPETENCY: SHEET METAL/COMPOSITES TECHNICIAN

	Bench Work and Layout	Precision Tools & Measure.	Industrial Specs & Safety	Occupational Mathematics	Intro. to Metal Working Proc.	Introduction to Plastics	Survey of Weld. Proc./Applic.	Sheet Metal Processing I	Plastic Materials & Testing	Manufacturing Processes	CAD/CAM I	Sheet Metal Processing II	Composites	Sheet Metal Structures	EXIT PROFICIENCY LEVEL
A. PRACTICE SAFETY															
A-1 Follow Safety Manuals and All Safety Regulations/Requirements			X				X								4
A-2 Use Protective Equipment			X				X								4
A-3 Follow Safe Operating Procedures for Hand and Machine Tools	X	X	X				X							X	4
A-4 Maintain a Clean and Safe Work Environment			X				X								4
A-5 Control Fire Hazards			X			X	X		X						4
A-6 Apply American Red Cross First Aid and CPR Procedures			X				X						X		4
A-7 Recommend Hazardous Waste Management Techniques			X							X			X		4
A-8 Apply Ergonomic Principles to the Workplace	X		X												4
B. APPLY MATHEMATICAL CONCEPTS															
B-1 Perform Basic Arithmetic Functions	X	X			X						X			X	3
B-2 Interconvert Fractions/Decimals		X									X			X	3
B-3 Interconvert Metric/English Measurements		X									X			X	3
B-4 Perform Basic Algebraic Operations	X	X			X						X			X	3
B-5 Perform Basic Trigonometric Functions	X	X									X				3
B-6 Extract Roots and Raise Numbers to a Given Power		X									X				3
B-7 Determine Areas and Volumes of Various Geometric Shapes											X			X	3
B-8 Solve Ratio, Proportion, and Percentage Problems	X	X			X						X			X	3
C. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS															
C-1 Review Blueprint Notes and Dimensions	X							X			X	X		X	3
C-2 Identify Basic Layout of Drawings	X							X			X	X		X	3
C-3 Identify Basic Types of Drawings	X							X			X	X		X	3
C-4 List the Purpose of Each Type of Drawing	X							X			X	X		X	3
C-5 Verify Drawing Elements	X							X			X	X		X	3
C-6 Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology		X									X			X	2
C-7 Describe the Relationship of Engineering Drawings to Planning	X							X				X		X	3
C-8 Use Standards to Verify Requirements	X	X					X	X				X		X	3
C-9 Analyze Bill of Materials (BOM)						X	X	X	X			X	X	X	3
C-10 Understand and Use Quality Systems										X					2
C-11 Review Sketches of Repairs and Alterations							X	X				X	X	X	2

Technical Workplace Competencies/Course

CROSSWALK

TECHNICAL COMPETENCY: SHEET METAL/COMPOSITES TECHNICIAN

	Bench Work and Layout	Precision Tools & Measure.	Industrial Specs & Safety	Occupational Mathematics	Intro. to Metal Working Proc.	Introduction to Plastics	Survey of Weld. Proc./Applic.	Sheet Metal Processing I	Plastic Materials & Testing	Manufacturing Processes	CAD/CAM I	Sheet Metal Processing II	Composites	Sheet Metal Structures	EXIT PROFICIENCY
C-12 Use Blueprint Information	X	X					X	X			X	X	X	X	4
D. IDENTIFY MATERIALS AND PROCESSES															
D-1 Identify and Select Appropriate Non-Destructive Testing Methods									X				X		3
D-2 Perform Chemical Etching								X						X	3
D-3 Understand Basic Heat-Treating Processes							X								3
D-4 Inspect and Check Welds							X								4
D-5 Perform Precision Measurements		X					X		X			X	X	X	4
E. PERFORM CLEANING AND CORROSION CONTROL															
E-1 Identify and Select Cleaning Materials								X				X		X	3
E-2 Perform Aircraft Cleaning and Corrosion Control														X	4
F. WORK WITH SHEET METAL STRUCTURES															
F-1 Inspect Bonded Structures								X				X	X	X	4
F-2 Inspect and Repair Sheet Metal Structures							X	X				X		X	4
F-3 Inspect and Repair Plastics, Honeycomb, and Laminated Structures									X				X		4
F-4 Install Special Rivets and Fasteners								X				X		X	4
F-5 Remove and Install Conventional Rivets								X				X		X	4
F-6 Hand Form, Layout and Bend Sheet Metal								X				X		X	4
G. WORK WITH COMPOSITE STRUCTURES															
G-1 Identify method of repair													X		4
G-2 Identify Bill of Materials (BOM)													X		4
G-3 Repair Per Technical Order/Engineering Specifications or Disposition													X		4
G-4 Perform Resin Transfer Molding													X		4
G-5 Lay Up a Fiberglass Mold													X		4
G-6 Build Honeycomb Structure to Specifications													X		4

SHEET METAL/COMPOSITES TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES
EXIT LEVEL PROFICIENCY MATRIX

Sheet Metal/Composites Technician:

plan, layout, cut, fabricate and join sheet metal and/or composite material to produce a work piece to referenced engineering standards. Includes lay up and shaping, either by hand or machine, metallic, non-metallic and composite materials to include metals, resins, hard plastics, fiberglass, and ceramics.

The following matrix identifies the five exit levels of technical workplace competencies for the Sheet Metal/Composites Technician Certificate at Texas State Technical College Waco.

EXIT LEVEL OF PROFICIENCY					
Technical Workplace Competency	**1**	**2**	**3**	**4**	**5**
	rarely	routinely with supervision	routinely with limited supervision	routinely without supervision	initiates/ improves/ modifies and supervises others

THE MAST SCANS/COURSE CROSSWALK

The Secretary's Commission on Achieving Necessary Skills (SCANS), U. S. Department of Labor, has identified in its "AMERICA 2000 REPORT' the following five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance:

COMPETENCIES:

Resources:	Identifies, organizes, plans, and allocates resources
Interpersonal:	Works with others
Information:	Acquires and uses information
Systems:	Understands complex inter-relationships
Technology:	Works with a variety of technologies

FOUNDATION SKILLS:

Basic Skills:	Reads, writes, performs arithmetic and mathematical operations, listens and speaks
Thinking Skills:	Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons
Personal Qualities:	Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty

Recognizing the value of SCANS proficiencies to job performance, as well as the growing mandate in many states to include SCANS activities in course curricula, MAST asked survey respondents to review the SCANS skill sets in the context of the draft skill standards for each occupational specialty area. MAST also incorporated evaluation of SCANS competencies and foundation skills into its assessment of the pilot training curricula. The results were summarized in a crosswalk that allowed MAST staff to modify course content where needed to strengthen achievement of SCANS competencies.

The following pages present the SCANS/Course Crosswalk for the pilot curriculum in Courses are listed along the top and SCANS competencies and foundations are shown along the left side of the matrix. An exit level proficiency matrix for SCANS competencies and foundation skills is provided as well.

As "soft" skills, the SCANS competencies are inherently difficult to quantify. MAST realizes that some faculty will emphasize the SCANS more or less than others. The SCANS/Course Crosswalk matrix has been included with this course documentation to show the importance of these "soft skills" and the importance of their being addressed in the classroom (particularly in technical classes). In time, faculty will learn to make these types of SCANS activities an integral and important part of the teaching process.

Included on the following pages is the SCANS/Course Crosswalk for the pilot program curriculum. This crosswalk validates the fact that the "soft skills" (SCANS) which were identified by industry as being necessary for entry level employees have been incorporated into the development of the course syllabi. Also included is a matrix which defines the exit level of proficiency scale (1-5).

SCANS/Course

CROSSWALK

SHEET METAL/COMPOSITES TECHNICIAN

COMPETENCY	Bench Work and Layout	Precision Tools & Measure.	Industrial Specs & Safety	Occupational Mathematics	Intro. to Metal Working Proc.	Introduction to Plastics	Survey of Weld. Proc./Applic.	Sheet Metal Processing I	Plastic Materials & Testing	Manufacturing Processes	CAD/CAM I	Sheet Metal Processing II	Composites	Sheet Metal Structures	EXIT PROFICIENCY LEVEL
(RS) RESOURCES:															
A. Allocates time	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3
B. Allocates money					X	X	X	X	X	X	X	X		X	3
C. Allocates material and facility resources	X					X	X	X	X	X	X	X	X	X	4
D. Allocates human resources	X	X			X	X	X	X	X	X	X	X	X	X	1
(IN) INTERPERSONAL SKILLS:															
A. Participates as a member of a team	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4
B. Teaches others	X	X	X		X	X	X	X	X	X	X	X	X	X	1
C. Serves clients/customers	X						X	X			X	X	X	X	2
D. Exercises leadership	X	X				X	X	X	X	X	X	X	X	X	1
E. Negotiates			X							X		X		X	1
F. Works with cultural diversity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4
(IF) INFORMATION SKILLS:															
A. Acquires and evaluates information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4
B. Organizes and maintains information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4
C. Interprets and communicates information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4
D. Uses computers to process information		X		X							X	X	X	X	2
(SY) SYSTEMS:															
A. Understands systems			X		X					X	X	X		X	3
B. Monitors and corrects performance	X	X		X		X	X	X	X		X		X	X	2
C. Improves and designs systems			X							X	X	X			1
(TE) TECHNOLOGY:															
A. Selects technology	X	X			X	X	X	X	X	X	X	X	X	X	4
B. Applies technology to task	X	X			X	X	X	X	X	X	X	X	X	X	4
C. Maintains and troubleshoots technology	X	X			X	X	X	X	X	X	X	X	X	X	3

J.PENICK/W.PELTON/R.TIMMONS

SCANS/Course

CROSSWALK

SHEET METAL/COMPOSITES TECHNICIAN

FOUNDATION SKILLS	Bench Work and Layout	Precision Tools & Measure.	Industrial Specs & Safety	Occupational Mathematics	Intro. to Metal Working Proc.	Introduction to Plastics	Survey of Weld. Proc./Applic.	Sheet Metal Processing I	Plastic Materials & Testing	Manufacturing Processes	CAD/CAM I	Sheet Metal Processing II	Composites	Sheet Metal Struct.	Extra
(BS) BASIC SKILLS:															
A. Reading	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
B. Writing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
C. Arithmetic and mathematics	X	X		X	X	X	X	X	X	X	X	X	X	X	
D. Listening	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
E. Speaking	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
(TS) THINKING SKILLS:															
A. Creative thinking	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
B. Decision making	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
C. Problem solving	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
D. Seeing things in the mind's eye	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
E. Knowing how to learn	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
F. Reasoning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
(PQ) PERSONAL QUALITIES:															
A. Responsibility	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
B. Self-esteem	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
C. Social	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
D. Self-management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
E. Integrity/honesty	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

SCANS
COMPETENCIES AND FOUNDATION SKILLS
EXIT LEVEL PROFICIENCY MATRIX

The Secretary's Commission on Achieving Necessary Skills (SCANS), U. S. Department of Labor, has identified in its "AMERICA 2000 REPORT' the following five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance:

COMPETENCIES:

Resources:	Identifies, organizes, plans, and allocates resources
Interpersonal:	Works with others
Information:	Acquires and uses information
Systems:	Understands complex inter-relationships
Technology:	Works with a variety of technologies

FOUNDATION SKILLS:

Basic Skills:	Reads, writes, performs arithmetic and mathematical operations, listens and speaks
Thinking Skills:	Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons
Personal Qualities:	Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

The following matrix identifies the five exit levels of proficiency that are needed for solid job performance.

EXIT LEVEL OF PROFICIENCY					
SCANS Competencies and Foundation Skills	**1**	**2**	**3**	**4**	**5**
	rarely	routinely with supervision	routinely with limited supervision	routinely without supervision	initiates/ improves/ modifies and supervises others

MAST/01/012296

THE MAST COURSE SYLLABI
"PILOT PROGRAM"

MAST has produced a very unique set of course outlines, driven and validated by industry and encompassing the broad range of technologies covered by the MAST grant. The course outlines also include proposed SCANS activities that will be useful to an instructor in preparing students to enter the workforce of the future.

Included in the following pages are final course outlines developed and refined in the process of piloting the MAST training programs. The outlines include a brief course description; required course materials (e.g., textbook, lab manual, and tools, if available); proposed method of instruction; proposed lecture and lab outlines; and detailed course objectives for both Technical Workplace Competencies and SCANS Competencies.

These outlines were completed and revised during the second year of MAST, following completion of the pilot phase. The outlines are intended to serve as an aide to other instructional designers and faculty in community college programs across the nation.

Included on the following pages are the Course Syllabi for each of the courses which were taught during the pilot program.

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

BENCH WORK AND LAYOUT

MAST PROGRAM
COURSE SYLLABUS
BENCH WORK AND LAYOUT

Lecture hours/week: 2 **Lab hours/week: 8** **Credit hours: 4**

COURSE DESCRIPTION:

Introduction to bench work and layout. The student will be taught use of common hand tools in the machine shop industry; reading of steel rules and the conversion of fractions to decimals; and how to read a blueprint and successfully layout a work piece to be completed with other machine shop tools.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Machine Tool Practices, Kibbe, Neely, and Meyer, Wiley Pub., 4th Ed.
Lab Manual: Bench Work & Layout, Pelton, TSTC Pub., latest edition.

