

# ***METALWORKING STANDARDS***



This document was prepared by:

Office of Career, Technical and Adult Education  
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### **BUSINESS AND INDUSTRY VALIDATION**

All CTE standards developed through the Nevada Department of Education are validated by business and industry through one or more of the following processes: (1) the standards are developed by a team consisting of business and industry representatives; or (2) a separate review panel was coordinated with industry experts to ensure the standards include the proper content; or (3) the adoption of nationally-recognized standards endorsed by business and industry.

The Metalworking standards were validated through a complete review by an industry panel.

### **PROJECT COORDINATOR**

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## INTRODUCTION

The standards in this document are designed to clearly state what the student should know and be able to do upon completion of an advanced high school Metalworking program. These standards are designed for a three-credit course sequence that prepares the student for a technical assessment directly aligned to the standards.

These exit-level standards are designed for the student to complete all standards through their completion of a program of study. These standards are intended to guide curriculum objectives for a program of study.

The standards are organized as follows:

**Content Standards** are general statements that identify major areas of knowledge, understanding, and the skills students are expected to learn in key subject and career areas by the end of the program.

**Performance Standards** follow each content standard. Performance standards identify the more specific components of each content standard and define the expected abilities of students within each content standard.

**Performance Indicators** are very specific criteria statements for determining whether a student meets the performance standard. Performance indicators may also be used as learning outcomes, which teachers can identify as they plan their program learning objectives.

The crosswalk and alignment section of the document shows where the performance indicators support the English Language Arts and the Mathematics Common Core State Standards, and the Nevada State Science Standards. Where correlation with an academic standard exists, students in the Metalworking program perform learning activities that support, either directly or indirectly, achievement of one or more Common Core State Standards.

All students are encouraged to participate in the career and technical student organization (CTSO) that relates to their program area. CTSOs are co-curricular national associations that directly enforce learning in the CTE classroom through curriculum resources, competitive events, and leadership development. CTSOs provide students the ability to apply academic and technical knowledge, develop communication and teamwork skills, and cultivate leadership skills to ensure college and career readiness.

The Employability Skills for Career Readiness identify the “soft skills” needed to be successful in all careers, and must be taught as an integrated component of all CTE course sequences. These standards are available in a separate document.

**CONTENT STANDARD 1.0 : IDENTIFY LAB ORGANIZATION AND SAFETY PROCEDURES**

**PERFORMANCE STANDARD 1.1 : DEMONSTRATE GENERAL LAB SAFETY RULES AND PROCEDURES**

- 1.1.1 Describe general shop safety rules and procedures (i.e., safety test)
- 1.1.2 Describe the roles of OSHA in workplace safety
- 1.1.3 Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities (i.e., personal protection equipment – PPE)
- 1.1.4 Utilize safe procedures for handling of tools and equipment
- 1.1.5 Operate lab equipment according to safety guidelines
- 1.1.6 Identify and use proper lifting procedures and proper use of support equipment
- 1.1.7 Utilize proper ventilation procedures for working within the lab/shop area
- 1.1.8 Identify marked safety areas
- 1.1.9 Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment
- 1.1.10 Identify the location and use of eye wash stations
- 1.1.11 Identify the location of the posted evacuation routes
- 1.1.12 Identify and wear appropriate clothing for lab/shop activities
- 1.1.13 Secure hair and jewelry for lab/shop activities
- 1.1.14 Demonstrate knowledge of the safety aspects of high voltage circuits
- 1.1.15 Locate and interpret material safety data sheets (MSDS)
- 1.1.16 Prepare time or job cards, reports or records
- 1.1.17 Perform housekeeping duties
- 1.1.18 Follow verbal instructions to complete work assignments
- 1.1.19 Follow written instructions to complete work assignments

**PERFORMANCE STANDARD 1.2 : IDENTIFY AND UTILIZE HAND TOOLS**

- 1.2.1 Identify hand tools and their appropriate usage
- 1.2.2 Identify standard and metric designation
- 1.2.3 Demonstrate the proper techniques when using hand tools
- 1.2.4 Demonstrate safe handling and use of appropriate tools
- 1.2.5 Demonstrate proper cleaning, storage, and maintenance of tools

