CareerClusters™
PATHWAYS TO COLLEGE & CAREER READINESS
Manufacturing

State Approved Courses for Manufacturing Programs

Foundational CTE Courses

Career Exploration (22151^) Employability (22152^) Entrepreneurship (12053^) Foundations of Technology (10004^) Leadership & Service (22101^)

Cluster Courses

Introduction to Manufacturing (13001) Intro to Technical Education (21051) Electronics (17106)

Introduction to Drafting & Design (21102) MS Intro to STEM (21050) MS Mechatronics/Robotics (21049)

Pathway Courses

Welding Pathway	*Precision Machining Pathway*	*Design & Engineering Pathway*	*Automation Pathway*
Welding Technology (13207) Advanced Welding Technology (13208)	Machine Tool Technology (13203) Advanced Machine Tool Technology (13204)	Introduction to Engineering (21001) Engineering Design & Development (21007) Mechanical Drafting & Design (21106)	Robotics (21009) Welding Technology (13207) Advanced Welding Technology (13208) Machine Tool Technology (13203) Advanced Machine Tool Technology (13204)

Dual Credit Courses

Visit https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf for a full list of dual credit courses in the Manufacturing Career Cluster.

Supporting Academic Courses

Geometry (02072^) Pre-Calculus (02110^) Physics (03151^)

Capstone CTE Courses

Entrepreneurship Experience (80026) Senior Experience (80019^) Youth Apprenticeship (80020) Service Learning (22104) Youth Internships (80018^)

^Denotes course is available on the SD Virtual School (http://www.sdvs.k12.sd.us/)

south dakota DEPARTMENT OF EDUCATION
Learning. Leadership. Service.

Advanced Machine Tool Technology

Career Cluster	Manufacturing
Course Code	13204
Prerequisite(s)	Algebra 1/Machine Tool Technology
Credit	0.5 or 1.0 credit
Program of Study and Sequence	Cluster course – Machine Tool Technology – Advanced Machine Tool Technology – Capstone Experience
Student Organization	Skills USA
Coordinating Work-Based Learning	Guest speakers, project-based learning, community outreach, internships, field trips, and industry partnerships
Industry Certifications	National Career Readiness Certificate (NCRC)
Dual Credit or Dual Enrollment	https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf
Teacher Certification	7-12 Technology Education; Machine Tool; Manufacturing Cluster Endorsement; Welding & Precision Machining Pathway Endorsement
Resources	OSHA/NIMS

Course Description
Advanced Machine Tool Technology students will perform advanced machining processes in the areas of safety, applied math skills and machining operations. The goal is for the student to use learned techniques from machine tool technology to obtain higher levels of competency through creation of projects to emulate industry needs.

Program of Study Application
Advanced Machine Tool Technology is the second pathway course in the Manufacturing cluster, Machining pathway. Machine tool technology is a prerequisite to the Advanced Machining course.

Course Standards

AMT 1: Demonstrate knowledge of safety and essential academic concepts in machine tool.

Webb Level	*Sub-indicator*
Two Skill/Concept	AMT 1.1 Prove knowledge of shop operations and tool safety procedures consistent with Occupational Safety and Health Administration (OSHA) standards.
Two Skill/Concept	AMT 1.2 Apply advanced concepts, including machine tool mathematics, mechanical drawing, science, and communications to machine tool processes.
Two Skill/Concept	AMT 1.3 Demonstrate and apply computer numerical control (CNC) programming concepts.

AMT 2: Demonstrate machine use and functions, utilizing problem solving skills to resolve machining issues.

Webb Level	*Sub-indicator*
Three Strategic Thinking	AMT 2.1 Utilize prior knowledge of tools, methods of measurement, materials, and material layout.
Three Strategic Thinking	AMT 2.2 Set up and run lathe and milling machines to do advanced machining operations.
Four Extended Thinking	AMT 2.3 Evaluate and solve issues related to lathe and milling setups and operations.

AMT 3: Apply career readiness skills in the workplace as they relate to today's society.

Webb Level	*Sub-indicator*
One Recall	AMT 3.1 Identify and demonstrate career readiness (soft skills) in the workplace.

AMT 4: Machine tool technology career exploration and development.

