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Title: Online Manufacturing Training: ToolingU Review (U)

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Online Manufacturing Training: ToolingU Review (U)

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Abstract

The following report is a review of ToolingU, an online manufacturing training website. ToolingU provided the author with a trail account where a number of courses were taken and the overall program was evaluated. A review of the classes revealed that most of the offerings directly align with work at the Laboratory. Ease of use, effectiveness of the system and price all make ToolingU an attractive option for manufacturing training needs.

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1.0 Introduction

ToolingU is an online program that was being considered by Los Alamos National Laboratory (LANL) in 2013 [1]. Since then ToolingU has added a significant amount of online classes. Also, according to ToolingU, more than 50% of Fortune 500 manufacturing companies are ToolingU customers [2]. Those events provided enough intrigue to further investigate this as a possible solution for some of LANL's training needs.

2.0 Previous Work

LANL utilizes ToolingU for the Machinist Apprenticeship Program (MAP). The program requires inspiring machinist to take about thirty percent of the classes offered by ToolingU as part of the curriculum [3]. These classes fall into the departments listed in Table 1.

Table 1. Machinist Apprenticeship Program ToolingU Required Classes

Functional Area	Department	Required Apprenticeship Classes
Additive Manufacturing	Additive Manufacturing	4
Foundational	Inspection	12
	Materials	6
	Quality	11
	Safety	12
	Shop Essentials (Applied Math)	13
Machining	Abrasives	7
	CNC	15
	CNC Controls: Fanuc	12
	CNC Controls: Haas	12
	CNC Controls: Mazak	18
	Manual Machining	9
	Metal Cutting	16
	Workholding	7
	Mechanical Systems	2
Fabricating	Press Brake	6
Total		**162**

3.0 Online Classes

ToolingU currently offers 551 online classes in English. Some classes are also available in foreign languages such as Spanish and Chinese.

3.1 Class Breakdown

There are nine functional areas with 31 departments and three levels of difficulty as seen in Table 2.

Table 2. Online Class Breakdown

Functional Area	Department	Number of Classes	Beginner	Intermediate	Advanced
Additive Manufacturing	Additive Manufacturing	4	4	0	0
Assembly and Final Stage Processes	Adhesives	6	4	2	0
	Coatings	5	5	0	0
	Fasteners	10	7	3	0
	Soldering	7	3	4	0
Composites Processing	Composites	12	10	1	1
Foundational	Inspection	33	12	9	12
	Materials	26	13	12	1
	Quality	55	29	16	10
	Rigging	5	3	1	1
	Safety	33	28	5	0
	Shop Essentials (Applied Math)	31	23	7	1
Leadership	Supervisor Essentials	14	11	3	0
Machining	Abrasives	11	3	7	1
	CNC	22	8	13	1
	CNC Controls: Fanuc	12	1	7	4
	CNC Controls: Haas	12	0	8	4
	CNC Controls: Mazak	18	1	13	4
	Manual Machining	10	3	7	0
	Metal Cutting	28	10	13	5
	Workholding	8	5	3	0
Maintenance	Electrical Systems	16	7	9	0
	Hydraulics and Pneumatics	21	8	8	5
	Mechanical Systems	12	5	7	0
	Motor Controls	20	0	8	12
	PLCs	18	0	9	9
	PLCs: Siemens	17	1	10	6
	Robotics	16	10	6	0
Stamping Forming Fabricating	Press Brake	6	4	2	0
	Stamping	11	5	5	1
Welding	Welding	52	17	30	5
Total		**551**	**240**	**228**	**83**
Percent		**100**	**44**	**41**	**15**

3.2 Certifications

ToolingU offers the following certifications [2]:

- Lean Bronze
  Begins the Lean Certification program and validates employee' tactical Lean experience and solid understanding of Lean principles and tools.
- Lean Silver
  Expands upon employees' knowledge and understanding of Lean principles and tools. Silver level candidates should be fully capable of orchestrating the transformation of a complete value stream.
- Lean Gold
  Focuses on the strategic transformation of the enterprise. Gold level candidates have sufficient Lean experience and knowledge to teach Lean strategy and leadership, and completely transform an organization.
- Certified Manufacturing Technologist (CMfgT)
  Certification primarily benefits new manufacturing engineers and experienced manufacturers without other credentials.
- Certified Manufacturing Engineer (CMfgE)
  Professionals who earn a CMfgE demonstrate a comprehensive knowledge of manufacturing processes and practices.
- Electrical/Electronics Technology (EET)
  Knowledge of basic electrical concepts, digital and analog electronics, microcontrollers, microprocessors, and practical laboratory skills.

3.3 Advanced Manufacturing Employment Program

The advanced manufacturing employment program is an online fast-track curriculum designed for dislocated workers, returning veterans, incumbent workers and at-risk youth in the advance manufacturing sector [2].

- Manufacturing 101 Boot Camp – Manufacturing Fundamentals (~25 hours)
- Manufacturing 102 – Welding Basics (Manufacturing 101 plus ~20 hours)
- Manufacturing 103 – Industrial Maintenance Basics (Manufacturing 101 plus ~24 hours)
- Manufacturing 104 – Machining Basics (Manufacturing 101 plus ~40 hours)

4.0 Web Interface

ToolingU can be accessed through the use a web browser. Simply type in the following website "www.toolingu.com", click on student login, and enter your login and password information.

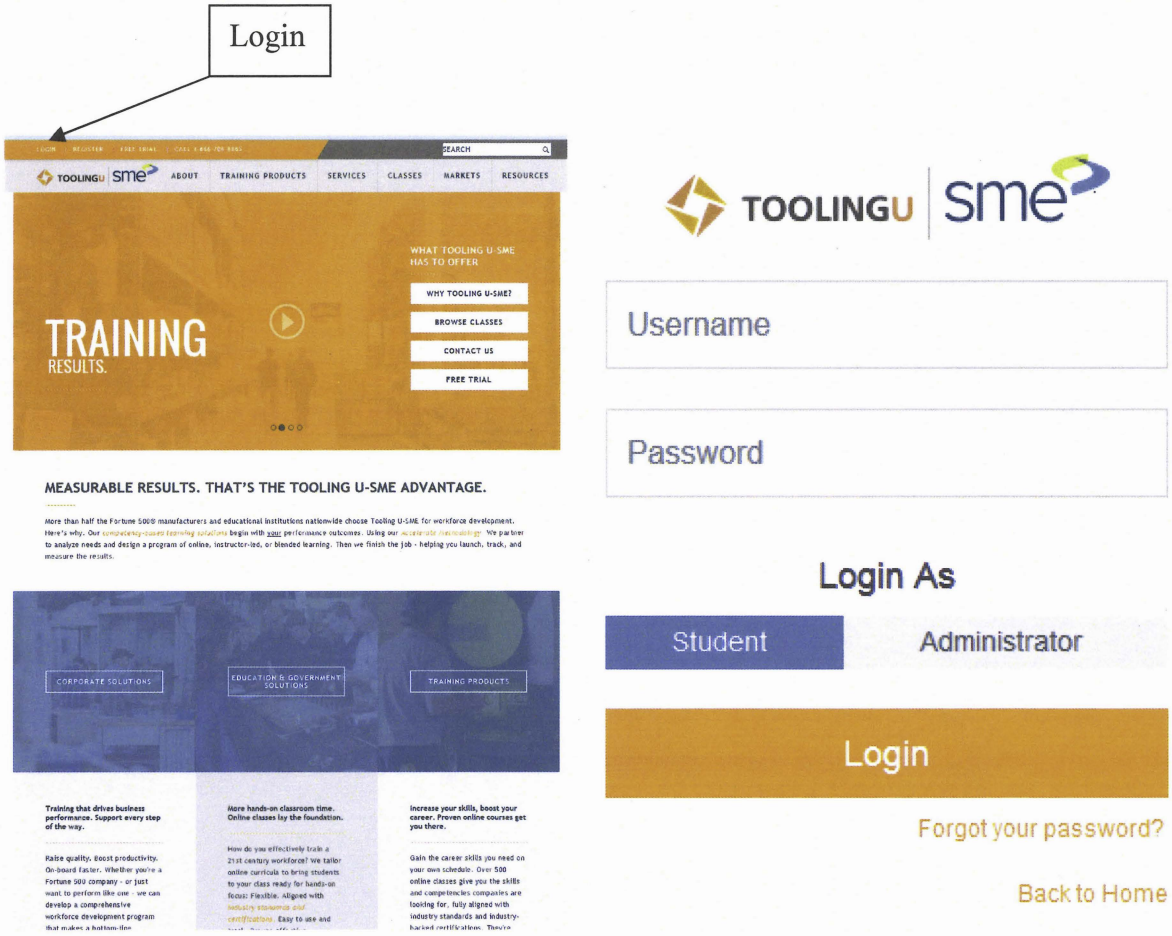


Figure 1. ToolingU Website (left) and Login (right)

4.1 Student Center

The Student Center is the user's home page. The user will have different tabs available for "My Schedule", "My Messages", "My Account", "My Goals", "My Competencies", and "Help". There are also options available to filter by department, set multimedia settings, view my transcript, add classes from a skills assessment, class notes, choice of certificate styles, and other ToolingU tools.

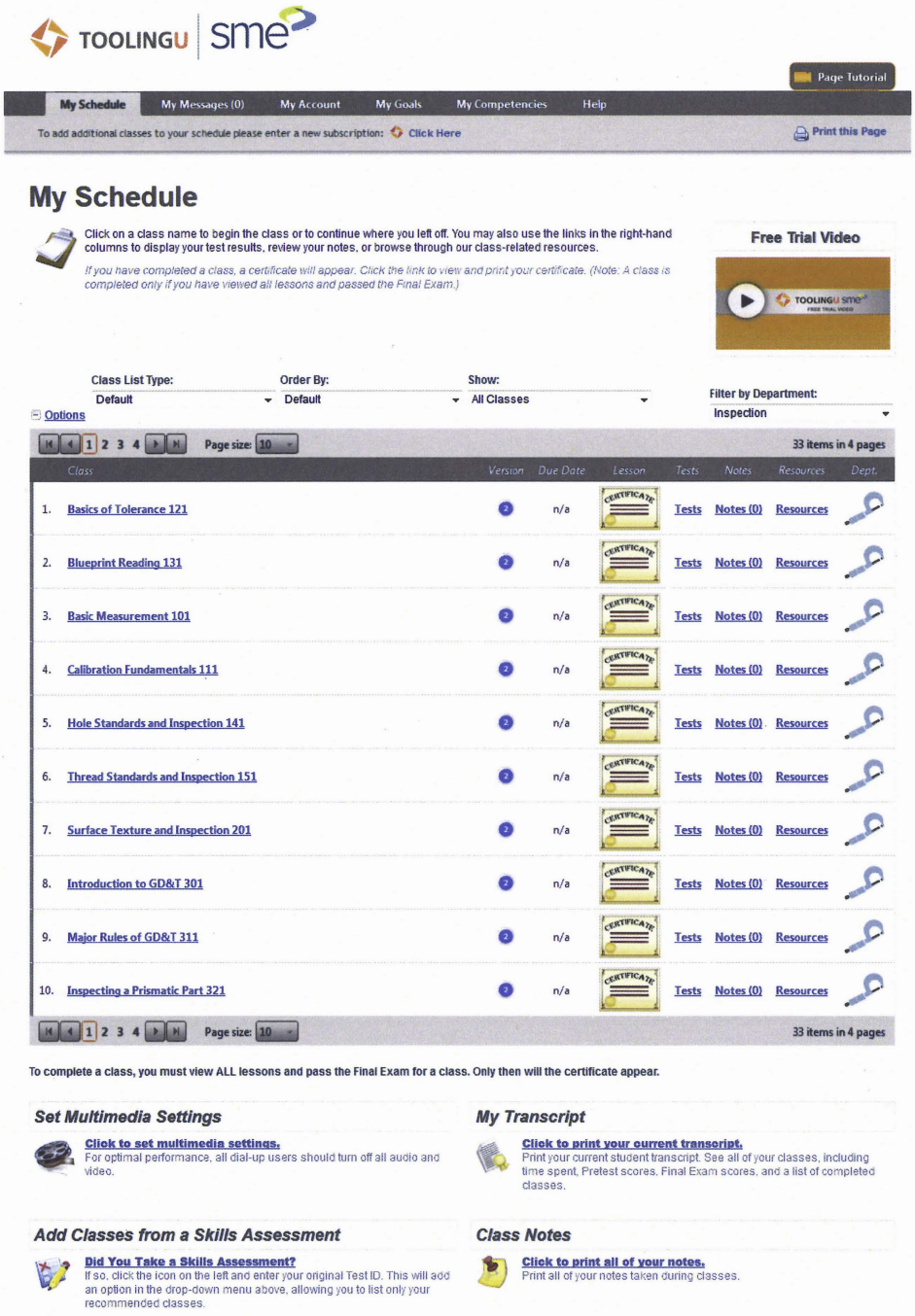


Figure 2. Student Center

4.2 Class Overview

After selecting a class the student is taken to the Class Overview. Here the student is presented with the Overview, Outline, Objectives, Vocabulary, and provides links to a pretest, final exam, and an optional rate the class feedback link.

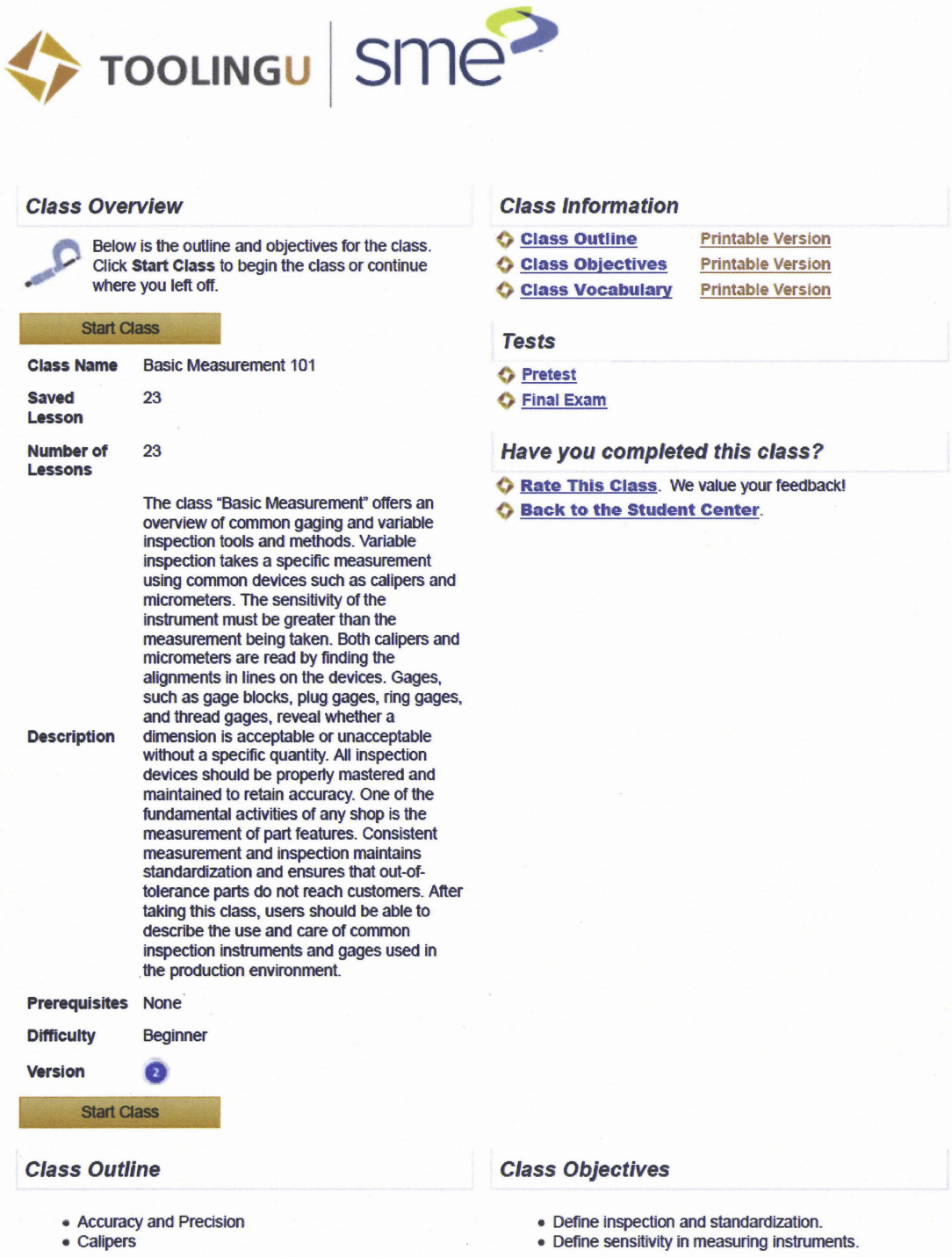


Figure 3. Class Overview

4.3 Class Outline

The class outline is presented with bullets to provide the framework for the course.

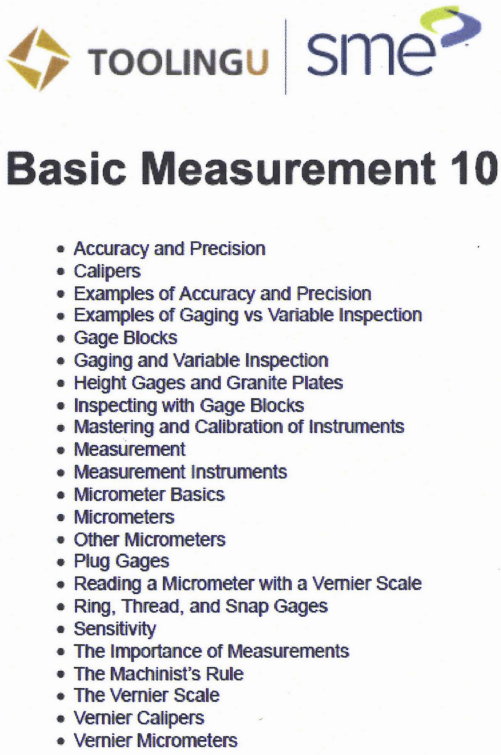


Figure 4. Class Outline

4.4 Class Objectives

The class objectives are presented with bullets to provide a list of topics for the course.

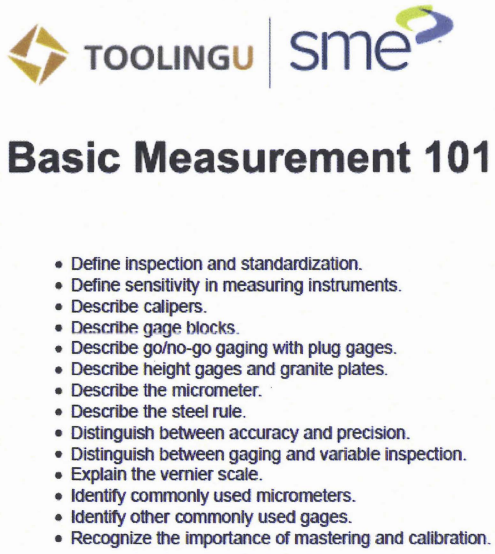


Figure 5. Class Objectives

4.5 Class Vocabulary

The class vocabulary is listed in alphabetical order by term with definitions relative to the course. Throughout the course these terms are highlighted and contain mouseovers allowing the student to simply move the mouse over the word to display the definition.

Basic Measurement 101

Term	*Definition*
Accuracy	The difference between a measurement reading and the true value of that measurement. The less error present in the measurement, the more accurate the results.
Alloy Steel	Steel that contains added materials that change the property of the metal. Common alloy elements include chromium, manganese, molybdenum, and nickel.
Blade Micrometer	A type of micrometer with flattened tips on the anvil and spindle. The blade micrometer is primarily used to measure the diameter of narrow grooves and slots.
Calibration	The comparison and adjustment of a device with unknown accuracy to a device with a known, accurate standard. Calibration eliminates any variation in the device being checked.
Calipers	A measuring instrument with a pair of jaws on one end and a long beam containing a marked scale of unit divisions. The jaws can measure both internal and external features.
Carbide	A compound developed by the combination of carbon, usually with chromium, tungsten, or titanium. Carbide materials are very hard and wear resistant.
Depth Micrometer	A type of micrometer with a spindle perpendicular to a flat base. The depth micrometer is primarily used to measure the depth of holes.
English System	A system of measurements based on the inch, pound, and degrees Fahrenheit primarily used in the United States and England. It is also known in the United States as the U.S. Customary System.
Gage Block	A hardened steel block manufactured with highly accurate dimensions that is used to measure part dimensions after a part is made. Gage blocks are available in a set of standardized lengths.
Gaging	The physical inspection of part features using a device with an established standard size. Gaging results in a pass/fail decision.
Go/no-go Gaging	The use of a gage to determine whether a part feature simply passes or fails inspection. No effort is made to determine the exact degree of error.
Granite	A dense, hard type of rock that exhibits excellent wear resistance, stability, and flatness. Granite tables and surface plates are used for various measuring applications such as inspection surfaces and for mounting devices.
Groove Micrometer	A type of micrometer with a long stem and two small discs at the end. The groove micrometer is primarily used to measure the width and position of internal grooves.
Height Gage	A measuring device with a column mounted on a base such as a granite surface plate, a unit that slides up and down, an indicator, and an arm that extends out. Height gages are used to measure vertical and other distances.
Inspection	The examination of a part during or after its creation to confirm that it adheres to specifications. During inspection, defects may be identified and corrected.
Lapped	Polished with an abrasive paste to remove the last bit of unwanted material. Gage blocks are lapped by hand or machine.
Machinist's Rule	A simple measuring instrument consisting of a long, thin metal strip with a marked scale of unit divisions used by a skilled machine operator. The steel rule comes in many sizes and forms and can be rigid or flexible.

Figure 6. Class Vocabulary

4.6 Exam

There is an optional pretest that can be used as a metric to show a measurable increase in student knowledge. A final exam is required after the completion of a course to receive a certificate of completion. After the completion of a test, results are instantly presented to the student. Results can be investigated by clicking on the "recap" link to see individual questions.

Review Your Test Results

Back to Previous Page

Below are your complete test results. You can compare your choices to the correct answers and view links back to the class by clicking the **Recap** link. The first grid shows the tests for the class you selected in your schedule, and the second grid lists all the tests you have taken.

Test Results for: Basics of Tolerance 121

1

Page size: 20 select

1 items in 1 pages

Test Type	Correct	Incorrect	Score	Date Taken	Recap
Final Exam	10	0	100.00 %	10/15/2015 11:58:14 PM	Recap
Pretest Total:	0	0	0.00 % [?]		
Final Exam Total:	10	0	100.00 % [?]		

1

Page size: 20 select

1 items in 1 pages

Complete Test List

1

Page size: 20 select

13 items in 1 pages

Class Name	Test Type	Correct	Incorrect	Score	Date Taken	Recap

Figure 7. Test Results

TOOLINGU | sme

Test Recap

Back to Previous Page

Review Your Test Results

You can compare your answers to the correct ones below. If you do not see the correct answer your company might have disabled this feature. By clicking **Link to Lesson**, you'll be able to view the matching lesson that addresses the question.

