

# Course Outline

Manufacturing and Product Development

REVISED: July/2021

**Job Title**

Welder

**77-95-75**

**Career Pathway:**

Welding and Materials Joining

## Welding/Certification Upgrade

**Credits:** 0

**Hours:** 20

**Industry Sector:**

Manufacturing and Product Development

**Course Description:**

This competency-based course is the last after a sequence of three designed for welding. Instruction includes introduction and safety, groove welds, combination welding, Los Angeles Department of Building & Safety written exam, and employability skills review. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

**O\*NET-SOC CODE:**

51-4121.00

**Prerequisites:**

Enrollment requires a reading level of 8.0 as measured by the CASAS GOALS test.

**CBEDS Title:**

Welding Technology

**NOTE:** For Perkins purposes this course has been designated as an **capstone** course.

**CBEDS No.:**

5619

This course **can** be repeated once a student receives a Certificate of Completion.



## **COURSE OUTLINE COMPETENCY-BASED COMPONENTS**

A course outline reflects the essential intent and content of the course described. Acceptable course outlines have six components. (Education Code Section 52506). Course outlines for all apportionment classes, including those in jails, state hospitals, and convalescent hospitals, contain the six required elements:

(EC 52504; 5CCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

### **COURSE OUTLINE COMPONENTS**

### **LOCATION**

#### **GOALS AND PURPOSES**

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The educational goals or purposes of every course are clearly stated and the class periods are devoted to instruction. The course should be broad enough in scope and should have sufficient educational worth to justify the expenditure of public funds.

The goals and purpose of a course are stated in the COURSE DESCRIPTION. Course descriptions state the major emphasis and content of a course, and are written to be understandable by a prospective student.

#### **PERFORMANCE OBJECTIVES OR COMPETENCIES**

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Objectives should be delineated and described in terms of measurable results for the student and include the possible ways in which the objectives contribute to the student's acquisition of skills and competencies.

Performance Objectives are sequentially listed in the COMPETENCY-BASED COMPONENTS section of the course outline. Competency Areas are units of instruction based on related competencies. Competency Statements are competency area goals that together define the framework and purpose of a course. Competencies fall on a continuum between goals and performance objectives and denote the outcome of instruction.

Competency-based instruction tells a student before instruction what skills or knowledge they will demonstrate after instruction. Competency-based education provides instruction, which enables each student to attain individual goals as measured against pre-stated standards.

Competency-based instruction provides immediate and continual repetition and In competency-based education the curriculum, instruction, and assessment share common characteristics based on clearly stated competencies. Curriculum, instruction and assessment in competency-based education are: explicit, known, agreed upon, integrated, performance oriented, and adaptive.

**COURSE OUTLINE COMPETENCY-BASED COMPONENTS**  
**(continued)**

**COURSE OUTLINE COMPONENTS**

**LOCATION**

**INSTRUCTIONAL STRATEGIES**

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Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.

Instructional strategies for this course are listed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructional strategies and activities for a course should be selected so that the overall teaching approach takes into account the instructional standards of a particular program, i.e., English as a Second Language, Programs for Adults with Disabilities.

**UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT**

Cover

The approximate time devoted to each instructional unit within the course, as well as the total hours for the course, is indicated. The time in class is consistent with the needs of the student, and the length of the class should be that it ensures the student will learn at an optimum level.

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Units of study, with approximate hours allotted for each unit are listed in the COMPETENCY AREA STATEMENT(S) of the course outline. The total hours of the course, including work-based learning hours (community classroom and cooperative vocational education) is listed on the cover of every CBE course outline. Each Competency Area listed within a CBE outline is assigned hours of instruction per unit.

**EVALUATION PROCEDURES**

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The evaluation describes measurable evaluation criteria clearly within the reach of the student. The evaluation indicates anticipated improvement in performances as well as anticipated skills and competencies to be achieved.

Evaluation procedures are detailed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructors monitor students' progress on a continuing basis, assessing students on attainment of objectives identified in the course outline through a variety of formal and informal tests (applied performance procedures, observations, and simulations), paper and pencil exams, and standardized tests.

## **ACKNOWLEDGMENTS**

Thanks to MILTON MARTINEZ and MAURICIO REYES for developing and editing this curriculum. Acknowledgment is also given to ERICA ROSARIO for designing the original artwork for the course covers.

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**CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS**  
**Manufacturing and Product Development Industry Sector**  
**Knowledge and Performance Anchor Standards**

**1.0 Academics**

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Manufacturing and Product Development academic alignment matrix for identification of standards.