Webb Level	*Sub-indicator*
Two Skill/Concept	AMT 4.1 Define and compare career pathways in machine tool technology.
Four Extended Thinking	AMT 4.2 Design a personal learning plan for career interest in machine tool technology.
Two Skill/Concept	AMT 4.3 Explain trends and issues in machine tool technology careers.

south dakota DEPARTMENT OF EDUCATION
Learning. Leadership. Service.

Advanced Welding Technology

Career Cluster	Manufacturing
Course Code	13208
Prerequisite(s)	Welding Technology
Credit	0.5 or 1.0 credit
Program of Study and Sequence	Welding Technology – Advanced Welding Technology – Welding Engineering or Capstone Experience
Student Organization	Skills USA
Coordinating Work-Based Learning	Guest speakers, project-based learning, community outreach, internships, field trips, and industry partnerships
Industry Certifications	National Career Readiness Certificate (NCRC), https://doe.sd.gov/CTE/documents/Industry-0221.pdf
Dual Credit or Dual Enrollment	https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf
Teacher Certification	Welding; Manufacturing Cluster Endorsement; Welding & Precision Machining Pathway Endorsement
Resources	AWS, NCCER, and Industry

Course Description
Advanced Welding provides students with opportunities to effectively perform cutting and welding applications of increasing complexity used in the advanced manufacturing industry. Proficient students will build on the knowledge and skills of the Welding Technology course while learning additional welding techniques not covered in previous courses. Specifically, students will be proficient in fundamental safety practices in welding, gas metal arc welding (GMAW) and other advanced welding and cutting processes. Upon completion of the Advanced Welding Technology course, proficient students will be prepared to complete the American Welding Society (AWS) Entry Welder qualification and certification.

Program of Study Application
Advanced Welding Technology is the second pathway course in the Manufacturing cluster, welding pathway. Welding Technology is a prerequisite for this course. The course may be followed by further dual-enrollment studies or a capstone experience.

Course Standards

AWT 1: Implement welding safety practices.

Webb Level	*Sub-indicator*
Two Skill/Concept	AWT 1.1 Identify and demonstrate general safety in accordance with government regulations, health standards, and company and/or school policy.

AWT 2: Integrate core academic concepts as used in the welding industry.

Webb Level	*Sub-indicator*
Three Strategic Thinking	AWT 2.1 Demonstrate mathematical skills related to work assignments.
Two Skill/Concept	AWT 2.2 Communicate using welding terms and definitions from American National Standards Institute (ANSI)/American Welding Society (AWS) A3.0, Standard Welding Terms and Definitions.

AWT 3: Interpret, layout, and fabricate in conformance to fabrication drawings.

Webb Level	*Sub-indicator*
Three Strategic Thinking	AWT 3.1 Interpret and apply dimensions and locations of components in fabrication drawings.
Four Extended Thinking	AWT 3.2 Layout and fabricate according to the fabrication drawing industry standards.

AWT 4: Perform other advanced cutting processes.

Webb Level	*Sub-indicator*
Two Skill/Concept	AWT 4.1 Identify and explain the safety, parts, and operation of thermal cutting equipment.
Two Skill/Concept	AWT 4.2 Prepare layouts for cutting individual parts.
Three Strategic Thinking	AWT 4.3 Perform cuts using thermal cutting processes.

AWT 5: Perform Gas Metal Arc Welding (GMAW) process.

Webb Level	*Sub-indicator*
Two Skill/Concept	AWT 5.1 Identify and understand the safety, parts, and operation of GMAW.
Two Skill/Concept	AWT 5.2 Prepare base metal for various welding processes.
Three Strategic Thinking	AWT 5.3 Demonstrate Gas Metal Arc Welding (GMAW) on steel.

AWT 6: Identify and demonstrate knowledge of the inspection of welding and cutting processes.

Webb Level	*Sub-indicator*
Three Strategic Thinking	AWT 6.1 Visually inspect a weld.
Two Skill/Concept	AWT 6.2 Examine thermally cut surfaces and edges for discontinuities.

AWT 7: Perform other advanced welding processes.

Webb Level	*Sub-indicator*
Two Skill/Concept	AWT 7.1 Identify and understand the safety, parts, and operation of another advanced welding process.
Two Skill/Concept	AWT 7.2 Prepare base metal for various welding processes.
Three Strategic Thinking	AWT 7.3 Demonstrate another advanced welding process on steel.