Student Tool List	Qty. Req'd.
Tool Box	1
Safety Glasses	1 pair
6 inch Ruler	1/8, 1/16, 1/32, and 1/64 inch
Ball Peen Hammer	1
10 inch Adjustable Wrench	1
Center Punch	1
Magic marker, Jumbo, black.	1
Aluminum Oxide Cloth, 9" X 11", 240 Grit	2 sheets
Aluminum Oxide Cloth, 9" X 11", 320 Grit	2 sheets
Flat Mill Bastard File, 10 inch.	1
File Handle	1
Allen Wrench Set, Long English and Metric	1 each
Center Drill #3	1
Scribe	1
6" Dial Caliper	1
Center Gage	1
Screw Driver, 8 inch	1
File Card Brush	1

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to the Course	Handout	
Tool List		
Safety	5	
Measuring Tools		
6" scale	106	
Decimal equivalents	101	
Dial calipers	114	
Vernier instruments	118	
Quiz #1 (over above lectures)		
Layout	231	
Basic blue print reading	26	
Layout tools		
Basic layout techniques (semi-precision)	242	
Advanced layout techniques (precision)	247	
Quiz #2 (over above lectures)		
Hand Tools		
Hammers, wrenches, chisels, screwdrivers	35	
Vises and hacksaws	43	
Files	54	
Taps and dies	64	
Reamers, broaches and laps	60	
Quiz #3 (over above lectures)		
Basic Machine Tools		
Sawing machines	309	
Drilling machines	338	
Grinding machines	617	
Quiz #4 (over above lectures)		
Complete Lab Projects - No lecture	---	
	Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Shop orientation	2
Leaving the shop in order	4
Measuring Tools practice	10
Basic blue print reading	8
Layout tools practice	4
Basic layout techniques (semi-precision)	8
Advanced layout techniques (precision)	8
Proper hand tools techniques and usage	16
Sawing machines	16
Drilling machines	16
Grinding machines	16
Inspecting the finished work	4
Total Lab Hours	**96**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions

C. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions
   d. Identify general note symbols
   e. Locate notes on a print
   f. Interpret commonly used abbreviations and terminology
   g. Determine the tolerances associated with dimensions on a drawing
   h. Determine the tolerance for a referenced dimension
   i. Determine the surface finish for a given part
   j. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
   c. Identify the purpose of exploded isometric drawing
   d. Identify the purpose of assembly drawings
5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints

D. IDENTIFY MATERIALS AND PROCESSES

1. Perform Precision Measurements
   a. Use a micrometer and caliper to make precise measurements
   b. Measure a small hole using a micrometer and a hole gage
   c. Read and interpret a vernier micrometer scale
   d. Use a dial indicator, V-blocks, and a surface plate to check alignment of a shaft

E. WORK WITH SHEET METAL STRUCTURES

1. Inspect and Repair Sheet Metal Structures
   a. Select and use twist drills
   b. Select and use a hand file for soft metals
   c. Use a reamer

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
   1. Follows a schedule to complete assigned tasks on time
   2. Determine the initial cost of materials and "value added" as result of machining
   3. Complete a stock request form for required material
   4. Provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
   1. Complete assigned responsibilities within the shop floor serving as a member of the team
   2. Provide individual assistance/direction to peers as requested
   3. Produce machine parts to acceptable levels of quality as required
   4. Works well with all members of the class

C. ***Information:*** *Acquires and uses information*
   1. Read and interpret blueprints
   2. Organize and apply theories of machine tool operation
   3. Perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*
   1. Demonstrate knowledge of the following systems:
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities on the shop floor
      c. systematic approach to the metal removal process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. Monitors and corrects performance during
      a. the machining process
      b. adjustments of individual laboratory work schedule
      c. constantly evaluating the quality of work to achieve acceptable standards
      d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*
   1. Chooses procedure, tools and equipment required to produce a part
   2. Applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
   3. Maintains and troubleshoots equipment

a. applies appropriate preventative maintenance
b. when operating machines
c. reports all malfunctions of equipment to supervisor/instructor
d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. taps and threads
   e. keeps a running computation of individual grade
   f. interconverts fractions to decimal expressions
   g. use protractors to lay-out angle machining
   h. use trigonometry to solve angle and taper calculations
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement

b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. *Sociability: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. *Self-Management: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual gradebook)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers

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***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

PRECISION TOOLS & MEASUREMENTS

MAST PROGRAM
COURSE SYLLABUS
PRECISION TOOLS & MEASUREMENTS

Lecture hours/week: 2 **Lab hours/week: 4** **Credit hours: 3**

COURSE DESCRIPTION:

Introduction to the function and reason for measurements. Relationship between different types of measuring tools that a machinist is required to use. Upon completion, the student will be able to properly handle, use, care for, and calibrate measuring instruments.

This course is designed to familiarize the student with the use, handling and maintenance of a variety of precision tools and instruments which will be encountered in industry. Care and calibration of instruments and metric conversions will be covered.

Students will use measuring tools such as: rulers, surface gages, verniers, micrometers, dial indicators, dial test indicators, gage blocks and accessories, electronic indicators, optical comparators, precision height gages, ring and plug gages, thread gages, snap gages, v-blocks, 1-2-3 blocks, angle plates and surface plates to check test specimens for: locations of holes, radii etc., lengths, diameters, surface finish, parallelism, squareness, and concentricity, rectangular coordinates, angles, thread fits, maximum and minimum material condition to tolerances as close as +/-.000010". Students will also learn to make comparison measurements and inspections using the optical comparator and the coordinate measuring machine (CMM).

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Machine Tool Practices, Kibbe, Neely, and Meyer, Wiley Pub., 4th Ed.

Student Tools List/Qty. Req'd: Same as for Bench Work and Layout

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will consist of "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments

2. apply theory to laboratory assignments
3. perform satisfactorily on written, oral, or practical examinations
4. perform satisfactorily on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Precision Tools and Measurement	89	1
Measuring with Ruled Instruments (English and metric)	108	2
Measuring with Vernier Measuring Tools	122	2
Measuring with Micrometer Measuring Tools	133	2
Using Gage Blocks and Accessories	178	3
Measuring Angles	187	2
Making Comparison Measurements	157	2
Measuring with Fixed and Adjustable Gages	94	2
Using High Amplification Electrical Comparators	105	2
Using Optical Comparators	176	2
Using Coordinate Measuring Machines	103	3
Final Examination		1
	Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Using the inch & metric measuring systems	3
Make measurements with inch & metric ruled instruments	1
Measure with inch & metric vernier tools	2
Measure with inch & metric dial calipers	1
Read and use inch & metric micrometer tools	2
Calculate gage block requirements	2
Clean and assemble required gage blocks and accessories	1
Calibrate measuring tools with gage blocks	2
Use gage blocks for direct measurement	1
Identify types of angles	1
Measure angles with protractor head and rule	1
Measure angles with the vernier protractor	2
Measure angles with sine bar, sine plate, gage blocks, etc.	2
Make semi-precision comparison measurements	1
Make precision comparison measurements within +/- .001"	2

Make precision comparison measurements within +/- .0001"	2
Measure with fixed gages	1
Measure with adjustable gages	2
Use dial indicator comparators	1
Use precision height gages	1
Use a Reed-type comparator	1
Measurement by motion using the optical comparator	3
Measurement by comparison using the optical comparator	2
Angular measurement using the optical comparator	3
Measure with the super micrometer	1
Measure with the multi-scale electronic comparator	2
Measure/Inspect using the Coordinate Measuring Machine (CMM)	5
Total Lab Hours	**48**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   - a. Add, subtract, multiply and divide whole numbers
   - b. Add, subtract, multiply, and divide fractions
   - c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   - a. Convert fractions to decimal equivalents
   - b. Convert decimal values to nearest fractional equivalent
   - c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   - a. Convert English dimensions to Metric
   - b. Convert Metric dimensions to English
   - c. Use Metric/English conversion chart
4. Perform Basic Algebraic Operations
   - a. Express word statements as algebraic equations
   - b. Solve word statements as algebraic equations
   - c. Calculate the center of gravity relative to the datum
5. Perform Basic Trigonometric Functions
   - a. Solve for unknown angles
   - b. Solve for unknown sides
6. Determine Areas and Volumes of Various Geometric Shapes
   - a. Calculate the area of rectangles, squares, triangles, circles, and trapezoids
   - b. Calculate the volume of rectangles, cubes, and cylinders
7. Solve Ratio, Proportion, and Percentage Problems
   - a. Determine the ratio of two numbers
   - b. Convert decimal numbers to their fractional equivalent

B. IDENTIFY MATERIALS AND PROCESSES

1. Perform Precision Measurements
   - a. Use a micrometer and caliper to make precise measurements
   - b. Measure a small hole using a micrometer and a hole gage

c. Read and interpret a vernier micrometer scale
d. Use a dial indicator, V-blocks, and a surface plate to check alignment of a shaft

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. determine cost associated with "tight" vs. "loose" tolerances

B. Interpersonal: Works with others
1. complete assigned responsibilities within the laboratory
2. provide individual assistance/direction to peers as requested
3. works well with all members of your class

C. Information: Acquires and uses information
1. read and interpret blueprints

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities in the laboratory
   c. systematic approach to the use of measuring tools/instruments
   d. dimensioning and measurement systems
2. monitors and corrects performance during
   a. the measuring processes
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies
1. chooses procedure, tools and instruments required to inspect a part
2. applies appropriate procedures and uses appropriate tools and techniques to properly measure a work piece
3. Maintains and calibrates measuring instruments
   a. applies appropriate preventative maintenance
   b. check calibration prior to using measuring instruments
   c. calibrates measuring instruments against standards

d. perform clean-up assignments of laboratory at the end of the period

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

a. read/studies textbook
b. studies student laboratory worksheets
c. interprets blueprints and technical drawings
d. follow a daily laboratory schedule to maintain appropriate time-line for successful course requirements

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*

a. outline the steps necessary to accurately measure a machined part
b. maintain a lecture notebook

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*

a. interconvert English to metric systems of measurement
b. interconverts fractions to decimal expressions

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*

a. assimilate classroom instruction
b. interpret and assimilate video instruction
c. observe laboratory demonstrations
d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*

a. participates in classroom discussions
b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the lab

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*

a. identifies personal goals
b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*

a. makes daily accommodations to stay on schedule
b. seeks additional instruction/clarification for assignment completion
c. balances social and academic life/responsibilities
d. accepts responsibility

3. *Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. select appropriate measuring tool based on drawing requirements
   c. understands both written and verbal instructions

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrates mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the operator
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. *Sociability: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (measurement instruments, accessories and instructor's individual attention)

4. *Self-Management: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. accept the responsibility for self-management
5. *Integrity/Honesty: Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examinations and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Mathematics for Machine Technology; Robert Smith, Delmar Publishers

MET1103
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*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

INDUSTRIAL SPECIFICATIONS AND SAFETY

MAST PROGRAM
COURSE SYLLABUS
INDUSTRIAL SPECIFICATIONS AND SAFETY

Lecture hours/week: 2 **Lab hours/week: 4** **Credit hours: 3**

COURSE DESCRIPTION:

This course is designed to give the student an opportunity to study the fundamentals of specifications in the form of blueprints, work orders, and associated engineering directives. Safety as pertains to machining and shop operations will be covered.

Students will identify potential hazards in the machine shop area(s) and will be required to develop and implement preventive or corrective action(s). The student will be required to interpret various blueprint dimensions, machining symbols, tolerance zones, Geometric Dimensioning & Tolerancing (GD&T) symbols, machining details, sectional views, and perform basic shop sketching.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook/Lab Manual: Blueprint Reading for Manufacturing, Edward Hoffman and Paul Wallach, Delmar Publishers, Latest Edition.

Student Tool List/Quantity Required: None

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video, and instructor demonstrations.

Laboratory: Laboratory will consist of hands-on activities. Students will complete exercises in their laboratory workbooks.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments
5. contribute to class discussions

6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to the course		1
Safety in the machine shop		
Technical Modules MAC-A1	"Follow Safety Manuals and All Safety Regulations/Requirements"	1
Technical Modules MAC-A2	"Use Protective Equipment"	1
Technical Modules MAC-A3	"Follow Safe Operating Procedures for Hand and Machine Tools"	1
Technical Modules MAC-A4	"Maintain a Clean and Safe Work Environment"	1
Features of the blueprint	9	2
Interpreting print dimensions	117	2
Identifying the characteristics of detail and assembly prints	153	2
Identifying the types and uses of sectional views	167	2
Interpreting machine details on blueprints	183	3
Interpreting geometric dimensioning and tolerancing control symbols (GD&T)	233	3
Interpreting metric blueprint dimensions	295	2
Basic shop sketching techniques	39	1
Reading and interpreting industrial blueprints, engineering directives and work orders		2
	Total Lecture Hours	**24**

LAB OUTLINE:

Lecture Topics	Exercise Reference	Contact Hrs.
Identify features on a blueprint	E2-1	2
Interpret print dimensions	E8-1, 2, 3	6
Identify characteristics of detail & assembly prints	E9-1, 2	4
Identify the types and uses of sectional views	E10-1, 2	4
Interpret machine details on blueprints	E11-1, 8	4
Interpret Geometric Dimensioning and Tolerancing control symbols	E12-1	4
Interpret metric blueprint dimensions	E15-1, 2	4
Perform basic shop sketching	E4-1, 2, 3, 4	6
Read and interpret industrial blueprints, engineering directives and work orders		12
	Total Lab Hours	**48**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment
6. Apply American Red Cross First Aid and CPR Procedures
   a. Notify appropriate personnel of injury
   b. Check and evaluate life-endangering conditions
   c. Determine need for CPR
   d. Apply appropriate first aid techniques
   e. Complete accident report as needed
7. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Evaluate and determine hazards
   c. Describe the proper collection for a variety of hazardous wastes
   d. Respond to emergencies in the appropriate manner
8. Apply Ergonomic Principles to the Workplace
   a. Define ergonomics
   b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

B. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology

b. Interpret the various types of lines employed in blueprints and schematics
c. Identify the types of dimensions
d. Identify general note symbols
e. Locate notes on a print
f. Interpret commonly used abbreviations and terminology
g. Determine the tolerances associated with dimensions on a drawing
h. Determine the tolerance for a referenced dimension
i. Determine the surface finish for a given part
j. List the essential components found in the general drawing notes

2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
   c. Identify the purpose of exploded isometric drawing
   d. Identify the purpose of assembly drawings
5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
9. Analyze Bill of Materials (BOM)

a. Discuss components found on BOM
b. Determine materials needed to produce the part
c. Determine quantities necessary to produce the part
d. Submit completed stock request form as required
e. Submit completed tool request form as needed

10. Understand and Use Quality Systems
    a. Use ISO 9000, 9002, and 9003 for external quality assurance
    b. Use ISO 9004 for internal quality management
    c. Document paper trails for document revisions
11. Use Blueprint Information
    a. Identify/interpret information presented in blueprint title blocks
    b. Install and modify component parts by reference to blueprints

C. IDENTIFY MATERIALS AND PROCESSES

1. Identify and Select Appropriate Non-Destructive Testing Methods
    a. Apply the use of ultrasonic inspection methods for detecting cracks
    b. Apply methods for detecting surface cracks in aluminum castings and forgings
    c. Apply techniques for locating cracks in materials when only one side of the material is accessible
2. Perform Chemical Etching
    a. Perform general magnetic particle inspection general procedures
    b. Demagnetize steel parts after magnetic inspection
    c. Clean parts in preparation for penetrant inspection
    d. Identify visual indications of a subsurface flaw or fracture during magnetic particle inspection
    e. Locate cracks and blowholes in welded assemblies
    f. Perform dye penetrant procedures
    g. Distinguish between heat-treated and non-heat-treated aluminum alloys when the identification marks are not on the material
3. Inspect and Check Welds
    a. Identify the characteristics of a good weld
    b. Identify the types of stress that welded joints can withstand
    c. Determine the effects of welding over a previously brazed or soldered joint

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. *Resources: Identifies, organizes, plans, and allocates resources*
   1. follows a schedule to complete assigned tasks on time
   2. provide a self-evaluation of performance based on the time and quality of work

B. *Interpersonal: Works with others*
   1. complete assigned responsibilities within the lab serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. works well with all members of the class

C. *Information: Acquires and uses information*
   1. read and interpret blueprints

D. *Systems: Understands complex inter-relationships*
   1. demonstrate knowledge of the following systems:
      a. systematic approach to obtaining information from an engineering drawing
      b. dimensioning and measurement systems
      c. systematic organization of training materials
   2. monitors and corrects performance during
      a. adjustments of individual laboratory work schedule
      b. constantly evaluating the quality of work to achieve acceptable standards
      c. maintains record of evaluations and sets individual goals

E. *Technology: Works with a variety of technologies*
   1. chooses procedure, tools and equipment required to produce a part
   2. applies appropriate procedures and uses appropriate safety equipment to work safely in the shop

II. FOUNDATION SKILLS

A. *Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*
   1. *Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
      a. studies student laboratory manual
      b. interprets blueprints and technical drawings
      c. follow a daily laboratory schedule to maintain appropriate time-line and course completion
   2. *Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
      a. submit written responses to chapter question assignments
      b. complete all written assignments
   3. *Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
      a. calculates machining points from blueprint information
      b. estimates machine time from blueprint information
      c. keeps a running computation of individual grade

d interconverts fractions to decimal expressions

4. *Listening: Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. *Speaking: Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

INTRODUCTION TO METAL WORKING PROCESSES

MAST PROGRAM
COURSE SYLLABUS
INTRODUCTION TO METAL WORKING PROCESSES

Lecture hours/week: 2 **Lab hours/week: 6** **Credit hours: 4**

COURSE DESCRIPTION:

A course designed for the student enrolled in technologies that are associated with metal working processes to become familiar with metal working equipment and processes used in industry. Equipment and processes introduced will include foundry, bench work, drills, grinders, lathe, milling machine, and demonstrations on Computer Numerical Control machining.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Machine Tool Practices, Kibbe, Neely, and Meyer, Wiley Pub., 4th Ed.
Lab Manual: Machine Tool Practices I, Raborn, TSTC Pub., 4th Ed.