Class Name	Test Type	Your Score	Date Taken
Basic Measurement 101	Final Exam	**92.86 %** - *(13/14)*	10/14/2015 12:36:54 AM

Your Responses

	Question	Your Answer	Correct Answer	Result	Lesson Link
1.	Which quality describes how close a measurement is to its actual value?	Accuracy	Accuracy	✓	Lesson
2.	Which measuring device consists of a metal strip with measurement graduations along its edges and a pair of jaws at one end?	Calipers	Calipers	✓	Lesson
3.	Which of the following is true about gaging? Gaging:	Determines if a measurement is either acceptable or unacceptable.	Determines if a measurement is either acceptable or unacceptable.	✓	Lesson
4.	Which of the following is true about gage blocks? Gage blocks:	Can be combined to produce almost any standard length.	Can be combined to produce almost any standard length.	✓	Lesson
5.	A digital micrometer or manual vernier micrometer is how many times more sensitive than a standard manual micrometer?	Ten times	Ten times	✓	Lesson
6.	Which best describes the role of standardization? Standardization:	Is intended to ensure that required parts accurately fit together.	Is intended to ensure that required parts accurately fit together.	✓	Lesson
7.	What is the purpose of a vernier scale?	The presence of a vernier scale increases the precision of measurements.	The presence of a vernier scale increases the precision of measurements.	✓	Lesson
8.	What type of micrometer is used to measure narrow grooves and slots?	Groove micrometer	Blade micrometer	✗	Lesson
9.	Which of the following devices should be used to check the smaller diameter of the parts in the photo? Image	Thread gage	Thread gage	✓	Lesson

Figure 8. Test Recap

4.7 Feedback

There is an optional rate this class feedback that is also available.

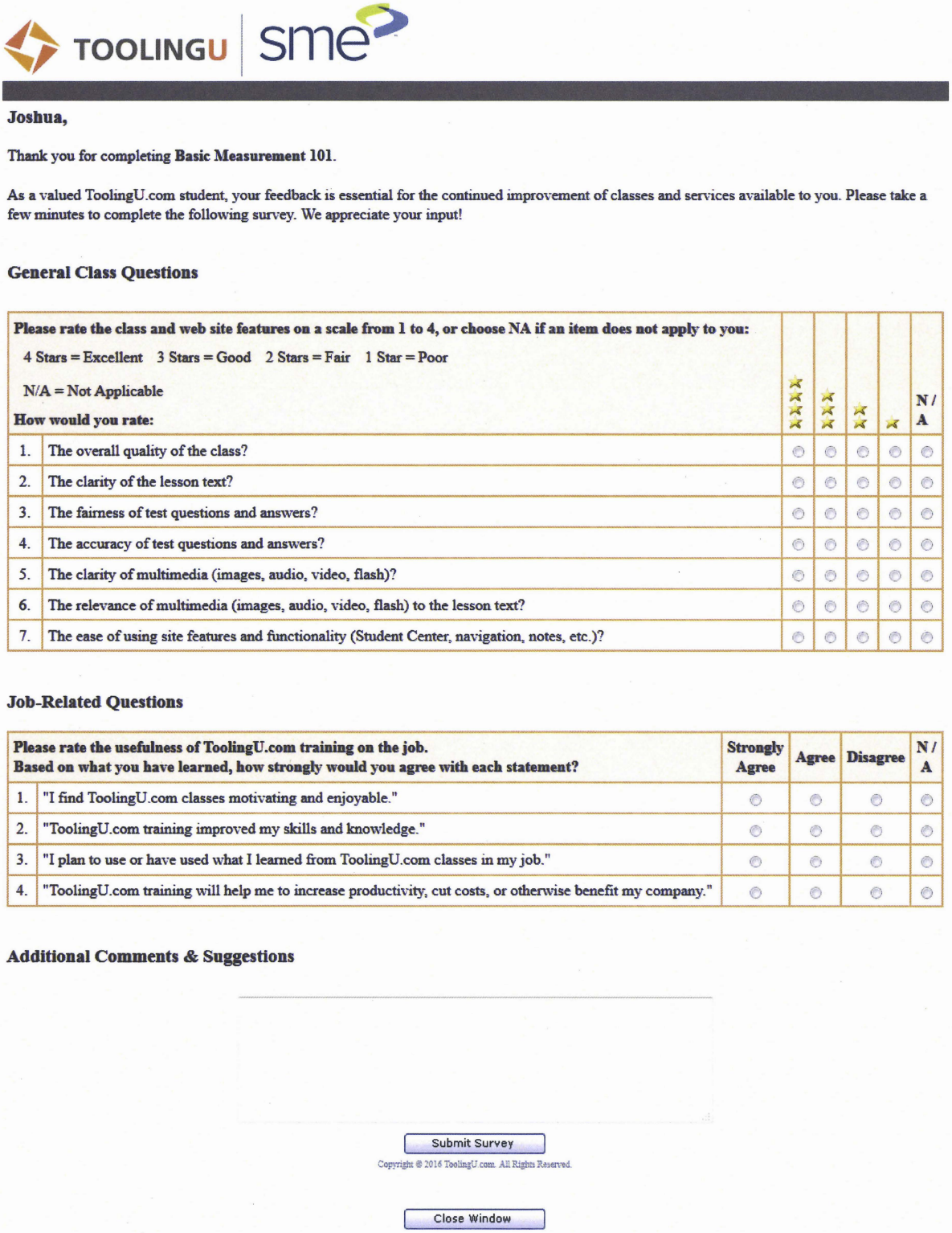


Figure 9. Feedback

4.8 Certificates

Certificates of completion come in six different styles and are user selectable.

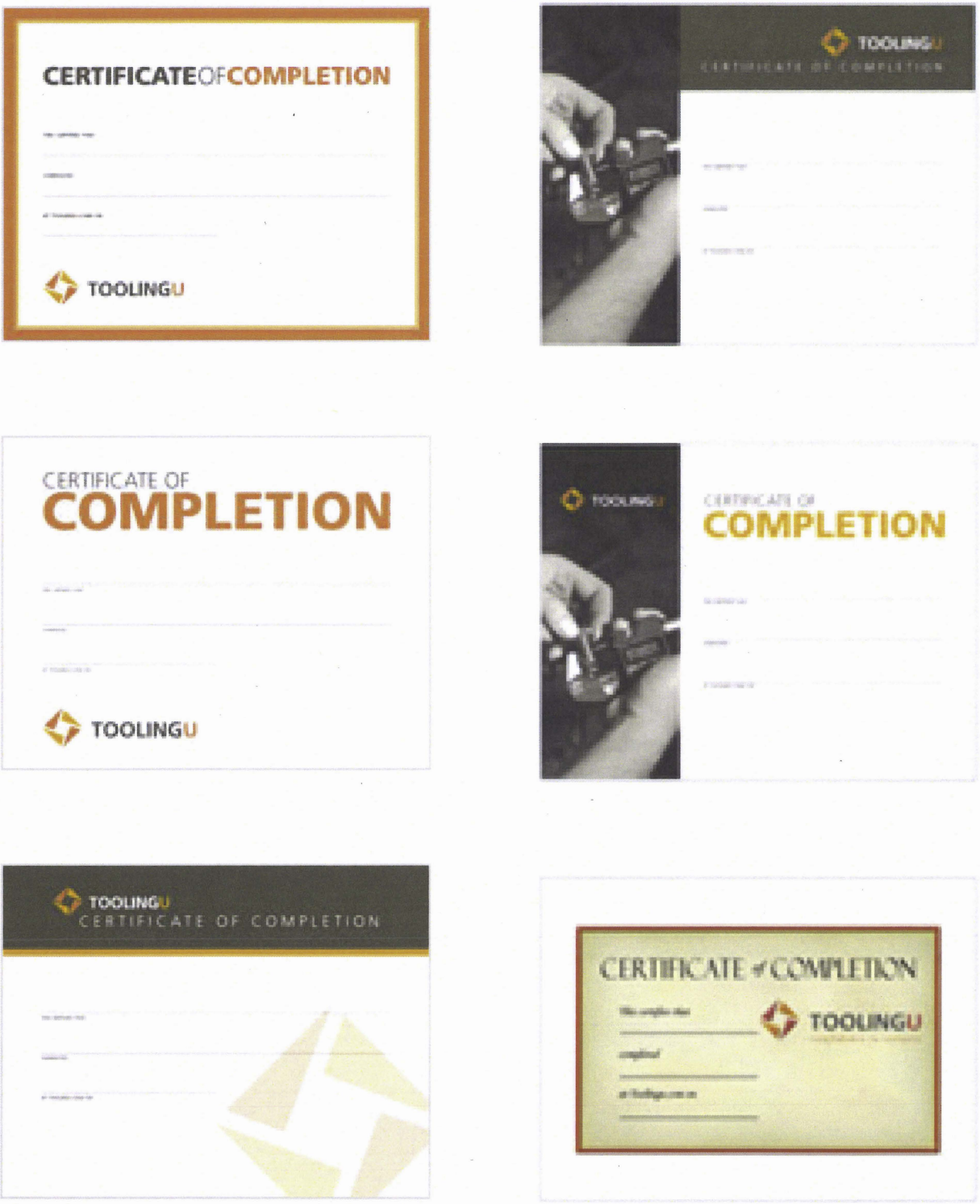


Figure 10. Certificates

5.0 Administrative Functions

ToolingU administrators access the system in same way as users but select "Administrator" at the login page.

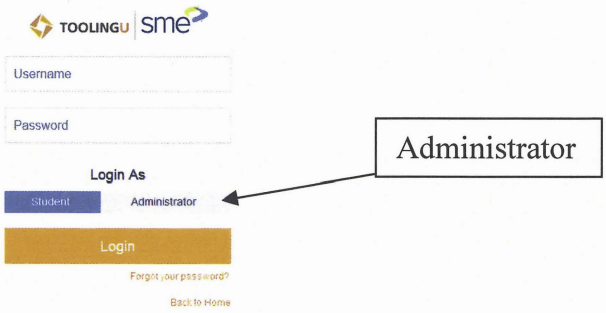


Figure 11. Administrator Login

5.1 Student List

After login the administrator is presented the administration center and a student list. Very much like the student center, there are many options available.

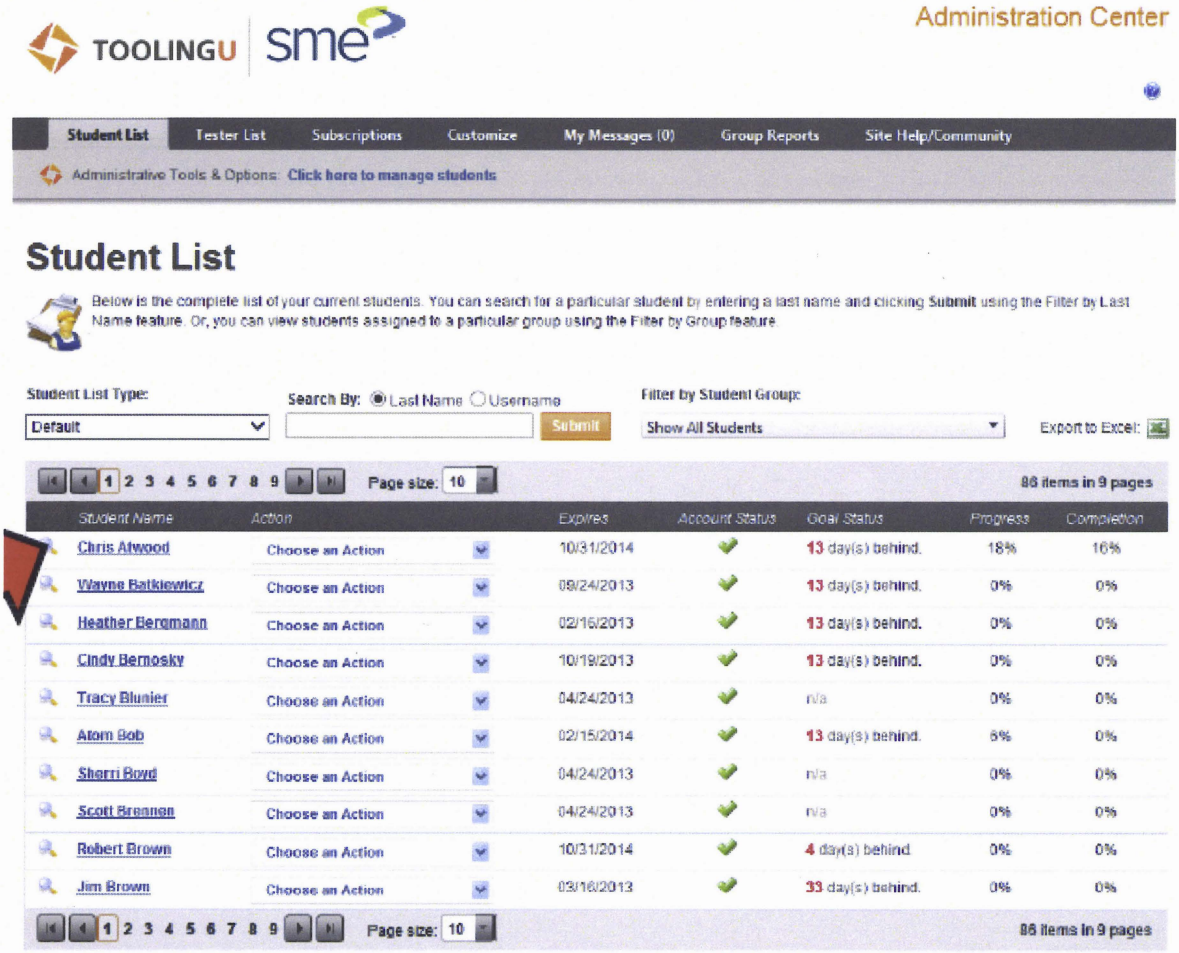


Figure 12. Student List

5.2 Individual Student Reports

Reports are available by individual with test score performance available.

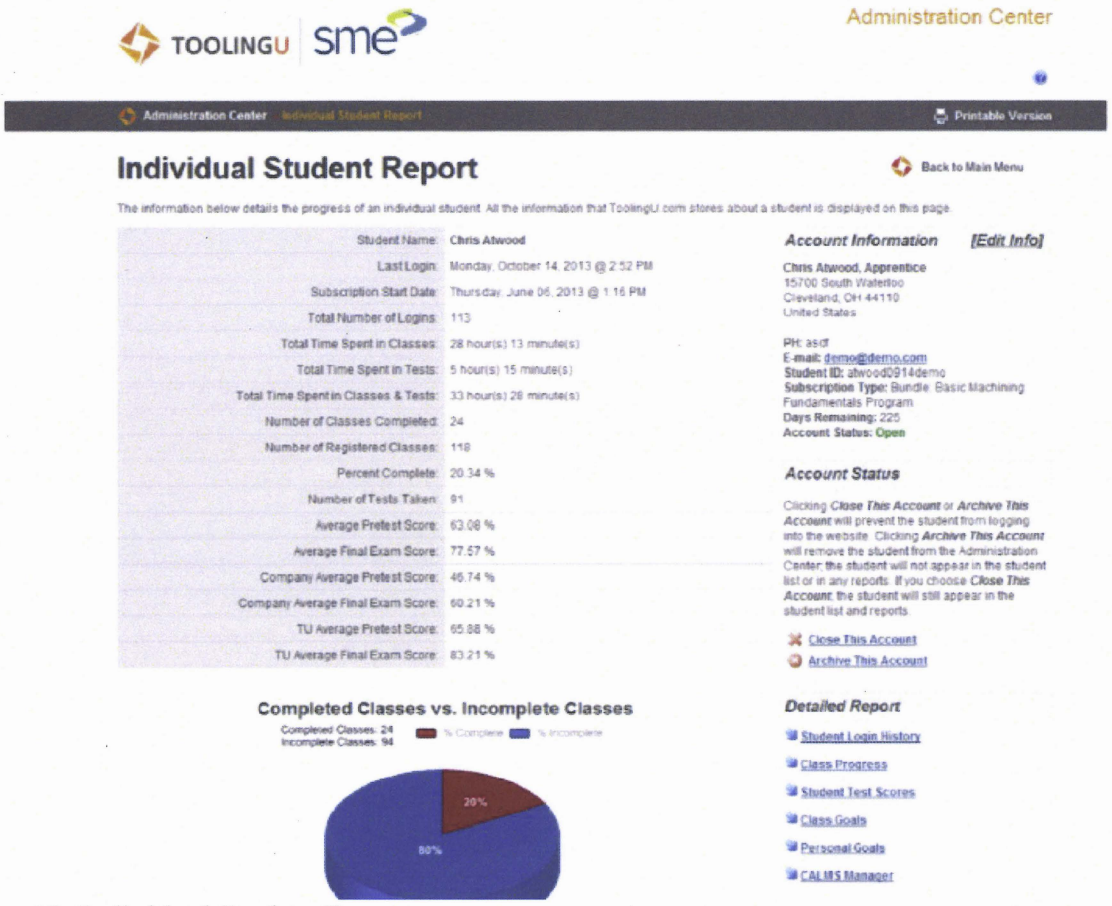
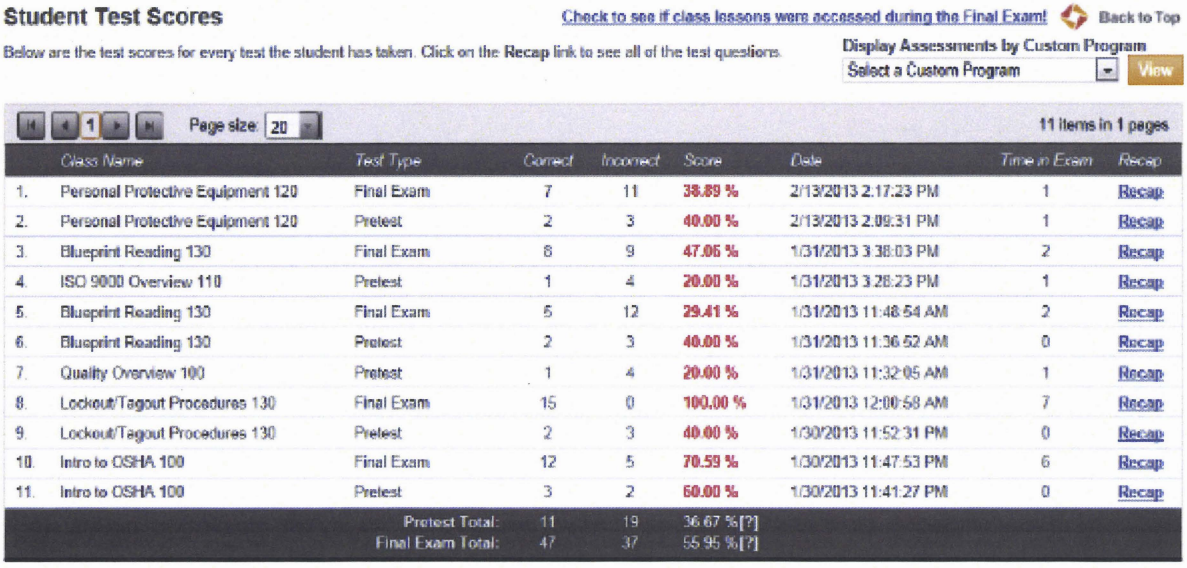


Figure 13. Individual Student Reports

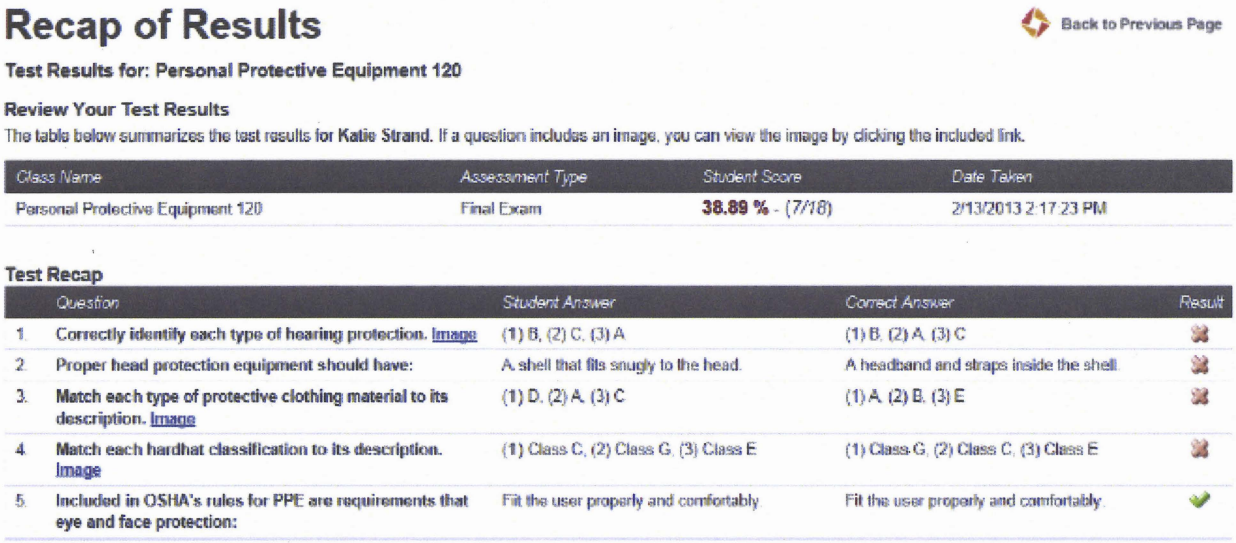


	Class Name	Test Type	Correct	Incorrect	Score	Date	Time in Exam	Recap
1.	Personal Protective Equipment 120	Final Exam	7	11	38.89 %	2/13/2013 2:17:23 PM	1	Recap
2.	Personal Protective Equipment 120	Pretest	2	3	40.00 %	2/13/2013 2:09:31 PM	1	Recap
3.	Blueprint Reading 130	Final Exam	8	9	47.06 %	1/31/2013 3:38:03 PM	2	Recap
4.	ISO 9000 Overview 110	Pretest	1	4	20.00 %	1/31/2013 3:28:23 PM	1	Recap
5.	Blueprint Reading 130	Final Exam	5	12	29.41 %	1/31/2013 11:48:54 AM	2	Recap
6.	Blueprint Reading 130	Pretest	2	3	40.00 %	1/31/2013 11:36:52 AM	0	Recap
7.	Quality Overview 100	Pretest	1	4	20.00 %	1/31/2013 11:32:05 AM	1	Recap
8.	Lockout/Tagout Procedures 130	Final Exam	15	0	100.00 %	1/31/2013 12:00:58 AM	7	Recap
9.	Lockout/Tagout Procedures 130	Pretest	2	3	40.00 %	1/30/2013 11:52:31 PM	0	Recap
10.	Intro to OSHA 100	Final Exam	12	5	70.59 %	1/30/2013 11:47:53 PM	6	Recap
11.	Intro to OSHA 100	Pretest	3	2	60.00 %	1/30/2013 11:41:27 PM	0	Recap
		Pretest Total:	11	19	36.67 %[?]			
		Final Exam Total:	47	37	55.95 %[?]			

Figure 14. Student Test Scores

5.3 Recap of Results

Individual tests can be researched if desired.



Recap of Results

Back to Previous Page

Test Results for: Personal Protective Equipment 120

Review Your Test Results

The table below summarizes the test results for **Katie Strand**. If a question includes an image, you can view the image by clicking the included link.