**2.0 Communications**

Acquire and accurately use Manufacturing and Product Design sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

**3.0 Career Planning and Management**

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

**4.0 Technology**

Use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the Manufacturing and Product Design sector workplace environment.

**5.0 Problem Solving and Critical Thinking**

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Manufacturing and Product Design sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

**6.0 Health and Safety**

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Manufacturing and Product Design sector workplace environment.

**7.0 Responsibility and Flexibility**

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Manufacturing and Product Design sector workplace environment and community settings.

**8.0 Ethics and Legal Responsibilities**

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

**9.0 Leadership and Teamwork**

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organizations.

**10.0 Technical Knowledge and Skills**

Apply essential technical knowledge and skills common to all pathways in the Manufacturing and Product Design sector, following procedures when carrying out experiments or performing technical tasks.

**11.0 Demonstration and Application**

Demonstrate and apply the knowledge and skills contained in the Manufacturing and Product Design anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organizations.

## ***Manufacturing and Product Development Pathway Standards***

### **C. Welding and Materials Joining Pathway**

The Welding and Materials Joining pathway provides students with an understanding of manufacturing processes and systems common to careers in welding and related industries. The following pathway standards are based on, but not limited to, well established American Welding Society (AWS) EG2.0 Guidelines for the Entry Level Welder. Representative topics include the interpretation and layout of welded and assembled-part prints, cutting, mechanical bonding, joining, cohesive bonding, adhesive bonding, and mechanical fastening.

Sample occupations associated with this pathway:

- ◆ Metal Fabricator
- ◆ Sales
- ◆ Welders, Cutters, and Fitters
- ◆ Welding Inspector
- ◆ Welding Engineer

- C1.0 Interpret and demonstrate the planning and layout operations used in the welding processes.
- C2.0 Understand and demonstrate how materials can be processed through the use of welding tools and equipment.
- C3.0 Differentiate and apply various types of welding assembly processes.
- C4.0 Understand finishing processes and the differences between various types of finishing materials used in the manufacture of welded parts and products.
- C5.0 Understand and defend the purposes and processes of inspection and quality control in welding manufacturing processes.
- C6.0 Explore and understand various welding systems that require standard hand and machine tools.
- C7.0 Understand various automated welding systems, welding design for manufacturing, flexible manufacturing systems, and materials resource planning.
- C8.0 Understand various joining or combining processes, including welding processes used in manufacturing, maintenance, and repair.
- C9.0 Understand how a manufacturing company is organized and the elements of welding production management.

**CBE**  
**Competency-Based Education**

**COMPETENCY-BASED COMPONENTS**  
**for the Welding Certification Upgrade Course**

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. INTRODUCTION AND SAFETY</p> <p>Review, apply, and evaluate classroom and workplace policies and procedures used in accordance with federal, state, and local safety and environmental regulations.</p> <p>(3 hours)</p>	<ol style="list-style-type: none"> <li>1. Review the scope and purpose of the course.</li> <li>2. Review the overall course content as a part of the Linked Learning Initiative.</li> <li>3. Review classroom policies and procedures.</li> <li>4. Review the opportunities available for women in the welding field.</li> <li>5. Review the purpose of the California Occupational Safety and Health Administration (Cal/OSHA) and its laws governing welders.</li> <li>6. Review and demonstrate the use of the Safety Data Sheet (SDS) as it applies to the welding industry.</li> <li>7. Review classroom and workplace first aid and emergency procedures according to American Red Cross (ARC) standards.</li> <li>8. Review how each of the following insures a safe workplace:               <ol style="list-style-type: none"> <li>a. employees' rights as they apply to job safety</li> <li>b. employers' obligations as they apply to job safety</li> <li>c. role of the Division of Workers' Compensation (DWC)</li> <li>d. safe use and storage of flammable liquids, materials, and safety supplies</li> <li>e. wearing of eye protection</li> <li>f. removal of jewelry</li> <li>g. avoidance of loose clothing</li> <li>h. never leaving an operating machine unattended</li> <li>i. not stopping and starting a machine for someone else</li> </ol> </li> <li>9. Pass the safety exam with 100% accuracy.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 7, 8, 9, 10, 11, 12</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4 Technology: 4.1, 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8 Responsibility and Flexibility: 7.2, 7.3, 7.4, 7.7 Ethics and Legal Responsibilities: 8.1, 8.2, 8.4, 8.5, 8.7 Leadership and Teamwork: 9.3, 9.4, 9.6 Technical Knowledge and Skills: 10.1, 10.2, 10.4 Demonstration and Application: 11.1, 11.3</p> <p><b>CTE Pathway:</b> C1.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>B. GROOVE WELDS</p> <p>Understand and apply the tools and techniques used in welding various types of grooves in all positions.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Define groove welding.</li> <li>2. Describe and demonstrate the following: <ol style="list-style-type: none"> <li>a. Preparation of lay-out and fit-up of V-groove welds with back-up strip</li> <li>b. Tacking procedures</li> <li>c. Root pass technique in groove welds</li> <li>d. Welding sequence and technique in groove welds</li> <li>e. Fit-up procedures on single V-groove welds in the 3G &amp; 4G positions</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 10, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.4 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.4, 6.7, 6.8 Technical Knowledge and Skills: 10.1, 10.2, 10.4 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C1.1, C1.3, C2.3, C3.1, C3.2, C4.1, C4.2, C5.3, C5.4, C5.5, C5.6, C7.1, C7.2, C8.2, C8.3</p>
<p>C. COMBINATION WELDING</p> <p>Understand, apply, and evaluate the tools, equipment, safety issues, and techniques commonly used in combination welding.</p>	<ol style="list-style-type: none"> <li>1. Identify each of the following combination welding equipment and demonstrate its use: <ol style="list-style-type: none"> <li>a. Gas Tungsten Arc Welding (GTAW) equipment (If applicable)</li> <li>b. Gas Metal Arc Welding (GMAW) equipment (if applicable)</li> <li>c. Shielded Metal Arc Welding (SMAW) equipment (if applicable)</li> <li>d. Flux Core Arc Welding (FCAW) equipment (if applicable)</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 10, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.4, 6.7, 6.8 Technical Knowledge and Skills: 10.1, 10.2, 10.4</p>