AWT 8: Welding technology career exploration and development.

Webb Level	*Sub-indicator*
Two Skill/Concept	AWT 8.1 Define and compare career pathways in welding technology.
Four Extended Thinking	AWT 8.2 Design a personal learning plan for career interest in welding technology.
Two Skill/Concept	AWT 8.3 Explain trends and issues in welding technology careers.

AWT 9: Apply career readiness skills in the workplace as they relate to today's society.

Webb Level	*Sub-indicator*
One Recall	AWT 9.1 Identify and demonstrate career readiness (soft skills) in the workplace.

south dakota DEPARTMENT OF EDUCATION
Learning. Leadership. Service.

Introduction to Manufacturing

Career Cluster	Manufacturing
Course Code	13001
Prerequisite(s)	None
Credit	0.5 per semester
Program of Study and Sequence	Foundation courses – Introduction to Manufacturing – entry pathway course in any of four manufacturing pathways - Capstone
Student Organization	Skills USA
Coordinating Work-Based Learning	Guest speakers, project-based learning, community outreach, field trips, and industry partnerships
Industry Certifications	National Career Readiness Certificate (NCRC), https://doe.sd.gov/CTE/documents/Industry-0221.pdf
Dual Credit or Dual Enrollment	https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf
Teacher Certification	7-12 Technology Education; STEM Cluster Endorsement; Engineering & Robotics Pathway Endorsement; Manufacturing Cluster Endorsement
Resources	South Dakota Manufacturing Website

Course Description
Introduction to Manufacturing provides entry level exposure and career exploration in the manufacturing industry. This introductory course teaches students the skills common to all manufacturing occupations such as reading technical drawings, safety, and using tools. Students will learn the process of the manufacturing industry by designing and producing a product.

Program of Study Application
Introduction to Manufacturing is a cluster course in the Manufacturing program of study. Upon completion of Introduction to Manufacturing, a student will be prepared to take an entry pathway course in any of the four manufacturing pathways: welding, machining, design/engineering, or automation.

Course Standards

IM 1: Career exploration and development.

Webb Level	*Sub-indicator*
One Recall	IM 1.1 Research the various career pathways/occupations that are available in manufacturing process/industry/business.
Four Extended Thinking	IM 1.2 Design a personal learning plan for career interest in the manufacturing cluster.
Two Skill/Concept	IM 1.3 Explain trends and issues in the manufacturing industry.

IM 2: Research various manufacturing plans/drawings.

Webb Level	*Sub-indicator*
One Recall	IM 2.1 Identify the features of a manufacturing plan or technical drawing.
One Recall	IM 2.2 Identify various measurement tools used in manufacturing.
Two Skill/Concept	IM 2.3 Utilize various measurement tools used in manufacturing with precision.
Two Skill/Concept	IM 2.4 Apply mathematical concepts to measurement techniques.

IM 3: Implement manufacturing safety practices.

Webb Level	*Sub-indicator*
Two Skill/Concept	IM 3.1 Identify and demonstrate general safety in accordance with government regulations, health standards, and company and/or school policy.
One Recall	IM 3.2 Identify ergonomic measures to prevent worker fatigue and injury.

IM 4: Apply career readiness skills in the workplace as they relate to today's society.

Webb Level	*Sub-indicator*
One Recall	IM 4.1 Identify and demonstrate career readiness (soft skills) in the workplace.

IM 5: Utilize the appropriate tools and equipment used in the manufacturing industry.

Webb Level	*Sub-indicator*
One Recall	IM 5.1 Research and understand basic manufacturing tools.
Two Skill/Concept	IM 5.2 Use basic tools and equipment common to the manufacturing processes.

IM 6: Manufacture a product.

Webb Level	*Sub-indicator*
Three Strategic Thinking	IM 6.1 Interpret or create basic technical drawings/plans.
Four Extended Thinking	IM 6.2 Develop a prototype of a product.
Four Extended Thinking	IM 6.3 Test and evaluate a product.
Four Extended Thinking	IM 6.4 Redesign product for final production.

south dakota DEPARTMENT OF EDUCATION
Learning. Leadership. Service.