Student Tool List	**Qty. Req'd.**
Tool Box	1
Safety Glasses	1 pair
6 inch Ruler	1/8, 1/16, 1/32, and 1/64 inch
Ball Peen Hammer	1
10 inch Adjustable Wrench	1
Center Punch	1
Magic marker, Jumbo, black.	1
Aluminum Oxide Cloth, 9" X 11", 240 Grit	2 sheets
Aluminum Oxide Cloth, 9" X 11", 320 Grit	2 sheets
Tool Steel, 3/8", H.S.S.	2
Flat Mill Bastard File, 10 inch.	1
File Handle	1
Allen Wrench Set, Long English and Metric	1 each
Center Drill #3	1
Scribe	1
Center Gage	1
Screw Driver, 8 inch	1
File Card Brush	1
0-6 inch Dial Calipers	1
Shop Apron (blue denim)	1
Shop Towels (1 roll)	1

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" machining process

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to the Course	---	
Tool List	Handout	
Safety	5-12	
BENCHWORK		
The Inch Rule	113-118	
The Inch Micrometer	140-145	
Hand Tools	46-55	
Hacksaws	55-58	
Files	58-63	
The Drill Press	365-374	
Drilling Tools	375-384	
Drilling Operations	389-394	
QUIZ I (over above lectures)	---	
LATHE WORK		
Lathe Parts	414	
Lathe Accessories	394	
Cutting Speeds and Feeds	270	
Knurling and Grooving	452	
Tapers	477	
Threads	457	
QUIZ 2 (over the above units)	---	
MILL WORK		
Milling Machines	502	
Milling Cutters	507	
Milling Operations	526	
QUIZ 3 (over the above units)	---	
No lecture - complete lab work...	---	
	Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Shop orientation	1
Use of the cut-off saw	1
Grinding a lathe tool	2
Grinding a mill tool	2
Using the band saw	1
Using the radial drill	2
Using the sensitive drill	2
Bench work	19
Lathe work	19
Mill work	19
Leaving the shop in order	1
Inspecting the finished work	3
Total Lab Hours	72

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions

C. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions
   d. Identify general note symbols
   e. Locate notes on a print
   f. Interpret commonly used abbreviations and terminology
   g. Determine the tolerances associated with dimensions on a drawing
   h. Determine the tolerance for a referenced dimension
   i. Determine the surface finish for a given part
   j. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
   c. Identify the purpose of exploded isometric drawing
   d. Identify the purpose of assembly drawings
5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
7. Use Standards to Verify Requirements

a. Discuss the purpose of standards
b. Discuss source locations for standards

8. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

D. IDENTIFY MATERIALS AND PROCESSES

1. Perform Precision Measurements
   a. Use a micrometer and caliper to make precise measurements
   b. Measure a small hole using a micrometer and a hole gage
   c. Read and interpret a vernier micrometer scale
   d. Use a dial indicator, V-blocks, and a surface plate to check alignment of a shaft

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
   1. follows a schedule to complete assigned tasks on time
   2. determine the initial cost of materials and "value added" as result of machining
   3. complete a stock request form for required material
   4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
   1. complete assigned responsibilities within the shop floor serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. produce machine parts to acceptable levels of quality as required
   4. works well with all members of the class

C. Information: Acquires and uses information
   1. read and interpret blueprints
   2. organize and apply theories of machine tool operation
   3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
    a. laboratory organization structure: physical and social
    b. organization of personnel and facilities on the shop floor
    c. systematic approach to the metal removal process
    d. dimensioning and measurement systems
    e. systematic organization of training materials
2. monitors and corrects performance during
    a. the machining process
    b. adjustments of individual laboratory work schedule
    c. constantly evaluating the quality of work to achieve acceptable standards
    d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
    a. applies appropriate preventative maintenance
    b. when operating machines
    c. reports all malfunctions of equipment to supervisor/instructor
    d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
    a. studies student laboratory manual
    b. interprets blueprints and technical drawings
    c. read/studies textbook
    d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
    a. outline the steps necessary to produce a simple machine part
    b. maintain a lecture notebook
    c. submit written responses to chapter question assignments
    d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
    a. determines optimum machining speeds, feeds, and depth of cut
    b. calculates "value added to the part"
    c. aligns machine and/or work holding device
    d. taps and threads
    e. keeps a running computation of individual grade
    f. interconverts fractions to decimal expressions

g. use protractors to lay-out angle machining
h. use trigonometry to solve angle and taper calculations

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. *Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. *Responsibility: Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. *Self-Esteem: Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. *Sociability: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. *Self-Management: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. *Integrity/Honesty: Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

INTRODUCTION TO PLASTICS

MAST PROGRAM
COURSE SYLLABUS
INTRODUCTION TO PLASTICS

Lecture hours/week: 2 **Lab hours/week: 2** **Credit hours: 3**

COURSE DESCRIPTION:

This is a survey course designed to introduce the student to the field of plastics. This overview will include both thermoplastic and thermoset materials along with the major processing methods being utilized by industry today.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Plastics: Materials and Processing, by Strong. Published by Prentice Hall. Latest edition.

Lab Manual: None

Student Tool List/Qty. Req'd: None

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will consist of "hands on" activities which will enable the student to learn the selection and preparation of raw materials, machining functions, mold set up, and the use of auxiliary equipment associated with injection molding.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Plastics	Chapter 1	2
Forms of Plastic	Chapter 5	3
Ingredients of Plastics	Chapter 6	3
Thermoplastics and their Properties	Chapter 7	5
Thermosetting Plastics	Chapter 8	4
Molding Processes	Chapter 10	3
Extrusion Processes	Chapter 11	2
Thermoforming Processes	Chapter 15	3
	Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Identification of Plastic Materials	3
Introduction to Thermoplastic Processing	3
Introduction to Thermoset Processing	3
Introduction to Molding Equipment	6
Introduction to Molding Processes	3
Introduction to Extrusion Molding	3
Introduction to Thermoforming	3
Total Lab Hours	**24**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards

a. Handle/store flammable materials appropriately
b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
c. Prevent spontaneous ignition by practicing proper waste disposal habits
d. Keep marked aisles clear of equipment and materials
e. Identify fire exits and fire-fighting equipment

6. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Evaluate and determine hazards
   c. Describe the proper collection for a variety of hazardous wastes
   d. Respond to emergencies in the appropriate manner
7. Apply Ergonomic Principles to the Workplace
   a. Define ergonomics
   b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

B. WORK WITH COMPOSITE STRUCTURES

1. Identify Bill of Materials (BOM)
   a. Calculate required materials
   b. Compare required materials to the BOM in the repair order
   c. Adjust BOM if necessary

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of processing
3. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce molded parts to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints
2. organize and apply theories of plastic molding equipment operation

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the plastic molding process
   d. systematic organization of training materials
2. monitors and corrects performance during
   a. the molding process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a molded part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets molding machine manuals
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a molded plastic part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum time and temperature settings for various plastic polymers
   b. calculates "value added to the part"
   c. adjusts timers and heaters to maintain a quality part

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the technician
   c. understands the relationship between different plastic materials and the processing variables and adjusts molding parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on molded parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

SURVEY OF WELDING PROCESSES AND APPLICATIONS

MAST PROGRAM
COURSE SYLLABUS
SURVEY OF WELDING PROCESSES AND APPLICATIONS

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

This course is a survey of shielded metal arc, gas tungsten arc, gas metal arc, flux cored arc, and submerged arc welding processes. Metal weldability and weld symbols are considered. Process safety, electrode selection, and process parameters are emphasized. Hard surfacing, using shielded metal arc and oxyacetylene processes and techniques are studied.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Oxy-Acetylene Handbook, by Linde, Union Carbide Publisher, Latest Edition
New Lessons in Arc Welding, by Lincoln Electric, Lincoln Electric Publisher, Latest Edition

Lab Manual: None Required

Student Tool List	**Qty. Req'd.**
Oxy-acetylene cutting and welding goggles (mono) with #5 filter lens and one clear plastic lens	1 pair
Friction lighter	1
Wire brush 1" wide with long handle	1
Soap stone	2 pieces
Welder's cap	1
Welding gloves, long gauntlet	1 pair
Chipping hammer	1
Safety glasses	1 pair
Slip joint pliers	1 pair

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video, and demonstrations.

Laboratory: Hands on laboratory activities to enable the students to learn the various aspects of the welding process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to the course		1
Introduction to oxy-acetylene fusion	1	1
Oxy-acetylene welding and cutting	9	2
Introduction to mechanical and physical properties	77	1
Non-fusion welding		1
Introduction to the oxy-acetylene cutting processes		1
Test #1		1
The shielded metal arc welding process	1-7	1
Running a good quality bead in the flat position	1-21	1
Introduction to shielded metal arc welding electrodes	3-3	2
Shielded metal arc power sources	2-3	1
Test #2		1
Weld joints, weld types and weld positions	1-54	2
Introduction to fillet welds	1-56	1
Test #3		1
Introduction to gas metal arc welding and flux core arc welding	7-37	2
Short circuiting metal transfer		1
Test #4		1
Power sources for GMAW and FCAW		1
SMAW and FCAW filler metal transfer modes		1
Test #5		1
Shielding gases used with the GMAW process	7-37	1
Shielding gases used with the FCAW process		1
Test #6		1
Introduction to gas tungsten arc welding		2
Power sources for GTAW		1
GTAW electrodes		1
Test #7		1

Introduction to submerged arc welding and techniques	7-69	1
Submerged arc welding processes		1
Test #8		1
	Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
The Oxy-Acetylene Welding and Cutting Process	**9**
Demonstration of setting up and break down of equipment	
A. Welding beads on plate	
(1) Flat position	
(2) Without and with filler	
B. Square butt joints	
(1) Flat and vertical position	
(2) With filler material	
C. Brazing beads on plate	
(1) Flat position	
(2) With filler material	
D. Brazing square butt joint	
(1) Flat and vertical position	
(2) With filler	
E. Oxy-acetylene cutting	
(1) Cutting to a straight line	
The Shielded Metal Arc Welding Process (SMAW)	**9**
A. Welding beads on plate	
(1) E6010, E6011 and/or E7018 dependent on availability	
(2) Flat, horizontal and vertical	
B. Welding tee joint	
(1) E6010, E6011 and/or E7018 dependent on availability	
(2) Flat, horizontal and vertical	
The Gas Metal Arc Welding and Flux Core Welding Processes (GMAW)	**6**
A. Set up 3 machines each process	
B. Welding beads on plate, both processes	
(1) Have hands on with observers at each station	
C. Demonstration of GMAW spot welder	
The Gas Tungsten Arc Welding Process (GTAW)	**6**
A. Set up machines for welding steel and aluminum (2 or 3 each)	
B. Welding beads on plate steel	
(1) Have hands on with observers	
C. Welding bead on plate aluminum	
(2) Have hands on with observers	
The Submerged Arc Welding Process	**6**
A. Demonstrate beads on plate	
B. Demonstrate running beads roll position	
C. Let students have hands on and observation	
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals

C. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
2. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
3. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part

c. Determine quantities necessary to produce the part
d. Submit completed stock request form as required
e. Submit completed tool request form as needed

D. IDENTIFY MATERIALS AND PROCESSES

1. Inspect and Check Welds
   a. Identify the characteristics of a good weld
   b. Identify the types of stress that welded joints can withstand
   c. Determine the effects of welding over a previously brazed or soldered joint

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. provides a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
1. complete assigned responsibilities within the welding lab serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce required welds to acceptable levels of quality
4. works well with all members of the class

C. Information: Acquires and uses information
1. read and interpret weld symbols
2. organize and apply theories of welding and cutting
3. perform basic layout as necessary

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b organization of personnel and facilities on the shop floor
   c systematic approach to the cutting and welding processes
   d welding rod classification and match to various metals
   e systematic organization of training materials
2. monitors and corrects performance during
   a. the welding process
   b. adjustments of individual laboratory work schedule

c. constantly evaluating the quality of work to achieve acceptable standards
d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to perform the welding process
2. applies appropriate procedures and uses appropriate tools and equipment to produce a weld to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when using welding equipment
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of welding lab at the end of the class

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

*1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

*2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to set up, properly adjust and weld/cut using different types of welding equipment
   b. maintain a lecture notebook
   c. complete all written assignments

*3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. calculates "value added to the part"
   c. interconverts fractions to decimal expressions

*4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe and assimilate laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
   e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics

*5. **Speaking:** Organizes ideas and communicates orally*
   a. participates in classroom discussions

b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. troubleshoots welding problems and makes process adjustments to correct
   d. balances social and academic life/responsibilities
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the welder
   c. applies knowledge of material characteristics, job requirements, and welding processes to perform assignments
   d. applies knowledge of material characteristics, job requirements, and welding processes to troubleshoot and/or improve the welding process

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. displays promptness and preparation for the day's work
   b. plans work to use time efficiently

c. accepts responsibility for mistakes, and takes corrective and preventive actions
d. takes initiative when needed to gain resources or assistance to complete assignments

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. takes pride in work through positive reinforcement
   b. sees self as a valued member of the group through continued contributions toward common goals
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. share laboratory resources (welding machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on weldments
   b. maintain a record of academic achievement (individual grade book)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Welding Technology Today, Principles and Practices, Stinchcomb, Craig;: Prentice Hall Inc., New Jersey 1989
3. Welder Handbook, W-100 E-1 Corp., Publication #51077, Nov., 1995
4. Hobart Audio - Visual Training Program
5. Miller Audio - Visual Training Program

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

SHEET METAL PROCESSING I

MAST PROGRAM
COURSE SYLLABUS
SHEET METAL PROCESSING I

Lecture hours/week: 3 **Lab hours/week: 9** **Credit hours: 6**

COURSE DESCRIPTION:

Students will be assigned specifically designed projects that will be fabricated using sheet metal hand tools and manually operated sheet metal brakes and shears, drill presses, and various light industrial saws, rollers, beaders, and punches. Sheet metal drawing and blueprints, hand held precision measuring instruments, and basic layout and fabrication will be stressed.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbooks:	Sheet Metal Handbook, Fournier, HP Books Pub., 2nd Ed.
Lab Manual:	Sheet Metal Drawings, Kern, School Craft Pub., 1st Ed.
Videos:	Sheet Metal Drawings, Kern, School Craft Pub., 1st Ed. AV1014

Student Too List	**Qty. Req'd.**
Tool Box	1
Scribe	1
File Card Brush	1
Apron (blue denim)	1
Shop Towels (1 roll)	1
Right, left and straight cutting aviation snips	1 each
Wide nose peen body hammer	1
Standard picking and dinging hammer	1
Rawhide mallet	1
Universal dolly	1
Combination square, 24 inch	1
Layout divider, 6 inch	1
Vise Grip, 8 inch	1
Welding clamp vise grip, 6 inch	1
Safety Glasses	1 pair
6 inch Ruler, 1/64 inch scale	1
Ball Peen Hammer	1
10 inch Adjustable Wrench	1
Center Punch	1
Prick punch	1
Magic marker, Jumbo, black.	1
Aluminum Oxide Cloth, 9" X 11", 80 Grit	2 sheets
Aluminum Oxide Cloth, 9" X 11", 120 Grit	2 sheets