**PERFORMANCE STANDARD 1.3 : IDENTIFY AND UTILIZE POWER TOOLS AND EQUIPMENT**

- 1.3.1 Identify power tools and their appropriate usage
- 1.3.2 Identify equipment and their appropriate usage
- 1.3.3 Demonstrate the proper techniques when using power tools and equipment
- 1.3.4 Demonstrate safe handling and use of appropriate power tools and equipment
- 1.3.5 Demonstrate proper cleaning, storage, and maintenance of power tools and equipment

**CONTENT STANDARD 2.0 : APPLY FUNDAMENTAL PRINT READING, MEASUREMENT, AND LAYOUT/FIT-UP TECHNIQUES**

**PERFORMANCE STANDARD 2.1 : DEMONSTRATE PRINT READING AND SKETCHING PRACTICES**

- 2.1.1 Interpret basic elements of a technical drawing (i.e., title block information, dimensions, line types)
- 2.1.2 Identify industry standard welding symbols
- 2.1.3 Prepare a materials list from a technical drawing
- 2.1.4 Describe various types of drawings (i.e., part, assembly, pictorial, orthographic, isometric, schematic)
- 2.1.5 Understand dimensioning, sectional drawings, fasteners, tables, charts, and assembly drawings
- 2.1.6 Sketch or draw a basic welding drawing
- 2.1.7 Fabricate parts from a drawing or sketch

**PERFORMANCE STANDARD 2.2 : DEMONSTRATE MEASURING AND SCALING TECHNIQUES**

- 2.2.1 Identify industry standard units of measure
- 2.2.2 Convert between customary (i.e., SAE, Imperial) and metric systems
- 2.2.3 Determine appropriate engineering and metric scales
- 2.2.4 Measure and calculate size, area, and volume
- 2.2.5 Determine and apply the equivalence between fractions and decimals
- 2.2.6 Demonstrate proper use of precision measuring tools (i.e., wire gauge, micrometer, dial-indicator, dial-caliper)

**PERFORMANCE STANDARD 2.3 : UTILIZE LAYOUT PRINCIPLES AND PRACTICES**

- 2.3.1 Interpret drawing, sketch or specification information
- 2.3.2 Prepare work area for layout
- 2.3.3 Select appropriate materials to complete work assignment
- 2.3.4 Use layout and marking tools as required
- 2.3.5 Layout parts using measurement practices

**PERFORMANCE STANDARD 2.4 : DEMONSTRATE PREPARATION AND FIT-UP PRACTICES**

- 2.4.1 Identify and explain job code specifications
- 2.4.2 Use fit-up gauges and measuring devices to check joint fit-up
- 2.4.3 Identify and explain distortion and how it is controlled
- 2.4.4 Fit-up joints using plate and pipe fit-up tools
- 2.4.5 Check for joint misalignment and poor fit-up before and after welding

**CONTENT STANDARD 3.0: IDENTIFY PROPERTIES OF METALS****PERFORMANCE STANDARD 3.1: IDENTIFY MATERIAL PROPERTIES AND SCIENCE**

- |       |   |
|-------|---|
| 3.1.1 | Identify and explain the composition and classification of base metals  |
| 3.1.2 | Explain and demonstrate field identification methods for base metals (i.e., mill certificate)                 |
| 3.1.3 | Identify and explain the physical characteristics and mechanical properties of metals                         |
| 3.1.4 | Identify and explain forms and shapes of structural metals  |
| 3.1.5 | Explain metallurgical considerations for metals (i.e., base metal prep, heat treatment, thermal conductivity) |

**PERFORMANCE STANDARD 3.2: IDENTIFY FILLER METAL**

- |       |   |
|-------|---|
| 3.2.1 | Explain filler metal classifications systems (i.e., American Welding Society, American Society of Mechanical Engineers) |
| 3.2.2 | Identify different types of filler metals   |
| 3.2.3 | Explain the storage and control of filler metals  |
| 3.2.4 | Explain filler metal traceability requirements and how to use applicable code requirements                              |