Machine Tool Technology

Career Cluster	Manufacturing
Course Code	13203
Prerequisite(s)	Algebra 1 Recommended
Credit	0.5 or 1.0 credit
Program of Study and Sequence	Manufacturing Cluster Course – Machine Tool Technology – Advanced Machine Tool Technology – Capstone Experience
Student Organization	Skills USA
Coordinating Work-Based Learning	Guest speakers, project-based learning, community outreach, field trips, internships, and industry partnerships
Industry Certifications	National Career Readiness Certificate (NCRC), https://doe.sd.gov/CTE/documents/Industry-0221.pdf
Dual Credit or Dual Enrollment	https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf
Teacher Certification	7-12 Technology Education; Machine Tool; Manufacturing Cluster Endorsement; Welding & Precision Machining Pathway Endorsement
Resources	

Course Description
Machine Tool Technology students will demonstrate machining processes, safety, math skills, and machining operations. The goal is for the student to succeed at a basic level through building projects with various machining tools. This course is designed to introduce students to careers in the machine tool industry.

Program of Study Application
Machine Tool Technology is a pathway course in the Manufacturing cluster Machining pathway. This course follows a cluster course and is a prerequisite for Advanced Machine Tool Technology.

Course Standards

MT 1: Demonstrate knowledge of safety and essential academic concepts in machine tooling.

Webb Level	*Sub-indicator*
One Recall	MT 1.1 Demonstrate knowledge of machine shop operations and tool safety procedures consistent with Occupational Safety and Health Administration (OSHA) standards.
One Recall	MT 1.2 Introduce concepts of basic mathematics, mechanical drafting, science, tool terminology and communications used in machine tool processes.
Two Skill/Concept	MT 1.3 Demonstrate basic CNC programming and processes.

MT 2: Show proper machine use and functions, utilizing problem solving skills to resolve machining issues.

Webb Level	*Sub-indicator*
Three Strategic Thinking	MT 2.1 Demonstrate knowledge of tools, methods of measurement, materials, and material layout.
Three Strategic Thinking	MT 2.2 Set up and run lathe and milling machines to do basic machining operations.
Four Extended Thinking	MT 2.3 Demonstrate testing and problem-solving skills in basic lathe and milling setups and operations.

MT 3: Apply career readiness skills in the workplace as they relate to today's society.

Webb Level	*Sub-indicator*
One Recall	MT 3.1 Identify and demonstrate career readiness (soft skills) in the workplace.

MT 4: Machine tool technology career exploration and development.

Webb Level	*Sub-indicator*
Two Skill/Concept	MT 4.1 Define and compare career pathways in machine tool technology.
Four Extended Thinking	MT 4.2 Design a personal learning plan for career interest in machine tool technology.
Two Skill/Concept	MT 4.3 Explain trends and issues in machine tool technology careers.

south dakota DEPARTMENT OF EDUCATION
Learning. Leadership. Service.

Mechanical Drafting and Design

Career Cluster	Manufacturing
Course Code	21106
Prerequisite(s)	Drafting and Design I course 21102 (recommended)
Credit	1.0
Program of Study and Sequence	Drafting and Design I – Mechanical Drafting and Design – Capstone Experience
Student Organization	Skills USA
Coordinating Work-Based Learning	Guest speakers, internships, tours
Industry Certifications	National Career Readiness Certificate (NCRC), https://doe.sd.gov/CTE/documents/Industry-0221.pdf
Dual Credit or Dual Enrollment	https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf
Teacher Certification	7-12 Technology Education; STEM Cluster Endorsement; Engineering & Robotics Pathway Endorsement; Drafting; Manufacturing Cluster Endorsement; Welding & Precision Machining Pathway Endorsement
Resources	

Course Description
People with careers in mechanical drafting, design, and engineering create our future. They turn a concept into a set of plans whether it is a component or assembly. These plans will guide manufacturing professionals as they continue the manufacturing process. Mechanical Drafting and Design will expose students to the American Design Drafting Association (ADDA) Apprentice standards in mechanical drafting and students will be given the option to take the ADDA Apprentice drafting test.

Program of Study Application
This is the second pathway course in the Manufacturing cluster, Design and Engineering pathway. Drafting and Design I Course number 21102 is a recommended prerequisite for this course. The course would be followed by a capstone experience.