Class Name	Assessment Type	Student Score	Date Taken
Personal Protective Equipment 120	Final Exam	**38.89 %** - (7/18)	2/13/2013 2:17:23 PM

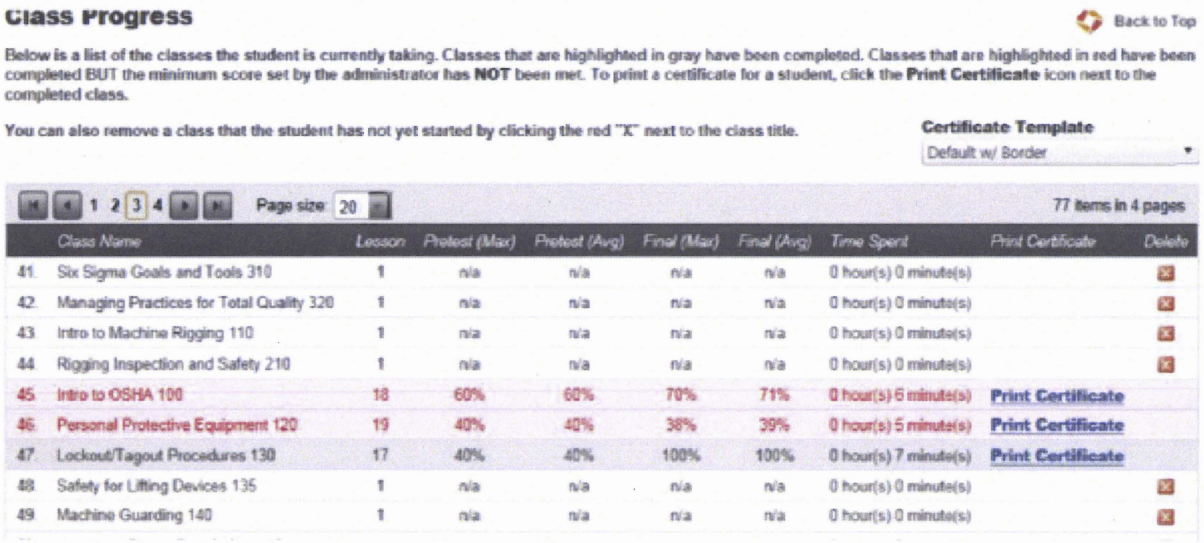
Test Recap

	Question	Student Answer	Correct Answer	Result
1.	**Correctly identify each type of hearing protection.** Image	(1) B, (2) C, (3) A	(1) B, (2) A, (3) C	✗
2.	**Proper head protection equipment should have:**	A shell that fits snugly to the head.	A headband and straps inside the shell.	✗
3.	**Match each type of protective clothing material to its description.** Image	(1) D, (2) A, (3) C	(1) A, (2) B, (3) E	✗
4.	**Match each hardhat classification to its description.** Image	(1) Class C, (2) Class G, (3) Class E	(1) Class G, (2) Class C, (3) Class E	✗
5.	**Included in OSHA's rules for PPE are requirements that eye and face protection:**	Fit the user properly and comfortably.	Fit the user properly and comfortably.	✓

Figure 15. Recap of Results

5.5 Class Progress

Class progress reports are available.



Class Progress

Back to Top

Below is a list of the classes the student is currently taking. Classes that are highlighted in gray have been completed. Classes that are highlighted in red have been completed BUT the minimum score set by the administrator has NOT been met. To print a certificate for a student, click the Print Certificate icon next to the completed class.

You can also remove a class that the student has not yet started by clicking the red "X" next to the class title.

Certificate Template

Default w/ Border

1 2 3 4 Page size: 20 — 77 items in 4 pages

	Class Name	Lesson	Pretest (Max)	Pretest (Avg)	Final (Max)	Final (Avg)	Time Spent	Print Certificate	Delete
41.	Six Sigma Goals and Tools 310	1	n/a	n/a	n/a	n/a	0 hour(s) 0 minute(s)		✗
42.	Managing Practices for Total Quality 320	1	n/a	n/a	n/a	n/a	0 hour(s) 0 minute(s)		✗
43.	Intro to Machine Rigging 110	1	n/a	n/a	n/a	n/a	0 hour(s) 0 minute(s)		✗
44.	Rigging Inspection and Safety 210	1	n/a	n/a	n/a	n/a	0 hour(s) 0 minute(s)		✗
45.	Intro to OSHA 100	18	60%	60%	70%	71%	0 hour(s) 6 minute(s)	Print Certificate	
46.	Personal Protective Equipment 120	19	40%	40%	38%	39%	0 hour(s) 5 minute(s)	Print Certificate	
47.	Lockout/Tagout Procedures 130	17	40%	40%	100%	100%	0 hour(s) 7 minute(s)	Print Certificate	
48.	Safety for Lifting Devices 135	1	n/a	n/a	n/a	n/a	0 hour(s) 0 minute(s)		✗
49.	Machine Guarding 140	1	n/a	n/a	n/a	n/a	0 hour(s) 0 minute(s)		✗

Figure 16. Class Progress

5.6 Other Reports

Group reports, total time spent in class, and comprehensive reports are also available.

6.0 Conclusions

ToolingU provided the author with a free trail account to evaluate the system. All the courses in the Inspection, Quality and Math departments were completed as representative sample. Courses typically have 10-20 pages and take about 45 minutes to one hour to complete. There are lots of pictures, examples, interactive assignments, and all the text comes with audio. Another feature most students will appreciate is how the ToolingU system will automatically send a confirmation email once a course is completed.

The cost of ToolingU is on the order of $1000 per student per year. Given the price of travel ToolingU could prove to be an extremely economical training solution. Additional cost savings might be possible if LANL were to pursue a site license. A training map for the Inspection Team is provided below, but a simple review of departments and classes provided indicates that many training maps could easily be implemented at the Laboratory. Some examples might include: LANL's maintenance team, Detonator Production, Manufacturing Quality, Material Science, Environmental Health and Safety, First Line Managers, etc.

Table 3. LANL Inspection Training Map

	Job Category				
Course	**QA/QC Inspector 1 & Inspector 2**	**QA/QC Inspector 3**	**QA/QC Inspector 4**	**QA/QC Inspector 5**	**Eng. Tech & Staff**
Math Basic	x	x	x	x	x
Inspection Basic	x	x	x	x	x
Math Intermediate		x	x	x	x
Inspection Intermediate		x	x	x	x
Math Advanced			x	x	x
Inspection Advanced			x	x	x
Quality Basic			x	x	x
Quality Intermediate				x	x
Quality Advanced					x

7.0 References

[1] Montano, Martinez, *"Metrology Training (U)"*, LA-UR-15-20015, LANL, 2013

[2] ToolingU, *"www.toolingu.com"*, ToolingU-SME

[3] Hidalgo, *"Machinist Apprentice Program"*, Los Alamos National Laboratory

8.0 Appendix: Class Catalog [2]

Abrasives

Intro to Abrasives 100
This class defines abrasive processes and explains the major groups of abrasive tools.

What Is Grinding? 110
This class describes the grinding action, explains how chips are formed, and covers wheel maintenance and safety.

Grinding Processes 120
This class identifies the major types of grinding operations and explains how they are performed on the machine. Includes an Interactive Lab.

Grinding Variables 200
This class identifies the most common variables that occur during grinding, with an emphasis on speeds and feeds. Includes an Interactive Lab.

Grinding Wheel Materials 210
This class describes common abrasive and bond materials for grinding wheels, as well as their applications.

Grinding Wheel Geometry 220
This class describes the major types of grinding wheels listed in the ANSI standard and explains the relationship between wheel geometry and workpiece shape.

Dressing and Truing 230
This class describes the common methods used to balance, true, and dress a standard grinding wheel.

Surface Grinder Operation 240
This class discusses the steps involved in grinding horizontal and vertical surfaces with a horizontal-spindle, reciprocating-table grinding machine.

Cylindrical Grinder Operation 250
This class identifies the main components of common cylindrical grinders and describes the various types of operations that can be performed.

Centerless Grinder Operation 260
This class addresses how to perform common grinding operations on the centerless grinder, as well as methods for mounting and truing the grinding and regulating wheels.

Setup for Centerless Grinders 320
This class explains how to set up the main components of a centerless grinder, as well as how to accurately position the workpiece on the work rest blade for various centerless grinding operations.

Additive Manufacturing

Intro to Additive Manufacturing 110
This class introduces the basic concepts of additive manufacturing (AM), and discusses the history and development of AM, as well as the future. In addition, the basic process of AM is outlined and the technologies and classfications of AM are explored.

Additive Manufacturing Safety 120
Additive Manufacturing Safety describes how users can protect themselves against common mechanical, electrical, thermal, and airborne hazards associated with AM processes. This class also provides an overview of personal protective equipment (PPE), lockout/tagout procedures, Hazard Communication Standards (HCS), and Safety Data Sheets (SDS).

The Basic Additive Manufacturing Process 130
This class provides an overview of the build process used in additive manufacturing. Upon completing "The Basic AM Process," users should know the eight basic steps involved in creating an AM product.

Additive Manufacturing Methods and Materials 140
Additive Manufacturing Methods and Materials provides users with an overview of the different processes used in additive manufacturing. This class also details the materials used in each process and any additional considerations specific to those materials.

Adhesives

Intro to Adhesive Bonding 110
This class describes adhesive bonding, adhesive classification, and the various factors that lead to a successful adhesive bond.

Basics of the Bonding Process 120
This class describes the basics of the adhesive bonding process, as well as the various solidification methods of adhesives.

Intro to Adhesive Properties 130
This class describes the mechanical and nonmechanical properties of adhesives and addresses how they impact adhesive bonding.

Types of Adhesives 140
This class describes the characteristics, pros and cons, and applications of types of synthetic adhesives.

Surface Preparation 210
This class discusses surface factors that affect adhesion, the nature of the different types of surfaces used in adhesive bonding, and the methods of selecting and preparing a surface for adhesive bonding.

Steps for Adhesive Application 220
This class discusses each step involved in the adhesive application process, as well as basic dispensing methods and methods of testing the effectiveness of the application process on the assembly line.

CNC

History and Definition of CNC 100
This class outlines the origin of today's CNC machines and explains how modern CNC evolved from its original designs.

Mechanics of CNC 110
This class describes the mechanical systems involved in CNC axis movement, as well as how feedback is used for tool location.

Basics of the CNC Turning Center 120
This class describes the basic components of the turning center as well as the devices used on this machine. Includes an Interactive Lab.

Basics of the CNC Machining Center 130
This class describes the basic components of the machining center as well as the devices used on this machine. Includes an Interactive Lab.

Basics of the CNC Swiss-Type Lathe 135
This class describes the basic components of the Swiss-type lathe, as well as common tooling and machining operations.

CNC Coordinates 140
This class explains the arrangement and orientation of the basic axes on a common CNC lathe and both a vertical and horizontal CNC mill. Includes an Interactive Lab.

Part Program 150
This class introduces the major code groups used in a CNC part program. Includes an Interactive Lab.

CAD/CAM Overview 160
This class describes the general process of using computers to design and manufacture parts and identifies common features available in CAD/CAM software.

CNC Manual Operations 200
This class describes the control features that allow a CNC operator to execute tasks manually. Includes an Interactive Lab.

Introduction to CNC Machines 201
"Intro to CNC Machines" provides a comprehensive introduction to computer numerical control (CNC), which uses numerical data to control a machine. CNC machines rely on a system of three linear and three rotational axes in order to calculate the motion and position of machine components and workpieces. A machine control unit controls and guides the movements of the machine tool. This class also describes PTP positioning, which moves to the end position before the tool begins to cut, and continuous path systems that can move a tool along two or more axes at once and cut during the movement. Additionally, closed-loop systems provide feedback, while open-loop systems do not.
CNC machines are used to make a variety of products using a number of different processes. With proper training, a human operator can use CNC machines to make accurate parts with decreased risk of error. After taking this class users should be able to describe common components of CNC machine tools and controls.

CNC Offsets 210
This class identifies the various offsets used on both the lathe and the mill to properly reference each cutting tool in relationship to the workpiece. Includes an Interactive Lab.

Basics of the CNC Lathe 211
"Basics of the CNC Lathe" explains the components and functions of both the chucker and bar machine CNC lathe varieties. CNC lathes have spindles that spin workpieces held in chucks or collets. A carriage and cross slide move along ways to position cutting tools against the spinning part. A cutting tool may remove metal from the inside or outside surface. Carbide inserts are the most common cutting tools used in turning operations. Turning centers are also capable of creating holes with the use of drills and reamers. The turret rotates to place the required tool in the cutting position.
It is essential for a CNC lathe operator to be familiar with machine basics prior to executing any cutting operation. A trained operator can use a CNC lathe to create precise parts safely and consistently. After taking this class, users should be able to describe the basic functions and general machine components of a CNC lathe.

Basics of the CNC Mill 212
"Basics of the CNC Mill" explains the components and function of CNC mills. A CNC mill produces flat or curved surfaces on square or rectangular workpieces. CNC mills may have a vertical spindle or a horizontal spindle and either their table or cutting tool may move to execute a cutting operation. CNC mills use a variety of tools, which are kept in the toolchanger on a toolholder, to perform different cutting operations. The spindle grabs the toolholder and secures it. On the worktable, vises or fixtures may secure workpieces during machining. The CNC mill can perform multiple operations in the same setup.
It is essential for a CNC mill operator to be familiar with machine basics prior to executing any cutting operation. A trained operator can use a CNC mill to create precise parts safely and

consistently. After taking this class, users should be able to describe the general machine components of a CNC mill and their basic function.

CNC Specs for the Mill 220
This class identifies common specifications of CNC mills and describes the various features and options available on different machines.

CNC Specs for the Lathe 225
This class identifies common specifications of CNC lathes and describes the various features and options available on different machines.

Basics of G Code Programming 231
"Basics of G Code Programming" provides a comprehensive introduction to G code programming. Programmers use G codes to create part programs, which direct CNC machines to create a part. Part programs consist of blocks, which contain words that are a combination of a letter address and a numerical value. N codes name or title a program block. G codes describe the operation that the machine will perform. X, Y, and Z codes determine the cutting operation location. F and S codes set the feed and speed, T codes signal the correct cutting tool, and M codes complete other miscellaneous functions.
Programmers often rely on computer-assisted programming software to efficiently create part programs. However, to create or edit a part program for a CNC machine, a programmer must understand the different codes in G code programming and what they do. After taking this class, users should be able to describe how G code programming is used to create a part program.

Control Panel Functions for the CNC Mill 252
"Control Panel Functions for the CNC Mill" explains how operators use the machine and control panel functions to operate a CNC mill. Operators use the handle and jog mode to move mill axes incrementally or steadily. MDI mode executes isolated lines of programming and memory mode selects and edits existing programs. Before running a program, an operator may choose to execute the program in single block mode to prove it out or select the optional stop or block delete functions. The cycle start button starts the program. Once a program is running, the operator can use the machine control unit to adjust speed and feed with an override.
To use a CNC mill, an operator needs to know how to perform important operations using machine panel functions to move machine components and control panel functions to execute programming codes. After taking this class, users should be able to explain the purpose of frequently used controls on the control panel of a CNC mill.

Creating a Turning Program 280
This class explains the key components in the creation and execution of a simple turning program. Includes an Interactive Lab.

Turning Calculations 285
This class explains the common calculations necessary to plot the toolpaths for a basic turning program.

Creating a Milling Program 290
This class explains the key components in the creation and execution of a simple milling program. Includes an Interactive Lab.

Milling Calculations 295
This class explains the common calculations necessary to plot the toolpaths for a basic milling program.

Canned Cycles 310
This class describes the operation of common canned cycles that appear on machining and turning centers. Includes an Interactive Lab.

CNC: Fanuc Controls

Fanuc Mill: Control Panel Overview 250
This class describes the various sections of the Fanuc 0-C mill control panel as well as the steps for powering up, powering down, and homing the machine. Includes Fanuc CNC Simulators.

Fanuc Lathe: Control Panel Overview 255
This class describes the various sections of the Fanuc 0-C lathe control panel as well as the steps for powering up, powering down, and homing the machine. Includes Fanuc CNC Simulators.

Fanuc Mill: Entering Offsets 260
This class provides step-by-step instructions for adjusting offsets on the Fanuc 0-C mill control during a production run. Includes Fanuc CNC Simulators.

Fanuc Lathe: Entering Offsets 265
This class provides step-by-step instructions for adjusting offsets on the Fanuc 0-C lathe control during a production run. Includes Fanuc CNC Simulators.

Fanuc Mill: Locating Program Zero 270
This class describes how to determine work offsets and tool geometry offsets on the Fanuc 0-C mill control during setup. Includes Fanuc CNC Simulators.

Fanuc Lathe: Locating Program Zero 275
This class describes how to determine work offsets and tool geometry offsets on the Fanuc 0-C lathe control during setup. Includes Fanuc CNC Simulators.

Fanuc Mill: Program Execution 280
This class describes the steps necessary to activate, execute, and restart programs using the Fanuc O-C control for the mill. Includes Fanuc CNC Simulators.

Fanuc Lathe: Program Execution 285
This class describes the steps necessary to activate, execute, and restart programs using the Fanuc O-C control for the lathe. Includes Fanuc CNC Simulators.

Fanuc Mill: Program Storage 310
This class describes common methods for transferring and storing part programs on the Fanuc 0-C control for the mill. Includes Fanuc CNC Simulators.

Fanuc Lathe: Program Storage 315
This class describes common methods for transferring and storing part programs on the Fanuc 0-C lathe control. Includes Fanuc CNC Simulators.

Fanuc Mill: First Part Runs 320
This class describes how to verify the accuracy of a program and make minor editing changes on the Fanuc 0-C mill control. Includes Fanuc CNC Simulators.

Fanuc Lathe: First Part Runs 325
This class describes how to verify the accuracy of a program and make minor editing changes on the Fanuc 0-C lathe control. Includes Fanuc CNC Simulators.

CNC: Haas Controls

Haas Mill: Control Panel Overview 250
This class describes the various sections of the Haas mill control panel as well as the steps for powering up, powering down, and homing the machine. Includes Haas CNC Simulators.

Haas Lathe: Control Panel Overview 255
This class describes the various sections of the Haas lathe control panel as well as the steps for powering up, powering down, and homing the machine. Includes Haas CNC Simulators.

Haas Mill: Entering Offsets 260
This class provides step-by-step instructions for adjusting offsets on the Haas mill during a production run. Includes Haas CNC Simulators.

Haas Lathe: Entering Offsets 265
This class provides step-by-step instructions for adjusting offsets on the Haas lathe during a production run. Includes Haas CNC Simulators.

Haas Mill: Locating Program Zero 270
This class describes how to determine work offsets and tool geometry offsets on the Haas mill during setup. Includes Haas CNC Simulators.

Haas Lathe: Locating Program Zero 275
This class describes how to determine work offsets and tool geometry offsets on the Haas lathe during setup. Includes Haas CNC Simulators.

Haas Mill: Program Execution 280
This class describes the steps necessary to activate, execute, and restart programs on the Haas mill. Includes Haas CNC Simulators.

Haas Lathe: Program Execution 285
This class describes the steps necessary to activate, execute, and restart programs on the Haas lathe. Includes Haas CNC Simulators.

Haas Mill: Program Storage 310
This class describes common methods for transferring and storing part programs on the Haas mill. Includes Haas CNC Simulators.

Haas Lathe: Program Storage 315
This class describes common methods for transferring and storing part programs on the Haas lathe. Includes Haas CNC Simulators.

Haas Mill: First Part Runs 320
This class describes how to verify the accuracy of a program and make minor editing changes on the Haas mill. Includes Haas CNC Simulators.

Haas Lathe: First Part Runs 325
This class describes how to verify the accuracy of a program and make minor editing changes on the Haas lathe. Includes Haas CNC Simulators.

CNC: Mazak Controls

Mazak Mill: Control Panel Overview 250
This class introduces the Mazak Mazatrol Matrix mill control panel and describes the steps for powering up and powering down the machine.

Mazak Lathe: Control Panel Overview 255
This class introduces the Mazak Mazatrol Matrix lathe control panel and describes the steps for powering up and powering down the machine.

Mazak Mill: Safety for the Mill 260
This class discusses common safety issues concerning the Mazak mill, as well as OSHA and ANSI requirements for Mazak mill operators.

Mazak Lathe: Safety for the Lathe 265
This class discusses common safety issues concerning the Mazak lathe, as well as OSHA and ANSI requirements for Mazak lathe operators.

Mazak Mill: Locating Program Zero 270
This class discusses the various coordinates systems involving machine components and the considerations for selecting workpiece zero.

Mazak Lathe: Locating Program Zero 275
This class discusses the various coordinate systems involving machine components and the considerations for selecting workpiece zero.

Mazak Mill: Entering Offsets 280
This class provides an overview of offsets and the step-by-step instructions needed for measuring, entering, and adjusting offsets using the Mazak Mazatrol Matrix Mill control.

Mazak Lathe: Entering Offsets 285
This class will teach you various offsets of the Matrix lathe, how to view offsets using the Matrix control, and how to adjust offsets to compensate for tool wear.

Creating an EIA/ISO Program for the Mazak Mill 286
This class explains the key components in the creation and execution of a simple milling program.

Creating an EIA/ISO Program for the Mazak Lathe 287
This class explains the key components in the creation and execution of a simple turning program.

Creating a Mazatrol Program for the Mill 288
This class covers the basics of creating a simple milling program on the Mazatrol Matrix Mill control. Topics include the basic units that comprise a Mazatrol program and the range of machining units available to make almost any milled part.

Creating a Mazatrol Program for the Lathe 289
This class covers the basics of creating a simple turning program on the Mazatrol Smart lathe control. Topics include the basic units that comprise a Mazatrol program and the range of turning units available to make almost any turned part.

Mazak Mill: Program Execution 290
This class addresses the steps needed to start, stop, and restart programs on the Mazak mill, along with the steps used to activate a program.

Mazak Lathe: Program Execution 295
This class addresses the steps needed to start, stop, and restart programs on the Mazak lathe, along with the steps used to activate a program.

Mazak Mill: Program Storage 310
This class describes common methods for transferring and storing part programs on the Mazak Mazatrol Matrix mill control.

Mazak Lathe: Program Storage 315
This class describes common methods for transferring and storing part programs on the Mazak Mazatrol Matrix lathe control.

Mazak Mill: First Part Runs 320
This class describes how to verify the accuracy of a program and make minor editing changes on the Mazak Mazatrol Matrix Mill control to ensure part quality.

Mazak Lathe: First Part Runs 325
This class describes how to verify the accuracy of a program and make minor editing changes on the Mazak Mazatrol Matrix Lathe control to ensure part quality.

Coatings

Intro to Coating Composition 110
This class discusses key components of a coating, as well as the environmental risks solvents pose and alternatives to using solvent as a carrier for coatings.

Surface Preparation for Coatings 120
This class covers various options for preparing surfaces before the application of a coating. The class also addresses the nature of common surfaces.

Processes for Applying Coatings 140
This class covers the processes used to apply coatings to a variety of surfaces. This class includes descriptions of manual coating, automated coating, electroplating, and powder coating.

Coating Defects 150
This class covers the common types of coating defects, as well as their related causes and prevention techniques.

Troubleshooting Coating Defects 170
This class covers the basics of troubleshooting coating processes. It includes descriptions of various tools used in the troubleshooting process, including Pareto charts, check sheets, and fishbone diagrams.

Composites

Intro to Composites 110
This class covers the basic materials used to make composites, how composites are processed, and the applications of composites in various markets.

Safety for Composite Processing 115
This class teaches operators how to protect themselves from illness and injury when working with composites. You will also learn how to store and discard hazardous materials. Finally, you will learn about the agencies that develop and regulate workplace safety standards.

Overview of Composite Processes 120
This class covers the basic methods for processing composites, as well as some of the materials used for these processes.

Traditional Composites 125
This class covers the materials commonly used to create resins and reinforcements for traditional composites. It also describes the basic characteristics of polymers.