**CONTENT STANDARD 4.0 : APPLY WELDING TECHNIQUES****PERFORMANCE STANDARD 4.1 : APPLY SAFETY PROCEDURES**

- |        |  |
|--------|--|
| 4.1.1  | Identify and explain the use of GMAW and FCAW equipment (i.e., spray transfer, globular, short circuit, pulse) |
| 4.1.2  | Perform safety inspections of OFW and SMAW equipment and accessories   |
| 4.1.3  | Perform safety inspections of GMAW and FCAW equipment and accessories  |
| 4.1.4  | Perform safety inspections of GTAW equipment and accessories   |
| 4.1.5  | Make minor external repairs to OFW and SMAW equipment and accessories  |
| 4.1.6  | Make minor external repairs to GMAW and FCAW equipment and accessories   |
| 4.1.7  | Make minor external repairs to GTAW equipment and accessories  |
| 4.1.8  | Demonstrate safe startup, shutdown, disassembly, and cylinder exchange procedures of OFW                       |
| 4.1.9  | Demonstrate safe startup, shutdown, disassembly, and cylinder exchange procedures of GMAW and FCAW equipment   |
| 4.1.10 | Demonstrate safe startup, shutdown, disassembly, and cylinder exchange procedures of GTAW equipment            |

**PERFORMANCE STANDARD 4.2 : PRODUCE WELDS USING OXY-FUEL WELDING (OFW)**

- |       |   |
|-------|---|
| 4.2.1 | Set up for OFW operations               |
| 4.2.2 | Operate OFW equipment                   |
| 4.2.3 | Perform welds in the 1F and 2F position |

**PERFORMANCE STANDARD 4.3 : PRODUCE WELDS USING SHIELDED METAL ARC WELDING (SMAW) ON CARBON STEEL**

- |       |                                  |
|-------|----------------------------------|
| 4.3.1 | Set up for SMAW operations       |
| 4.3.2 | Operate SMAW equipment           |
| 4.3.3 | Perform welds in the 1F position |
| 4.3.4 | Perform welds in the 2F position |
| 4.3.5 | Perform welds in the 1G position |
| 4.3.6 | Perform welds in the 2G position |
| 4.3.7 | Perform welds in the 3G position |

<b>PERFORMANCE STANDARD 4.4 : PRODUCE WELDS USING GAS METAL ARC WELDING SHORT CIRCUITING TRANSFER (GMAW-S) ON CARBON STEEL</b>	
<ul style="list-style-type: none"> <li>4.4.1 Set up for GMAW-S operations</li> <li>4.4.2 Operate GMAW-S equipment</li> <li>4.4.3 Perform welds in the 1F position</li> <li>4.4.4 Perform welds in the 2F position</li> <li>4.4.5 Perform welds in the 3F position</li> <li>4.4.6 Perform welds in the 1G position</li> <li>4.4.7 Perform welds in the 2G position</li> <li>4.4.8 Perform welds in the 3G position</li> </ul>	
<b>PERFORMANCE STANDARD 4.5 : PRODUCE WELDS USING FLUX CORE ARC WELDING SHORT CIRCUITING TRANSFER (FCAW-G) ON CARBON STEEL</b>	
<ul style="list-style-type: none"> <li>4.5.1 Set up for FCAW-G operations</li> <li>4.5.2 Operate FCAW-G equipment</li> <li>4.5.3 Perform welds in the 1F position</li> <li>4.5.4 Perform welds in the 2F position</li> <li>4.5.5 Perform welds in the 3F position</li> <li>4.5.6 Perform welds in the 1G position</li> <li>4.5.7 Perform welds in the 2G position</li> <li>4.5.8 Perform welds in the 3G position</li> </ul>	
<b>PERFORMANCE STANDARD 4.6 : PRODUCE WELDS USING GAS TUNGSTEN ARC WELDING (GTAW) ON CARBON STEEL</b>	
<ul style="list-style-type: none"> <li>4.6.1 Set up for GTAW operations</li> <li>4.6.2 Operate GTAW equipment</li> <li>4.6.3 Perform welds in the 1F position</li> <li>4.6.4 Perform welds in the 2F position</li> <li>4.6.5 Perform welds in the 3F position</li> <li>4.6.6 Perform welds in the 1G position</li> <li>4.6.7 Perform welds in the 2G position</li> <li>4.6.8 Perform welds in the 3G position</li> </ul>	
<b>PERFORMANCE STANDARD 4.7 : PRODUCE WELDS USING GAS TUNGSTEN ARC WELDING (GTAW) ON ALUMINUM</b>	
<ul style="list-style-type: none"> <li>4.7.1 Set up for GTAW operations</li> <li>4.7.2 Operate GTAW equipment</li> <li>4.7.3 Perform welds in the 1F position</li> <li>4.7.4 Perform welds in the 2F position</li> <li>4.7.5 Perform welds in the 1G position</li> </ul>	