Course Standards

MDD 1: Demonstrate the use of geometric construction

Webb Level	*Sub-indicator*
Two Skill/Concept	MDD 1.1 Apply geometric design and mechanical drafting to the design process.
Three Strategic Thinking	MDD 1.2 Demonstrate basic geometric dimensioning and tolerancing (GD&T).

MDD 2: Prepare mechanical drawings.

Webb Level	*Sub-indicator*
Three Strategic Thinking	MDD 2.1 Create a multi-view drawing.
Two Skill/Concept	MDD 2.2 Examine drawing identification and management techniques used in mechanical drafting.
Three Strategic Thinking	MDD 2.3 Create sectional views of a mechanical drawing.
Three Strategic Thinking	MDD 2.4 Develop auxiliary views of mechanical drawings.
Three Strategic	MDD 2.5 Generate pictorial drawings.

MDD 3: Understand the design for manufacturing and assembly.

Webb Level	*Sub-indicator*
One Recall	MDD 3.1 Analyze different manufacturing processes.
One Recall	MDD 3.2 Identify basic welding symbols used in the manufacturing design process.

MDD 4: Mechanical drafting career exploration and development.

Webb Level	*Sub-indicator*
Two Skill/Concept	MDD 4.1 Define and compare career pathways in mechanical drafting.
Four Extended Thinking	MDD 4.2 Design a personal learning plan for career interest in mechanical drafting.
Two Skill/Concept	MDD 4.3 Explain trends and issues in mechanical drafting careers.

MDD 5: Apply career readiness skills in the workplace as they relate to today's society.

Webb Level	*Sub-indicator*
One Recall	MDD 5.1 Identify and demonstrate career readiness (soft skills) in the workplace.

south dakota DEPARTMENT OF EDUCATION
Learning. Leadership. Service.

Welding Technology

Career Cluster	Manufacturing
Course Code	13207
Prerequisite(s)	None
Credit	0.5 or 1.0 credit
Program of Study and Sequence	Cluster Course – Welding Technology – Advanced Welding Technology – Capstone Experience
Student Organization	Skills USA
Coordinating Work-Based Learning	Guest speakers, project-based learning, community outreach, field trips, internships and industry partnerships
Industry Certifications	National Career Readiness Certificate (NCRC), https://doe.sd.gov/CTE/documents/Industry-0221.pdf
Dual Credit or Dual Enrollment	https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf
Teacher Certification	Welding; Manufacturing Cluster Endorsement; Welding & Precision Machining Pathway Endorsement
Resources	AWS, National Center for Construction Education (NCCER), and Industry

Course Description
Welding Technology provides students with an understanding of manufacturing processes and systems common to careers in welding and related industries. Welding Technology is based on, but not limited to, American Welding Society (AWS) Guidelines for the Entry Level Welder. Students will be able to perform Shielded Metal Arc Welding and thermal cutting processes.

Program of Study Application
Welding Technology is the first pathway course in the Manufacturing cluster, welding pathway. It follows a cluster course and is a prerequisite for the Advanced Welding course.

Course Standards

WT 1: Implement welding safety practices.

Webb Level	*Sub-indicator*
Two Skill/Concept	WT 1.1 Identify and demonstrate general safety in accordance with government regulations, health standards, and company and/or school policy.

WT 2: Integrate core academic concepts as used in the welding industry.

Webb Level	*Sub-indicator*
Two Skill/Concept	WT 2.1 Apply mathematical concepts to measurement techniques.
One Recall	WT 2.2 Read, comprehend, and communicate welding terms and definitions from American National Standards Institute (ANSI)/American Welding Society (AWS) A3.0, *Standard Welding Terms and Definitions.*

WT 3: Interpret drawings and welding symbol information.

Webb Level	*Sub-indicator*
One Recall	WT 3.1 Identify basic weld symbols and joints.
Two Skill/Concept	WT 3.2 Use appropriate lines in welding drawing.
Three Strategic Thinking	WT 3.3 Read and sketch drawings.

WT 4: Perform thermal cutting operations.

Webb Level	*Sub-indicator*
Two Skill/Concept	WT 4.1 Identify and explain the safety, parts, and operation of thermal cutting equipment.
Two Skill/Concept	WT 4.2 Prepare layouts for cutting individual parts.
Three Strategic Thinking	WT 4.3 Perform cuts using thermal cutting processes.