Advanced Thermoset Resins for Composites 130
This class covers the thermoset resins commonly used to create advanced composite parts, as well as their properties and general considerations for material selection.

Advanced Materials for Composites 135
This class covers the thermoplastic and non-polymeric resins used to create advanced composite parts, as well as the materials used to create high-performance fiber reinforcements.

Intro to Lay-up and Spray-up Molding 140
This class covers lay-up and spray-up molding of traditional fiberglass composites.

Intro to Compression Molding 170
This class will teach you about the compression molding process, as well as the materials and equipment associated with it.

Surface Finishing Composites 190
Understanding how to finish the surface of a composite part helps an operator create parts that meet the demands of the customer. This class will teach you about surface finishing operations for composite parts.

Vacuum Bagging Technique: Single-sided Bagging 230
This class covers basic procedures for performing single-sided vacuum bagging. It also covers general safety precautions and strategies for preventing common problems.

Composite Inspection and Defect Prevention 240
This class describes common methods for inspecting composites and preventing defects.

Repair Methods for Composites 250
This class covers basic procedures and best practices for repairing composites, as well as the structure of composite laminates and sandwich panels.

Electrical Systems

Electrical Units 101
"Electrical Units" provides a foundational overview of electricity, including fundamental measures and terminology used to discuss electricity. Electricity is the flow of electrons, which are negatively charged particles. The amount of valence electrons in an atom determines how well it allows electricity to flow. There are two types of electricity, alternating current and direct current, but both flow from negative to positive. Current is measured by certain terms, including amperage, voltage, resistance, and wattage. Ohm's Law and Watt's Law describe the relationships between these values in a circuit.
When working with electrical systems, knowing how electricity flows and what different terms mean is very important. After taking this class, users should be familiar with the fundamentals of electricity and the vocabulary used to describe it. This enables users to build an understanding of more advanced electrical concepts and discuss them with the correct terminology.

Electrical Units 110
This class describes how electricity flows and explains the basic units used to measure electricity.

Safety for Electric Work 115
This class describes the safety risks associated with electricity. It also discusses the necessary precautions for working with electricity safely. Includes an Interactive Lab.

Intro to Circuits 120
This class describes the basic components of an electrical circuit and explains how they are represented in schematic drawings. Includes an Interactive Lab.

Intro to Magnetism 130
This class covers the fundamental principles of magnetism and explains its relationship to electricity.

DC Circuit Components 140
This class explains the function and purpose of the various components used in DC circuits.

NEC Overview 150
This class introduces the NEC codebook and explains how it is used by electrical workers. Includes an Interactive Lab.

Series Circuit Calculations 200
This class covers the formulas and rules for calculating the values of voltage, current, resistance, and power in direct-current series circuits.

Parallel Circuit Calculations 205
This class introduces the rules and formulas for parallel circuit calculations.

AC Fundamentals 210
This class introduces the concept of alternating current (AC) and describes the variables that measure AC power.

Electrical Instruments 220
An overview of the various meters used in electrical maintenance. Basic principles, proper usage, and safety procedures are discussed.

Electrical Print Reading 225
This class explains the basic principles of reading electrical prints with an emphasis on schematic symbols. Includes an Interactive Lab.

DC Power Sources 230
This course introduces the various means by which DC power is created and used. It also discusses DC power generation and the limits of its applications. Includes an Interactive Lab.

AC Power Sources 235
This course introduces the various means by which AC power is produced and used. It also covers AC's advantages over DC and power transformation. Includes an Interactive Lab.

Conductor Selection 240
This course describes different conductor and insulation types and explains proper wire sizing according to NEC standards and calculations. Includes an Interactive Lab.

Battery Selection 250
This class discusses the factors on which batteries are rated and describes many of the most common battery types. Includes an Interactive Lab.

Fasteners

Intro to Assembly 100
This class describes the common assembly methods of mechanical fastening, adhesive bonding, and welding.

Safety for Assembly 105
This class introduces general safety guidelines for assembly. Includes an Interactive Lab.

Intro to Fastener Threads 110
This class describes fastener threads and their characteristics, as well as explains different thread standards and classifications. Includes an Interactive Lab.

Overview of Threaded Fasteners 117
This class summarizes the various types of threaded fasteners used in assemblies and describes their common applications.

Tools for Threaded Fasteners 120
This class outlines the different types of tools for assembly commonly used with threaded fasteners.

Overview of Non-Threaded Fasteners 125
This class summarizes the various types of non-threaded fasteners used in assemblies and describes their common applications.

Intro to Fastener Ergonomics 130
This class introduces ergonomics and discusses the ergonomic concerns associated with assembly.

Properties for Fasteners 200
This class describes the key properties of steel fasteners as well as common fastener failures that may occur.

Understanding Torque 210
This class explains the importance of torque as well as how torque is derived and applied to bolted joints. Includes an Interactive Lab.

Threaded Fastener Selection 215
This class describes how to select a threaded fastener as well as how to install a bolt and nut combination into a joint.

Hydraulics and Pneumatics

Intro to Fluid Systems 100
This class provides an introduction to fluid power systems, including hydraulic and pneumatic components.

Safety for Hydraulics and Pneumatics 105
This class addresses safe work practices for hydraulics and pneumatics and includes information on preventive measures for safety hazards in the manufacturing workplace.Includes an Interactive Lab.

The Forces of Fluid Power 110
This class provides an introduction to the forces of fluid power, including force multiplication, work, energy, and power.

Intro to Hydraulic Components 120
This class presents an overview of basic hydraulic system components. Includes an Interactive Lab.

Intro to Pneumatic Components 125
This class presents an overview of basic pneumatic system components.

Intro to Fluid Conductors 130
This class provides an overview of fluid power conductors, including pipe, tubing, hose, and manifolds.

Fittings for Fluid Systems 135
This class provides an overview of fittings for fluid power systems, including pipe fittings, tube fittings, hose fittings, and the seals that make them work.

Preventive Maintenance for Fluid Systems 140
This class provides an introduction to preventive maintenance for hydraulic and pneumatic fluid systems.

Hydraulic Power Variables 200
This class discusses the variables involved in hydraulic power transmission and how they describe the capabilities of a hydraulic system. Includes an Interactive Lab.

Pneumatic Power Variables 205
This class discusses the variables involved in pneumatic power transmission and how they describe the capabilities of a pneumatic system.

Hydraulic Power Sources 210
This class discusses the various types of hydraulic pumps and how they create fluid flow. It also describes prime movers and the considerations for selecting a pump and motor unit for a specific application.

Pneumatic Power Sources 215
This class describes different types of compressors and how they generate gas flow. It also describes prime movers and primary factors to consider when selecting a compressor for a particular application.

Fluid System Print Reading 220
This class describes the basic layout of hydraulic and pneumatic prints and addresses the most commons symbols used to identify components.

Hydraulic Control Valves 230
This class surveys the most common types of hydraulic control valves and explains how each type functions within a hydraulic system. Includes an Interactive Lab.

Pneumatic Control Valves 235
This class surveys the most common types of pneumatic control valves and explains how each type functions within a pneumatic system.

Actuator Applications 240
This class provides an overview of actuators for fluid power systems, including cylinders, rotary actuators, and fluid motors. Includes an Interactive Lab.

Basic Hydraulic Circuit Design 310
This class provides an overview of basic hydraulic circuits and how they are designed to perform basic tasks.

Basic Pneumatic Circuit Design 315
This class provides an overview of basic pneumatic circuits and how they are designed to perform basic tasks.

Hydraulic Fluid Selection 320
This class provides an overview of the types of hydraulic fluid and the properties that make them ideal for certain applications. Includes an Interactive Lab.

Contamination and Filter Selection 330
This class provides an overview of contamination, hydraulic filters, and fluid maintenance. Includes an Interactive Lab.

Hydraulic Principles and System Design 340
This class provides an overview of common mathematical calculations used to size fluid components in the design phase of circuit creation. Includes an Interactive Lab.

Inspection

Basic Measurement 101
The class "Basic Measurement" offers an overview of common gaging and variable inspection tools and methods. Variable inspection takes a specific measurement using common devices such as calipers and micrometers. The sensitivity of the instrument must be greater than the measurement being taken. Both calipers and micrometers are read by finding the alignments in lines on the devices. Gages, such as gage blocks, plug gages, ring gages, and thread gages, reveal whether a dimension is acceptable or unacceptable without a specific quantity. All inspection devices should be properly mastered and maintained to retain accuracy. One of the fundamental activities of any shop is the measurement of part features. Consistent measurement and inspection maintains standardization and ensures that out-of-tolerance parts do not reach customers. After taking this class, users should be able to describe the use and care of common inspection instruments and gages used in the production environment.

Basic Measurement 110
This class introduces the basic measuring devices used in the shop to ensure part quality. Includes an Interactive Lab.

Calibration Fundamentals 111
The class "Calibration Fundamentals" provides a basic introduction to the importance of calibrating measuring instruments. Calibration determines the accuracy of measuring instruments by comparing its value to a higher-level measurement standard, usually a working standard gage block. Measurement standards follow a hierarchy consisting of primary, secondary, and working standards. Traceability links these standards together. Measurement uncertainty estimates the accuracy of a measurement. It is the range in which the true value of a measurement is expected to lie. High-accuracy parts require tight tolerances. Tighter tolerances require higher-accuracy measuring instruments. While uncertainty and error exists in every measurement, careful calibration can help to minimize inaccuracy when inspecting parts with measuring instruments. After taking this class, users should be able to explain how calibration and traceability impact the use and care of inspection devices.

Linear Instrument Characteristics 115
This class describes the various characteristics of linear measuring instruments and explains how variation affects the inspection process. Includes an Interactive Lab.

Basics of the CMM 120
This class identifies the major types and components of the coordinate measuring machine and describes the coordinate system.

Basics of Tolerance 121
"Basics of Tolerance" provides a comprehensive overview on part tolerancing, including different types of tolerances and the relationship between tolerances and part dimensions. Every manufactured part must meet certain specifications. Tolerances describe the range of acceptable measurements in which a part can still perform its intended function. Tolerance ranges typically describe a linear measurement. Surface texture can require a certain tolerance as well. Tolerances attempt to balance the use of a product with the cost required to produce that product.
Improper tolerancing can result in parts that do not function in the way they were intended or parts produced with dimensions that are more precise than necessary, adding unwanted cost to production. After the class, users will be able to describe common methods used for part tolerancing, as well as the impact tolerances have on part production and quality.

Basics of the Optical Comparator 130
This class explains the principles of optical inspection and describes the components of the optical comparator.

Blueprint Reading 131
The class "Blueprint Reading" provides a thorough understanding of blueprints and how to read them. Blueprints are documents that contain three major elements: the drawing, dimensions, and notes. The drawing illustrates the views of the part necessary to show its features. Together, the extension and dimension lines on the drawing indicate dimensions and specific tolerance information of each feature. The notes contain administrative and global information about the part. A blueprint contains all instructions and requirements necessary to manufacture and inspect a part.
An understanding of how to read a blueprint is critical to manufacture and inspect parts to accurate specifications. Accurate blueprint creation helps to ensure that finished parts will function in a way that meets the original intent. After taking this class, users should be able to read a basic blueprint and determine the critical features on a part that need to be measured.

Surface Measurement 140
This class identifies the different types of surface texture and describes how the surface texture of a part affects its use.

Hole Standards and Inspection 141
The class "Hole Standards and Inspection" provides a comprehensive introduction to hole inspection using contact instruments. Hole inspection ensures that a hole will meet its proper job specifications, including fit, diameter, roundness, and condition. Gaging instruments, like pin and plug gages, determine fit. Variable instruments determine size and must make three points of contact to find out-of-round conditions. Variable instruments may be mechanical, electronic, optical, or pneumatic. More complex handheld devices include telescoping gages, split-ball gages, calipers, inside micrometers, and bore gages. Job specifications, environmental concerns, and economic issues all determine which hole inspection device to use. Choosing the wrong tool could result in an out-of-tolerance hole passing inspection. After taking this class, users should be able to explain how to measure common hole features with plug gages, pin gages, and calipers and verify they are within tolerance.

Overview of Threads 150
This class describes the various parts of a screw thread, common thread standards and tolerances, and the various tools used to inspect them.

Thread Standards and Inspection 151
"Thread Standards and Inspection" explains the various parts of threads and how to inspect them. Manufacturers inspect threads according to unified or ISO standards or using System 21, System 22, and System 23. Several features must be checked to make sure that threads meet specifications. Gaging inspection tools, or go/no-go gages, simply determine whether or not a part will fit. Variable thread inspection tools determine whether a thread falls within a specified tolerance range. Thread type and specifications affect the tools used to inspect threads.
Understanding the various components and classifications used to identify threads is critical for accurate inspection. After the class, the user will be able to explain how to measure common threaded features with internal and external thread gages and verify the features are within tolerance.

Intro to GD&T 200 (1994)
This class introduces the fundamental concepts of geometric dimensioning and tolerancing (GD&T) and describes the main types of tolerances included in the standard. This class references the 1994 standard. Includes an Interactive Lab.

Surface Texture and Inspection 201
The class "Surface Texture and Inspection" provides information on surface finish and methods involved for its inspection. The surface finish achieved by a machining process determines how well a surface performs its given function. Surface inspection compares the specified nominal surface and real surface to find the measured surface. Measurement can be completed by comparison, direct measurement with a stylus-type instrument, or noncontact methods. A real surface contains irregularities (flaws, roughness, waviness, and lay) that make up its surface texture. Roughness is the most common irregularity used to inspect surfaces. The desired finish of a surface changes how precisely a part must be machined. Inspecting for surface roughness reduces the cost of surface finish by allowing companies to produce parts to customer specifications. After the class, users should be able to describe commonly used methods for tolerancing a part's surface roughness in a production environment.

Intro to GD&T 205 (2009)
This class introduces the fundamental concepts of geometric dimensioning and tolerancing (GD&T) and describes the main types of tolerances included in the standard, ASME Y14.5 2009.Includes an Interactive Lab.

Calibration Fundamentals 210
This class describes the calibration process and explains how measuring instruments are traced back to national and international standards. Includes an Interactive Lab.

Inspecting with CMMs 220
This class compares the advantages and common uses of various CMM components and software applications.

Inspecting with Optical Comparators 230
This class compares different types of optical comparators and explains how they work best under different conditions.

Hole Inspection 240
This class explains different hole characteristics and describes how specific gages are used for different hole inspection applications. Includes an Interactive Lab.

Thread Inspection 250
This class provides suggestions and how-to information for inspecting threads with a range of common instruments and gages. Includes an Interactive Lab.

Hardness Testing 260
This class provides an overview of the most common hardness testing methods and describes how to read hardness ratings.

Measuring System Analysis 300
This class explains the purpose and methods of measuring systems analysis, including measurement variation and gage repeatability and reproducibility studies.

Introduction to GD&T 301
"Introduction to GD&T" provides a basic introduction to the symbols and vocabulary of geometric dimensioning and tolerancing, or GD&T. GD&T is an international design standard that uses 14 standard geometric tolerances to control the shape of features. GD&T emphasizes the fit, form, and function of a part by comparing the physical features of the part to the imaginary datums specified in the design instructions. Every part feature is described by a series of symbols, which are organized in the feature control frame.
Because GD&T uses tolerance zones that more accurately follow the shape of a feature rather than a square grid and emphasizes the relationship between features, blueprints usually utilitize GD&T to describe parts. This means that to fully understand a blueprint, it is necessary to know the GD&T symbols and what they mean. After taking this class, users should be able to better understand the symbols commonly used in a GD&T print.

Interpreting GD&T 310 (1994)
This class explains important rules of GD&T and also describes how common features are specified in GD&T prints. This class references the 1994 standard. Includes an Interactive Lab.

Major Rules of GD&T 311
The class "Major Rules of GD&T" provides an overview of the rules and concepts of geometric dimensioning and tolerancing, or GD&T, including Rule #1, Rule #2, bonus tolerance, the 3-2-1 Rule, and virtual and resultant conditions, as well as the datum reference frame (DRF). The DRF limits all six degrees of freedom by mapping three perpendicular planes onto the part using datum feature simulators. GD&T standards offer specific guidelines on a wide range of part features, including projected tolerance zones, radii, controlled radii, tapers, threads, and gears. Special rules also apply for composite or single segment tolerancing and statistical tolerancing. GD&T functions as a complex language used in blueprints to convey all necessary information

about a part. To accurately read a GD&T print, the student must understand its many guidelines. After taking this class, users should be able to explain key GD&T concepts and various approaches for situating a part within the DRF.

Interpreting GD&T 315 (2009)
This class explains important rules of GD&T and also describes how common features are specified in GD&T prints. This class reflects ASME Y14.5 2009.

Inspecting a Prismatic Part 321
"Inspecting a Prismatic Part" explains the measurements, methods, and inspection tools necessary to confirm that a prismatic part meets its specifications. A number of instruments have the right amount of sensitivity required to inspect most prismatic parts, but a CMM is often the most accurate. Inspection starts by measuring each size dimension in two ways: the cross-sectional dimension, or actual local size, and, sometimes, the actual mating envelope (AME). Prismatic parts are also routinely inspected for certain geometric tolerances, including straightness, flatness, profile of a line, profile of a surface, angularity, perpendicularity, parallelism, and position.
The ways in which a part must be inspected is based largely upon its shape, so proper inspection of a prismatic part requires an understanding of its basic dimensions and tolerances. After taking this class, users will be able to describe best practices for inspecting the complete layout of a prismatic part.

Inspecting a Cylindrical Part 331
"Inspecting a Cylindrical Part" explains the measurements, methods, and inspection tools necessary to confirm that a cylindrical part meets its specifications. A number of instruments have the right amount of sensitivity required to inspect most cylindrical parts, but a CMM is often the most accurate. Inspection starts by measuring each size dimension in two ways: the cross-sectional dimension, or actual local size, at one location along the part and the actual mating envelope (AME) along the part's entire length. Cylindrical parts are also routinely inspected for certain geometric tolerances.
The ways in which a part must be inspected is based largely upon its shape. Thus proper inspection of a cylindrical part requires an understanding of its basic dimensions and tolerances. After the class users should be able to describe best practices for inspecting the complete layout of a cylindrical part.

Advanced Hole Inspection 341
"Advanced Hole Inspection" provides an overview of hole inspection using noncontact instruments. Holes that require a specific type of fit, either clearance, interference, or transition, also require a higher degree of accuracy. Noncontact hole inspection devices provide this, as well as an ability to measure fragile parts and high volumes of parts. These more sophisticated variable hole inspection devices include coordinate measuring machines, measuring microscopes, optical comparators, borescopes, laser systems, and air gages.
Job specifications, part dimensions, and feature size all determine which hole inspection device to use on holes requiring a certain fit. Choosing a tool without a high degree of accuracy could result in an out-of-tolerance hole passing inspection. After taking this class, users will be able to

describe advanced methods for inspecting hole dimensions and geometric features in a lab setting.

Inspecting with Optical Comparators 351
"Inspecting with Optical Comparators" provides an overview of the optical comparator, which uses optics to project an enlarged, two-dimensional shadow of a part onto a glass screen for measurement of its length, width, and surface. Simple optics display the part upside down and backwards. Corrected optics display the part right side up and backwards. Fully corrected optics yield an image identical to the part orientation. Regardless of type and complexity, all optical comparators measure by comparison, screen rotation, and motion.
If optical comparators are properly maintained, measurement error is the result of the operator. By understanding the components and measurement methods of the optical comparator, operators can avoid unwanted variation. Variation in measurement can lead to faulty parts passing inspection and reaching consumers. After completing the class, users will be able to describe best practices for using the optical comparator to inspect parts.

Inspecting with CMMs 361
"Inspecting with CMMs" provides a comprehensive overview of the functions and mechanics of the coordinate measuring machine, or CMM. A CMM's probe contacts the various features on a workpiece and records their Cartesian coordinate locations with software. CMMs measure using either contact or noncontact methods and can be used in a lab or on the production floor. CMMs use either manual operation, joystick, or DCC to guide components.
As long as the operator is trained in its use, the CMM provides high accuracy measurements with minimum human influence in a very short amount of time. This allows the operator to respond to machining errors and reduce scrap. After this class, users should be able to describe best practices for using the CMM to inspect parts.

Calibration and Documentation 371
"Calibration and Documentation" details the calibration of measuring instruments and its necessary documentation. Calibration should occur at regular intervals. Companies should have a written document that defines their calibration procedures. Calibration records and reports ensure that traceability is intact. This documentation proves that measurements are accurate. The required accuracy of the measuring instrument determines in-house or outside calibration. Without traceability, there is no way to ensure that a measurement made by an inspection device is accurate.
Calibration and documentation reduce waste and increase part accuracy, which in turn increases customer satisfaction. After taking the class, users should be able to describe best practices for instrument and gage calibration, along with correct documentation of calibration efforts.

In-Line Inspection Applications 381
"In-Line Inspection Applications" offers an in-depth look at the uses of in-line inspection, or error-proofing, in a production environment. Error-proofing uses individualized setups to inspect a part while it is still in production. Gage selection for in-line inspection depends on variables such as part type, production specifics, environment, and process control needs. Possible gaging options include limit or proximity switches, counters or timers, photoelectric or laser sensors, air

gages, machine vision systems, and ultrasonic systems. In-line inspection is only feasible if it can be done with repeatability and accuracy.
Inspection of parts during production, instead of after it is complete, allows a company to prevent errors before they occur and reach customers. After taking the class, users should be able to describe the various methods for incorporating in-line inspection into an established production process.

Manual Machining

Basics of the Manual Mill 110
This class describes the basic components of the manual mill and also describes common workholding devices, cutting tools, and toolholders used on the mill.

Basics of the Engine Lathe 115
This class describes the basic parts of the engine lathe as well as the cutting tools and workholding devices used on a typical lathe.

Overview of Manual Mill Setup 200
This class describes the proper setup for a typical mill operation and explains how to determine mill settings, align mill components, and select proper tooling.

Overview of Engine Lathe Setup 205
This class describes the proper setup for a typical lathe operation and explains how to align, adjust, and select the components on the lathe.

Benchwork and Layout Operations 210
This class describes common benchwork operations performed on the mill before and after machining a part and describes common layout tools and procedures.

Manual Mill Operation 220
This class guides you through the machining of a common part on the mill as well as explains common milling operations performed on the mill.

Engine Lathe Operation 225
This class guides you through the machining of a cylindrical part using inner- and outer-diameter cutting operations as well as explains general principles surrounding each operation.

Holemaking on the Mill 230
This class describes how to perform common holemaking operations on the manual mill and explains common principles about each holemaking process.

Threading on the Engine Lathe 235
This class describes the manual lathe components used for threading and explains how to cut and inspect an external and internal thread.

Taper Turning on the Engine Lathe 240
Taper Turning on the Engine Lathe 240 is an introductory class covering methods for turning basic tapered parts on an engine lathe.

Materials

Intro to Materials 100
This class identifies the major categories of materials used in manufacturing and compares their general properties.

Introduction to Physical Properties 101
Intro to Physical Properties provides an overview of manufacturing materials and their physical properties, including thermal, electrical, and magnetic properties. This class also introduces users to volumetric characteristics, such as mass, weight, and density. Physical properties determine how a material will react to moisture, heat, electricity, and other factors. In order to choose the best tooling or raw material for an application, manufacturers must understand the physical properties of key metals, plastics, and other materials. After taking this course, users will be able to identify and describe key physical properties and their value in a manufacturing setting.

Structure of Metals 110
This class describes the atomic structure of metals and explains how this structure affects each metal's properties.