**CONTENT STANDARD 5.0 : APPLY THERMAL CUTTING PROCESSES****PERFORMANCE STANDARD 5.1 : DEMONSTRATE OXY-FUEL GAS CUTTING (OFC)**

- |       |   |
|-------|---|
| 5.1.1 | Perform safety inspections of OFC equipment and accessories   |
| 5.1.2 | Make minor external repairs to OFC equipment and accessories  |
| 5.1.3 | Demonstrate safe startup, shutdown, disassembly, and cylinder exchange procedures of OFC equipment      |
| 5.1.4 | Set up for OFC operations   |
| 5.1.5 | Operate OFC equipment   |
| 5.1.6 | Perform straight, square edge cutting operations in the flat position                                   |
| 5.1.7 | Perform shape, square edge cutting operations in the flat position                                      |
| 5.1.8 | Perform straight, bevel edge cutting operations in the flat position                                    |
| 5.1.9 | Perform scarfing and gouging operations to remove base and weld metal, in flat and horizontal positions |

**PERFORMANCE STANDARD 5.2 : DEMONSTRATE PLASMA ARC CUTTING (PAC) ON CARBON STEEL AND ALUMINUM**

- |       |   |
|-------|---|
| 5.2.1 | Perform safety inspections of PAC equipment and accessories           |
| 5.2.2 | Make minor external repairs to PAC equipment and accessories          |
| 5.2.3 | Set up for PAC operations   |
| 5.2.4 | Operate PAC equipment   |
| 5.2.5 | Perform straight, square edge cutting operations in the flat position |
| 5.2.6 | Perform shape, square edge cutting operations in the flat position    |

**CONTENT STANDARD 6.0 : IDENTIFY WELDING CODES, INSPECTIONS, AND TESTING PRINCIPLES**

**PERFORMANCE STANDARD 6.1: IDENTIFY WELDING CODES, QUALIFICATIONS, AND CERTIFICATIONS**

- |       |   |
|-------|---|
| 6.1.1 | Identify and explain codes governing welding              |
| 6.1.2 | Identify and explain weld imperfections and their causes  |
| 6.1.3 | Identify and explain nondestructive examination practices |
| 6.1.4 | Identify and explain welder qualification tests           |
| 6.1.5 | Explain the importance of quality workmanship             |
| 6.1.6 | Identify common destructive testing methods               |
| 6.1.7 | Perform a visual inspection of fillet welds               |

**PERFORMANCE STANDARD 6.2 : DEMONSTRATE WELDING INSPECTION AND TESTING PRINCIPLES**

- |       |   |
|-------|---|
| 6.2.1 | Research the role of welding inspection/inspector and testing in industry |
| 6.2.2 | Examine cut surfaces and edges of prepared base metal parts               |
| 6.2.3 | Examine tack, root passes, intermediate layers, and completed welds       |

**CONTENT STANDARD 7.0: APPLY FABRICATION FUNDAMENTALS****PERFORMANCE STANDARD 7.1: UTILIZE BASE METAL PREPARATION FUNDAMENTALS**

- 7.1.1 Clean base metal for welding or cutting
- 7.1.2 Identify and explain joint design
- 7.1.3 Explain joint design considerations
- 7.1.4 Mechanically bevel the edge of a mild steel plate
- 7.1.5 Thermally bevel the end of a mild steel plate
- 7.1.6 Select the proper joint design based on a welding procedure specification (WPS)

**PERFORMANCE STANDARD 7.2: DEMONSTRATE PART PREPARATION WITH CUTTING AND FORMING TECHNIQUES**

- 7.2.1 Perform bending or forming operations
- 7.2.2 Perform drilling or boring operations
- 7.2.3 Perform shearing operations