Flat Mill Bastard File, 10 inch.	1
File Handle	1

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" sheet metal fabrication processes

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Textbook review and tool list	Handout	
Safety	1-13, Fournier text	
Basic sheet metal hand tool operations	15-26	
Project orientation	Handout	
Sheet metal equipment overview	27-40	
Foot operated shears	41-48	
Shear sheet stock	---	
Types of sheet metal (metals classification systems)	Chapter 4	
Gauging and measurement with hand held instruments	Handout	
Patterns and layout	49-54	
Basic geometric construction	Handout	
Use of formulas in design and planning	Handout	
Mechanical and freehand drawing	Handout	
Blueprint reading	School Craft Video	
QUIZ 1	---	
Metal shaping by hand	55-74	
Hammer forming	---	
Annealing, planishing and polishing	75-88	
Fitting duct work	---	
Templates	---	
Layout in the flat	Handouts	
Mark brake lines for inside and outside		

breaks	Handout
Hand brake operations	---
Straight bending sheet metal brake components	27-31
Box pan brakes	---
Box finger brakes	---
Combination brakes	Handouts
Sheet metal rollers	32-33
Sheet metal beaders	33-34
Shrinkers and stretchers	34-35
Hand operated equipment punches	36-38
Saws, band and reciprocating	36 and handout
QUIZ 2	---
Cold formed sheet metal processes	Handout
Cold rolling, blanking, punching and piercing overview	Handout
Trimming, drawing, bending and shearing overview	Handout
Hot rolled sheet metal processes	Handout
Shaping with powered equipment	Chapter 6
Craftformers and englishwheels	---
Air planishing hammers and power hammers	64-68
Station bucks, molds, forms and jigs	Chapter 7
Riveting overview	Chapter 8
General types (blind and solid)	---
Preparation of the surface parts	---
Power riveting	Handout
Clamping methods to include Clecos	Handout
Surface preparation for painting	Handout
Painting	Handout
QUIZ 3	---
Complete lab projects - no lecture	---
Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Shop orientation	2
Use of the sheet metal shear	4
Use of power saws	3
Pattern making	3
Metal shaping by hand	3
Using drills	3
Duct work	3
Using sheet metal brakes	23
Using power shaping equipment	23
Using power riveting equipment	23
Using painting devices	10

Leaving the shop in order	3
Inspecting the finished work	5
Total Lab Hours	**108**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart

4. Perform Basic Algebraic Operations
   a. Express word statements as algebraic equations
   b. Solve word statements as algebraic equations
   c. Calculate the center of gravity relative to the datum
5. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
6. Extract Roots and Raise Numbers to a Given Power
   a. Determine the square or cube of a number
   b. Determine the square root of a number
7. Determine Areas and Volumes of Various Geometric Shapes
   a. Calculate the area of rectangles, squares, triangles, circles, and trapezoids
   b. Calculate the volume of rectangles, cubes, and cylinders
8. Solve Ratio, Proportion, and Percentage Problems
   a. Determine the ratio of two numbers
   b. Convert decimal numbers to their fractional equivalent

C. INTERPRET SHEET METAL DRAWINGS AND BLUEPRINTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions
   d. Identify general note symbols
   e. Locate notes on a print
   f. Interpret commonly used abbreviations and terminology
   g. Determine the tolerances associated with dimensions on a drawing
   h. Determine the tolerance for a referenced dimension
   i. Determine the surface finish for a given part
   j. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
   c. Identify the purpose of exploded isometric drawing
   d. Identify the purpose of assembly drawings
5. Verify Drawing Elements

a. Determine the scale of the view or section
b. Check for revisions
c. Recognize out-of-date blueprints

6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
9. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed
10. Draw Sketches of Repairs and Alterations
    a. Illustrate a major repair or alteration
    b. Use dividers, compass, ruler, T-square, etc., in the development of sketches of repairs and alterations
11. Use Blueprint Information
    a. Identify/interpret information presented in blueprint title blocks
    b. Install and modify component parts by reference to blueprints

D. IDENTIFY MATERIALS AND PROCESSES

1. Identify and Select Appropriate Non-Destructive Testing Methods
   a. Apply the use of ultrasonic inspection methods for detecting cracks
   b. Apply methods for detecting surface cracks in aluminum castings and forgings
   c. Apply techniques for locating cracks in materials when only one side of the material is accessible
2. Perform Chemical Etching
   a. Perform general magnetic particle inspection general procedures
   b. Demagnetize steel parts after magnetic inspection
   c. Clean parts in preparation for penetrant inspection
   d. Identify visual indications of a subsurface flaw or fracture during magnetic particle inspection
   e. Locate cracks and blowholes in welded assemblies
   f. Perform dye penetrant procedures
   g. Distinguish between heat-treated and non-heat-treated aluminum alloys when the identification marks are not on the material

3. Understand Basic Heat-Treating Processes
   a. Identify the types of aluminum alloys considered to be heat-treatable
   b. Identify the steps in the heat-treatment of aluminum alloys
   c. Identify the effect of various forms of heat-treatment
   d. Identify the effect of incorrect heat-treatment on the corrosion-resistant properties of aluminum alloy
   e. Identify the degree of temper for aluminum alloy products from code designators
   f. Identify the effect of heating a metal slightly above its critical temperature, and then rapidly cooling it
   g. Identify the effect of strain hardening on the tensile strength of aluminum alloy
   h. Compare and contrast the relationships between tensile strength and metal hardness
   i. Anneal a welded steel part
4. Inspect and Check Welds
   a. Identify the characteristics of a good weld
   b. Identify the types of stress that welded joints can withstand
   c. Determine the effects of welding over a previously brazed or soldered joint
5. Perform Precision Measurements
   a. Use a micrometer and caliper to make precise measurements
   b. Measure a small hole using a micrometer and a hole gage
   c. Read and interpret a vernier micrometer scale
   d. Use a dial indicator, V-blocks, and a surface plate to check alignment of a shaft

E. PERFORM CLEANING AND CORROSION CONTROL

1. Identify and Select Cleaning Materials
   a. Determine the effect of caustic cleaning products on aluminum structures
   b. Identify the characteristics and use of chemical cleaners
   c. Determine the type of cleaner for use on high strength metals

F. WORK WITH SHEET METAL STRUCTURES

1. Inspect Bonded Structures
   a. Identify the reasons for using metal sandwich panels in high-speed aircraft
   b. Use the metallic "ring" test to inspect for delamination damage of bonded structures
   c. Evaluate the extent of damage to a bonded structure and determine the type repair needed
2. Inspect and Repair Sheet Metal Structures
   a. Select and use twist drills
   b. Select and use a hand file for soft metals
   c. Prepare dissimilar metals for assembly
   d. Drill holes in stainless steel
   e. Define shear failure
   f. Construct a water tight joint
   g. Countersink a hole
   h. Perform the dimpling process
   i. Stop drill cracks in sheet metal
   j. Repair a slightly oversize hole

k. Repair shallow scratches in sheet metal
l. Use a reamer

3. Install Special Rivets and Fasteners
   a. Determine correct rivet length and diameter
   b. Install hi-shear rivets
   c. Identify the precautions concerning rivet fit
   d. Identify the stresses that a rivet is designed to resist
4. Remove and Install Conventional Rivets
   a. Prepare Sheet Metal for installation of flush rivets
   b. Identify and select rivets
   c. Determine the correct rivet length and diameter
   d. Select and use the correct rivet set for specified rivet head styles
   e. Select and use bucking bars
   f. Remove rivets
   g. Determine the condition of a driven rivet
   h. Determine the circumstances under which 2117 rivets may be used to replace 2017 and 2024 rivets
   i. Define rivet tipping
   j. Determine the correct number of rivets to be used in making a structural sheet metal repair
   k. Handle and install rivets that require heat treatment prior to use
   l. Adjust and use an air-operated riveting gun
5. Hand Form, Layout and Bend Sheet Metal
   a. Make a joggle or offset bend
   b. Bend Sheet Metal that requires the use of a large radius
   c. Determine the neutral axis of a bend
   d. Determine the amount of material required to make a specific bend
   e. Bend sheet metal to a desired angle
   f. Layout and bend in relationship to metal "grain" to minimize the possibility of cracking
   g. Determine the flat layout dimensions of a component part to be formed by bending
   h. Form metal by bumping

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of fabrication or repair
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce fabricated parts to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints.
2. organize and apply theories of sheet metal tool and equipment operation.
3. perform basic layout as necessary.

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the fabrication process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a fabricated part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. reports all malfunctions of equipment to supervisor/instructor
   c. perform clean-up assignments of shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. *Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings

c. read/studies textbook
d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple fabricated part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum cuts, shears and bends
   b. calculates "value added to the work piece"
   c. aligns bucks, jigs and/or work holding devices
   d. taps and threads
   e. keeps a running computation of individual grade
   f. interconverts fractions to decimal expressions
   g. use protractors to lay-out angles
   h. use trigonometry to solve angle calculations
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*

a. interprets technical drawings
b. interprets technical illustrations and symbols
c. understands both written and verbal instructions
d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the craftsman

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (equipment, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on fabricated parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken equipment/tools

d. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

MET211
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*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

PLASTIC MATERIALS AND TESTING

MAST PROGRAM
COURSE SYLLABUS
PLASTIC MATERIALS AND TESTING

Lecture hours/week: 3 **Lab hours/week: 4** **Credit hours: 3**

COURSE DESCRIPTION:

This course covers the properties, peculiarities and applications of commercial polymers, including identification techniques and testing methods. Experiments will be conducted to determine various industrial required test results, including strength, thermal and hardness using appropriate testing equipment.

PREREQUISITES: **INTRODUCTION TO PLASTICS**

REQUIRED COURSE MATERIALS:

Textbook: Injection Molding Handbook, by Rosato
Industrial Plastic, by Richardson

Lab Manual: **NONE**

Student Tool List: Safety Glasses

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will consist of "hands on" activities which will enable the student to learn the peculiarities and applications of commercial polymers, including identification techniques and testing methods.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. recognize the need for plastics testing
4. identify materials via testing
5. prepare specimens for testing
6. perform common testing procedures:
   a. melt
   b. impact, i.e., tensile, Charpy, tension, drop
7. relate molding parameters to test specimens

Charpy
Tension
Drop Impact
Tensile KUT
Environment Chamber

Total Lab Hours **48**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment
6. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Evaluate and determine hazards
   c. Describe the proper collection for a variety of hazardous wastes
   d. Respond to emergencies in the appropriate manner

B. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions

d. Identify general note symbols
e. Locate notes on a print
f. Interpret commonly used abbreviations and terminology
g. Determine the tolerances associated with dimensions on a drawing
h. Determine the tolerance for a referenced dimension
i. Determine the surface finish for a given part
j. List the essential components found in the general drawing notes

2. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards

C. IDENTIFY MATERIALS AND PROCESSES

1. Identify and Select Appropriate Non-Destructive Testing Methods
   a. Apply the use of ultrasonic inspection methods for detecting cracks
   b. Apply methods for detecting surface cracks in aluminum castings and forgings
   c. Apply techniques for locating cracks in materials when only one side of the material is accessible

D. WORK WITH COMPOSITE STRUCTURES

1. Identify Method of Repair
   a. Determine extent of damage
   b. Interpret repair order and/or blueprint build sheet
   c. Determine stress requirements
   d. Select materials for repair IAW repair order and Standard Repair Method (SRM)

COURSE OBJECTIVES: SCANS COMPETENCIES

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The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
   1. follows a schedule to complete assigned tasks on time.
   2. determine the initial cost of materials and "value added" as result of machining
   3. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce machine parts to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
1. read and interpret blueprints
2. organize and apply theories of machine tool operation

D. ***Systems:*** *Understands complex inter-relationships*
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*
1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*
1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments

d. complete all written assignments

3. *Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. taps and threads
   e. keeps a running computation of individual grade
   f. interconverts fractions to decimal expressions
   g. use protractors to lay-out angle machining
   h. use trigonometry to solve angle and taper calculations
4. *Listening: Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. *Speaking: Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. *Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. *Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. *Problem Solving: Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. *Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. *Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills

c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times

c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook
2. Technology of Machine Tools, 4th Ed., McGraw Hill Publishers

MET209
01/080196

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

MANUFACTURING PROCESSES

MAST PROGRAM
COURSE SYLLABUS
MANUFACTURING PROCESSES

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

Essential studies into the processes and materials for manufacturing, including metal casting, hot and cold forming of steel, powder metallurgy and plastics. Analysis of newer processes such as electrical discharge machining, chemical machining, and ultra-sonic machining; with a emphasis on the economical manufacturing of products.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Modern Materials and Manufacturing Processes, John E. Neeley & Richard R. Kibbe, Prentice Hall Career & Technology, Englewood Cliffs, N.J., 1987

Lab Manual: None Required

Student Tool List: Safety glasses

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will consist of "hands-on" activities. Students will operate various conventional metalworking machines to manufacture a product.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the students ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
The Manufacturing Industry	Chapter 21	
Processing of Metals: Casting	Chapter 7	
Processing of Metals: Hot Working	Chapter 8	
Processing of Metals: Cold Working	Chapter 9	
QUIZ I		
Powder Metallurgy	Chapter 10	
Non-traditional Machining Processes	Chapter 13	
Plastics & Composite Processes	Chapter 15	
QUIZ II		
Joining Processes	Chapter 14	
Corrosion & Protection for Materials	Chapter 16	
Design, Tooling & Production Lines	Chapter 18	
QUIZ III		
	Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Lab Orientation and Safety	2
Lab Sheet #1-Stock preparation; measure (semi-precision), shear and debur	3
Lab Sheet #2-Layout, drill, ream and debur holes	3
Lab Sheet #3-Metal forming (bending) and countersinking holes	3
Lab Sheet #4-Metal joining (welding), stress relieving and sawing	3
Mid-term project evaluation and rework	2
Lab Sheet #5-Surface preparation (sand blast) and surface finish (paint)	3
CNC stock preparation	2
CNC Machining Demonstration and CIM Lab Demonstration	3
Lab Sheet #6-Component sub-assembly and precision machining activity	3
Lab Sheet #7-Sub-assembly manufacture (handle)	3
Lab Sheet #8-Final assembly and test (final project evaluation)	3
Lab clean-up	
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery

c. Locate and properly use protective equipment
d. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions

C. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions
   d. Identify general note symbols
   e. Locate notes on a print
   f. Interpret commonly used abbreviations and terminology
   g. Determine the tolerances associated with dimensions on a drawing
   h. Determine the tolerance for a referenced dimension
   i. Determine the surface finish for a given part
   j. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views

b. Identify positions of views (top, front, side, and auxiliary)
c. Visualize one or more views from a given view
d. Identify isometric views
e. Identify exploded isometric drawings
f. Identify assembly drawings

4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
   c. Identify the purpose of exploded isometric drawing
   d. Identify the purpose of assembly drawings
5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
7. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
8. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