Introduction to Mechanical Properties 111
"Intro to Mechanical Properties" provides a thorough introduction to key mechanical properties, such as tensile strength, hardness, ductility, and impact resistance. This class discusses how shear, compression, and tensile stress impact a material's properties, how force is shown on a stress-strain graph, and common methods manufacturers use to test a material's strength. To make quality products, manufacturers must anticipate how a material responds to shaping and cutting forces and understand how that material will ultimately function once it reaches the customer. Evaluating a material's mechanical and physical properties is the first step to choosing reliable tooling and processing methods. After taking Intro to Mechanical Properties, users will know more about hardness, ductility, and strength, what materials exhibit these characteristics, and common methods a facility might use to test these qualities.

Overview of Plastic Materials 115
This class describes the different types of plastics and their characteristics.

Mechanical Properties of Metals 120
This class describes common mechanical properties of metals and explains the stress-strain curve. Includes an Interactive Lab.

Introduction to Metals 121
"Intro to Metals" provides an overview of popular ferrous and nonferrous metals and their properties. This course introduces users to the three types of metal crystal structures, how grains develop in metal, the purpose of heat treating, and how these aspects impact a material's

characteristics. Steel, aluminum, titanium, and other metals have a wide range of commercial and advanced applications, including structural shapes, machine components, and medical devices. To choose the best material for a project, manufacturers must first understand how different metals respond to heat, pressure, electricity, chemical exposure, and weather. After completing Intro to Metals, users will know how various metals function in different environments, making them better equipped to select materials and tooling.

Physical Properties of Metals 130
This class introduces the physical properties of metals and explains how these properties determine potential applications.

Overview of Properties for Plastics 135
This class describes the mechanical and chemical properties of plastics and addresses how they impact design considerations.

Metal Manufacturing 140
This class walks through the steps used to produce commercial steel from its original ore.

Overview of Plastic Processes 145
This class describes the most common plastic manufacturing processes and the machinery used to manufacture plastic components.

Metal Classification 150
This class introduces the AISI-SAE classification for steels.

Classification of Steel 201
"Classification of Steel" introduces users to steel designations systems, particularly AISI-SAE and UNS methods. This class describes classifications for plain carbon, alloy, high-strength low alloy, stainless, and tool steels, with a focus on AISI-SAE designations. There are many different types of steels, each having unique chemical contents and properties. Manufacturers distinguish between these metals by a numerical designation. In the AISI-SAE system, this number indicates the family of steel and the steel's carbon content. Some designations also describe the metal's intended use or special properties.
Because composition and processing methods determine a metal's properties, understanding steel classification is critical to choosing the best material for an application. After this class, users will be able to distinguish between major types of steel classifications and describe the nomenclature used to identify various grades of steel.

Ferrous Metals and Alloys 210
This class identifies the major categories, properties, and uses of steels and their alloys.

Essentials of Heat Treatment of Steel 211
"Essentials of Heat Treatment" provides a through introduction to steel heat treatment, including a discussion of how heat and carbon content impact a steel's microstructure. This class also describes common heat treating methods, such as annealing, quenching, normalizing, and tempering.

Steel is heat treated to adjust the metal's properties. Heat treatments can increase a steel's hardness or ductility, or relieve stresses that accumulate due to other processing steps. To choose the best heat treating method for an application, manufacturers must understand how heat and carbon dictate phase changes and how different processes can be combined to produce a desired property. After completing this course, users will be familiar with heat treating theories and processes and be better equipped to use heat treatments.

Nonferrous Metals and Alloys 220
This class identifies the major categories, properties, and uses of nonferrous metals and their alloys.

Hardness Testing 221
"Hardness Testing" provides a thorough overview of the most common hardness testing methods, including Rockwell, Brinell, Vickers, Knoop, rebound, and ultrasonic tests. This class presents a description of each method, along with discussions on how to choose and perform a test, how to read hardness ratings, and how to prevent common errors.
Hardness tests ensure that raw, in-process, and finished materials have the correct mechanical properties. There are many different testing methods depending on the type of material, the work environment, and the desired accuracy of the reading. This course will prepare new and practicing manufacturers to choose and conduct different hardness tests by introducing them to popular methods used in the industry.

Overview of Exotic Metals 225
This class identifies and describes exotic metals and superalloys that are commonly used when traditional materials are inadequate. It also covers the physical and mechanical properties that make exotics desirable for advanced applications.

Heat Treatment of Steel 230
This class describes the different steel phases as well as common heat treatment methods for steel. Includes an Interactive Lab.

Ferrous Metals 231
"Ferrous Metals" discusses the properties and applications of cast iron and steel, including an overview of plain carbon steel, stainless steel, and HSLA steels, along with an introduction to AISI-SAE designations. This course also describes gray, ductile, white, and malleable cast irons and their uses. Ferrous metals have broad commercial and industrial applications due to their strength, versatility, and relatively low costs. Fasteners, automotive components, structural shapes, tooling, and even aircraft parts can be made with ferrous metals. Understanding the range of cast iron and steels available enables manufacturers to choose reliable raw materials and effective processing methods. After completing this course, users will be better equipped to evaluate materials and anticipate how ferrous metals will function in different environments.

Plastics 240
This class identifies the major categories, properties, and uses of plastics.

Nonferrous Metals 241
"Nonferrous Metals" provides an overview of the properties and uses of common nonferrous metals, including aluminum, copper, magnesium, nickel, lead, and titanium. This class also discusses how refractory metals and how nonferrous metals are classified in the Unified Numbering System (UNS).
Selecting the best alloy for an application begins with understanding each metal's properties and interactions. Nonferrous metals, although not as widely used as steel, are still valued as essential alloying elements or for advanced applications. After taking this class, new or practicing manufacturers will be able to identify various nonferrous metals, their characteristics, and their uses.

Ceramics 250
This class identifies the major categories, properties, and uses of ceramics.

Principles of Injection Molding 255
This class will familiarize you with injection molding and the design concerns associated with injection molding.

Principles of Thermoforming 265
This class describes the thermoforming process and explains the different variations of thermoforming, including pressure forming and vacuum forming.

Exotic Alloys 301
"Exotic Alloys" provides an introduction to the properties and applications of superalloys and exotic metal alloys. In this class, users will learn about iron-based, nickel-based, and cobalt-based superalloys, as well as tungsten, vanadium, tantalum, and other exotic metals.
Superalloys and exotic metals have unique properties for specialized applications. Complex, proprietary superalloys are commonly used in aerospace and petrochemical applications, while exotic metals are often used as alloying elements to enhance the properties of a base metal. After completing this class, users will be able to identify prominent superalloys and exotic metals and describe their uses.

Mechanical Systems

Intro to Mechanical Systems 100
This class examines simple machines such as the lever and inclined plane and covers basic concepts of physical science, including mechanical advantage and friction.

Safety for Mechanical Work 105
This class describes safety precautions for performing maintenance on mechanical systems.

Forces of Machines 110
This class identifies the various types of mechanical forces and describes how these forces act on objects. Includes an Interactive Lab.

Power Transmission Components 120
This class discusses the process of mechanical power transmission and describes the components used to transmit mechanical energy.

Lubricant Fundamentals 130
This class describes different types of industrial lubricants and explains the importance of proper lubrication procedure. Includes an Interactive Lab.

Mechanical Power Variables 200
This class discusses the variables involved in mechanical power transmission and how they affect industrial processes. Includes an Interactive Lab.

Bearing Applications 210
This class describes different types of bearings, the operating conditions in which they are used, and important considerations for proper installation and maintenance of the major types of bearings available. Includes an Interactive Lab.

Spring Applications 220
This class discusses different types of springs, how they are used in machines, and how to select the right spring for a particular application.

Belt Drive Applications 230
This class explains how belt drive systems are used to transmit power and discusses various types of belts used in industry. Includes an Interactive Lab.

Gear Geometry 240
This class discusses the geometry and design of gears commonly used in industry. Includes an Interactive Lab.

Gear Applications 245
This class discusses various types of gears used in industry, including information on how gears are used, maintained, and classified.

Clutch and Brake Applications 250
This class describes different types of clutches and brakes, the operating conditions in which they are used, and installation, maintenance, and safety concerns..

Metal Cutting

Intro to EDM 100
This class introduces the process, components and machines of electric discharge machining.

Safety for Metal Cutting 101
"Safety for Metal Cutting" provides a comprehensive overview of the safety hazards associated with metal cutting operations, such as hot flying chips, broken tools, and rotating components. In addition, the class addresses contact with cutting fluids, which can cause skin and eye irritation,

and machine guarding. Manual machines often require machine guards because the operator works in close proximity with the point of operation and moving components. CNC machines often have fixed guards, which prevent the operator from reaching into the point of operation. Also, operators must handle all sharp-edged tools properly.
Awareness of potential safety hazards reduces the risk of operator injury. The key to cutting safety is to follow the proper guidelines for the facility and maintain a well-organized, safe work environment. After taking the class, users should be able to demonstrate awareness of and follow proper safety protocols in a metal-cutting environment.

Metal Removal Processes 110
This class describes traditional machining processes such as metal cutting and grinding, as well as various nontraditional methods of machining.

Cutting Processes 111
"Cutting Processes" provides an introductory overview of the common metal cutting operations. To those new to manufacturing and machining, familiarity with the basic machines, tools, and principles of metal cutting is essential. The class focuses on the most common machining tools, the saw, lathe, and mill, and the common processes performed on each, such as band sawing, turning, end milling, and drilling. "Cutting Processes" also offers an introduction to holemaking and describes the differences between inner and outer diameter operations.
A basic, foundational knowledge of metal cutting processes is essential to gain understanding of more advanced information such as cutting theory, tool and workpiece material, cutting variables, and tool geometries. After taking this class, students should be able to identify the most common cutting processes, as well as the machines used to perform them.

Safety for Metal Cutting 115
This class identifies the safety hazards associated with cutting operations and the precautions you must take to avoid injury.

What Is Cutting? 120
This class addresses the theory of proper chip formation during the machining process. Includes an Interactive Lab.

Overview of Machine Tools 121
"Overview of Machine Tools" provides an overview of the basic machine tools used in metal cutting operations. The class describes the appearance, components, and uses of lathes, mills, drill presses, saws, and broaches. Lathes and mills are described in detail, including the various types of cutting operations performed and the different types of tools commonly used on both machines.
This class provides new users with the foundational information about machine tools and their uses that is necessary for users to gain familiarity with common metal cutting machines and knowledge of metal cutting theory and processes. A basic understanding of the types of machine tools used in metal cutting operations will prepare users for becoming machine operators.

Machines for Metal Cutting 130
This class identifies and describes the common machines used in metal cutting.

Cutting Processes 140
This class provides a comprehensive overview of the most common metal cutting operations performed in the shop. Includes an Interactive Lab.

Sawing Fundamentals 155
This class identifies the main types of sawing and introduces basic terminology for saw blade types and materials.

Intro to Screw Machining 160
This class identifies the common components and operations of the screw machine and compares common screw machine designs.

Cutting Variables 200
This class describes some of the variables that impact common machining operations. Includes an Interactive Lab.

Basic Cutting Theory 201
"Basic Cutting Theory" provides an introductory overview of metal cutting theory and chip formation. The most fundamental aspect of cutting theory is the use of a cutting tool to remove material in the form of chips. Cutting tools can be divided into single-point tools, commonly used on the lathe, and multi-point tools, commonly used in milling and holemaking. The shape and type of chip created by cutting indicates whether or not cutting conditions are optimized. Adjusting tool angles and cutting variables has the largest effect on chip creation and cutting conditions.
Understanding how chips are formed and what factors change or optimize chip formation is essential to performing an effective metal cutting operation. Chip formation affects surface finish, part quality, and tool life, and thus has a large effect on manufacturing economy.

Cutting Fluids 210
This class identifies the major cutting fluids and their common uses.

Band Saw Operation 211
"Band Saw Operation" gives an in-depth description of the considerations required for band sawing operations. Band sawing is a common way to perform rough cuts on raw stock, and uses a continuous, flexible metal blade looped over machine wheels. Band sawing can be performed with a variety of blade materials and styles, including different tooth spacing and geometry. The specific blade type and cutting variables used depend on the specific workpiece and cutting operation.
Band sawing can be an efficient, low-cost way to rough cut stock to size. However, in order to effectively perform band sawing operations, operators must be aware of factors such as blade material, tooth set, tooth form, tooth spacing, and optimal speed and feed settings. This class provides the information necessary to identify optimal band sawing variables and conditions.

Band Saw Blade Selection 215
This class compares the various types of band saw blades and identifies the factors that influence blade selection.

Cutting Tool Materials 220
This class describes common cutting tool materials and their common applications.

Carbide Grade Selection 230
This class describes the common forms of carbide available in cutting tools.

Metal Cutting Fluid Safety 231
"Metal Cutting Fluid Safety" provides an overview of the safety concerns related to working with metal cutting fluids. Some of the ingredients in various cutting fluids, as well as microorganisms that can grow in them, can be harmful. Exposure can occur through skin contact, inhalation, or ingestion. This exposure can lead to skin and respiratory disorders, including long-term illness. Safety measures, including ventilation, PPE, sanitation, training, and fluid maintenance, can reduce exposure to contaminants.
Manufacturers always want to ensure that operators are safe, that they are OSHA compliant, and that they do not lose productivity due to accidents. Operations using cutting fluids have specific safety concerns that must be addressed in order to maintain a safe work environment. After taking this class, users will know how to differentiate between various cutting fluids, recognize the health risks they pose, and understand how to use, handle, and maintain them safely.

Tool Geometry 240
This class identifies the major tool angles that impact the turning operation. Includes an Interactive Lab.

Milling Geometry 245
This class identifies and explains the face mill and end mill tool angles that impact a milling operation. Includes an Interactive Lab.

Drill Geometry 247
This class identifies the major drill components and angles that impact drilling operations. Includes an Interactive Lab.

ANSI Insert Selection 250
This class walks through the ANSI B212.4-1995 standard for insert identification.

Toolholders for Turning 260
This class explains the components and identification of OD and ID toolholders used on the lathe.

Speed and Feed Selection 300
This class identifies the various speed and feed values used with the lathe and mill and describes how to convert these variables. Includes an Interactive Lab.

Optimizing Insert Life 305
This class describes common forms of insert wear that lead to insert failure and identifies the appropriate control methods for each type. Includes an Interactive Lab.

High-Speed Machining 310
This class compares high-speed machining to traditional machining and explains the key factors that impact its successful application.

Hard Turning 315
This class covers hard turning, including its advantages when compared to grinding and strategies for successful implementation.

Machining Titanium Alloys 325
This class identifies and addresses the challenges related to machining titanium and its alloys.

Motor Controls

Intro to Electric Motors 200
his class discusses how various types of electric motors are applied throughout industry and the principles behind motor operation. Includes an Interactive Lab.

Symbols and Diagrams for Motors 210
This class describes common types of motor control symbols found in most schematic diagrams as well as their function in a motor application.

Logic and Line Diagrams 220
This class will teach you the basic rules for line diagrams and their common elements. You will also learn how line diagrams are put together and how they are referenced.

DC Motor Applications 230
This class focuses on DC motors, their main parts, and how they are used and maintained. Includes an Interactive Lab.

Solenoids 235
This class describes the principles behind solenoid operation, lists the main types of solenoids, and explains their function and application. Includes an Interactive Lab.

AC Motor Applications 240
This class describes the common parts of AC motors as well as different types and their applications, maintenance, and troubleshooting concerns.

Contactors and Motor Starters 250
This class provides information on the basic design and function of contactors and motor starters. Includes an Interactive Lab.

Control Devices 260
In this class, you will learn about various types of control devices, their parts, and how control devices are used in different applications. Includes an Interactive Lab.

Reversing Motor Circuits 310
This class describes the proper ways to design reversing motor control circuits for many types of electric motors, using different types of starters and switches.

Distribution Systems 320
This class describes the means of distributing power to motors and other electrical devices within a typical industrial shop, focusing on distribution systems within a shop.

Specs for Servomotors 330
This class covers the basic types of servomotors and the components that can be used in a servo system.

Timers and Counters 340
This class describes the functions and applications of various mechanical, electromechanical, and electronic timers and counters. Includes an Interactive Lab.

Electronic Semiconductor Devices 350
In this class covers the functions and characteristics of many different electronic semiconductor devices.

Photonic Semiconductor Devices 355
This class covers the characteristics and functions of photonic semiconductor devices.

Limit Switches and Proximity Sensors 360
This class covers the properties and functions of limit switches and inductive and capacitive proximity sensors, as well as hall effect sensors. Includes an Interactive Lab.

Photoelectric and Ultrasonic Devices 365
This class covers the properties and functions of photoelectric and ultrasonic sensors. Includes an Interactive Lab.

Reduced Voltage Starting 370
This class describes the various methods of reduced voltage starting and explains when each type of starter is used.

Solid-State Relays and Starters 375
This class covers the characteristics and functions of solid state relays and motor starters. Includes an Interactive Lab.

Deceleration Methods 380
This class describes the various methods used to cause motor deceleration. It explains the situations where braking is needed and shows how braking is accomplished.
Acceleration Methods 385
This class will describe the factors involved with motor acceleration and how they relate to each other. It will also explain how speed and acceleration are controlled in various types of electric motors.

PLCs

Intro to PLCs 200
This class introduces the parts and operations of programmable logic controllers (PLCs) and describes the functions and different programming languages you will find on most PLCs. Includes an Interactive Lab.

Hardware for PLCs 210
This class covers the characteristics and functions of different types of PLC hardware, and provides basic troubleshooting procedures and maintenance tips. Includes an Interactive Lab.

Basics of Ladder Logic 220
This class describes the basic principles of ladder logic, identifies the symbols used to program a PLC and explains the primary logic functions those symbols create. Includes an Interactive Lab.

Numbering Systems and Codes 230
This class explains how to convert between binary, decimal, octal, and hexadecimal number systems and describes how these systems are used to convey information for PLCs.

PLC Inputs and Outputs 240
This class covers different types, configurations, capacities, and current conversions for PLC I/Os. Includes an Interactive Lab.

Basic Programming 250
This class will teach you the basics of PLC programming using ladder logic. The class will identify common PLC commands and describe how those commands can be used to program a controller.

PLC Timers and Counters 260
This class explains how different types of PLC timers and counters work.

Networking for PLCs 270
This class covers the basic principles of PLC networking and provides an introduction to some common industrial networks. Includes an Interactive Lab.

Hand-Held Programmers of PLCs 280
This class covers the basic functions and characteristics of hand-held programmers. Includes an Interactive Lab.

PLC Diagrams and Programs 300
This class will teach you how to convert line diagrams and wiring diagrams for use with PLCs.

Overview of PLC Registers 305
This class introduces how digital signals are converted into binary data and how that data is stored into various types of registers.

PLC Program Control Instructions 310
This class covers some of the most common program control instructions for PLCs. Includes an Interactive Lab.

Math for PLCs 320
This class covers common mathematical functions for PLCs as well as the integer and decimal values and numeric codes involved in PLC math calculations.

Sequencer Instructions for PLCs 330
This class covers sequencer instructions for PLCs.

PLC Installation Practices 340
This class covers the proper steps for planning and installing a basic PLC system. Includes an Interactive Lab.

PID for PLCs 350
This class covers the effects of PID control in closed-loop systems as well as methods for tuning your controller in order to achieve the desired performance.

Data Manipulation 360
This class explains basic data moving functions and describes how and why these functions are used.

Shift Registers 370
This class explains the various register shifts than can be used in a PLC.

PLCs: Siemens

Basics of Siemens PLCs 200
This class introduces the parts and operations of Siemens programmable logic controllers (PLCs) and describes the functions and different programming languages you will find on these PLCs.

Siemens PLC Hardware 210
This class describes the basic hardware components of Siemens PLCs. It also covers the methods of communication between hardware components and discusses basic guidelines for PLC installation.

Numbers, Codes, and Data Types for Siemens PLCs 220
This class reviews the basic types of numbers, codes, and data used by Siemens PLCs. Binary, octal, decimal, and hexadecimal numbers are covered, as well as different types of integers and scientific notation.

Siemens PLC Communication 230
This class provides a comprehensive look at the techniques and devices used by Siemens PLCs to communicate with other devices.

Siemens PLC Inputs and Outputs 240
This class covers the variety of PLC input/output modules and devices. In addition, the class discusses PLC device addressing and configuration, as well as PLC tag usage.

Siemens Human Machine Interfaces 250
This class provides an overview of the different types of HMI devices and systems used by Siemens PLCs.

Siemens SIMATIC Modular PLCs 260
This class provides a brief description of the different varieties of SIMATIC PLCs and a more in-depth overview of Modular PLCs in particular.

Siemens PLC Programming Concepts 270
This class discusses the basic concepts of programming Siemens PLCs. Linear and modular programming are both discussed, as well as different types of Siemens PLC engineering software and PLC program memory usage.

Basic Ladder Diagram Programming for Siemens PLCs 280
This class explains how basic ladder diagram programming is used to program PLCs. It examines the basic rules that are used to construct a ladder diagram program, including Boolean logic functions. It then illustrates these rules and how they relate to hard-wired circuitry by showing the various methods used to create a start-stop control application.

Basic Function Block Diagram Programming for Siemens PLCs 290
This class explains how function block diagram programming is used to program PLCs. It examines the basic rules that are used to construct an FBD program, including Boolean logic functions. It then illustrates these rules and how they relate to hard-wired circuitry by showing the various methods used to create a forward-reverse control application.

Ladder Diagram Timers and Counters for Siemens PLCs 300
This class explains how ladder diagram programming is used to program timers and counters. It examines the basic rules for each type of timer and counter used in LAD programming for S7-1200 PLCs.

Function Block Diagram Timers and Counters for Siemens PLCs 310
This class explains how function block diagram programming is used to program timers and counters. It examines the basic rules for each type of timer and counter used in FBD programming for S7-1200 PLCs.

Additional Ladder Diagram Instructions for Siemens PLCs 320
This class describes the bit logic instructions used in a ladder diagram program. Then, it more thoroughly explains compare, math, move, convert, jump, label, word logic, shift, and rotate instructions.

Additional Function Block Diagram Instructions for Siemens PLCs 330
This class describes the bit logic instructions used in a function block diagram program. Then, it more thoroughly explains compare, math, move, convert, jump, label, word logic, shift, and rotate instructions.

Siemens SIMATIC S7-1200 PLCs 340
This class describes SIMATIC S7-1200 PLCs and the various S7-1200 PLC modules that make up the PLC. This class also provides an overview of the STEP 7 Basic (TIA Portal) software used to configure and program the PLC as well as the various S7-1200 integrated technologies.

Siemens SIMATIC S7-1500 PLCs 350
This class describes SIMATIC S7-1500 PLCs and the various S7-1500 modules. This class also summarizes the capabilities of the STEP 7 Professional (TIA Portal) software used to configure and program S7-1500 PLCs.

Siemens Safety Integrated for Factory Automation 360
This class describes Siemens Safety Integrated for Factory Automation, which incorporates safety technology into standard automation, significantly reducing engineering costs, ensuring reliable and efficient operation, and enabling greater availability.

Press Brake

Press Brake Safety 100
This class provides an overview of safety procedures for the press brake, including a description of how to adjust pullback cables.

Press Brake Components 110
This class identifies the major components of the press brake and describes the most common press brake designs. Includes an Interactive Lab.

Bending Fundamentals 120
This class describes key factors that affect a bending operation on the press brake and also surveys the common types of forming and bending operations. Includes an Interactive Lab.