**PERFORMANCE STANDARD 7.3: DEMONSTRATE FABRICATION TECHNIQUES**

- 7.3.1 Demonstrate proper setup of fabrication area, equipment, and materials
- 7.3.2 Construct projects in the proper sequence
- 7.3.3 Produce tack welds to specifications
- 7.3.4 Properly layout projects from prints
- 7.3.5 Check work for accuracy

**PERFORMANCE STANDARD 7.4: IDENTIFY THREADS AND FASTENERS**

- 7.4.1 Identify SAE and metric threads (i.e., screw, tapered, self-tapping)
- 7.4.2 Cut internal and external threads manually and mechanically (i.e., tap and die, lathe)
- 7.4.3 Identify various fastening methods (i.e., rivets, adhesive, screws, seams, etc.)
- 7.4.4 Categorize fastening methods by appropriate applications
- 7.4.5 Demonstrate fastening methods on various materials

**PERFORMANCE STANDARD 7.5: UTILIZE METAL FORMING PROCESSES**

- 7.5.1 Identify and explain various forming processes
- 7.5.2 Identify different types of forming equipment
- 7.5.3 Demonstrate metal drawing and tapering processes
- 7.5.4 Demonstrate heat treating processes
- 7.5.5 Demonstrate braking and bending applications, both manually and mechanically

**CONTENT STANDARD 8.0 : APPLY SHEET METAL TECHNIQUES****PERFORMANCE STANDARD 8.1: UTILIZE SHEET METAL LAYOUT PRINCIPLES AND PRACTICES**

- |       |   |
|-------|---|
| 8.1.1 | Construct paper patterns for a simple sheet metal project                               |
| 8.1.2 | Layout directly on metal using dyes, scribes, dividers, trammel points, and edge gauges |
| 8.1.3 | Identify edges and seams used in typical sheet metal layout                             |
| 8.1.4 | Demonstrate the use of triangulation development  |
| 8.1.5 | Demonstrate how to find true length lines   |

**PERFORMANCE STANDARD 8.2 : DEMONSTRATE FASTENING TECHNIQUES**

- |       |  |
|-------|--|
| 8.2.1 | Identify and list the various sheet metal fastening techniques   |
| 8.2.2 | Demonstrate the ability to join sheet metal together with rivets, resistance welding, and seaming techniques |

**PERFORMANCE STANDARD 8.3: UTILIZE FORMING AND CUTTING TECHNIQUES**

- |       |   |
|-------|---|
| 8.3.1 | Perform basic preventative non-electrical maintenance on machines and tools to comply with safety requirements for optimal performance levels |
| 8.3.2 | Form sheet metal using a box and pan break, bar folder, slip roll, and a rotary machine   |
| 8.3.3 | Cut sheet metal using foot shears/power shears, hand shears, Beverly shears, and Whitney punches  |
| 8.3.4 | Use appropriate cutting and folding techniques  |

**CONTENT STANDARD 9.0: APPLY MACHINING TECHNIQUES****PERFORMANCE STANDARD 9.1: DEMONSTRATE FUNDAMENTALS OF MACHINING**

- 9.1.1 Use charts and tables to determine cutting, drilling, and knurling speeds
- 9.1.2 Select the proper cutting tool based on job requirements
- 9.1.3 Safely sharpen cutting tools
- 9.1.4 Center a tailstock

**PERFORMANCE STANDARD 9.2: UTILIZE METALWORKING MACHINES**

- 9.2.1 Identify and explain the purpose and use of metalworking lathes and milling machines
- 9.2.2 Perform facing, straight turning, shoulder turning, center drilling, knurling, and parting operations on a lathe
- 9.2.3 Turn a taper using one of the three taper cutting techniques on a lathe (i.e., taper attachment, tailstock offset, and compound rest)
- 9.2.4 Perform thread cutting operations on a lathe
- 9.2.5 Perform boring operations on a lathe

**PERFORMANCE STANDARD 9.3: UTILIZE DRILLING MACHINES**

- 9.3.1 Identify components of the drill press
- 9.3.2 Set up and securely clamp a work piece to the drill press table
- 9.3.3 Use charts and tables to determine cutting speeds and feeds for drilling a specific medium
- 9.3.4 Select appropriate drill size based on job requirements
- 9.3.5 Perform drilling operations