D. IDENTIFY MATERIALS AND PROCESSES

1. Identify and Select Appropriate Non-Destructive Testing Methods
   a. Apply the use of ultrasonic inspection methods for detecting cracks
   b. Apply methods for detecting surface cracks in aluminum castings and forgings
   c. Apply techniques for locating cracks in materials when only one side of the material is accessible
2. Perform Chemical Etching
   a. Perform general magnetic particle inspection general procedures
   b. Demagnetize steel parts after magnetic inspection
   c. Clean parts in preparation for penetrant inspection
   d. Identify visual indications of a subsurface flaw or fracture during magnetic particle inspection
   e. Locate cracks and blowholes in welded assemblies
   f. Perform dye penetrant procedures
   g. Distinguish between heat-treated and non-heat-treated aluminum alloys when the identification marks are not on the material
3. Understand Basic Heat-Treating Processes
   a. Identify the types of aluminum alloys considered to be heat-treatable
   b. Identify the steps in the heat-treatment of aluminum alloys

c. Identify the effect of various forms of heat-treatment
d. Identify the effect of incorrect heat-treatment on the corrosion-resistant properties of aluminum alloy
e. Identify the degree of temper for aluminum alloy products from code designators
f. Identify the effect of heating a metal slightly above its critical temperature, and then rapidly cooling it
g. Identify the effect of strain hardening on the tensile strength of aluminum alloy
h. Compare and contrast the relationships between tensile strength and metal hardness
i. Anneal a welded steel part

4. Perform Precision Measurements
   a. Use a micrometer and caliper to make precise measurements
   b. Measure a small hole using a micrometer and a hole gage
   c. Read and interpret a vernier micrometer scale
   d. Use a dial indicator, V-blocks, and a surface plate to check alignment of a shaft

E. PERFORM CLEANING AND CORROSION CONTROL

1. Identify and Select Cleaning Materials
   a. Determine the effect of caustic cleaning products on aluminum structures
   b. Identify the characteristics and use of chemical cleaners
   c. Determine the type of cleaner for use on high strength metals
2. Perform Aircraft Cleaning and Corrosion Control
   a. Identify the cause and corrective procedures for fretting corrosion
   b. Identify and control intergranular corrosion of heat-treated aluminum alloy
   c. Protect multi-metal and/or composite structure against dissimilar-metal corrosion
   d. Prevent and remove rust
   e. Protect the interior surfaces of closed steel and aluminum tubing against corrosion
   f. Apply methods of protecting aluminum alloy parts against corrosion
   g. Remove corrosion products such as metal flakes, scale powder, and salt deposits from aluminum
   h. Clean corrosion-resistant parts by blast cleaning methods
   i. Use paints and similar organic coatings for corrosion protection purposes

F. WORK WITH SHEET METAL STRUCTURES

1. Inspect Bonded Structures
   a. Identify the reasons for using metal sandwich panels in high-speed aircraft
   b. Use the metallic "ring" test to inspect for delamination damage of bonded structures
   c. Evaluate the extent of damage to a bonded structure and determine the type repair needed
2. Inspect and Repair Sheet Metal Structures
   a. Select and use twist drills
   b. Select and use a hand file for soft metals
   c. Prepare dissimilar metals for assembly
   d. Drill holes in stainless steel

e. Define shear failure
f. Construct a water tight joint
g. Countersink a hole
h. Perform the dimpling process
i. Stop drill cracks in sheet metal
j. Repair a slightly oversize hole
k. Repair shallow scratches in sheet metal
l. Use a reamer

3. Install Special Rivets and Fasteners
   a. Determine correct rivet length and diameter
   b. Install hi-shear rivets
   c. Identify the precautions concerning rivet fit
   d. Identify the stresses that a rivet is designed to resist
4. Remove and Install Conventional Rivets
   a. Prepare Sheet Metal for installation of flush rivets
   b. Identify and select rivets
   c. Determine the correct rivet length and diameter
   d. Select and use the correct rivet set for specified rivet head styles
   e. Select and use bucking bars
   f. Remove rivets
   g. Determine the condition of a driven rivet
   h. Determine the circumstances under which 2117 rivets may be used to replace 2017 and 2024 rivets
   i. Define rivet tipping
   j. Determine the correct number of rivets to be used in making a structural sheet metal repair
   k. Handle and install rivets that require heat treatment prior to use
   l. Adjust and use an air-operated riveting gun
5. Hand Form, Layout and Bend Sheet Metal
   a. Make a joggle or offset bend
   b. Bend Sheet Metal that requires the use of a large radius
   c. Determine the neutral axis of a bend
   d. Determine the amount of material required to make a specific bend
   e. Bend sheet metal to a desired angle
   f. Layout and bend in relationship to metal "grain" to minimize the possibility of cracking
   g. Determine the flat layout dimensions of a component part to be formed by bending
   h. Form metal by bumping

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is

made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of machining
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce machine parts to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret laboratory worksheets
2. organize and practically apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to manufacturing for profit
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. when operating machines
   b. reports all malfunctions of equipment to supervisor/instructor
   c. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. read/studies textbook
   b. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. calculates "value added to the part"
   b. aligns machine and/or work holding device
   c. keeps a running computation of individual grade
   d. interconverts fractions to decimal expressions
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. *Self-Management: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook
2. Technology of Machine Tools, 4th Ed., McGraw Hill Publishers

MET301
01/080196

Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

CAD/CAM I

MAST PROGRAM
COURSE SYLLABUS
CAD/CAM I

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

Student will introduced to "Process Modeling" utilizing a CNC graphics programming system called "SMARTCAM". Using engineering drawings, students will program various parts for both CNC mills and CNC lathes. Related topics include: job planning, tool selection, process model construction, tool path verification, machine simulation, quality control, CAD/CAM transfer and CNC code generation.

PREREQUISITES: NONE

REQUIRED COURSE MATERIALS:

Textbook: SMARTCAM-2D, Pelton, TSTC Pub., 2nd Ed.
Lab Manual: **NONE**

Student Tool List and/or Supplies: 2 - double sided, high density 3 ½" floppy diskettes

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, overheads and SMARTCAM and related software demonstrations.

Laboratory: Laboratory will be a "hands-on" (computer based) process modeling using the SMARTCAM System.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. Demonstrate the ability to use DOS commands
2. Create a basic procedure for machining a part on a machine center and a turning center, including: machine tool selection, tool selection and application, operational sequences, speeds, feeds and depth of cuts and tool length offsets
3. Develop job plans using SMARTCAM
4. Demonstrate the ability to develop a SHAPE file in the SMARTCAM graphics system
5. Demonstrate the ability to manipulate files to successfully complete a graphics project within a CAM system
6. Create part profiles and part geometry to produce accurately coded information for both CNC lathes and mills
7. Utilize plotters and printers to produce accurate documents

8. Perform and demonstrate the ability to transfer CAD files to CAM files and CAM files to CAD files
9. Generate a tool path from CAD to CAM files
10. Edit a tool path from a CAD file and proof the tool path from a CAD file.
11. Satisfactorily perform on written, oral, and practical examinations
12. Satisfactorily perform on outside assignments including writing assignments
13. Contribute to class discussions
14. Maintain attendance per current policy

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Unit 1 - CNC/CAD/CAM Overview		
1.01 - Description of CNC	handouts	
1.02 - Computer Systems Review	and	
1.03 - Job Opportunities in the CAM Field	overheads	
1.04 - Employability Skills in CAM		
Unit 2 - The Structure of a CAM System		
2.01 - From Print to Part	5-6	
2.02 - The Graphical User Interface	11-18	
2.03 - Working with SMARTCAM's Display Areas	37-41	
Unit 3 - Process Planning (Mill)		
3.01 - Interpreting a Part Print	handouts	
3.02 - Creating a Job Sheet from a Part Print	overheads	
3.03 - Entering Tool Information into the Job Plan	28-29	
Review for Quiz 1		
Quiz 1		
Return and Discuss Quiz 1		
Unit 4 - Working with a CNC Process Model (Mill)		
4.01 - Starting a CNC Process Model	19-24; 37-42	
4.02 - Roughing and Finishing an Existing Process Model	and	
4.03 - Modifying Existing Geometry	handouts	
4.04 - Methods for Creating Geometry for the Process Model		
Unit 5 - Generating CNC Code with a CAM System		
5.01 - Basic NC Code Structure	overheads	
5.02 - Locating the Data Source for Code Generation		
5.03 - How a CAM System Generates CNC Code		
Review for Quiz 2		
QUIZ 2		
Unit 6 - Additional Modeling Practices		
6.01 - Pocketing and Facing with		

Islands/Notches, etc.	21-22
6.02 - Re-sequencing Machining Operations	
6.03 - Rotate, Move, Copy, Mirror and Scale Commands	overheads
Unit 7 - Process Planning (Lathe)	
7.01 - CNC Lathe Coordinate Systems	overheads
7.02 - Carbide Tooling for CNC Lathes	overheads
7.03 - Entering Tool Information into the Job Plan	overheads
Unit 8 - Working with a CNC Process Model (Lathe)	
8.01 - Turning, Facing, Boring and Drilling	overheads
Review for Quiz 3	
Quiz 3	
Unit 9 - Additional Modeling Practices	
9.01 - Threading Cycles and Grooving Cycle	overheads
9.02 - Roughing for Turning and Facing Operations	
Unit 10-Working with CAD Geometry	
10.01 - Conventions of CAD Geometry	overheads
10.02 - Using a CAM System to Transfer CAD Geometry	
10.03 - Working with CAD Geometry in a CAM System	
10.04 - Transferring a CNC Process Model to a CAD System	
Quiz 4 Review	
Quiz 4	
Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Job Plan	2
"Try it" Exercises 1 thru 5	2
Simple Part Profile (Mill 1)	2
Simple Part Profile (Mill 2)	2
Profile with Roughing (Mill 3)	2
Using Multiple Tools (Mill 4)	2
Using Multiple Tools and Roughing (Mill 5)	2
Using Layers, Islands and Rough Facing (Mill 6)	3
Rough Processing (Mill 7)	2
Converting Geometry to Profiles, Using Copy (Mill 8)	2
Complex Part Geometry With Multiple Tools (Mill 9)	2
Using Rotate and Move Commands (Mill 10)	2
Roughing, Pocketing Drilling and Tapping (Mill 11)	2
Complex Modeling, Rotating, Moving Scaling (Mill 12)	3
Turning Lengths and Diameters (Lathe 1)	2

O.D. and I.D. Contour Turning (Lathe 2)	2
Multiple Tool with Roughing (Lathe 3)	2
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart

B. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions
   d. Identify general note symbols
   e. Locate notes on a print
   f. Interpret commonly used abbreviations and terminology
   g. Determine the tolerances associated with dimensions on a drawing
   h. Determine the tolerance for a referenced dimension
   i. Determine the surface finish for a given part
   j. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing

a. Identify the purpose of orthographic (3 views) drawings
b. Identify the purpose of isometric drawing
c. Identify the purpose of exploded isometric drawing
d. Identify the purpose of assembly drawings

5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
9. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time

2. determine the initial cost of materials and "value added" as result of machining
3. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce machine parts to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part

b. maintain a lecture notebook
c. submit written responses to chapter question assignments
d. complete all written assignments

3. *Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. taps and threads
   d. keeps a running computation of individual grade
   e. interconverts fractions to decimal expressions
4. *Listening: Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. *Speaking: Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. *Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. *Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. *Problem Solving: Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. *Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. *Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual gradebook)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. SMARTCAM Advanced 3-D Machining Reference Manual
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers
3. Machine Tool Catalogs

MET302
01/080196

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

SHEET METAL PROCESSING II

MAST PROGRAM
COURSE SYLLABUS
SHEET METAL PROCESSING II

Lecture hours/week: 3 **Lab hours/week: 9** **Credit hours: 6**

COURSE DESCRIPTION:

An advanced metalforming course to assist students in achieving proficiency in handling and placing tooling and materials into service; in set-up and operation of metal stamping equipment, tools and dies, and power bending/forming ancillary devices. Includes custom roll forming processes, metal spinning, press brake operation and die setter training.

PREREQUISITES: **Sheet Metal Processing I and Manufacturing Processes**

REQUIRED COURSE MATERIALS:

Textbooks:	Basic Diemaking, McGraw-Hill Pub.,3rd Edition
Lab Manual:	Metalforming Skills, Stamping--Level III, Precision Metalforming Association, 1st Edition.
Videos:	Manufacturing Processes, School Craft Publishing
	Computers in Process Control, School Craft Publishing
	Sheet Metal Processes, A Series of Seven Tapes, School Craft Publishing

Student Tool List	**Qty. Req'd.**
Tool Box	1
Scribe	1
File Card Brush	1
Apron (blue denim)	1
Shop Towels (1 roll)	1
Right, left and straight cutting aviation snips	1 each
Wide nose peen body hammer	1
Standard picking and dinging hammer	1
Rawhide mallet	1
Universal dolly	1
Combination square, 24 inch	1
Layout divider, 6 inch	1
Vise Grip, 8 inch	1
Welding clamp vise grip, 6 inch	1
Safety Glasses	1 pair
6 inch Ruler, 1/64 inch scale	1
Ball Peen Hammer	1
10 inch Adjustable Wrench	1
Center Punch	1
Prick punch	1

Magic marker, Jumbo, black	1
Aluminum Oxide Cloth, 9" X 11", 80 Grit	2 sheets
Aluminum Oxide Cloth, 9" X 11", 120 Grit	2 sheets
Flat Mill Bastard File, 10 inch.	1
File Handle	1

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" sheet metal fabrication processes

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Course Introduction		
Safety		
Mass production principles	School Craft Video, "Keys to Mass Production"	
Sheet metal stampings		
Punch press	Chapter 1	
Blanking and piercing operations	Chapter 2, pages 11-18	
Punch clearance	Chapter 2, pages 20-22 Library assignment and handout	
Cutting and stripping forces	Classroom handout with homework assignment	
Computation of forces	Classroom handout	
Quiz 1 (over above lectures)	---	
Basic die sets	Various Die Catalogs (Danley, Producto, Superior, etc.)	
Review of Test 1		
Power bending	Chapter 3	
Bend elements	Homework assignments	
Stresses	(Calculation of blank length)	
Bend allowance curve		

Bending - V Dies	Chapter 3, Lateral forces
Bending - Spring Back	
Blank orientation factors	Chapter 15, Part A
Strip layout functions	Chapter 15, Part B
Field Trip to Industry	---
Quiz 2 (over above lectures)	Chapters 1-3, Chapter 15 and handouts
Discuss Field Trip	
Punch wear	Chapter 4
Die Block Life	
Punch classifications/applications	Chapter 5
Perforators	Chapters 6 and 7
Pilots	
Stripping action	Chapters 8 and 9
Stripper categories and types	
Shedders and knockouts	Chapter 10
Field trip to industry	Chapter 11
Quiz 3 (over above lectures)	---
Stock material utilization	Chapters 12-14
Press brake operations	Video and handout
Coil fed operation and die setter training	Video and handout
Metal spinning machine operations	NTMA Operator Handout
Dimensional variations in flat rolled metals	PMA Trainee Manual
Roll forming	PMA Handbook on Roll Forming
Field trip to industry	---
Laser cutting of sheet metals	TSTC Handout
Slide forming skills	PMA Handout
Spring making skills	PMA Handout
Final Quiz (over above lectures)	---
Complete Lab Projects - No Lecture	
Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Shop orientation	2
Care and use of tooling	2
Handling, use and installation of materials and related fluids	4
Setup and operation of metalforming equipment	3
Operation of Open-Back Inclinable (OBI) presses	4
Automatic feeds	14
Inverted and compound dies	14
Blanking operations	14
Secondary operations; pierce, semipierce, shearform, and form	10
Secondary operations; notch, trim and shave	10
Drawing operations	21