Die Bending Operations 130
This class describes the different types of bends that can be formed on the press brake.

Operating the Press Brake 200
This class describes how to operate a press brake and also covers the different modes of operation and controls used when operating a press brake.

Press Brake Specifications 220
This class identifies common specifications of press brakes and describes the various features and options available for common machines. Includes an Interactive Lab.

Quality

Quality Overview 100
This class identifies how each department and function of a company plays a role in producing quality products for the customer.

Lean Manufacturing Overview 101
"Lean Manufacturing Overview" provides an introduction to the principles and terminology of lean strategies, including a discussion of the seven forms of waste, the definition of value-added, the difference between push and pull systems, and the importance of continuous improvement. This class also highlights other quality concepts, such as single minute exchange of dies (SMED), inventory reduction, and Five S.
Lean manufacturing approaches help companies optimize their processes through organization and waste reduction. Although change can be a challenge, more efficient, streamlined processes will ultimately lead to improved customer satisfaction. This class outlines the foundational concepts and vocabulary that every practitioner needs when beginning, or continuing, a lean initiative.

ISO 9000 Overview 110
This class identifies and describes the key components of ISO 9001:2008, as well as its supporting standards ISO 9000:2005 and ISO 9004:2009.

Approaches to Maintenance 120
This class provides an introduction to the maintenance profession and describes various approaches to the practice of maintenance.

Basics of Tolerance 121
"Basics of Tolerance" provides a comprehensive overview on part tolerancing, including different types of tolerances and the relationship between tolerances and part dimensions. Every manufactured part must meet certain specifications. Tolerances describe the range of acceptable measurements in which a part can still perform its intended function. Tolerance ranges typically describe a linear measurement. Surface texture can require a certain tolerance as well. Tolerances attempt to balance the use of a product with the cost required to produce that product.
Improper tolerancing can result in parts that do not function in the way they were intended or parts produced with dimensions that are more precise than necessary, adding unwanted cost to production. After the class, users will be able to describe common methods used for part tolerancing, as well as the impact tolerances have on part production and quality.

Continuous Process Improvement: Managing Flow 124
This class covers the principles of continuous process improvement and the tools used to implement it.

Continuous Process Improvement: Identifying and Eliminating Waste 125
This class covers process improvement through the identification and elimination of different kinds of waste.

Lean Manufacturing Overview 130
This class describes the basic principles of lean manufacturing and compares them to traditional manufacturing approaches. Includes an Interactive Lab.

Approaches to Maintenance 131
"Approaches to Maintenance" provides an introduction to common manufacturing maintenance strategies, including reactive, corrective, predictive, preventive, reliability-centered, and total productive maintenance. This class describes the advantages and disadvantages of each method, the benefits of planned downtime, and the importance of a customized maintenance approach.
Having a targeted, well-designed maintenance plan reduces costly machine breakdowns and production downtime. With this class, manufacturers will learn about the benefits, limitations, and goals of popular maintenance approaches, making them better equipped to support and improve their facility's method.

Process Design and Development 133
This class covers the approaches to process design, particularly concurrent engineering and design for manufacturability. The class also addresses strategies for enhancing and testing manufacturability, and process analysis, modeling, and documentation.

Product Design and Development 134
This class describes the elements that go into effective product design. It identifies key concepts for geometric dimensioning and tolerancing and explains the use of computer aided design.

Developing a Lean Culture 135
This class covers strategies and tools for developing a lean culture within your company.
ISO 9000 Review 121 "ISO 9000 Overview" provides an introduction to the key components and requirements of ISO 9001:2008. This class discusses the standard's eight sections, along with describing the role of a Quality Management System (QMS) and ISO 9001:2008's connection to other standards in the ISO 9000 series. "ISO 9000 Overview" also outlines the steps to registration, the auditing process, and the importance of continuous improvement.
ISO 9001:2008 is an internationally recognized standard that outlines the requirements of an effective, organized quality system. Many organizations are becoming ISO 9001:2008 certified to prove their commitment to product quality and customer service. Although streamlining documentation and implementing change can be a challenge, ISO 9001:2008 can create a more goal-oriented, connected, and efficient organization. This class helps new practitioners familiarize themselves with ISO 9001:2008's structure, content, and purpose in quality management.

Production System Design and Development 136
This class introduces important factors involved in setting up a production system, such as location analysis, process and equipment selection, testing, and safety and quality standards. Careful planning and design leads to the production of reliable quality goods at a competitive price.

Equipment/Tool Design and Development 137
This class will introduce you to basic machine design concepts, common die assemblies, and inspection devices. You will also learn about current developments in nanotechnology and nanomanufacturing.

Intro to Supply Chain Management 140
This class describes the flow of products and information in a supply chain and explains the importance of customer service.

Total Productive Maintenance 141
"Total Productive Maintenance" introduces users to TPM concepts and principles. This class provides an overview of each key TPM pillar, including autonomous maintenance, Five S, planned maintenance, quality maintenance, kaizen, training, safety, and office TPM.
TPM combines aspects from lean manufacturing and quality initiatives to create a blended maintenance approach for both production and administrative areas. Improved safety, longer machine life, and increased employee involvement are just a few benefits of a well-executed TPM strategy. After taking this course, users will be able to describe the key components of total productive maintenance and their role in continuous improvement.

Total Productive Maintenance Overview 150
This class describes the elements of Total Productive Maintenance (TPM) and explains how TPM helps reduce losses and waste.

5S Overview 151
"Five S Overview" provides a thorough introduction to the purpose and process of 5S quality initiatives. This class includes separate discussions on each of the five steps, along with information on challenges, advantages, and possible assessment tools.
Many companies implement quality initiatives to improve operations and eliminate waste. 5S is a quality method that promotes organization, efficiency, and team work through several sequential steps. After completing this class, users will understand the value of each 5S step and be better equipped to execute and evaluate 5S.

5S Overview 155
This class provides an introduction to the 5S quality system and describes techniques for implementing 5S.

Cell Design and Pull Systems 160
This class covers the basics of cellular manufacturing, including the characteristics of cells and pull systems. Includes an Interactive Lab.

Cell Design and Pull Systems 161
"Cell Design and Pull Systems" provides an introduction to the origin, purpose, and advantages of cellular manufacturing. This class describes the basic characteristics of a work cell, along with how cells are planned, organized, and improved. Cell Design and Pull Systems also includes a discussion of related quality concepts, such as takt time, cycle time, kanban systems, and error prevention.

Work cells have become an integral component of many lean facilities due to their ability to streamline operations and decrease lead time. However, cells require planning, organization, and constant team effort. In order for the system to work, everyone must know his or her role in the cell. With this class, someone new to cellular manufacturing will be able to identify the benefits of work cells, use common quality terminology, and understand how supporting strategies, such as kanban and kaizen, come together to create an effective quality system.

Intro to Six Sigma 170
This class covers the basic concepts of Six Sigma, including data analysis, types of variation, common and special causes, the roles of Six Sigma team members, and the DMAIC method.

Intro to Six Sigma 171
"Intro to Six Sigma" provides a comprehensive introduction to the goals, methods, and tools used during Six Sigma initiatives. This class discusses the different roles in a Six Sigma team, DMAIC steps, and how to identify variation. Intro to Six Sigma also covers the tools practitioners use to track and analyze data, such as Pareto charts, frequency distribution charts, and run charts.
Unlike some quality initiatives, Six Sigma offers tangible, measurable methods to gage a project's success. This class gives new practitioners the foundational knowledge needed to support a Six Sigma project by introducing them to key terminology and important data analysis tools.

Quality and Customer Service 175
This class describes manufacturers' focus on quality and the customer. This class also identifies organizations that certify quality and describes ways quality can be quantified, controlled, and measured.

Troubleshooting: Identifying Problems 180
This class provides an introduction to the troubleshooting process and describes basic steps for identifying problems.

Troubleshooting 181
"Troubleshooting" provides a comprehensive overview of various methods and tools used to troubleshoot problems. Troubleshooting often involves finding the root cause of a problem and being able to distinguish deviations from problems and early warning signs from warning signs. Many tools are used to collect and interpret troubleshooting data, including check sheets, fishbone diagrams, and Pareto charts. The 5 Why technique, brainstorming, documentation, and troubleshooting teams are common methods of gathering troubleshooting data. Troubleshooting teams gather data in order to find possible solutions. Teams must test solutions to make sure they offer long-term results.
Troubleshooting is an extremely important skill for all areas of industry. The information provided in this class prepares students to solve problems and understand how to work to prevent them in many different settings. Without this knowledge, students would not be able to solve problems effectively.

Troubleshooting: Understanding Causes and Effects 182
This class provides an introduction to the process of determining problem causes and effects.

Troubleshooting: Taking Corrective Actions 184
This class discusses ways to identify, implement, and document effective solutions in the troubleshooting process.

Conducting Kaizen Events 191
"Conducting Kaizen Events" provides a comprehensive overview of kaizen events and how they work. A kaizen event is a focused project conducted by a cross-functional team that targets a particular problem area. Kaizen events produce both quantitative and qualitative benefits, although there are some potential challenges. During a kaizen event, a team analyzes the current state of the target and plans improvements for the future state. Kaizen events require preparation, training, and follow up.
Kaizen events are an important part of lean manufacturing that often lead to dramatic changes and significant results. Kaizen events optimize processes and eliminate waste, which improves quality and reduces costs. After taking this class, students will have a foundational understanding of why kaizen events are held and what happens during a kaizen event. This familiarity prepares students to participate in, and eventually lead, kaizen events.

Conducting an Internal Audit 200
This class describes the steps of the internal auditing process and explains effective approaches for conducting audit interviews.

Conducting an Internal Audit 201
"Conducting an Internal Audit" provides an introduction to the steps involved in performing an internal audit on company processes. This class describes the purpose of internal audits and the role of the audit team, along with guidelines for conducting interviews and identifying nonconformances.
In order for a company to succeed, they must establish and follow practices that promote quality production. Internal auditing helps organizations review their daily activities, educate employees, and improve their quality management system. Many companies have regular internal audits in order to maintain ISO 9000 registration. Even if an organization is not seeking registration, auditing is a valuable tool for quality control and continuous improvement. Before beginning an audit, the group must understand the goals of the review and their role in the team. With this class, employees will be better prepared to conduct interviews, evaluate evidence, and contribute to corrective actions.

SPC Overview 210
This class describes the main concepts of statistical process control and explains how to recognize processes that are affected by special causes. Includes an Interactive Lab.

SPC Overview 211
"SPC Overview" offers a thorough introduction to the purpose and main concepts of statistical process control (SPC). This class describes different types of control charts, such as X bar, R,

and P charts, and how these tools are used to determine if a process is in-control or out-of-control.
Identifying and eliminating special cause variation is essential to creating quality products and reducing waste. SPC methods are an efficient, effective means to track variation and monitor processes. With SPC tools, manufacturers have the ability to find and fix issues before they lead to product problems. After taking this course, new and current personnel will understand commonly used control charts and recognize out-of-control signs, making them better equipped to contribute to quality control efforts at their facility.

TS 16949:2009 Overview 220
This class compares ISO 9001:2008 and TS 16949:2009 and explains how their differences affect the standard operating procedures in a quality management system.

TS 16949:2009 Overview 221
"TS 16949 Overview" is an introduction to the structure and requirements of the TS 16949:2009 international automotive standard. This class compares the latest edition of TS 16949 to ISO 9001:2008 and explains how the additions affect standard operating procedures in a quality management system (QMS). It includes an overview of the history and development of TS 16949 and a summary of the standard's eight sections, including a focused discussion on each Product Realization sub-clause.
Many auto manufacturers and part makers become TS 16949:2009 certified to improve their business and prove the effectiveness of their QMS. TS 16949:2009 certification requires thorough documentation, product planning, and a commitment to employee training and continuous improvement. With this class, anyone in the auto manufacturing industry will better understand the contents of the standard and be prepared to navigate the document during quality initiatives.

Metrics for Lean 230
This class describes the most common metrics used to measure timing, error, and costs and encourage continuous improvement in a lean system. Includes an Interactive Lab.

Metrics for Lean 231
“Metrics for Lean” provides an introduction to the information and data used to track processes in lean manufacturing facilities, including takt time, cycle time, total time of operations, overall equipment effectiveness (OEE), and first-time quality.
Metrics are measurable variables that can be tracked over time in order to identify errors or gauge progress. In lean facilities, metrics are tools manufacturers use to identify non-value added activities, streamline operations, and improve operations. After taking this class, users will be able to distinguish between broad and narrow metrics and calculate key values such as takt time and OEE. Understanding this information will help users contribute to lean initiatives and everyday continuous improvement efforts.

Process Flow Charting 240
This class covers the purpose and methods of flow charting, including spaghetti diagrams, process maps, and value stream maps.

Process Flow Charting 241
"Process Flow Charting" provides an overview of the types and purposes of flow charts, including spaghetti diagrams, process maps, and value stream maps. This class describes the value of current- and future-state charts and how they contribute to quality initiatives.
Process flow charts are a means to identify waste and inefficiencies in the production process. Choosing a flow chart depends on the needs and goals of the manufacturer; some charts use symbols and incorporate metrics, while others can simply be drawn by watching activities in the facility. With this class, new practitioners will learn about the development and use of flow charts and be better prepared to utilize these tools.
Strategies for Setup Reduction 250
This class covers different strategies for reducing setup times, including ideas for streamlining operations and tactics for pre-staging processes. Includes an Interactive Lab.

Strategies for Setup Reduction 251
The class "Strategies for Setup Reduction" presents several common strategies for decreasing setup, the activities required to prepare a product for processing. The single minute exchange of dies (SMED) method, which strives to reduce setups to under 10 minutes, is a core approach to setup reduction. SMED focuses on transitioning internal steps to external steps, which can be performed while machines are running. Additional SMED practices include using setup teams in parallel operations and prepping tools, paperwork, and materials. Standardization and special devices like one-turn and one-touch fasteners and intermediate jigs also help reduce setup times. Setup reduction is one of the many goals of lean manufacturing. Reducing setup times allows manufacturers to perform more setups for smaller, more-varied batches so that they can better respond to customer demands. After taking this class, users should be familiar with methods and understand the importance of setup reduction.

Approaches to Quality Management 255
This class discusses the concept of total quality, as well as methods of implementing and measuring TQM within a company's structure.

Conducting Kaizen Events 260
This class describes the sequence of steps for conducting kaizen events and explains common areas for process improvement.

Total Quality Management Overview 261
"Total Quality Management" discusses the major principles of total quality management (TQM). TQM evolved from quality assurance methods, which emphasize quality by design. TQM is a management philosophy that focuses on customer satisfaction, since customers define quality. Efforts to improve quality are integrated throughout each stage of the industrial cycle. Leadership is responsible for creating and executing a strategic TQM plan, as well as establishing an open company culture that involves and empowers all employees. There are many methods that can be used to measure, analyze, and implement TQM.
A company can be successful only if its customers are satisfied. TQM helps companies stay competitive by establishing a culture focused on customer satisfaction and continuous improvement. After taking this class, users should understand the importance of TQM and be prepared to contribute to total quality efforts in the workplace.

Management Tools: Problem Solving 270
This class covers lean tools that managers can use for problem solving and root cause analysis.

Management Tools: Product and Process Design 275
This class covers lean tools for managing product and process design.

Value Stream Mapping: The Present State 300
This class introduces the elements used to create a value stream map and covers how to create a value stream map of the present state.

Value Stream Mapping: The Current State 301
"Value Stream Mapping: The Current State" provides an introduction to the tools and process of value stream mapping. This course explains common value stream mapping (VSM) icons, the steps to creating a VSM, and outlines how to calculate key metrics, such as cycle time, parts per hour, and capacity. Users will also be guided through the development of a current state VSM for a company making a low-variety/high-volume product.
Isolating and eliminating waste are critical to achieving streamlined operations in lean manufacturing. Current and future state value stream maps are one tool companies can use to track their processes and make plans for improvement. After taking this course, users will be able to identify VSM icons, calculate critical metrics, and contribute to current state VSM development.

Value Stream Mapping: The Future State 305
This class introduces strategies commonly used to create a future state value stream map based on findings from a present state value stream map.

Six Sigma Goals and Tools 310
This class covers the Six Sigma DMAIC process improvement method and its primary goals, including the most common sub-steps and frequently used tools.

Value Stream Mapping: The Future State 311
"Value Stream Mapping: The Future State" builds on concepts users used in "Value Stream Mapping: The Current State." This class describes how to develop a future state value stream map, including how to evaluate a current state value stream map, target problem areas, and design a plan to reduce non-value added activities.
A value stream map (VSM) is a process flow chart that manufacturers use to identify waste. The first step in value stream mapping is to create a current state map that represents the present flow of the facility. The next step is to identify areas of waste and develop a future state map. Future state maps represent changes the company can make to improve the facility's layout, production management, and communication systems. Reducing waste and streamlining processes is a goal in all manufacturing facilities. After completing these courses, users will be able to create VSMs and contribute to quality improvement efforts.

Managing Practices for Total Quality 320
This class discusses management roles and business categories for TQM, processes used to implement TQM, and methods of measuring TQM results.

Maintaining a Consistent Lean Culture 330
This class covers the methods and tools for maintaining a consistent lean culture within an enterprise.

Transforming Lean into Business Results 340
This class teaches key processes and systems that optimize value flow and therefore produce optimum results in a lean system.

Measuring Lean Systems 350
This class covers the metrics for measuring lean systems.

Rigging

Intro to Machine Rigging 110
This class covers basic rigging equipment, calculating loads, inspecting equipment, and following safety precautions.

Rigging Equipment 120
This class covers the different kinds of equipment used in rigging, the properties of rope and chains, basic knots, hitches, and sling configurations, and fittings and end attachments.

Lifting and Moving Equipment 130
This class covers the different kinds of lifting devices, moving equipment, and scaffolds used in rigging.

Rigging Inspection and Safety 210
This class covers basic inspection and safety procedures for rigging equipment and lifting devices.

Rigging Mechanics 220
This class covers the mechanical laws involved in rigging, as well as essential practices for calculating the weight of a load and determining its center of gravity.

Robotics

Intro to Robotics 110
This class covers the classifications, characteristics, and functions of industrial robots as well as basic safety precautions for working with robots.

Robot Safety 115
This class covers different methods of protecting workers from industrial robot accidents.

Robot Components 120
This class covers the functions and characteristics of the different components of an industrial robot.

End Effectors 125
This class describes the various types of end effectors and their uses. It also explains the issue of compliance and describes how to maintain end effectors.

Applications for Robots 130
This class covers the most common applications of industrial robots.

Automated Systems and Control 135
This class identifies common methods of industrial automation. It describes the available technologies and explains how they are applied in manufacturing.

Robot Axes 140
This class will describe the most common robot axes. It will explain how to understand these axes, and how they are used to control robot movement.

Robot Sensors 150
This class describes the various types of sensors that provide feedback data to robots. It also explains the categories of sensors and shows how sensors are used in industrial robotics.

Robot Troubleshooting 160
In this class, you will be introduced to the troubleshooting process and will learn how to identify problems and their causes. It will also go through some problems specific to robots and identify common causes and solutions.

Robot Maintenance 170
This class will teach you about the importance of maintenance, as well as the various approaches and methods used by maintenance workers today to keep industrial robots performing optimally.

Concepts of Robot Programming 210
This class covers the fundamental concepts required for programming industrial robots.

Robotic Drives, Hardware, and Components 220
This class describes the physical components of industrial robots. It also describes how these devices move and cause motion to perform work.

Robot Installations 230
This class covers the basic steps for installing and maintaining an industrial robot.

Robotic Control Systems 240
In this class, you will learn about the basic types control systems. You will also learn about the effects of PID control in closed-loop control systems and how to tune your system in order to achieve the desired performance.

Vision Systems 250
This class describes how vision systems work and how they are used for industry. It also describes concerns with mounting cameras and lighting.

Industrial Network Integration 260
This class describes common ways networks are used for manufacturing. It also describes practical network concerns and indentifies some of the technology used to make industrial networks function correctly.

Safety

Intro to OSHA 100
This class covers the goals and purposes of the Occupational Safety and Health Administration, including its standards, programs, and interactions with employers and employees.

Intro to OSHA 101
"Intro to OSHA" provides an introduction to the purpose of OSHA and how its standards and guidelines affect employers and employees. Most U.S. workplaces are covered by OSHA, and its existence has greatly improved workplace safety. Some industries are not covered by OSHA, however, and some states have safety programs that take the place of OSHA. OSHA standards are enforceable by law. Compliance with OSHA standards is enforced by inspections and record keeping, which have specific steps and requirements. Employers and employees have different rights and responsibilities regarding OSHA standards.
Both employers and employees benefit from basic knowledge about OSHA's purpose, standards, and practices. Violations of OSHA standards are punishable by law and render the workplace unsafe for all personnel. A basic awareness of the standards, rights, and responsibilities will help employees to bolster workplace safety as well as keep the workplace legally compliant.

Ergonomics 102
The class "Ergonomics" provides an overview of the science of ergonomics and its application in the workplace. Ergonomic hazards may be present in any work environment, and are a common safety risk. Not all ergonomic risks are apparent, but they can still cause musculoskeletal disorders (MSDs). Vibration, poor posture or positioning, and repetitive motion are common ergonomic hazards, though back injuries are the most common workplace injuries. The majority of work-related back injuries are caused by unsafe lifting techniques. Even computer tasks can cause MSDs over time. Ergonomic solutions should be tailored to the individual employee performing the job or task.
Ergonomic programs are an effective way for any employer to increase employee safety, decrease injury and illness, reduce sick time, boost employee morale, and reduce turnover rates. Implementing proper ergonomics in the workplace increases productivity and reduces the cost of sick leave and new employee training.

Fire Safety and Prevention 110
This class addresses OSHA fire safety and prevention measures and describes emergency action plans, fire prevention plans, fire detectors and alarms, and fire extinguishing equipment. Includes an Interactive Lab.

Personal Protective Equipment 111
The class "Personal Protective Equipment" introduces the purpose and uses of personal protective equipment (PPE). As defined by the Occupational Safety and Health Administration

(OSHA), PPE minimizes exposure to hazards and helps prevent injury. In order to select appropriate PPE, employers must first evaluate the workplace with a hazard assessment. PPE may be categorized by the area of the body it protects. PPE is available in several types, designs, and materials. Every employer is responsible for providing the appropriate PPE for workers who require it, and it is every employee's responsibility to properly wear and use PPE. OSHA does not often specify which types of PPE should be worn, but requires that employers train each employee in proper use and retrain when PPE changes or if PPE is used improperly. After taking this class, users should be able to describe OSHA regulations regarding personal protective equipment and how they impact day-to-day operations in the workplace.
Personal Protective Equipment 120 This class addresses personal protective equipment requirements from OSHA and includes information about hazard assessments, PPE selection, and standards that govern PPE. Includes an Interactive Lab.

Bloodborne Pathogens 115
This class addresses how bloodborne pathogens are transmitted and includes information on preventive measures and procedures for exposure in the manufacturing workplace.

Noise Reduction and Hearing Conservation 121
In the class "Noise Reduction and Hearing Conservation," students will learn about the effects of sound and noise on the body and how to protect themselves from related injuries. Occupational hearing loss is preventable through hearing conservation.
The two main types of hearing loss are conductive hearing loss and sensorineural hearing loss. Hearing loss may be caused by excess noise, hereditary factors, certain drugs, or illnesses. When excessive noise is present, employees must be provided with hearing protection. Using proper hearing protection will help ensure that ears remain capable of detecting important and subtle sound changes.
Students enrolled in this course will learn various ways to protect their hearing and why preventative measures should be taken to avoid hearing damage. They will be able to describe OSHA regulations regarding noise levels and hearing conservation and the impact had on daily operations in the workplace.