**CROSSWALKS AND ALIGNMENTS OF  
METALWORKING STANDARDS  
AND THE COMMON CORE STATE STANDARDS,  
THE NEVADA SCIENCE STANDARDS,  
AND THE COMMON CAREER TECHNICAL CORE STANDARDS**

**CROSSWALK (ACADEMIC STANDARDS)**

The crosswalk of the Metalworking Standards shows links to the Common Core State Standards for English Language Arts and Mathematics and the Nevada Science Standards. The crosswalk identifies the performance indicators in which the learning objectives in the Metalworking program support academic learning. The performance indicators are grouped according to their content standard and are crosswalked to the English Language Arts and Mathematics Common Core State Standards and the Nevada Science Standards.

**ALIGNMENTS (MATHEMATICAL PRACTICES)**

In addition to correlation with the Common Core Mathematics Content Standards, many performance indicators support the Common Core Mathematical Practices. The following table illustrates the alignment of the Metalworking Standards Performance Indicators and the Common Core Mathematical Practices. This alignment identifies the performance indicators in which the learning objectives in the Metalworking program support academic learning.

**CROSSWALK (COMMON CAREER TECHNICAL CORE)**

The crosswalk of the Metalworking Standards shows links to the Common Career Technical Core. The crosswalk identifies the performance indicators in which the learning objectives in the Metalworking program support the Common Career Technical Core. The Common Career Technical Core defines what students should know and be able to do after completing instruction in a program of study. The Metalworking Standards are crosswalked to the Manufacturing Career Cluster™ and the Production Career Pathway.



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**CROSSWALK OF METALWORKING STANDARDS  
AND THE COMMON CORE STATE STANDARDS**

**CONTENT STANDARD 1.0: IDENTIFY LAB ORGANIZATION AND SAFETY PROCEDURES**

Performance Indicators	Common Core State Standards and Nevada Science Standards
1.1.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
1.1.2	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p><b>English Language Arts: Speaking and Listening Standards</b> SL.11-12.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well reasoned exchange of ideas.</p>
1.1.9	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
1.1.15	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.</p> <p>RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</p>
1.1.16	<p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>

1.1.18	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b>  RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p><b>English Language Arts: Speaking and Listening Standards</b>  SL.11-12.1d Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.</p>
1.1.19	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b>  RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>

**CONTENT STANDARD 2.0: APPLY FUNDAMENTAL PRINT READING, MEASUREMENT, AND LAYOUT /  
FIT-UP TECHNIQUES**

Performance Indicators	Common Core State Standards and Nevada Science Standards
2.1.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
2.1.2	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.</p>
2.1.3	<p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
2.1.4	<p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
2.2.4	<p><b>Math: Geometry – Similarity, Right Triangles, and Trigonometry</b> G-SRT.9 Derive the formula <math>A = \frac{1}{2} ab \sin C</math> for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.</p> <p>G-SRT.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).</p> <p><b>Math: Geometry – Geometric Measurement and Dimension</b> G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.</p>
2.3.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
2.4.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
2.4.3	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>

## CONTENT STANDARD 3.0: IDENTIFY PROPERTIES OF METALS

Performance Indicators	Common Core State Standards and Nevada Science Standards
3.1.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
3.1.2	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
3.1.3	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
3.1.4	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
3.1.5	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
3.2.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
3.2.3	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>

3.2.4	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
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## CONTENT STANDARD 4.0: APPLY WELDING TECHNIQUES

Performance Indicators	Common Core State Standards and Nevada Science Standards
4.1.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
4.1.2	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
4.1.3	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
4.1.4	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
4.1.5	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
4.1.6	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
4.1.7	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
4.1.8	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
4.1.9	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
4.1.10	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>

**CONTENT STANDARD 5.0: APPLY THERMAL CUTTING PROCESSES**

<b>Performance Indicators</b>	<b>Common Core State Standards and Nevada Science Standards</b>
5.1.1	<b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
5.1.2	<b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
5.1.3	<b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
5.2.1	<b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
5.2.2	<b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.