Work planning and job control	5
Inspection and quality assurance	5
Total Lab Hours	**108**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart

4. Perform Basic Algebraic Operations
   a. Express word statements as algebraic equations
   b. Solve word statements as algebraic equations
   c. Calculate the center of gravity relative to the datum
5. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
6. Extract Roots and Raise Numbers to a Given Power
   a. Determine the square or cube of a number
   b. Determine the square root of a number
7. Determine Areas and Volumes of Various Geometric Shapes
   a. Calculate the area of rectangles, squares, triangles, circles, and trapezoids
   b. Calculate the volume of rectangles, cubes, and cylinders
8. Solve Ratio, Proportion, and Percentage Problems
   a. Determine the ratio of two numbers
   b. Convert decimal numbers to their fractional equivalent

C. INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions
   d. Identify general note symbols
   e. Locate notes on a print
   f. Interpret commonly used abbreviations and terminology
   g. Determine the tolerances associated with dimensions on a drawing
   h. Determine the tolerance for a referenced dimension
   i. Determine the surface finish for a given part
   j. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
   c. Identify the purpose of exploded isometric drawing
   d. Identify the purpose of assembly drawings
5. Verify Drawing Elements

a. Determine the scale of the view or section
b. Check for revisions
c. Recognize out-of-date blueprints

6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
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   a. Discuss production schedule
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   a. Discuss the purpose of standards
   b. Discuss source locations for standards
9. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed
10. Draw Sketches of Repairs and Alterations
    a. Illustrate a major repair or alteration
    b. Use dividers, compass, ruler, T-square, etc., in the development of sketches of repairs and alterations
11. Use Blueprint Information
    a. Identify/interpret information presented in blueprint title blocks
    b. Install and modify component parts by reference to blueprints

D. IDENTIFY MATERIALS AND PROCESSES

1. Identify and Select Appropriate Non-Destructive Testing Methods
   a. Apply the use of ultrasonic inspection methods for detecting cracks
   b. Apply methods for detecting surface cracks in aluminum castings and forgings
   c. Apply techniques for locating cracks in materials when only one side of the material is accessible
2. Perform Chemical Etching
   a. Perform general magnetic particle inspection general procedures
   b. Demagnetize steel parts after magnetic inspection
   c. Clean parts in preparation for penetrant inspection
   d. Identify visual indications of a subsurface flaw or fracture during magnetic particle inspection
   e. Locate cracks and blowholes in welded assemblies
   f. Perform dye penetrant procedures
   g. Distinguish between heat-treated and non-heat-treated aluminum alloys when the identification marks are not on the material

3. Understand Basic Heat-Treating Processes
   a. Identify the types of aluminum alloys considered to be heat-treatable
   b. Identify the steps in the heat-treatment of aluminum alloys
   c. Identify the effect of various forms of heat-treatment
   d. Identify the effect of incorrect heat-treatment on the corrosion-resistant properties of aluminum alloy
   e. Identify the degree of temper for aluminum alloy products from code designators
   f. Identify the effect of heating a metal slightly above its critical temperature, and then rapidly cooling it
   g. Identify the effect of strain hardening on the tensile strength of aluminum alloy
   h. Compare and contrast the relationships between tensile strength and metal hardness
   i. Anneal a welded steel part
4. Inspect and Check Welds
   a. Identify the characteristics of a good weld
   b. Identify the types of stress that welded joints can withstand
   c. Determine the effects of welding over a previously brazed or soldered joint
5. Perform Precision Measurements
   a. Use a micrometer and caliper to make precise measurements
   b. Measure a small hole using a micrometer and a hole gage
   c. Read and interpret a vernier micrometer scale
   d. Use a dial indicator, V-blocks, and a surface plate to check alignment of a shaft

E. PERFORM CLEANING AND CORROSION CONTROL

1. Identify and Select Cleaning Materials
   a. Determine the effect of caustic cleaning products on aluminum structures
   b. Identify the characteristics and use of chemical cleaners
   c. Determine the type of cleaner for use on high strength metals

F. WORK WITH SHEET METAL STRUCTURES

1. Inspect Bonded Structures
   a. Identify the reasons for using metal sandwich panels in high-speed aircraft
   b. Use the metallic "ring" test to inspect for delamination damage of bonded structures
   c. Evaluate the extent of damage to a bonded structure and determine the type repair needed
2. Inspect and Repair Sheet Metal Structures
   a. Select and use twist drills
   b. Select and use a hand file for soft metals
   c. Prepare dissimilar metals for assembly
   d. Drill holes in stainless steel
   e. Define shear failure
   f. Construct a water tight joint
   g. Countersink a hole
   h. Perform the dimpling process
   i. Stop drill cracks in sheet metal
   j. Repair a slightly oversize hole

k. Repair shallow scratches in sheet metal
l. Use a reamer

3. Install Special Rivets and Fasteners
   a. Determine correct rivet length and diameter
   b. Install hi-shear rivets
   c. Identify the precautions concerning rivet fit
   d. Identify the stresses that a rivet is designed to resist
4. Remove and Install Conventional Rivets
   a. Prepare Sheet Metal for installation of flush rivets
   b. Identify and select rivets
   c. Determine the correct rivet length and diameter
   d. Select and use the correct rivet set for specified rivet head styles
   e. Select and use bucking bars
   f. Remove rivets
   g. Determine the condition of a driven rivet
   h. Determine the circumstances under which 2117 rivets may be used to replace 2017 and 2024 rivets
   i. Define rivet tipping
   j. Determine the correct number of rivets to be used in making a structural sheet metal repair
   k. Handle and install rivets that require heat treatment prior to use
   l. Adjust and use an air-operated riveting gun
5. Hand Form, Layout and Bend Sheet Metal
   a. Make a joggle or offset bend
   b. Bend Sheet Metal that requires the use of a large radius
   c. Determine the neutral axis of a bend
   d. Determine the amount of material required to make a specific bend
   e. Bend sheet metal to a desired angle
   f. Layout and bend in relationship to metal "grain" to minimize the possibility of cracking
   g. Determine the flat layout dimensions of a component part to be formed by bending
   h. Form metal by bumping

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The following activities will be performed by each student for successful completion of this course:

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A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of fabrication or repair
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce fabricated parts to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of sheet metal tool and equipment operation
3. perform basic layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the fabrication process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a fabricated part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. reports all malfunctions of equipment to supervisor/instructor
   c. perform clean-up assignments of shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

   a. studies student laboratory manual
   b. interprets blueprints and technical drawings

c. read/studies textbook
d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple fabricated part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum cuts, shears and bends
   b. calculates "value added to the work piece"
   c. aligns bucks, jigs and/or work holding devices
   d. taps and threads
   e. keeps a running computation of individual grade
   f. interconverts fractions to decimal expressions
   g. use protractors to lay-out angles
   h. use trigonometry to solve angle calculations

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

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   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*

a. interprets technical drawings
b. interprets technical illustrations and symbols
c. understands both written and verbal instructions
d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the craftsman

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (equipment, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on fabricated parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken equipment/tools

d. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

COMPOSITES

MAST PROGRAM
COURSE SYLLABUS
COMPOSITES

Lecture hours/week: 1 **Lab hours/week: 3** **Credit hours: 2**

COURSE DESCRIPTION:

Introductory course showing the benefits of combining various types of reinforcing elements (fibers) with a polymer resin (matrix) to yield specific characteristics and properties not attainable by either constituent acting alone.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Introduction to Composites, Published by SPI. Latest edition.
Lab Manual: **NONE**

Student Tool List: Safety Glasses
Brown Jersey Gloves

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will consist of "hands on" activities which will enable the student to learn the selection and preparation of raw materials, machining functions, mold set up, and the use of auxiliary equipment associated with injection molding.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. describe the basic components of a polymer composite
4. list the major marketplace applications of polymer composites
5. describe the various advantages of using polymer composites
6. design and fabricate a small bench top polymer composite structure
7. satisfactorily perform on written, oral, and practical examinations
8. satisfactorily perform on outside assignments including writing assignments
9. contribute to class discussions
10. maintain attendance per current policy

11. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Composite Materials		4
a. Resins		
b. Reinforcements		
c. Fillers/Additives		
Introduction to Composite Processes		6
a. Open/Contact molding		
b. Compression molding		
c. Filament winding		
d. Injection molding		
Designing with Composites		2
a. Economics of composites		
b. The future of composites		
	Total Lecture Hours	**12**

LAB OUTLINE:

Lab Topics		Contact Hrs.
Reinforced reaction injection molding (RRIM)		8
Resin Transfer Molding (RTM)		8
Pultrusion		8
Other composite molding processes		12
	Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed

c. Put tools away when work is finished
d. Keep aisles clear of equipment and materials
e. Perform preventative maintenance as required

5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment
6. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Evaluate and determine hazards
   c. Describe the proper collection for a variety of hazardous wastes
   d. Respond to emergencies in the appropriate manner

B. WORK WITH COMPOSITE STRUCTURES

1. Identify Method of Repair
   a. Determine extent of damage
   b. Interpret repair order and/or blueprint build sheet
   c. Determine stress requirements
   d. Select materials for repair IAW repair order and Standard Repair Method (SRM)
2. Identify Bill of Materials (BOM)
   a. Calculate required materials
   b. Compare required materials to the BOM in the repair order
   c. Adjust BOM if necessary
3. Repair Per Technical Order/Engineering Specifications or Disposition
   a. Use blueprint information
   b. Remove damaged material IAW the repair order
   c. Perform cleaning (and corrosion control if required)
   d. Perform metal to metal repair
   e. Perform composite to metal repair
   f. Perform composite to composite repair
4. Perform Resin Transfer Molding
   a. Design and fabricate a polymer resin mold with reinforcing elements (fibers) using either a dimensionally correct part or build a casting with slip/plaster from a blueprint
   b. Debur mold base and chamfer edges
   c. Select and use mold cleaners
   d. Select and use mold releases
   e. Use soft tool method with mold cavities
   f. Select and operate drill presses, sanders, saws and ovens
5. Lay Up a Fiberglass Mold
   a. Design a fiberglass mold from a dimensionally correct part or build a slip casting from a blueprint or drawing
   b. Prepare surface for bonding
   c. Lay up by hand the fiberglass mats (for small molds)
   d. Select and use vacuum bags
   e. Operate an autoclave

f. Operate sanders and saws
g. Operate dust collecting equipment
h. Select and operate tape wrap machines
i. Select and operate obturators

6. Build Honeycomb Structure to Specifications
   a. Design and fabricate sheet metal components
   b. Prepare surfaces for bonding
   c. Select and use hole punches
   d. Apply honeycomb material to specification

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of processing
3. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce molded parts to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information
1. read and interpret blueprints
2. organize and apply theories of plastic molding equipment operation

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the plastic molding process
   d. systematic organization of training materials
2. monitors and corrects performance during
   a. the molding process
   b. adjustments of individual laboratory work schedule

c. constantly evaluating the quality of work to achieve acceptable standards
d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a molded part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets molding machine manuals
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a molded plastic part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum time and temperature settings for various plastic polymers
   b. calculates "value added to the part"
   c. adjusts timers and heaters to maintain a quality part
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill

d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the technician
   c. understands the relationship between different plastic materials and the processing variables and adjusts molding parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*

a. learns to take pride in his or her work through positive reinforcement
b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on molded parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

SHEET METAL STRUCTURES

MAST PROGRAM
COURSE SYLLABUS
SHEET METAL STRUCTURES

Lecture hours/week: 4 **Lab hours/week: 9** **Credit hours: 7**

COURSE DESCRIPTION:

The principles and practices used in the inspection, repair, layout, and fabrication of aircraft sheet metal structures. Students will become familiar with fiberglass and honeycomb structures and perform repair procedures.

PREREQUISITES: **Shop Practices or Hand Tools Class**

REQUIRED COURSE MATERIALS:

Textbook: Aircraft Maintenance and Repair, Glenco Macmilliam/McGraw-Hill Pub., 6th Ed. ISBN 0-02-803459-7.

Lab Manual(s): Aircraft Maintenance and Repair, Student Study Guide, Glenco Macmilliam/Mcgraw-Hill Pub., 6th Ed. ISBN 0-02-803461-9.
AER 3027 Module - Aviation Maintenance Technology, TSTC Waco.

Student Tool List/Quantity Required: See basic tool list

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lectures, video and instructor demonstrations.

Laboratory: Laboratory will be conducted by the instructor using demonstrations and student hands-on activities.

Method of Evaluation: Student grades will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform satisfactorily on written, oral, or practical examinations
4. perform satisfactorily on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Metal and Composite Structure		
Sheet Metal Materials Classroom discussion of rivets and metals used in structure repair		
Sheet Metal Tools The student is familiarized with the tools used in sheet metal repair		
Sheet Metal Layout Classroom discussion of layout operations and computation of bend allowance and bending sheet metal		
Riveting Techniques Classroom discussion of conventional methods of riveting, drilling, removing, inspections, spacing and selection of protruding and countersink rivets		
Special Fasteners Classroom discussion of the types of special fasteners and tools used to install them, and precautions observed in their use		
Principles of Structural Repair Classroom discussion of stresses imposed in aircraft, characteristics of overloaded structures and the planning process for preparation of structure repair		
Structural Repairs Classroom discussion of the basic types of repairs to aircraft skins, stringers, bulkheads, panels, access doors, leading edges, corrugations formers, longerons, spars, trusses, trailing edges, webs, flight controls, float and hulls, reinforcement by doublers		
Honeycomb, Bonded and Fiberglass Structure Classroom discussion on inspection and repair of bonded and fiberglass structures		

Review and Final Examination
Minimum Periods

Total Lecture Hours 36

LAB OUTLINE:

Lab Topics	Contact Hrs.
Rivet Identification The student will sort, identify, and properly store various types of conventional and special rivets	
Riveting Techniques The student will: 1. select proper bits 2. drill holes in aluminum and stainless steel 3. select and use clecos 4. select proper diameter and length of rivet 5. select proper rivet gun, bar, and set 6. use deburring tools and files 7. observe dissimilar metals protection 8. burnish metals 9. drive, inspect, remove, and reinstall rivets 10. countersink and dimple 11. ream oversize holes	
Bend Allowance The student will layout and bend sheet metal	
Sheet Splice Patterns The student will layout and construct single, double, and multiple row rivet patterns	
Special Fasteners The student will install and remove typical fasteners used for metallic, bonded and composite structures	
Forming Metal The student will form a joggle	
Inspection of Damaged Structures The student will inspect various parts that have been critically loaded in shear, tension, compression, and bending	
Structure Repair The student will layout and construct sheet metal repairs to, but not limited to, stressed skin, stringers, and bulkheads	
Inspect and Repair Fiberglass and Bonded Structures The student will inspect for voids and delamination and make a repair determination to a fiberglass and bonded structure	

Total Lab Hours 108

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe equipment operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g.,defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Identify fire exits and fire-fighting equipment
6. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Evaluate and determine hazards
   c. Describe the proper collection for a variety of hazardous wastes
   d. Respond to emergencies in the appropriate manner

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English

c. Use Metric/English conversion chart

4. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
5. Determine Areas and Volumes of Various Geometric Shapes
   a. Calculate the area of rectangles, squares, triangles, circles, and trapezoids
   b. Calculate the volume of rectangles, cubes, and cylinders