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(6 hours)		<b>CTE Pathway:</b> C1.1, C1.3, C2.3, C3.1, C3.2, C4.1, C4.2, C5.1, C5.2, C5.3, C5.4, C5.5, C5.6, C6.2, C7.1, C7.2, C8.2, C8.3
<p>D. LOS ANGELES DEPARTMENT OF BUILDING AND SAFETY (LADBS) WRITTEN EXAM</p> <p>Understand and apply the geometric joint design, welding symbols, and city codes per American Welding Society (AWS) D1.1, D1.2, D1.3, D1.4, D1.5, and D1.6, in preparation for the Los Angeles Department of Building and Safety Written Exam.</p>	<ol style="list-style-type: none"> <li>1. Identify and describe the following:               <ol style="list-style-type: none"> <li>a. destructive testing</li> <li>b. side bends, root bends, and face bends</li> <li>c. visual inspection</li> </ol> </li> <li>2. Describe application and procedures for taking the Los Angeles Department of Building and Safety written exam.</li> <li>3. Pass the practical welding exam according to AWS D1.1, D1.2, D1.3, D1.4, D1.5 and D1.6 guidelines.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 8</p> <p><b>CTE Anchor:</b>            Communications: 2.4            Problem Solving and Critical Thinking: 5.2, 5.4            Health and Safety: 6.8            Responsibility and Flexibility: 7.4            Ethics and Legal Responsibilities: 8.1            Technical Knowledge and Skills: 10.1, 10.2            Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C9.1, C9.2, C9.3</p>
<p>E. EMPLOYABILITY SKILLS REVIEW</p> <p>Review, apply, and evaluate the employability skills required in the welding industry.</p>	<ol style="list-style-type: none"> <li>1. Review employer requirements for the following:               <ol style="list-style-type: none"> <li>a. punctuality</li> <li>b. attendance</li> <li>c. attitude toward work</li> <li>d. quality of work</li> <li>e. teamwork</li> <li>f. responsibility</li> <li>g. timeliness</li> <li>h. communication skills</li> </ol> </li> <li>2. Update potential employers through traditional and internet sources.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2</p> <p><b>CTE Anchor:</b>            Communications: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(2 Hours)	3. Review the role of electronic social networking in job search. 4. Update sample résumés and cover letters. 5. Review the importance of filling out a job application legibly, with accurate and complete information. .	Career Planning and Management: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9 Technology: 4.5, 4.6 Problem Solving and Critical Thinking: 5.1, 5.4 Health and Safety: 6.2 Responsibility and Flexibility: 7.3, 7.4 Ethics and Legal Responsibilities: 8.4 Leadership and Teamwork: 9.3, 9.4 Technical Knowledge and Skills: 10.4 Demonstration and Application: 11.5  <b>CTE Pathway:</b> C9.1, C9.2, C9.3

## ***SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES***

### **TEXTBOOKS**

Bowditch, William A., Kevin E. Bowditch, and Mark A. Bowditch. Welding Fundamentals, 5<sup>th</sup> Edition. Goodheart-Wilcox Publisher, 2016.