## CONTENT STANDARD 6.0: IDENTIFY WELDING CODES, INSPECTIONS, AND TESTING PRINCIPLES

Performance Indicators	Common Core State Standards and Nevada Science Standards
6.1.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
6.1.2	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
6.1.3	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
6.1.4	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
6.1.5	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
6.2.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.</p>

## CONTENT STANDARD 7.0: APPLY FABRICATION FUNDAMENTALS

Performance Indicators	Common Core State Standards and Nevada Science Standards
7.1.2	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
7.1.3	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>
7.3.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
7.4.4	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
7.5.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b> WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>

**CONTENT STANDARD 8.0: APPLY SHEET METAL TECHNIQUES**

<b>Performance Indicators</b>	<b>Common Core State Standards and Nevada Science Standards</b>
8.3.1	<b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b> RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

**CONTENT STANDARD 9.0: APPLY MACHINING TECHNIQUES**

Performance Indicators	Common Core State Standards and Nevada Science Standards
9.2.1	<p><b>English Language Arts: Reading Standards for Literacy in Science and Technical Subjects</b>                      RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p><b>English Language Arts: Writing Standards for Literacy in Science and Technical Subjects</b>                      WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>

**ALIGNMENT OF METALWORKING STANDARDS  
AND THE COMMON CORE MATHEMATICAL PRACTICES**

Common Core Mathematical Practices	Metalworking Performance Indicators
1. Make sense of problems and persevere in solving them.	9.1.1; 9.3.3
2. Reason abstractly and quantitatively.	
3. Construct viable arguments and critique the reasoning of others.	
4. Model with mathematics.	
5. Use appropriate tools strategically.	2.1.6, 2.1.7; 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6; 2.3.4, 2.3.4, 2.3.5 2.4.3, 2.4.5  7.2.1, 7.2.2, 7.2.3; 7.3.4, 7.3.5; 7.4.2, 7.4.4  8.1.2, 8.1.4, 8.1.5  9.2.2, 9.2.3, 9.2.4, 9.2.5; 9.3.5
6. Attend to precision.	2.1.6, 2.1.7; 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6; 2.3.4, 2.3.4, 2.3.5 2.4.3, 2.4.5  7.2.1, 7.2.2, 7.2.3; 7.3.4, 7.3.5; 7.4.2, 7.4.4  8.1.2, 8.1.4, 8.1.5  9.2.2, 9.2.3, 9.2.4, 9.2.5; 9.3.5
7. Look for and make use of structure.	
8. Look for and express regularity in repeated reasoning.	

**CROSSWALKS OF METALWORKING STANDARDS  
AND THE COMMON CAREER TECHNICAL CORE**

<b>Manufacturing Career Cluster™ (MN)</b>	<b>Performance Indicators</b>
1. Evaluate the nature and scope of the Manufacturing Career Cluster™ and the role of manufacturing in society and in the economy.	
2. Analyze and summarize how manufacturing businesses improve performance.	2.4.1, 2.4.2; 6.2.1
3. Comply with federal, state and local regulations to ensure worker safety and health and environmental work practices.	1.1.1-1.1.3; 6.1.1
4. Describe career opportunities and means to achieve those opportunities in each of the Manufacturing Career Pathways.	6.2.1
5. Describe government policies and industry standards that apply to manufacturing.	1.1.2; 6.1.1
6. Demonstrate workplace knowledge and skills common to manufacturing.	

<b>Production Career Pathway (MN-PRO)</b>	<b>Performance Indicators</b>
1. Diagnose production process problems and take corrective action to meet production quality standards.	4.1.2-4.1.7 5.1.1, 5.1.2; 5.2.1, 5.2.2
2. Manage safe and healthy production working conditions and environmental risks.	1.1.7, 1.1.11
3. Make continuous improvement recommendations based on results of production process audits and inspections.	6.1.3-6.1.7; 6.2.2, 6.2.3
4. Coordinate work teams when producing products to enhance production process and performance.	
5. Demonstrate the safe use of manufacturing equipment.	1.1.5; 1.2.4; 1.3.4 4.1.8-4.1.10; 4.2.1, 4.2.2 4.3.1, 4.3.2; 4.4.1, 4.4.2 4.5.1, 4.5.2; 4.6.1, 4.6.2 4.7.1, 4.7.2; 5.1.3-5.1.5 5.2.3, 5.2.4