C. **INTERPRET BLUEPRINTS AND SHEET METAL DRAWINGS**

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Interpret the various types of lines employed in blueprints and schematics
   c. Identify the types of dimensions
   d. Identify general note symbols
   e. Locate notes on a print
   f. Interpret commonly used abbreviations and terminology
   g. Determine the tolerances associated with dimensions on a drawing
   h. Determine the tolerance for a referenced dimension
   i. Determine the surface finish for a given part
   j. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
   c. Identify the purpose of exploded isometric drawing
   d. Identify the purpose of assembly drawings
5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
7. Use Standards to Verify Requirements

a. Discuss the purpose of standards
b. Discuss source locations for standards

8. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed
9. Understand and Use Quality Systems
   a. Use ISO 9000, 9002, and 9003 for external quality assurance
   b. Use ISO 9004 for internal quality management
   c. Document paper trails for document revisions
10. Draw Sketches of Repairs and Alterations
   a. Illustrate a major repair or alteration
   b. Use dividers, compass, ruler, T-square, etc., in the development of sketches of repairs and alterations
11. Use Blueprint Information
   a. Identify/interpret information presented in blueprint title blocks
   b. Install and modify component parts by reference to blueprints

D. IDENTIFY MATERIALS AND PROCESSES

1. Identify and Select Appropriate Non-Destructive Testing Methods
   a. Apply the use of ultrasonic inspection methods for detecting cracks
   b. Apply methods for detecting surface cracks in aluminum castings and forgings
   c. Apply techniques for locating cracks in materials when only one side of the material is accessible
2. Perform Chemical Etching
   a. Perform general magnetic particle inspection general procedures
   b. Demagnetize steel parts after magnetic inspection
   c. Clean parts in preparation for penetrant inspection
   d. Identify visual indications of a subsurface flaw or fracture during magnetic particle inspection
   e. Locate cracks and blowholes in welded assemblies
   f. Perform dye penetrant procedures
   g. Distinguish between heat-treated and non-heat-treated aluminum alloys when the identification marks are not on the material
3. Understand Basic Heat-Treating Processes
   a. Identify the types of aluminum alloys considered to be heat-treatable
   b. Identify the steps in the heat-treatment of aluminum alloys
   c. Identify the effect of various forms of heat-treatment
   d. Identify the effect of incorrect heat-treatment on the corrosion-resistant properties of aluminum alloy
   e. Identify the degree of temper for aluminum alloy products from code designators
   f. Identify the effect of heating a metal slightly above its critical temperature, and then rapidly cooling it
   g. Identify the effect of strain hardening on the tensile strength of aluminum alloy

h. Compare and contrast the relationships between tensile strength and metal hardness
i. Anneal a welded steel part

4. Inspect and Check Welds
   a. Identify the characteristics of a good weld
   b. Identify the types of stress that welded joints can withstand
   c. Determine the effects of welding over a previously brazed or soldered joint
5. Perform Precision Measurements
   a. Use a micrometer and caliper to make precise measurements
   b. Measure a small hole using a micrometer and a hole gage
   c. Read and interpret a vernier micrometer scale
   d. Use a dial indicator, V-blocks, and a surface plate to check alignment of a shaft

E. PERFORM CLEANING AND CORROSION CONTROL

1. Identify and Select Cleaning Materials
   a. Determine the effect of caustic cleaning products on aluminum structures
   b. Identify the characteristics and use of chemical cleaners
   c. Determine the type of cleaner for use on high strength metals
2. Perform Aircraft Cleaning and Corrosion Control
   a. Identify the cause and corrective procedures for fretting corrosion
   b. Identify and control intergranular corrosion of heat-treated aluminum alloy
   c. Protect multi-metal and/or composite structure against dissimilar-metal corrosion
   d. Prevent and remove rust
   e. Protect the interior surfaces of closed steel and aluminum tubing against corrosion
   f. Apply methods of protecting aluminum alloy parts against corrosion
   g. Remove corrosion products such as metal flakes, scale powder, and salt deposits from aluminum
   h. Clean corrosion-resistant parts by blast cleaning methods
   i. Use paints and similar organic coatings for corrosion protection purposes

F. WORK WITH SHEET METAL STRUCTURES

1. Inspect Bonded Structures
   a. Identify the reasons for using metal sandwich panels in high-speed aircraft
   b. Use the metallic "ring" test to inspect for delamination damage of bonded structures
   c. Evaluate the extent of damage to a bonded structure and determine the type repair needed
2. Inspect and Repair Sheet Metal Structures
   a. Select and use twist drills
   b. Select and use a hand file for soft metals
   c. Prepare dissimilar metals for assembly
   d. Drill holes in stainless steel
   e. Define shear failure
   f. Construct a water tight joint
   g. Countersink a hole
   h. Perform the dimpling process
   i. Stop drill cracks in sheet metal

j. Repair a slightly oversize hole
k. Repair shallow scratches in sheet metal
l. Use a reamer

3. Inspect and Repair Plastics, Honeycomb, and Laminated Structures
   a. Distinguish between transparent plastic and plate glass
   b. Protect plastics during handling and repair operations
   c. Remove scratches and surface crazing from plastic
   d. Drill shallow or medium depth holes in plastic materials
   e. Identify the effects of moisture trapped in honeycomb structures
   f. Use a router to remove damaged area from honeycomb panels
   g. Clean honeycomb panels prior to patching
   h. Form and shape acrylic plastic
   i. Repair shallow surface scratches in transparent plastic
4. Install Special Rivets and Fasteners
   a. Determine correct rivet length and diameter
   b. Install hi-shear rivets
   c. Identify the precautions concerning rivet fit
   d. Identify the stresses that a rivet is designed to resist
5. Remove and Install Conventional Rivets
   a. Prepare Sheet Metal for installation of flush rivets
   b. Identify and select rivets
   c. Determine the correct rivet length and diameter
   d. Select and use the correct rivet set for specified rivet head styles
   e. Select and use bucking bars
   f. Remove rivets
   g. Determine the condition of a driven rivet
   h. Determine the circumstances under which 2117 rivets may be used to replace 2017 and 2024 rivets
   i. Define rivet tipping
   j. Determine the correct number of rivets to be used in making a structural sheet metal repair
   k. Handle and install rivets that require heat treatment prior to use
   l. Adjust and use an air-operated riveting gun
6. Hand Form, Layout and Bend Sheet Metal
   a. Make a joggle or offset bend
   b. Bend Sheet Metal that requires the use of a large radius
   c. Determine the neutral axis of a bend
   d. Determine the amount of material required to make a specific bend
   e. Bend sheet metal to a desired angle
   f. Layout and bend in relationship to metal "grain" to minimize the possibility of cracking
   g. Determine the flat layout dimensions of a component part to be formed by bending
   h. Form metal by bumping

G. WORK WITH COMPOSITE STRUCTURES

1. Identify Method of Repair
   a. Determine extent of damage
   b. Interpret repair order and/or blueprint build sheet

c. Determine stress requirements
d. Select materials for repair IAW repair order and Standard Repair Method (SRM)

2. Identify Bill of Materials (BOM)
   a. Calculate required materials
   b. Compare required materials to the BOM in the repair order
   c. Adjust BOM if necessary
3. Repair Per Technical Order/Engineering Specifications or Disposition
   a. Use blueprint information
   b. Remove damaged material IAW the repair order
   c. Perform cleaning (and corrosion control if required)
   d. Perform metal to metal repair
   e. Perform composite to metal repair
   f. Perform composite to composite repair
4. Perform Resin Transfer Molding
   a. Design and fabricate a polymer resin mold with reinforcing elements (fibers) using either a dimensionally correct part or build a casting with slip/plaster from a blueprint
   b. Debur mold base and chamfer edges
   c. Select and use mold cleaners
   d. Select and use mold releases
   e. Use soft tool method with mold cavities
   f. Select and operate drill presses, sanders, saws and ovens
5. Lay Up a Fiberglass Mold
   a. Design a fiberglass mold from a dimensionally correct part or build a slip casting from a blueprint or drawing
   b. Prepare surface for bonding
   c. Lay up by hand the fiberglass mats (for small molds)
   d. Select and use vacuum bags
   e. Operate an autoclave
   f. Operate sanders and saws
   g. Operate dust collecting equipment
   h. Select and operate tape wrap machines
   i. Select and operate obturators
6. Build Honeycomb Structure to Specifications
   a. Design and fabricate sheet metal components
   b. Prepare surfaces for bonding
   c. Select and use hole punches
   d. Apply honeycomb material to specification

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is

made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

- *A. Resources: Identifies, organizes, plans, and allocates resources*
  - 1. follows a schedule to complete assigned tasks on time
  - 2. determine cost associated with "tight" vs. "loose" tolerances
- *B. Interpersonal: Works with others*
  - 1. complete assigned responsibilities within the laboratory
  - 2. provide individual assistance/direction to peers as requested
  - 3. work well with all members of your class
- *C. Information: Acquires and uses information*
  - 1. read and interpret blueprints
- *D. Systems: Understands complex inter-relationships*
  - 1. demonstrate knowledge of the following systems:
    - a. laboratory organization structure: physical and social
    - b. organization of personnel and facilities in the laboratory
    - c. systematic approach to use of measuring tools/instruments
    - d. dimensioning and measurement systems
  - 2. monitors and corrects performance during
    - a. the measuring process
    - b. adjustments of individual laboratory work schedule
    - c. constantly evaluating the quality of work to achieve acceptable standards
    - d. maintains record of evaluations and sets individual goals
- *E. Technology: Works with a variety of technologies*
  - 1. chooses procedure, tools and equipment required to inspect a part
  - 2. applies appropriate procedures and uses appropriate tools and techniques to properly measure a work piece
  - 3. maintains and calibrates measuring instruments
    - a. applies appropriate preventative maintenance
    - b. check calibration prior to using measuring instruments
    - c. calibrates measuring instruments against standards
    - d. perform clean-up assignments of laboratory at the end of the period

II. **FOUNDATION SKILLS**

- *A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*
  - 1. *Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
    - a. studies student laboratory manual
    - b. interprets blueprints and technical drawings
    - c. read/studies textbook

d. follow a daily laboratory schedule to maintain appropriate time-line for successful course completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to accurately measure a machined part
   b. maintain a lecture notebook
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. interconvert English to Metric systems of measurement
   b. interconvert fractions to decimal expressions
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. select appropriate measuring tool based on drawing requirements
   c. understands both written and verbal instructions
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook
2. Mathematics for Machine Technology; Robert Smith, Delmar Publishers

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APPENDIX A - INDUSTRY COMPETENCY PROFILES

The following pages contain the individual Competency Profiles for each of the companies surveyed by the MAST development center for the occupational specialty area of . These Competency Profiles/skill standards were used to develop the curriculum for the pilot program.

The participation of the companies as partners in the MAST effort is greatly appreciated. Each company has approved the use of its logo in MAST materials. None of the participating companies shall be held responsible or liable for any of the findings of the project.

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Knowledge of Cutting Fluids/Lubricants
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

FUTURE TRENDS AND CONCERNS

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

DR. HUGH ROGERS
Director

DR. JON BOTSFORD
Assistant Director

JOE PENICK
Project Coordinator

TERRY SAWMA
Research Coordinator

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

SCOTT CRAIG
Composites Repairman

Texas State Technical College Waco

COMPETENCY PROFILE

Non-Metallics Composites Processing Technician

Conducted By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

CHRYSLER TECHNOLOGIES
AIRBORNE SYSTEMS, INC.

NON-METALLICS COMPOSITES PROCESSING TECHNICIAN ....

Duties ← **Tasks** →

Duties													
A	Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross first aid and CPR procedures	A-7 Recommend hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations	A-10 Follow fuel cell safety procedures	A-11 Understand ground support equipment		
B	Read/Interpret Work (MPP) Instructions and Drawings	B-1 Interpret symbols and nomenclature	B-2 Identify and interpret drawing views	B-3 Interpret drawing notes	B-4 Interpret parts and materials list	B-5 Interpret NOR's	B-6 Interpret MPP format	B-7 Interpret and apply MPP codes	B-8 Interpret sketches	B-9 Interpret detailed job performance steps	B-10 Insure drawing and MPP coincide and are complete	B-11 Identify specifications needed to perform job	B-12 Review documentation plan and organize work	B-13 Punch job information into computer
		B-14 Perform work within time standards	B-15 Record process control data	B-16 Complete traceability sheets	B-17 Review and submit final documentation	B-18 Identify and submit to inspection	B-19 Review MPP for complete processing instructions							
C	Read and Interpret Manufacturing Process (MP)	C-1 Interpret MP format	C-2 Work to latest available MP	C-3 Identify information required for your job	C-4 Identify process control requirements	C-5 Identify inspection criteria	C-6 Prepare test specimen	C-7 Identify and apply clean materials handling techniques						
D	Select and Prepare Materials	D-1 Locate and obtain direct materials	D-2 Check issued materials	D-3 Identify and select supporting materials	D-4 Determine temperature of materials	D-5 Select and use solvents	D-6 Select and use indirect supplies	D-7 Locate supplies and equipment	D-8 Determine special material handling criteria					
E	Select and Use Hand and Shop Tools	E-1 Read and interpret scales	E-2 Select and use screwdrivers	E-3 Select and use hammers and mallets	E-4 Select and use chisels	E-5 Select and use files and rasps	E-6 Select and use scribes	E-7 Select and use knives	E-8 Select and use straight edges and squares	E-9 Select and use allen wrenches	E-10 Select and use socket wrenches	E-11 Select and use combination wrenches	E-12 Select and use adjustable wrenches	E-13 Select and use pliers
		E-14 Select and use scissors and shears	E-15 Select and use hole punches	E-16 Select and use scrappers	E-17 Select and use spreaders and spatulas	E-18 Select and use vises and "C" clamps	E-19 Select and wear safety apparel	E-20 Select and use drill motors and bits	E-21 Select and use hot air guns	E-22 Select and use hand forming tools	E-23 Select and use micrometers and verniers			
F	Select and Operate Shop Equipment	F-1 Select and use jacks	F-2 Read and balance weigh scale	F-3 Operate die-cut press	F-4 Select and operate ovens	F-5 Operate industrial can opener	F-6 Use paint shaker	F-7 Use magnifier light	F-8 Operate sanders	F-9 Operate drill press	F-10 Operate vacuum pump and chamber	F-11 Operate sewing machine	F-12 Operate exhaust/vent hoods	F-13 Operate radial arm saw
		F-14 Operate band saw	F-15 Operate potting gun	F-16 Operate lifting devices	F-17 Select and use vacuum bags	F-18 Operate leak detectors	F-19 Select and use pneumatic equipment	F-20 Operate vacuum forming machine	F-21 Select and operate hydraulic presses	F-22 Operate mandrel loader	F-23 Select and operate tape wrap machine	F-24 Operate obturator winder	F-25 Operate vapor degreaser	F-26 Operate spray coating equipment
		F-27 Operate roller press	F-28 Operate acid etching equipment	F-29 Operate autoclave	F-30 Operate temperature records	F-31 Operate material cutters	F-32 Operate dust collecting equipment	F-33 Operate spray booths	F-34 Operate volt-ohm meter					