Lockout/Tagout Procedures 130
This class covers lockout/tagout requirements and procedures and includes an explanation of employees' roles during lockout/tagout. Includes an Interactive Lab.

Respiratory Safety 131
“Respiratory Safety” details the appropriate types and use of breathing equipment for various airborne hazards. There are two common types of breathing equipment: air-purifying respirators and atmosphere-supplying respirators. Employees who require breathing equipment must undergo a medical evaluation and fit-testing. OSHA requires employers to provide employees who require breathing equipment with clean respirators in good condition, and comprehensive, understandable training. Employees must be able to demonstrate their knowledge of and ability to use respirators prior to ever wearing one.
Training on the use and importance of respirators is crucial to doing safe and effective work and reduces accidents, injuries, and lost work hours. After taking this class, users will be able to

describe OSHA regulations and best practices for using respiratory equipment, along with environments that require this equipment.

Safety for Lifting Devices 135
This class addresses lifting device and equipment safety requirements from OSHA and surveys lifting devices and equipment commonly used for material handling, inspections, and testing.

Machine Guarding 140
This class covers basic machine guarding practices and devices and includes information on hazardous machine components, motions, and actions.

Lockout/Tagout Procedures 141
"Lockout/Tagout Procedures" details the OSHA requirements and best practices for preventing accidental startup during maintenance and repair. It addresses electrical power and the many other forms of energy that a machine or device may use. All forms of energy must be successfully restrained or dissipated in order for safe maintenance. "Lockout/Tagout Procedures" describes using a lockout device that prevents unauthorized access of the energy-isolating mechanism. OSHA has strict requirements for lockout and tagout devices, which must be standardized, easily recognized warning signs. Users will learn OSHA's specific steps for all parts of the control of hazardous energy, from shutdown to startup, including defining authorized vs. affected employees.
Following proper lockout/tagout procedures is essential to preventing employee injuries and fatalities. All employees must be familiar with lockout/tagout in order to prevent the dangers of accidental machine startup.

Hand and Power Tool Safety 145
This class covers general safety guidelines for using hand and power tools as regulated by OSHA.

Environmental Safety Hazards 150
This class explains the different types and levels of environmental hazards in the workplace and how employees may be exposed to these hazards. Includes an Interactive Lab.

SDS and Hazard Communication 151
"SDS and Hazard Communication" focuses on communication methods about hazardous workplace substances and how they increase employee awareness and safety. Education, labeling, data collection, testing, and other communication methods detail the dangers of specific chemicals and offer methods of protection from physical and health hazards. OSHA requires that employers establish a written hazard communication program to communicate employee responsibilities, standard implementation, chemical hazards, and safety measures. Hazard communication programs must include a chemical inventory, specific labeling, SDS for each individual chemical, and training.
After taking this class, users will be able to describe OSHA regulations regarding hazardous materials and SDS and their impact on daily workplace operations. Understanding these regulations is critical in maintaining workplace safety and efficient operation.

Flammable/Combustible Liquids 155
This class describes the hazards associated with flammable and combustible liquids and explains proper methods for safe storage, handling, and transferring of these liquids.

SDS and Hazard Communication 160
This class covers different types of chemical hazards, standards for hazardous chemicals, and how information about chemical hazards reaches the employee, including through SDS. This class reflects the latest Hazard Communication Standards aligned with the Globally Harmonized System (GHS).

Bloodborne Pathogens 161
The class "Bloodborne Pathogens" explains the nature of common bloodborne pathogens and how to handle exposure in the workplace. A bloodborne pathogen is a microorganism present in human blood that can cause disease. Common pathogens include HIV, which causes AIDS, HBV, which causes hepatitis B, and HCV, which causes hepatitis C. Exposure to blood can occur in the workplace through work-related tasks and procedures, through accidents, or by administering first aid. To avoid exposure, workers should observe the universal precautions recommended by the CDC. Employers are required by OSHA to implement controls to minimize exposures in the workplace.
Employees who understand how to protect themselves from bloodborne pathogen exposure make the workplace safer for everyone and benefit their employer. After taking this class, users should be able to describe OSHA regulations regarding bloodborne pathogens and how they impact day-to-day operations in the workplace.

Metalworking Fluid Safety 165
This class explains the health and safety risks inherent to working with metalworking fluids and also describes safe practices that help to reduce metalworking fluid exposure.

Noise Reduction and Hearing Conservation 170
This class explains the causes of hearing damage and describes how to avoid exposure to excessive noise.

Walking and Working Surfaces 171
"Walking and Working Surfaces" will inform employees of the ways they can decrease the risks of injury and death regarding walking and working surfaces by following the guidelines as provided by OSHA. Hazards exist when people or objects may fall from one level to another through various openings such as floor and wall openings, floor and wall holes, platforms, or runways. All openings must be guarded by devices such as railings, covers, and toeboards. Standards regarding the construction, dimension, and usage of stairs, ladders, scaffolding, and manually propelled ladder stands are also set by OSHA. Failing to use and maintain walking and working surfaces correctly can result in serious injury. After taking this course, employees will be able to describe OSHA regulations covering safe practices with walking and working surfaces and how following those regulations will positively impact daily operations in the workplace.

Walking and Working Surfaces 180
This class covers the requirements necessary to ensure the safety of typical walking and working surfaces such as platforms, stairs, ladders, and scaffolds.

Fire Safety and Prevention 181
The class "Fire Safety and Prevention" examines common workplace fire safety procedures. Fires, no matter how small, should be reported immediately. Buildings are equipped with extinguishing systems that actuate an alarm and discharge an extinguishing agent to control advanced stage fires. Portable fire extinguishers are available for extinguishing incipient stage fires using the P.A.S.S. technique. Employees not authorized to fight the fire should evacuate immediately. Employers should create an emergency action plan that dictates the procedures to be carried out in the event of an emergency. In the event of a fire, employees should stay calm, follow procedures, and go directly to assembly areas. Employers must account for all employees and provide first aid until medical services arrive. After taking this class, users will be able to describe OSHA regulations regarding fire safety and how they impact day-to-day operations in the workplace.

Confined Spaces 190
This class covers different types of confined spaces and the hazards they present, the roles and responsibilities of employers and employees, and proper work practices and safety precautions for confined spaces.

Flammable/Combustible Liquids 191
"Flammable and Combustible Liquids" describes procedures required to safely handle, store, and dispose of dangerous liquids. Flammable and combustible liquids are divided into different categories or classifications based on properties such as flash and boiling points. Anyone who must handle or transfer these liquids must take precautions such as bonding and grounding to prevent accidental ignition. OSHA requires proper hazard communication and written procedures for any process involving flammable and combustible liquids, and details various standards for methods of storage, transfer, and safe disposal.
Proper handling, storing, and disposing of flammable and combustible liquids prevents costly and potentially deadly fires in the workplace. "Flammable and Combustible Liquids" provides users with information on liquid hazards as well as safe methods of storage, handling, transfer, use, and disposal.

Respiratory Safety 195
This class covers the most common types of respirators and includes information about fit testing, medical evaluation, and training for employees.

Hand and Power Tool Safety 201
The class "Hand and Power Tool Safety" provides guidelines for the safe use of common hand and power tools. Employees should never remove any safety guards from a tool's point of operation unless authorized. Tools must be regularly cleaned and maintained, and all blades must be kept sharp. The worksite must be kept organized, clean, and dry. All tool applications require PPE, including eye and other protection. Before working, employees must consult the owner's

manual and be familiar with how the tool functions. Employees must also use the right tool for the job and follow the work practices that are specific to each type of tool.
When employees use proper safety guidelines when handling hand and power tools, their employers benefit from reduced accidents on the job and lowered costs caused by work-related injuries. Safe handling of tools also increases work quality. After taking this class, users should be able to describe the safe use and care of hand and power tools.

Powered Industrial Truck Safety 210
This class covers different types of powered industrial trucks, such as forklifts, and includes guidelines for use, training requirements, and stability principles.

Safety for Lifting Devices 211
"Safety for Lifting Devices" covers the different pieces of lifting equipment that may be used in the workplace and the safest ways to work with those pieces of equipment. Overhead cranes and hoists are used for lifting heavy loads. Other lifting devices include slings, portable lifting stands, gantry cranes, and derricks. Extra equipment is necessary to secure loads to lifting devices. This equipment must be inspected daily for excessive wear and damage. Understanding how to maintain and operate lifting devices will allow future operators and employers to work with lifting devices safely and effectively. After taking this class, students will be able to describe the proper steps necessary to safely lift and transport materials within the work environment.

Powered Industrial Truck Safety 221
"Powered Industrial Truck Safety" provides an overview of safety topics related to forklifts and other PITs. OSHA has many standards surrounding the use of PITs in the workplace for operators, non-operators, attended vehicles, and unattended vehicles. OSHA also has detailed training requirements for PIT operators. To safely operate a PIT, operators must understand basic principles of stability, including the concepts of a fulcrum and centers of gravity. Operators must also be aware of the weight and shape of loads and what individual vehicles are capable of handling.
Powered industrial trucks are a common source of workplace accidents, so a strong knowledge of how to safely operate and work with PITs is crucial for any environment where they are used. PIT accidents can lead to property and inventory damage as well as employee injury. Operators should know how to avoid OSHA violations and how to handle a load without tipping the vehicle.

Confined Spaces 231
The class "Confined Spaces" explains the OSHA requirements pertaining to confined spaces. A confined space has limited means of entry or exit and is not designed for continuous occupancy. Confined space hazards are caused by the material in the confined space, the activity carried out in the space, and the external environment. OSHA requires a permit for entering any confined space with an additional hazard.
Confined spaces pose a safety hazard for employees. Employers must develop a written permit-required confined space program and train and certify all permit space entrants. Training should discuss the specific types of confined spaces and hazards employees will encounter at their worksite. Entrants must wear proper PPE and use specialized equipment that does not cause additional hazards.

After taking this class, the user should be able to describe OSHA regulations and best practices for performing work safely in a confined space.

Environmental Safety Hazards 241
"Environmental Safety Hazards" details the risks of chemical, biological, physical, and ergonomic hazards in the work environment. Hazard exposure can cause injury and illness, causing short- and long-term effects. Many hazards can be detected using the senses, but special equipment is sometimes necessary. There are many forms of hazard communication, including SDS. Using PPE diminishes risks posed by exposure to environmental hazards. There are government agencies that help assure employees' safety by creating standards and legislation and studying hazards. However, the employer is ultimately responsible for providing a safe and hazard-free environment. Awareness of environmental safety hazards can prevent employee injury, reducing time off and workplace accident rates. After taking this course, users will be able to identify various hazards in the workplace and their possible effects on the human body.

Environmental Safety Hazards 150
This class explains the different types and levels of environmental hazards in the workplace and how employees may be exposed to these hazards. Includes an Interactive Lab.

Shop Essentials (Applied Math)

Math: Fundamentals 100
This class explains how to add, subtract, multiply, and divide to solve a problem following the correct order of operations.

Math Fundamentals 101
The class "Math Fundamentals" covers basic arithmetic operations, including addition, subtraction, multiplication, and division. Additionally, it introduces the concept of negative numbers and integers. The class concludes with an overview of the order of operations and grouping symbols.
Basic mathematical operations are the foundations upon which all math relies. Mastery of these foundational tasks will ease a student into more complicated mathematics, such as algebra and geometry, both of which are commonly used in a variety of manufacturing environments.

Math: Fractions and Decimals 105
This class explains how to add, subtract, multiply, and divide fractions and decimals, as well as how to convert these numbers to percentages.

Applied and Engineering Sciences 110
This class provides an overview of the key concepts of physics and works through practical mathematic application.

Math: Fractions and Decimals 111
"Math: Fractions and Decimals" provides the methods used to perform basic mathematical operations using fractions, decimals, and percentages. The class covers addition, subtraction,

multiplication, and division with fractions and decimals. It also discusses conversions between fractions, decimals, mixed numbers, and improper fractions.
Almost any manufacturing print uses fractions and decimals in its measurements. Knowing how to handle these numbers and convert between them is an essential part of the basic skills needed to work in a manufacturing environment.

Units of Measurement 112
The class "Units of Measurement" provides a thorough explanation of the English and Metric systems and how conversion between them occurs. The common base units of measurement are length, area, volume, mass, and temperature. The English system uses inches, feet, yards, and miles to measure length, while the Metric system uses the meter, millimeter, centimeter, and kilometer. Metric conversion requires simply knowing the equivalent number of units and moving the decimal point accordingly. When converting between Metric and English units, use a reference chart, multiply, or divide, depending on the conversion. Units of measurement are used every day in a production environment. Converting between units is often required, especially for businesses dealing internationally. After taking this class, users should be able to perform calculations involving common English units, metric units, and conversions between the two systems.

Math: Units of Measurement 115
This class addresses common units of measurement used in manufacturing and explains how to convert from one unit of measurement to another.

Basics of Tolerance 120
This class explains the purpose of tolerances in manufacturing and describes how these tolerances are specified. Includes an Interactive Lab.

Manufacturing Process Applications: Part I 124
This class introduces common metal shaping operations, including sheet and bulk metal processes, extrusion, forging, casting, and powder metallurgy.

Manufacturing Process Applications: Part II 125
This class will introduce you to common finishing and coating processes, printed circuit board fabrication, and common material handling methods.

Blueprint Reading 130
This class identifies the information communicated on a blueprint with emphasis on interpreting the part drawing. Includes an Interactive Lab.

Algebra Fundamentals 141
"Math: Algebra Fundamentals" provides a detailed overview of the basics of algebra, including the operations needed to solve a single variable equation. Basic algebra is used constantly in manufacturing, from the production floor to the accounting department.
Any time a number is unknown, algebra can be used to determine that missing value. Although algebra uses the same basic operations as other mathematics, there are several new operations used to find missing variables in problems. After taking this class, users will be able to simplify,

factor, and balance basic equations, as well as calculate for missing values in equations with only one variable. The user will also be able to use algebra to create an equation based on a simple story problem.

Geometry: Lines and Angles 151
The class Geometry: Lines and Angles discusses the basic building blocks of all geometry: the line and the angle. Every print used in manufacturing is composed of lines and angles which must be interpreted to manufacture the depicted part. Though part geometry can be incredibly complex, all geometric prints can be broken down into simpler lines and angles. The relationships between the various angles formed when lines intersect can be used to solve geometry problems and interpret blueprints. An understanding of lines and angles is fundamental to learning and applying geometry as well as trigonometry and calculus. After taking this class, users should have a grasp on the types of lines and angles used in geometry, the angles that are formed by intersecting lines, and tranversals. An understanding of the basics of geometry is necessary in various fields including inspection, part program applications, and other important areas of manufacturing.

Geometry: Lines and Angles 155
This class describes the properties of lines and angles and demonstrates how they are used to solve sample part drawings.

Geometry: Triangles 161
The class "Geometry: Triangles" discusses triangles and the specific mathematical operations unique to them. While the triangle is a very basic shape, it can be found as a part of more complex shapes. Triangles are often used as the basic shapes that compose three-dimensional CAD designs. Right triangles also form the basis of trigonometry. Since triangles are so commonly used, an understanding of the types of triangles and the methods for calculating missing information from them is essential to users.
After taking this class, users will be able to categorize triangles by their sides and angles, calculate missing angles based on the measurements of other angles, and determine the area of a triangle.

Geometry: Triangles 165
This class describes the properties of the various types of triangles and demonstrates how they are used to solve sample part drawings.

Shop Geometry Overview 170
This class presents a general overview and refresher for the the most common rules of geometry.

Geometry: Circles and Polygons 171
"Geometry: Circles and Polygons" covers the specifics of geometry involving circles and polygons with any number of sides. The class includes a discussion on the internal angles of a circle as well as the method to calculate the circumference and area of a circle. Additionally, this class covers the calculation of missing angles in any polygon

Circles and polygons, along with triangles, are the basic building blocks of any geometric figure. Knowledge of the calculations and uses of circles and polygons can prove useful when working with prints in any number of manufacturing capacities.

Geometry: Circles and Polygons 185
This class explains basic circle and polygon geometry and how their features are used to find dimensions in sample shop drawings.

Shop Algebra Overview 200
This class explains basic principles of algebra and demonstrates how to solve equations containing multiple operations.

Trigonometry: The Pythagorean Theorem 201
"Trigonometry: The Pythagorean Theorem" provides an explanation of the Pythagorean theorem and how it is used to solve various math problems involving and using right triangles. The class covers the use of powers and roots and the process that is used to solve for unknown dimensions on blueprints.
The Pythagorean theorem is used to solve for the lengths of sides of right triangles. To find missing measurements in a print with a right angle, manufacturers can find or create right triangles and use the Pythagorean theorem. After taking this class, users will be able to use the Pythagorean theorem to calculate missing lengths in right triangles and solve for missing dimensions on various types of blueprints by utilizing right triangles where appropriate.

Trig: Pythagorean Theorem 205
This class introduces the Pythagorean theorem and explains how to apply this rule to find unknown information in sample part drawings.

Shop Trig Overview 210
This class presents a general overview and refresher for the rules of trigonometry.

Trigonometry: Sine, Cosine, Tangent 211
The class "Trigonometry: Sine, Cosine, and Tangent" discusses the three basic ratios that are the basis for trigonometry. Trigonometry is based on the specific relationships between the sides and angles of right triangles. Using trigonometry, a person can determine the missing angle and side measurements of a right triangle based on the information present in a drawing. Although solving trigonometric ratios often requires a calculator, users must know which ratios to apply to a particular problem and how to calculate them. In situations where parts are being manufactured, this knowledge is crucial to effective production of parts that require specific dimensions and angles.
After taking this class, a user should be able to define the various trigonometric ratios, and use them to solve various problems, including calculating a taper angle on a print.

Trig: Sine, Cosine, and Tangent 215
This class explains how to use sine, cosine, and tangent to find information about the sides and angles of right triangles in sample shop prints.

Statistics 220
This class covers the main concepts of statistics and relates these concepts to shop situations.

Trigonometry: Sine Bar Applications 221
"Trigonometry: Sine Bar Applications" discusses sine bars and the trigonometry required to use them. Sine bars are used when an angle needs to be machined, measured, or inspected. Sine bars are used with gage blocks to set a workpiece at an angle. To find the necessary measurements for the gage blocks or the sine bar angle, trigonometric ratios are used. These ratios include sine, cosine, and tangent. Gage pins are sometimes used with sine bars and gage blocks to increase the range of measurements.
After taking this class, a user should be able to make the necessary calculations for setting up a specific workpiece angle using a sine bar.

Trig: Sine Bar Applications 225
This class explains how to use the sine bar for machining and inspection purposes and explains step-by-step examples for using trig ratios and the sine bar to find missing information.

Interpreting Blueprints 230
This class provides an overview of common features found in prints and describes how to properly inspect them. Includes an Interactive Lab.

Statistics 231
"Statistics" provides a good overview of the various terms and methods commonly used for statistical analysis. In modern manufacturing, statistics are used as part of continuous improvement methods to analyze the data gathered during inspections to determine the quality of a product and examine the processes used to make it.
Every person in a manufacturing environment should have an awareness of what statistical terminology and be able to use statistical concepts in the workplace. After taking this class, a user will be able to calculate the mean, median, and mode for a set of data. The user will also be able to explain the difference between natural and unnatural variation, the use histograms and bell curves, and the meaning of standard deviation.

Concepts of Calculus 310
This class covers the basic concepts of calculus.

Soldering

What Is Soldering? 110
This class provides an overview of the basic tools and components used for soldering, briefly explores the importance of soldering to the electronics industry, and covers basic procedures for soldering preparation, safety, and cleanup.

Safety for Soldering 115
This class describes common safety hazards and precautions for soldering applications. Includes an Interactive Lab.

Soldering Equipment 130
This class provides an introduction to basic soldering equipment selection, including safety equipment.

Soldering Applications 200
This class describes essential skills for proper hand soldering and also explains how to inspect a finished joint and rework or repair a bad joint. Includes an Interactive Lab.

Solder and Flux Selection 210
This class describes various types of solder and flux and discusses how to select them for particular applications.

Soldering PCBs 220
This class covers how to create and repair printed circuit assemblies by soldering and desoldering various types of electronic components on printed circuit boards (PCBs).

Lead-Free Soldering 230
This class covers the specific characteristics, flux requirements, and thermal profile of lead-free solders, as well as the proper techniques to apply when using these new solder materials. Includes an Interactive Lab.

Stamping

Press Basics 110
This class introduces common stamping presses, as well as their main components and functions.

Stamping Safety 115
This class describes general safety practices that all people in the shop must observe during a press operation. Includes an Interactive Lab.

Punch and Die Operations 120
This class introduces the common sheet metal operations performed with the help of dies and presses. Includes an Interactive Lab.

Die Components 130
This class introduces dies, their main components and function within a press.

Coil Handling Equipment 140
This class describes the equipment used in a coil-fed press line and explains general coil line arrangements.

Die Cutting Variables 200
This class describes the steps that take place during a cutting operation and shows how clearance impacts the cutting process. Includes an Interactive Lab.

Monitoring Press Operations 220
This class describes how to use the basic controls on a typical press and explains how a press operator monitors the press operation. Includes an Interactive Lab.

Guiding System Components 230
This class describes common guiding system components used in die sets, as well as their advantages and disadvantages.

Stripper System Components 235
The class describes the major types of strippers and springs used in die sets, as well as their advantages and disadvantages.

Coil Loading Procedures 250
This class explains how to properly handle and load coil onto the uncoiler, as well as describes how to thread the straightener and feed coil stock into the die area.

Die Setting Procedures 300
This class describes how to change a die and explains proper setup procedures for die setting.

Supervisor Essentials

Essentials of Leadership 110
This class describes the basic responsibilities of a leader and gives helpful ideas about how to gain the respect and trust of others. Includes an Interactive Lab.

Essentials of Communication 120
This class describes key types of communication and common roadblocks to communication, as well as how to use effective communication as a tool to help build teamwork and manage conflict. Includes an Interactive Lab.

Managing Performance: Best Practices 130
This class covers the various aspects of performance management as well as strategies for motivating employees. Includes an Interactive Lab.

Managing Performance: Corrective Actions 135
This class covers how to address employee performance issues, as well as the basic practices for employee termination. Includes an Interactive Lab.

Basics of Manufacturing Costs 140
This class describes the basic costs associated with manufacturing and how these costs are typically controlled.

Intro to Managerial Accounting 145
This class explains the basics of managerial accounting and how this information helps a manager make informed decisions.

Conflict Resolution Principles 150
This class covers the basic steps that a manager can take to resolve conflicts in the workplace and help ensure that the same conflicts do not return. Includes an Interactive Lab.

Conflict Resolution for Different Groups 155
This class describes a variety of situations in which a conflict may occur and offers advice for the best approaches to dealing with those conflicts. Includes an Interactive Lab.

Team Leadership 160
This class teaches the basics of effectively leading a team, including picking team members and resolving conflicts. Includes an Interactive Lab.

Manufacturing Management 180
This class is an introduction to management for CMfgT. It covers a number of management topics, including project planning, organizational design, theories of leadership and labor relations.

Personal Effectiveness 190
This class introduces the importance of effective communication and the various forms and mediums of communication in the workplace. The need for encouraging creativity, innovation, and the importance of knowledge and learning in the 21st century workplace is also described.