Jeffus, Larry. Welding: Principles and Applications, 8<sup>th</sup> Edition. Cengage Learning, 2020.

Kou, Sindo. Welding Metallurgy, 2<sup>nd</sup> Edition. Wiley, John & Sons, Incorporated, 2002.

Ruck, James. Welding Projects, 2<sup>nd</sup> Edition. Goodheart-Willcox Publisher, 2005.

American Welding Society. AWS D 1.1 Structural Steel Code, 2015 Edition. American National Institute, 2015.

American Welding Society. AWS D 1.2 Aluminum Code, 2014 Edition. American National Institute, 2015.

American Welding Society. AWS D 1.3 Sheet Steel Code, 2018 Edition. American National Institute, 2017.

American Welding Society. AWS D 1.4 Structural Steel Code, 2018 Edition. American National Institute, 2018.

American Welding Society. AWS D 1.5 Bridge Code, 2015 Edition. American National Institute, 2015.

American Welding Society. AWS D 1.6 Stainless Steel Code, 2017 Edition. American National Institute, 2017.

American Welding Society. AWS D 1.8 Structural Steel Seismic Code, 2016 Edition. American National Institute, 2016.

American Society for Mechanical Engineers SEC IX Boiler and High Pressure Vessels Code, 2015 Edition. ASME International, 2015.

American Institute of Steel Construction, AISC Steel Construction Manual, 14<sup>th</sup> Edition. AISC, 2015.

### **RESOURCES**

Employer Advisory Board members

CTE Model Curriculum Standards for Manufacturing and Product Development:

<http://www.cde.ca.gov/ci/ct/sf/documents/manproddev.pdf>

American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126; Phone: 800-443-9353,

<http://www.aws.org>

[American Society for Mechanical Engineers, 2 Park Avenue, New York, NY 10016](http://www.asme.org)

<http://www.asme.org>

[America Institute of Steel and Construction, 130 EAST RANDOLPH, SUITE 2000, CHICAGO, IL, 60601: 312-670-2400](http://www.aisc.org)

[Aisc.org](http://www.aisc.org)

### **COMPETENCY CHECKLIST**

## **TEACHING STRATEGIES and EVALUATION**

### **METHODS AND PROCEDURES**

- A. Lectures and discussions
- B. Demonstrations and participation
- C. Individualized instruction
- D. Projects

### **EVALUATION**

SECTION A – Introduction and Safety – Pass the safety test with 100% accuracy.

SECTION B – Groove Welds – Pass all assignments and exams on groove welds per AWS and L.A. City standards and procedures.

SECTION C – Combination Welding – Pass all assignments and exams on combination welding per AWS and L.A. City standards and procedures.

SECTION D – Los Angeles Department of Building & Safety Written Exam – Pass all assignments and exams on City of Los Angeles departmental exam with a minimum score of 80% or higher, or according to AWS guidelines.

SECTION E – Employability Skills Review – Review, apply, and evaluate the employability skills required in the welding industry.

## ***Standards for Career Ready Practice***

**1. Apply appropriate technical skills and academic knowledge.**

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and performing other work-related practices.

**2. Communicate clearly, effectively, and with reason.**

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others: they are active listeners who speak clearly and with purpose, and they are comfortable with terminology that is common to workplace environments. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.

**3. Develop an education and career plan aligned with personal goals.**

Career-ready individuals take personal ownership of their educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process, and they understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.

**4. Apply technology to enhance productivity.**

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications, and they take actions to prevent or mitigate these risks.

**5. Utilize critical thinking to make sense of problems and persevere in solving them**

Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve a problem and, once agreed upon, follow through to ensure the problem is resolved.

**6. Practice personal health and understand financial literacy.**

Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.

**7. Act as a responsible citizen in the workplace and the community.**

Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them, and they think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.

**8. Model integrity, ethical leadership, and effective management.**

Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.

**9. Work productively in teams while integrating cultural and global competence.**

Career-ready individuals contribute positively to every team, as both team leaders and team members. To avoid barriers to productive and positive interaction, they apply an awareness of cultural differences. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.

**10. Demonstrate creativity and innovation.**

Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.

**11. Employ valid and reliable research strategies.**

Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.

**12. Understand the environmental, societal, and economic impacts of decisions.**

Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.

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## Statement for Civil Rights

All educational and vocational opportunities are offered without regard to race, color, national origin, gender, or physical disability.

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