Duties ← **Tasks** →

Duties	Tasks												
G Select and Use Specialized Tools	G-1 Select and use torque wrenches	G-2 Select and use mandrels	G-3 Select and use templates	G-4 Select and use dollies	G-5 Select and use hole punches (specialized)	G-6 Select and use folding tools	G-7 Select and use lay-up and form fixtures	G-8 Select and install preform molds	G-9 Select and use handling containers	G-10 Select and use bonding fixtures	G-11 Select and install compression molds	G-12 Select and use slings	G-13 Select and use locating fixtures
	G-14 Select and use potting molds	G-15 Select and operate rotating spray fixtures	G-16 Operate spray gun	G-17 Operate vacuum table	G-18 Select and use soldering irons	G-19 Select and use saw fixtures							
H Perform Bonding Process Procedures	H-1 Lay-out bonding area	H-2 Mask areas	H-3 Lay-out and cut adhesive film	H-4 Lay-out and cut rubber	H-5 Lay-out and cut plastics	H-6 Pre-fit and trip parts	H-7 Determine shingle angle orientation	H-8 Perform surface preparation procedures	H-9 Prime surface areas	H-10 Mix adhesives	H-11 Apply adhesives	H-12 Apply unvulcanized rubber using mold	H-13 Apply unvulcanized rubber using adhesive
	H-14 Select and apply bond line spacer materials	H-15 Select and apply joining technique	H-16 Remove excess adhesive	H-17 Employ bond pressure technique	H-18 Monitor pot life	H-19 Set-up and monitor curing process	H-20 Perform bond disassembly and clean-up procedures	H-21 Identify and fill voids	H-22 Weigh and mix liquid material	H-23 De-air materials	H-24 Fill potting molds	H-25 Remove air bubbles from poured material	H-26 Assemble and close molds
	H-27 Apply identification numbers on parts or CAT cards	H-28 Make and connect thermocouple junctions	H-29 Troubleshoot thermocouples	H-30 Develop and determine foam charge weight									
I Perform Compression Molding Process Procedures	I-1 Weigh materials	I-2 Measure and cut materials	I-3 Lay-up and prepare preforms	I-4 Stage the preforms	I-5 Prepare molds for molding	I-6 Preheat mold and materials	I-7 Prepare details for mold assembly	I-8 Load preweighed materials into compression molds	I-9 Position preforms in compression molds	I-10 Close and apply pressure	I-11 Set and adjust pressure and temperature regulators	I-12 Monitor temperature and pressure gauges	I-13 Set and monitor timing devices
	I-14 Assemble and disassemble molds	I-15 Remove and deflash molded parts	I-16 Cool down molds	I-17 Select and apply mold release agents	I-18 Operate mold temperature controller	I-19 Plan and organize utilization of equipment							
J Communicate	J-1 Identify chain of command	J-2 Identify role of related departments	J-3 Identify sources of assistance	J-4 Phrase and ask questions	J-5 Listen	J-6 Interpret and apply terminology	J-7 Employ problem solving techniques	J-8 Coordinate with others the use of shop equipment	J-9 Provide direct response to questions	J-10 Communicate new ideas to supervisor	J-11 Assist others in the attainment of skills	J-12 Lead others in performing job	J-13 Consult with support personnel
K Perform Tape Wrap and Ablative Coating Procedures	K-1 Load mandrels	K-2 Activate hot air heating unit	K-3 Load tape in tape wrapper	K-4 Set-up and adjust tape wrapping machine	K-5 Prepare mandrel for wrapping	K-6 Wrap part	K-7 Monitor wrapping process	K-8 Adjust and monitor pressure wrap procedure	K-9 Prepare part for oven cure	K-10 Remove lagging tape	K-11 Apply ablative coatings	K-12 Perform water break test	K-13 Measure ablative coating thickness
L Develop Personal Competence	L-1 Interpret and apply security regulations and procedures	L-2 Interpret and follow safety regulations	L-3 Interpret and apply company policy and regulations	L-4 Interpret and abide by terms of bargaining agreement	L-5 Maintain punctuality and attendance	L-6 Maintain positive work attitude	L-7 Recognize priority of jobs	L-8 Exercise confidentiality	L-9 Work with fellow employees	L-10 Display appearance through posture, grooming and personal hygiene	L-11 Maintain clean work area	L-12 Exercise craftsmanship	L-13 Perform preliminary inspection of completed work

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Duties ← **Tasks** →

L-14 Display initiative	L-15 Interpret and follow directions	L-16 Recall instructions	L-17 Recognize needs of new employees	L-18 Respond to positive and negative feedback	L-19 Develop team concept	L-20 Budget time	L-21 Demonstrate supply discipline	L-22 Exercise common sense and good judgment	L-23 Interpret and apply metric system	L-24 Develop new procedures and techniques	L-25 Set-up and maintain personal notebook	

SKILLS AND KNOWLEDGE
Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

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Director

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Project Coordinator

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Research Coordinator

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Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

RUSS OVERKAMP
Technical Specialist, Education & Technical Training

DAN STROOT
Specialist, Education & Technical Training

VINCE GEHRIN
Specialist, Technical Training

Texas State Technical College Waco

TRAITS AND ATTITUDES
Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT
Vacuum Wrap and Gauges
Machinist's Tools (e.g., calipers, dial indicators, magnetic tool holders, etc.)
Measuring Tools
Power Tools
Drill Presses
Power Saws
Power Drills
Hydraulic/Arbor Press
Grinding Machines
Alignment Tools and Templates
Computer
Ventilation Equipment
Personal Safety Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Coordinate Measurement Machine

FUTURE TRENDS AND CONCERNS
Statistical Process Control
Laser Measuring Devices
Advanced Computer Applications
Environmental Concerns

COMPETENCY PROFILE

Non-Metallics Composites Processing Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

MCDONNELL DOUGLAS

NON-METALLICS COMPOSITES PROCESSING TECHNICIAN ....

Duties ← **Tasks** →

Duties													
A	Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Adhere to proper respiratory safety requirements including dust control measures							
B	Read/Interpret Work (MPP) Instructions and Drawings	B-1 Interpret symbols and nomenclature	B-2 Identify and interpret drawing views	B-3 Interpret drawing notes	B-4 Interpret parts and materials list	B-5 Interpret NORs	B-6 Interpret MPP format	B-7 Interpret and apply MPP codes	B-8 Interpret sketches	B-9 Interpret detailed job performance steps	B-10 Insure drawing and MPP coincide and are complete	B-11 Identify specifications needed to perform job	B-12 Review documentation plan and organize work	B-13 Punch job information into computer
		B-14 Perform work within time standards	B-15 Record process control data	B-16 Complete traceability sheets	B-17 Review and submit final documentation	B-18 Identify and exercise caution regarding hazardous materials	B-19 Identify and submit to inspection	B-20 Review MPP for complete processing instructions						
C	Read and Interpret Manufacturing Process (MP)	C-1 Interpret MP format	C-2 Work to latest available MP	C-3 Identify information required for your job	C-4 Identify process control requirements	C-5 Identify inspection criteria	C-6 Prepare test specimen	C-7 Identify and apply clean materials handling techniques						
D	Select and Prepare Materials	D-1 Locate and obtain direct materials	D-2 Check issued materials	D-3 Identify and select supporting materials	D-4 Determine temperature of materials	D-5 Select and use solvents	D-6 Select and use indirect supplies	D-7 Locate supplies and equipment	D-8 Determine special material handling criteria					
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		E-14 Select and use scissors and shears	E-15 Select and use hole punches	E-16 Select and use scrappers	E-17 Select and use spreaders and spatulas	E-18 Select and use vises and "C" clamps	E-19 Select and wear safety apparel	E-20 Select and use drill motors and bits	E-21 Select and use hot air guns	E-22 Select and use hand forming tools	E-23 Select and use micrometers and verniers			
F	Select and Operate Shop Equipment	F-1 Select and use jacks	F-2 Read and balance weigh scale	F-3 Operate die-cut press	F-4 Select and operate ovens	F-5 Operate industrial can opener	F-6 Use paint shaker	F-7 Use magnifier light	F-8 Operate sanders	F-9 Operate drill press	F-10 Operate vacuum pump and chamber	F-11 Operate sewing machine	F-12 Operate exhaust/vent hoods	F-13 Operate radial arm saw
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		F-27 Operate roller press	F-28 Operate acid etching equipment	F-29 Operate autoclave	F-30 Operate temperature records	F-31 Operate material cutters	F-32 Operate dust collecting equipment	F-33 Operate spray booths	F-34 Operate volt-ohm meter					

Duties		Tasks												
G	Select and Use Specialized Tools	G-1 Select and use torque wrenches	G-2 Select and use mandrels	G-3 Select and use templates	G-4 Select and use dollies	G-5 Select and use hole punches (specialized)	G-6 Select and use folding tools	G-7 Select and use lay-up and form fixtures	G-8 Select and install preform molds	G-9 Select and use handling containers	G-10 Select and use bonding fixtures	G-11 Select and install compression molds	G-12 Select and use slings	G-13 Select and use locating fixtures
		G-14 Select and use potting molds	G-15 Select and operate rotating spray fixtures	G-16 Operate spray gun	G-17 Operate vacuum table	G-18 Select and use solder-ing irons	G-19 Select and use saw fixtures							
H	Perform Bonding Process Procedures	H-1 Lay out bonding area	H-2 Mask areas	H-3 Lay out and cut adhesive film	H-4 Lay out and cut rubber	H-5 Lay out and cut plastics	H-6 Pre-fit and trip parts	H-7 Determine shingle angle orientation	H-8 Perform surface preparation procedures	H-9 Prime surface areas	H-10 Mix adhesives	H-11 Apply adhesives	H-12 Apply unvulcanized rubber using mold	H-13 Apply unvulcanized rubber using adhesive
		H-14 Select and apply bond line spacer materials	H-15 Select and apply joining technique	H-16 Remove excess adhesive	H-17 Employ bond pressure technique	H-18 Monitor pot life	H-19 Set up and monitor curing process	H-20 Perform bond dis-assembly and clean-up procedures	H-21 Identify and fill voids	H-22 Weigh and mix liquid material	H-23 De-air materials	H-24 Fill potting molds	H-25 Remove air bubbles from poured material	H-26 Assemble and close molds
		H-27 Apply identification numbers on parts or CAT cards	H-28 Make and connect thermocouple junctions	H-29 Trouble-shoot thermocouples	H-30 Develop and determine foam charge weight									
I	Perform Compression Molding Process Procedures	I-1 Weigh materials	I-2 Measure and cut materials	I-3 Lay up and prepare preforms	I-4 Stage the preforms	I-5 Prepare molds for molding	I-6 Preheat mold and materials	I-7 Prepare details for mold assembly	I-8 Load preweighed materials into compression molds	I-9 Position preforms in compression molds	I-10 Close and apply pressure	I-11 Set and adjust pressure and tempera-ture regulators	I-12 Monitor temperature and pressure gauges	I-13 Set and monitor timing devices
		I-14 Assemble and dis-assemble molds	I-15 Remove and deflash molded parts	I-16 Cool down molds	I-17 Select and apply mold re-lease agents	I-18 Operate mold tempera-ture controller	I-19 Plan and organize utilization of equipment							
J	Perform Tape Wrap and Ablative Coating Procedures	J-1 Load mandrels	J-2 Activate hot air heating unit	J-3 Load tape in tape wrapper	J-4 Set up and adjust tape wrapping machine	J-5 Prepare mandrel for wrapping	J-6 Wrap part	J-7 Monitor wrapping process	J-8 Adjust and monitor pressure wrap procedure	J-9 Prepare part for oven cure	J-10 Remove lagging tape	J-11 Apply ablative coatings	J-12 Perform water break test	J-13 Measure ablative coating thickness

MDONCOCOMP PMS
MASTIN991195

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Knowledge of Cutting Fluids/Lubricants
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

FUTURE TRENDS AND CONCERNS

Hot Bonds
Cold Bonds
Composite on Metal Repair
Composite on Composite
Honeycomb
Distributing Loads
Different Laminates and Honeycombs
New Corrosion Preventative Measures
Strict Environmental Requirements
Taper Lock Fasteners
Hard Tooling

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

DR. HUGH ROGERS
Director

DR. JON BOTSFORD
Assistant Director

JOE PENICK
Project Coordinator

TERRY SAWMA
Research Coordinator

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

JIM PETERS
Production Manager

GEORGE MOORE
A&P Mechanic

SCOTT CRAIG
Composites Repairman

Texas State Technical College Waco

COMPETENCY PROFILE

Sheet Metal/Aircraft Structural Technician

Conducted By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

CHRYSLER TECHNOLOGIES
AIRBORNE SYSTEMS, INC.

SHEET METAL/AIRCRAFT STRUCTURAL TECHNICIAN .... apply modern aircraft scientific knowledge in the installation, testing and maintenance of complex airframe equipment.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross first aid and CPR procedures	A-7 Recommend hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations	A-10 Follow fuel cell safety procedures	A-11 Understand ground support equipment		
B Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Interconvert fractions/ decimals	B-3 Interconvert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Extract root and raise numbers to a given power	B-7 Determine areas and volumes of various geometric shapes						
C Interpret Engineering Aircraft Drawings and Control Documents	C-1 Review blueprint notes and dimensions	C-2 Identify basic layout of drawings	C-3 Identify basic types of drawings	C-4 List the purpose of each type of drawing	C-5 Verify drawing elements	C-6 Practice geometric dimensioning and tolerancing (GD&T) methodology	C-7 Describe the relationship of engineering drawings to planning	C-8 Use standards to verify requirements	C-9 Analyze Bill of Materials (BOM)	C-10 Understand and use quality systems, i.e., MIL specs and ISO standards	C-11 Draw sketches of repairs and alterations	C-12 Use blueprint information	C-13 Understand importance of aircraft maintenance records
D Identify Materials and Processes	D-1 Identify and select appropriate non-destructive testing methods	D-2 Perform chemical etching	D-3 Understand basic heat-treating processes	D-4 Identify and select aircraft hardware and materials	D-5 Inspect and check welds	D-6 Perform precision measurements	D-7 Use sealants, i.e., fuel cell, firewall and high temperature						
E Perform Cleaning and Corrosion Control	E-1 Identify and select cleaning materials	E-2 Perform aircraft cleaning and corrosion control											
F Use Maintenance Publications	F-1 Select/use FAA and manufacturer's aircraft maintenance specifications	F-2 Select/use FAA and manufacturer's aircraft maintenance data sheets	F-3 Select/use FAA and manufacturer's aircraft maintenance manuals & publications	F-4 Select/use related federal aviation regulations	F-5 Read technical data								
G Work With Sheet Metal Structures	G-1 Install special rivets and fasteners	G-2 Inspect bonded structures	G-3 Inspect and repair plastics, honeycomb and laminated structures	G-4 Inspect, check, service, and repair windows, doors and interior finishings	G-5 Inspect and repair sheet metal structures	G-6 Remove and install conventional rivets	G-7 Hand form, layout and bend sheet metal						
H Work With Composite Structures	H-1 Determine extent of damage	H-2 Identify method of repair/standard repair method (SRM)	H-3 Identify bill of materials (BOM)	H-4 Repair per technical order/ engineer specification or disposition	H-5 Perform metal to metal repawir	H-6 Perform composite to metal repair	H-7 Perform resin transfer molding	H-8 Perform resin transfer molding	H-9 Lay-up a fiberglass mold	H-10 Build honeycomb structure to specification	H-11 Prepare surfaces for bonding	H-12 Perform hot bonding	H-13 Perform cold bonding
	H-14 Install a boron patch	H-15 Conduct non-destructive inspection (NDI)	H-16 Perform simultaneous sample testing										

For more information:

MAST Program Director
Texas State Technical College
3801 Campus Drive
Waco, TX 76705

(817) 867-4849
FAX (817) 867-3380
1-800-792-8784
http://machinetool.tstc.edu

U.S. DEPARTMENT OF EDUCATION
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