Managing the Diverse Workplace 210
This class describes the issues surrounding diversity in the modern workplace, as well as describing some employer responsibilities in regards to diversity management. Includes an Interactive Lab.

Harassment and Discrimination 215
This class covers how to identify and prevent harassment and discrimination in a diverse workplace, as well as some basic Federal laws that protect workers from harassment and discrimination. Includes an Interactive Lab.

Performance Management and the Law 230
This class covers the basic Federal employment laws that apply to manufacturing. Includes an Interactive Lab.

Welding

What Is Oxyfuel Welding? 100
This class describes the basic concepts of oxyfuel welding, including what equipment and gases are needed to weld. Also, it describes the various other processes that an oxyfuel torch may be used for.

Welding Safety Essentials 101
The class "Welding Safety Essentials" provides a broad overview of safety topics for various welding processes. The course describes general safety practices, such as electrical, fire,

cylinder, and fume safety, that welders must follow. The class also provides an overview of guideline-setting organizations, such as OSHA and ANSI.
Preventing accidents is crucial to any welder or welding organization. Safety issues endanger personnel, reduce quality and productivity, and harm the performance of any organization. After taking "Welding Safety Essentials," welders will be prepared to follow welding safety guidelines and will be informed about safety standards important to the welding industry, allowing for a productive workplace.

Oxyfuel Welding Safety 105
This class covers the basic safety procedures for handling oxyfuel welding equipment, including personal protective equipment, ventilation, and fire safety.

What Is Arc Welding? 110
This class introduces the advantages of arc welding as a joining process and explains the fundamentals of arc welding.

PPE for Welding 111
"PPE for Welding" introduces the purpose and uses of personal protective equipment (PPE) for welders. Welding hazards include electric shock, fume and gas exposure, arc radiation, and fire and explosion. Welders are most likely to sustain burns to the skin or eyes. OSHA and ANSI issue standards for PPE. To prevent injury, welders should wear appropriate PPE to cover all exposed skin, including safety glasses or goggles, a welding helmet, hearing protection, welding gloves, and leather high-top shoes. Welding PPE should be fire resistant, protect the eyes from harmful light, fit comfortably, and provide adequate protection. Employers must train employees in proper PPE use and complete a hazard assessment.
Proper PPE not only protects workers from injury, but helps prevent productivity loss due to sick time and ensures that workplaces are OSHA compliant. After taking this class, users should be able to describe the PPE necessary to perform welding operations safely.

Arc Welding Safety 115
This class describes general safety practices that all welders must follow during arc welding procedures. Includes an Interactive Lab.

Arc Welding Processes 120
This class describes the various arc welding processes as well as the particular advantages and disadvantages of each process. Includes an Interactive Lab.

Welding Fumes and Gases Safety 121
The class "Welding Fumes and Gases Safety" helps students to understand the dangers of fume and gas generation in welding. The fume plume, a visible cloud of smoke rising from the molten metal, consists of complex metallic oxides and particles formed from the consumable and base metal. Shielding gases used in welding may also produce potentially harmful fumes. Exposure to fumes can be managed through engineering controls, ventilation, proper PPE, and adherence to exposure limits set by OSHA or other organizations. After taking this class, the student will understand the potential dangers of welding fumes and gases, as well as the acute and chronic symptoms that may develop after overexposure. This class discusses how workplace practices

and engineering controls can be used to control exposure, in addition to following Permissible Exposure Limits and using air-supplied respirators when necessary.

Overview of Weld Types 130
This class describes the various joint and weld types, welding positions, and possible weld defects that can occur on a welded joint. Includes an Interactive Lab.

Electrical Safety for Welding 131
"Electrical Safety for Welding" introduces users to the electrical hazards of arc welding and methods of reducing them. Arc welding requires a live electrical circuit, which presents several potential safety hazards. Electricity can cause burns, fires, and electric shock. There are two types of electric shock: primary voltage shock and secondary voltage shock. To prevent the risks associated with electricity, welders must make sure equipment is properly installed, grounded, and maintained. Welders must also use the necessary PPE and insulation to prevent injury.
After taking this class, users will have a good understanding of the major safety hazards associated with electricity and precautions that minimize these risks. This knowledge allows users to work more safely and effectively with electrical equipment, which is required for all arc welding processes.

Electrical Power for Arc Welding 140
This class describes electrical variables, the path of electricity, and the effect of electricity on the arc welding process.

Introduction to Welding 141
"Introduction to Welding" provides the foundational understanding of welding and welding processes on top of which process-specific knowledge and a more comprehensive understanding of welding in general is built. The class introduces the different welding processes as well as their general attributes and applications. In addition, it reviews joint and weld types, covers measurements which pertain to welding, discusses welding procedure specifications, and, finally, gives the user information on emerging welding practices and their effect on the practice of welding and the economy.
"Introduction to Welding" builds foundational knowledge necessary for the educational development of any welder. Moreover, it exposes the user to conceptual ideas of welding theory and less-common welding practices such as laser welding.

Introduction to Welding Processes 151
"Introduction to Welding Processes" provides a comprehensive overview of the most commonly used welding processes, including oxyfuel welding, gas metal arc welding, gas tungsten arc welding, flux-cored arc welding, and shielded metal arc welding. In addition, it continues to develop students' understanding of measurements in welding and covers the Welding Procedure Specification from writing through testing and finally use.
This class continues to develop the general understanding of welding begun in "Introduction to Welding" with a more comprehensive overview of each of the most common welding processes. It covers welding variables and presents an in-depth discussion of welding discontinuities that is continued in "Overview of Weld Defects."

Intro to Submerged Arc Welding 160
This class describes the submerged arc welding process as well as its advantages and limitations.

Math Fundamentals for Welding 161
The class "Math Fundamentals for Welding" covers basic arithmetic operations used in welding, such as addition, subtraction, multiplication, and division. This class discusses the concept of rounding whole numbers and decimals before or after calculating a problem. "Math Fundamentals for Welding" also gives an overview of fractions, which are used in welding measurements and blueprints along with decimals.
Knowledge of basic math concepts is integral to a welder's understanding of welding measurements and joint design.

Geometry Fundamentals for Welding 171
The class "Geometry Fundamentals for Welding" teaches students how geometry is used in welding. A fundamental understanding of geometry and geometric concepts is a necessary skill for welding. This class discusses lines and angles, which are the basic building blocks of geometry. This class teaches users how to identify the parts of a circle and how to identify different types of triangles based on their sides and angles. In addition, this class includes lessons on how to find the area of a circle or triangle.
The relationship between lines and angles can be used to read and interpret welding blueprints, as well as machine settings. After this class, users will be able to understand and work with the basic building blocks of geometry. Users will also be able to calculate the area and circumference of a circle and the area of a triangle.

Ferrous Metals for Welding 200
This class provides an overview of the properties of common ferrous metals used for arc welding.

Material Tests for Welding 201
"Material Tests for Welding" introduces users to the types and purposes of welding material tests. Welding materials are tested to evaluate their properties, examine for discontinuities, and ensure the project meets welding code specifications. Testing can be destructive or non-destructive. Testing can also be used to classify metals according to their carbon content.
This class includes lessons on non-destructive testing methods such as visual inspection, radiographic, ultrasonic, penetrant, and magnetic particle tests. Users will also become familiar with destructive testing methods such as the macro-etch test, fillet weld break test, guided bend test, and transverse tension test. After completing this course, users will be able to identify common material tests, the practical applications of destructive and non-destructive methods, and the advantages and disadvantages of each method.

Nonferrous Metals for Welding 205
This class provides an overview of the properties of common nonferrous metals used for arc welding.

Oxyfuel Welding Applications 207
This class describes the procedures for use and maintenance of an oxyfuel welding outfit.

SMAW Applications 210
This class describes the SMAW process and the variables that affect electrode selection, electrical variables, and methods for starting and extinguishing the arc. Includes an Interactive Lab.

Welding Ferrous Metals 211
"Welding Ferrous Metals" defines ferrous metals, describes the common forms of ferrous metal, and discusses best welding practices for each. Each type of ferrous metal has different mechanical, physical, and chemical properties. Though all ferrous metals contain iron, their varying compositions require a number of different welding approaches.
Ferrous metals are the most common metals that welders will encounter. Knowledge of ferrous metal types, composition, and best welding practices is crucial. After taking this class, welders should be able to identify the various ferrous metals, their properties, and the best welding practices for each type.

Welding Nonferrous Metals 212
"Welding Nonferrous Metals" defines nonferrous metals, describes a range of nonferrous metals and their properties, and discusses best welding practices for each type. The nonferrous metal label encompasses a wide range of metals with varying mechanical and physical properties, all of which require different approaches when welding.
Though less common than ferrous metals, nonferrous metals are used in a wide range of applications that require welding. Understanding nonferrous metals and their welding processes is essential for any welder. After completing this class, a user will be able to identify the various nonferrous metals, explain their properties, and describe the best welding approach for each type of metal.

GMAW Applications 220
This class describes the GMAW process and the variables that affect shielding gas selection, electrode selection, metal transfer methods, and electrode orientation. Includes an Interactive Lab.

Overview of Weld Types 221
The class "Overview of Weld Types" provides an overview of different joints and types of welds as well as their applications. Common weld types such as fillet and groove welds, as well as combination, plug, slot, spot, and seam welds, are discussed. In addition, the different parts of a weld and different welding positions are reviewed. Finally, the class covers the requirements of a variety of joints. A short lesson on weld discontinuities is also included in order to introduce the concept to the user.
"Overview of Weld Types" helps to build a solid foundation for advanced welding techniques as well as more comprehensive reviews of specific welding processes. After taking the class, users should have a good general understanding of the names and functions of different joints, weld types, welding positions, and joint requirements.

Overview of Weld Defects 222
"Overview of Weld Defects" provides a comprehensive introduction to the most common varieties of weld discontinuities and distortion. It illustrates the causes of each of the twenty

different weld discontinuities and defects and suggests effective solutions. In addition, it presents an overview of six different kinds of cracks and demonstrates how to prevent cracking and distortion in a finished weld.
This class is especially crucial for beginning welders who do not yet have the skills or knowledge to avoid many of the mistakes that the class illustrates. Beginning welders will find this class particularly useful because it defines the reasons why defects or discontinuities may occur as well as the ways in which welders may rectify them.

FCAW Applications 230
This class describes the FCAW process and the variables that affect electrode selection, shielding gas selection, and electrode orientation. Includes an Interactive Lab.

Weld Symbols and Codes 231
"Welding Symbols and Codes" describes how welding blueprints represent welding requirements. A weld is represented in a blueprint using a welding symbol. Welding symbols, which were created by the American Welding Society, include a reference line, arrow element, weld symbol or symbols, tail, and weld dimensions. When needed, the welding symbol will also have supplementary symbols and finish symbols.
The welding symbol includes various components on the reference line to show the characteristics of the weld and provide specific instructions to the welder. After taking this class, users should be able to explain the many types of welding symbols and their characteristics, as well as the welding codes and specifications used in the welding industry.

Fabrication Process 232
"Fabrication Process" outlines the procedures that a project planner should follow when creating a product from start to finish. A fabrication project can be something as simple as building a cabinet or as complex as constructing a motorcycle. After coming up with a project idea, the planner should list all of the requirements, including material, safety, and budgetary concerns. If all requirements can be met, the planner should research objects similar to the project idea and develop a design. The planner then creates a blueprint of the project, as well as a bill of materials. After deciding on the order of operations that will result in the completed project, the planner should implement the plan step by step to complete the project.
There are many important considerations involved with any fabrication process. After this class, users will be able to develop a fabrication plan and complete a project.

GTAW Applications 240
This class describes the GTAW process and the variables that affect welding current, electrode selection, electrode preparation, and arc-starting methods. Includes an Interactive Lab.

Electrical Power for Arc Welding 241
"Electrical Power for Arc Welding" explains the basic principles of electricity and the effect that electricity has on arc welding processes. Electricity travels in closed circuits. A basic circuit consists of a source, path, load, and control. Current is the flow of electricity. Voltage is the force that pushes current through a circuit. Resistance opposes current flow, but also makes it possible for electricity to perform work. Electrical work is called wattage. In welding circuits, the resistance of the arc converts electricity into light and heat, which melts the base metals.

After taking this class, users will have a foundational understanding of electricity, electrical variables, and how electricity is used in arc welding. This will prepare users for welding, since every welder must understand basic electrical concepts to work with the arc and the welding equipment that produces the arc.

Arc Welding Symbols and Codes 250
This class describes welding symbols and how to read them. It also explains the importance of welding codes and the procedures involved for a welding application.

Introduction to GMAW 251
"Introduction to GMAW" provides a comprehensive overview of the gas metal arc welding process and its equipment. GMAW is a semi-automatic or automatic process that uses a consumable electrode and a shielding gas. GMAW equipment includes a power source, wire electrode, wire feeder, shielding gas, and welding gun. GMAW typically uses a constant voltage power source and direct current electrode positive polarity (DCEP). In GMAW, there are several modes of metal transfer: short circuit, globular, and axial spray.
GMAW is one of the most popular arc welding processes. Because it is semi-automatic or automatic, it is also one of the easiest to learn. After taking this class, users will be familiar with GMAW equipment and the various modes of metal transfer. This information provides the foundation necessary to learn how to perform GMAW. A good understanding of GMAW is also helpful when learning about related types of welding such as gas tungsten arc welding (GTAW).

Introduction to SMAW 252
"Introduction to SMAW" covers the basic theories and practices of shielded metal arc welding (SMAW), as well as common operational procedures. SMAW is a welding process that uses shielding to protect the weld from contamination. SMAW is one of the most common arc welding processes in the world because of its simplicity, versatility, affordability, and suitability for most applications. SMAW requires a range of specialized equipment, specific electrodes, and knowledge of a number of safety precautions.
After taking "Intro to SMAW," welders will know how to safely handle, prepare, and operate SMAW equipment. They will know also have a basic understanding of how to perform an SMAW weld.

SAW Applications 255
This class describes SAW and how to make a submerged arc weld.

Arc Welding Power Sources 260
This class describes different types of arc welding power sources and explains how each power source produces welding power.

Introduction to FCAW 262
"Introduction to FCAW" provides a comprehensive overview of the flux-cored arc welding (FCAW) process and its equipment. FCAW is a semi-automatic or automatic process that is divided into self-shielded flux-cored arc welding (FCAW-S) and gas-shielded flux-cored arc welding (FCAW-G). Both FCAW-S and FCAW-G use a consumable, tubular electrode that is

filled with flux-materials. FCAW equipment includes a constant voltage power source, wire electrode, wire feeder, welding gun, and, if appropriate, a shielding gas.
Understanding the basic theory and process of FCAW is essential to using it successfully. After taking this class, users will be familiar with FCAW equipment and be able to distinguish between different methods and materials. Users will also be able to identify the performance characteristics, operating requirements, and finished weld properties of FCAW electrodes. This information provides the foundation necessary to perform FCAW successfully and safely.

Introduction to GTAW 262
"Introduction to GTAW" defines gas tungsten arc welding (GTAW), describes the tools used in GTAW, and discusses the various factors that should be considered when using GTAW. GTAW, or TIG welding, is a precise welding process that uses a nonconsumable tungsten electrode and inert shielding gas. GTAW can be used on a wide variety of metals, and can be performed manually or with the use of semi-automated or totally automated systems.
GTAW gives the welder increased control over the weld, which allows for the fabrication of stronger and higher quality welds. The process can be complex and requires practice to master, but the improved weld quality is vital to certain applications. By the end of this class, users will be able to define GTAW, identify the tools used in GTAW, and describe the various GTAW processes and applications.

Plasma Cutting 265
This class describes plasma cutting equipment and the basic procedures for plasma cutting, gouging, and piercing.

Electrode Selection 270
This class describes electrode characteristics for the four major arc welding processes and explains how to select the appropriate electrode for a specific welding application.

Overview of Soldering 271
"Overview of Soldering" defines soldering, describes the tools used in soldering, and discusses the various soldering processes. Soldering is a low-heat joining process used in applications where the heat of welding or brazing would be too great or where precise control is required. There are a number of manual and automatic soldering processes. Soldering is particularly useful in electronics and jewelry fabrication as well as in creating air and watertight seals in plumbing and other systems.
After this class, users will be able to define soldering, identify the important tools involved in soldering, list soldering safety concerns, and describe the various soldering processes. It is essential for any operator who may be required to solder materials to understand the basic soldering equipment, processes, and practices.

Visual Inspection of Welds 280
This class will teach you about the visual inspection of welds, the equipment used during a visual inspection, proper inspection procedure, and common discontinuities in the surface of a weld.

Thermal Cutting Overview 281

"Thermal Cutting Overview" provides a comprehensive introduction to the four most common industrial thermal cutting processes. Oxyfuel cutting uses a fuel gas flame that is mixed with pure oxygen. Air-carbon arc cutting uses heat generated by an electrical arc. Plasma cutting ionizes a high-powered stream of gas to create a plasma arc. Laser cutting severs metal with a highly concentrated and focused laser beam.

Understanding the basic theories behind the four widely used methods of thermal cutting is essential to using them successfully. After taking this class, users will be able to distinguish between different thermal cutting methods as well as identify the equipment used for each. Users will also be able to identify the performance characteristics and safety considerations for these thermal cutting processes. This information provides the necessary information to perform thermal cutting methods successfully and safely.

Oxyfuel Cutting Applications 282

"Oxyfuel Cutting Applications" provides an overview of the oxyfuel cutting process and its safety requirements, equipment components, and operating procedures. Before performing oxyfuel cutting, it is important to correctly setup the oxyfuel outfit and perform essential safety inspections. After lighting an oxyfuel torch, an operator must control the ratio of gas to produce a neutral cutting flame. During the cutting process, an operator must control specific variables, including tip height, gas flow rate, travel speed, and torch angles. Understanding these variables along with the proper cutting procedures help produce a quality oxyfuel cut.

The information in this class helps prepare users to perform oxyfuel cutting, a popular thermal cutting process with a variety of applications. After taking this class, users will be familiar with many of the considerations and variables that go into oxyfuel cutting, which is essential to safely and successfully producing quality cuts.

Plasma Cutting 283

“Plasma Cutting” describes plasma cutting equipment and discusses the setup and operation steps for plasma cutting, gouging, and piercing. Plasma cutting is a precise and efficient cutting method that uses an ionized jet of gas to generate a high temperature cutting arc and can be done by hand or with the use of CNC machine.

Plasma cutting is an increasingly affordable and popular method of metal cutting. Plasma cutting balances the lower cost of cutting methods such as oxyfuel with the higher quality of laser cutting methods. After this class, users will be able to define plasma cutting, identify the tools used in plasma cutting, and describe the various cutting applications and processes. Understanding the basic plasma cutting functions and processes is essential for users to make precise, accurate cuts safely and efficiently.

Introduction to Automation 291

"Introduction to Automation" provides a comprehensive overview of the automation technology used in welding and thermal cutting processes. Automation is the use of either CNC machinery or robotic systems to both power and perform one or more processes. Automation offers manufacturers several benefits, such as minimizing production costs and waste, reducing a part's cycle time and a work area's footprint, and improving part quality and process reliability.

Understanding basic machine components, their movement, and the way in which they are controlled is essential to performing any automated welding or thermal cutting process. After

taking this class, users will be familiar with automated equipment, operation requirements, and safety measures. This information provides the foundation necessary to working with automated machinery successfully and safely.

GMAW Application 301

"GMAW Applications" provides a comprehensive overview of how to perform gas metal arc welding (GMAW), important variables to consider, and how to prevent common defects. Before beginning GMAW, it is important to prepare by cleaning base metals and selecting an appropriate electrode. During GMAW, the welder controls electrode orientation and travel speed. Welders must also be aware of many variables, such as amperage, voltage, and shielding gas, and their effects. Understanding these variables helps prevent weld discontinuities and defects, including porosity, undercut, incomplete penetration, and incomplete fusion.

The information in this class prepares users to perform GMAW, an extremely common welding process. After taking this class, users will be familiar with many of the considerations and variables that go into GMAW. A good understanding of these concepts helps prevent welders from producing irregular or defective welds.

Advanced GMAW Applications 302

"Advanced GMAW Applications" provides an overview of various specialized GMAW processes. When performing GMAW on stainless steel or aluminum, welders must be aware of several factors. Many advanced processes use power sources that offer different types of control, such as waveform control, adaptive control, and synergic control. Advanced GMAW processes include pulse transfer, precision pulse, Surface Tension Transfer, and AC aluminum pulse. GMAW is also well-suited to automation. Robotic GMAW is one of the most popular forms of automated welding.

After taking this class, users will be prepared to learn to perform more specialized and advanced GMAW processes. These processes are becoming increasingly popular because they consistently produce quality welds without the same drawbacks as conventional methods. Understanding advanced and specialized GMAW processes is important to remaining competitive in modern welding.

Arc Welding Aluminum Alloys 310

This class describes the welding characteristics of aluminum and explains how its properties affect each variable in the welding process.

SMAW Applications 311

"SMAW Applications" details the process of preparing SMAW equipment for welding and the basic steps a welder should take to perform a successful SMAW weld. Welders must be able to identify the different types of electrodes that can be used for SMAW and select the appropriate electrode for an application. A welder must then choose a method to start the arc and run a bead, and must know how to effectively break and re-start the arc when necessary. SMAW is not a perfect process, and this class covers the different flaws that a weld may contain as a result of different operator errors or other sources.

To be an experienced and skilled employee, a welder must know the basic foundational techniques of the welding process. "SMAW Applications" teaches welders the essential

components of performing shielded metal arc welding processes, as well as how to identify and avoid common discontinuities.

FCAW Applications 321
"FCAW Applications" provides a comprehensive overview of how to perform FCAW processes. Before beginning FCAW, it is important to prepare the joint and select the appropriate electrode. During FCAW, the welder controls the electrode's orientation and travel speed. Welders must also be aware of many FCAW-specific variables, such as amperage, voltage, and shielding gas, as well as the effects of such variables. Understanding variables helps prevent FCAW weld discontinuities and defects, such as excessive spatter, porosity, and slag inclusion.
After taking this class, users will be familiar with many of the considerations and variables that go into using FCAW processes, which is essential to producing quality welds and avoiding weld discontinuities and defects. The ability to recognize and avoid common welding issues reduces scrapped parts and increases quality.

GTAW Applications 331
"GTAW Applications" provides an overview of the practical applications of the gas tungsten arc welding process. It covers all parts of the process, including personal protective equipment, power supplies, polarity, amperage, electrodes, shielding gas, cups, starting the arc, filler metal, welding techniques, possible defects, and professional and industrial applications.
"GTAW Applications" is essential for any welder who requires an in-depth understanding of GTAW. Its focus on application extends "Intro to GTAW" to the practical sphere, paving the way for hands-on learning of GTAW welding.

Workholding

Intro to Workholding 104
This class introduces the role of a workholding device during the manufacturing process and identifies common groups of these devices.

Supporting and Locating Principles 106
This class describes the fundamental theory to properly supporting, locating, and clamping a workpiece. Includes an Interactive Lab.

Locating Devices 107
This class identifies the most common types of locating components used in custom workholding devices and fixtures.

Clamping Basics 108
This class covers the most common types of clamping components and explains their relative advantages and applications.

Chucks, Collets, and Vises 110
This class identifies the standard workholding devices used for both the mill and the lathe.

Fixture Body Construction 200
This class discusses common tool body forms and the material and cost considerations associated with their construction.

Fixture Design Basics 210
This class identifies the major factors to consider when beginning the design of a customized fixture. Includes an Interactive Lab.

Drill Bushing Selection 230
This class will identify the major groups of bushings and their appropriate use.